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A wholly owned subsidiary of **St Barbara Limited**
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Fifteen Mile Stream Gold Project

Environmental Impact Statement

Highway 374

Trafalgar, Nova Scotia

February 2021

February 9, 2021

Impact Assessment Agency of Canada
Suite 200, 1801 Hollis Street
Halifax, NS 63J 3N4

Environmental Assessment Branch
Nova Scotia Environment
Suite 2085, 1903 Barrington Street
PO Box 442, Halifax, NS B3J 2P8

To Whom It May Concern,

Atlantic Mining NS Inc, a wholly owned subsidiary of St Barbara Limited, is pleased to continue to move forward the Environmental Assessment of its proposed Fifteen Mile Stream Gold Project.

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

This EIS / EARD has been developed in accordance with the Guidelines for the Preparation of an Environmental Impact Statement (Fifteen Mile Stream Gold Project) dated August 31, 2018 and the Nova Scotia Environment Environmental Assessment Registration Document requirements. This EIS / EARD has also been developed in accordance with the Conformity Review outcome for the Project dated November 4, 2019, following initial submission of the EIS / EARD in October 2019, as well as the Conformity Review request dated November 5, 2020, provided directly to AMNS from IAAC. Table CS-1 provides the response locations within this EIS document to the Conformity Review information requirements.

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

Any correspondence regarding the Environmental Assessment should be directed to the undersigned, James Millard, at 902-499-7910 or James.Millard@atlanticgold.ca.

Sincerely,

<Original signed by>

James Millard
Manager, Environment and Community
Atlantic Mining NS Inc

cc. Laird Brownlie (AMNS);
Meghan Milloy (MEL)

Table CS-1: Conformity Review Concordance Table (November 4, 2019 and November 5, 2020)

Requirement of the FMS EIS Guidelines (Please refer to the August 31, 2018 EIS Guidelines for the complete text. Text in this column for reference only.	Section of the EIS	Information Requirement	Location of Information Requirement in Updated EIS Submission 2020
PART 1			
4.3 Study strategy and methodology "The proponent will provide the Mi'kmaq of Nova Scotia the opportunity to review and provide comments on the information used for describing and assessing effects on the Mi'kmaq of Nova Scotia (further information on engaging with the Mi'kmaq of Nova Scotia groups is provided in Part 2, section 5 of this document). The proponent will respond to the comments of the Mi'kmaq of Nova Scotia prior to submitting the EIS to ensure that the comments are adequately addressed. Where there are discrepancies in the views of the proponent and the Mi'kmaq of Nova Scotia on the information to be used in the EIS, the EIS will document these discrepancies and the rationale for the proponent's selection of information."	Throughout	Clarify whether the Mi'kmaq of Nova Scotia (Kwilmu'kw Maw-klusuaqn Negotiation Office, Millbrook First Nation and Sipekne'katik First Nation) were provided with the opportunity to review and provide comments on the information used for describing and assessing effects on the Mi'kmaq of Nova Scotia. Document efforts that were undertaken by the proponent to provide Indigenous groups with the opportunity to review and provide comments on the information used for describing and assessing effects on Indigenous peoples, including impacts on Aboriginal or Treaty rights. Demonstrate that the proponent responded to the comments provided by the Mi'kmaq of Nova Scotia to ensure that the comments are adequately addressed.	Section 2.4.6 Sections 4.1, 4.2, 4.3, 4.4, 4.5 Section 6.13.3 Section 6.13.6 Appendix K.2
4. PREPARATION AND PRESENTATION OF THE ENVIRONMENTAL IMPACT STATEMENT			
4.5 Summary of the environmental impact statement	EIS Summary	In the EIS summary, include an overview of how the factors under paragraph 19(1) of *CEAA 2012* were considered, specifically the environmental effects of malfunctions or accidents, cumulative effects and changes to the project caused by the environment. Improve the clarity of Figures throughout the EIS Summary, in particular: Figure 1.1- label all roads as they appear in the text (e.g. Beaver Dam Haul Road) Figure 1.2- include all relevant project components, including site access, proposed and existing bypass roads/routes.	Summary Document Figure 1.1 Figure 1.2
PART 2			
3. PROJECT DESCRIPTION			
3.1 Project Components	Map Book	Improve the clarity of Figures throughout the EIS, in particular: Figure 1.1-1- label all roads as they appear in the text (e.g. Beaver Dam Haul Road) Figure 1.1-2- include all relevant project components, including site access, proposed and existing bypass roads/routes Figure 2.1-4- include haul roads.	 Figure 1.1-1 Figure 1.1-2 Figure 2.1-4
3.2. Project activities	Section 2.4.6 Section 4.5	Describe how the changes made to the project since originally proposed considered feedback from the Mi'kmaq of Nova Scotia during engagement sessions and how the changes benefit the Mi'kmaq of Nova Scotia.	Section 2.4.6 Section 4.4 Section 4.5

Table CS-1: Conformity Review Concordance Table (November 4, 2019 and November 5, 2020) (continued)

Requirement of the FMS EIS Guidelines (Please refer to the August 31, 2018 EIS Guidelines for the complete text. Text in this column for reference only.	Section of the EIS	Information Requirement	Location of Information Requirement in Updated EIS Submission 2020
	Section 2.2.19	Demonstrate that the planned Seloam Brook Diversion is technically feasible and that the diversion channel (as well as upstream and downstream watercourses) will remain stable over the long term since the diversion is permanent. Provide detailed information about the proposed Seloam Brook Diversion such as: • the preliminary design of the diversion channel • the gradient, width and depth of the proposed diversion channel • whether alterations to watercourses at the downstream end of the diversion channel need to be made to accommodate anticipated flows and remain stable over the long term • the fish habitat functions and features the diversion channel will provide • the construction methods and materials • the planned sequencing and timing of the construction and operation of the Seloam Brook diversion in relation to other relevant project components such as construction of the diversion berm • the studies and modelling that have been done to demonstrate that the diversion channel will be appropriately designed and sized to accommodate the anticipated flows and remain stable over the long term • whether Nova Scotia Power's most recent operational requirements and procedures for upstream and downstream reservoirs and dams have been factored into the design of the diversion channel.	Section 2.2.1.9 Section 2.4.1.1.3 Section 6.8.6.1.1.1 Appendix D.4 Appendix J.5 Appendix J.7 Appendix B.9
	Section 2.6.12.1	Provide an assessment of whether the Seloam Brook Diversion and diversion berms around the open pit will be able to accept and function in the event of elevated flows under various dam operational scenarios, and under what circumstances this may occur.	Appendices D.4
5. INDIGENOUS ENGAGEMENT AND CONCERNS			
5. Indigenous Engagement and Concerns	Section 4 Section 4.5 Appendix K.1	Describe how engagement activities by the proponent allowed Indigenous groups to understand the project and evaluate its impacts on their communities, activities, potential or established Aboriginal or Treaty rights. Where impacts are identified, provide a discussion of how those would be managed or mitigated (and provide this information for each Mi'kmaq of Nova Scotia group separately, including those communities represented by KMKNO, Millbrook First Nation and Sipekne'katik First Nation). Describe the impacts identified by the Mi'kmaq of Nova Scotia during engagement activities and the approaches the proponent discussed to manage or mitigate those impacts. Describe the efforts made to discuss the degree of those impacts after mitigation (residual effects) with the Mi'kmaq of Nova Scotia before submitting the EIS to the Agency. Describe how the following requirement in section 5 of the EIS Guidelines was fulfilled: "The proponent will facilitate these meetings by making key EA summary documents (baseline studies, EIS, key findings, plain language summaries) accessible in advance. The proponent will ensure there are sufficient opportunities for individuals and groups to provide oral input in the language of their choice. If possible, the proponent should consider translating information for these groups into the appropriate Mi'kmaq of Nova Scotia languages(s) in order to facilitate engagement activities during the EA."	Section 2.4.6 Sections 4.1, 4.2, 4.3, 4.4, 4.5 Section 6.13.4 Section 6.13.6 Section 6.13.7 Section 6.13.8 Appendix K.2 (PLS) Appendix K.2 (Summary of Impacts to Mi'kmaq of NS and proposed Mitigation Measures)

Table CS-1: Conformity Review Concordance Table (November 4, 2019 and November 5, 2020) (continued)

Requirement of the FMS EIS Guidelines (Please refer to the August 31, 2018 EIS Guidelines for the complete text. Text in this column for reference only.	Section of the EIS	Information Requirement	Location of Information Requirement in Updated EIS Submission 2020
6. IMPACTS TO POTENTIAL OR ESTABLISHED ABORIGINAL OR TREATY RIGHTS			
6. Impacts to Potential or Established Aboriginal or Treaty Rights	Section 4.4 Section 6.13, Section 6.14 Appendix H.1	Based on additional information collected in fulfillment of conformity gaps noted throughout Annex 1, update the EIS as applicable. For example: • location(s) in which rights are being practiced or exercised • context in which the right is practiced or exercised (including information about which groups of an Indigenous group practice the right (women, elders, youth etc.), how the right was practiced historically) • how the Indigenous group's cultural traditions, laws and governance systems inform the manner in which they exercise their rights (the who, what, when, how, where, and why) • the Indigenous group's perspectives on the importance of the land on which the Project is located and how it intersects with any land management uses and/or plans they may have • how often the right is practiced or exercised and timing or seasonality of the practice or exercise of the right • maps and data sets (e.g. fish catch numbers). If information is not provided or available, include a rationale. Include the perspectives of the Mi'kmaq of Nova Scotia concerning the proposed mitigations and adverse direct and cumulative effects, including but not limited to their views of the proposed bypass roads, ability to pursue traditional activities on nearby crown land, potential effects of the proposed Seloam Brook diversion, etc.	Section 1.5.3 Sections 4.1, 4.3, 4.4, 4.5 Section 6.13.1 Section 6.13.2 Section 6.13.3 Section 6.13.5 Section 6.13.6 Section 6.13.7 Section 6.13.8 Section 8.3.3 Section 8.5.7 Appendix H.1 Appendix K.2
7. EFFECTS ASSESSMENT			
7.1.4 Riparian, wetland and terrestrial environments	Section 6.7	Wetland species composition for the wetlands identified within the Fifteen Mile Stream Gold study area. This must include, as a minimum, representative vegetation composition for each wetland type.	Section 6.7.3.1
7.1.5 Groundwater and surface water	Section 6.5 Section 6.6 Appendix B.2 Appendices F.1 and F.2	The EIS requires an appropriate hydrogeologic model for the project area, which discusses the hydrostratigraphy and groundwater flow systems; a sensitivity analysis will be performed to test model sensitivity to climatic variations (e.g. recharge) and hydrogeologic parameters (e.g. hydraulic conductivity). Provide information or a sufficient rationale for the omission of the following from the hydrogeological model: • addressing the zones of "enhanced hydraulic conductivity" • regional (deep) groundwater flow regime • the use of large uniform beds to represent fractured rock • calibration of the model using baseflow (and not just heads) from streams • the irregular model extent shape • representative ranges of input parameters that represent the hydrogeological conditions that are then assessed in the sensitivity analysis. Provide a sensitivity analysis to assess the effects in the event that some potentially acid generating waste rock is classified, incorrectly, as non-acid generating wasterock and be then either used for construction purposes or stored in the incorrect waste rock stockpile.	Appendix B.2
	Section 6.6.2	Describe the monitoring protocol for the collection of surface water data.	Appendix G.11 (Surface Water Sampling SOP)

Table CS-1: Conformity Review Concordance Table (November 4, 2019 and November 5, 2020) (continued)

Requirement of the FMS EIS Guidelines (Please refer to the August 31, 2018 EIS Guidelines for the complete text. Text in this column for reference only.	Section of the EIS	Information Requirement	Location of Information Requirement in Updated EIS Submission 2020
	Section 6.6.3	Provide baseline information pertaining to the bathymetry, maximum and mean depths, and water level fluctuations for all watercourses described in the EIS. *As the reference document "McCallum (2019") is not publically available, a description of the baseline data collection methodology is not available.* Provide a characterization of groundwater – surface water interactions. Describe the temperature changes in surface water as a result of groundwater-surface water interactions.	Appendix G.1 Appendix G.11 Section 6.6.8.1.2.5 Appendix B.2
7.1.6 Fish and fish habitat	Section 6.8.3.1	Describe the seasonal variation of primary and secondary productivity in the affected water bodies. Describe the habitat by homogenous section for potentially affected surface waters. Specifically, provide further detail of the watercourses in Table 6.6-6 including: • a description of the riparian vegetation • water depths • representative photos for each homogenous section of watercourse.	Section 6.8.3.1.6 Section 6.8.3.1.7 Section 6.8.2.1.2.2 Section 6.6.3.1.1 Appendix G.10 (photo log)
7.1.10 Indigenous Peoples	Section 6.13 Appendix K.1 Appendix H.1	Describe the Mi'kmaq of NS populations and subpopulations. Demonstrate how the differences of experiences by sub-populations within an Indigenous group (e.g. women, youth, elders, families) were considered in the description of baseline information for Indigenous peoples and cumulative effects. Describe the overall quality of the experience of the practice (e.g. noise, air quality, visual landscape, presence of others). Provide a model or virtual representation of the Project area (before construction, during operation, decommissioning and post reclamation) to illustrate how the visual landscape from nearby areas; including areas used by Indigenous groups such as Seloam Lake and Highway 374 will be affected.	Section 6.13.2.1 Section 6.13.2.2.3 Section 6.13.5 Section 6.13.5.1 Section 8.5.7 Appendix K.2 Appendix G.13 (Visual Simulation)
7.2.2 Changes to Groundwater and Surface Water	Section 6.6.6 Section 6.6.8	Describe how project activities may impact pH, turbidity, or temperature in the surrounding waterbodies. If no changes to pH, turbidity, dissolved oxygen, or temperature are anticipated, substantiate conclusions with scientific knowledge. Clearly state assumptions and describe how each assumption was tested.	Section 6.8.6.1.2.3 Appendix B.6
7.3.1 Fish and fish habitat	Section 6.8.6	Provide an assessment of potential impacts to fish habitat in watercourses immediately upstream and downstream of the Seloam Brook Diversion. Indicate how the channel morphology and other relevant fish habitat features and functions change within watercourses immediately upstream and downstream of the Seloam Brook Diversion change. Provide the current seasonal water levels and flows in these watercourses and indicate how will the diversion channel affect them.	Section 6.8.6.1.2.1 (Seasonal water levels and flows in Appendices – D.4 and J.5)
	Section 6.8.6 Section 6.8.8	Provide an assessment of the potential effects to the food web or the potential effects on primary and secondary productivity.	Section 6.8.6.1.2.1.3
	Section 2.2.1.9	Provide additional information and detail regarding the purpose and construction of the Seloam Brook Diversion. Specifically, describe how the Seloam Brook Diversion channel and associated berms will provide fish habitat components and features.	Section 2.2.1.9 Section 2.4.1.1.3 Section 6.8.6.1.1.1 Appendix J.5 Appendix J.7

Table CS-1: Conformity Review Concordance Table (November 4, 2019 and November 5, 2020) (continued)

Requirement of the FMS EIS Guidelines (Please refer to the August 31, 2018 EIS Guidelines for the complete text. Text in this column for reference only.	**Section of the EIS**	**Information Requirement**	**Location of Information Requirement in Updated EIS Submission 2020**
	Table 6.8-20	Describe the effects on ongoing water withdrawal requirements from Seloam Lake on fish and fish habitat. Include a rationale and relevant information to support any determinations of whether or not fish habitat in Seloam Lake will be potentially impacted by water withdrawals.	Section 6.8.6.1.2.2
7.3.5 Indigenous Peoples	Section 6.13 Section 6.14 Appendix K.1 Appendix H.1	Demonstrate how potential effects to mental and social well-being on the Mi'kmaq of NS were considered in the assessment of potential project effects to Indigenous health and socioeconomic conditions, and any incidental effects on the current use of lands and resources for traditional purposes Describe how the effects of changes to the environment on Indigenous peoples could be different for particular sub-populations within an Indigenous group (e.g., women, youth, elders, specific families). Provide an assessment of impacts to human health assessing effects of changes to the environment on the Mi'kmaq of Nova Scotia's socio-economic conditions, including, but not limited to: • the use of navigable waters (including any water used for Mi'kmaq of Nova Scotia transport) • forestry and logging operations • commercial fishing, hunting, trapping, and gathering activities (e.g., Food, Social, Ceremonial and Communal Commercial fishing licenses and the right to fish for a moderate livelihood) • commercial outfitters • recreational use • food security • income inequity • changes at the community level that affect socio-economic conditions for the Mi'kmaq of Nova Scotia as a result of increased population, economic activity, cost of living, among other factors • non-commercial / trade economy. Describe how the proponent considered in its assessment: • the regional context for traditional use, and the value of the project area in that regional context, including alienation of lands from traditional use • potential to return affected areas to pre-project conditions to support traditional practices (including the identification of end land use goals). • Describe potential effects to the practice of current use or activities, including: • accessing areas and resources without difficulty or additional cost used to conduct an activity or practice, as well as the opening up of areas to non- Indigenous populations for access and use, and consideration of preferred areas, timing of harvest, and options of traveling there in preferred manner • changes that affect the spiritual and cultural experiences of the activity or practice, as well as sense of place and wellbeing, and the applicability and transmission of Mi'kmaq of Nova Scotia knowledge, laws, customs and traditions.	Section 6.13.5.2 Section 6.13.5.3 Section 6.13.5.4 Appendix H.1 Appendix K.2
7.5 Significance of Residual Effects	Section 6.6.5.6	Provide a definition for Significant Adverse Effects for both surface water quality and quantity.	Section 6.6.5.6

Table CS-1: Conformity Review Concordance Table (November 4, 2019 and November 5, 2020) (continued)

Requirement of the FMS EIS Guidelines (Please refer to the August 31, 2018 EIS Guidelines for the complete text. Text in this column for reference only.	**Section of the EIS**	**Information Requirement**	**Location of Information Requirement in Updated EIS Submission 2020**
9. FOLLOW-UP AND MONITORING			
9.1 Follow-up Program	Throughout	Describe how Indigenous groups were engaged regarding the design or proposed implementation of the follow-up and monitoring program(s).	Sections 6.1.9, 6.2.9, 6.3.9, 6.4.9, 6.5.10, 6.6.9, 6.7.9, 6.8.9, 6.9.9, 6.10.9, 6.11.9, 6.12.9, 6.13.8, 6.14.9, 6.15.9, 6.17.9 Section 9.0 Section 10.0
GENERAL			
Missing information	Appendix K.1	Update the Summary of Engagement Activities with Mi'kmaq of Nova Scotia (Appendix K.1) beyond April 21, 2019.	Appendix K.2
Correct table number	Summary document, Section 6.10.2, page 113	There is reference to Table 6.10-5, but it should read Table 6.10-3.	Corrected
Correct table number	Summary document, Section 6.11.2, page 118	There is reference to Table 6.11-2, but it should read Table 6.11-1.	Corrected
Include tables	Summary document, Section 6.12.4, page 129	There is reference to tables that are not in the report. " ... are not carried forward in the tables below." Ensure tables referenced in the report are included in the EIS.	Corrected
Edit spelling	Section 4.4.3, page 120	"Support to the Mawita'jik "Let Use Gather" ..., should read "Let Us Gather".	Corrected
Insert correct Figure number	Section 6.17.7, page 767	Reference to a figure appears as "provided on Error! Reference source not found" confirm this should be "provided on Figure 6.17-1".	Corrected
Be consistent with terms	Section 6.17.7, page767	Figure 6.17-1 Risk Ranking Matrix is referred to in the text as a Risk Rating Matrix.	Corrected
Correct units	Section 8.5.2.1, page 820	The text for µg is illegible.	Corrected
Inaccurate information	Table 9.1-3: Summary of Mitigation Measures page 893 Table 6.13-7: Mitigation and Monitoring Programs for Potential Effects on the Mi'kmaq of Nova Scotia page 686	The following statement is inaccurate and needs to be revised: *The Proponent to support joint funding initiatives with CEAA for Mi'kmaq third party review of the Proponent's proposed mitigation and monitoring programs during EIS review. Scope and scale of this commitment to be determined.* The Agency does not provide specific funding initiatives for Mi'kmaq third party review.	Corrected
ANNEX 2: ADVICE TO THE PROPONENT			
Department: DFO-1	Appendix D.3 – Conceptual Fish Habitat Offsetting Plan	This is standard advice to proponents regarding habitat offsetting measures required for Fisheries Act authorizations. To offset harmful alteration, disruption, and destruction (HADD) of fish habitat from the Project, the Conceptual Fish Habitat Offsetting Plan will need to be revised and take into consideration habitat quality, uncertainty, and time-lag. Project components, such as the Seloam Brook Diversion Channel, cannot be used as offsetting measures; however, any fish habitat features included in project components may mitigate the area of residual HADD that must be offset. It is recommended that the proponent seek further advice from DFO regarding offsetting the HADD of fish habitat	Section 6.8.7.3 Appendix J.7 (Fish Habitat Offset Plan)

Table CS-1: Conformity Review Concordance Table (November 4, 2019 and November 5, 2020) (continued)

Requirement of the FMS EIS Guidelines (Please refer to the August 31, 2018 EIS Guidelines for the complete text. Text in this column for reference only.	Section of the EIS	Information Requirement	Location of Information Requirement in Updated EIS Submission 2020
DFO-2	Section 6.83 Baseline Conditions - Fish and Fish Habitat	This is standard advice to proponents regarding the information required to demonstrate fish absence from a waterbody. DFO assumes that waterbodies with hydrological connectivity to fish-bearing waterbodies are frequented by fish unless the proponent is able to demonstrate otherwise. Determination of the absence of fish from a waterbody is difficult and the ultimate "proof" of absence must be associated with the most intensive and efficient sampling procedures appropriate for the habitat, species, life stage, and time of year. Fish sampling procedures should include multi-season sampling events, and utilize multiple gear- types with appropriate methods wherever possible. Fish sampling efforts should be well documented: date/time, GPS locations, datasheets, photos, effort, catch, etc. Within the Project area the annual maximum flows and water levels typically occur in April followed by November and December whereas annual minimum flows and water levels typically occur July through September. To demonstrate fish absence from a waterbody, fish sampling and hydraulic connectivity assessments should be timed to coincide with annual maximum flows and water levels.	Section 6.8.2.1.5 (updated sample methods) Section 6.8.2.1.7 (eDNA)
DFO-3	Section 6.8.2.1.1.5 Fish Habitat Assessment	This is standard advice to proponents regarding the information required to describe fish habitat in FMS Study Area and the significance of effects to fish habitat from the Project. The appropriateness of the use of the Standard Methods Guide for Freshwater Fish and Fish Habitat Surveys in Newfoundland and Labrador: Rivers and Streams and Beak (1980) to describe the quality of fish habitat for the FMS Study Area and the significance of effects of the Project on fish habitat is questionable. It is our understanding that the FMS Study Area is effectively inaccessible to Atlantic Salmon. Therefore, using Atlantic Salmon as an index for the relative quality and productivity of the streams, waterbodies, and wetlands for fish populations may not be the most appropriate or practical approach. It may be more relevant and better suited to describe the habitat quality in terms of the fish species that are known to be present in the FMS Study Area and how those species utilize the area. Obviously, brook trout are salmonids. However, their tolerances and preferences and life history differ from Atlantic Salmon. Furthermore, the other fish species known to be present in the FMS Study Area differ greatly from Atlantic Salmon. Basing habitat types and describing the habitat quality in reference to Atlantic Salmon spawning and rearing habitat may not be relevant given the type of habitat present at the FMS Study Area. For example, poor quality juvenile salmonid rearing habitat with no spawning capability may be moderate to good quality habitat for other fish species.	Section 6.8.2.1.2
ECCC-1	Section 2.2.1.11, Page 34	It is stated "The TMF is located to the east and up gradient of the open pit and is situated in a position that limits interactions with wetlands and streams frequented by fish to the maximum practical extent." If the TMF footprint is located on waters frequent by fish, the proponent will have to go through the Schedule 2 amendment process under Metal and Diamond Mining Effluent Regulations (MDMER). "Maximum practical extent" is not an option.	Section 2.2.1.11 Appendix J.6
ECCC-2	Section 2.2.1.5 – Overburden Till Stockpile	Please provide the volume of overburden.	Section 2.2.1.5
ECCC-3	Section 2.2.1.6 – Topsoil and Organic Material Stockpiles	Please provide the volume of topsoil.	Section 2.2.1.6
ECCC-4	Section 2.4.2.1.2 – Waste Rock Management	Provide a discussion on the potential for metal leaching.	Section 2.4.2.1.2 Appendix B.6 Appendix F.2

Table CS-1: Conformity Review Concordance Table (November 4, 2019 and November 5, 2020) (continued)

Requirement of the FMS EIS Guidelines (Please refer to the August 31, 2018 EIS Guidelines for the complete text. Text in this column for reference only.	Section of the EIS	Information Requirement	Location of Information Requirement in Updated EIS Submission 2020
TC-01	Sub-paragraph, 1.3.1.5 Navigation Protection Act, 1985 (Page 13)	Refers to Transport Canada (TC)'s Navigation Protection Act and communication with TC regarding any requirements as part of the project. The Canadian Navigable Waters Act (CNWA) came into force on August 28, 2019. The CNWA still possesses a Schedule of waterways to which the Act applies, however, as previously indicated, the proposed project does not appear to implicate any Scheduled waterways pursuant to the CNWA. HOWEVER, the EIS mentions the use of a Tailing Management Facility and other water control structures involving tailings disposal/storage. Infilling or dewatering of any navigable waterway remains prohibited under the CNWA and requires an Exemption by Order of the Governor in Council pursuant to Section 24 of the CNWA. This requirement can only be ascertained once the proponent submits a Notice of Work detailing the work, its effects, and the nature of the water bodies that may be involved/affected. It is also understood that elements of the project may involve the diversion of watercourses. Under the Major Works Order made pursuant to the CNWA, proposed water control structures located on ANY navigable waterway that divert water, or change the water levels of watercourses require a CNWA approval (on scheduled OR non-scheduled waterways) Finally, with respect to any new or existing works located on non-scheduled waterways (culverts/ bridges etc.) that may require construction, placement, alteration, repair or replacement as part of the overall project – under the CNWA, owners of works – (other than a minor work or a major work) - that are located on navigable waterways not listed in the schedule, which may interfere with navigation, have the option to: 1.either apply to the Minister of Transport for approval (approval review process and advertising and 30 day registry public review);or 2.seek authorization through the public resolution process, and deposit specific information regarding their work on the new Common Project Search (online registry) inviting any interested party to comment. (advertising and 30 day registry public review) With the coming into force of the CNWA, the Navigation Protection Program has transitioned to the use of the external submission site (ESS) linked below. This is the central point to submit an application for an approval or to publish a notification for a work: https://wwwapps.tc.gc.ca/Prog/3/NWAR-RLEN-E/en/Account/Login The proponent will need to create an account first. Once an application Is submitted on the ESS, it will be pushed to the Common Project Search Registry: https://common-project- search.canada.ca/ for public review. Additional guidance information and links for the NPP regulatory process can be found here: Canadian Navigable Waters Act https://www.tc.gc.ca/eng/programs-632.html https://www.tc.gc.ca/eng/canadian-navigable-waters-act.html Navigation Protection Program, Transport Canada http://www.tc.gc.ca/eng/programs-621.html	Noted Updated in Section 1.3.1.5
IAAC Electronic (email) Correspondence dated November 5, 2020	Appendix I.4: Groundwater Flow and Solute Transport Modelling to Evaluate Disposal of Fifteen Mile Stream Tailings in Touquoy Open Pit – Fifteen Mile Stream Gold Project	An up-to-date and accurate base model for Touquoy is required for reviewers to conduct the technical review of the addition of the Fifteen Mile Stream tailings to the Touquoy open pit. Please confirm that the upcoming submissions for the Fifteen Mile Stream Project will include the revised Touquoy model.	Appendices I.4, I.5, I.6 and C.2

Table ES-1: Concordance Table - IAAC

FMS EIS Guidelines (CEAA 2018)		**Fifteen Mile Stream EIS Report**	
Section	**Title**	**Section**	**Title**
1.	INTRODUCTION AND OVERVIEW	1.	Introduction
1.1	The proponent	1.2	Proponent Information
1.2	Project overview	1.1	Project Overview
1.3	Project location	1.1.2	Project Location
1.4	Regulatory framework and the role of the government	1.3	Regulatory Framework and Role of Government
2.	PROJECT JUSTIFICATION AND ALTERNATIVES CONSIDERED	1.4	Purpose of the Project
		2.6	Alternative Means of Carrying Out the Project
2.1	Purpose of the project	1.4	Purpose of the Project
2.2	Alternative means of carrying out the project	2.6	Alternative Means of Carrying Out the Project
3.0	PROJECT DESCRIPTION	2.0	Project Description
3.1	Project components	2.2	Project Components
3.2	Project activities	2.4	Project Activities
3.2.1	Site preparation and construction	2.4.1	Subsections titled “Construction Phase/Pre-Production Phase (Year 1)”
3.2.2	Operation	2.4.2	Subsections titled “Operation (Years 2 to 9)”
3.2.3	Decommissioning and abandonment	2.4.3	Subsections titled “Closure (Years 9 to 11+)”
4.	PUBLIC CONSULTATION AND CONCERNS	3.	Public Consultation and Engagement Program
5.	ENGAGEMENT WITH THE MI’KMAQ OF NOVA SCOTIA AND CONCERNS RAISED	4.	Indigenous Peoples Consultation and Engagement Program
6.	IMPACTS TO POTENTIAL OR ESTABLISHED ABORIGINAL OR TREATY RIGHTS	6.13	Mi’kmaq of Nova Scotia
7.	EFFECTS ASSESSMENT	6.	Environmental Effects Assessment
7.1	Project setting and baseline conditions	6.X.3	Subsections for each VC titled “Baseline Conditions”

FMS EIS Guidelines (CEAA 2018)		Fifteen Mile Stream EIS Report	
Section	**Title**	**Section**	**Title**
7.1.1	Atmospheric environment	6.1	Noise
		6.2	Air
		6.3	Light
7.1.2	Geology and geochemistry	6.4	Geology, Soil and Sediment
7.1.3	Topography and soil	6.4	Geology, Soil and Sediment
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The purpose and need of the undertaking	1.4	Project Purpose
The proposed construction and operation schedule.	2.4	Project Schedule
A description of undertaking	2.0	Project Description
Environmental baseline information	6.0	Environmental Effects Assessment
All steps taken or proposed by the proponent to identify and address the concerns of the public and Aboriginal peoples	3.0	Public Consultation and Engagement Program
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Commonly Used Acronyms Index

Commonly Used Acronyms	
ABA	Acid-Base Analyses
ACPF	Atlantic Coastal Plain Flora
AMO	Abandoned Mine Opening
ANFO	Ammonium Nitrate and Fuel Oil
AP	Acid Potential
AR	Argillite
ARD	Acid Rock Drainage
As	Arsenic
ASX	Australian Securities Exchange
AUCCA	Average Upper Continental Crust Abundance
BAPs	Best Available Practices
BFL	Boreal Felt Lichen
BMPs	Best Management Practices
CAAQS	Canadian Ambient Air Quality Standards
CAC	Criteria Air Contaminants
CCC	Criterion Continuous Concentration
CCH	Communities, Culture and Heritage
CCME	Canadian Council of Ministers of the Environment
CDA	Canadian Dam Association
CEA	Cumulative Effects Assessment
CEAA	Canadian Environmental Assessment Agency
CEAA 2012	Canadian Environmental Assessment Act, 2012
CEAR	Canadian Environmental Assessment Registry
CEO	Chief Executive Officer
CEPA	Canadian Environmental Protection Act

Commonly Used Acronyms	
CFM	Cubic Feet per Minute
CGVD28	Canadian Geodetic Vertical Datum of 1928
CGVD2013	Canadian Geodetic Vertical Datum of 2013
CH_4	Methane
CIE	Commission Internationale de l'Eclairage
CIL	Carbon in Leach
CLC	Community Liaison Committee
CMA	Census Metropolitan Area
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CO_2 e	Carbon Dioxide Equivalent Units
CONI	Common Nighthawk
COO	Chief Operating Officer
COPC	Chemical of Potential Concern
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CPUE	Catch per unit Effort
CRM	Cultural Resource Management Group
CSM	Conceptual Site Model
CWS	Canada Wide Standards
CWS	Canadian Wildlife Services
DC	Direct Current
DFO	Fisheries and Oceans Canada
DO	Dissolved Oxygen
DOC	Dissolved Organic Carbon
Dv	Danesville series soil

Commonly Used Acronyms	
EA	Environmental Assessment
EARD	Environmental Assessment Registration Document
ECCC	Environment and Climate Change Canada
EDGM	Earthquake Design Ground Motion
EEM	Environmental Effects Monitoring
EIS	Environmental Impact Statement
EMS	Environmental Management System
EOM	End of Mine
EPP	Environmental Protection Plan
EQS	Environmental Quality Standards
ERP	Emergency Response Plan
ESMH	Eastern Shore Memorial Hospital
FAL	Freshwater Aquatic Life Guidelines
FEC	Forest Ecosystem Classification of Nova Scotia
FEFLOW	Finite-Element Simulation System for Subsurface Flow and Transport Processes
FEQG	Environment Canada Federal Environmental Quality Guideline
FIA	Fish Impact Area
FMS	Fifteen Mile Stream
FMS Mine Site	Fifteen Mile Stream Mine Site
FMS Study Area	Fifteen Mile Stream Study Area: For the purpose of the environmental assessment, this is the infrastructure footprint plus an associated buffer.
FSC	Food Social and Ceremonial Purposes
FTEs	Full Time Equivalents
FWAL	Freshwater Aquatic Life
GCL	Ground Concentration Levels
GDP	Gross Domestic Product

Commonly Used Acronyms	
GHG	Greenhouse Gas
GIS	Geographic Information System
GPS	Global Positioning System
GRG	Gravity Recoverable Gold
GW	Greywacke
HADD	Harmful Alteration, Disruption, or Destruction of Fish Habitat
Hg	Mercury
HHRA	Human Health Risk Assessment
HREC	Halifax Regional Education Centre
HRM	Halifax Regional Municipality
Hx	Halifax Series Soil
IA	Industrial Approval
IAAC	Impact Assessment Agency of Canada; agency name change from CEAA August 2019
ICMC	International Cyanide Management Code
IDF	Inflow Design Flood
IR	Indian Reserve
ISQGs	Freshwater Interim Sediment Quality Guidelines
KP	Knight Piesold
LAA	Local Assessment Area
LCA	Local Catchment Areas
LGO	Low Grade Ore
LOEC	Lowest Observed Effect Concentration
MAP	Mean Annual Precipitation
MAPS	Mi’kma’ki All Points Services
MBBA	Maritime Breeding Bird Atlas
MBCA	*Migratory Birds Convention Act*

Commonly Used Acronyms	
MBR	Migratory Birds Regulations
MDMER	Metal and Diamond Mining Effluent Regulations
MEKS	Mi'kmaq Ecological Knowledge Study
MEL	McCallum Environmental Ltd.
ML	Metal Leaching
ML/ARD	Metal Leaching / Acid Rock Drainage
MODG	Municipality of the District of Guysborough
MPOI	Maximum Point of Impingement
MPS	Municipal Planning Strategy
MU	Mixed Use
MW	mixedwood
NaCN	Sodium Cyanide
NAG	Non-Acid Generating
NaOH	Sodium Hydroxide
NAPS	National Air Pollution Surveillance Network
NB	New Brunswick
NGO	Non-Governmental Organization
NOEC	No Observed Effect Concentration
NOx	Oxides of Nitrogen
N_2O	Nitrous Oxide
NP	Neutralization Potential
NPA	Navigation Protection Act, 1985
NPRI	National Pollutant Release Inventory
NRC	Natural Resources Canada
NRCAN	Natural Resources Canada
NS	Nova Scotia

Commonly Used Acronyms	
NSAQS	Nova Scotia Air Quality Standards
NSEQS	Nova Scotia Tier 1 Environmental Quality Standards
NSESA	*Nova Scotia Endangered Species Act*
NSCC	Nova Scotia Community College
NSCCH	Nova Scotia Department of Communities, Culture, and Heritage
NSDFA	Nova Scotia Department of Fisheries and Aquaculture
NSDMA	Nova Scotia Department of Municipal Affairs
NSDEM	Nova Scotia Department of Energy and Mines
NSEQS	Nova Scotia Environment Qualify Standards
NSESA	Nova Scotia Endangered Species Act
NSDNR	Nova Scotia Department of Natural Resources
NSE	Nova Scotia Environment
NSEL	Nova Scotia Environment and Labour
NSL&F	Nova Scotia Lands and Forestry
NSLC	Nova Scotia Liquor Commission
NSPI	Nova Scotia Power Inc.
NSSA	Nova Scotia Salmon Association
NSTIR	Nova Scotia Department of Transportation and Infrastructure Renewal
NWPA	Navigable Waters Protection Act, 1985 (repealed)
O_3	Ozone
OAA	Nova Scotia Office of Aboriginal Affairs
OMECP AAQC	Ontario Ministry of Environmental Conservation and Parks Ambient Air Quality Criteria
OMS	Operations, Maintenance and Surveillance
PA	Project Area (For the purpose of the environmental assessment the Project Area includes 2 components: the FMS Study Area and the Touquoy Mine Site.)

Commonly Used Acronyms	
PAG	Potentially Acid Generating
PAH	Polycyclic Aromatic Hydrocarbon
PAPR	Powdered Air Purifying Respirators
PC	Post Closure
PEL	Probable Effect Level
PGAs	Peak Horizontal Ground Accelerations
PGI	Pellet Group Inventory
PID	Property Identification Number
PMF	Probable Maximum Flood
PM	Particulate Matter
POPC	Parameters of Primary Concern
POR	Point of Reception
$PM_{2.5}$	Particulate with aerodynamic diameter of 2.5 μm or less (Fine Particulate Matter)
PM_{10}	Particulate with aerodynamic diameter of 10 μm or less (Coarse Particulate Matter)
PPE	Personnel Protector Equipment
PSS	Pathway Specific Standards
RAA	Regional Assessment Area
RC	Reverse Circulation
RBC	Rotating Biological Contractor
RFA	Rainfall Frequency Atlas
RGWD	Relative Groundwater Depth
ROI	Radius of Influence
ROM	Run Of Mine
S	Sulphur
RQD	Low Rock Quality Designation
SAD	Strong Acid Dissociable

Commonly Used Acronyms	
SAR	Species at Risk
SARA	*Species at Risk Act, 2002*
SFE	Shake Flask Extraction
SH	Spruce Hemlock Forest Group
SO_2	Sulphur Dioxide
SOCI	Species of Conservation Interest
SP	Spruce Pine Forest Group
SSD	Species Sensitivity Distribution
SSDH	Significant Species and Habitats Database
SSWQO	Site-Specific Water Quality Objective
SWRT	Single Well Response Tests
TC	Transport Canada
TDS	Total Dissolved Solids
TH	Tolerant Hardwood Groups
TMF	Tailings Management Facility
TOR	Terms of Reference
TPM	Total Particulate Matter
TSI	Trophic Status Index
TSP	Total Suspended Particulates (Total Dust)
TSS	Total Suspended Solids
TVS	Total Volatile Solids
USEPA	United States Environmental Protection Agency
VC	Valued Component
VEC	Valued Environmental Components
VESDAs	Very Early Smoke Detection Alarms
VOC	Volatile Organic Compounds

Commonly Used Acronyms	
VTs	Ecosite Vegetation Types
WAD	Weak Acid Dissociated
WAM	Wet Areas Mapping
WESP-AC	Wetland Ecosystem Services Protocol - Atlantic Canada
WC	Watercourse
WITAP	Wild Islands Tourism Advancement Partnership
WL	Wetland
WMMP	Wildlife Management and Monitoring Plan
WRSA	Waste Rock Storage Area
WSS	Wetlands of Special Significance
Wv	Wolfville Series Soil
Zenith	A point directly above an observer in the sky

Commonly Used Units of Measurement Index

Commonly Used Units of Measurement	
dBA	A-weighted decibel unit
g/L	Grams per litre
gpt	Grams per tonne
ha	Hectare
kg	Kilogram
km	kilometer
kl	Kiloliter
kt	Kilotonnes
kt – CO_2e	Kilotonne of carbon dioxide equivalent
kV	Kilovolts
l	Litres
L_{eq}	Sound Level Equivalent
lux	Lumens per square meter
m	Metre
m^2	Square metre
m^3/d	Cubic metres per day
Ma	Million years
mag/arcsec^2	Sky brightness in magnitudes per square arcsecond
masl	metres above sea level
mg	Milligrams
mbgs	Metres below ground surface
mg/kg	Milligrams per kilogram
mg/L	Milligrams per litre
mg/m^3	Milligram per cubic meter
mm	Millimeter

Commonly Used Units of Measurement	
Mm^3	million cubic metres
msec	Millisecond
m/s	Metres per second
Mt	Megatonne (1 million tonnes or 10^9 kg)
Mt-CO_2e	Megatonne of carbon dioxide equivalent
MW	Megawatt
ppb	Parts per billlion
Ppd	People per dwelling
tpd	Tonnes per day
µg/kg bw/day	Microgram per kilogram of body weight per day
µg/L	micrograms per litre
µg/m^3	Microgram per cubic meter
µm	Micron (1/1,000,000th of a metre)
wt %	Percentage by weight or weight percent

1.0 Introduction

1.1 Project Overview

1.1.1 Name of Designated Project

The designated Project will be known as the "Fifteen Mile Stream Gold Project" (the Project).

1.1.2 Project Location

The Project is located at the eastern boundary of Halifax County, central Nova Scotia, approximately 95km northeast of Halifax and 17km to the northeast of the Atlantic Mining NS Inc. Beaver Dam Mine Project. The property covers the historic Fifteen Mile Stream Gold District located on NTS sheets 11E01/C and 11E02/D and is centered at approximately 538584 E and 4999404 N (UTM Zone 20 NAD 83 CSRS). The Touquoy Mine Site, which forms part of the Project description, is located on the NTS sheet 11D15 and is centered at 504599 E and 4981255 N (UTM Zone 20 NAD 83 CSRS).

1.1.3 Project Overview

The Project is proposed to be developed in association with the currently operating Touquoy Gold Project. The Project is planned to be permitted and operated as a separate satellite surface mine operating at a rate of approximately two million tonnes (Mt) of gold-bearing ore per year. Fifteen Mile Stream (FMS) ore will be crushed and concentrated through processing on site to produce a gold concentrate which will be hauled by on-road highway trucks to the Touquoy Mine Site carbon-in-leach (CIL) processing facility for final processing into gold doré bar, a distance of just over 76 km on existing public roads. This will eliminate the need for a separate CIL cyanide leach circuit at the FMS Mine Site to support the Project. The FMS concentrate will be processed at the Touquoy Mine Site in conjunction with ore supply from Touquoy, Beaver Dam and Cochrane Hill surface mines.

The planned start date for construction for the Project is 2023 with a scheduled start-up for 2024. The mine will operate for 6.75 years and will employ up to 200 persons including both salaried and hourly personnel. At the cessation of mining activities, the site will be reclaimed in accordance with federal and provincial requirements.

The Project is subject to both federal and provincial environmental assessment processes. This document presents both the Environmental Impact Statement (EIS) and the Environmental Assessment (EA) registration Document (EARD) to satisfy requirements of the federal and provincial processes, respectively.

This EIS/EARD for the Project has been prepared to facilitate the approval of the Project in accordance with the *Canadian Environmental Assessment Act, 2012* (*CEAA 2012*) and Environmental Assessment Regulations made under the *Nova Scotia Environment Act*. The Guidelines for the Preparation of an Environmental Impact Statement Pursuant to the *Canadian Environment Assessment Act, 2012* and Nova Scotia Registration Document Pursuant to the *Nova Scotia Environment Act* - Fifteen Mile Stream Gold Project (FMS EIS Guidelines) (CEAA 2018) prepared by Canadian Environmental Assessment Agency (CEAA) [now Impact Assessment Agency of Canada (IAAC) (agency name change as of August 2019)] have provided a framework for the organization of this EIS. No public money is being sought to undertake the Project.

The Project Area (PA) includes the FMS Study Area and the necessary components of the Touquoy Mine Site to process the gold concentrate and manage the associated additional tailings. This PA is shown at a regional scale, including proposed transportation routes, on Figure 1.1-1 attached to this document. The two options for transportation of gold concentrate include an initial route, and a second route once the Beaver Dam Mine Project becomes operational. The initial route is on public roads (Highway 374, Highway 7 and the Mooseland Road); the second route includes the use of Highway 224 and the Beaver Dam constructed interior haul road from Highway 224 to Mooseland Road. The transportation of concentrate on public roads is not included in the Project description, and the public roads are not included in the PA. The Beaver Dam constructed interior haul road from Highway 224 to Mooseland Road is included in the Beaver Dam Mine Project description and is considered in this EIS/EARD only within the cumulative effects assessment.

The total proposed FMS Mine Site infrastructure footprint is approximately 400 hectares (ha). The FMS Study Area for the purpose of the environmental assessment is the infrastructure footprint plus an associated buffer and is also shown on Figure 1.1-2.

Operations at the FMS Mine Site will include mining, crushing, ore processing and concentration, and operation of a waste rock storage area (WRSA), ore stockpiles and a tailings management facility (TMF). Two streams of gold concentrate will be produced at site and transported to the Touquoy Mine Site processing facility for final processing into gold doré bars. Tailings will be generated from mill processing and deposited into the exhausted Touquoy pit. Infrastructure at the FMS Mine Site will include crushing facilities, fine ore stockpile and reclaim, concentrator facilities, maintenance facilities, fuel storage, office infrastructure and site haul roads.

An existing 69kV, north-south hydroelectric transmission line is located west of Highway 374 and this line will supply power to the site via a small spur line (approximately 5.3 km) and sub-station to step the voltage down to 25kV. It is anticipated that clearing for powerline corridors will be minimal.

Development of the Project will require the realignment of Seloam Brook to accommodate development of the open pit. A realignment channel and a diversion berm will be constructed to convey Seloam Brook flow around the north of the proposed open pit and planned diversion berm. The Seloam Brook Realignment will isolate the mine site from the watercourse while maintaining fish connectivity through the Seloam Brook system.

Two processing concentrate streams will be produced at the Project; a gravity concentrate and a float concentrate. Both will be transported from the FMS Mine Site to the Touquoy Mine Site using existing highways in conjunction with the Beaver Dam Haul Road thus requiring minimal upgrades to existing road infrastructure.

Tailings produced at the FMS Mine Site will be stored in an approved TMF. The containment dams will be constructed with rock aggregate material sourced from mine waste rock or nearby quarries with upstream clay blanket and seepage cut off constructed using local till material.

Changes to the Touquoy Mine Site as a result of the Project are anticipated to be minimal. Only minor changes to the existing processing facility at the Touquoy Mine Site will be required, including the addition of concentrate storage and the addition of a second gravity concentrate leach reactor and a gravity electrowinning cell. These changes can be accommodated within the existing facility footprint. There will be tailings deposition into the exhausted Touquoy pit as a result of processing of concentrate from the Project. All other aspects of the Touquoy Mine Site will remain the same as previously assessed including the disturbed footprint, tailings management aspects and the size and locations of stockpiles.

The approved reclamation plan for the Touquoy Mine Site calls for the mined-out pit to be allowed to fill with water. At the end of processing at the Touquoy Mine Site the remaining volume within the open pit would naturally fill with water and the deposited tailings will be stored under a water cap, creating a water feature, or lake, as per the approved plan for the reclaimed Touquoy pit, albeit slightly shallower. “Wet” disposal is accepted internationally as a superior method of permanent tailings management as opposed to “dry” storage.

Following the production period for the Project, reclamation would occur at the FMS Mine Site and all associated facilities, as will be developed in the Project Reclamation and Closure Plan as described in the Environmental Management System (EMS) Framework Document (Appendix L.1). Any changes to the current reclamation plan for the Touquoy Mine Site as a result of the Project would require approval by the province of Nova Scotia.

1.2 Proponent Information

1.2.1 Proponent Profile

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

Currently, the Proponent holds four gold development projects in Nova Scotia: the Touquoy Gold Project, the Beaver Dam gold deposit, the Cochrane Hill gold deposit; and the Fifteen Mile Stream gold deposit. The Touquoy Gold Project has been in operation since October 2017. The Beaver Dam Mine Project Environmental Impact Statement has been submitted to IAAC and is in the information request phase. The Fifteen Mile Stream Gold Project is presented herein, and submission of the EIS for the Cochrane Hill Gold Project is anticipated in 2022.

Environmental data collection for the Project commenced in November 2016 when diamond drilling began in order to clearly define the gold resource. In January 2018, Ausenco Engineering Canada Inc. (Ausenco) was commissioned by the Proponent to complete a Project Pre-Feasibility Study and the NI 43-101 Technical Report for the development of the Moose River Consolidated Project Phase I (Touquoy and Beaver Dam deposits), and Phase II expansion (Fifteen Mile Stream and Cochrane Hill deposits).

Regulatory consultation officially began on July 5th, 2017 with a Provincial “One Window Process: Mineral Development in Nova Scotia” meeting to present the planned Project and to receive feedback on the regulatory regime and regional expertise. The purpose of the meeting was to provide guidance to the Proponent on the processes and timelines for regulatory approvals and other issues regarding development of the FMS and Cochrane Hill gold projects. A One Window update meeting was held February 21st, 2018 to allow the Proponent to introduce their new ‘Life of Mine Plan’ and for attendees to share information on the processes and timelines for regulatory approvals and to discuss any issues or concerns regarding the Proponent’s plan. Informal regulatory consultation with relevant provincial and federal agencies to inform and support field programming and all aspects of the environmental assessment has been on-going since Spring 2017.

A large proportion of the surface rights in the PA are held by MacGregor Properties Ltd of Halifax, including the area over the Egerton-McLean, Hudson and Plenty zones of mineralization. An agreement is in place with MacGregor Properties Ltd. whereby the Proponent, through Acadian Mining Nova Scotia Corporation (Acadian), a wholly owned subsidiary, can both explore and mine on the property after meeting various financial requirements. Most of the remaining surface area is held by the Crown (administered by the Province of Nova Scotia) including the identified fourth main zone of mineralization, the 149 Zone.

An agreement to explore, develop and mine is in place with MacGregor Properties Ltd. Acadian signed an Access Agreement and Option to Lease with MacGregor Properties Limited on April 8, 2010, which provides the Proponent with exclusive rights to conduct exploration on the MacGregor Properties Ltd. land and thereafter the option to lease the lands for mining. The exploration period timeframe extended until December 31, 2019, at which time the Proponent exercised the lease option of the agreement. The lease period timeframe extends from the lease commencement date until December 31, 2034. If a mine is operating on the area on December 31, 2034, then the lease period may be extended by agreement.

The property overlays ten Exploration Licences. Eight of these licences (EL05889, EL06440, EL10406, EL50664, EL51690, EL 51683, EL51573 and EL52901) are held by Atlantic Mining NS Inc. The eight licences comprise a total of 152 contiguous claims covering a surface area of approximately 2461 ha. One exploration licence (EL50714), held by Rick Horne, lies under the powerline corridor and one exploration license (EL51644) held by 1156219 B.C. Limited, lies under the Seloam Lake water intake line. The mineral rights associated with these private exploration licenses should not be affected by the proposed infrastructure. A Mining Lease will be sought once the Project receives Environmental Assessment Approval.

Atlantic Mining NS Inc. holds the existing permits, leases and licences for the Touquoy Gold Project.

1.2.2 Corporate Governance and Management Structure

The Proponent is committed to the highest practical standards of corporate governance and to being a responsible corporate citizen. Safe production and environmental stewardship are keys to the Proponent's organization. The guiding principles, including the purpose, commitments and core values of St Barbara Limited, are detailed on their company website: https://stbarbara.com.au/about-us/our-vision-and-values/.

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

The current senior management team of St Barbara Limited:

- Craig Jetson – Managing Director and Chief Executive Officer (CEO);
- Garth Campbell-Cowan– Chief Financial Officer (CFO);
- Rowan Cole – Corporate Secretary;
- Laird Brownlie – Head of External Affairs and Business Continuity;
- James Millard – Manager Environment and Community; and,
- Neil Schofield – Consulting Resource Geologist.

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

- Craig Jetson – Managing Director and CEO;
- Tim Netscher – Independent Non-Executive Chairman;
- Kerry Gleenson – Independent Non-Executive Director;
- David Moroney - Independent Non-Executive Director;
- Stef Loader – Independent Non-Executive Director; and
- Steven Dean – Independent Non-Executive Director.

Traded on the Australian Securities Exchange (ASX) as SBM, St. Barbara committed to maintaining high standards of ethics, integrity and statutory compliance in all Company dealings and conformance with the ASX Corporate Governance Principles and Recommendations (3rd Edition). The Proponent has a Nominating and Corporate Governance Committee, an Audit Committee and a Compensation Committee, as well as policies and codes, such as Code of Conduct which includes obligations regarding environmental standards, health and safety, contributions to local communities, and respect and tolerance. Any breaches of this Code must be immediately reported to the Chair of the Nominating and Corporate Governance Committee.

As part of its commitment to corporate responsibility and incorporation of best practices, the Proponent will voluntarily establish an Independent Tailings Review Board(Review Board) for design, construction and operation phases of project infrastructure including the TMF. This includes tailings management, waste rock storage and open pit mining activities. Reporting to the Head of External Affairs and Business Continuity, Laird Brownlie, the Review Board is established to provide on-going, independent confirmation to the Proponent by internationally-recognized experts that the design, construction, operation and closure of the projects conform with international best practice and to minimize impact in compliance with its permits and licenses. The Review Board is independent, and its scope includes reviewing, commenting, questioning, critiquing and advising on all aspects including, but not limited to:

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

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

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

1.2.3 Proponent Personal Details

A corporate office in Melbourne, Victoria, Australia and a local office in Mooseland, Nova Scotia are maintained in support of the Proponent's projects. Key management and technical staff will be located in both locations for the duration of the Project. The addresses for both office locations are provided in Table 1.2-1.

Table 1.2-1: Office Locations

Corporate Office	Local Office
Level 10, 432 St Kilda Road, Melbourne, VIC 3004 Locked Bag 9, Collins Street East, VIC 8003 Tel: +61 (3) 8660 1900 Fax: +61 (3) 8660 1999	409 Billybell Way, Mooseland Middle Musquodoboit, Nova Scotia, B0N 1X0 Tel: +902.384.2772 Fax: +902.384.2259

All communications regarding the EIS for the Project should be sent to the Manager of Environment and Community or as directed by the Head of External Affairs and Business Continuity. The contact information for these two roles is outlined in Table 1.2-2.

Table 1.2-2: Proponent Contacts

Position	Proponent
Head of External Affairs and Business Continuity	Laird Brownlie Middle Musquodoboit, Nova Scotia Phone: +902.384.2772 Email: Laird.Brownlie@atlanticgold.ca
Manager Environment and Community	James Millard Middle Musquodoboit, Nova Scotia Phone: +902.384.2772 Email: James.Millard@atlanticgold.ca

1.2.4 Environmental Assessment Study Team

The EIS was prepared by a consulting team comprised of McCallum Environmental Ltd. (MEL), Golder Associates Ltd. (Golder), Stantec Consulting Ltd (Stantec), Wood, Knight-Piésold Ltd. (KP), Ausenco, Lorax Environmental Ltd. (Lorax), Intrinsik Corporation (Intrinsik), and other technical-specific consultants, under contract to the Proponent. The Project Manager for the EIS is Meghan Milloy of MEL. James Millard (Proponent) provided on-going direction, guidance, and review of all aspects of the Project. Staff of the Proponent provided input and review of the submission. Contact information for the EA Project Manager is provided in Table 1.2-3. MEL, sub-contractors and their role in completion of the EIS/EARD are included in Table 1.2-4.

Table 1.2-3: EA Project Manager

McCallum Environmental Limited (MEL) Project Manager
Meghan Milloy, MES Phone: +902.446.8252 E-mail: meghan@mccallumenvironmental.com 2 Bluewater Road, Suite 115 Bedford, Nova Scotia, B4B 1G7

Table 1.2-4: MEL and Sub-contractors and EIS/EARD Role

Sub-contractor	Contributing Role	EIS Sections and Appendices
Allnorth Consultants Ltd.	Concentrate Haulage	Technical supporting documentation for Section 2.0
Ausenco	Process Engineering and Site Infrastructure	Technical supporting documentation for Section 2.0
Brighter Community Planning & Consulting	Socio-economic Evaluation, Public and Mi'kmaq Engagement	Sections 3.0. 4.0, and 6.15
Cultural Resource Management Group Limited (CRM Group)	Archaeological Screening and Reconnaissance Study	Technical supporting documentation for Section 6.14; Appendix A.1 - A.3
Golder Associates Ltd. (Golder)	Valued Components: Surface and Groundwater (FMS Mine Site) Predictive Modelling and Effects Assessment (FMS Mine Site) Pit Slope Analysis and Design Seloam Brook Realignment: Hydraulic Analysis – Downstream Environment	Sections 6.5 and 6.6; Appendices B.1 - B.10
Intrinsik Corp.	Aquatic Effects Assessment, Human Health Risk Assessment	Technical supporting documentation for sections 6.2, 6.6, 6.13; Appendices C.1 and C.2.
Jay Hartling Consulting Ltd.	Indigenous Relations Advisor	Technical support for Sections 4.0 and 6.13
Knight-Piésold Ltd. (KP)	Design and Engineering, TMF, Site Water Balance, Seloam Brook Realignment Channel Design	Technical supporting documentation for Sections 2.0, 6.6 and 6.8; Appendices D.1 - D.4.
KPMG LLP	Economic Impact Assessment of the Project	Appendix E.1
Lorax Environmental Services Ltd. (Lorax)	Geochemistry Source Terms, Metal Leaching and Acid-Rock Drainage (ML/ARD) Evaluation Mine Rock Management Plan	Technical supporting documentation for Sections 6.4, 6.5 and 6.6; Appendices F.1 and F.2

Sub-contractor	Contributing Role	EIS Sections and Appendices
McCallum Environmental Ltd. (MEL)	Valued Components: Surface Water identification and physical characterization, Geology, Soils and Sediment, Wetlands, Fish and Fish Habitat, Habitat and Flora, Terrestrial Fauna, Avifauna, Species at Risk and Species of Conservation Interest, Physical and Cultural Heritage, Mi'kmaq of Nova Scotia Cumulative Effects Assessment, EIS Compliance and Summary; EIS Summary Document Introduction, Project Description, EIS Methodology, Accidents and Malfunctions, Effects on the Environment, Federal Jurisdiction (in conjunction with Proponent)	Sections 1.0, 2.0, 5.0, 6.1, 6.2, 6.3, 6.4, 6.6, 6.7, 6.8, 6.9, 6.10, 6.11, 6.12, 6.13, 6.14, 6.16, 6.17, 7.0, 8.0, 9.0, 10.0; Appendix G.3, G.4, G.6, G.9
Mi'kma'ki All Points Services (MAPS)	Mi'kmaq Ecological Knowledge Study (MEKS)	Technical supporting documentation for Section 6.13; Appendix H.1
Moose Mountain Technical Services	Mine Engineering and Site Infrastructure	Technical supporting documentation for Section 2.0
Nortek Resource Solutions Inc.	Visual Simulations	Appendix G.12
Stantec Consulting Ltd. (Stantec)	Valued Components: Groundwater and Surface Water (Touquoy Mine Site) Predictive Modelling and Effects Assessment (Touquoy Mine Site) Historical Tailings Delineation and Management	Sections 6.5 and 6.6 and technical supporting documentation for Section 6.4; Appendices I.1 - I.7
Wood Environment & Infrastructure Solutions (Wood)	Air, Noise and Light Predictive Modelling and Evaluation (technical support and effects assessment in conjunction with MEL) FMS Mine Site Conceptual Minewater Treatment Design Seloam Brook Realignment Section Memo Model Results Fish Habitat Offset Plan: Preliminary Concept Update Assessment of Alternatives for Storage of Mine Waste	Technical supporting documentation for Sections 6.1, 6.2, 6.3; and 6.6 Appendices J.1 - J.7

1.3 Regulatory Framework and Role of Government

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

Table 1.3-1: Legislation Potentially Applicable to the Project

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

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

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

Federal

- Canadian Council of Ministers of the Environment (CCME) Canadian Water Quality Guidelines for the Protection of Freshwater Aquatic Life (FWAL) (CCME 1999a);
- CCME Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health (CCME 1999b);
- CCME Canadian Sediment Quality Guidelines for the Protection of Aquatic Life (CCME 2001);
- CCME Canada Wide Standards for Particulate Matter (PM) and Ozone (CCME 2010);
- Environmental Codes of Practice for Metal Mines (EC 2012c);
- Guidelines for the Assessment of Alternatives for Mine Waste Disposal (EC 2011);
- Streamlining the Approvals Process for Metal Mines with Tailings Impoundment Areas (EC 2012a);
- Guidance Document for Flow Measurement of Metal Mining Effluents (EC 2001);
- Guidance Document for Sampling and Analysis of Metal Mining Effluents (EC 2002);
- Federal Environmental Quality Guideline (FEQG): Cobalt. May 2017. (ECCC 2017a);
- Fisheries Protection Policy Statement (DFO 2013a);
- Fisheries Productivity Investment Policy: A Proponent's Guide to Offsetting (DFO 2013b);

- Assessing Cumulative Environmental Effects under the Canadian Environmental Assessment Act, 2012: Interim Technical Guidance (CEAA 2018);
- Guide for Reporting to the National Pollutant Release Inventory (NPRI) 2016 and 2017 (ECCC 2016a); and
- Federal Policy on Wetland Conservation (EC 1991).

Provincial

- Guidelines for Environmental Noise Measurement and Assessment (NSE 1990);
- Toward a Greener Future: Nova Scotia's Climate Change Action Plan (NSE 2009a);
- Guide to Consider Climate Change in Project Development in Nova Scotia (NSE 2011a);
- Nova Scotia Wetland Conservation Policy (NSE 2019);
- The Path We Share: A Natural Resource Strategy for Nova Scotia 2011-2020 (NSDNR 2011);
- Water for Life: Nova Scotia's Water Resource Management Strategy (NSE 2010a);
- Environmental Quality Standards (NSEQS) for Contaminated Sites (Tier 1) for Groundwater, Surface Water (fresh water), Soils and Sediment (NSE 2013b);
- Remediation Levels Protocol. Table 3, Pathway Specific Standards for Groundwater (NSE 2013a);
- Nova Scotia Standard Specifications: Highway Construction and Maintenance (NSTIR 1997);
- Erosion and Sediment Control Handbook for Construction Sites (NSE 1988);
- Guide to Altering Watercourses (NSE 2015a);
- Nova Scotia Watercourse Alterations Standard (NSE 2015b);
- Generic Environmental Protection Plan for Construction of 100 Series Highways (NSTIR 2007);
- Storm Drainage Works Approval Policy (NSE 2002a);
- Pit and Quarry Guidelines (NSDEL 1999);
- Blasting Safety Regulations made under Section 82 of the *Occupational Health and Safety Act* S.N.S. 1996, c. 7 O.I.C. 2008-65 (February 26, 2008, effective April 1, 2008), N.S. Reg. 89/2008 as amended by O.I.C. 2013-65 (March 12, 2013, effective June 12, 2013), N.S. Reg. 54/2013;
- Air Quality Regulations (NSE 2007); and
- Greenhouse Gas Emissions Regulations (NSE 2018).

Municipal

- Musquodoboit Valley/Dutch Settlement Municipal Planning Strategy (HRM 1996a);
- Musquodoboit Valley/Dutch Settlement Land Use By-law (HRM 1996b);

- Eastern Shore (East) Municipal Planning Strategy (HRM 1996c); and
- Eastern Shore (East) Land Use By-law (HRM 1996d).

1.3.1 Federal Regulatory Framework

1.3.1.1 *Canadian Environmental Assessment Act*, 2012

The *Impact Assessment Act* 2019 (IAA) and its regulations establish the current legislative basis for the federal impact assessment process. However, on July 17, 2018 the IAAC provided the Proponent with a Notice of Commencement of an Environmental Assessment, pursuant to *CEAA 2012* for the Fifteen Mile Stream Project. As a result, the Proponent has prepared this EIS in accordance with *CEAA 2012* for submission and review.

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

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

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

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

Date	Event
22 May 2018	The Proponent submits a Project Description and Project Description Summary documents to IAAC in order to initiate the EA determination process.
1 June 2018	IAAC releases a public notice inviting comments on the Project Description and Summary documents in order to acquire assistance in the EA determination process. The public has 20 days to comment.
16 July 2018	IAAC releases the Notice of EA Determination indicating that a federal EA is required for the Project.
17 July 2018	IAAC releases the Notice of Commencement of an EA.
17 July 2018	IAAC releases the draft EIS Guidelines and a public notice inviting comments on the guidelines in order to ensure they reflect which aspects of the environment may be affected and should be examined during the EA. The public has 34 days to comment. A news release of the same subject is provided on this date as well.
31 August 2018	IAAC releases the final EIS Guidelines specific to the Project.
4 October 2019	The Proponent submits the Fifteen Mile Stream Gold Project EIS.
4 November 2019	IAAC issues a request for further clarity and additional information to meet conformity review requirements.

Note: Canadian Environmental Assessment Agency (CEAA) updated the agencies name to Impact Assessment Agency of Canada (IAAC) in August 2019. .

Following submission of this EIS to IAAC, another public notice will be released inviting public comment. The provincial and federal government reviews will be completed in conjunction with this public review period. IAAC will then prepare and publish a draft EA report which considers all public and government comments, and detail conclusions regarding the potential for environmental effects from the Project. The Project is contingent upon receipt of an approved EA decision statement.

1.3.1.2 ***Fisheries Act,* 1985**

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

Under Section 35(1) *The Minister may designate, as a work, undertaking, or activity that is associated with a designated project, any work, undertaking or activity, that the Minister considers likely to result in the death of fish or the harmful alteration, disruption or destruction [HADD] of fish habitat* unless authorized by or carried on in accordance with regulations issued in accordance with the *Fisheries Act*. In addition, Section 36(3) prohibits the discharge or deposition of *a deleterious substance of any type in water frequented by fish or in any place under any conditions where the deleterious substance or any other deleterious substance that results from the deposit of the deleterious substance may enter such water* unless authorized or carried on in accordance with those same regulations.

The Project mining infrastructure will require the realignment of Seloam Brook and will encroach on waters frequented by fish. In the presence of impacts to recognized fish or fish habitat, authorization will be required from Fisheries and Oceans Canada (DFO) under Paragraph 35(3) of the *Fisheries Act*. This document addresses potential effects of the proposed Project activities on fish and fish habitat and provides a Fish Habitat Offset Plan (Appendix J.7) to support future expected Fisheries Act Authorization.

<u>Metal and Diamond Mining Effluent Regulations</u>

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

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

In addition to likely residual impacts that constitute a HADD, any fish and fish habitat that may be subject to a MDMER Schedule 2 designation and accordingly a fish habitat compensation process for these residual impacts has also been included in the Fish Habitat Offset Plan (Appendix J.7).

1.3.1.3 ***Migratory Birds Convention Act*, 1994**

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

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

Migratory Bird Regulations

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

1.3.1.4 ***Species at Risk Act*, 2002**

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

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

1.3.1.5 ***Canadian Navigable Waters Act,* 2019**

The *Navigation Protection Act* (*NPA*), formerly the *Navigable Waters Protection Act* (*NWPA*), was amended in April 2014 and effectively changed the definition of navigable waters under this legislation. Prior to the last amendment of the NPA, navigable waters included all bodies or courses of water that were capable of being navigated by any type of floating vessel for transportation, recreation, or commerce. This definition created the need for works in, on, under, or over any water body or watercourse to obtain a Navigable Waters Protection Approval.

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

The federal government recently made changes to these regulations and the *Canadian Navigable Waters Act (CNWA)* that replaced the *Navigation Protection Act* came into effect August 28, 2019. There is potential that, under this new regulation, waterways within the Project Area could require permitting. Further consultation with Transport Canada (TC) will be required as permitting proceeds. The Proponent has consulted with TC and confirmed that no pre-existing permits are in place within the PA under the repealed NWPA or the schedule of waterways that has been retained from the NPA in the new CNWA. Based upon the absence of any designations of local waterways, the requirement of permits for navigable waters is not anticipated for the Project under the CNWA. However, the Project involves diverting water and upgrades or construction of new works that may restrict navigation of a non-scheduled waterway (e.g. installation or upgrades of bridges, culverts, etc.). This requirement can only be ascertained once the Proponent submits a Notice of Work to TC.

1.3.1.6 **Federal Guidance Applicable to the Project**

In addition to the FMS EIS Guidelines (CEAA, 2018) developed for the Project, other guidance documents from IAAC that have been consulted include but are not limited to:

- Operational Policy Statement Assessing Cumulative Environmental Effects under the Canadian Environmental Assessment Act, 2012 (CEAA 2013a);

- Operational Policy Statement Addressing "Purpose of" and "Alternative Means" under the Canadian Environmental Assessment Act, 2012 (CEAA 2013b);
- Operational Policy Statement Determining Whether a Designated Project is Likely to Cause Significant Adverse Environmental Effects under the Canadian Environmental Assessment Act, 2012 (CEAA 2015a);
- Draft Technical Guidance for Assessing Cumulative Environmental Effects Under the Canadian Environmental Assessment Act, 2012 (CEAA 2014a); and,
- Technical Guidance for Assessing Physical and Cultural Heritage or any Structure, Site, or Thing that is of Historical, Archaeological, Paleontological, or Architectural Significance under the Canadian Environmental Assessment Act, 2012 (CEAA 2014b).

1.3.2 Provincial Regulatory Framework

1.3.2.1 *Environment Act*, 1995

Environmental Assessment Regulations

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

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

This EIS will fulfill all the requirements of a provincial Environmental Assessment Registration Document (EARD). Concordance Table ES-2 outlines the requirements of the EARD and where they have been addressed in the EIS.

Activities Designation Regulations

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

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

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

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

1.3.2.2 Nova Scotia Endangered Species Act, 1999

The Nova Scotia Endangered *Species Act* (NSESA) prohibits the killing or disturbing species at risk, destroying or disturbing its residence, and destroying or disturbing of core habitat.

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

1.3.3 Provincial Guidance Applicable to the Project

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

- A Proponents Guide to Environmental Assessment (NSE 2001);
- Guide to Preparing an EA Registration Document for Mining Developments in Nova Scotia (NSE 2002b);
- Guide to Considering Climate Change in Environmental Assessment in Nova Scotia (NSE 2011b); and
- Guide to Addressing Wildlife Species and Habitat in an EA Registration Document (NSE 2005).

1.3.4 Municipal Regulatory Framework

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

The proposed pit, waste rock storage, till pile, and ore stockpile are located within the Musquodoboit Valley and Dutch Settlement Plan Area, along with the Touquoy Mine Site. The majority of the tailings management facility, along with the plant facilities, are located within the Eastern Shore (East) Plan Area. Both plan areas have a Municipal Planning Strategy and Land Use By-law, which were amended in November 2018. The portion of the Project which lies within the Musquodoboit Valley and Dutch Settlement Plan Area is zoned as mixed use, while the portion which lies within the Eastern Shore (East) Plan Area is zoned as rural resource. The Touquoy Mine Site is designated as mixed use as well. Each of these zoning designations permits extractive facilities, which includes mining related infrastructure. The Land Use By-laws prescribe minimum separation distances from features such as lot lines, dwellings, watercourses, domestic wells and residential zones.

The physical activity of mining or extraction is not specified in each by-law as it is governed in the provincial and federal regulatory regime. The Municipal Planning Strategies describe extraction as an important land use within the Plan Area from an economic perspective; but also acknowledge that extractive operations can potentially create harmful environmental effects.

1.3.5 Mi’kmaq of Nova Scotia

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

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

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

- Proponents' Guide: The Role of Proponents in Crown Consultation with the Mi'kmaq of Nova Scotia (Province of Nova Scotia 2012); and,
- Mi'kmaq Ecological Knowledge Study Protocol, 2nd Edition (KMKNO 2007).

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

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

1.4 Purpose of the Project

The implementation of the Project will transport concentrate to the existing Touquoy processing plant. This will extend the life of the Touquoy Gold Project to continue to provide economic and social benefits with minimal additional infrastructure. Completing the Project with safe production, environmental stewardship and community engagement is key to ensure that the Proponent, the Province, the community, and the Mi'kmaq of Nova Scotia receive optimum benefit.

Worldwide annual gold production is about 3,200 tonnes (NRCAN 2019). Gold is used primarily for jewelry and as a storage form of wealth with China and India responsible for the majority of the demand. Canada produced about 5% of the world total in past years. With the Proponent's four gold development projects in Nova Scotia, there is much opportunity to supply gold, based on the existing and expected future demand.

The Proponent has recognized that the quantity of gold at the FMS deposit will support a commercially viable surface mining operation with on-site initial processing of ore into a gold concentrate, and final off-site processing of ore at the Touquoy Mine Site. The amount of gold expected to be recovered will represent more than one-third of the gold produced from the historic goldfields of Nova Scotia since the 1860s.

The Proponent wishes to develop this resource in line with all applicable regulatory requirements and recognizes the significant potential benefits to the local economy, the Province of Nova Scotia, the Mi'kmaq of Nova Scotia and the company in completing this Project. The Proponent has designed a project that is in line with the intent of Nova Scotia Department of Energy and Mines (NSDEM) for efficient use of mineral resources and to "*promote the concepts of environmental responsibility and sustainable development, stewardship of the mineral resource sector, and integrated resource planning.*"(NSDNR 2018)

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

1.5 Guiding Principles

1.5.1 Planning Tool

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

1.5.2 Public Participation

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

The Proponent has been engaging stakeholders, including the local community, non-governmental organizations, governmental departments since planning and permitting began on the Touquoy Gold Project over a decade ago. Engagement activities related to the Beaver Dam Mine Project commenced in May 2016 and continued with commencement of specific engagement activities for the Project in February 2018.

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

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

1.5.3 Mi'kmaq of Nova Scotia Engagement

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

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

The Proponent engaged with the Mi'kmaq of Nova Scotia to obtain views on:

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

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

Since the initiation of the Touquoy Gold Project over a decade ago, the Proponent has engaged in a pro-active and mutually beneficial relationship with the Mi'kmaq of Nova Scotia. Specific engagement activities related to the Project commenced in February 2018 and will continue through the environmental assessment and associated permitting process, including participation in the One Window meetings, and many presentations and meetings with different Mi'kmaq groups.

Comments from the Mi'kmaq of Nova Scotia were considered in the development of the EIS in terms of planning and designing the Project and its assessment for each valued component (VC); responses from the Proponent and any adjustments or changes to the Project are documented in this EIS. Refer to Section 4 of this EIS for details regarding the Mi'kmaq of Nova Scotia engagement program.

1.5.4 Precautionary Approach Application

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

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

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

1.6 Benefits of the Project

1.6.1 Environmental Benefits

The environmental benefits of the Project to Nova Scotia are numerous. Given the area has been subjected to extensive exploration, mining, and logging activity over the past 150 years, baseline conditions show obvious effects from these historic activities. The current condition of the FMS Study Area includes disturbed and fragmented habitat that resulted from significant timber harvesting, associated road building and yarding areas, and historic exploration/mining activities. The FMS Study Area contains a diversity of habitat types and landscape features but has experienced a considerable amount of disturbance and habitat fragmentation as a result of these activities, including deposition of historic tailings and waste rock with elevated mercury and arsenic. The level of disturbance within the FMS Mine Site footprint affects both upland and wetland habitat.

The realignment of Seloam Brook and development of the open pit offers a potential environmental benefit to the local watershed area. The realignment will construct fish habitat along the realignment channel to support local species of fish. The development of the pit will necessitate excavation and management of historical tailings and waste rock that were deposited along the shores of

Seloam Brook. The newly designed and realigned Seloam Brook will not be affected by historical tailings and associated reduced water quality. Furthermore, the existing Seloam Brook has also been affected by physical manipulation due to historical mining (ditching, straightening).

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

At closure, reclamation will occur at the FMS Mine Site and the facilities at the Touquoy Gold Project. The Project Reclamation and Closure Plan will be developed as part of the EMS Framework Document (Appendix L.1) and will be secured with a bond posted by the Proponent and held by the Province of Nova Scotia. This will ensure there are sufficient funds to reclaim the Project at each Project phase. The plan for reclamation requires approval of the NSDEM, Nova Scotia Department of Lands and Forestry (NSL&F) and Nova Scotia Environment (NSE).

1.6.2 Socio-economic Benefits

KPMG International completed an Economic Impact Assessment to evaluate the economic benefits stemming from the Project (KPMG 2019; Appendix E.1). This assessment was conducted based on the 2018 technical report and considered the exploration, construction and operation phases and found that significant economic activity and jobs will be generated as a result of the Project. In total, the Proponent will spend an estimated $400 million on the Project.

Construction activities will involve site preparation, setting up infrastructure and facilities, and purchasing mining processing equipment to enable the Project to reach full production. Much of the spending associated with these activities will be incurred in Nova Scotia and Canada. As per the KPMG report, it was projected that initial investment costs will be approximately $150 million while average annual operating costs amount to $39.0 million. As a result of this spending, it is anticipated that 778 full time equivalent jobs will be created in Nova Scotia per year during construction. For Canada as a whole, the construction phase will create 915 full time equivalent jobs per year. Tax revenues stemming from the construction phase are expected to be $2.4 million for the municipal government, $4.4 million for the Government of Nova Scotia, and $4.3 million for the Government of Canada. KPMG estimates that, including suppliers, the Project would create $93.1 million (value added).

Operational mining and processing activities will involve the deployment and operation of new mining production capacity. Similar to the construction phase, much of the spending associated with operation of the Project will be incurred in Nova Scotia and Canada. KPMG projects that annual operating costs will be approximately $39 million per year, resulting in a total of $234 million for the operational period. The costs can be generally categorized as follows:

- Mining costs including labour, materials and specialized equipment (43% of spending);
- Processing costs such as labour, chemicals, electricity feud (35% of total spending);
- Sustaining Capex including materials and spare parts, owner costs and environmental services (12% of total spending);
- General and administration such as electronic equipment office supplies (9% of total spending); and
- Effluent Treatment (2% of total spending).

As a result of this spending, KPMG estimates report that 289 yearly and recurrent full-time equivalent jobs will be created in Nova Scotia during operation. For Canada as a whole, the operation phase will create 323 yearly and recurrent full-time equivalent jobs during operation. Tax revenues stemming from the operation phase are expected to be $13 million annually for the Government of

Nova Scotia and $8.6 million annually for the Government of Canada. These represent conservative estimates as corporate income taxes paid by suppliers cannot be estimated.

The Province of Nova Scotia's unemployment rate is typically higher than the national average (7.4%>5.7% in 2019) and its gross domestic product (GDP) growth has been the slowest of all Canadian provinces. In addition, the GDP per capita is the second lowest in Canada. The Project would greatly benefit the Province of Nova Scotia due to substantial upfront investments and significant annual operation spending contributing to job creation and government tax revenue. The Project will also provide positive growth for the local area, supporting local infrastructure investment, housing opportunities and provide employment opportunities that will attract new residents.

The Proponent is committed to working with the local community and the Mi'kmaq of Nova Scotia to maximize socio-economic benefits as it develops its projects in the Province, including the Project.

2.0 Project Description

2.1 Project Location and History

The Project, as proposed, encompasses two primary components in Halifax County, Nova Scotia. The Fifteen Mile Stream Mine Site (FMS Mine Site) will be located 31 km north of Sheet Harbour along Highway 374 near Trafalgar, Nova Scotia. A gold concentrate will be produced on site and hauled by highway transport truck to the Touquoy Mine Site located at Moose River for final processing into gold doré bars.

No federal lands will be used to undertake the Project. The nearest federal lands are the satellite communities to the Millbrook First Nation of Beaver Lake and Sheet Harbour. These two Indian Reserves (Beaver Lake IR 17, Sheet Harbour IR 36) are both located approximately 25 km from the Project. No federal lands are in close proximity to the Touquoy Mine Site. Figure 2.1-4 displays the two locations and the ownership of land in which they occupy.

2.1.1 FMS Mine Site

The FMS Mine Site will be developed within a property area of approximately 1065 hectares (ha) with an infrastructure footprint of approximately 400 ha, near Trafalgar, Halifax County, Nova Scotia. A large proportion of the surface rights in the FMS Study Area are held by MacGregor Properties Ltd of Halifax, including the area over the open pit. An agreement is in place with MacGregor Properties Ltd. whereby the Proponent can both explore and mine on the property. The agreement is an Access Agreement and Option to Lease dated April 8, 2010, which provided the Proponent with exclusive rights to conduct exploration on the MacGregor Properties Ltd. lands and thereafter the option to lease the lands for mining. The exploration period ran from the execution of the agreement to December 11, 2019 when the option to lease was exercised by the Proponent. The lease term is now in effect and runs from December 11, 2019 to December 31, 2034. If a mine is operating on the area on December 31, 2034, then the lease period may be extended by agreement. Most of the remaining surface area is held by the Crown (administered by the Province of Nova Scotia through NSL&F), for which a Crown Land Lease is in progress. The property covers the historic Fifteen Mile Stream Gold District located on NTS sheets 11E01/C and 11E02/D and is centered at approximately 538584 E and 4999404 N (UTM Zone 20 NAD 83 CSRS).

The surface topography of the FMS Mine Site can be characterized as unpopulated, gently rolling and forested situated in an area of low topographic relief, climbing gently to the east from around 110 masl (meters above sea level) to 150 masl with scattered drumlins reaching 170 masl near East Lake. The main drainage pattern on the property is from the northeast to west-southwest via Seloam Brook, a major tributary to Fifteen Mile Stream that flows south through Anti Dam Flowage and continues on to Marshall Flowage near Malay Falls where it flows into the East River Sheet Harbour to the Atlantic Ocean near Sheet Harbour. Seloam Brook originates from a small dam located near the southwest corner of Seloam Lake and flows west-southwest across the FMS Study Area. The entire system from Seloam Lake to the Ruth Falls Hydro Station near the outlet of East River Sheet Harbour is highly managed by a system of dams operated by Nova Scotia Power Incorporated (NSPI). Drainage in the FMS Mine Site is generally west along a number of poorly drained streams and wetlands that flow into Seloam Brook (130-100 masl) and Anti Dam Flowage (100 masl); however, a drainage divide is present inside the east-southeast boundary of the FMS Mine Site that drains water to the south/southeast through East Lake, ultimately ending up in Anti Dam Flowage. The FMS Mine Site is bordered on all sides by forest in various stages of regrowth due to logging activities in the region, and waterbodies, watercourses, and wetlands draining the catchment areas within the FMS Mine Site.

The FMS gold deposit is located in an area of Nova Scotia dominated by the Meguma Supergroup, consisting of a thick basal greywacke dominated Goldenville Group and a thick overlying, finer grained, argillite dominated Halifax Group. Mineralization at the FMS gold deposit is hosted in folded and faulted strata of the Moose River Formation within the axis and limbs of a north-dipping, overturned regional anticline. In this area, the anticline is commonly referred to as the FMS anticline with gold hosted both within quartz veins and disseminated throughout the folded argillite and greywacke host rocks. There are four zones of mineralization at the FMS Mine Site: Egerton-McLean, Hudson, Plenty and 149 Zone, with Egerton-McLean being the main deposit and the resource to be developed into the open pit for this Project.

There are no hospitals, retirement hospices, treatment facilities, schools or day care centres located within 20 km of the FMS Mine Site. The FMS Mine Site can be accessed from Highway 374 via the Seloam Lake Road which intersects Highway 374 approximately 30 km north of Sheet Harbour and links with the proposed access road 575 m from the highway. All blasting will occur more than 5 km away from any residential structures; there is no residential development near the Project. The closest residence is a seasonal property located 4.9 km south of the FMS Study Area along Anti Dam Flowage. Three seasonal residences are located south along Hwy 374, as noted in Table 2.1-1 and on Figure 2.1-2.

Table 2.1-1: Closest Structures to the FMS Study Area

Structure ID	Structure Description	Receptor?	Distance from FMS Study Area (km)*	Direction from FMS Study Area	Seasonal/ Permanent Residence	Potable well (Y/N)	Well Type
1	Gated Residence (Lowe Property)	Yes	4.9	South	Seasonal cottage	No	N/A
2	Old Warden's Cabin	No	7.9	South	Not in use Under NSL&F management	Unconfirmed	--
3	Civic 3411 Hwy 374 (Crowell Property)	Yes	8.7	South	Seasonal but plans to make it permanent dwelling in the future Used regularly	Yes	Dug well
4	Civic 3411 Hwy 374 (Rutledge Property)	Yes	8.7	South	Seasonal Used mostly July-September	No	N/A

*Linear distance from driveway entrance on Hwy 374 to FMS Study Area

The FMS Mine Site is located in the Eastern Shore East Plan area. The properties are designated Mixed Use (MU) and zoned Mixed Used. The Mixed-Use zone permits extractive facilities subject to zoning regulations (pers. comm. T Langille, 2018). Extractive facilities, as defined by the Land Use By-law, "means all buildings, aggregate plants, material storage areas and weigh scales associated with extractive uses and may include residential uses which are accessory to the extractive facility provided such residential uses are connected to a properly installed on-site sewage disposal system" (Halifax Regional Municipality, 2018a). Mineral extraction is regulated by the province through the *Mineral Resources Act* and is not subject to municipal regulation.

<u>Exploration and Production History</u>

The first mining in the area is reported from 1874 with development along the Jackson Lead, approximately 300 m south of the Egerton-MacLean area where much of the mining activity would later take place.

A number of different companies, including the Hall Bros., the Hall-Anderson Gold Mining Company, Egerton Syndicate, the Egerton Gold Mining Company and the New Egerton Gold Mining Company were active in the Old Egerton and MacLean Shaft area between 1874 and 1893. Small mines were worked from various shafts with the deepest recorded workings on the Egerton Lead with two stamp mills operating: the Egerton Mill and smaller, Stanley Crusher.

Gold was discovered in the Hudson area in 1879 and some mining appears to have taken place between 1883 and 1887. Work finished in 1887 when the mill and hoist were destroyed by fire.

From 1893, the focus of mining shifted to an area approximately 200 m southwest of the Old Egerton Mine area following the discovery by the New Egerton Gold Mining Company of what was to become the Mother Seigel mine. Mining was interrupted in 1897 or early 1898 by an underground collapse in the Mother Seigel Mine. A subsequent attempt to continue mining via an open-cut (the Mother Seigel Open-Cut) wasn’t considered successful despite producing gold at a grade of the order of 5 gpt.

Further financing was obtained with the support of an English group and the Egerton Syndicate formed with development and mining between 1901 and 1903 via the Borlace Shaft, approximately 70 m northwest of the Mother Seigel Open-Cut. Last recorded production from this area, including the Mother Seigel mine is from 1903.

Minor production is recorded in the Fraser McLeod area, approximately 100 m southeast of the Egerton-MacLean area in 1910 and 1911. There does not appear to have been any other development or mining in the district between 1903 and 1938 after which time, the provincial government took over the leases in the area and undertook a rehabilitation project with the aim of training older or unemployed men and to further test the potential of the gold district. Between 1939 and 1941, the former MacLean shaft was rehabilitated and deepened to 67 m with some mill testing of material using a portable 5-stamp mill.

There appears to have been very little work in the area from 1941 until 1980 with the exception of a program that sampled tailings from the Egerton Stamp Mill in 1973.

In 1980, St Joseph Explorations staked claims in the area, undertaking humus and soil geochemical surveys. The results included several strongly anomalous values to the south of the Egerton-MacLean area which were attributed to contamination by mine tailings.

In 1981, Pan East Resources completed an airborne very low frequency electromagnetic (VLF-EM) and magnetic survey and later that year acquired eight claims immediately to the west of the Hudson Zone, completing a soil humus geochemical survey in 1982 and follow-up geological mapping in 1983. They were sufficiently encouraged to acquire claims covering the Egerton-MacLean, Mother Seigel and Hudson workings.

From 1985 through 1988, Pan East and other companies working within the terms of agreements with Pan East and utilizing MPH Consulting to manage the programs, completed 134 diamond drill holes from surface for 26,612 m, including 84 drill holes for 18,654 m concentrated on the Egerton-MacLean and Hudson Zones and the area between. MPH reported in 1987 that drilling results indicated that a gold deposit of substantial grade and tonnage had been identified, however, while several informal resource estimates were undertaken, MPH decided in 1988 that it was not possible to estimate resources with the current information, partly due to the erratic distribution of coarse gold within the samples, and recommended that the Egerton-MacLean Zone of gold mineralization be further explored from underground.

In the same period, several geophysical surveys were completed, including detailed ground magnetics that allowed the main anticlinal axis to be traced across the property, together with VLF-EM and dipole-dipole IP surveys. The Egerton-MacLean Zone was noted as displaying a 100 nT magnetic high and strong, coincident VLF-EM response together with a strongly anomalous 40-50 msec chargeability anomaly.

A soil orientation geochemical survey was completed in 1987 with the majority of samples anomalous in both gold and arsenic and with several anomalies identified that may have been derived from as-yet unidentified primary sources.

The detailed geophysical data together with geochemical data were used to define targets along the anticlinal axis and led to the discovery of the 149 East Zone in 1988. Broad intervals of distinctly anomalous gold mineralization which included occasional visible gold and frequent values in excess of 0.5 gpt were intersected in mudstones, associated with pyrrhotite aligned along axial planar cleavage.

In the NovaGold area, covering the Plenty Zone, three diamond drill programs were completed between May 1986 and Oct 1987 with 97 holes drilled for a total of 13,822 m. In 1988, a decision was made to excavate an open pit on the Plenty Zone in order to take a bulk sample. Eight more diamond holes for 1594 m were drilled in 1988 in support of this approach and two bulk samples then taken via an open pit. The first sample comprised 4030 tonnes of hand-selected material and was processed at Westminer Canada's Gays River plant with estimated recovery of 93.7% and a head grade of 2.0 gpt. Results were considered disappointing and the second sample, comprising 1788 tonnes was processed at Murray Brook Resources Cochrane Hill plant in the same year. Results from this test are not available but were also described as disappointing. Department of Natural Resources (NSDNR) records indicate that 21,292 ounces of gold were produced in the Fifteen Mile Stream Gold District between 1878 and 1941(Bates 1987).

There was very little exploration undertaken in the historic mining areas from 1989 until 2008 when Hudgtec Consulting completed a resource estimate for Acadian Mining, utilizing data from holes drilled by the various companies associated with Pan East Resources in the Egerton – MacLean Zone.

In 2009, Acadian Mining started re-examining some of the historic drill core and in 2010, Acadian took 2139 samples representing previously unsampled intervals from 22 of the historic drill holes. They demonstrated that much of the previously unsampled core was mineralized and that mineralization was more extensive than had been recognized. In 2011, Acadian drilled 29 diamond holes for 3,741 m. Twenty holes were drilled in the Egerton – MacLean area, ten holes in the Hudson area and the remaining hole in the 149 East Zone. This new information was utilized, together with the historic drill data by Snowden Consulting for a 2012 estimate of resources.

In 2014, Acadian Mining was acquired by Atlantic Gold Corporation. FSSI Consultants completed a resource update using the same database as that used by Snowden Consulting in the 2012 estimate. In 2016, the Proponent commenced an exploration drilling program to determine mineralization extents at the FMS site. A total of 11 holes were drilled for 945 m. The program was continued in 2017 with a further 180 holes drilled for 23,044 m. In the same year, the Proponent commenced infill drilling to improve resource confidence and supplement drilling completed in the early 1980s. A total of 186 holes were drilled for 26,062 m. These additional holes were utilized, together with the historical drill data, by FSSI Consultants to complete a 2017 resource update.

Based on the results of the previous infill drilling program and subsequent resource up date, the Proponent commenced another infill program with the objective of (i) identifying additional gold resources immediately peripheral to those resources previously defined at the Project, (ii) upgrading previously defined inferred resources to measured and indicated categories - particularly at the Hudson and Plenty zones, and (iii) to identify additional new resources within the 350 m gap between the Plenty and Egerton MacLean zones. This program was completed by the end of February 2018, and a total of 238 holes were drilled totaling 26,846 m.

The property overlays ten Exploration Licences as shown on Figure 2.1-3. Eight of these licences (EL05889, EL06440, EL10406, EL50664, EL51690, EL 51683, EL51573 and EL52901) are held by Atlantic Mining NS Inc. The eight licences comprise a total of 152 contiguous claims covering a surface area of approximately 2461 ha. One exploration licence (EL50714), held by Rick Horne, lies under the powerline corridor and one exploration license (EL51644) held by 1156219 B.C. Limited, lies under the Seloam Lake water intake line. The mineral rights associated with these private exploration licenses should not be affected by the proposed infrastructure. A Mining Lease will be sought once the Project receives Environmental Assessment Approval.

Atlantic Mining NS Inc. holds the existing permits, leases and licences for the Touquoy Mine Site.

The provincial abandoned mine openings (AMO) database records 72 AMOs within the FMS Study Area with another five in close proximity. Of these openings, 46 (64%) will be consumed by the proposed open pit. The openings consist of shafts, pits, and raises that have had various forms of safety protection afforded to them over the years. The provincial AMO records are depicted on Figure 2.1-3.

2.1.2 Touquoy Mine Site

The Touquoy Mine Site is a fully permitted and approved facility currently operating as part of the Touquoy Gold Project in Moose River, Halifax County, Nova Scotia. It is located on land owned by the Proponent and the Province (administered by NSL&F) and centered at 504599 E and 4981255 N (UTM Zone 20 NAD 83 CSRS). Access to Crown land for the construction of the Touquoy Gold Project has been granted through a Crown Land Lease Agreement with NSL&F (Lease No. 2794371 and Petition No. 37668).

The Touquoy Mine is within the Musquodoboit Valley and Dutch Settlement Municipal Planning Strategy and Land Use By-law (LUB). The Mine is zoned Mixed Use and extractive uses are permitted in this zone. The LUB defines Extractive Uses as, "all buildings, aggregate plants, material storage areas and weight scales associated with extractive uses which involve blasting or crushing but does not include structures or storage areas which are fundamental to the activities of mining or extraction." (HRM 2018b). All existing structures that were required to have building and development permits were municipally permitted before construction. Minor changes to the processing facility may be required for the Project. These changes will be properly permitted by Halifax Regional Municipality before construction occurs.

Camp Kidston, which operates only in the summer months, is located 3.5 km northeast of the 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 Mine Site are approximately 7.4 km to the northwest and 11.7 km to the southeast.

There are several watercourses in the vicinity of the Touquoy Mine Site. The Touquoy Mine Site is currently an operating mine (as of October 2017) and as a result, the runoff from the site infrastructure areas has been altered and is managed and controlled by means of collection ditches and ponds. Moose River is the largest watercourse adjacent to the property and flows along the western border of the Touquoy Mine Site. A tributary to the Moose River (known as WC4) flows south through the property, between the open pit and tailing management area. Scraggy Lake is located to the south of the property and is a water supply source for the Touquoy Mine Site. Fish River drains Square Lake to Scraggy Lake and both lakes are part of the Fish River Watershed that flows west and then south into Lake Charlotte, eventually emptying into Ship Harbour.

2.1.3 Ecological Setting

Overall, current and historic land use throughout the FMS Study Area has resulted in a patchwork of mature, immature, regenerating and disturbed forest stands. The FMS Study Area contains a diversity of habitat types and landscape features but is largely disturbed with habitat fragmentation caused by historic mine operations, and current and historic timber harvesting practices. Generally speaking, uplands within the FMS Study Area contain immature or uneven-aged coniferous stands or mixed wood stands. Several pockets of mature coniferous forests are scattered throughout the FMS Study Area, but over mature stands were generally infrequent. Pure deciduous stands (including both tolerant and intolerant hardwood forests) are infrequent within the FMS Study Area.

Significant Habitats within the Provincial Landscape Viewer (NSDNR 2015a) are identified as:

- Mainland Moose Concentration Area (entire PA), and
- Areas with Species of Concern (4.7 km west of FMS Study Area; 1.8 km and 7.5 km northeast of Touquoy Mine Site; immediately south and adjacent to Touquoy Mine Site).

Provincial Landscape Viewer (NSDNR 2015a) indicates the following protected areas within 10 km of the proposed Project:

Nature Reserves

- Abraham Lake (4.9 km west of FMS Study Area);
- Rush Lake (5.1 km northeast of FMS Study Area), and
- Cowan Brook (9.1 km south of Touquoy Mine Site).

Wilderness Areas

- Toadfish Lakes (<500 m south of FMS Study Area);
- Boggy Lake (<1 km southeast of FMS Study Area);
- Denis Lakes (3.5 km east of the FMS Study Area);
- Twelve Mile Stream (4.0 km southwest of FMS Study Area);
- Liscomb River (5.4 km east of FMS Study Area);
- Ship Harbour Long Lake (immediately south of Touquoy Mine Site), and
- Tangier Grand Lake (8.0 km south of Touquoy Mine Site).

Natural Water Supply Area

- Middle Musquodoboit (6.3 km north of Touquoy Mine Site).

Game Sanctuary

- Liscomb (no restrictions to mining – FMS Study Area sits within Game Sanctuary).

Figure 2.1-4 displays the location of the FMS Study Area and the Touquoy Mine Site in relation to the above protected areas.

2.2 Project Components

The Project is planned to be permitted and operated as a separate satellite open pit mine operating at an annual production rate of approximately two million tonnes (Mt) of gold-bearing ore per year, and an average nominal processing rate of approximately 5,500 t/day. Ore will be crushed and concentrated on site to produce 80,000 to 100,000 t of gold concentrate per year which will be hauled by on-road highway trucks to the Touquoy carbon-in-leach (CIL) processing facility for final processing into gold doré bar, a distance of just over 76 km on existing public roads. This will eliminate the need for a separate CIL cyanide leach circuit at the FMS Mine Site. The concentrate will be processed at Touquoy Mine Site in conjunction with ore supply from Touquoy Gold Project, Beaver Dam Mine Project and Cochrane Hill Gold Project surface mines.

The primary components associated with the Project include the following:

- FMS Mine Site
  - open pit for extracting ore and waste rock;
  - mine site haul roads;

  - local traffic bypass roads;
  - powerline;
  - waste rock storage area (WRSA);
  - overburden till piles;
  - topsoil and organics storage piles;
  - separate run of mine (ROM) stockpile and low grade ore (LGO) stockpile;
  - Seloam Brook Realignment: realignment channel and diversion berm around open pit;
  - crusher and concentrator facilities;
  - tailings management facility (TMF); and,
  - water management system including water discharge.
- the existing Touquoy Mine Site
  - concentrate storage;
  - gravity concentrate leach reactor;
  - Gravity electrowinning cell; and,
  - exhausted pit for FMS concentrate tailings storage.

Figures 2.1-5 and 2.1-6 display the location of the components at the FMS Mine Site, and the location of the relevant components of the Touquoy Mine Site related to the Project.

2.2.1 FMS Mine Site

2.2.1.1 Open Pit

The primary feature of the FMS Mine Site will be an open pit (Egerton-MacLean deposit) from which a total of 40.5 million tonnes (Mt) of combined ore, non-ore bearing waste rock, and till will be removed. Figure 2.1-5 displays the development of the open pit over the 6.75 year extraction/operations period. The open pit will be advanced from the surface at 115 masl down to -50 masl. At completion, the open pit will be 27 ha (approximately 850 m long and 500 m wide at its widest points) and will have a maximum approximate depth of 165 m based on the current mining scenario. The pit will be developed as a series of pushbacks in an effort to minimize upfront stripping and to maximize ore extraction. Access to active mine areas will be via a single ramp system designed to allow dual lane traffic flow. Pit walls will be developed based on independent geotechnical engineering recommendations to ensure stability and safety.

Clearing, grubbing, grading, and stockpiling of vegetation, topsoil, and till in the pit area will be conducted progressively prior to accessing bedrock for mining purposes, to avoid erosion. Topsoil, organics, and till will be stored in stockpiles for use in reclamation and construction of berms, impoundments, mine site roads, and/or general site grading. Stockpile locations can be viewed on Figure 2.1-5. Once vegetation, topsoil, and till have been removed, drilling and blasting will be used to mine ore and non-ore bearing waste rock, as well as to establish benches along rock walls.

In the active mining area, in-situ rock will be drilled and blasted on 5 m to 10 m bench heights. Diesel powered down-the-hole hammer drills will be used for production drilling and will also be used for horizontal highwall depressurization drilling on the ultimate pit walls. All blasting activities will be conducted by a licensed contractor with blasting typically occurring two to three times per week.

Pre-production grade control drilling will be carried out to better delineate the ore and waste rock in advance of mining. Ore and waste rock will be defined further within the pit shell by means of a grade control system based on dedicated reverse circulation (RC) grade control drilling and sampling rigs.

On average, 21,800 t of rock will be extracted from the open pit per day. Of that average quantity, approximately 8,200 t will be ore-bearing and 13,600 t will be waste rock. Ore and non-ore bearing waste rock will be loaded into off-highway haul trucks for transport out of the pit. From there, ore will be separated into ROM and LGO stockpiles. ROM ore will be directed to the crusher, while low grade ore will be progressively processed throughout the mine life. Non-ore bearing waste rock will be stockpiled at its final disposal point and managed and reclaimed in place.

2.2.1.2 Mine Site Roads

A well-maintained bituminized road (Highway 374), which connects several large towns in Pictou County (Stellarton, New Glasgow) with the coastal community of Sheet Harbour, provides access to the site. The administration office and plant site are accessed via a mine access road. This road will utilize the existing Seloam Lake Road for approximately 1 km at which point a dedicated 4 km mine access road will be constructed. This road will not be paved. The road will be dual lane and will have a gravel base and be approximately 16 m wide, including berms and drainage, with a maximum speed limit of 40 km/h.

In addition to the mine access road, several major onsite roads will be constructed using the mine fleet during the pre-production period and will be used to haul ore and waste rock material. The ore haulage road is 1.8 km and connects the mine open pit to the ROM pad. The waste rock haulage road will consist of two roads, one connecting the open pit with the WRSA from both pit ramps (1.4 km) and the other connecting the open pit with the TMF (1.5 km). The primary use of mine site roads will be the transportation of ore and non-ore bearing waste rock from the open pit to stockpile locations. Mine site haul roads will be dual lane and connect the pit exit with the topsoil, till, waste rock stockpiles and ROM pad. The roads will be constructed out of non-ore bearing, Non-Acid Generating (NAG) waste rock from the open pit and be approximately 25 m wide, including berms and drainage, with a maximum speed limit of 40 km/h. There are five to ten watercourses that will require crossings along the mine site roads including a bridge upgrade at the crossing of Fifteen Mile Stream on Seloam Lake Road. Culverts or bridges will be installed as required and in accordance with the Nova Scotia Watercourse Alteration Standard.

Additional onsite roads/tracks will include:

- A road for decant line and tailings line;
- A road for accessing the raw water intake at Seloam Lake;
- A road to the organic material stockpile from the open pit area;
- A road for the powerline (spur line) access;
- A road for the engineered discharge to Anti Dam Flowage; and
- A road around the perimeter of the TMF.

The general location of the mine site roads is displayed on Figure 1.1-2. Mine site road details will be finalized during permitting and may be adjusted based on geotechnical and detailed Project planning.

2.2.1.3 Local Traffic Bypass Roads

The locations of the open pit and TMF will impact several local access and ATV trails on the FMS Mine Site. To allow for continued, multiuse, public access around the FMS Mine Site, two local traffic bypass roads will be constructed and turned over to the landowner(s). Traffic flow will be diverted from the current Seloam Lake Road approximately 800 m from its intersection with Highway 374. The first bypass (approximately 1.6 km) will head north crossing Seloam Brook and then east connecting to an existing forestry road. This bypass will require a bridge across Seloam Brook. The traffic will then rejoin with the existing Seloam Lake Road just south of the lake. Traffic heading south that would currently travel along the forestry road that runs south through the TMF area will be diverted to a second bypass (approximately 2 km) running north-south on the east side of the FMS Study Area between the TMF and Moser Lake before connecting to the existing road. There are watercourse crossings, including the Seloam Brook crossing, that will require installation of bridges or culverts along the local traffic bypass roads. Culverts or bridges will be installed as required and in accordance with the Nova Scotia Watercourse Alteration Standard. These local traffic bypass roads are being designed and developed in consultation with NSL&F, the Mi'kmaq of Nova Scotia and local stakeholders including ATV clubs. The approximate location of these bypass roads is shown on Figure 2.1-7. Bypass road details will be finalized during permitting and may be adjusted based on geotechnical and detailed Project planning.

2.2.1.4 Waste Rock Storage Area

All waste rock removed from the open pit will be placed in the WRSA, shown on Figure 2.1-5. The WRSA will separate NAG and potentially acid generating (PAG) material into separate stockpiles to allow for appropriate management of any potentially acid generating material. These stockpiles will range in height from 20 m to 45 m above the existing ground surface and will contain waste rock excavated from the pit. This height generally conforms with local topographic variations. The northern edge of the PAG rock stockpile will have a maximum height of 25 m while the southern edge will be tied into natural topography. Total capacity of the PAG rock stockpile will be approximately 3.6 Mt. The northern edge of the NAG rock stockpile will have a maximum height of 45 m while the southern edge will have a maximum height of 20 m. Total capacity of the NAG rock stockpile will be approximately 13.2 Mt. A haul road along the north-eastern limit of the WRSA will provide access ramps to the lift elevations.

The WRSA will typically be built bottom-up in lifts, spread out and compacted by track type dozers. Haul trucks will deliver the waste rock to the WRSA, then dump out either as free dump piles, or off the edge of an established dump lift over a safety berm. Once these smaller lifts reach 10 m in height, the face of the lift will be re-sloped as required to allow for an overall 3:1 slope for reclamation. Re-sloping will be completed by track type dozers and small hydraulic excavators.

The waste rock will be placed according to standard practices and will ensure compliance with provincial regulations with respect to slopes, potentially acid generating material (if any), and provincial and federal regulations pertaining to surface and contact water run-off.

2.2.1.5 Overburden Till Stockpile

A separate stockpile will be constructed to the northeast of the WRSA to contain unconsolidated overburden as indicated on Figure 2.1-5. Total capacity of the Till stockpile will be approximately 1.5 Mt. This material will be utilized for reclamation. Stockpile details will be finalized during permitting and may be adjusted based on geotechnical and detailed Project planning.

2.2.1.6 Topsoil and Organic Material Stockpiles

Prior to construction, areas planned for development will be grubbed and topsoil removed and stockpiled for use in reclamation upon closure. The main topsoil stockpiles are located north of the open pit (approximate capacity of 1.2 Mt) and to the northeast of the TMF (approximate capacity of 200,000 $m^{3)}$ as indicated on Figure 2.1-5. The north stockpile has been labelled the organic materials stockpile and will hold loose or unsuitable overburden materials (i.e. saturated peat and topsoil material) excavated from wetland areas. Based on the results and recommendations of the flow modelling for Seloam Brook, the organic material stockpile will be built with a safety berm around its eastern side for protection from potential flooding and erosion during peak flood events. Stockpile details will be finalized during permitting and may be adjusted based on geotechnical and detailed Project planning.

2.2.1.7 Run of Mine and Crusher Pad

Run-of-mine (ROM) ore from the pit will be hauled to the primary crusher using off-highway haul trucks. At the ROM pad, haul trucks will dump ore material directly into the primary crusher or place it in an active stockpile on the pad, to be re-handled at a later time as crusher feed. Crusher loading of the stockpiled ore will be accomplished with a diesel-powered wheeled loader. The ROM pad is sized to provide an adequate short term storage supply of ROM piles. The ROM and crusher pad are located directly south of the plant as indicated on Figure 2.1-5.

2.2.1.8 Low Grade Ore Stockpile

To ensure continuity of mill feed and allow initial processing of higher-grade material, an LGO stockpile will be developed to the north of the plant (Figure 2.1-5). The northern edge of the LGO will have a maximum height of 40 m while the southern edge will have a maximum height of 10 m. Total capacity of the LGO will be approximately 5.0 Mt.

As with the WRSA, the LGO stockpile will be built bottom-up in lifts, spread out and compacted by track type dozers. Haul trucks will deliver the low-grade ore to the LGO stockpile, then dump out either as free dump piles, or off the edge of an established dump lift over a safety berm. Unlike the WRSA, this stockpile will be re-handled and processed over the mine life. The LGO stockpile footprint will be reclaimed upon closure.

2.2.1.9 Seloam Brook Realignment

The proposed open pit underlies Seloam Brook, which will necessitate the realignment of Seloam Brook around the open pit limits prior to commencement of mining. This realignment will be completed during the construction phase of the Project. Seloam Brook will be realigned through the construction of a 1.6 km raised perimeter berm along the east, north and west of the open pit, which will divert flows from Seloam Brook, and its main tributary, Watercourse 12, around the open pit to the north of the pit through an approximate 800m constructed realignment channel. Knight Piésold (KP) has completed a feasibility level design of the Seloam Brook Realignment (included in Appendix D.4) including the diversion berm, realignment channel, the haul road from the open pit to the organic material stockpile, and the associated culvert at the road crossing. The primary purpose for the realignment channel is to promote fish passage from Fifteen Mile Stream and enable connection to the upstream habitat of Seloam Lake, as well as to convey low flows to support fish. The channel is designed to remain stable throughout the operational life of the Project and, given the fact that this realignment channel is planned to be permanent, it has also been designed to remain stable in the long-term following closure. The haul road crossing the realignment channel provides access from the open pit area to the organic material stockpile. The road is sized to provide single lane traffic for haul trucks with appropriately sized safety berms on either side of the road. The culvert design is based on the requirement to pass the 1 in 200 year flood event without overtopping the haul road or the diversion berm. The probability of a 200 year flood occurring during the seven-year mine life is 3.4%, or 0.5% in any year of operations. The culvert will be designed to provide fish passage under normal and low flow conditions. Additional considerations for the culvert include sufficient clearance to allow construction crews to work inside the culvert to construct any required fish passage features.

Multiple realignment strategies were investigated to realign Seloam Brook around the open pit. The Seloam Brook Realignment design development was an iterative process that included flow modelling used to confirm or modify the sizing of the realignment channel, haul road culvert, required riprap, and heights for the diversion berm and the haul road (see Appendix D.4). The currently proposed berm alignment and crest elevation sufficiently realigns and diverts flows from a 1-in-200 year, 24-hour precipitation event away from the mine working areas, while maintaining operational features and requirements provided by NSPI. The 1-in-200 year, 24-hour precipitation event that was evaluated results in overbank flows for the natural stream channels. The maximum depth of water as a result of this storm event is approximately 1.35 m, which maintains sufficient freeboard along the entire berm alignment and haul road that are not overtopped during the modelled peak flood events. Based on the results of the flow modelling, the organic material stockpile will be built with a safety berm on its eastern side in order to protect it from flooding or erosion during the modelled peak flood events. A 15% climate change factor was applied to the peak flow estimates in order to account for potential future increases in storm intensity as a result of climate change, as recommended in the Preliminary Engineering Hydrometeorology report (Appendix D.1).

KP evaluated the preliminary design and found the maximum velocities along the berm during the 1-in-200 year, 24-hour precipitation event are in the range of 0.5-0.7 m/s. Critical areas along the berm that may experience these maximum velocities and may require additional bank protection from erosion include the middle section of the berm directly north of the open pit and the western section of the berm immediately prior to the divide in the natural Seloam Brook. The Seloam Brook diversion berm and preliminary channel design is included in the preliminary water management design in Appendix D.2.

Wood was retained to provide a Fish Habitat Offset Plan: Preliminary Concept Update (Appendix J.7). Offsetting alternatives were developed that are consistent with DFO guidance policy for Applying Measures to Offset Adverse Effects on Fish and Fish Habitat under the *Fisheries Act*. A key aspect of the development of offsetting alternatives was the consideration of available on-site mitigation measures to reduce overall impacts to fish and fish habitat. To this end, Wood worked to further envision the Seloam Brook Realignment from that engineered by KP (Appendix D.4). This vision included an integrated floodplain and natural channel design principles to develop highly suitable fish habitat with biological features to mitigate a large portion of the habitat losses within Seloam Brook and avoid additional HADD. Habitat design will incorporate features to mimic characteristics within the existing habitat that will be lost but will also include increased species-specific spawning habitat to provide greater productivity potential. The realignment channel will have a defined flow path to improve fish passage through the reach and mitigate the braided configuration of the existing habitat, caused by past mining activities, and will utilize the consolidated flow to maximize habitat stability and suitability.

To support the fish offset concept and to build from the KP design, Wood has completed preliminary flow design estimates of the Seloam Brook Realignment habitat considering the integrated floodplain and natural channel design principles. The modelling that was completed uses existing hydrological data generated from the KP realignment channel design to estimate the flow parameters (water depth, velocity, and wetted perimeter) within the conceptual realignment channel. The estimates generated will provide greater certainty to the design team and regulators that the concept can convey the anticipated flows and can be sustainable beyond the life of mining operations (Appendix J.5).

The concept considers that the stream channel will be the primary fish habitat and will contain the anticipated principle flows while the flood plain will allow high-flow events such as spring freshets and extreme storm events to pass, similar to a natural wetland/flood plain ecosystem. The channel and floodplain would both be designed to provide substrates, morphology and cover in the high suitability range for the fish species known to exist in the system and to provide ecological function for other species of wildlife that depend on creek corridors.

The flows used to design the stream channel and floodplain have been based on previous analytical work completed by KP during the initial design phase of the Seloam Book Realignment. While the KP diversion design was less habitat-focused, the flows estimated from historic hydrologic records and measures remain valid and were used in the revised integrated floodplain design. The initial diversion channel design provided general conditions at the realignment location such as overall slope and measures of existing, local stream conditions. These were also incorporated into the habitat design where required. Details of the modelling efforts to support the integrated floodplain and channel realignment are detailed in Appendix J. 5.

The main stream channel was designed with a bottom width of 1.5m and side slopes of 1:2. An estimated flow of around 1.0m^3/s will remain within the main channel before overtopping into the flood plain. The width of the stream at this flow is estimated at 2.90m. The model outputs also indicate that a mean water depth within the main stream channel will remain near 0.25-0.30m during the 1:20 Dry Annual flow if the channel is designed similar to existing habitat.

Flows in excess of 1.0m^3/s are shown to overtop the main stream channel into the flood plain mimicking the function of a natural channel condition. The modelled results show that flows as high as the 200-year event would easily be contained within the conceptual flood plain, and or within a combination of constructed channel and natural topography.

An overall general flood plain width of 40-45m could easily contain the predicted 1:200 year flood event and a main channel of 1.5m in bottom width and overall total wetted width of 3.0m would be capable of providing fish habitat similar to existing channel conditions. Greater detail regarding final channel design, 2-D extent of extreme flows, and possible use of existing topography to provide more natural flood conditions will be completed during the Fisheries Act authorization process. The Seloam Brook Realignment is shown on Figure 2.2-1 including the general stream/floodplain concept for the Seloam Brook realignment channel.

2.2.1.10 Plant and Ancillary Buildings

The plant and ancillary building area is shown on Figure 2.1-5. Plant and ancillary building details will be finalized during permitting and may be adjusted based on geotechnical and detailed Project planning. Buildings located at site will include:

- Gatehouse;
- Administration office;
- Mining office and change rooms;
- Truck workshop, warehouse and wash facility;
- Plant offices and change rooms;
- Plant workshop;
- Fine ore stockpile;
- Filtration, storage & loadout;
- Process plant;
- Ball mill lube room;
- Plant switch room;
- Raw water supply; and
- Laboratory.

All buildings will have a heating and ventilation system, using propane space heaters. Associated with the above listed infrastructure, there may be construction and operational laydown areas for the storage of non-hazardous materials and equipment, as well as parking lots to support employee and service vehicles.

<u>Gatehouse</u>

The guardhouse will be located on the site access road where security staff can control entry to the mine and process plant areas.

Administration

The Administration Office will include private offices, open plan offices, meeting and training rooms, kitchen, toilets, change-house and first aid facilities. The building will be of a similar area and construction as that at the Touquoy Mine Site. Office trailers may be set up adjacent to the administration office, or other strategic locations, to allow for periodic increases in office staff and contractors.

Mining Office and Change Room

Mining Office and Change Room facilities for the workforce will be constructed in the mine facility area. These facilities will have wet and dry areas complete with showers, basins, toilets, lockers and overhead laundry baskets.

Truck Workshop and Warehouse

The Truck Workshop and Warehouse will be positioned adjacent to the mine office. This area will likely be divided, one section for warehousing spare parts and the other will be a maintenance workshop. Alternatively, two separate, but adjacent buildings will be constructed. Other maintenance activities will be performed outside the building on a hardstand area. Lifting and handling activities will be fulfilled by an overhead crane within the building and forklift.

A vehicle wash-down facility may be provided adjacent to the workshop/warehouse. The facility will likely consist of manually directed water jets and a high-pressure hot water and steam generator cleaner. The bulk of the mud will be washed off equipment within the pit area with surface water run-off captured within a sump. Final cleaning will occur in the maintenance shop where runoff from cleaning operations will be captured in a cleanout sump and processed via a triple interceptor oil trap and oil-water separation device.

Plant Office and Change Room

The Plant Office and Change Room facilities for the process plant will house the majority of the employees associated with the processing facilities. A meal room and all ablutions will be provided within the building for these employees including wet and dry areas complete with showers, basins, toilets, lockers and overhead laundry baskets.

Plant Workshop

The Plant Maintenance building will be located adjacent to the concentrator building and will house maintenance personnel undertaking maintenance activities in support of ore processing. This building will be a pre-engineered building.

Fine Ore Stockpile Building

The Fine Ore Stockpile building will keep the crushed ore dry and heated to prevent freezing during the winter. The building will be pre-engineered and sized appropriately to handle the process plant throughput requirements.

Filtration, Storage & Loadout

The Concentrate Loadout, located adjacent to the Concentrator building, will provide secure storage, stockpiling and loading facilities for gold concentrate prior to trucking to the Touquoy Mine Site for final processing. The building will also include a concentrate thickener and filter press to remove surplus water from the concentrate prior to trucking. This water will be recirculated for use as process water. This building will be a pre-engineered building.

Process Plant

The Process Plant Building will house milling, gravity, flotation and reagent equipment. The building will be divided into two sections. The first section contains the mill; the second section contains the gravity, flotation and reagent system equipment. Both sections are serviced by overhead cranes. The building will be heated using electrical space heaters. This building will be a pre-engineered building.

Individual areas within the process building will be bunded, each with a sump, to provide for process upsets and spill management.

Ball Mill Lube Room

The Ball Mill Lube Room will be located outside the Process Plant Building, adjacent to the Ball Mill section. This building will be a pre-cast concrete building.

Plant Switch Room

The Plant Switch Room will be located just outside the Process Plant Area. This building will house the control equipment for the switch yard. This building will be a pre-cast concrete building.

Raw Water Supply

The Raw Water Supply Building will be located at Seloam Lake and house the pumping equipment. The building will be a pre-engineered building.

Laboratory

The laboratory will be situated adjacent to the plant and will house the laboratory equipment for the site, including the metallurgical and environmental requirements. Any mechanical items associated with the dust collection equipment will be located external to the building.

Sewage and Waste

Sewage from the plant site buildings will flow by gravity drain via a piped network buried below the frost line to septic tanks equipped with septic fields. Chemical waste will not be disposed of through the septic system. The septic tanks will be pumped out as required by a contractor.

Chemical waste from the laboratory will, depending on type, be pumped to the tailings hopper or stored for off-site disposal. Office and domestic waste (food and food packaging) will be collected and disposed of off-site in accordance with the applicable provincial and municipal regulations. Wherever practicable, recyclable wastes will be segregated, stored, and shipped off site to appropriate waste recycling facilities by an accredited contractor.

Hazardous wastes, such as used oil, lubricants, batteries and antifreeze will be collected by qualified hazardous waste contractors and taken off-site for re-cycling or disposal in accordance with applicable legislation. General non-mine waste will be collected by a accredited contractor and transported off site for disposal at approved facilities.

Fire Protection

Fire protection for the plant site will be via a “wet system” with hydrants located around the plant site area. The water contained within the lower portion of the raw water tank will be reserved for fire protection, sourced from Seloam Lake. A main fire alarm indicator panel (MIFB) for surface facilities will be provided in the main control room, cabled to fire detectors in the following areas:

- process plant MCC rooms;
- main control room;

- workshop store and offices; and
- laboratory.

In each area, a combination of heat and smoke detectors will be provided with break-glass units mounted externally to the buildings. Within the process plant MCC rooms, very early smoke detection alarms (VESDAs) will be installed for early smoke detection and alarm initiation.

The large primary mining fleet including excavators, front end loader, haul truck, dozers and drills will be fitted with fire suppression systems in case of fire.

Powerline (spur line)

A three phase 69 kV hydroelectric transmission linking Sheet Harbour and New Glasgow is located west of Highway 374. This line will supply power to the plant via a 69 kVA or 25 kVA spur line (5.3km).

The incoming 69kV feed will be stepped down to 25kV. Power will be distributed throughout the site to supply the gatehouse, mine office, truck workshop, warehouse, mining office, change room buildings and TMF via overhead power lines and buried conduits wherever required. The 25kV will be stepped down to each of these buildings with small transformers typically 100 kVa and less will be pole mounted and larger transformers will be placed on the ground.

A black-start diesel generator will provide emergency power. In the event of a total power black-out the generator will be started by an operator. The emergency generator will only supply back-up power to select equipment in the process plant area.

Lighting

Pole-mounted high intensity discharge type weatherproof lights will be utilized for plant, crusher, and conveyor lighting. Portable lighting will be utilized for ROM, and plant area lighting. High bay and low bay lighting will be used for process plant building operating floors. Energy efficient LED type lighting fixtures will be applied where suitable. Emergency lighting will be also installed throughout the plant, in stairways and exits to provide sufficient light to allow safe egress of personnel from the buildings.

2.2.1.11 Tailings Management Facility

The principle design objective of the TMF is to protect the environment during the operations and throughout the closure stage of the Project and to achieve effective surface reclamation at mine closure. The design of the TMF has considered the following requirements:

- Permanent, secure and total confinement of all tailings solids within an engineered facility;
- Control, collection, and removal of free draining liquids from the tailings during operations, for recycling as process water to the maximum practical extent; and
- Inclusion of monitoring features for key aspects of the facility to verify that performance goals are achieved, and design criteria are met.

The TMF is located to the east and up-gradient of the open pit and is situated in a position that limits interactions with wetlands and streams frequented by fish to the maximum practical extent. The TMF positioned in this manner allows the mine facilities to be situated upstream of the open pit and simplifies surface water and groundwater management requirements for the FMS Mine Site. The TMF arrangement is shown on Figure 2.1-5.

The TMF embankment will be constructed as a zoned earthfill-rockfill structure. The TMF will be developed in three stages over the mine life using downstream methods of construction. The maximum Stage 1 embankment height was estimated to be approximately 16 m. The embankment will include an upstream liner system with the liner extending from the upstream toe of the embankment into the TMF basin to control seepage gradients prior to the development of the tailings beaches. The embankment height will be raised over the life of the mine in three stages (of approximately 4 m each) to a maximum height of approximately 28 m at Stage 4.

The embankment will be constructed with a crest width of approximately 15 m to allow for single lane haul truck traffic within safety berms and pipeline routes. The embankments will be constructed with NAG pit run waste rock. Filter and transition zones consisting of filter sand and drain gravel will be placed on the upstream face of the embankment. A liner material consisting of compacted, low-permeability till will be constructed on top of the filter zone material. A second layer of NAG waste rock will be constructed to complete the upstream face of the embankment, with a geotextile layer separating the till and the waste rock and will function as ice and erosion protection for the embankment. Instrumentation will be installed in the TMF embankments and underlying foundations and monitored during all phases of the project. Monitoring data will be used to assess performance and to identify any conditions that differ from those assumed during design and analysis.

The TMF embankments have been assigned a dam classification of HIGH following Canadian Dam Association (CDA) guidelines. The dam classification is used to determine the minimum target levels for the Inflow Design Flood (IDF) and Earthquake Design Ground Motion (EDGM) for the TMF embankments. The following minimum target design flood and earthquake levels were adopted from the CDA guidelines (CDA, 2013 and 2014 as cited in Appendix D.2) for a HIGH dam hazard classification for the construction and operations phases of the project:

- IDF: 1/3 between the 1/1,000-year return period event and the Probable Maximum Flood (PMF)
- EDGM: the 1/2,475-year return period seismic event

Collection ditches along the perimeter road around the toe of the TMF embankment will collect runoff from the embankment and seepage through the embankment and foundation. The collection ditches will convey these flows to the two seepage collection ponds. Flows collected in the ponds (including precipitation on the surface of the pond) will be pumped back to the TMF supernatant pond.

Non-contact water will be diverted around site facilities to the maximum practicable extent to minimize the impact to local water courses and the unnecessary collection of fresh water. Contact water from site facilities and stockpiles will be collected in a system of ditches that convey collected flows to water management ponds. Water collected in the water management ponds will be pumped to the TMF supernatant pond.

The surplus water management system allows for the removal of excess water from the TMF supernatant pond during operations to maintain target operating pond volumes, tailings beach length, and minimum freeboard requirements. Surplus water will be removed by pumping water to a water treatment plant located near the plant site, if required to meet discharge criteria. Model refinement and adjustments will be undertaken to determine the need for, and design of, any treatment works to ensure such discharge meets environmental requirements. Water will be discharged to Anti Dam Flowage via a gravity discharge pipeline.

The water management plan forms the basis of a site wide water balance, which has been developed on a monthly basis and considers a range of climatic conditions consistent with historic variability in the area of the Project (included as Appendix D.2). The primary goal of the water balance model is to estimate the anticipated volume of surplus water that must be released from the FMS Mine Site on an annual basis to manage the inventory of water stored in the TMF within a target range consistent with the design basis of the impoundment.

The anticipated scenario for closure of the facility is that exposed tailings beaches will be capped and re-graded through a waste rock cover to allow free flow of runoff out of the facility to the open pit post-closure through a breach in the southwestern abutment of the TMF embankment. Erosion protection against wind and runoff will be provided on exposed surfaces. The erosion protection consists of a revegetated topsoil cap using topsoil stockpiled during initial construction and pre-stripping of the TMF embankment foundation and open pit footprint. The preliminary design of the TMF is subject to on-going engineering studies and further refinement. Further information on the TMF design can be found in the Preliminary Waste and Water Management Design Report (Appendix D.2).

2.2.1.12 Water Management

The landscape in the FMS Study Area is characterized by undulating to rolling topography, wetlands and woodlands dissected by a few lakes and streams. The Project is situated to the east of Highway 374 and Fifteen Mile Stream and to the south/southwest of Seloam Lake. The Project facilities are located entirely in the drainage area of Seloam Brook or its tributaries, and are confined by natural topography to the west and south, with the exception of the TMF which overlaps with a small portion of the East Lake drainage area, which drains south/southeast and then west into Anti Dam Flowage.

The Seloam Brook diversion berm will isolate the mine facilities to the south and east from the unaffected areas to the north and west and the Seloam Brook Realignment will maintain stream flow and fish connectivity from Seloam Lake through to Fifteen Mile Stream. The TMF will act both as containment for tailings and site contact water unsuitable for discharge during the operations phase. Initial water balance calculations indicate the TMF will operate under surplus water conditions and require a discharge. Further work will be undertaken to determine the need for, and design of, any treatment works to ensure such discharge meets environmental and regulatory requirements. There will be a modular effluent treatment plant present on site during the construction phase and this system can be adapted and utilized throughout the life of mine, as required based on site effluent quality.

2.2.1.12.1 *Operational Water Management*

Runoff and seepage from the TMF, WRSA, and stockpiles will be collected in perimeter ditches and/or ponds and directed back to the TMF prior to release to the environment. If water quality meets regulatory requirements, site contact water will be directly released to the environment, subject to regulatory approval.

Water collection ditches will be established surrounding the bases of the WRSA and stockpiles. Relief is designed into these facilities so that surface contact water will be directed to the surrounding collection ditches by gravity, wherever practicable. Runoff from the active mine areas will be collected in collection ponds and discharged to the receiving environment or conveyed to the TMF supernatant pond if unsuitable for discharge and used as process water.

A plant site management pond will be located adjacent to the plant facilities. Water collection ditches will be established surrounding the facilities area, as well as the ROM ore stockpile, that will divert collected surface water via gravity flow to the water management pond. The earthworks for the facilities are designed with enough relief that contact surface water will run by gravity into these surrounding collection ditches, and into the collection pond. Settled water will be released to the environment if of suitable quality or if unsuitable pumped to the TMF or plant for use as process water. In addition to the Seloam Brook diversion berm, locally placed berms surrounding the open pit will direct clean surface water away from the open pit and into the surrounding drainage basin. An in-pit water diversion ditch will be established along the top bench of the open pit to intercept any surface water that makes it through the berm and comes into contact with the open pit. This ditch will direct water to in-pit sumps for collection, where it will be pumped out of the pit and to the TMF.

Where necessary, sub-horizontal drain holes will be established in the final open pit walls as they are exposed. On the active bench floor, the water that is collected from these drain holes, along with surface runoff, will be directed to a sump. All collected ground and surface water in the pit will be handled by high lift skid mounted pumps installed in each active pit bottom as part of the in-pit pumping system. The mine sump pumps will be connected to semi-permanent and permanent piping systems to convey water through a High

Density Poly-Ethylene (HDPE) pipe directly to the TMF located east of the open pit. The in-pit sumps will be installed with each box cut as the benching is advanced.

Seepage from the TMF and runoff from the TMF embankment will be captured in the seepage collection ditches beyond the ultimate footprint of the embankment. Water will be conveyed to a central seepage collection point downstream of the embankment and pumped back to the TMF during operations until water quality is suitable for release to the downstream receiving environment.

The water management system includes a 1 km long HDPE pipe for surplus water removal from the TMF, with a skid-mounted centrifugal pump. Surplus water will be discharged from the water treatment plant to Anti Dam Flowage via a 2 km long HDPE gravity discharge pipe. Water suitable for discharge will be released from the surplus water management pond by pipe to Anti Dam Flowage and the downstream receiving environment.

Refer to Figure 2.1-5 for surface water management conceptual design and structures.

2.2.1.12.2 *Water Management at Closure*

At closure, all surface water runoff in the vicinity of the open pit will be directed as dispersed flow into the pit to decrease filling time. Runoff from remaining waste rock, till stockpiles, and TMF will be directed to the pit prior to release to the environment. Groundwater and surface water models will be revised periodically to better predict post closure water quality and to identify the planned extent and duration of treatment requirements. There will be a modular effluent treatment plant present on site during the construction phase and this system can be adapted and utilized throughout the life of mine, as required based on site effluent quality.

Water management at closure is further discussed in Section 2.4.3.

2.2.2 Concentrate Transport

The gold concentrate produced by the Project will consist of a gravity concentrate and a float concentrate. The gravity concentrate represents a small portion of the gold concentrate produced and will be stored and transported in specialized hoppers. The hoppers will be transported on the back of a flatbed once a hopper has been filled (in the order of one hopper every two days). The majority of concentrate to be hauled will be float concentrate. Up to 100,000 t will be hauled on an annual basis in B Train tanker trailers. The transport trucks will be monitored prior to leaving site to ensure appropriate loading.

The concentrate will then be transported to the Touquoy process plant along a combination of existing public roads and a private road (Figure 1.1-1). The initial route proposed is along Highway 374 south to Highway 7, west along Highway 7 through Sheet Harbour to Mooseland Road at Tangier, and then north-west along Mooseland Road to the Touquoy Mine. When the Beaver Dam Mine Project comes online (proposed in 2022 or 2023), FMS haul trucks are expected to travel along Highway 374 south to Highway 7, west along Highway 7 through Sheet Harbour to Highway 224 and then north-west along Highway 224 connecting with the upgraded Beaver Dam Haul Road to Mooseland Road.

The initial route uses only public roads, with the 58 km section of public Highway (Highway 374 - 31 km and Highway 7 - 27 km) which forms a large part of the link being dual lane sealed roads built to support heavy truck traffic. The Mooseland Road (35 km) is a provincially owned road that has sealed and unsealed sections. The second phase of hauling will also use mainly public Highways (Highway 374 – 31 km, Highway 7 – 4 km, Highway 224 – 17 km). The Beaver Dam Haul Road (Moose River Cross Rd. - existing logging roads - 12.7 km) is a private logging road that will be upgraded to support the development of the Beaver Dam Mine Project. This upgrading will involve widening to two lanes and improving alignment to provide safer curves and gradients and, where necessary, to achieve an operational design speed of approximately 70 km/h.

The upgrade of the Beaver Dam Haul Road between Highway 224 and the Touquoy Mine Site will be permitted and constructed separately from the Project, as part of the Beaver Dam Mine Project. The Project is not dependent on this upgrade as the initial haul route exists and as such, this Project will not be considering the upgrade of this section of Haul Road as a Project activity. This Haul Road is considered in the cumulative effects section of this EIS.

Truck payloads will be consistent with the limits applied by the Nova Scotia Highways department to comply with the proposed route segments. Trucks with trailers in a B Train configuration will be used to haul concentrate. The 8 axle, 58,500 kg B Train is a standard across Canada. Based on the requirement to haul 300 t/d and a maximum payload of 41 t, 8-11 return trips per day will be required. Assuming a single 12-hour shift, this would result in approximately one truck per hour, however, the exact number will depend on the final hauling schedule, and it is anticipated that hauling of concentrate will occur between the hours of 7 am and 11pm, seven days per week. Reduction in truck loads could be realized through an adjustment based on payload. This would also allow for additional greenhouse gas (GHG) reduction through a reduction in total number of trucks required to transport concentrate. Approximately four trucks would be required necessitating the hiring of eight drivers plus supporting personnel for truck maintenance and road maintenance. During construction and pre-production there will be no concentrate hauled.

The Spring Weight Restriction period in Halifax County, Nova Scotia is legislated from March 23rd to May 18th of each year but is typically adjusted (shortened) due to yearly conditions and can be expected to be in place for approximately one month. Highway 374, Highway 7 and Highway 224 in the area of interest are exempt from the Spring Weight Restrictions and the Beaver Dam Haul Road (including Moose River Cross Rd. between Highway 224 and Mooseland Road) is private and is therefore not subject to provincial restrictions. Mooseland Road is currently subject to spring weight restrictions. However, as the majority of the haul route is not subject to weight restrictions, an exemption will be requested for the Mooseland Road section of the initial haul route, approximately 35 km. Alternatively, the Mooseland Road could be upgraded to allow a gross vehicle operating weight of 58,500 kg, year round.

2.2.3 Touquoy Mine Site

The Project will utilize the existing permitted processing facility at the Touquoy Mine Site to process FMS gold concentrate. The small volume of additional tailings generated from processing of FMS concentrate at the existing Touquoy processing plant will be pumped to the mined out Touquoy pit for storage. Process water will be recycled from the Touquoy TMF. At some point, based on the results of water balance, process water will be sourced from the exhausted Touquoy pit. The Touquoy Mine Site footprint will be maintained as originally permitted and cyanide will not be needed at the FMS Mine Site. All other aspects of the Touquoy Gold Project will remain as assessed and approved through the Nova Scotia EA process in 2008 and as approved and regulated under the Touquoy IA.

Changes to the Touquoy Mine Site as a result of the Project will include the following:

- an increase in the duration of ore processing (seven additional years);
- minor alterations to the Touquoy processing facility to accommodate FMS concentrate; and
- disposal of tailings from FMS concentrate in the exhausted Touquoy pit.

The Touquoy Mine Site will be operational for an additional seven years beyond the current lifespan anticipated for the Touquoy Gold Project. There will be a marginal increase in the Touquoy processing rate to accommodate FMS concentrate. This will result in seven additional years of ore processing, water management, and tailings management. The Touquoy processing facility main building houses ball mill, gravity recovery, reagent make-up, elution, and refinery sections. The crushing, carbon in leach (CIL), and cyanide destruction sections are located outdoors.

Tailings disposal for the Project will be in the exhausted Touquoy pit. Tailings deposition will be performed using subaqueous deposition of a conventional tailings slurry through a barge. Deposition strategies will require routine modification based on the season (See Touquoy Integrated Water and Tailings Management Plan – Appendix I.6). Tailings from the FMS concentrate will be deposited in conjunction with tailings from Touquoy and Beaver Dam ore, and Cochrane Hill concentrate (Appendix I.7). A total of approximately 7.91 Mm^3 of combined tailings will be deposited into the Touquoy exhausted pit, subject to regulatory approval. An approximate volume of deposited tailings of 0.41 Mm^3 is required for processing of FMS concentrate, including the pore water lockup. The capacity of the exhausted Touquoy pit can manage both the tailings and water volume, accommodating flood storage and freeboard (Appendix I.6; Appendix I.7).

The Touquoy exhausted pit is not expected to completely fill with water during the processing of the FMS concentrate but if this does occur, surplus water will be pumped into the existing Touquoy TMF and pass through the water treatment system, polishing pond and constructed wetland.

Make up water requirements will be sourced from Scraggy Lake or other sources as per existing approvals. Figure 2.1-6 displays the location of these components. A technical report that presents the technical water and tailings management plan, including tailings deposition and the overall Touquoy Mine Site water balance including the direction of flow between components, effluent discharge locations, mine component drainage areas, and locations of MDMER final discharge is provided in Appendix I.6. The existing effluent treatment plant will be utilized during closure, if required, until such time regulatory discharge requirements are met and excess water from the pit discharges by gravity to the Moose River along a constructed discharge outline.

The additional operational life of the Touquoy Mine Site involves no new footprint disturbance to the existing Touquoy facility or property. As originally planned in the approved Touquoy Gold Project Reclamation Plan, the inflow of groundwater, surface flow and precipitation into the pit will naturally create a water feature/lake upon closure of the site. Air emissions generated from the Touquoy Mine Site associated with the processing of FMS concentrate will be limited to emissions from the existing permitted plant operation during processing. The primary potential effect of the continued use of the Touquoy Mine Site is on surface water and groundwater quality associated with processing the FMS concentrate through the use of the exhausted open pit for tailings storage. It should be noted that geochemical and water quantity/quality data collected during the operational phase of the current permitted Touquoy Gold Project has been utilized to model surface and groundwater and to make predictions of future water quantity and quality. As the Touquoy operation progresses, these predictive models will continue to be refined and revised as warranted.

2.2.3.1 Currently Approved Operations at the Touquoy Mine Site

The Touquoy Gold Project was originally described in a Provincial EARD and planned as a surface operation using drilling and blasting, with processing on site. Production was estimated at approximately 5,480 tonnes of ore per day with a total ore production estimate over the life of the mine of at least 9.2 million tonnes for recovery of 0.4 million ounces (oz.) of gold. The Touquoy Gold Project is currently in its third year of operation (operational in late 2017) and the mine life is estimated to be four to six years. The Touquoy Gold Project will be extended by four to five years to accommodate processing of FMS concentrate, followed by two years for closure and decommissioning.

The open pit and associated infrastructure are centered on areas of previous (bulk sample in 1980's) and historic mining activity at Moose River Gold Mines. The Touquoy facilities include an open pit, processing plant, tailings storage facility, waste rock piles, power and water supply systems, offices, and a service support complex. The total area of the ultimate development at the Touquoy Gold Project is approximately 265 ha. The open pit and mine site roads will occupy approximately 40 ha, processing plant and service complex will occupy approximately 60 ha, the tailings management facilities will occupy approximately 130 ha, and the waste rock stockpile occupies approximately 35 ha. The current total disturbance footprint of the Touquoy facilities as of September 2019 is 249 ha.

Ore is mined from the nearby Touquoy pit and delivered to the mill for processing. Processing involves size reduction of the ore by crushing and grinding and recovery of the contained gold by mechanical and chemical processes. Recovery entails gravity concentration, carbon-in-leach (CIL), elution and carbon regeneration, electro-winning and smelting, and cyanide destruction. Tailings from processing of the Touquoy ore are deposited in the permitted TMF. Water associated with the Touquoy tailings is recycled for use in processing. At closure, all facilities will be removed, disturbed lands rehabilitated, and the property returned to otherwise functional use.

As part of the conceptual reclamation plan for the Touquoy Gold Project identified in the Provincial EARD, all site facilities will be removed, and the pit will be allowed to fill with water forming a lake. The flooding of the pit will create a lake approximately 15 ha in size with edge habitat.

2.2.3.2 Touquoy Gold Project Environmental Assessment

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

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

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

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

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

2.2.3.3 Existing Industrial Approval at the Touquoy Gold Project

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

- Particulate emissions (dust) and sound levels;
- Blasting management and monitoring;

- Air emissions from plant operations;
- Groundwater and surface water management and monitoring;
- Liquid effluent discharge management and monitoring;
- Tailings management and requirement for an engineer of record for the TMF;
- Management and containment of historic tailings;
- Management of waste rock and sampling procedures;
- Handling, storage and management of reagents;
- Contingency / Emergency Response Plan;
- Environmental impairment liability insurance requirements;
- Complaint response procedures;
- Community liaison committee (CLC) facilitation;
- Reporting requirements; and
- Reclamation planning and posting of bond to ensure completion.

The IA has specific requirements at various project stages of the Touquoy Gold Project. This included installation of 32 nested pairs of groundwater monitoring wells prior to construction and completion of four quarterly monitoring events prior to operation. Subsequent to the start of operations, an additional 10 groundwater wells have been installed and monitored: eight shallow wells, and 1 nested pair. These groundwater monitoring data, as well as surface water monitoring data, are now being collected at the Touquoy Gold Project and are being used to periodically update the surface and groundwater modelling predictions for operations and post closure.

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

2.2.3.4 Ongoing Operations at Touquoy Mine Site and Benefits to the Project

Prior to the use of the Touquoy facility for the processing of FMS concentrate and storage of tailings in the exhausted Touquoy pit, approximately five years of operational data from the Touquoy Gold Project operations will have been collected and modelling studies will be updated based on a review of these data. Monitoring of the current Touquoy Gold Project includes air and noise monitoring, surface water monitoring of nearby water bodies, and groundwater monitoring of an extensive network of near and far groundwater monitoring wells. This ability to have actual data from an operational setting that is very similar to that proposed at FMS Mine Site is unique and important. The two sites have similar geology, ore, mining methods, wetlands and surface water bodies in close proximity to the extraction areas. The Proponent will utilize these operational data to update models and provide greater refinement in the potential effects prediction for the FMS tailings deposition in the Touquoy exhausted pit.

Mining by nature is complex and necessitates the proper use of personnel and equipment in creating an operation that is safe, benefits communities, and is executed in a manner that minimizes potential harm to the current and future natural settings. This operational expertise gained through the development and operation of the Touquoy Gold Project will be applied at the FMS Mine Site as proposed.

2.3 Project Phases

The Project phases have been defined as follows:

Construction Phase/Pre-Production Phase

- Twelve month pre-production period commencing 2023

Operations

- 6.75 years of production, includes 1.5 years of processing low grade stockpile.

End of Mine (EOM) Life

- The condition immediately following the cessation of mining, with the pit excavated to the maximum proposed depth and completely dewatered and all low-grade stockpiles have been processed.

Closure

- Reclamation Stage (2-3 years)
  - During reclamation, all infrastructure will be removed. The open pit will be allowed to flood creating a lake. Re-contouring of the WRSA will be carried out progressively throughout the Project life where practical. The FMS Mine Site infrastructure footprint will be covered with soil, where required, or otherwise the surface will be ripped or scarified, sloped, re-contoured to a stable angle and hydroseeded to match the local topography where practicable. WRSA slopes will be graded to an overall 3:1 slope and the tailings dam embankment has been designed for a 2:1 downstream slope. TMF reclamation will commence. Note that final slopes for the WRSA and tailings dam downstream embankment will be dependent on geotechnical stability studies to be undertaken at the permitting phase as well as other environmental considerations.
  - Based on modelling results, there will likely be a requirement for the PAG stockpile to be covered with a compacted low permeable till (clay) and topsoil cover to reduce the infiltration of precipitation. A geosynthetic cover or equivalent will also be considered. The construction of a layered soil cover would consist of alternating layers of low-permeability till and a drainage medium (i.e. filter sand), with the final reclaimed stockpile being capped with a topsoil growth medium and revegetated. Final decisions on requirement for cover and resulting design details will be determined through ongoing testing and modelling and will be included as part of the Reclamation and Closure Plan that will be developed, in consultation with the Mi'kmaq of Nova Scotia, to support the EMS Framework (Appendix L.1) that will be submitted to NSE, NSL&F and NSDEM.
- Post Closure (PC) Stage
  - During post-closure, pit filling and all necessary monitoring will be completed. The post-closure stage will end when the pit lake is full, monitoring requirements are fulfilled, and the site has confirmed structural and environmental stability for the long term (steady state). TMF reclamation is expected to continue into the first several years of the post-closure stage.

2.3.1 Opportunities for FMS Mine Life Extension

The proposed development plan and current mine life for the Project as described in this EIS is based upon extraction of the proven and probable reserves of 13.4 Mt of ore grading 1.11 g/t from the Egerton-MacLean Zone.

As with most mining properties, however, additional mineralized zones have been identified within the FMS Study Area which have been the subject of various levels of exploration over time.

At the Project, the additional gold resources include:

- the Hudson resource located approximately 800 m west of Egerton–MacLean;
- the Plenty resource located approximately 400 m southwest of Egerton–MacLean; and
- the 149 resource located approximately 1.5 km east of Egerton–MacLean near the proposed TMF area.

Both the Hudson and Plenty resources, as currently defined, are lower in grade and much smaller extent when compared to the Egerton-MacLean deposit and as such would be developed at the end of mining as presented in the March 2019 NI 43-101 Technical Report (Atlantic Gold Corporation, 2019). Additional infill drilling and engineering studies will be undertaken to determine the viability and economics of recovering the above noted resources. Factors that may affect future exploitation will include, amongst other things: the size and grade of mineralization zones, the geometry and continuity of mineralization zones, metal prices, exchange rates, operating costs, etc. Should any or all of the above resources remain economically viable, it is expected that they would extend the mine life of the Project whilst maintaining the daily ore production capacity. These potential mineral deposits would be permitted post-EIS approval for the Egerton-MacLean deposit.

2.4 Project Activities

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

2.4.1 Construction Phase/Pre-Production Phase (Year 1)

2.4.1.1 FMS Mine Site

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

- clearing, grubbing, and grading;
- drilling and rock blasting;
- establishment of topsoil, organic material (saturated topsoil/peat), till, and waste rock stockpiles; and
- Seloam Brook Realignment construction and pit site dewatering.

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

- watercourse and wetland alteration;
- mine site road construction;

- local bypass rod construction;
- surface infrastructure installation and construction;
- powerline construction;
- pit pre-stripping;
- TMF embankment construction; and
- collection ditch and water management pond construction.

The FMS Mine Site will have a total disturbed area of approximately 400 ha, consisting of the pit (27 ha); WRSA (53 ha); TMF (123 ha); low grade ore stockpile (15 ha); till stockpile (12 ha); topsoil stockpiles (5 ha); organic material stockpile (19 ha); operational facilities (40 ha); Seloam Brook diversion berm (6 ha); water management ponds and structures (16 ha); potential borrow pit areas (30 ha); access road (6 ha); local road bypasses (5 ha); powerline (2 ha) and mine site roads (16 ha). Ore, till, topsoil, and organic material stockpiles will comprise approximately 51 ha during operations but are not anticipated to remain at the completion of the Project.

Pre-construction and construction activities will be staged in accordance with the status of various permitting initiatives. For example, in the event there is a delay to the required fisheries authorizations, pre-construction and construction activities will be focused during that period on areas that will not have a direct impact on area of fish habitat. Impacts during this and other phases of the development will be managed and limited by means of an Erosion Prevention and Sediment Control Plan which will be developed to support the EMS Framework Document (Appendix L.1).

2.4.1.1.1 *Site Preparation and Pre-Production*

A twelve-month pre-production period is anticipated to supply material for construction including internal haul roads, water collection ponds and TMF starter dams. The planned mine mobile equipment fleet will be procured and utilized for pre-production operations.

Topsoil will be excavated beneath the entire TMF embankment and upstream TMF basin liner footprint to a depth of approximately 0.5 m. Topsoil will be stockpiled for use in reclamation. Loose or unsuitable overburden materials (i.e. wetland material) will be excavated completely in wetland areas beneath the embankment footprint and either stockpiled in the organic material stockpile or disposed of within the TMF basin. Any suitable construction materials for the starter embankment that are encountered during sub-excavation will be stockpiled separately.

The open pit footprint, mine infrastructure and waste rock storage areas will be cleared and grubbed in advance of operations with the timing informed by Environment and Climate Change Canada (ECCC) directives, wherever practicable, relative to migratory bird nesting. Topsoil will be salvaged to a nearby stockpile for later use in reclamation activities. Glacial till overburden within the open pit footprint will be salvaged to a till stockpile storage area for later use to support reclamation activities.

Once vegetation, topsoil, and till have been removed and the Seloam Brook Realignment is complete, drilling and blasting will be used to mine ore and non-ore bearing waste rock, as well as to establish benches along rock walls. Holes will be drilled into the host rock to receive explosives used for blasting. The pit will be mined down to the -50 bench (bench floor elevation in metres above sea level), approximately 165 m in depth.

Areas of waste material storage at the FMS Mine Site will include topsoil stockpiles, till stockpile, and waste rock stockpiles. All these locations will be cleared and grubbed concurrently with the pit. The till and WRSA will also have topsoil removed and stored at the topsoil stockpile locations.

2.4.1.1.2 *Management of historic waste rock and tailings*

The Proponent is committed to responsibly managing historical tailings and waste rock that are encountered during the construction of the Project. Historical tailings and waste rock that is outside the planned disturbance footprint will be left undisturbed. With respect to the management of historic tailings and waste rock materials within the proposed disturbance footprint, four options have been examined by Stantec (Appendix I.1) on behalf of the Proponent:

- Reprocessing followed by residuals storage within the FMS TMF;
- Short term storage if the material does not exceed industrial Tier 1 EQS or other environmental criteria followed by reuse during reclamation;
- Long term storage within the TMF; and
- Offsite transport and disposal.

The Proponent is currently evaluating these options with respect to historic tailings and waste rock chemistry, potential environmental impacts of each option, the risk to human and ecological health, cost and feasibility. In their Historical Tailings and Waste Rock Management Plan for the FMS Mine Site (Appendix I.1), Stantec proposed a series of mitigation measures to ensure these materials are managed appropriately during excavation. These measures include additional sampling, stormwater management, monitoring, remedial verification, documentation and reporting.

During construction, the first step will be to build berms and complete the Seloam Brook Realignment and re-route water around the proposed pit development area. This will allow for an “in the dry” working area for the pit. However, based on topography and delineated wetlands and open water sections within the proposed pit area, some degree of water management is expected to be required during pit development. There is elevated arsenic and potentially mercury within this development area documented in surface water and sediment. Water management ponds (lined with clay or geosynthetic liner) will be built for the proposed WRSA first and will be used to manage construction water from the pit development area. A modular effluent treatment plant for water will be available during construction if required to manage water quality issues should they arise. This system can be adapted and utilized throughout the life of mine, as required based on site effluent quality.

During operations, runoff from the waste rock/historic tailings piles and low grade ore stockpile will be directed to seepage collection ditches and/or the excess water pond. Runoff from the active mine areas will be collected in ditches, directed to the site management pond and discharged to the receiving environment or conveyed to the TMF supernatant pond if unsuitable for discharge and used as process water.

2.4.1.1.3 *Seloam Brook Realignment*

Seloam Brook will be realigned through the construction of a raised perimeter berm along the east, north and west of the open pit and a constructed 800 m channel, which will divert flows from Seloam Brook, and its main tributary, Watercourse 12, around the open pit to the north of the pit. The stream channel will be the primary fish habitat and will contain the anticipated principle flows, while the floodplain will allow high-flow events such as spring freshets and extreme storm events to pass, similar to a natural wetland/floodplain ecosystem. Development of an Erosion Prevention and Sediment Control Plan will be completed to support the EMS Framework Document (Appendix L.1), and a Seloam Brook Realignment Construction Plan will be completed in advance of commencement of this stream realignment. A Fisheries Authorization will be required, with associated fisheries off-setting, to allow for the realignment of Seloam Brook to facilitate pit development.

2.4.1.1.4 *Site Construction*

Mine site haul roads will be constructed to enable the mining fleet (loaders, dozers, haul trucks) to access various site locations including the open pit, stockpiles and primary crusher ROM pad area. A haulage road will be constructed connecting the pit exit with the topsoil, till, and non-ore bearing waste rock stockpiles. Another haulage road will be constructed connecting the pit exit and ROM stockpile. The roads will be dual lane and approximately 25 m wide, including berms and drainage, with a maximum speed limit of 40 km/h.

The mine access road will be constructed to connect the property exit with the operational facility area. The road will be dual lane and will have a gravel base and be approximately 16 m wide, including berms and drainage, with a maximum speed limit of 40 km/h.

Two local traffic bypass roads will be constructed in order to allow for continued multiuse public access around the FMS Mine Site. Traffic flow will be diverted from the current Seloam Lake Road approximately 800 m from its intersection with Highway 374. The two bypass roads will be dual lane and will have a gravel base and be approximately 16 m wide, including berms and drainage. A bridge will be required to cross Seloam Brook. These local traffic bypass roads will be designed and developed in consultation with NSL&F as they are mainly on Crown land (Figure 2.1-7).

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

Borrow and quarry materials for the construction will be sourced from the pit during initial development and the processing areas, wherever practicable. Extra borrow material will be sourced from drumlins on site identified as potential borrow sites on Figure 2.1-5. Suitable low permeability till (clay) material extracted from these areas will be used for the TMF berm and apron liner. During start-up, prior to the availability of quarry materials from the pit, some material may be transported to the site from other quarry sites, external to the Project.

The TMF embankments will be constructed as zoned earthfill-rockfill structures. The embankments will include an upstream liner system consisting of a low-permeability till layer and geotextile material. The maximum Stage 1 embankment height was estimated to be approximately 16 m. The liner will extend from the upstream toe of the embankment into the TMF basin for a length of approximately three times the height of the Stage 1 embankment to control seepage gradients prior to the development of the tailings beaches. The embankment height will be raised over the life of the mine in three additional stages (of approximately 4 m each) to a maximum height of approximately 28 m at Stage 4. The configuration of the Stage 1 TMF embankment may be modified to avoid waters frequented by fish (in the event that an amendment to Schedule 2 under MDMER is required and not obtained at the time of commencement of construction) to allow for ongoing construction and operation during the period prior to receiving the Schedule 2 amendment.

The embankment will be constructed with a crest width of approximately 15 m to allow for single lane haul truck traffic within safety berms and pipeline routes. The embankments will be primarily constructed with NAG pit run waste rock. Filter and Transition Zones consisting of filter sand and drain gravel will be placed on the upstream face of the embankment. A liner material consisting of compacted, low-permeability till will be constructed on top of the filter zone material. A second layer of NAG waste rock will be constructed to complete the upstream face of the embankment, with a geotextile layer separating the till and the waste rock and will function as ice and erosion protection for the embankment.

Collection ditches along the perimeter road around the toe of the TMF embankment will be established to collect runoff from the TMF embankments and seepage through the TMF embankments and foundations. The collection ditches will convey these flows to the two seepage collection ponds. Flows collected in the ponds (including precipitation on the surface of the pond) will be pumped back to the TMF supernatant pond. The north seepage collection pond has a maximum volume of approximately 20,000 m^3 and the east seepage collection pond has a maximum volume of approximately 15,000 m^3.

Non-contact water will be diverted around site facilities to the maximum practicable extent to minimize the impact to local watercourses and the unnecessary collection of fresh water. Diversion channels will collect and divert runoff from undisturbed catchment areas for precipitation events up to a 1-in-200-year precipitation event.

Water required for mill operations will be sourced from the plant site collection pond, reclaimed from the TMF supernatant pond, water in ore, and freshwater makeup from Seloam Lake. Freshwater makeup requirements are for clean (i.e. non-contact) water required for various components in the mill process.

Since the design volume of the plant site collection pond is currently unknown, it was assumed that the plant site collection pond will not store water and that all inflows to the plant site collection pond are conveyed directly to the mill. Inflows to the plant site collection pond are direct precipitation on the pond surface and catchment runoff (both from un-diverted natural catchment areas and from the disturbed footprint of the plant site). An assumed plan area of 7,500 m^2 was used to evaluate the direct precipitation and evaporation of the plant site collection pond for inclusion in the water balance model.

Three water management ponds are designed to collect runoff from the stockpiles and open pit (Figure 2.1-5). The ponds were designed to store catchment runoff for the 1 in 10-year 24-hour storm event (116 mm) plus direct precipitation for the 1 in 200-year 24-hour storm event (184 mm). The ore stockpile and open pit collection pond collect runoff from the ore stockpile and dewatering flows from the open pit and have a maximum design volume of approximately 23,000 $m^{3.}$ The till stockpile collection pond collects runoff from the till stockpile and has a maximum design volume of approximately 22,000 m^3. The NAG collection pond collects runoff from the NAG stockpiles. The NAG stockpile collection pond has a maximum design volume of approximately 35,000 m^3. These water management ponds will be built prior to initial pit development and lined with a geosynthetic or clay liner in order to manage any potential contaminated water during construction from excavation of historic tails. Water collected in the water management ponds will be pumped to the TMF supernatant pond, unless discharge to the receiving environment is appropriate based on water quality analysis and regulatory approval.

The final design of the collection and water management ponds will be submitted as part of the IA application and process.

A berm will be constructed surrounding the pit to prevent shallow groundwater flow and/or surface water from entering the pit. A water diversion ditch will be established around the perimeter of the open pit to intercept any surface water that infiltrates the berm and flows into the mine. This ditch will direct water to in-pit sumps where it will be directed to the collection pond located to the east of the open pit.

Development of the FMS Mine Site will cause direct and in-direct impacts to wetlands and fish habitat mostly within the construction phase of the Project and mostly associated with pit development and the realignment of Seloam Brook. Direct impacts will be associated with clearing, grubbing, infilling and development of the mine and its associated infrastructure. Wetlands located within the FMS Study Area are discussed further in Section 6.7 and Fish and Fish Habitat is discussed in Section 6.8.

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

2.4.1.2 Touquoy Mine Site

2.4.1.2.1 *General*

Final processing of gold concentrate will take place at the existing Touquoy facility currently operating at the Touquoy Mine Site. The Touquoy plant has the capacity and is designed to be able to treat the concentrate with some modifications required including:

For FMS Flotation Concentrate (new flotation concentrate building)

- Float concentrate stockpile area;
- No-hold up hopper with static grizzly;
- Screw conveyor feeder;
- Intensive mixing tank (repulping);
- Pre-aeration tank, Leach tank, pump and pump box (new);

For Gravity Gold Concentrate (new gold room expansion building)

- Intensive leach reactor (new) –ILR 6000 or equivalent;
- Barren Solution tank (new);
- Gravity electrolyte tank (new);
- Electrowinning cell with sludge hopper (new); and
- Gold room expansion building enclosure with ventilation ducting (new).

The Touquoy process plant is located east of Moose River, north east of the Touquoy open pit and north-west of the TMF. The approach by road to the plant will be from the east via the Mooseland Road. The main plant building houses the grinding, classifying cyclones, gravity recovery and ILR intensive leaching, reagent, elution and refinery sections. The crushing, leach, CIL and cyanide detoxification sections are located outdoors.

The Touquoy plant will handle the FMS concentrate with installation of two new buildings: flotation concentrate building located south of the current Touquoy plant and gold room expansion building located adjacent to the existing gold room. Consequently, the Touquoy process flowsheets will remain fundamentally unchanged with the processing of FMS concentrate.

2.4.1.2.2 *Upgrades to the Touquoy Process Plant*

Flotation Concentrate Handling/CIL Circuit

The FMS flotation concentrate will be introduced to the Touquoy process plant via CIL Circuit. Prior to combining the feed slurry to the CIL circuit, the flotation concentrate will be slurried, pre-aerated and leached where about 92% of the gold extraction will occur. In order to introduce the FMS concentrate to the Touquoy process plant, a new flotation concentrate building will be installed at the south of the current mill within the existing footprint of disturbance. The FMS flotation concentrate will be transferred to this new building using 40 tons trucks during day shifts only. This building will consist of mainly a stockpile area allowing for 24 hours storage of concentrate, a pre-aeration tank and a leach tank.

Re-handling of the FMS concentrate will be by front-end loader, which will discharge the concentrate into a fairly small no-holdup hopper with capacity of 3 to 5 m^3 located above a screw conveyor feeder. The feeder head chute will discharge into a conical intensive mixing tank, where the adequate process water will be added for slurrying the concentrate. The feed slurry will be pumped to a new pre-aeration tank and subsequently to a new flotation concentrate leaching tank on a continuous basis. The residence time in the leach tank will be about 30 hours. The pre-aeration tank will act as a surge tank during the night shift where no FMS flotation concentrate will be trucked. The pre-aeration tank will provide 18 hours of pre-aeration and 12 hours of surge capacity. The concentrate leached slurry will be sampled and overflowed to a launder and a pump box prior transferring to CIL circuit via.

Gravity Concentration Feed

No mechanical changes are expected to the existing Touquoy process plant gravity circuit. Given the increase in gravity gold concentrate, it is proposed to install a new parallel intensive leach reactor (ILR 6000 or equivalent) and electrowinning circuit to increase the capacity for gravity gold recovery in a new gold room expansion building adjacent to the existing gold room building. The FMS gravity gold concentrate will be transported to Touquoy plant via a skid-mounted transportable concentrate hopper on a daily basis, which will be positioned adjacent to the new ILR unit using a forklift. The ILR skids will combine the gravity concentrate with cyanide, caustic soda and hydrogen peroxide to extract the gold from the concentrate, Upon completion of a gravity gold intensive leach cycle which takes about 20 hours including the transfer, reagent addition, and leaching time, the pregnant solution will be pumped to a gravity electrolyte tank and will be circulated through a new electrowinning cell which will plate the extracted gold onto the electrowinning cathodes. Periodically, the electrowinning sludge will be high-pressure washed into a sludge hopper which will transfer the sludge to the existing sludge press feed hopper for dewatering ahead of smelting. The barren solution from the electrowinning cell will be pumped either to the CIL circuit or it will be transferred to the new barren solution tank for bleeding to either the flotation concentrate leach or to the existing or new ILRs. The ILR residue will be transferred to the grinding circuit upon completion of leaching circuit.

Leaching

No changes are required to both intensive leach reactor and electrowinning cell. Much smaller carbon adsorption tanks are required to handle the significantly reduced volumetric flow of FMS flotation concentrate. Preliminary sizing suggests that 10 x 30 m^3 pumpcell circuit is required replacing the current seven 1,329 m^3 tanks. Adsorption of gold still requires six stages of carbon movement to capture the gold, just on a smaller scale.

Other Changes

No changes are required for the elution detoxification and reagent plant with the exception of adding new cyanide pump, sodium hydroxide pump, hydrogen peroxide dosing pump and flocculant dosing pump for the new ILR system. Smaller tailings pumps and pipes are required to handle much smaller volume of tailings. As an alternative, tailings can be diluted with water to end up with the similar tailings volumetric flow rate as the current operating tailings. With diluted tailings, existing tailings pumps and pipes can be used.

The minor works necessary to modify the Touquoy Mine Site for FMS concentrate, as described above, will begin before initiation of operation of the FMS Mine Site. This transition phase will likely not exceed four to six months.

No other changes will be made to the remainder of the processing facility and no additional land disturbances are anticipated to prepare the Touquoy Mine Site to receive FMS concentrate.

2.4.1.3 Existing Environmental Mitigation and Monitoring Requirements Associated with Construction

The construction activities at the Touquoy Mine Site required for the Project are minimal and within the existing Touquoy Mine Site footprint. The existing Touquoy IA adequately addresses construction activities, such as sediment and erosion control and spill protection and containment associated with construction equipment, e.g., fueling.

The existing environmental monitoring requirements at Touquoy Gold Project include surface and groundwater monitoring as part of the IA. This will have occurred for approximately five years before construction activities associated with the Project commence. Also, existing approvals for wetland alteration include requirements for monitoring and compensation; these will be completed during the life of the Touquoy Gold Project, and no additional disturbance of wetlands are predicted as part of the Project activities at the Touquoy Mine Site.

2.4.1.4 Touquoy Upgrade Schedule

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

2.4.2 Operations (Years 2 to 9)

2.4.2.1 FMS Mine Site

During operation and maintenance of the Project, the following activities will be undertaken:

- surface mine operation and maintenance
  - drilling and rock blasting;
  - surface mine dewatering;
- ore management;
- milling operations
  - crushing
  - grinding
  - gravity concentration
  - conventional flotation circuit
  - concentrate thickening, filtration and storage
- concentrate loading and haulage;
- waste rock management;
- tailings management;
- water management;
- dust and noise management;
- petroleum products management; and
- site maintenance and repairs.

2.4.2.1.1 *Mine Operation*

In the active mining area, in-situ rock is drilled and blasted on 5 m to 10 m bench heights. Diesel powered down-the-hole hammer drills will be used for production drilling and will also be used for horizontal highwall depressurization drilling on the ultimate pit walls. Blasting will typically occur two to three times per week.

Grade control drilling is carried out to better delineate the ore and waste rock in advance of mining. Ore and waste rock blocks will be identified and delineated with a grade control system based on dedicated reverse circulation (RC) grade control drilling and sampling, and a fleet management system will keep track of each load.

A contract explosives supplier will provide the blasting supplies and materials for the mine. Emulsion will be the primary blasting agent as the majority of blast holes may be wet. Explosives and all accessories will be supplied on an as needed basis from the contractor's base location off-site and delivered to the contractor's onsite explosive storage facilities or directly to the blast holes typically using the contractor's equipment. All on and off-site permitting requirements will be the responsibility of the contractor through Natural Resources Canada (NRCAN) for the Project. An operational blast material sampling program will be implemented to provide confirmatory testing of open pit blast hole drill cuttings at a frequency to be determined by the Project geochemists, geologist and with consideration of available NRCAN and comparable guidance. In this way, the geochemical predictions of the mine rock can be confirmed.

Diesel powered hydraulic excavators will load both ore and waste rock into haul trucks. These loading units will also function to re-handle low grade ore material from stockpile and load overburden and topsoil for transport to stockpile.

Ore will be loaded into off-highway rigid frame haul trucks and hauled to the ROM pad and primary crusher. All waste rock will be loaded into off-highway rigid frame haul trucks and hauled to the WRSA. If dust is generated from hauling in the warmer months of the year, it will be controlled by applying dust suppression measures that may include water and/or chemical dust suppressants to the haul roads utilizing specialized water trucks.

At the ROM pad, haul trucks will dump ore material directly into the primary crusher or place it in an active stockpile on the pad, to be re-handled as crusher feed at a later time. Crusher loading of the stockpiled ore will be accomplished with a diesel-powered wheeled loader.

At the WRSA, the haul trucks will dump waste rock in lifts.

A small support fleet will be used for mine operations support services. These services will include:

- Haul road maintenance
- Pit floor and ramp maintenance
- Ditching
- Reclamation
- Open pit dewatering
- Open pit lighting
- Mine safety and rescue
- Transportation of personnel and operating supplies
- Snow removal

A fleet of diesel-powered mobile equipment is specified to handle the above pit support activities and include a hydraulic excavator, wheeled loader, track dozers and motor grader.

Maintenance activities on the mine mobile fleet will be performed in a mine maintenance facility located near the primary crusher, as well as in the field. Fuel, lube and field maintenance will be performed with a mobile maintenance fleet of equipment by qualified and trained staff.

Diesel fuel and lubricant storage will be located near the primary crusher, and a dedicated fuel and lube truck will deliver these materials to the mine and maintenance mobile fleet. Diesel will be supplied from local sources by road tankers and stored in approved, above ground double walled tanks. Fuel will be distributed to equipment consumers by means of a dedicated fuel truck or cardlock system located at the storage facility.

The trucks required to transport the gold concentrate from the Project to the process plant at the Touquoy Mine Site will be refueled at the Project site as needed using the cardlock system noted above.

The workforce at the Project will be approximately 200 persons working two shifts per day or approximately 50 persons per shift (personnel will work four days on and four days off), similar to that at the operating Touquoy Mine.

In addition, the trucking operation hauling concentrate from the Project to the Touquoy Mine Site will create approximately 20 jobs which may be contract positions to drive the highway trucks and conduct vehicle maintenance.

2.4.2.1.2 *Waste Rock Management*

All waste rock removed from the open pit will be placed in the WRSA, shown on Figure 2.1-5. On behalf of the Proponent, Lorax Environmental Services Ltd (Lorax) analyzed mine ore, waste rock and tailings to determine the metal leaching/acid rock drainage (ML/ARD) properties of these materials (Appendix F.2). ML/ARD is a natural process that results from the weathering, primarily through oxidation, of sulphide-bearing rocks and overburden. When these materials are exposed to oxygen and water, metal sulphide minerals oxidize which results in the release of acidity and dissolved metals into contact water. If not neutralized by carbonate or silica-based minerals, this process can lead to low pH conditions and elevated metal concentrations in mine drainage. The waste rock will be segregated based on NAG and PAG characteristics and placed into separate stockpiles to allow for appropriate management of waste rock material. See Section 6.4 for further details on the results of waste rock geochemical analyses and the management of those materials. A sensitivity analysis was completed to understand potential effects to groundwater, surface water and aquatic resources in the event of potential errors in the waste rock segregation process leading to improper waste rock storage of PAG materials. (refer to Appendix B.6).

These waste rock storage piles will range in height from 20 m to 45 m above the existing ground surface and will contain waste rock excavated from the pit. This height generally conforms with local topographic variations. The northern edge of the PAG rock stockpile will have a maximum height of 25 m while the southern edge will be tied into natural topography. Total capacity of the PAG rock stockpile will be approximately 3.6 Mt. The northern edge of the NAG rock stockpile will have a maximum height of 45 m while the southern edge will have a maximum height of 20 m. Total capacity of the NAG rock stockpile will be approximately 13.2 Mt. A haul road along the north-eastern limit of the WRSA will provide access ramps to the lift elevations.

The WRSA will typically be built bottom-up in lifts, spread out and compacted by track type dozers. Haul trucks will deliver the waste rock to the WRSA, then dump out either as free dump piles, or off the edge of an established dump lift over a safety berm. Once these smaller lifts reach 10 m in height, the face of the lift will be re-sloped as required to an overall slope of 3:1 for reclamation. Re-sloping, as required, will be completed by track type dozers and small hydraulic excavators.

The waste rock will be placed according to standard practices and will ensure compliance with provincial regulations with respect to slopes, potentially acid generating material (if any), and surface water run-off.

2.4.2.1.3 *Low Grade Ore Stockpile*

To ensure continuity of mill feed and allow initial processing of higher grade material, an LGO stockpile will be developed to the north of the plant (Figure 2.1-5). The northern edge of the LGO stockpile will have a maximum height of 40 m while the southern edge will have a maximum height of 10 m. Total capacity of the LGO stockpile will be approximately 5.0 Mt.

As with the WRSA, the LGO stockpile will be built bottom-up in lifts, spread out and compacted by track type dozers. Haul trucks will deliver the low-grade ore to the LGO stockpile, then dump out either as free dump piles, or off the edge of an established dump lift over a safety berm.

The LGO will be placed according to standard practices and will ensure compliance with provincial regulations with respect to slopes, potentially acid generating material (if any), and surface water run-off.

2.4.2.1.4 *Milling Operations*

The mill is located south-east of the proposed pit area and southwest of the TMF. The approach by road to the plant will be from the west off of Highway 374.

The main plant building houses the grinding, gravity recovery, flotation, concentrate dewatering and reagent sections. The concentrate storage will be located in a separate building. The single-stage crushing circuit is based on modular mobile crushing equipment and will be located to the south of the main plant building. The fine ore stockpile is covered for snow protection and dust control.

Process water will be reclaimed from the TMF for re-use in the milling operations. Initial start-up water and ongoing make-up water is expected to be sourced from nearby Seloam Lake through application for a surface water withdrawal approval (NSE).

Figure 2.1-5 shows the plant location in relation to the overall Project site. Figure 2.4-1 outlines the process flow at the FMS Mine Site.

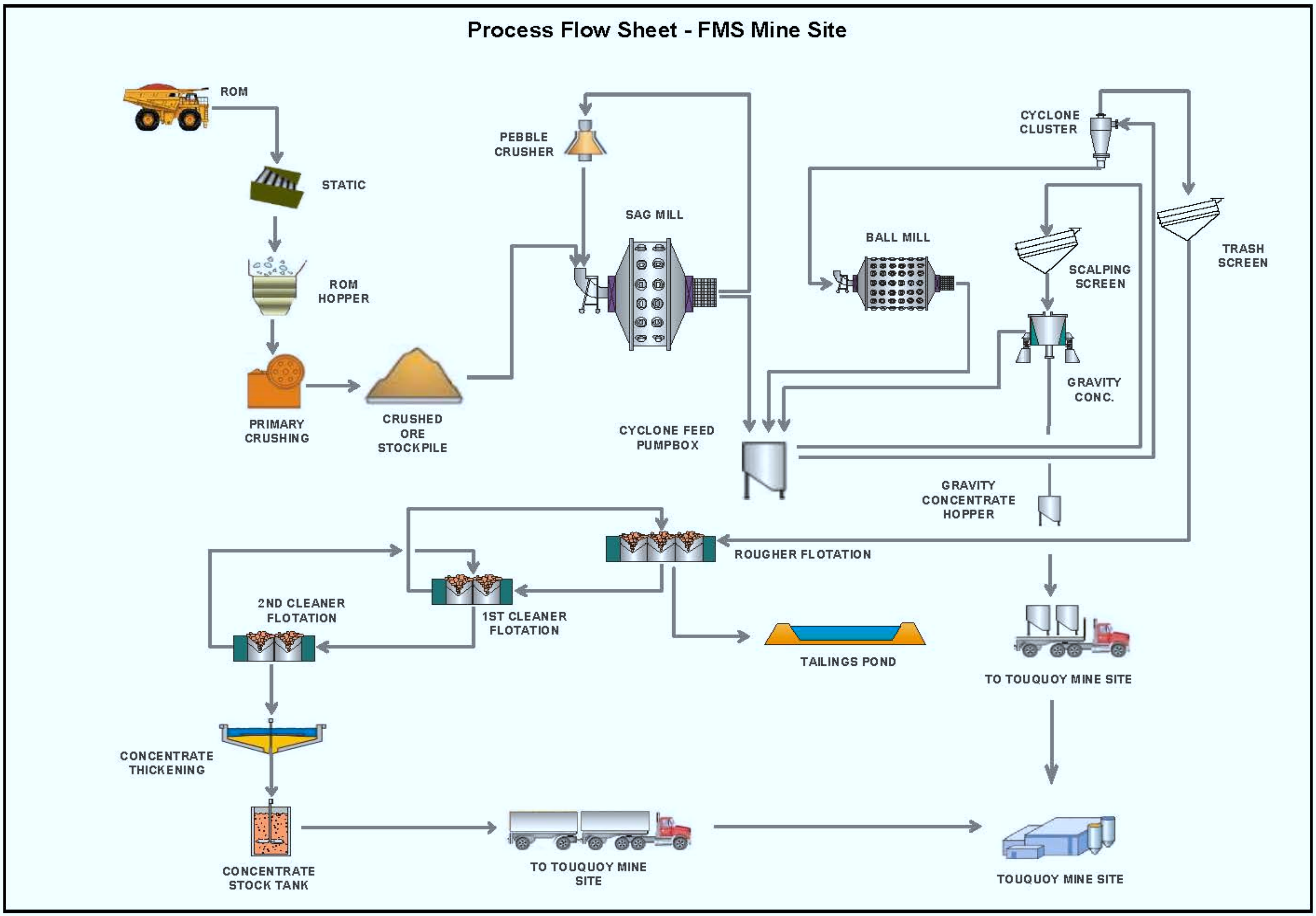


Figure 2.4-1: Process Flow Sheet – Fifteen Mile Stream Mine Site (Prepared by Ausenco, 2020)

2.4.2.1.4.1 Crushing

The crushing facility will be a single-stage crushing circuit that will process the ROM ore at an average estimated rate of 326 t/h. The major equipment and facilities at the ROM receiving and crushing areas include:

- ROM hopper;
- Rock breaker;
- Vibrating grizzly feeder;
- Jaw crusher;
- Covered coarse ore stockpile;
- Stockpile reclaim belt feeders;
- Stockpile transfer and feed conveyors.

ROM ore will be trucked in from the open pit and dumped directly into the ROM hopper or stockpiled on the ROM storage pad from which it can be reclaimed by a front end loader for continuous feed to the plant. Any oversized pieces of ore will be retained on the static grizzly above the ROM hopper and broken down by a rock breaker.

ROM ore will be fed from the bin onto the vibrating grizzly feeder and grizzly oversized material will be fed directly into a single toggle jaw crusher. Ore will be crushed and discharged onto the jaw crusher discharge conveyor, which will also receive the vibrating grizzly undersize material. The jaw crusher discharge conveyor will be equipped with a magnet and a metal detector to detect and remove tramp metal pieces. Crushed ore and grizzly undersize streams will be combined and transferred to the coarse ore stockpile by the stockpile feed conveyor.

Coarse ore storage will consist of a covered conical stockpile with 12 hours live capacity.

Ore from the coarse ore stockpile will be reclaimed by one of two variable speed stockpile reclaim belt feeders at a nominal rate of approximately 248 t/h. The belt feeder will transfer ore onto the semi-autonomous grinding (SAG) mill feed conveyor. Coarse ore from the SAG mill feed conveyor will discharge directly into the SAG mill. The SAG mill feed conveyor will be equipped with a belt scale to provide feed rate data for feed control to the grinding circuit.

2.4.2.1.4.2 Grinding

Crushed ore from the coarse ore stockpile will be reclaimed and fed into the SAG mill for grinding. A SAG mill in closed circuit with a pebble crusher and ball milling (SABC) grinding circuit is proposed. The primary grinding circuit will consist of a SAG mill and pebble recycle crusher treating 25% of the SAG mill feed. The secondary grinding circuit will consist of a ball mill in a closed circuit with primary classifying cyclones. SAG and ball mill discharge is collected in a common cyclone feed pump box. The proposed circulation load for the closed circuit is 300% of new feed.

SAG mill trommel screen oversize is collected on the SAG mill oversize conveyor and transferred onto the pebble crusher feed conveyor. These conveyors will be equipped with a magnet and a metal detector respectively to detect and remove tramp metal pieces ahead of the pebble crusher. A bypass chute will divert pebble crusher feed directly onto the pebble crusher discharge conveyor if metal is detected. The surge bin ahead of the pebble crusher ensures that the crusher is choke fed.

The comminution circuit will be equipped with two gravity concentrators to recover gravity recoverable gold (GRG). The gravity concentrators are fed simultaneously from the cyclone feed pump box by a dedicated pump at a rate equivalent to 50% of the ball mill discharge.

The grinding circuit will grind the crushed product to a P_{80} of 150 μm. The major equipment in the grinding circuit will include:

- One 7.3 m diameter by 3.8 m effective grinding length SAG mill driven by one 3,500 kW motor
- One 220 kW cone crusher with an 11mm closed side setting
- Pebble crusher feed and product conveyors
- One 4.27 m diameter by 6.7 m effective grinding length ball mill driven by one 2,000 kW motor
- One primary cyclone cluster, consisting four 650mm diameter cyclones (three operating, one standby)

As required, steel balls will be added into the ball mill using a manual kibble system to maintain grinding efficiency. The SAG mill will be equipped with an automated rotary ball feeder and ball counter.

The primary cyclone overflow will be gravity flowed to the flotation circuit.

2.4.2.1.4.3 Gravity Concentration

A portion of the combined mill discharge will be split and fed into two 50% duty parallel gravity concentrator trains. The gold concentrate solids recovered will be stored in a mobile hopper.

The equipment is arranged to provide a gravity cascade under the gravity circuit scalping screen. Two outlets from the screen underpan provide the feed slurry to two gravity concentrator trains. The two gravity concentrators in parallel are sized for 168 t/h solids feed rate each.

The oversize from the scalping screen will gravitate to the ball mill feed chute, while the undersize will feed the concentrators. The tailings from the concentrators will be transferred back to the cyclone feed pump box and the gold-containing gravity concentrate will be stored in a secure hopper. Once a hopper is full, the water will be decanted, and the hopper will be changed out via forklift and put onto a flatbed truck for transportation to the Touquoy Mine Site for final processing. The expected mass of gravity concentrate to be produced is 4.4 tons per day.

2.4.2.1.4.4 Conventional Flotation Circuit

The slurry from the cyclone overflow will gravity flow to a trash screen ahead of the flotation circuit while the cyclone underflow will recirculate back to the grinding circuit. The flotation circuit consists of:

- 7 x 30 m^3 Rougher flotation tank cells
- 6 x 10 m^3 First stage cleaner flotation tank cells
- 4 x 5 m^3 Second stage cleaner flotation tank cells

<u>Rougher Flotation</u>

Primary cyclone overflow will flow by gravity to the rougher flotation cell feed box. In the rougher flotation cells, potassium amyl xanthate (PAX) collector and methyl isobutyl carbinol (MIBC) frother will be added to enhance the flotation performance.

Concentrates from the rougher circuit are collected via a series of launders and directed into the cleaner feed pump box for transfer to the cleaner circuit. Rougher tailings will be pumped to the TMF.

Cleaner Flotation

The cleaner flotation circuit is configured in two stages, with first cleaner tails returning to rougher feed and the first cleaner concentrate advancing as feed to the second cleaner circuit. Second cleaner tails are returned to the first cleaner feed and second cleaner concentrate is the final concentrate which is pumped to the concentrate thickener.

The cleaner circuit reduces the mass of concentrate produced while maintaining high gold recovery. Overall flotation circuit mass pull is approximately 2.8%.

2.4.2.1.4.5 Concentrate Thickening, Filtration and Storage

The concentrate thickening, filtration, storage and loadout facilities for flotation concentrate consist of:

- One 7m diameter high-rate thickener

Concentrate Thickener

Second stage cleaner flotation concentrate will be thickened to a target of 56% solids in a 7m diameter high-rate thickener. The concentrate will be mixed with diluted flocculant solution at the thickener feed well. Flocculated solids settle towards the thickener discharge cone and will be pumped to the concentrate surge tank, while the supernatant water will overflow to the concentrate thickener overflow tank. Thickener overflow water will be pumped to the process water tank for use as process water in the plant.

Concentrate Filtration & Storage

Thickened concentrate, at 56% solids, will be pumped to the concentrate surge tank, and in turn pumped into a B-Train tanker truck. Concentrate is transported by truck for further processing at the Touquoy Mine Site. Flotation concentrate production is expected to be approximately 150 tpd.

2.4.2.1.5 *Tailings Disposal and Reclaim Water*

The flotation tailings from the rougher/scavenger flotation tank cells will flow will be pumped to the TMF for storage and disposal. The supernatant from the tailings pond will be reclaimed by the reclaim water pumps and recirculated via pumping to the process water tank and re-used as process water.

2.4.2.1.6 *Reagents*

The reagents will be prepared and stored in a separate, self-contained area within the process plant and delivered by individual metering pumps or centrifugal pumps to the required addition points. All reagents will be prepared using raw water.

Potassium Amyl Xanthate (Collector)

Potassium Amyl Xanthate (PAX) is used as a collector in the flotation circuit and is supplied in 25 kg bags in the form of pellets. The pellets are mixed with raw water to produce 15% solution strength. The PAX mixing system is a skid package provided by the vendor. The PAX solution will be distributed to the flotation circuit by three reagent metering pumps. Preparation of the PAX will require a bulk handling system, mixing and holding tanks, and metering pumps.

Methyl Isobutyl Carbinol (Frother)

Methyl Isobutyl Carbinol (MIBC) is used as a frother in the fines rougher/scavenger and cleaner flotation circuit and is supplied in bulk tote containers in liquid form. MIBC will be pumped directly from the tote by two reagent metering pumps and is used as 100% solution strength.

Flocculant

The flocculant will be supplied in 25 kg bulk bags as a dry powder. The flocculant is mixed with raw water and diluted to 0.50% mix concentration. The flocculant mixing system is a skid package provided by the vendor. The mixed solution is supplied to the thickeners by two flocculant metering pumps.

As a result of the concentrate being transported and processed at the Touquoy Mine Site, cyanide is currently not planned for use at the FMS Mine Site.

2.4.2.1.7 *Air Services*

Blower Air

The flotation blowers will supply air to the rougher/scavenger tank cells and cleaner tank cells. The installed blowers will be multiple-stage, centrifugal type blowers and will be used with a "blow-off" arrangement to adapt to fluctuations in flotation air demand.

Plant & Instrument Air

Rotary screw air compressors will provide high pressure compressed air operating in lead-lag mode, to meet the demand for plant and instrument air requirements.

Pressure filter will use the wet high-pressure air produced from the rotary screw air compressors. There will be a dedicated air receiver to store necessary compressed air required for pressure filter operation.

Wet Plant air will be stored in the plant air receivers to account for variations in demand prior to being distributed throughout the plant. Instrument air will be dried in an Instrument Air Dryer before distributed throughout the plant.

2.4.2.1.8 *Water Services*

Raw Water

Raw water will be pumped from Seloam Lake, following permitting (NSE), to the raw and fire water tank to feed the plant. Raw water in the tank is used to supply the following services:

- Primary crushing circuit dust suppression water;
- Reagent preparation water;
- Slurry pumps gland seal water;
- Cooling water systems;
- Make-up water for the process water system; and
- Fire water.

Raw water is supplied to the plant by two raw water pumps in a duty-standby configuration.

Potable Water

Potable water will be sourced from the raw water tank and treated in the potable water treatment skid. The treated water will be stored in the potable water storage tank for use by two potable water pumps in a duty–standby configuration.

A potable water system will pull about 1 m^3/hr from the raw water system and will go through a filtration, UV and hypochlorite treatment process. This services safety showers, eye washes and all tap water on site. This potable water will not be used for human consumption, so therefore, drinking water will be brought in for consumption.

Gland Water

Gland water is supplied from the raw water and distributed to the plant by two gland seal water pumps in a duty-standby configuration.

Process Water

Process water is comprised mainly of concentrate thickener overflow water and tailings pond reclaim water. Process water is stored in the process water storage tank and distributed by the two process water pumps, in a duty-standby configuration.

2.4.2.1.9 *Equipment Requirements*

A summary of the major mining equipment fleet requirements is provided in Table 2.4-1. Note that minor changes to this list may be proposed at the permitting stage based on further studies and refinements.

Table 2.4-1: FMS Primary Mining and On-site Hauling Equipment Requirements

Activity and Equipment	**Requirement**		
	Year 1 (Construction)	**Year 2-9 (Operations)**	**Year 9-11+ (Active reclamation and post closure stages)**
Drilling			
Diesel DTH Tracked Drill, 144 mm holes	2	2	1
Diesel RC Tracked Drill, 144 mm holes	2	2	1
Loading			
Hydraulic Excavator – 5.0 m^3 bucket	3	3	1
Wheel Loader – 7.0 m^3 bucket	1	1	1
On Site Hauling			
Rigid Frame Haul Truck – 64 tonne payload	9	9	3
Articulated Haul Truck – 41 tonne payload	2	2	2

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

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

A summary of the equipment required to conduct these support services and their specific role is provided in Table 2.4-2. Note that minor changes to this list may be proposed at the permitting stage based on further studies and refinements.

Table 2.4-2: FMS Operational Equipment Requirements

Equipment	Function	Requirement
Motor Grader (4.9 m blade)	Mine site road maintenance	1
Motor Grader (4.3 m blade)	Mine site road maintenance	1
Water/Gravel Truck	Mine site road maintenance	2
Track Dozer (325 kW)	Waste rock stockpile maintenance	2
Water Pumps (150 m^3/h)	Mine sump dewatering	2
Track Dozer (233 kW)	Mine support and construction	4
Wheel Loader (4.5 m^3)	Mine support and construction	1
Hydraulic Excavator (3 m^3)	Utility excavator and rock breaker	2
Soil Compactor (117 kW)	Construction support	1
On-highway Dump Truck	Utility material movement	1
Fuel and Lube Truck	Mobile fuel/lube service	1
Shuttle Bus (16 passenger)	Employee transportation	2
Pickup Trucks (1/4 tonne)	Staff transportation	8

Equipment	Function	Requirement
Light Plants (20 kW)	Surface mine lighting	9
Side by Side ATV	Environmental crew transport	2
Emergency Response Vehicle	First aid and mine rescue	1
Maintenance Trucks	Mobile maintenance crew and tool transport	1
Mobile Crane (36 tonne capacity)	Mobile maintenance material handling	1
Float Trailer (55 tonne capacity)	Equipment transport	1
Forklift (3 tonne capacity)	Shop material and tire handling	1
Mobile steam cleaner	Mobile maintenance equipment cleaning	1

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

2.4.2.1.10 *Ore Management*

On average, approximately 21,800 t of rock will be extracted from the open pit per day. Of that, approximately 8,200 t will be ore-bearing and approximately 13,600 t will be waste rock. Ore and non-ore bearing waste rock will be loaded into off-highway haul trucks for transport out of the open pit. From there, ore will be separated into low and ROM stockpiles prior to entering the crusher, while non-ore bearing waste rock will be stockpiled for final disposal.

The ore stockpiles will include the LGO stockpile, located north of the crusher and operational facilities pad, and a ROM stockpile at the crusher. Acid rock drainage potential is discussed further in Section 6.4. Results indicate that the majority of the ore deposit is net acid consuming over the life of the operating period.

The ROM stockpile will likely have up to a 15-day capacity for storing ore during plant shut-downs or short-term periods where ore extraction from the mine exceeds crusher or plant capacity. The ROM stockpile can also accommodate plant feed if ore hauling from the mine is reduced for weather or other reasons.

The LGO stockpile will temporarily store ore which will be re-handled through the crusher once the mine has been exhausted. Re-handling of the stockpiled ore will take place during Years 6 and 7 of operations.

Table 2.4-3 identifies the approximate tonnage of waste rock broken down by PAG and NAG for overburden, argillite and greywacke. The results indicate that there will be adequate NAG waste rock for use in constructing the TMF berm, drainage structures, roads, and other site facilities.

Table 2.4-3: Approximate Quantities of Waste Rock: PAG and NAG within Argillite and Greywacke

Unit	Total Waste (Mt)		PAG Waste		NAG Waste	
	(Mt)	Total %	(Mt)	PAG%	(Mt)	NAG%
Overburden	2.3	8%	0.2	8%	2.1	92%
Argillite	6.0	23%	0.8	14%	5.2	86%
Greywacke	18.3	69%	2.3	13%	16.0	87%
Total	26.7	100%	3.3	12%	23.3	88%

2.4.2.1.11 *Surface Water Management*

Surface water collected will be directed to the TMF. The TMF will act both as containment for tailings and site contact water unsuitable for discharge. Initial water balance calculations indicate the TMF will operate under surplus water conditions and require a discharge. Further analysis will be undertaken to determine the need for, and design of, any treatment works to ensure such discharge meets environmental requirements. Water quality modelling conclusions indicate that water treatment during operations will not be necessary. There will be a modular effluent treatment plant present on site during the construction phase and this system can be adapted and utilized throughout the life of mine, as required based on site effluent quality.

Water suitable for discharge will flow via HDPE discharge pipe to Anti Dam Flowage and the downstream receiving environment.

2.4.2.1.12 *Power Supply and Reticulation*

The incoming 69kV feed will be stepped down to 25kV. Power will be distributed throughout the site to supply the gatehouse, mine office, truck workshop, warehouse, mining office, change room buildings and TMF. The power distribution will be via overhead power lines and buried conduits wherever required. The 25kV will be stepped down to each of these buildings through a bank of pole top transformers.

A black-start diesel generator will provide emergency power. In the event of a total power black-out the generator will be started by an operator. The emergency generator will only supply back-up power to select equipment in the process plant area.

2.4.2.1.13 *Fuel Supply, Storage and Distribution*

A diesel storage and distribution facility (50,000 - 75,000 L) will be located adjacent to the workshop/warehouse. Diesel will be delivered to site in tanker trucks and will be available for use by vehicles using a bowser arrangement with cardlock. There may be a smaller diesel tank (5,000 L) at the TMF for use by contractors during construction. Gasoline usage is expected to be minor, as required for light vehicles use only, and will be satisfied by one gasoline tank (5,000 L) located in the ancillary building area. The road trucks required to transport FMS concentrate to the Touquoy Mine Site will be refueled at FMS or Touquoy as needed. A propane storage facility will be located near the process building. The major propane use will be for space heating. Fuel, gasoline, and propane tanks will be constructed and registered as required based on applicable ECCC regulations.

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

2.4.2.2 Concentrate Transport

The concentrate will be transported to the Touquoy process plant along a combination of existing public roads and private road. The initial route proposed is along Highway 374 south to Highway 7, west along Highway 7 through Sheet Harbour to Mooseland Road at Tangier, and then north-west along Mooseland Road to the Touquoy mine. Once the Beaver Dam Mine Project comes online (proposed in 2022/2023), FMS haul trucks are expected to travel along Highway 374 south to Highway 7, west along Highway 7 through Sheet Harbour to Highway 224 and then north-west along Highway 224 connecting with the upgraded Beaver Dam Haul Road to Mooseland Road.

Assuming a 41 t payload, approximately four highway trucks will be required to transport the concentrate from the FMS Mine Site to the Touquoy Mine Site. The exact number will depend on final payloads and the hauling schedules, which will likely be a single 12-hour shift, or two 8-hour shifts per day operating between the hours of 7:00am to 11:00pm. The number of return truck trips per day will be an annual average of approximately 8-11 for 350 days per year (contingency of 15 bad weather days) for the anticipated duration of the Project operations. Hours of operation during active hauling will likely occur between 7:00am to 11:00pm. The exact number of trucks will depend on final payloads and the hauling schedules.

Approximately 20 individuals will be required to operate the transport trucks. A summary of the equipment chosen to conduct these transport services and their specific role is provided in Table 2.4-4.

Table 2.4-4: FMS Concentrate Transport Equipment Requirements

Equipment	Function	Requirement
On highway transport trucks (B-train configuration)	Concentrate Transportation	4

2.4.2.3 Touquoy Mine Site

During operation and maintenance of the Touquoy Mine Site the following activities will be undertaken:

- ore processing; and
- tailings management.

2.4.2.3.1 *Ore Processing*

Final processing of gold concentrate will take place at the existing Touquoy facility currently operating at the Touquoy Mine Site. The Touquoy plant has the capacity and is designed to be able to treat the concentrate with only minor modifications required including:

- Concentrate storage;
- Gravity concentrate leach reactor; and
- Gravity electrowinning cell.

This can be accommodated in the existing process building footprint. Figure 2.4-2 outlines the process flow at the Touquoy Mine Site for final processing of FMS concentrate.

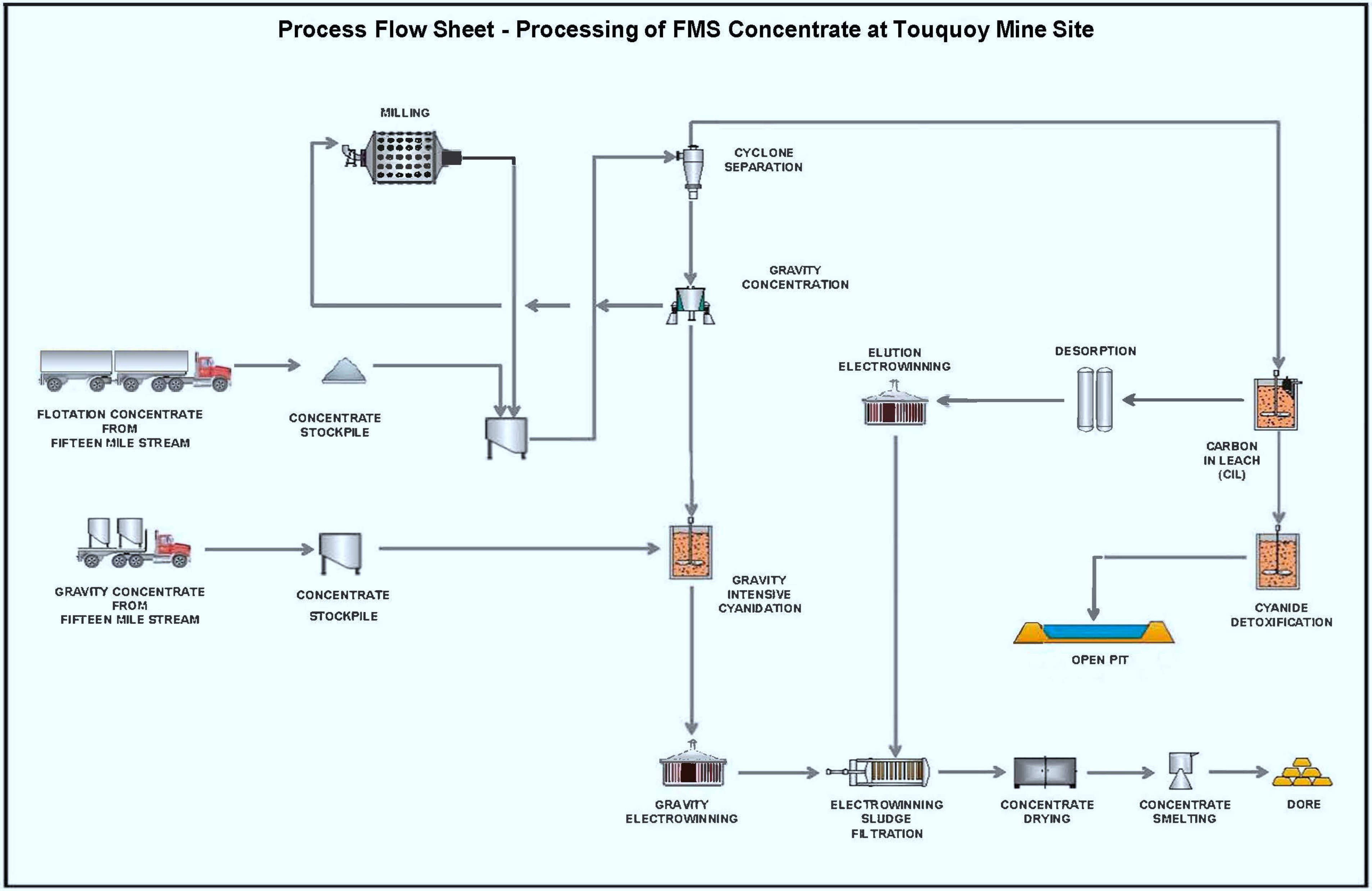


Figure 2.4-2: Process Flow Sheet - Processing FMS Concentrate at the Touquoy Mine Site (Prepared by Ausenco, 2020)

2.4.2.3.2 *Intensive Cyanidation*

Gravity gold concentrate will be transported to the Touquoy Mine Site within a mobile hopper. The hopper will be designed to connect directly with the intensive batch leach system, thus avoiding re-handling of concentrate. The intensive batch leach circuit will receive the periodic gold concentrate for treatment in an ILR. The gold-containing pregnant solution will pump periodically to a dedicated eluate tank in the gold room.

2.4.2.3.3 *Carbon-in-Leach (CIL)*

Flotation gold concentrate will be transferred into the leach feed box for slurry conditioning prior to leaching. The leach feed slurry will be mixed with lime slurry in the leach feed box to raise the slurry pH for cyanide gold extraction. The feed box will gravitate to the leach tank and optionally can feed directly to CIL Tank 1.

The circuit is a hybrid CIL type and consists of one leach tank and six adsorption tanks in series, each having a live volume of 1,169 m^3. The design allows for a 250 t/h solids feed rate at 50% solids for an average 24-hour residence time. Each tank will be interconnected with launders to allow slurry to flow sequentially by gravity to each tank in the train.

Barren carbon will enter the adsorption circuit at CIL Tank 6. The carbon will advance countercurrent to the main slurry flow during periodic transfers of slurry and carbon using air lift movement from a downstream to upstream tank. Carbon concentrations of 10 to 15 g/L are required in all tanks. Carbon will be retained in the upstream tank by an intertank screen. The countercurrent process will be repeated until the carbon becomes loaded and reaches CIL Tank 1. A recessed impeller pump will be used to transfer slurry and carbon to a loaded carbon recovery screen. The loaded carbon will be washed with water and released to the acid wash column located inside the main plant, in the desorption area. The slurry will be returned to CIL Tank 1.

Following elution of the loaded carbon and thermal regeneration, the barren carbon will be screened and discharged to CIL Tank 6. Fine carbon will be discarded to the CIL tailings hopper.

Tailings slurry from CIL Tank 6 will flow by gravity to the vibrating carbon safety screen to recover any carbon in the event of damage, wear or other issues with the CIL Tank 6 interstage screen. Recovered carbon will be collected in a bin that can be manually transferred for re-use or disposal. Tailings discharging from the safety screen will gravitate to the cyanide detox Tank 1 in the cyanide detoxification circuit.

2.4.2.3.4 *Desorption and Regeneration*

The following operations are carried out in the desorption and regeneration areas:

- Acid washing of carbon
- Stripping of gold from loaded carbon
- Regeneration of carbon

This circuit comprises a fibre reinforced plastic column located within the process building. A separate acid-proofed concrete bund is provided under the acid wash column area to ensure that all spillage is captured and kept separate from other process streams. Transfer and fill operations of the acid wash column are controlled manually. All other aspects of the acid wash and the pumping sequence are automated.

A pressure Zadra elution comprising an elution column, strip solution tank, strip solution pump and a strip solution heater package operates in a closed loop with the electro-winning cells located inside the Gold room.

The elution column is a pressure vessel with a live volume equivalent to 6 t of carbon. The elution column is constructed from carbon steel and includes insulation of all hot surfaces. The column is located next to the acid wash column and shares a bund and a sump pump with the strip solution and transfer water tanks.

The strip solution heater package is located inside the process building, near the elution column, but separately bunded. Within this package there is a recovery heat exchanger, trim heat exchanger, direct-fired heater, control panel, all interconnecting electrics and pipework. The heater is a direct-fired type with a propane fuel modulating burner. The heater is designed for a heat output to maintain the strip solution at 145 °C during the stripping cycle. Both heat exchangers are plate and frame type and ensure that the nominal temperature of solution entering the electro-winning cells is <100 °C.

After completion of the elution process barren carbon is transferred from the elution column to the kiln dewatering screen and into the carbon regeneration kiln feed hopper. In the kiln feed hopper, any residual and interstitial water is drained from the carbon before it enters the kiln. The kiln is a horizontal rotary unit sized for a feed rate of 330 kg/h at 75% utilization and is propane-fired.

The kiln operates at 650–750 °C and has a nominal retention time of 15 minutes to allow reactivation to occur. Regenerated carbon discharges from the kiln to a quench tank and is then pumped using a recessed impeller pump to the carbon sizing screen. The screen oversize returns to CIL Tank 6, while the quench water and fine carbon report to the tailings hopper via the carbon safety screen for disposal in the TMF. Fumes from the kiln pass through a wet scrubber to remove entrained minute carbon particles and then to atmosphere via an exhaust stack.

2.4.2.3.5 *Gold Room*

Three electrowinning sludging cells are used; one cell will be dedicated to the intensive cyanidation circuit and the other two to the elution circuit.

The electrowinning cell dedicated to the intensive cyanidation circuit is fed leach solution via a fixed speed centrifugal pump from the gravity leach liquor storage tank. Solution is pumped to the electrowinning cell and then gravitates back into the gravity leach solution storage tank in a closed loop until suitable gold recovery is achieved. The duration of this cycle varies with the quantity of gold recovered by gravity but is typically less than 24 hours.

The two electrowinning cells dedicated to the elution circuit operate in a closed loop with the elution column and associated equipment. Eluate flows directly from the top of the elution column to the electrowinning cells after cooling through heat exchangers. The eluate flows through the electrowinning cells and then gravitates back to the strip solution tank and then to the elution column in a continuous closed loop. The duration of this cycle is about 16 hours.

2.4.2.3.6 *Cyanide Handling and Detoxification*

2.4.2.3.6.1 Cyanide

Sodium cyanide (NaCN) is a key reagent used to leach gold from a sold matrix to form a gold cyanide complex that can be extracted from the slurry by adsorption onto activated carbon.

NaCN is delivered in the form of in dry briquettes from an approved supplier as per the International Cyanide Management Code (ICMC) standards. NaCN deliveries are made by truck in one tonne secured (strapped) wooden crates. Within the crates, the NaCN is double and sealed close. At the Touquoy Mine Site, the sodium cyanide is stored in a locked fenced area within the secure reagent building and kept under camera surveillance.

Prior to use, NaCN is mixed with water and sodium hydroxide (NaOH) for dilution and pH control within a mixing tank. Prior to mixing, operators will suit up in full personnel protective equipment (PPE) including Tyvek suits and powdered air purifying respirators

(PAPR). Water and NaOH are added to the cyanide mix tank. The wooden crates are opened, and a gantry crane lifts the bags out and transports them to the mix tank. The bags are lifted by crane into the bag cutter on top of the mix tank and the door is shut to enclose the bag. The bag is slowly lowered onto the bag cutter and the dry solids are emptied into the mix tank. The bag cutter has water sprays to clean the cyanide bags prior to removing from the enclosure. This process is repeated for four cyanide (NaCN) bags to achieve a mix concentration of ~22%. Once the NaCN storage tank level is below 20% the mix tank is then transferred to the storage tank for distribution throughout the plant.

Cyanide is added into three areas; Leach tank #1, ILR and barren eluate tank #12. Leach tank #1 is a continuous addition whenever the leach circuit is being fed with ore. It is controlled based on constant cyanide titrations throughout the leach/CIL circuit. The ILR and barren eluate tank are dosed based on a batch process. When a batch is ready, the dosage is controlled based on a flowmeter to a targeted concentration. All these addition points have pH control reagents (NaOH or Lime) with automated interlocks that will not permit NaCN addition until a suitable pH is achieved to avoid the formation of hydrogen cyanide (HCN) gas.

Cyanide target concentrations are as follows:

- Leach tank # 1 = 55-60ppm (0.006%). By the end of the CIL circuit (CIL tank #6), the remaining cyanide is about 30ppm (0.003%)
- ILR = 14, 000ppm (1.4%). Once the process is complete, this small volume (5.2m^3) is transferred and diluted in the much larger Leach/CIL circuit (9,100 m^3) for consumption.
- Barren Eluate Tank #12 = 1000ppm (0.1%). Once the process is complete, the remaining cyanide stays in the tank to be re-used during the next batch. Each new batch, the cyanide is just topped up to the target concentration.

2.4.2.3.6.2 Cyanide Destruction

Cyanide destruction occurs within the cyanide destruction circuit. Slurry passing through the carbon safety screen gravitates to two 300 m^3 cyanide detoxification tanks which are designed on the conventional air-SO_2 process and can operate in series or parallel for operational flexibility. The average slurry residence time at 250 t/h is 1.5 hours.

The tanks utilize high shear agitators and air injection to enhance high oxygen dissolution in the slurry to meet the high oxygen demand of the cyanide destruction process. Sodium metabisulphite and copper sulphate solutions are dosed into either tank providing the oxidizing agent and catalyst respectively for the cyanide destruction. Acid generation is neutralized by the addition of lime slurry to the detox tanks via a ring main.

The detoxified slurry stream gravitates to the tailings hopper from where it is pumped through a single pipeline to the TMF by variable speed tailings pumps (1 duty/1 standby). The tailings slurry is then discharged at selected outlet points around the periphery of the facility. Pipe runs are designed to be self-draining to avoid dead legs.

Contingency measures for cyanide detoxification include primary linear and secondary rotary vezin tailings samplers taking representative tailings samples after the slurry has been detoxified and prior to entering the tailings hopper. The cyanide destruction and tailings hopper area has a dedicated bunded concrete area for collecting spillage. A local sump pump returns any spillage to the carbon safety screen. The area is enclosed for cold weather protection. A CNWAD analyzer automatically monitors slurry levels and an HCN detector provides monitoring for airborne gas.

Shutdown procedures are in place in the event of process upsets including cyanide detoxification.

2.4.2.3.7 *Tailings Disposal*

Following the completion of Touquoy mining, a tailings line will be routed to the exhausted Touquoy pit in preparation to receive FMS tailings. Tailings slurry will be discharged to the exhausted Touquoy pit upon commencement of processing of the FMS ore concentrate. Tailings will be discharged to the exhausted pit via double walled HDPE pipe. Initially, reclaim water will be withdrawn from the supernatant pond in the existing TMF to supply processing water needs for the FMS concentrate. A reclaim water pump and barge, with a new pipeline to the process water tank, will be installed when process water accumulation from the tailings slurry deposited in the pit is adequate. The transition from the TMF to the open pit reclaim water system is expected to be smooth, requiring minimal downtime, and additional fresh water requirements beyond what is currently permitted from Scraggy Lake under Touquoy water withdrawal approvals may be required.

Supernatant water collected in the open pit will be pumped to the process water tank located next to the pre-leach thickener. The sections of the tailings and reclaim pipelines between the plant site and open pit will run in engineered, clay lined trenches with adequately sized emergency duel-lined collection ponds capable of containing the volume of the pipeline, in the event of piping failure. Automated monitoring systems will be installed for pipeline leak detection and shutdown procedures.

The Touquoy Gold Project currently employs an Operation, Maintenance and Surveillance (OMS) Manual for the existing TMF. This manual will be updated in advance of using the open pit for storage of FMS concentrate tailings in order to reflect changes in operating conditions and environmental factors. As well, Touquoy also currently employs a Spill Contingency Plan which will also be updated to reflect changes from the Project. Environmental monitoring will continue as prescribed under the Touquoy IA, which will be amended as necessary to reflect the changes in processing of FMS concentrate and storage of FMS concentrate tailings.

2.4.2.3.8 *Existing Environmental Mitigation and Monitoring Requirements Associated with Operations*

There is an existing IA for the Touquoy Gold Project which has specific environmental mitigation and monitoring requirements. This is relevant to the Project in two ways:

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

2.4.3 Closure (Years 9 to 11+)

The Closure Phase consists of two stages: Reclamation and Decommissioning; and Post-Closure.

During the reclamation stage, all infrastructure will be removed. Site water will be re-directed towards the open pit to facilitate pit flooding creating a water feature/lake. Re-contouring of the WRSA will be carried out progressively throughout the Project life where practical. Water quality modelling has indicated that because of the potentially acid-generating nature of the PAG stockpile, a clay cover or a geosynthetic membrane will be installed on the PAG stockpile before it is capped and reseeded. A clay cover with an assumed infiltration rate of 15% has been used for post-closure water quality modelling. Berm crests will be re-sloped to permit covering with soil and re-seeding. This approach will minimize the amount of exposed waste rock at any given time and reduce the potential for erosion and acid rock drainage (ARD).

The FMS Mine Site infrastructure footprint will be covered with soil, where required, or otherwise the surface will be ripped or scarified, sloped, re-contoured to a stable angle and hydroseeded to match the local topography where practicable – 2 to 3 year proposed reclamation stage. The WRSA will be graded to 3:1 slopes and tailings dam embankment slopes will be graded to 2:1 so that they are structurally stable. The final slopes will be based on site specific geotechnical stability studies that will be undertaken as part of the development of the final closure plan.

The long-term post-closure stage commences once active reclamation is complete. This post closure stage encompasses pit filling, water treatment as required, on-going TMF reclamation, and all monitoring programs. This stage is complete once the pit lake has filled and monitoring has been completed to confirm structural and environmental stability for the long term (steady state) for the pit and across the site.

2.4.3.1 Preamble on Reclamation/Decommissioning Stage

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

The Proponent will establish lease agreements with the province and private landowners for the life of the open pit mine. Land leased for the FMS Mine Site and Touquoy Mine Site will be returned to the province and private owners (if warranted) following the completion of operations, equipment decommissioning and removal, and the acceptance of decommissioning and reclamation activities by NSE.

The Proponent recognizes the requirements for reclamation through the NS *Environment Act* and *Mineral Resources Act* and the role that NSE and NSL&F have in determining reclamation activities, bonds and plans. The Proponent also recognizes the importance of involvement of the Mi’kmaq of Nova Scotia during reclamation planning. The Proponent is well familiar with these requirements and agencies through the development of the Touquoy Gold Project and the development of the accepted Reclamation Plan and bond values for that mine. This knowledge and history are advantageous for the successful development of the Reclamation and Closure Plan for the Project, which will be developed to support the EMS Framework Document (Appendix L.1) prior to the Industrial Approval stage of the Project development.

2.4.3.2 FMS Reclamation Stage: Objectives and Goals

The objective of the Reclamation and Closure Plan, which will be developed to support the EMS Framework Document (Appendix L.1), is to return the site to a safe and stable condition, compatible with the surrounding landscape and anticipated final land use. The plan will employ recognized reclamation best practices, acknowledged principles of ecological restoration, and consultation with relevant stakeholders and rightsholders including the Mi’kmaq of Nova Scotia. In the past, the FMS Mine Site has hosted numerous mining/exploration activities (underground mine workings, exploration declines, roads, camps, water management ponds, and waste piles of rock and overburden), along with successive tree harvesting and silviculture operations. Evidence of recreational land use (hunting and off-road vehicles) and surface water use (fishing and boating) directly within the FMS Study Area is present and suggests these activities could be re-instated once the surface mine ceases operation and reclamation activities have been completed.

The goals of a successful Reclamation and Closure Plan include:

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

The reclamation goals are designed to enable eventual abandonment of the site in a safe and stable state.

2.4.3.2.1 *Conceptual Reclamation and Closure Plan*

Both components affected by the Project will be included in reclamation activities. The Touquoy Mine Site will be reclaimed under a separate approved plan developed for the Touquoy Gold Project.

Reclamation and Closure Plan requirements in Nova Scotia include the need to submit a Conceptual Plan at the EA stage, a Reclamation and Closure Plan as part of the IA stage, and a Final Reclamation and Closure Plan six months prior to mine closure. The submission of a Conceptual Reclamation and Closure Plan in concurrence with the EA/EIS allows the public, regulators, and the Mi'kmaq of Nova Scotia to provide comments the Proponent can consider in the development of the Reclamation and Closure Plan. The Reclamation and Closure Plan will be used as the basis to determine the bond amounts and requirements at the Industrial Approval stage of the Project. The submission of a Final Reclamation and Closure Plan six months prior to surface mine closure will allow the Proponent to incorporate knowledge of the site gained through site preparation and construction, and operation and maintenance. Public and Mi'kmaq engagement will also be sought for the development of the Final Reclamation and Closure Plan through the Community Liaison Committee (CLC) or other technical advisory committee as determined through engagement with the Mi'kmaq and local stakeholders, as concerns raised during the development of the Reclamation and Closure Plan at the IA stage may have changed.

2.4.3.2.2 *FMS Reclamation: Site Infrastructure*

In order to achieve the goals described above, the Proponent will undertake general decommissioning and reclamation activities. During reclamation, the FMS Mine Site will include the following:

- All mine site facilities will have been removed;
- Site contact water will be re-directed towards the pit, to allow it to fill with water to eventually form a lake with a wetland edge habitat;
- Topsoil piles will be used up in reclamation and the footprint re-vegetated;
- The NAG stockpile will be capped with topsoil and re-seeded and all disturbed areas will be re-vegetated;
- The PAG stockpile will likely require an engineered cover system before capping and re-seeding due to the acid-generating nature of the waste rock;
- The till stockpile footprint and any residual materials, will be re-vegetated following reclamation;
- Mine site roads will remain in place, and ultimately will be utilized in the future for forestry and recreational use;
- TMF surface water ponds will be removed and tailing waters will be drained. The TMF will be capped using a combination of rock and soil cover;
- Water treatment, as required, at the site prior to discharge to the mined-out pit, and monitoring programs will be on-going;
- Fences will be removed once the majority of closure activities are completed;

Ultimately the land will be returned to conditions similar to its original state as a natural woodland and aquatic/wetland habitat used for recreation and forestry in consultation with stakeholders and the Mi'kmaq of Nova Scotia on their future use of the site. The existing conditions at the FMS Mine Site have been previously described as being in a disturbed state in many areas and therefore, improvements at the site will be realized through the reclamation activities proposed.

2.4.3.2.2.1 Vegetation Post Closure

Vegetation of areas disturbed by mine development will be integral to preventing erosion and encouraging the growth of native flora for a stable post-closure habitat. All disturbed areas will be covered with a layer of overburden material and topsoil and subsequently vegetated. Vegetation will be achieved through a combination of hydroseeding and the use of local topsoil with native seed and plant mixtures. The final Reclamation and Closure Plan, submitted at least six months prior to closure for approval, will define the specific soil amendments, seed mixes and plants to be used during vegetation.

2.4.3.2.2.2 Open Pit

At the end of mine operations at the FMS Mine Site, the dewatering pumps from the open pit will be decommissioned, and the pit will be allowed to flood. Based on the water balance report completed for the site (refer to Appendix D.2), the filling of the pit will take approximately three to four years. The Reclamation and Closure Plan submitted as part of an Industrial Approval process will detail information relative to pit security measures for public and wildlife safety during the refilling period. These measures require the input of multiple agencies to meet regulatory and corporate requirements.

Water levels in the FMS Mine Site pit will rise quickly in the initial years following cessation of operations but will slow as water reaches broader levels of the pit, and a greater volume is required per unit increase in water level. This will immerse the walls of the pit and limit the oxidation of exposed sulphide mineralization thereby reducing or eliminating the potential for acid generation.

Flooding of the pit will create a water feature/lake with a shallow water wetland border, where practicable.

Once the pit fills with water and water quality is acceptable for discharge, a connection will be re-established between the newly formed pit lake and Seloam Brook. If necessary, water treatment will be implemented for effluent which does not meet acceptable criteria and discharged to Anti Dam Flowage via the existing pipeline alignment.

2.4.3.2.2.3 Mine Site Roads

The loose-surface, all weather roads established on the site to facilitate operations will remain in place to enable closure activities, monitoring, and provide access for commercial and recreational activities after closure is completed, and ultimately will be returned to the land users.

2.4.3.2.2.4 Waste Rock Storage Area

The WRSA will be a favourable location for progressive reclamation during the operational phase of the mine. As construction proceeds the PAG and NAG stockpiles will be contoured to an overall acceptable closure slope of 3H:1V, covered with a layer of overburden material and a layer of topsoil and vegetated. The flat, ultimate top lift of the stockpile will be similarly contoured, capped and vegetated upon final closure of the mine. The final closure slopes will be informed by the results of geotechnical stability studies which will be completed as part of the closure plan development.

Water quality modelling has indicated that because of the potentially acid-generating nature of the PAG stockpile, a clay cover or geosynthetic equivalent will be installed on the PAG stockpile before it is capped and reseeded. A clay cover with an assumed infiltration rate of 15% has been used for post-closure water quality modelling (Appendix B.6). For reclamation, berm crests will be re-sloped to permit covering with soil and re-seeding. This approach will minimize the amount of exposed waste rock at any given time and reduce the potential for erosion and acid rock drainage (ARD).

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

2.4.3.2.2.5 Ore Stockpiles

Ore stockpiles are not expected to remain at the end of the surface mine life. The current cutoff grade is 0.3 g/t and the current production plan calls for all material above cutoff grade to be milled. The Proponent has hedged a portion of its production to ensure that any interim stockpiles that may exist can be processed profitably in the unlikely event that the mine closes early. If economics deem low grade ore to be unprofitable, then any remaining low-grade ore stockpiles will be remediated or returned to the open pit. Remediation would involve three options:

- If the low grade ore is classified NAG, cover with available till/clay and revegetate;
- Alternatively if the remaining low grade is classified PAG, cover the LGO stockpile with a compacted clay cover or geosynthetic equivalent, and drainage (filter layer) to minimize infiltration of surface water into the stockpile. The surface of the cover will be covered with topsoil and revegetated; or,
- Any remaining low grade ore that is classified PAG would be re-handled back into the mined out pit for permanent storage under water.

2.4.3.2.2.6 Operational Facilities

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

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

2.4.3.2.2.7 Tailings Management Facility

TMF closure and rehabilitation activities will be carried out progressively during the Operations Phase (where practicable) and at the end of economically viable mining. Closure and rehabilitation activities will be conducted in accordance with international closure standards. Specifically, measures will be taken to ensure that:

- Dust is not emitted from the facility as a result of moisture loss from the TMF surface;
- Runoff does not adversely affect surface or groundwater;
- The TMF embankments remain stable; and,
- The stored tailings remain physically and chemically stable.

The primary objective of the closure and reclamation initiatives will be to return the TMF site to a self- sustaining condition with pre-mining usage and capability. The reclaimed TMF will be required to maintain long-term geochemical and physical stability, protect the downstream environment and shed surface water. Activities that will be carried out during Operation Phase and at closure to achieve these objectives are discussed below.

Surface facilities will be removed in stages and full reclamation of the TMF will be initiated upon mine closure. General aspects of closure will include:

- Selective discharge of tailings around the facility prior to closure to establish a final tailings beach that will facilitate surface water drainage and reclamation;
- Removal of surface water ponds and drainage of tailing waters;
- Dismantling and removal of the tailings and reclaim delivery systems and all pipelines, structures and equipment not required beyond mine closure;
- Capping of the facility using combined rock and soil cover that will shed runoff to a permanent spillway;
- Establishment of a permanent TMF spillway in the TMF embankment;
- Removal of the seepage collection pump-back systems at such time that suitable water quality for direct release is achieved;
- Removal and re-grading of all access roads, ponds, ditches and borrow areas not required beyond mine closure; and,
- Long-term stabilization and vegetation of all exposed erodible materials.

Selected groundwater monitoring wells and all other geotechnical instrumentation will be retained for use as long-term dam safety monitoring devices. Post-closure requirements will also include annual inspection of the former TMF and ongoing evaluation of water quality, flow rates and instrumentation records to confirm design assumptions and performance for closure.

2.4.3.2.2.8 Other Site Infrastructure

Industry standard reclamation methods will be employed to close out the remainder of the Project infrastructure. Hazardous materials will be collected for off-site disposal including hazardous components of vehicles and equipment (i.e., fuel tanks, gear boxes and glycol-based coolant). Buildings and equipment stripped of hazardous components will be demolished and disposed in an approved landfill, off-site.

Once all buildings, facilities and equipment have been removed, the footprints (whether bedrock or pads) will be re-contoured to allow for restoration of natural drainage to the receiving environment.

2.4.3.2.3 *Water Management*

All surface water runoff in the vicinity of the open pit will be directed to the pit to decrease overall filling time. Runoff from remaining waste rock, till stockpiles, and TMF will be directed to the pit prior to release to the environment. Ongoing collection of water monitoring data will inform the periodic revision of groundwater and surface water models in an effort to better predict post closure water quality and to identify the planned extent and duration of treatment requirements. There will be a modular effluent treatment plant present on site during the construction phase and this system can be adapted and utilized throughout the life of mine, as required based on site effluent quality.

It is expected that clay cover or equivalent on the PAG stockpile and capping and re-vegetating both waste rock stockpiles will reduce erosion and limit the potential for ARD; therefore, inhibiting the mobility of any potentially deleterious substances.

Increased environmental disturbance is anticipated during initial site decommissioning, when operational facilities are dismantled, and the site surfaces are re-vegetated. This will be followed by a decrease in environmental disturbances during the post-closure monitoring phase.

Surface Water Management Post Closure

Surface water runoff at the site, post-closure, will be managed based on the following objectives:

- Prevent contamination of surface and groundwater flows;
- Promote filling of the open pit;
- Prevent erosion and sedimentation; and
- Protect natural watercourses and wetlands.

The Proponent commits to develop an Erosion Prevention and Sediment Control Plan to support the EMS Framework Document (Appendix L.1) for during and after reclamation activities.

Effluent Treatment

There is a commitment to treat mine contact water collected from site water management ponds during operations (if required), although modelling does not predict this will be necessary (Section 6.6)). Treatment of mine contact water that does not meet effluent discharge criteria will be undertaken during closure, and post closure phases. During the course of mine operations, geochemical and hydrogeological monitoring data will be collected and geochemical source terms revised as warranted. With periodic revisions to source terms and other relevant parameters, groundwater and surface water models will be revised in an effort to further refine post closure water quality predictions and to identify the planned extent and duration of treatment requirements. There will be a modular effluent treatment plant present on site during the construction phase and this system can be adapted and utilized throughout the life of mine, as required based on site effluent quality.

2.4.3.2.3.1 Plant Site

The Process Water / Runoff Ponds will be backfilled and reclaimed upon closure. Site grading during reclamation will divert drainage such that it disperses from the area following the natural pre-development flow pattern of the site. Ditches will be lined with suitable material to prevent erosion and sedimentation. All slopes will be reduced to 3H:1V in the plant site area to minimize erosion and encourage revegetation.

2.4.3.2.3.2 Open Pit

In the area surrounding the open pit, all surface runoff will be directed towards the pit to accelerate flooding. The proposed closure shoreline geometry will ensure all water draining through the till/bedrock interface is directed to the pit water feature/lake. The barrier berms will remain in place to allow the surface realignment of Seloam Brook to remain intact as this is considered a permanent feature. The barrier berm will define the perimeter of the flooded pit lake for long-term land use. It will be constructed with closure slopes (3H:1V) and will be vegetated during operations as part of the progressive Reclamation and Closure Plan.

2.4.3.3 Touquoy Mine Site

The Touquoy Mine Site will be reclaimed under a separate plan developed for the Touquoy Gold Project and already approved by regulatory agencies. As mentioned previously, the currently approved Reclamation Plan will be updated to reflect the above changes associated with processing FMS concentrate and re-submitted. Water treatment within the pit and/or at discharge location into the Moose River from the pit, as required, will occur, and monitoring programs will be on-going.

2.4.3.3.1 *Tailings Management - Closure*

During the closure phase, the objective is for water in the pit lake to meet the reclamation regulatory water quality requirements or site-specific criteria. Key water management features are described below.

The existing TMF effluent treatment plant and downstream discharge facilities will continue to be in operation to treat TMF water surplus. At the cessation of tailings deposition to the Touquoy open pit, the open pit will fill with water. During this period, there may be an opportunity to treat the pit lake as a batch reactor with the objective of adjusting the pH to precipitate metals thus improving discharge quality. Surplus water in the open pit will be pumped to the Touquoy TMF for treatment, until such time as water quality monitoring indicates that water quality is suitable for direct discharge to the environment. Until water quality meets discharge criteria, the water level in the pit lake will be maintained at or below elevation 104 masl (i.e., corresponding to the shallow permeable zone), thus reducing seepage to Moose River and normalizing treatment rates to the extent feasible. A minimum of 1 m water cover will be maintained above the deposited tailings to facilitate pumping. The water cover depth will vary over the tailings depositional period. The effluent treatment plant will operate intermittently during non-frozen periods (April – November, inclusive) to lower the pit lake to 103 masl seasonally by the end of November, thus providing storage over the period when the effluent treatment plant is shut down during the winter months. Operation of the existing effluent treatment plant will be modified to accommodate FMS water surplus or additional capacity will be added to effluent treatment plant to treat water over a shorter period simultaneously.

The effluent treatment plant and downstream discharge facilities are not required for the Project once effluent discharge meets regulatory discharge criteria and will not require treatment. Surplus water in the open pit will be discharged via a constructed spillway/conveyance channel to Moose River, subject to meeting regulatory discharge criteria. The spillway and conveyance channel will be sized to accommodate the inflow design flood in accordance with the Canadian Dam Association (CDA) guidelines. The spillway invert is planned for elevation 108 m, approximately 2 m below the lowest open pit elevation to prevent overtopping.

2.4.3.3.2 *Reclamation*

The Touquoy Mine Site will be reclaimed under the separate plan that was developed for and approved by regulatory agencies for the Touquoy Gold Project. As mentioned previously, changes to the Touquoy Mine Site and reclamation obligations as a result of processing FMS concentrate are expected to be minimal with the only major change being the subaqueous storage of tailings in the open pit and associated water quality considerations. The currently approved Touquoy Reclamation Plan will be updated to reflect described changes associated with processing FMS concentrate and submitted in accordance with IA requirements and the *Mineral Resources Act.*

The Touquoy Gold Project Reclamation Plan is developed, updated and finalized as required under the IA and requires approval of NSE in consultation with NSL&F and the Mi'kmaq of Nova Scotia. The Reclamation Plan for the Touquoy Gold Project is currently secured by a bond posted by the Proponent totaling $10.4 million, which is intended to allow the Province to reclaim the site at all phases of the Touquoy Mine. This plan includes allowing the pit to fill with water naturally from inflow of surface and ground waters and precipitation. Also required in the Reclamation Plan is ongoing monitoring post-closure to demonstrate stability of the site. This monitoring will cease in consultation with NSE once stability has been demonstrated by the collected monitoring data which will be compared with baseline, operational and reference data.

2.4.3.4 Post Closure Stage (Year 9 and beyond)

2.4.3.4.1 *FMS Mine Site Surface Mine*

During the post-closure stage, the pit will be filled with water, creating a lake, with the goal of re-establishment of a connection between the newly formed lake and Seloam Brook once water is acceptable for discharge. Water treatment will continue, as required, with discharge to Anti-Dam Flowage during the post-closure stage, and monitoring programs will be on-going until such time that discharge water quality meets appropriate confirmed criteria at the point of discharge. At that time, discharge will cease into Anti-Dam Flowage and will be re-directed to Seloam Brook. This post closure phase is estimated to be 15 to 20 years in length or longer and is subject to revision with expected refinements to model predictions. Groundwater and surface water models will be revised periodically based on revisions to source terms and other parameters in an effort to better predict post closure water quality and to identify the planned extent and duration of any necessary treatment requirements.

2.4.3.4.2 *Touquoy Mine Site Surface Mine*

During decommissioning, the tailings will be covered with water and the pit will fill, creating a lake, with the re-establishment of a connection between the newly formed lake and Moose River. Water treatment will continue, as required, in the existing water treatment facility, and monitoring programs will be on-going until such time that discharge water quality meets appropriate confirmed criteria. At this time, discharge will cease through the existing water treatment facility, and will be re-directed to Moose River. It is expected that water treatment may be required for several years after the re-direction of discharge to Moose River. This post closure phase estimate is subject to revision with expected refinements to model predictions. Groundwater and surface water models will be revised periodically in an effort to better predict post closure water quality and to identify the planned extent and duration of treatment requirements.

2.4.4 Project Schedule including Closure Phase

The estimated schedule for the Project is presented in the Table 2.4-5 below.

Table 2.4-5: Project Schedule

Project Phase	No. of Years	Start Date*	End Date
Construction	1	2023	2024
Operations	6.75	2024	2030
Closure: Reclamation Stage	2-3	2030	2033
Closure: Post -Closure Stage	3+	2033	2035+

*schedule is preliminary based on permitting and current model predictions that are subject to refinement

2.4.5 Greenhouse Gas Emissions

Greenhouse Gas (GHG) emissions were considered for each phase of work for the life of the Project (construction, operation, and closure). The primary sources of emissions from each work phase are stationary and mobile fuel combustion sources. During the operation phase of the Project, rock blasting using explosives was also considered as part of the GHG emissions that would be generated. For rock blasting, the explosive considered in the assessment was ammonium nitrate with fuel oil (ANFO), although an emulsion-based explosives will be primarily used for the Project. It is assumed that GHG emissions from the two types of explosives would be similar.

GHG emissions from Nova Scotia reported in 2015 were 16,200 kilotonnes CO_2e (Appendix J.2). Based on the Project GHG assessment, in an average full year of operation of the Project (most GHG-intensive phase), including operation of the FMS Mine Site, hauling of ore, and the processing of ore at the Touquoy facility, the Project facilities would emit 24.2 kilotonnes CO_2e - approximately 0.15% of the reported 2015 GHG total for Nova Scotia.

2.4.6 Summary of Changes to Project Activities

Changes to Project activities since the submission of the FMS Project Description in May 2018 have been driven by expanded resource definition, regulatory consultation, public and Mi'kmaq of Nova Scotia engagement, the corresponding design and engineering requirements, and efforts to reduce overall environmental footprint and impact based on predictive modelling and effect assessment. The following list of substantive design changes to the Project have been made in consideration of public and Mi'kmaq engagement (Sections 3 and 4). Section 2.6.13 provides more detail on the rationale for the selection of the TMF location and rejection of other alternatives (both location and technologies).

- The open pit and total mining volumes have driven an extension in the life of the mine as well as an expansion of the size of the pit and stockpiles;
- The TMF footprint has been adjusted several times to:
    - accommodate an area of potential mineralization (referred to as the 149 zone) which is the target of on-going regional exploration by the Proponent;
    - reduce overall potential impact to the environment including fish and fish habitat; and,
    - to ensure TMF design and engineering requirements are met.
- Several design iterations of the Seloam Brook Realignment have been considered to minimize impact to the local watersheds, surface water linear features, wetland habitat, and fish and fish habitat. These design iterations have also been considered in order to provide improvements to fish and fish habitat within and downstream of the realignment as part of Project offsetting measures;
- Segregation of PAG and NAG to support Project design, effective management of waste rock, and to reduce effects to receiving water quality;
- Milling operations have been updated based on the latest feasibility study;
- An organics stockpile has been added to the Project site plan to be used in progressive reclamation and site closure;
- A detailed water management system has been designed to manage mine contact water, and reduce overall impact to the regional and local watersheds, and to avoid fish and fish habitat;
- The addition of local traffic bypass roads was a direct result of public and Mi'kmaq engagement pertaining to the use of the area; and,
- Based on project sequencing (the Project and the Touquoy Gold Project), the Project design has been adjusted to have all Project concentrate tailings being deposited in the exhausted Touquoy pit. During early Project design, the intention was

to have Project tailings deposition in the Touquoy TMF for 6-12 months, followed by deposition of tailings into the exhausted Touquoy pit.

Project changes have been made in consideration of direct engagement with the public, affected stakeholders, and the Mi'kmaq of Nova Scotia during engagement sessions, and through regulatory consultation. Furthermore, refinements in Project design have also been made in consideration of input received during public, Indigenous and regulatory review of the FMS Project Description (AMNS 2018) submission. The majority of these shifts in Project design relate to minimization of Project footprint to reduce overall environmental impact, especially relating to fish and fish habitat, and species at risk considerations.

2.5 Project Schedule

Site preparation and construction for the Project will begin in 2023 near or just after the exhaustion of the Touquoy pit so that the concentrate from the FMS Mine Site to the Touquoy Mine Site come onboard as mining operations at Touquoy are slowing down. It is expected that the concentrate tails from FMS will be deposited into the exhausted Touquoy pit. Site preparation at the FMS Mine Site including clearing and grubbing will begin in 2023 outside of the approved breeding bird window, wherever practicable.

2.5.1 Year 1

Clearing, grubbing, and removal of topsoil and till from the pit, till stockpile locations, and waste rock stockpile location, as well as removal of waste rock from the top benches of the pit by drilling and blasting will begin one year prior to the start of operation. Clearing and grubbing will also occur during this time for the operational facilities location, stockpiles, pit, TMF, WRSA, and roads. Vegetation clearing will be conducted wherever practicable in compliance with nesting bird directives from NSL&F and ECCC. Subsequently, stockpiles for topsoil and till will be built, and the initial lift of the waste rock stockpile will be constructed. Surface and groundwater management facilities including monitoring wells, ditches and berms will also be constructed during this period. The pit will be mined down to the -50 bench (bench floor elevation). A berm surrounding the pit will be constructed to act as an access road and a flood berm.

The Seloam Brook Realignment will be constructed with work occurring within the approved fisheries timing window (June 1 to September 30), wherever practicable. Associated management of historical tailings and waste rock, and potential water treatment, will also be completed.

Local power supply infrastructure, installation of the fuel storage facility, and other supporting infrastructure will be linked to the start of early mining pre-strip operations. During the 12-month construction phase, flexibility in the schedule may be employed to take advantage of seasonality, etc.

Minor modifications to the plant and concentrate storage at the Touquoy Mine Site will occur during this construction phase, likely not exceeding a four to six month timeframe.

2.5.2 Years 2 to 9

Operation of the Project is planned to begin in 2024 and continue through mid 2030. Pre-production mining will last approximately 9-12 months, with full-scale mining operation lasting 6.75 years as outlined in Table 2.5-1. In 2029 and 2030, mining will be complete, but processing of stockpiled low grade ore will continue.

The anticipated mining schedule will consist of 24 hours per day, while trucking will consist of 12 to 16 hours per day within the window of 7:00am to 11:00pm, and crushing and other site operations will be 24 hours per day.

Table 2.5-1: Project Pit Production Schedule

Total Rock Mined (kt)	2024	2025	2026	2027	2028	2029	2030*	2031*
FMS Open Pit	4,983	11,349	10,420	8,477	3,937	1638	393	-

*In 2030 and 2031, mining will be complete, but processing of stockpiled low grade ore will continue.

2.5.3 Years 9 to 11 and Beyond

Decommissioning of the FMS Mine Site will generally require approximately two to three years after cessation of operations. Two years will be needed to remove equipment and infrastructure, as well as complete re-grading and re-vegetation of the site, after which monitoring will continue until deemed no longer necessary. Monitoring will continue until the site reaches reclamation objectives and requirements.

TMF reclamation timing at Touquoy and FMS will likely take between three and five years subsequent to cessation of mining. The timing will depend on the ability of operating heavy equipment on the TMF surface and the stability of the tailings surface which can take time to consolidate.

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

Table 2.5-2: FMS Construction, Operation, and Reclamation Schedule

Event	Timeline
FMS Construction	2023
FMS Operation	2024 to 2030
Touquoy Partial Reclamation (waste rock stockpile and tailings management facility) and Environmental Monitoring	2022/23-2026+
FMS Reclamation and Environmental Monitoring	2030-2033+
Touquoy Complete Reclamation (processing facility, open pit) and Environmental Monitoring	2028-2031+

2.6 Alternative Means of Carrying out the Project

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

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

Step 1 – identify technically and economically feasible alternative means;

Step 2 – list their potential effects on valued components;

Step 3 – select the approach for the analysis of alternative means; and

Step 4 – assess the environmental effects of alternative means.

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

2.6.1 Identification of Alternative Means

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

As a minimum, the FMS EIS Guidelines (CEAA, 2018) require the Proponent to conduct an alternative means analysis for the following Project components:

- mine type (e.g. open pit, underground);
- material extraction methods;
- processing (process types);
- processing location (e.g. FMS Mine Site versus Touquoy Mine Site);
- energy sources to power the project site (diesel, electricity, renewables);
- location of key project components;
- mine waste disposal (methods and sites considered);
- transportation of concentrate (means and routing considered);
- access to the project site;
- management of water supply and wastewater;
- water management and location of the final effluent discharge points; and,
- mine waste disposal and final effluent discharge (methods and sites considered).

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

2.6.2 Mine Type

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

2.6.2.1 Open Pit Mining

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

- ore deposits that begin at or near surface and that are covered by shallow overburden;

- large deposits with a uniformly distributed ore body or scattered randomly distributed pockets; and
- high tonnage, low grade deposits which are not economical using underground mining methods.

2.6.2.2 Underground Mining

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

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

2.6.2.3 VCs Potentially Affected

The environmental effects of underground mining would be similar to those of open pit mining at the FMS Mine Site with the need for the same general infrastructure noted for the surface operation. An underground operation would have a smaller disturbed footprint due to the absence of an open pit and smaller waste rock storage requirements, but likely a longer duration for ore extraction and overall project activities as a result of a reduced production rate due to the lower efficiency of underground mining.

2.6.2.4 Preferred Approach

The preferred mining method is dictated primarily by the location, geology and grade of the mineral resource or ore body. Mining can theoretically be undertaken by either underground or open pit methods. Underground mining as a primary extraction method typically requires relatively high grade and vein type mineralization following a fault-like structure in order to make practical or economic sense. In the case of the Project, the resource is relatively low grade, disseminated and originates near surface making it better suited to open pit extraction. A continuation of the surface mining into an underground operation below or adjacent to the pit bottom may be viable depending on the final depth of the deposit, but this is currently not under consideration and would likely not be economic unless there was a dramatic increase in grade with depth and/or gold price.

2.6.3 Ore Extraction Methods

2.6.3.1 Drilling and Blasting

Drilling and blasting is proposed to access and extract ore at the FMS Mine Site. Drilling and blasting is generally accepted as the most efficient method of breaking large volumes of rock. Drilling and blasting will generate dust and noise; however, the dust and noise from drilling would be significantly less than that generated by rock breaking. Blasting will generate short duration noise less frequently.

2.6.3.2 Rock Breaking (Ripping)

Rock breaking, or ripping, involves the use of heavy equipment that breaks the rock by inserting hardened metal teeth or prongs into fractures or planes of weakness within the rock. Rock breaking creates continuous significant noise. Due to the extremely hard nature of the native rock and ore in the vicinity of the FMS Mine Site, rock breaking is not considered to be economically or technically feasible.

2.6.3.3 VCs Potentially Affected

The atmospheric environment is the key VC that would be affected by both drilling and blasting, and rock breaking (ripping); however, ripping would create significantly more dust and noise over a continuous time period, whereas drilling and blasting creates very short duration dust and noise effects blasting occurs less frequently. Both effects diminish as the pit deepens.

2.6.3.4 Preferred Approach

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

2.6.4 Ore Processing Methods

2.6.4.1 Gravity/CIL Processing

The proposed process design assumes a conventional flowsheet, including crushing, grinding, gravity and flotation recovery, Carbon-In-Leach (CIL), desorption/electrowinning/refining, cyanide destruction and tailings management.as described in Section 2.4.2.3 of this EIS. This represents the most conventional processing option and is the preferred gold ore processing option in Canada and is used worldwide in almost all major gold mining/processing operations. Metallurgical test work has confirmed the gravity/flotation/CIL processing to be extremely well suited to FMS ore in that gold recoveries are very high (about 95%) resulting in maximum use of the resource, and the cyanide destruction process is proven to be highly efficient. Furthermore, the gold doré end product is produced on site at the Touquoy facility, with minimal off-site value-adding.

2.6.4.2 Other Processing Options

There are no proven technical or economic alternative processing methods suitable for consideration at the FMS Mine Site.

2.6.4.3 VCs Potentially Affected

There are no direct effects to VCs as a result of the alternatives to the ore processing methodology as all processing takes place within the confines of the processing plant. Indirect effects of the ore processing technology, such as tailings management, are discussed separately.

2.6.4.4 Preferred Approach

The preferred approach is for ore processing at the Project is proposed to be undertaken by conventional crushing, grinding and gravity/flotation methods at the FMS Mine Site, followed by carbon in leach and electro-winning processes to produce the gold doré end product at the existing facilities at the Touquoy Mine Site.

2.6.5 Ore Processing Locations

2.6.5.1 FMS and Touquoy Mine Sites (Option 1)

Ore processing for the Project is proposed to be undertaken by conventional crushing, grinding and gravity/flotation methods to produce a gold concentrate at the FMS Mine Site, followed by carbon in leach and electro-winning processes to produce the gold doré end product at the existing facilities at the Touquoy Mine Site. A crusher, conventional grinding and gravity/flotation concentrator and tailings management facility will be constructed at the FMS Mine Site. Concentrate will be hauled by highway truck via public roads to the Touquoy Mine Site. No new processing or tailings management facility will be required at the Touquoy Mine Site. The

Touquoy plant is designed to treat FMS concentrate with no significant modifications or increase in footprint. Tailings from processing of FMS concentrate will be stored in the mined out Touquoy open pit.

2.6.5.2 FMS Mine Site (Option 2)

One alternative would be to conduct all ore processing, including the carbon in leach and electro-winning processes, to produce the gold doré end product, at the FMS Mine Site. This would require construction of additional processing capacity in the form of the CIL, electrowinning and cyanide destruction circuits at the FMS Mine Site, as well as additional considerations for tailings disposal involving cyanide processing. This would eliminate the need for the trucking of concentrate from the FMS Mine Site to the Touquoy Mine Site, but would incur the additional potential impacts at the FMS Mine Site associated with the use of cyanide.

2.6.5.3 Touquoy Mine Site (Option 3)

A second alternative would be to conduct all ore processing, including crushing, grinding, gravity/flotation, carbon in leach and electro-winning processes to produce the gold doré end product at the Touquoy Mine Site. This would eliminate the need for the processing and tailings management facilities at the FMS Mine Site, but would involve hauling the projected 2 million tonnes of ore per year (10.8 million tonnes in total) some 93 km to the Touquoy Mine Site, as opposed to the haulage 100,000 tonnes per year of concentrate as proposed.

This alternative is not economically feasible due to the high cost of haulage of the projected amount of ore over the required distance.

2.6.5.4 VCs Potentially Affected

Option 1 has the potential to affect VCs through the effects of GHG emissions and also through potential accidents associated with hauling the concentrate from the FMS Mine Site to the Touquoy Mine Site.

Option 2 would require the construction of additional processing facilities at the FMS Mine Site, including the use of cyanide and a cyanide destruction circuit, as well as additional considerations in the design of tailings management facility and associated works owing to the presence of residual cyanide and byproducts from the cyanide destruction process, all of which have the potential to affect all VCs being considered in this EIS.

Option 3 would require significant expansion of the Touquoy TMF increasing the disturbed area and affected other existing facilities, such as the polishing pond. It would also affect VCs through the effects of additional GHG emissions, dust deposition, noise, and accidents associated with the significantly greater quantity of ore to be hauled for the FMS Mine Site to the Touquoy Mine Site

2.6.5.5 Preferred Approach

The preferred approach for ore processing locations is conventional crushing, grinding and gravity/flotation methods to produce a gold concentrate at the FMS Mine Site, followed by carbon in leach and electro-winning processes to produce the gold doré end product at the existing facilities at the Touquoy Mine Site (Option 1). This decision is based on both environmental and economic feasibility considerations. Option 1 is considered environmentally favourable in terms of restricting the use of cyanide to a single existing facility that is fully designed and permitted for its use, and limiting transportation of ore on roads over a 93 km distance. Option 1 is also considered economically favorable in that it does not require the additional capital costs associated with the construction of the CIL/electrowinning and cyanide destruction circuits.

2.6.6 Energy Sources

The total connected load for the Project is projected to be approximately 5.4 MW with an operating load of 4 MW.

2.6.6.1 Permanent Grid Tie-in

An existing sufficient and reliable power source is available via a 3 phase 69kV hydroelectric transmission line linking Sheet Harbour and New Glasgow located approximately 5 km west of the FMS Study Area just west of Highway 374. It is proposed that this line will supply power to the plant via a 5.3 km long, 69kV or 25 kV spur line. The incoming 69kV feed will be stepped down to 4.16V at the plant site substation. Power will be distributed from the plant site substation via overhead power lines and/or buried conduits to the gatehouse, mine office, truck workshop, warehouse, change room buildings, raw water pumphouse and TMF. The 4.16kV will be stepped down to each of these locations through transformers. A 500 kW black-start diesel generator will be located on site to provide emergency power. The emergency generator would only operate in the event of a total power black-out and is of sufficient size only to supply necessary back-up power to select equipment in the process plant area.

2.6.6.2 Diesel-Powered Generators

Diesel power generation, while technically feasible, would require importing, storing and using significant additional amounts of diesel fuel at the FMS Mine Site. Given the proximity to sufficient and reliable grid power, diesel powered generators would not be economically feasible or environmentally preferable.

2.6.6.3 Alternative Energy Sources

Reliable renewable energy sources of sufficient capacity, while technically feasible, would not be economically feasible or practicable due to the high capital cost to produce the projected power load combined with the relatively short duration of the Project.

2.6.6.4 VCs Potentially Affected

The key VCs affected by a permanent grid tie-in would be limited to potential impacts to wetlands, habitat and flora, and terrestrial fauna related to disturbances associated with constructing the 5.3 km right-of-way for the power line, and possibly to birds due to interaction with power lines during the operations period.

The environmental effects of diesel generation would include effects to the atmosphere as a result of additional GHG emissions, as well as potential effects of spills associated with the transport, storage and use of additional diesel quantities.

The environmental effects associated with a renewable energy source would depend on the renewable energy technology used but would likely have at least equivalent effects to grid power due to construction and clearing requirements.

2.6.6.5 Preferred Approach

The preferred approach based on economic feasibility and environmental considerations is to provide electrical power to the FMS Mine Site through the connection to grid power.

2.6.7 Location of Key Project Components

2.6.7.1 Open Pit

The location of the open pit is fixed given the location of the mineral resource. There are no technical or economic alternatives for the positioning of the open pit.

2.6.7.2 Site Infrastructure

Theoretically, project components could be located any place within the project tenure holdings where environmental conditions, including geotechnical considerations, permit. Practically, however, Project components tend to be located in close proximity to one another in order to minimize disturbed area associated with the Project footprint and to minimize costs associated with transporting materials such as overburden, ore, waste rock. and tailings from their source to their end location. Thus, the location of key project components is generally dictated primarily by the location of the open pit.

In the case of the Project, site infrastructure has been located in as close proximity to the open pit and TMF as practical in order to minimize the Project footprint and disturbed area requiring reclamation. The locations of key project components have been placed to generally avoid VCs, including wetlands, fish and aquatic resources and known heritage resources that have been identified during field investigations, wherever practicable.

2.6.7.3 VCs Potentially Affected

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

2.6.7.4 Preferred Approach

The preferred approach is to maintain Project component locations as shown on Figure 2.1-5. This minimizes the disturbance footprint and limits the impacts to watercourses, avoids wetlands, species at risk, and fish to the greatest extent practicable.

2.6.8 Mine Waste/Material Storage (Soil, Overburden, Waste Rock, Ore, Low Grade Ore)

2.6.8.1 Stockpiles

Stockpiles for mined materials could theoretically be developed anywhere within the FMS Mine Site where ground conditions are geotechnically suitable to meet design stability factors of safety. Key considerations in locating such stockpiles include foundation materials, aspect, haulage distance, storage volume, increased disturbed area, water management and impacts to wetlands, watercourses and other VCs. The further a stockpile location is from its source the more quickly it becomes not economically feasible due to increased haulage costs.

All mined materials, including Run of Mine Ore (ROM), Low Grade Ore (LGO), Waste Rock, Soil and Overburden have been designated to be placed in stockpiles located in as close proximity as possible to the open pit and key project components as shown on Figure 2.1-5. Such placement minimizes haulage distance and haulage costs, limits additional disturbed area associated with longer haul roads to more distant alternative stockpile locations minimizes impacts to key VCs such as fish and fish habitat, wetlands and watercourses and simplifies water management strategies.

At closure and reclamation:

- the soils stockpiles will have been recovered and used for reclaiming other disturbed areas;
- the ROM and LGO stockpiles will have been removed and processed;
- the PAG stockpile will be covered with a clay cover to reduce infiltration and ARD;
- the overburden and waste rock stockpiles will be reclaimed with topsoil and growing medium. After final shaping and vegetating, the reclaimed mounds will conform to local topography and landscapes.

The site configuration, including other Project components, has been specifically designed to avoid interference with aquatic habitat, and hence it is the preferred option to minimize environmental effects. Wetlands and fish habitat were avoided to the greatest extent possible for the placement of site infrastructure and the use of existing roads has been maximized in site layout planning as well.

2.6.8.2 Backfill

The primary alternative to the creation of permanent stockpiles is to backfill this stockpiled material into the open pit upon cessation of mining activity. Backfilling of the open pit with waste rock and overburden would eliminate the permanent storage stockpiles as described above. However, the same stockpile would still be required to be constructed over the life of the mine and then re-handled to place back in the pit at closure and the stockpile footprint would require reclamation. As well, backfilling with broken rock and overburden would overfill the open pit due to the swell factor, requiring reclamation of the open pit area as well as the remaining excess waste rock.

Environmental effects are generally similar in both alternatives as the stockpile is required in either case during operations and either the stockpile itself, or the footprint and the backfilled open pit would have to be reclaimed at closure. Additional atmospheric effects would be associated with the backfill alternative due to the extensive equipment use requirements associated with re-handling the waste rock.

While technically feasible, such re-handling would be cost prohibitive for the overall Project viability and therefore not economically feasible.

2.6.8.3 VCs Potentially Affected

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

2.6.8.4 Preferred Approach

The preferred approach is for mined materials is the use of on-site stockpiles in accordance with the project component locations as shown on Figure 2.1-5. This minimizes the disturbance footprint and limits the impacts to watercourses and avoids wetlands to the greatest extent possible. The preferred approach includes a clay cap on the PAG stockpile which minimizes ARD.

2.6.9 Transportation of Concentrate

2.6.9.1 Haulage Route

As proposed, gravity and flotation concentrate produced at the FMS Mine Site will be transported by highway truck to the existing process plant at the Touquoy Mine Site for further CIL/electrowinning and refining into gold doré bar.

The initial 93 km haul route will be south via Highway 374 to Highway 7, west along Highway 7 through Sheet Harbour to Mooseland Road at Tangier, and then north-west along Mooseland Road to the Touquoy mine (Figure 1.1-1). The initial route uses only public roads, with the 58 km section of public Highway (Highway 374 - 31 km and Highway 7 - 27 km) which forms a large part of the link being dual lane sealed roads built to support heavy truck traffic. The Mooseland Road (35 km) is a provincially owned road that has sealed and unsealed sections.

Once the Beaver Dam Mine Project comes online (proposed in 2022/2023), FMS haul trucks will have the option to travel 31 km south along Highway 374 to Highway 7, 4 km west along Highway 7 through Sheet Harbour to Highway 224 and then 17 km north-west along Highway 224 to connect with the 12.7 km upgraded Beaver Dam Haul Road and then 11 km along the Mooseland Road for an alternative haul distance of 74.7 km. The Beaver Dam Haul Road upgrade will involve widening to two lanes and improving alignment to provide better curves and gradients, where necessary, to achieve an operational design speed of approximately 70 km/h. This upgraded road is a component of the Beaver Dam Mine Project EIS submission and is not evaluated as part of the Project.

The proposed truck traffic is not envisaged to have a significant impact on the existing traffic on the segment of Highway 374, Highway 7, Mooseland Road, and Highway 224. Records of traffic volumes for nine years between 2007 and 2016 show Annual Average Daily Traffic volumes on Highway 224: Section 025 between Beaver Dam Rd and Pleasant Valley Road ranges from 290 to 370 vehicles per day. The Project will require a maximum of 11 trips per day to transport concentrate from the FMS Mine Site to the Touquoy Mine Site.

The majority of dwellings located along the proposed haul routes are located in the community of Sheet Harbour with a lower density of dwellings located between Sheet Harbour (Highway 7), Mooseland (Mooseland Road), Tangier, and Marinette (Highway 224). These dwellings are currently exposed to highway traffic which includes logging trucks and aggregate haulers. For the remainder of the haul route, there are a small number of houses that will be affected by these vehicles.

The proposed concentrate haulage routes provide the most direct routes connecting the FMS and Touquoy Mine Sites. Any alternative route would be longer, less efficient and would increase emissions and costs, making them less favorable in terms of potential environmental impacts and economic feasibility.

2.6.9.2 Haulage Means

Highway haul trucks with trailers in a C Train configuration will be used to haul concentrate. The 8 axle, 58,500 kg C Train configuration is a standard used across Canada. Truck payloads will be consistent with the limits applied by the Nova Scotia Highways department to comply with the proposed route segments. Based on the requirement to haul 300 t/d and a maximum payload of 28.5 t, 8-11 return trips per day will be required. Assuming a single 12-hour shift, this would result in approximately one truck per hour, however, the exact number will depend on the final hauling schedule. Approximately four trucks would be required necessitating the hiring of 20 personnel for concentrate hauling and truck maintenance. There will be no concentrate hauled during the construction and pre-production phases.

The Spring Weight Restriction period in Halifax County, Nova Scotia is legislated from March 23rd to May 18th of each year but is typically adjusted (shortened) due to yearly conditions and can be expected to be in place for approximately one month. Highway 374, 7 and 224 in the area of interest are exempt from the Spring Weight Restrictions and the Beaver Dam Haul Road (including Moose River Cross Rd. between Highway 224 and Mooseland Road) is private and is therefore not subject to provincial restrictions. Mooseland Road is currently subject to spring weight restrictions, however, as the majority of the haul route is not subject to weight restrictions an exemption will be applied for the Mooseland Road section of the initial haul route, approximately 35 km. Alternatively, the Mooseland Road could be upgraded to allow a gross vehicle operating weight of 58,500 all year round.

There is no practical alternative means of transporting concentrate from the FMS Mine Site to the Touquoy Mine Site other than by highway truck. The use of larger size trucks is limited by Nova Scotia Highways standards and the use of smaller trucks is less efficient, requiring more trucks and higher costs, making them less favorable in terms of potential environmental impacts and economic feasibility.

2.6.9.3 VCs Potentially Affected

The key VCs potentially affected by the haul route and haulage means include atmospheric and socioeconomic, as well as fauna in the case of possible wildlife collision. Only minor effects are expected associated with potential spills due to the insoluble nature of the concentrate as well as the fact the fact that it is the mine's product and of considerable value and would thus be cleaned up quickly and thoroughly.

2.6.9.4 Preferred Approach

The preferred approach is to maintain the haulage route as describe above and shown on Figure 1.1-1, and the haulage means by highway truck. This minimizes haulage distance and frequency and thus limits associated impacts to the extent practical.

2.6.10 Access to the Project Site

Provincial Highway #374 and the existing Seloam Lake Road provide access to the FMS Mine Site within approximately 4km of the proposed administration office and mill site area. A new 4km gravel access road will connect the site to the existing road following the shortest practical route in order to minimize disturbance. In addition to the main mine access road, three primary on-site roads will be constructed to provide operational access to key project components: an ore haulage road connecting the open pit to the ROM pad, a waste rock haulage road connecting the open pit with the WRSA and a haul road connecting the open pit with the TMF. Two bypass roads are also planned to allow the public to access Seloam Lake and areas farther southeast of the Mine.

Minor alternatives exist to route the access and site roads to connect with their respective destinations. All access road and site alternatives were evaluated and selected based upon the proximity to proposed site infrastructure and sited to minimize the extent of new disturbance and the potential for impacts to fisheries and aquatic resources and other valued environmental components.

2.6.10.1 VCs Potentially Affected

The key VCs potentially affected by the access and site roads include wetlands, surface water, fish and fish habitat, and physical and cultural heritage resources.

2.6.10.2 Preferred Approach

The preferred approach is to maintain project component locations as shown on Figure 2.1-5. The proposed road alignments provide the most direct routes in order to limit disturbed area and have been located in order to minimize potential impacts to VCs including watercourses, wetlands and known heritage resources to the greatest extent practicable. The bypass roads allow the public continued access to Seloam Lake and other areas farther south and southeast of the FMS Mine Site.

2.6.11 Management of Water Supply and Wastewater

2.6.11.1 Water Supply Management

Water is an integral component of mining and milling operations at the Project, with a large quantity of water being required in the mill process. Sources of water include: raw water; contact and non-contact water from precipitation and snowmelt run-off; a mix of groundwater and surface water from open pit dewatering, and recycled process water from the TMF.

The TMF will serve as the primary containment and storage facility for process water. Available process water will be recycled from the TMF, thus reducing requirements from the raw water source.

Raw water is required to supplement reclaim water for use in the mill in the flotation air sparges, as cooling water, pump gland water, reagent preparation water, primary crushing circuit dust suppression water and as make up water for losses due to pore water, seepage and evaporation, as well as for fire water and potable water uses

Raw water is proposed to be drawn from Seloam Lake, approximately 2.0 km north-east of the process plant. The water will be recovered by submersible pumps mounted within a decant structure. Water will be delivered to the plant via a buried HDPE pipeline to the raw water tank, the lower portion of which will be reserved for fire protection.

Water supply management measures to be implemented will include, but are not necessarily limited to:

- The quantity of raw water pumped from Seloam Lake will be monitored and recorded to document usage.
- A site wide water balance comprising all inputs and outputs from the mill and tailings management facility system will be maintained.
- The water level of the supernatant tailings pond and quantity of water pumped from the tailings pond will be monitored and recorded.
- Process water will be reclaimed from the TMF to the maximum extent practical for re-use in the milling operations.
- The water level of the supernatant tailings pond will be maintained to ensure sufficient water for pumps on the reclaim barge to function properly and at the same time to ensure a minimum freeboard to contain storm and flood events.
- Dam raises will be scheduled to ensure sufficient freeboard in the TMF is maintained.

The primary alternative considered for a raw water supply would be to source raw water from Anti Dam Flowage as opposed to Seloam Lake. Both sources are within the same watershed and would have similar potential for effects in terms of water withdrawal. Anti Dam Flowage is at a lower elevation and farther away and would therefore require greater pumping capacity and power requirements. as well as greater disturbance associated with placement of the raw water pipeline, powerline and service tote road.

Potable water will be sourced either from wells drilled on-site, or alternatively, raw water from Seloam Lake will be used for washing/showering, and potable bottled water will be brought into site drinking purposes. Wells capable of supplying sufficient volume as a raw water source would not be practical.

Potable water will be sourced from the raw water tank and treated in the potable water treatment skid. The treated water will be stored in the potable water storage tank for use by two potable water pumps in a duty–standby configuration.

A potable water system will pull about 1 m^3/hr from the raw water system and will go through a filtration, UV and hypochlorite treatment process. This services safety showers, eye washes and all tap water on site. This potable water is not drinkable so drinking water will be brought in for consumption.

2.6.11.2 Wastewater Management

Waste waters associated with mine-related activity include supernatant in the TMF, contact water from surface runoff and seepage, and sewage and greywater from changeroom and washroom facilities. Alternatives for general site water management and tailing management are discussed in more detail in the following sections

Selecting a sewage treatment methodology and discharge location/type revolves primarily around technical criteria on type and flow levels of sewage requiring treatment, site conditions, and effluent discharge requirements; economic criteria on capital and operating costs may be a secondary factor. In-ground septic systems are typically constrained by site conditions. In the case of FMS, discharge to ground is feasible based on-site conditions and projected flow rates.

As a result, wastewater and sewage from the plant site buildings will gravitate via a pipe network buried below the frost line to septic tanks with septic fields. Sludge from the septic tanks would be pumped out periodically and trucked to a local sewage treatment facility for disposal.

Alternative wastewater treatment could be achieved by installing a package rotating biological contactor (RBC) plant with discharge to the tailings line and TMF, or to a natural drainage channel reporting to Seloam Brook. An RBC plant requires power and has greater service and maintenance requirements and higher capital and operating costs without achieving significant benefit in terms of potential impacts.

2.6.11.3 VCs Potentially Affected

The key VCs with the potential to be affected by water supply management include surface water quantity and fish and fish habitat.

The key VCs with the potential to be affected by sewage wastewater management include surface water quality, wetlands and fish and fish habitat.

2.6.11.4 Preferred Approach

The preferred approach for water supply is for raw water to be drawn from Seloam Lake and delivered to the raw water tank adjacent to the mill via a pumphouse and an approximate 2 km pipeline. Raw water requirements will be minimized by maximizing recycling of process water from the TMF and by supplementing the reclaim water quantities in the TMF with contact water pumped from water management ponds as determined by the site water balance. Potable water will be sourced either from wells drilled on-site, if feasible, or alternatively, raw water treated to potable conditions from Seloam Lake will be used for washing/showering, and bottled water will be brought into site drinking purposes.

The preferred approach for sewage is for wastewater to gravitate via a pipe network buried below the frost line to septic tanks with septic fields.

2.6.12 Site Water Management and Final Discharge Points

Water management strategies are dictated primarily by topography, the locations of key Project components and Best Management Practices (BMPs), as opposed to consideration of minor alternatives in terms of placement or orientation.

The FMS Study Area is located between Seloam Lake to the northeast and Fifteen Mile Stream (Anti Dam Flowage) to the west and southwest. Seloam Brook connects these two waterbodies, flowing through the FMS Study Area from northeast to southwest. The Project facilities are located entirely within the drainage area of Seloam Brook or its tributaries, with the exception of a small portion of the TMF which is located in the adjacent East Lake catchment area which also drains to Anti Dam Flowage. The Project facilities are confined by natural topography to the west and south.

Two types of surface waters are identified for management consideration at the site:

- Non-contact water: which is natural runoff from undisturbed areas diverted around the FMS Mine Site infrastructure footprint areas; and,
- Contact water: which is water affected by mine workings and infrastructure including the mill, TMF, open pit, waste rock, ore and low-grade ore stockpiles and other disturbed areas, such as quarries, laydown areas, roads, etc.

The TMF will serve as the primary containment and storage facility for water on site, supplemented by a network of collection ditches and ponds to manage contact water. Process water will be reclaimed from the TMF to the maximum extent practical for re-use in the milling operations in order to minimize off-site water requirements. The reclaim water will be recovered by a submersible pump mounted in a decant structure within the TMF. The reclaim water will be delivered via an HDPE pipeline laid on the surface and routed along the reclaim causeway and then alongside the tailings line, to the process water tank located within the plant site.

2.6.12.1 Non-Contact Water

Non-contact water will be intercepted and redirected around the Project facilities by a system of berms and diversion ditches. Ditches will be sized to accommodate specific flood events and ditches will be designed to follow natural topography in order to minimize velocity and erosion potential. Diverted non-contact water will be released to the Seloam Brook drainage whenever practicable.

The proposed open pit lies below a portion of the Seloam Brook channel, which will necessitate realignment of Seloam Brook around the open pit limits prior to commencement of mining. Seloam Brook will be re-routed into a permanent 800 m long stream channel constructed to the north of the planned open pit. This will divert the majority of the non-contact surface water away from open pit mining operation. The stream re-route will isolate the mine facilities to the south and east from the unaffected areas to the north and west, and maintain drainage of Seloam Lake through to Fifteen Mile Stream.

Diverting Seloam Brook around the open pit is the only technically feasible alternative to preventing it from flowing into the open pit and being required to be handled as contact water, as well as for maintaining flow in Seloam Brook downstream of the open pit. Minor alternatives were examined with respect to the design of the realignment channel in order to maintain consistent flow and avoid back-up and flooding, however its location is dictated by primarily by the location of the open pit and topography.

2.6.12.2 Contact Water

Contact water in the form of shallow seepage and surface water runoff associated with areas related to mining activity will be captured in collection ditches constructed downstream of each specific facility and directed to water management ponds. Water in the management ponds will be monitored for water quality and if suitable for discharge will be released to a natural drainage channel within the Seloam Brook catchment. If unsuitable for discharge management pond water will be pumped to the TMF to be treated and released to Anti Dam Flowage.

Contact water management strategies for key project components are described below.

2.6.12.2.1 **Open Pit**

Water collected in the open pit due to groundwater infiltration, precipitation or surface runoff is classified as mine water. Mine water accumulation will be minimized by diverting natural runoff away from the open pit. Locally placed berms surrounding the open pit will direct surface water away from the open pit and into the surrounding Seloam Brook drainage basin.

An in-pit water diversion ditch will be established along the top bench of the open pit to intercept any surface water that makes it through the berm and comes into contact with the open pit. This ditch will direct water to in-pit sumps for collection. Where necessary for stability reasons, pressure releasing sub-horizontal drain holes will be established in the final open pit walls as they are exposed.

All ground and surface water reporting to the open pit will be directed to the sumps and mine sump pumps will pump it directly to the TMF.

2.6.12.2.2 **TMF Seepage**

Seepage from the TMF will largely be controlled by the low-permeability embankment face constructed prior to the development of the tailings beach, by the deposited tailings mass itself, and by the underlying low-permeability foundation materials.

Any seepage reporting through the embankment structure will be collected in the embankment filter and drain system before reporting to the seepage collection and recycle ponds. Seepage in the foundation would follow the natural topography to report to seepage collection ditches along the perimeter road. Water will be conveyed to a central seepage collection point downstream of the embankment and pumped back to the TMF during operations. During closure, this water will be directed to the pit, until water quality is suitable for direct release to the downstream receiving environment in the Seloam Brook drainage.

2.6.12.2.3 **General Site Seepage/Runoff**

Runoff from the active mine areas will be collected in a combination of seepage ditches and/or ponds and if of suitable quality will be released to the receiving environment, or if unsuitable conveyed to the supernatant pond in the TMF, and reused as a source of process water.

A plant site management pond will be located adjacent to the plant facilities. Water collection ditches will be established surrounding the facilities area, as well as the ROM ore stockpile that will divert collected surface water to this water management pond. The earthworks for the facilities are designed with enough relief that contact surface water will run by gravity into these surrounding collection ditches, and into the water management pond.

2.6.12.2.4 **Waste Rock and LGO Stockpiles**

Water collection ditches will be established surrounding the bases of the NAG and LGO stockpiles. Relief is designed into these facilities so that surface water that comes into contact with them will run to the surrounding collection ditches by gravity.

Water management ponds will be sized and pumping systems will be designed to maintain an operational pond level during the snowmelt and rainfall freshet, and to restore water levels to normal operating conditions following flood events.

All runoff from the WRSA and LGO collected in the seepage ditches will be directed to water management ponds prior to release to the environment if suitable for discharge, or if unsuitable for release to the environment directed to the TMF to supplement processing water requirements.

2.6.12.3 VCs Potentially Affected

The key VCs potentially affected by water management include surface water quality and quantity, groundwater quality and quantity, wetlands, and fish and fish habitat.

2.6.12.4 Preferred Approach

The preferred approach is to maintain project component locations as shown on Figure 2.1-5 with a system of ditches and water management ponds to divert non-contact water away from Project facilities and to collect contact water and release it to the Seloam Brook drainage is of suitable quality, and if not pump it to the TMF for treatment and release to Anti Dam Flowage.

2.6.13 Mine Waste Storage (Tailings)

The Proponent presented its preferred tailings storage option (conventional tailings slurry at the location shown on Figure 2.1-5) to DFO and ECCC, which have determined that a regulatory amendment to Schedule 2 of the Metal and Diamond Mining Effluent Regulations (MDMER) will be required. ECCC, with guidance provided by DFO, made a determination, based on currently available data, that there was the potential for the TMF to directly overprint on a small stream that is considered to be waters frequented by fish. Wood Environment & Infrastructure Americas (Wood) was contracted by the Proponent to undertake an alternatives assessment for mine waste disposal, pursuant to a potential regulatory amendment of Schedule 2 of the MDMER. A multiple accounts analysis (MAA) following the methodology outlined in the Guidelines for the Assessment of Alternatives for Mine Waste Disposal (Environment Canada 2011; as modified 2016) was used to examine and compare different storage options from the perspective of potential effects. Sensitivity analyses were subsequently conducted to test the robustness of the MAA. This Assessment of Alternatives is appended to this EIS (Appendix J.6). This section includes synopsis of the findings of this alternatives assessment.

2.6.13.1 Tailings Storage Type

Several alternative tailings technologies were evaluated to determine the most suitable tailings management strategy for the Project based on site-specific characteristics.

2.6.13.1.1 *Conventional (Slurry) Tailings*

Conventional subaqueous (saturated) or sub-aerial (beach) tailings storage involves permanent surface impoundment using both natural topographic features and construction and operation of containment structures (dams). Tailings are not dewatered, but are piped and deposited directly in the impoundment. Conventional slurry tailings are discharged from the mill at < 50% solids (by weight). The tailings may be pumped by centrifugal pumps, flow by gravity, or a combination thereof. Slurry is discharged through off-takes (spigots) along the embankments or around the perimeter of the TMF to optimize basin filling and control the location of the supernatant pond. Segregation occurs in the tailings, with coarser particles settling out near the discharge points to form tailings beaches, while the fines are transported further. Supernatant water and runoff are reclaimed for processing. This is the most common tailings storage methodology used for open pit mines in similar climates and topographies throughout Canada.

No fatal flaws were apparent for the use of conventional tailings slurry in a new TMF and this candidate tailings storage method was carried forward to the MAA.

Conventional slurry tailings disposal is well suited to project sites that operate with a surplus water balance and for facilities that contain PAG or metal leaching (ML) waste materials that require saturation to prevent adverse chemical reactions. Although conventional slurry tailings disposal entails the most attention to water management, it is operationally the simplest method. For these reasons, conventional slurry tailings are considered the most technically and economically viable tailings storage option for the Project.

2.6.13.1.2 *Thickened (Partially Dewatered) Tailings*

Thickened tailings production involves using dewatering systems to increase the solids content of the tailings to 50 to 70%. Similar to conventional tailings, thickened tailings require impoundment dams for containment, but can be advantageous in situations where a steeper tailings beach is achievable such as a natural slope draining towards a downstream impoundment dam. In this case, more tailings can be stored with less dam volume, as opposed to developing a flatter deposited tailings profile, ultimately reducing the TMF footprint. The storage of thickened tailings would require the construction of a dewatering system.

The topography around the Project does not require the use of thickened tailings for steeper tailings beaches and thickening of the tailings would not substantially reduce dam requirements. As thickened tailings storage methods do not lend any significant advantages over a conventional slurry and have additional power requirements / economic considerations, further review of thickened tailings was deemed not warranted and this alternative was screened from consideration in the MAA.

2.6.13.1.3 *Paste Tailings*

Paste tailings are produced by partial dewatering of the tailings to produce a thick slurry of toothpaste-like consistency, with a 67 to 70% solids composition, which can then be transported by pipeline. Paste tailings, sometimes combined with cement, are commonly used in underground mines as backfill support. The use of paste tailings for surface storage is not common. Paste tailings are not self-supporting and an impoundment for the paste tailings, as well as an impoundment for process water, would be required. The storage of paste tailings would involve the construction of a paste plant which would utilize a dewatering filter press system for a portion of the tailings and a high capacity thickener for the remainder. From an environmental and socio-economic perspective, the use of tailings as paste backfill to augment underground stability is ideal as it has virtually no adverse human or environmental effect. The use of tailings in paste backfill can help improve the long-term stability of underground workings, but is much more costly, for purely disposal purposes, compared with use of a surface impoundment with good natural containment. As the Project is an open pit operation, and the cost of constructing and operating a plant would be very high, and together with the operating pumping costs, would most likely render the Project uneconomical. For these reasons, paste tailing is not considered a technically or economically viable tailing storage option.

2.6.13.1.4 *Filtered (Dry Stack) Tailings*

Dry stacking of tailings involves dewatering tailings with vacuum or pressure filters to produce a relatively dry tailings (typically > 70% solids content) and placing the dry tailings in a storage area using trucks or conveyers. This tailings storage method is most beneficial in areas of flat topography and dry climate where water conservation is critical, areas where permafrost encapsulation is possible, or areas of high seismic activity where use of tailings dams is not supported. In general, the method relies on the tailings remaining dry in order to be self-supporting.

Although these conditions (arid climate, high arctic permafrost, or high seismic activity) are not applicable to the Project, and the use of filtered tailings technology is unconventional in Nova Scotia, filtered tailings have an advantage over conventional slurry tailings as the tailings are dewatered at the plant site and no large tailings pond, positioned over tailings is required. This eliminates the potential for a dam breach releasing tailings and effluent with a high potential energy into the environment. No fatal flaws were apparent for the use of filtered stack tailings and this candidate tailings storage method was carried forward to the MAA.

2.6.13.1.5 *Cycloned Tailings*

Cycloning Tailings is a variant on a conventional slurry TMF where conventional tailings slurry is pumped to the TMF and cyclones are used to mechanically separate coarse tailings (underflow) from the fine tailings and effluent (overflow). The coarse tailings can be used as inexpensive dam construction material and lowers the volume of tailings stored in the tailings beach.

The primary advantages of employing cycloning technology are economic in nature as rockfill is required for its dam raises. The use of cycloning technology would not substantially alter dam footprint and the impoundment at the preferred TMF location would still overprint water. In addition, the technology does not eliminate the need for a tailing pond located over tailings. Additional environmental concerns include increased dust and water management. Technical constraints include underdrainage and managing winter deposition as ice buildup could lead to sinkhole development after the spring thaw. Socio-economic constraints include public perception of using tailings material for dam construction and increased fugitive dust. As cycloned tailings do not allow alternatives to avoid overprinting of water and do not eliminate the need for tailings ponds located over tailings, the use of cyclone tailings does not provide a substantial benefit over conventional slurry technology and this alternative was eliminated from further consideration in the MAA.

2.6.13.1.6 *Co-Disposal of Mine Waste*

Co-disposal is the mixing of tailings with waste rock into a single storage facility. The mixing of tailings with the waste rock promotes the filling of voids and maximizes the density of the stored material. Co-disposal can be referred to based on the point in the waste stream where mixing occurs: co-mingling (mixed before placement), co-placement (placed separately) or co -deposition (layering).

When tailings are co-mingled, the tailings are typically dewatered to the point of a paste or filtered tailings prior to mixing with the mine rock. Co-mingling of tailings with mine rock not only has many of the same operational complexities as paste or filtered tailings, but additional complexity is introduced via the mixing process. Co-mingling of the two waste streams may result in the need for a larger facility, or multiple facilities, to contain the increased waste volume. Further, the increased equipment requirements (thickening, pumping and/or conveying, mixers, etc.) adds considerable capital and operating costs, which adversely impact the economic viability of the Project. Co-mingling is not considered feasible for mine waste generated by the Project and was eliminated from further consideration in the MAA.

2.6.13.1.7 *Open Pit Disposal*

Exhausted open pits provide a stable tailings impoundment without the requirement for additional constructed dams. Typically, open pits allow for subaqueous disposal in climates or hydrological situations where a water surplus will lead to pit filling and creation of a pit lake. Subaqueous tailings disposal is a proven and successful disposal method that can effectively isolate the mine waste and mitigate the potential effects of ML/ARD. In this case, a lobe of an open pit would be used for tailings deposition if appropriate topographical control is present and the open pit workings are effectively isolated from the deposition area not allowing movement into the active mining areas.

The open pit design does not have lobes that could provide basins for the impoundment of tailings and supernatant during operations. Due to pit geometry, the majority of the storage capacity available in the open pit is unavailable until the end of the mine life, unless an engineered structure is constructed within the operating pit. This would be further compounded by the need to have sufficient supernatant storage above the tailings to account for high precipitation events / periods. Even if the open pit could be utilized for tailings storage, only a small portion of the overall tailings stream could be directed to the open pit, necessitating a surface impoundment. The use of the open pit for storage of tailings was eliminated from further consideration in the MAA.

2.6.13.2 Tailings Storage Locations

The FMS Study Area is located between Seloam Lake to the northeast and Fifteen Mile Stream (Anti Dam Flowage) to the west/southwest. Seloam Brook connects these two waterbodies, flowing through the FMS site from northeast to southwest. The Project facilities are located entirely within the drainage area of Seloam Brook or its tributaries, with the exception of a small portion of the TMF which is located in the adjacent East Lake catchment area which also drains to Anti Dam Flowage. Project facilities are confined by natural topography to the west and south. The landscape in the FMS Study Area is characterized by undulating to rolling topography, wetlands and woodlands dissected by a few lakes and streams.

The basic requirement of the TMF is the capacity to store all of the tailing projected to be produced by the process plant over the life of the mine. The process plant will generate tailings at a production rate of approximately 5,500 tonnes per day (tpd) to yield a total of approximately 10.8 million tonnes (Mt) of tailings over a mine life of approximately 7 years.

The principle design objective of the TMF is to protect of the environment during operations and throughout the closure stage of the Project. To achieve this objective the design of the TMF considers the following:

- Permanent, secure and total confinement of all tailings solids within an engineered facility;
- Control, collection, and removal of free draining liquids from the tailings during operations, for recycling as process water to the maximum practical extent; and,
- Inclusion of monitoring features for all aspects of the facility to ensure performance goals are achieved and design criteria are met.

Ten potential tailings storage locations were initially identified for the alternatives assessment, however three of the locations were considered repetitive and removed from consideration. As a result, a total of seven TMF candidate locations (Figure 2.6-1) were selected based on engineering studies and the following criteria:

- The alternative location should be within an acceptable distance from the open pit;
- The alternative location should avoid encroaching upon or overprinting a major watershed divide, and encroaching into more than one watershed;

- The alternative location should avoid encroaching upon or overprinting a major waterbody (i.e., Seloam Lake or Anti-Dam Flowage);
- The alternative location should avoid encroaching upon or overprinting or substantially interfering with major provincial infrastructure; and,
- The alternative location should avoid encroaching upon or overprinting protected areas.

Locations #2, #4, #5 and #7 were carried forward into the MAA. Candidate locations #1, #3 and #6 had fatal flaws and did not meet the pre-screening criteria to carry forward.

2.6.13.3 Alternatives for the Multiple Accounts Analysis

Based on the two tailings storage methods, and four tailings storage locations identified as potentially practicable based on the pre-screening assessment, a total of eight possible alternatives were identified. In the interest of having a focused and manageable MAA, consistent with the Guidelines, rather than assessing every possible combination, alternatives which make the most sense from a mine development perspective have been developed for consideration in the MAA. All candidates not eliminated in the pre-screening step are considered through the alternatives carried forward to the MAA. As a result, conventional slurry tailings were only considered for Location #2 and #7. The use of filtered tailings at Location #2 and #7 was not considered feasible due to incompatible site conditions. However, Location #4 also considered an alternate orientation that avoided fish-frequented waters (Alternative G).

Alternatives A, B, C, D, E, F and G were carried forward into the MAA as shown on Figures 2.6-2 to 2.6-9. The other combinations of methodologies and locations had fatal flaws and did not meet the pre-screening criteria to carry forward.

Alternative A utilizes conventional slurry tailings, deposited at Location #2 approximately 3.5 km to the northwest of the deposit. Mine water would be managed within the TMF supernatant pond. This alternative would require MDMER Schedule 2 regulatory amendment. It is the smallest footprint of the options, but the farthest away from the center of the mine site.

Alternative B is the preferred option presented in this EIS located less than 1 km to the southeast of the deposit and is up-gradient of the open pit. It utilizes conventional slurry tailings, deposited at Location #4. Mine water would be managed within the TMF supernatant pond. This alternative would require MDMER Schedule 2 regulatory amendment.

Alternative C utilizes filtered stack tailings deposition at Location #4. Two associated mine water management ponds will be required for this alternative. Alternative C will require a MDMER Schedule 2 regulatory amendment for the TMF, but not for the associated mine water management ponds.

Alternative D utilizes conventional slurry tailings, deposited at Location #2. Mine water would be managed within the TMF supernatant pond. This alternative would require MDMER Schedule 2 regulatory amendment.

Alternative E utilizes filtered stack tailings deposition at Location #5. This alternative will also require two mine water management ponds. Alternative C will also require a MDMER Schedule 2 regulatory amendment for the TMF, but not for the mine water management ponds.

Alternative F utilizes conventional slurry tailings, deposited at Location #2 approximately 4 km to the west of the deposit. Mine water would be managed within the TMF supernatant pond. This alternative would require MDMER Schedule 2 regulatory amendment. This option requires mine traffic for embankment construction and a tailings pipeline to cross Route 374, which would complicate mine operations.

Alternative G is a variant of Alternative B and was selected as the best alternative that avoids placing mine waste over waters frequented by fish, and accordingly has no MDMER Schedule 2 requirements. It utilizes conventional slurry tailings, deposited at Location #4.

All alternatives were characterized based on their environmental, technical, Project economic, and socio-economic impacts using a multiple accounts ledger (Appendix J.6). These four general areas of consideration are referred to as accounts. Each account is split into evaluation criteria (sub-accounts) that are used to determine the level of impact to the account and indicators of each of these sub-accounts were identified. Identification of sub-accounts and indicators for each of these areas were chosen using the methodology described in Appendix J.6 in accordance with the Guidelines. While sub-accounts measure impacts between the alternatives, they are often not easy to quantify and rank in a transparent manner. Measurement criteria (indicators) allow qualitative or quantitative measurement of the impact associated with each sub-account. Sub-accounts and indicators were chosen based on Project team experience with mine rock stockpiles and assessments of alternatives for other mining projects. The Project Team included both Proponent staff and their consultants. During the preparation of the report, engagement with Mi'kmaq communities was undertaken and feedback / input was sought to inform the Assessment of Alternatives Report (Appendix J.6). This included the alternatives, accounts, subaccounts, indicators, measurement parameters and weightings. A full account of the sub-accounts and indicators considered are detailed in the Assessment of Alternatives Report (Appendix J.6).

Following the identification of the indicators, a value-based decision process was used to assign values and weightings to indicators. As provided in the Guidelines, the base case includes weighting the environment account twice as important as the technical and socio-economic accounts, which in turn are weighted twice as important as the Project economics account. All weights assigned to the sub-accounts and indicators, including rationale for the selection of each weight, can be found in the Assessment of Alternatives Report (Appendix J.6).

2.6.13.4 Preferred Approach

Using the MAA methodology, the preferred alternative for the mine waste disposal at FMS Mine Site for the Project is Alternative B with an alternative merit rating of 4.4 out of a maximum of 6.0 (See Appendix J.6 for full results of analysis).

A sensitivity analysis comprised of four additional scenarios was carried out to evaluate the robustness of the analytical process and to determine the degree to which various options are influenced by the choice of weightings. The sensitivity analysis found that the MAA is robust and not sensitive to change. For all scenarios, Alternative B remained the preferred alternative (Appendix J.6).

The preferred approach for tailings management is for storage of conventional slurry tailings from gravity and flotation processing at FMS within a newly constructed engineered tailings management facility located east of the FMS process plant (Alternative B).

2.6.14 Concentrate Tailings Storage (Touquoy)

2.6.14.1 Touquoy TMF

The existing TMF at the Touquoy Mine Site was designed to accommodate projected tailings generated from processing of Touquoy Gold Project. Based on current scheduling considerations, the deposition of FMS concentrate tailings into the TMF may not be possible. An expansion of the Touquoy TMF would be required to accommodate FMS concentrate tailings. This would require expansion of the TMF by raising of the dam to increase the storage capacity, and may affect overall TMF footprint.

2.6.14.2 Touquoy Open Pit

Once mining at the Touquoy Gold Project is complete, the mined out open pit at the Touquoy Mine Site will be available for storage of tailings. The mined out Touquoy open pit will provide a very stable natural containment structure for tailings and will have the capacity to store all projected FMS tailings. Hydrogeological assessments of the Touquoy open pit indicate that it will eventually fill with water from rainfall, runoff and groundwater infiltration creating an in-pit water feature/lake which is in accordance with the approved Reclamation Plan. Tailings storage in the pit will therefore be sub-aqueous and will require no additional disturbance. The alternative to using the Touquoy open pit for tailings storage would be to expand and continue to use the Touquoy TMF.

2.6.14.3 VCs Potentially Affected

The key VCs potentially affected by construction and operation of a tailings management facility at the FMS Mine Site include surface water quality and quantity, groundwater quality and quantity, wetlands, species at risk, and fish and fish habitat.

VCs potentially affected by the expansion and continued use of the Touquoy TMF are surface water and groundwater quality, wetlands, and species at risk.

VCs potentially affected by the use of the exhausted Touquoy open pit for tailings storage are surface water and groundwater quality.

It should be noted however that an existing monitoring program is already in place under the Touquoy IA and that groundwater and surface water quality and quantity will continue to be monitored over the life of the Touquoy Gold Project as part of existing approvals for approved life span of the facility and for the proposed extended life of the Touquoy Mine Site associated with processing of FMS concentrate. As well, there will be over 7 years of data available prior to the FMS tailings being introduced to the exhausted Touquoy pit, which will enhance water quality modeling and predictions.

2.6.14.4 Preferred Approach

Using the MAA methodology, the preferred alternative for the mine waste disposal at FMS Mine Site for the Project is Alternative B with an alternative merit rating of 4.4 out of a maximum of 6.0 (See Appendix J.6 for full results of analysis).

A sensitivity analysis comprised of four additional scenarios was carried out to evaluate the robustness of the analytical process and to determine the degree to which various options are influenced by the choice of weightings. The sensitivity analysis found that the MAA is robust and not sensitive to change. For all scenarios, Alternative B remained the preferred alternative (Appendix J.6).

The preferred approach for tailings management is for storage of conventional slurry tailings from gravity and flotation processing at FMS within a newly constructed engineered tailings management facility located east of the FMS process plant (Alternative B) to be followed by storage of conventional slurry tailings from concentrate CIL processing at the existing Touquoy facility in the mined out Touquoy open pit.

2.6.15 Tailings Storage Final Discharge Point

Water balance calculations indicate the TMF at the FMS Mine Site will operate under surplus water conditions. The TMF will be designed to handle storm events, however, at some point, water will be required to be discharged. Discharge works will be designed and constructed to remove excess water from the TMF to prevent surplus water accumulation. Further work will be undertaken to determine the need for, and design of, any treatment works, to ensure the discharge meets environmental requirements.

Two locations were assessed as the final discharge point for effluent from the TMF. These locations are Seloam Lake and Anti Dam Flowage Reservoir. The specific assessment points are referred to as EMZ-1 and EMZ-2 for each of Seloam Lake and Anti Dam Flowage Reservoir (Figure 6.6-20).

The assessment points are located 100 m downstream of the two proposed treated effluent discharge locations – that is, the effects assessment assumes a 100 m mixing zone located downstream of the effluent outfall (or ‘end-of-pipe’) location. The “EMZ” in the assessment location IDs refers to the “End of Mixing Zone”. The objective of the mixing zone is to meet the CCME CWQGs, the

NSEQSs and the site-specific criteria at the downstream end of the mixing zone (EMZ-1 or EMZ-2). The 100 m length of the mixing zone is consistent with the approach taken for other projects in Nova Scotia, such as the Touquoy Gold Project and Beaver Dam Mine Project.

Based on the results of the numerical modelling, the assimilative capacity is greater within the Anti Dam Flowage Reservoir than within Seloam Lake. Anti Dam Flowage Reservoir is located further downstream in the watershed, as compared to Seloam Lake, and therefore the higher assimilative capacity reflects the larger catchment area that reports to Anti Dam Flowage Reservoir.

As a result, Anti Dam Flowage Reservoir is considered the preferred option for discharge of treated effluent, and this option has been carried forward into the effects assessment, including discussion on residual effects and significance.

2.6.16 Seloam Brook Realignment

Seloam Brook currently overprints the deposit and future open pit. As discussed in Section 2.6.2, the only viable mining option is open pit extraction, therefore necessitating the realignment of the stream in order to move forward with the Project. The Seloam Brook Realignment channel design could be constructed as an engineered channel lined with rip rap and armor rock that would sufficiently convey the Seloam Brook flow volumes through the system while maintaining flow. The alternative to this would be to engineer and create floodplain and fish habitat along the channel in order to minimize impacts to fish and fish habitat and create better habitat within the system.

2.6.16.1 VCs Potentially Affected

The key VCs potentially affected by the Seloam Brook Realignment at the FMS Mine Site include surface water quality and quantity, groundwater quality and quantity, wetlands, species at risk, and fish and fish habitat.

2.6.16.2 Preferred Approach

The Seloam Brook Realignment with engineered fish habitat channel that incorporates fish habitat is the preferred option.

2.6.17 The Preferred Approach

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

- An open pit gold mine located at the FMS Mine Site;
- Ore extraction methods that employ drilling and blasting;
- Ore processing methods that employ gravity/flotation at a new mill constructed at FMS Mine Site followed by concentrate CIL/electrowinning processing and refining at the existing mill at the Touquoy Mine Site;
- An approximate 4km gravel access road connecting the FMS Mine Site to Highway Route #374;
- Transportation of concentrate by highway truck from the FMS Mine Site to the Touquoy Mine Site for processing via a public roads, including a combination of Hwy 374, Hwy 7, Hwy 224, Mooseland Road and the Beaver Dam Haul Road;
- Connection of the FMS Mine Site to grid power on the west side of Highway #374 by an approximate 5.3 km power line;
- Key Project component locations as shown on Figure 2.1-5;

- Raw water supply from a pumphouse on Seloam Lake connected by pipeline to a raw water tank located adjacent to the mill;
- On site water management by diverting non-contact water away from the mine facilities and collecting contact water via a system of collection ditches and water management ponds with discharge of suitable water to the Seloam Brook drainage, and all water that requires treatment (if required) will be diverted to the TMF, treated and released to Anti Dam Flowage;
- Seloam Brook Realignment around the open pit in an approximate 800 m realignment channel;
- Waste rock, low grade ore, overburden and soil management stockpiles located on the FMS Mine Site;
- Tailings management by storage of tailings from FMS gravity/flotation processing in an engineered TMF constructed at the FMS Mine Site;
- Discharge of excess water from the TMF to Anti Dam Flowage during operations and from the pit during closure;
- Tailings management by storage of tailings from FMS concentrate in the mined out Touquoy open pit, and
- Seloam Brook Realignment with fish habitat creation.

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

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

Project Component or Activity	Alternative Means	Technical Feasibility	Economic Feasibility	Environmental Effects	Preferred Option
Mine Type	Surface Mine (Open Pit)	Technically Feasible	Economically Feasible	Environmental effects are associated with the surface mine construction and operation; however, no significant residual environmental effects are anticipated	Yes
	Underground Mine	Not Technically Feasible considering the configuration of the gold deposit	Not Economically Feasible	Not assessed	No
Mineral Extraction Methods	Blasting	Technically Feasible	Economically Feasible	Environmental effects include noise and dust impacts; however blasting will be intermittent and short duration	Yes
	Rock Breaking	Not Technically Feasible considering the hardness of the ore deposit	Not Economically Feasible based on the hardness of the ore deposit	Environmental effects include continual noise and dust impacts	No
Ore Processing Methods	Gravity/Flotation CIL/Electrowinning	Technically Feasible This is the preferred processing option in Canada and is used worldwide in almost all major gold mining/processing operations Well suited to this particular ore	Economically Feasible	Environmental effects associated with processing are minimal as it all takes place within the confines of the process plant	Yes
	No Alternative	Not Technically Feasible	None Economically Feasible.		No

Project Component or Activity	Alternative Means	Technical Feasibility	Economic Feasibility	Environmental Effects	Preferred Option
Ore Processing Locations	FMS Crushing/Grinding and Gravity/Flotation To produce concentrate	Technically Feasible	Economically Feasible	Construction and operation of a processing plant and associated tailings management facility have the potential to affect all VCs being considered in this EIS	Yes
	Touquoy CIL/Electrowinning of concentrate To produce gold doré from concentrate	Technically Feasible as the Touquoy facility is already designed to treat FMS concentrate with minimal modifications	Economically Feasible as the infrastructure for processing FMS concentrate is already in place	Potential environmental effects for the existing Touquoy facility have previously been assessed and approved. Processing FMS concentrate at the Touquoy facility will result in an additional six years of processing beyond the current lifespan of the Touquoy Gold Project and greenhouse gas emissions due to transporting concentrate to Touquoy	Yes
	FMS Gravity/Flotation and CIL/Electrowinning To produce gold doré on site	Technically Feasible	Economically Feasible	Environmental effects would include the additional provisions for cyanide destruction and storage/handling of cyanide process tailings and reclaim water. Environmental effects for the existing Touquoy facility have previously been assessed and approved	No
	Touquoy Gravity/Flotation and CIL/Electrowinning To process ore offsite	Technically Feasible, although the existing TMF at Touquoy would require significant expansion resulting in a larger disturbed area due to downstream construction	Not Economically Feasible due to high costs associated with haulage of 10.8 Mt of ore from FMS to Touquoy	Environmental effects of processing all FMS concentrate at Touquoy would include increased disturbance due to TMF expansion and GHG emissions associated with hauling ore from FMS to Touquoy	No

Project Component or Activity	Alternative Means	Technical Feasibility	Economic Feasibility	Environmental Effects	Preferred Option
Energy Source	On-site Generators	Technically Feasible	Economically Feasible	Environmental effects include GHG emissions associated with operating diesel fuel-powered generators as well as haulage of diesel, plus the added potential for spills associated with transport and storage of diesel	No
	Provincial Grid Tie-in	Technically Feasible	Economically Feasible	Environmental effects to habitat associated with construction of a 5.3 km right-of-way for electrical lines	Yes
	Renewable Energy Sources	Technically Feasible	Not Economically Feasible due to projected power demand and short duration of Project	Environmental effects would depend on renewable energy technology used	No
Project Key Component Locations	As shown on Figure 2.1-5	Technically Feasible	Economically Feasible	Environmental effects will include loss of habitat; however efforts have been made to microsite and reduce impacts including to fish and fish habitat wherever practicable. Some impacts are unavoidable due to the proximity requirements of components	Yes
	Alternative Locations	Possibly Technically Feasible depending on locations	Possibly Economically Feasible depending on locations	Alternative locations were evaluated and were ruled out based on greater environmental impacts	No
Concentrate Transportation	Highway trucks via public roads	Technically Feasible	Economically Feasible	Environmental effects are similar for both alternatives, including GHG emissions, traffic noise and dust	Yes

Project Component or Activity	Alternative Means	Technical Feasibility	Economic Feasibility	Environmental Effects	Preferred Option
	Highway trucks via public roads and Beaver Dam Haul Road connector	Technically Feasible	Economically Feasible	Environmental effects are similar for both alternatives, including GHG emissions, traffic noise and dust	Yes
Mine Access	As shown on Figure 2.1-5	Technically Feasible	Economically Feasible	Potential environmental effects will include loss and alteration of terrestrial habitat and potential impacts to fish and fish habitat associated with construction of a 4 km access road right-of-way, as well as dust and noise impacts associated with operation	Yes
	Alternative Locations	Technically Feasible	Economically Feasible	Environmental effects would be similar for any alternative although likely greater since the preferred route is the shortest practical and located to minimize impacts to wetlands and aquatic resources	No
Water Supply and Management	Raw water supply from Seloam Lake	Technically Feasible	Economically Feasible	Potential environmental effects include impacts to terrestrial habitat associated with 2 km pipeline/powerline/tote road right of way route	Yes
	Raw water supply from Anti-Dam Flowage	Technically Feasible	Economically Feasible; more costly	Potential environmental effects would be similar for both alternatives, but include increased disturbance associated with longer right of way plus increased power requirements	No
	Wastewater to septic tanks with leach drains. Sludge pumped out for disposal	Technically Feasible	Economically Feasible	Potential environmental effects on surface and groundwater	Yes

Project Component or Activity	Alternative Means	Technical Feasibility	Economic Feasibility	Environmental Effects	Preferred Option
	Wastewater to RBC plant with discharge to TMF or receiving environment. Sludge pumped out for disposal	Technically Feasible	Economically Feasible; increased capital and operating costs	Both alternatives have similar potential environmental effects; no substantial benefit to justify additional capital and operating costs	No
Mine Waste Management Facilities	Waste rock stockpiles	Technically Feasible	Economically Feasible	Potential environmental effects will include loss of terrestrial habitat associated with construction. Stockpiles to be recontoured to conform with natural topography and revegetated at closure	Yes
	Waste rock backfill in open pit	Technically Feasible	Not Economically Feasible	Potential environmental effects similar for both alternatives. Stockpile disturbed area footprint, backfilled open pit and excess waste rock require reclamation after backfill. Additional GHG emissions associated with heavy equipment used for back haul	No
Tailings Management Facilities	FMS gravity/flotation tailings stored in new TMF at FMS (Alternative B)	Technically Feasible	Economically Feasible	Potential environmental effects on surface and groundwater	Yes
	FMS concentrate CIL processing tailings stored in Touquoy open pit	Technically Feasible	Economically Feasible	Potential environmental effects on surface and groundwater	Yes
	All tailings gravity/flotation/ CIL stored in TMF at FMS	Technically Feasible	Not Economically Feasible due to need for construction of additional CIL/electrowinning and	Additional potential environmental effects on surface and groundwater due to the use of cyanide at FMS;	No

Project Component or Activity	Alternative Means	Technical Feasibility	Economic Feasibility	Environmental Effects	Preferred Option
			cyanide destruction facilities at FMS		
	All tailings gravity/flotation/ CIL stored in TMF and/or open pit at Touquoy	Technically Feasible	Not Economically Feasible due to extremely high cost associated with ore haulage	Touquoy TMF would require significant expansion; additional GHG emissions associated with ore haul	No
Seloam Brook Realignment	Straight Engineered Channel	Technically Feasible	Economically Feasible	Environmental effects will include loss of fish habitat	No
	Engineered Channel with habitat	Technically Feasible	Economically Feasible	Mitigation of impacts to fish and fish habitat and creation of new habitat	Yes

3.0 Public Engagement Program

3.1 Objectives

The Proponent is committed to stakeholder and rightsholder engagement as part of the Project. Using key values of openness, transparency, collaboration and respect, the Proponent has continued to work with the local community, non-governmental organizations (NGOs), regulatory agencies, and interested members of the public for over a decade. Since 2019, Atlantic Gold has used the Community Relations Policy Statement, most recently updated in February 2020, issued by St. Barbara Ltd to guide community engagement efforts.

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

3.2 Engagement Strategy

A community engagement strategy has been developed by the Proponent for the Project and more generally for all its projects along the Eastern Shore area of Nova Scotia. The strategy sets out the formal engagement activities that the Proponent will undertake throughout all phases of its exploration activities and mining operations in Nova Scotia. This includes the construction, operation and closure of the Project, which includes the permitted Touquoy Mine Site and the proposed FMS Mine Site. The Proponent is also active in efforts to provide broader awareness relative to advanced exploration activities.

A successful community engagement strategy provides flexibility to allow adaptation to the needs of the community. In 2016, the Proponent developed its strategy for community engagement to coincide with the start of construction of the permitted Touquoy Gold Project and the development of the EA for the Project. This strategy raised awareness about the Touquoy Gold Project. In 2018, an engagement strategy was developed for the Proponent focused on the Fifteen Mile Stream Gold Project and the proposed Cochrane Hill Gold Project. This strategy is being continually updated and is paired with a broader communications plan for the Proponent to ensure messaging, communication and engagement initiatives are aligned and mutually supportive.

Community engagement also requires documenting and tracking all interactions, communications, and commitments. The Proponent uses stakeholder engagement software to plan, measure, and document engagements so that all stakeholder input and feedback is considered and integrated as appropriate.

3.2.1 Community Liaison Committee

Community engagement is important to the Proponent, and the Community Liaison Committee (CLC) for the Project is a key component throughout Project permitting, construction, operation, and closure. The CLC is diverse with representation from the surrounding communities. The volunteer membership acts as an advisory board to the Proponent. The CLC provides a mechanism for information exchange between communities and the company, as well as a forum to share questions, concerns, and input regarding the Project. The CLC meets quarterly with the potential for additional meetings depending on interest and Project developments. The CLC strives to meets quarterly.

The current members are: Susan Myers - Levy, Gilbert Fahie (Mooseland), Bill Williams, Jeff Hoegg, Dawn Howe-Power and Barry Prest (Mooseland). The CLC chair is currently in the process of recruiting additional members for the CLC.

The Proponent used the *Guide for the Formation and Operation of a Community Liaison Committee* produced by NSE (2010b) to aid in the CLC's formation. A draft Terms of Reference for the CLC was developed but has not yet been approved by the CLC members. This will occur if and when the Project is approved. The Terms of Reference sets out the governance for the CLC and defines its objective as an advisory body to the Proponent with volunteer members representing local communities. The CLC is chaired by an independent consultant, Chrystal Fuller of Brighter Community Planning & Consulting, who will act in this role until such time as the Industrial Approval is granted. The CLC had its inaugural meeting on December 10th, 2018, where the Chair provided an orientation to its function and role to the committee. Committee members had a chance to ask questions and get familiar with its function. The CLC strives to meets quarterly.

As defined in the Terms of Reference, guests, such as technical consultants or community groups, may be invited to the CLC meetings where topics of interest are planned.

3.2.2 Open Houses and Town Hall Meetings

Open houses allow a Proponent to inform the general public about a proposed Project, and conversely, interested members of the public have the opportunity to view information and speak directly with Proponent representatives. This allows one-on-one discussions to answer questions and allow for deeper, more detailed questions to be answered. For many members of the public, Open Houses are a more comfortable form of communication with the Proponent than other forms of engagement, such as town hall type meetings.

The Open Houses involve information boards and displays showing the location of the proposed Project in relation to nearby communities, fact and figures pertaining to the development and each VC, and an update for the general public on the status and progress of development activities, such as the EA and anticipated construction schedule. As the Project progresses, more technical and detailed information is provided during open house sessions.

There have been two open houses held in advance of the submission of the EIS. The first occurred on March 27th, 2018 and the second on March 14th, 2019.

3.2.3 Presentations and Meetings with Local Community Groups

The Proponent has made presentations to many organizations, community groups and educational institutions on its exploration and mine development activities in Nova Scotia. To date, these organizations include but are not limited to, Sheet Harbour Chamber of Commerce, Council of the Municipality of the District of St. Mary's, Nova Scotia Community College, Nova Scotia Business Inc., Duncan MacMillan High School, Halifax Partnership, and the local Nova Scotia Works office. Depending on the interest of community groups, the Proponent will continue to make presentations to share information about its operations in Nova Scotia. The Proponent actively searches for opportunities to speak with community groups in order to answer questions and promote partnerships where appropriate.

The Proponent has and will continue to meet with local community groups in smaller sessions, including the Eastern Shore Forestry Watch, the Sheet Harbour Wildlife Association, the Sheet Harbour Snowmobile and ATV Club, the Puma ATV Club, the Lake Charlotte ATV Association, the ATV Association of Nova Scotia, and Nova Scotia Salmon Association. Depending on the interest of community groups as the Project develops, the Proponent will continue to meet with community groups to provide information, discuss proposed mitigation measures, and respond to any concerns. This includes local ATV clubs, environmental groups, business development organizations and other interested community groups.

The Proponent presented at the Musquodoboit Harbour and Area Chamber of Commerce and Civic Affairs Town Hall meeting on February 21st, 2018 and provided an update on the Project and answered questions from the attendees. Approximately 15 members of the public attended, including the local municipal councilor.

On October 19th, 2018 the Proponent met with four representatives of the Sheet Harbour Chamber of Commerce to provide a general updated on the Project and seek feedback on the best way to engage with this community. Since this initial meeting, the Proponent has joined the local Chamber of Commerce and attended its annual general meeting on March 6th, 2019 and has continued to meet with them throughout 2020. The Proponent presented to the Chamber on April 3rd, 2019 to provide an overview of the FMS Open House held on March 14th, 2018.

The Proponent has met with the Halifax Partnership several times to explain the Project and discuss potential impacts on the Eastern Shore of the various gold projects. Opportunities to leverage investment in the communities local to the FMS Mine Site were discussed and the Proponent received studies and documents to assist in understanding the goals, plans and vision for the rural Eastern area of the Halifax Regional Municipality.

3.2.4 Community Bulletins (Newsletter)

Starting in May of 2018, the Proponent launched a quarterly community bulletin. The purpose of the bulletin is to keep the community informed about all Atlantic Gold Projects, provide information on the Proponent's activities in the local community and provide basic technical information on the Proponent's projects. The bulletin will continue indefinitely so that community members are kept informed throughout all stages of all the Projects.

3.2.5 Signage

The Proponent posts, and will post, signs at their Project sites with contact details and other general information. For example, in the instance of the Touquoy Gold Project, the blasting schedule is posted for public information.

3.2.6 Website, Email, Phone Line and other Digital Media

The Proponent established an organizational website (www.atlanticgold.ca). The website continues to be populated with new information and the Proponent intends for the website to be a hub of information for reference by the community. The purpose of the website is to:

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

The website provides a sign-up location for the quarterly community bulletin (newsletter), which as of July 30th, 2020 had 347 email addresses on its distribution list. The Proponent has issued five Community Bulletins, and two Special Bulletins to announce public comments periods for the Fifteen Mile Stream and Cochrane Hill Gold Projects. The May 15th, 2018 bulletin was delivered to 109 people and had an open rate of 69.5%. The June 31st, 2018 bulletin was delivered to 114 people and had an open rate of 44.6%. The October 15th, 2018 bulletin was delivered to 119 people and had a 47% open rate. The February 2019 bulletin was delivered to 135 subscribers and had an open rate of 48.9%. The November 5th 2019 bulletin was delivered to 252 recipients and had and open rate of 48.1%. The open rate demonstrates interest in the bulletin and that people are opening the email. The bulletins have also been forwarded by the initial recipients meaning the distribution network is wider than the initial recipients.

The Proponent has established an email address - communityrelations@atlanticgold.ca - specifically as a point of contact for the public, and it is monitored regularly and emails are generally responded to within 48 hours.

The Proponent will continue to monitor various social media channels for posts and comments regarding the Project. The purpose of this monitoring will be to check for information being shared regarding the Project, to better understand public questions and concerns, and to identify opportunities to engage. The Proponent has established a social media presence through Twitter, LinkedIn and an Atlantic Gold Corporation YouTube channel. The Twitter account, active since December 18th, 2018, uses the handle @AtlanticGoldCo. This account has 91 followers as of July 30th, 2020. The posts are generally geared to promoting its activity and presence in the Nova Scotia market and to make followers aware of public announcements.

The Proponent has created a series of videos to showcase employment opportunities, business impacts and community impacts. As of July 30th, 2020, the nine videos have been viewed 826,671 times, plus have been shown during presentations made by the Proponent to a variety of stakeholders.

The Proponent established a community phone line (902-391-4653) in March 2018 where the public can call with questions or concerns, or to request a meeting with a representative. This phone line is answered during business hours. This phone line has been advertised on the website, in all newsletters and on a business card given out to those who have expressed interest in further communicating with the Proponent.

3.2.7 Media and Press Releases

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

The Proponent has also been advertising and providing content in the Guysborough Journal to assist in sharing information on the Project.

3.2.8 Meetings with Local Residents and Landowners

Meetings with local residents and landowners occurred opportunistically where specific interests were expressed.

The Project is located in an unpopulated area with no permanent residents within close proximity to the FMS Mine Site. As such, there has been limited need to interact with property owners. However, landowners closest to the mine site were contacted and if they so desired, a phone or face-to-face meeting was conducted.

3.2.9 Complaints Response Procedure

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

3.3 Regulatory Consultation

Regulatory engagement on the Project has been ongoing since early 2018 with a Provincial "One Window Process: Mineral Development in Nova Scotia" meeting on February 21st, 2018. This initial meeting was intended to present the planned Project and to receive feedback on the regulatory regime and access regional expertise.

Departments from federal and provincial governments have been consulted on the Project, including:

- CEA Agency;

- Fisheries and Oceans;
- Environment and Climate Change Canada;
- Canadian Wildlife Service;
- Health Canada;
- Transport Canada;
- Natural Resources Canada;
- Nova Scotia Environment;
- Nova Scotia Transportation and Infrastructure Renewal;
- Nova Scotia Lands and Forestry (formerly Nova Scotia Department of Natural Resources);
- Nova Scotia Energy and Mines (formerly Nova Scotia Department of Natural Resources); and
- Nova Scotia Office Aboriginal Affairs.

Consultation includes one-on-one meetings or correspondence, larger meetings or workshops and site visits. A one-day site visit to the Project (FMS Mine Site and the Touquoy Mine Site) was held for interested provincial and federal regulators on December 7th. 2018 where over 24 regulators attended.

On November 9th, 2018 a site tour that included both the FMS Mine Site and the Touquoy Mine Site was held. The Tour was attended by five representatives from IAAC, two from DFO, one from the Office of Aboriginal Affairs, representatives from Millbrook and KMKNO, along with various experts and support staff from the Proponent.

3.4 Public Engagement Activities

While broader engagement on the Project has occurred for over a decade and will continue as per the community engagement strategy, specific public engagement activities have occurred to support the environmental assessment process for the Project since early 2018. Specifically, this includes community open houses, ongoing two-way information sharing with the CLC, and meetings with interested local stakeholders. These are detailed below and are included in the summary of engagement activities conducted with stakeholders (Appendix K.1)

3.4.1 Community Open Houses

The Proponent has held two open houses regarding the Project. The first was held on March 27th, 2018 and the second on March 14th, 2019.

The first Open House was advertised in the Chronicle Herald (Saturday edition) and the Guysborough Journal two weeks before the event. A flyer was sent to 755 mailboxes in the areas surrounding the FMS Project Area, email invitations issued to local politicians, community groups and provincial departments. In addition, posters were placed in twelve high visibility locations in the Sheet Harbour area. These included:

- Spry Bay Campground and Cabins
- Irving Gas

- Fairwinds Motel and Restaurant
- Home Hardware
- Canada Post
- Foodland
- NSLC
- Lawtons Drugs
- Wilsons Gas Stop
- Sheet Harbour Public Library
- Schooner Place
- Eastern Shore Wildlife Association Building

The Open House was held at the Royal Canadian Legion Branch 28, 23566 Nova Scotia Trunk 7, Sheet Harbour on March 27th, 2018 between 4 and 8 pm. At this Open House, information panels provided an overview of the *CEAA 2012* process, the location of the proposed Project, a high-level overview of the Project, a list of VCs, general information about reclamation and a bullet list of potential impacts. The goal of this Open House was to introduce the Project and the environmental assessment process to the local community, introduce the team members to community members and begin to log questions and issues that would need to be addressed during the EA process. The Proponent had a team of seven attend and approximately 32 members of the public attended the session, including two members of the media. The Proponent hosted the event and provided refreshments and an opportunity to review the eight poster boards. The Poster boards reviewed the following topics:

- Regional Map and Site Map
- Basic Project Description and description of the Role of CEA
- Schematic of the Fifteen Mile Stream Ore Processing
- Basic information relating to the reclamation process
- EA Overview and Timeline, including a description of the *CEAA 2012* process.
- Current site conditions and the EA Valued Components
- Potential Implications for the Community
- Engagement methods, role of the CLC. This board included the following question: What is the best way to consult with you?

The main issues discussed at this Open House included:

- Reclamation plans and bonding;
- The role of the CLC;

- Fish Habitat and baseline study information;
- Questions and clarification regarding processing;
- Species at Risk, Lichen and Moose questions, and
- Questions regarding approval process and where the Proponent was in the process.

All questions were answered by the Proponent team and there was short list of follow-up actions from the meeting which the Proponent completed shortly thereafter.

The second open house was held on March 14th, 2019 at the Eastern Shore Wildlife Association building at 202 Pool Rd in Sheet Harbour. The hours of the Open House were 3-5pm and 6-8pm to provide opportunities for people with different schedules to attend at a convenient time, encouraging the broadest participation possible. The goal of this Open House was to provide detailed information on important technical aspects and conclusions of the Project in advance of the submission of the Environmental Impact Statement, and to receive feedback from the public.

To publicize the Open House, ads were placed in the Guysborough Journal and Chronicle Herald, posters were placed in strategic locations around Sheet Harbour (same locations as used to advertise Open House #1), 1204 flyers were placed in the mailboxes of community members surrounding the FMS Mine Site, a notice was placed on Atlantic Gold's twitter account, and invitations were issued to CLC members, local politicians and community groups. A notice was also placed in the Proponent's quarterly newsletter which was sent in February 2019 and reached 135 subscribers and was subsequently shared by some of those subscribers with other people.

To communicate the plethora of information, 27 poster boards were prepared and presented that covered the following topics:

- Who is Atlantic Gold?
- Maps showing Project Location and FMS Study Area
- Touquoy Mine Site information
- Map showing Project Infrastructure and Seloam Brook Realignment
- Project Components and Current Condition of Site
- Project Phases
- EA Process and listing of Valued Components
- Summary Conclusions of Noise Study and noise contour mapping
- Summary Conclusions of Light modeling
- Geochemistry – Metal leaching and Acid Rock Drainage (two boards)
- Geochemistry – Historic tailings
- Groundwater – model description, radius of Influence and groundwater seepage
- Groundwater – Groundwater monitoring wells (current and proposed)

- Surface Water – Baseline Conditions
- Surface Water – Modelling Methodology
- Surface Water – Operational, closure and monitoring phases
- Fish and Fish Habitat conclusions
- Wetland/Habitat and Flora conclusions
- Fauna conclusions
- Bird conclusions
- Species at Risk & Species of Conservation Interest
- Physical & Cultural Heritage
- Indigenous Peoples – Mi'kmaq of Nova Scotia (two boards)
- Socio-economic Conditions
- Thank you and contact information

The Open House also showcased a physical 3-D model that demonstrated the proposed infrastructure and post-closure scenarios. This model was staffed during the Open House and explained to all who expressed interest in understanding the model.

The Open House was attended by approximately 78 members of the public. The Proponent's team included groundwater and surface water experts, biologists, geotechnical engineers, wetland specialists, metallurgist, human resource specialist, and a community engagement practitioner and land use planner. In total, there were 12 members of the Proponent team providing information and answering questions from the public.

The main issues that arose from this Open House were:

- Concerns about impacts on wildlife;
- Impact of proposal on Game Sanctuary;
- Access road and access to Seloam Lake;
- Managing water quality and water monitoring/water seepage at both the FMS Mine Site and the Touquoy Mine Site;
- Spills;
- Employment opportunities and economic benefits, and
- Traffic.

All questions were answered and addressed.

3.4.2 Community Liaison Committee

There was an initial CLC meeting where the CLC was provided a basic orientation on the functioning of a CLC, an overview of the EA process, opportunities for public comment on the EIS, an overview of the proposed Project, consultation that had occurred as of the date of the meeting. The CLC also met key members of the Proponent team and contact information for each of them. The CLC has subsequently met on the following dates:

- April 29, 2019
- August 6, 2019
- November 4 , 2019
- February 10, 2020 - meeting cancelled due to weather

CLC meetings will occur quarterly and all approved meeting notes will be posted on the Proponent's website.

3.5 Key Issued Raised and Proponent Responses

Table 3.5-1 provides a summary of key issues raised during public engagement activities relative to the EA of the Project. For each key issue identified, a summary of the Proponent's response is provided along with reference(s) to sections in the EIS which more fully addresses the issue.

Table 3.5-1: Summary of Key Issues Raised During Stakeholder Engagement

Key Issue	Summary of Proponent Response	Primary EIS Reference
Request to be informed on the Project activities	The Proponent is committed to maintaining its CLC for the life of the Project. Other aspects of community engagement will continue as per the community engagement strategy.	Section 3.6 Ongoing Community Engagement; Section 6.15.7 Mitigation and Monitoring associated with socio-economic considerations
Concern about volumes of truck traffic in context of safety on public roadways and recreational vehicles	The Proponent explained that there will be approximately 11 additional truck trips required during operation and that the public road system can accommodate this increase.	Section 6.15 Socio-Economic Impact
Questions about contingency planning for accidents and malfunctions	Hazards have been identified and assessed based on risk with mitigations and contingency planning in place. Future detailed planning and implementation of the Project will further address potential accidents and malfunctions.	Section 6.17 Accidents and Malfunctions
Questions about recreational access to Seloam Lake and the impact on the existing access to Seloam Lake	The Proponent committed to creating a new bypass access road to Seloam Lake.	Section 2 Project Description and Section 6.15 Socio-Economic Impact
Concerns about the impact on the Liscomb Game Sanctuary	The Proponent provided information on the history of game sanctuaries, the portion of the sanctuary covered by the Project and land use regulations inside the game sanctuary.	Section 6.15 Socio-Economic Impact
Impacts of Project on Wildlife	The Proponent provided details of wildlife species identified during baseline studies and provided information relating to the magnitude of disturbance to wildlife especially Species at Risk necessary to support Project development, mitigation strategies to reduce interactions with wildlife, and discussions relating to reclamation planning to support Closure Planning and re-establishment of wildlife habitat once mining activities are completed.	Section 6.10 Fauna Section 6.12 Species of Conservation Interest and Species at Risk
Managing water quality and water monitoring/water seepage	The Proponent provided a summary of all predictive water quality modelling work completed to support the EA and summarized for the Public that, if required during operations, water treatment will be completed. During the post-closure stage of Closure Phase, a water treatment system will be required, based on current modelling predictions. Aquatic effects assessment in Anti-Dam Flowage has demonstrated low risk to aquatic organisms as a result of Project discharge.	Section 6.6 Surface Water

Key Issue	Summary of Proponent Response	Primary EIS Reference
Concerns about archeological resources not being found and protected	The Proponent provided information relating to the baseline program completed to identify archaeological features at the FMS Mine Site, avoidance and mitigation measures taken to reduce potential impacts to these features from Project development and resulting residual impact from the Project.	Section 6.14 Physical and Cultural Heritage
Questions about FMS water, fish and impact on Seloam Brook	The Proponent provided information on baseline conditions of Seloam Brook and other surface water bodies, watercourses and wetlands within the Project footprint. Direct and indirect potential impacts to fish and fish habitat from Project development were described. The Seloam Brook Realignment was described to facilitate pit development along with proposed mitigation and offsetting measures (through a Fisheries Act Authorization process) to reduce residual effect to fish.	Section 6.8 Fish and Fish Habitat

In terms of the development of the EIS, there were no additional VCs included other than those identified in the FMS EIS Guidelines (CEAA, 2018); however, many specific monitoring commitments have been made by the Proponent to address concerns. The Proponent has made strong commitments to ongoing community engagement, including local community organizations.

The meetings, site visits, telephone calls, emails, and other correspondence that formed the stakeholder engagement activities are included in Appendix K.1.

3.6 Ongoing Community Engagement

As per the Proponent's engagement strategy, there are many tools to engage stakeholders, including members of the local community, government regulators, NGOs, landowners, and members of the public. As part of submitting the EIS to respective government authorities, the engagement to date associated with the Project was documented, including a summary of issues raised and Proponent responses. The Proponent has a broad objective to continue to engage the community and will continue to implement its strategy. Relative to the Project, specific commitments are made by the Proponent in terms of engagement during the next steps in the EA processes, in consideration of any adjustments required to accommodate necessary public health restrictions relating to COVID-19, including:

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

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

4.0 Indigenous Peoples Consultation and Engagement Program

4.1 Objectives

The Proponent is committed to developing a long-term, positive and productive relationship with the Mi'kmaq of Nova Scotia based on principles of mutual respect, transparency, honesty and integrity, and a partnership approach to engagement. Meaningful engagement is a key component of the Project and began as part of planning and environmental assessment of the Touquoy Gold Project over a decade ago. The engagement has focused on building relationships with the Assembly of Nova Scotia Mi'kmaq Chiefs and the Kwilmu'kw Maw-klusuaqn Negotiation Office (KMKNO), as well as the community members, staff and Chief and Council of nearby Mi'kmaq communities, Millbrook and Sipekne'katik First Nations, and the Pictou Landing First Nation (PLFN) and Paqtnkek First Nation. The Proponent has, and will continue to exchange important Project information and answer questions; discuss the concerns and interests of the Mi'kmaq, including traditional and current use and the importance of the area; discuss potential impacts on the Mi'kmaq and develop avoidance and mitigations strategies together to address their concerns; and, to develop opportunities for involvement in environmental monitoring, and other aspects of the Project.

The FMS EIS Guidelines (CEAA, 2018) for the Project's federal EA process give guidance to the Proponent to complete specific aspects of Mi'kmaq engagement. For Mi'kmaq groups with potential to be most affected by the Project, it was expected that the Proponent would strive toward developing a productive and constructive relationship based on on-going dialogue with the groups in order to support information gathering and effects assessment. Further, the Province of Nova Scotia's *Proponent's Guide: The Role of Proponents in Crown Consultation with the Mi'kmaq of Nova Scotia, 2011* provides guidance on engaging with Indigenous groups. The Proponent continues to follow the guidance from the federal and provincial governments, and intends to build on and strengthen the relationship developed with the Mi'kmaq of Nova Scotia during the past decade.

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

The "Made-in-Nova Scotia Process" is the forum for the Mi'kmaq of Nova Scotia, the Province of Nova Scotia, and the Government of Canada to resolve issues related to Mi'kmaq treaty rights, Aboriginal rights, including Aboriginal title, and Mi'kmaq governance. The process involves the Mi'kmaq of Nova Scotia as represented by the Assembly of Nova Scotia Mi'kmaq Chiefs, and the provincial and federal governments. The federal and provincial governments fulfill their requirements for consultation using the *Updated Guidelines for Federal Officials to Fulfill the Duty to Consult: 2011*, and the *Mi'kmaq-Nova Scotia-Canada Consultation Terms of Reference*. Further, the Nova Scotia *Environmental Assessment Regulations* include a requirement to identify the concerns of Indigenous People regarding potential adverse effects, the steps taken to identify the adverse effects, and the measures proposed to address concerns.

Participation of the Mi'kmaq of Nova Scotia is ongoing in Project discussions, such as the identification of impacts to the Mi'kmaq, and any potential avoidance or mitigation measures; the consideration of Indigenous knowledge in Project planning and development; development and implementation of environmental monitoring plans, wetland and fish compensation planning, reclamation planning, and the CLC. The Proponent respects the consultation, decision-making and governance structures that the Mi'kmaq of Nova Scotia have put in place within their organizations and communities. The focus of engagement has, and will continue to be, with the Assembly and the KMKNO, the communities of Millbrook and Sipekne'katik, as well as the other interested Mi'kmaq communities, such as Pictou Landing and Paq'tnkek First Nations. Aligning mutual interests, such as environmental protection specifically related to current use of land and resources for traditional purposes, is a core part of the Proponent's Mi'kmaq engagement strategy.

4.2 The Mi'kmaq of Nova Scotia

The Mi'kmaq are the original people of Nova Scotia and remain the predominant Indigenous Peoples within the Province. The courts have confirmed that the Mi'kmaq of Nova Scotia have both Aboriginal and Treaty rights protected under Section 35 of the *Constitution Act*. The nature and extent of those rights, as well as the responsibilities and authorities of governments with respect to those rights, are the subject of negotiation between the federal and provincial governments and the Mi'kmaq of Nova Scotia, as described above.

The Mi'kmaq Nation of Nova Scotia have a general interest in all lands and resources as the Mi'kmaq Nation maintain that they did not give up their land rights through treaty, voluntary cessation, or otherwise. The Mi'kmaq of Nova Scotia maintain a claim of Aboriginal title to the lands and waters of Nova Scotia and adjacent areas of the offshore.

As part of the Umbrella and Framework Agreements developed for the Made-in-Nova Scotia Process, a draft Consultation Terms of Reference (TOR) was adopted in 2007. After a three-year pilot period, the thirteen Mi'kmaq communities, through the Assembly of Nova Scotia Mi'kmaq Chiefs, signed the Mi'kmaq-Nova Scotia-Canada Consultation TOR in 2010 with the Governments of Canada and Nova Scotia. The TOR lays out a process for the parties to follow when governments wish to consult with the Mi'kmaq of Nova Scotia. The Made-in-Nova Scotia Negotiation Process and the historic development of the Consultation TOR are based on the principle of the Mi'kmaq of Nova Scotia as one Mi'kmaq Nation.

Nova Scotia has thirteen Mi'kmaq First Nation communities with a total registered population of 16,760 as of 2017, including both on- and off-reserve populations (AANDC 2019). The Assembly of Nova Scotia Mi'kmaq Chiefs (ANSMC) represents all thirteen communities in dealings with the Crown. The Kwilmu'kw Maw-klusuaqn Negotiation Office (KMKNO) is the administrative group that represents the ANSMC in the consultation and negotiations with the Province of Nova Scotia and the Government of Canada. Millbrook and Sipekne'katik First Nations have chosen to consult through their own community Chief and Councils, rather than the KMKNO.

As part of engagement with the Mi'kmaq of Nova Scotia, the following are groups who were listed in the FMS EIS Guidelines (CEAA, 2018) as being possibly affected by the Project. These include the thirteen Mi'kmaq First Nations in Nova Scotia, the Assembly of Nova Scotia Mi'kmaq Chiefs, and the KMKNO:

- Acadia First Nation;
- Annapolis Valley First Nation;
- Bear River First Nation;
- Potlotek First Nation;
- Eskasoni First Nation;
- Glooscap First Nation;
- Membertou First Nation;
- Millbrook First Nation;
- Paq'tnkek (Afton) First Nation;
- Pictou Landing First Nation;
- Sipekne'katik First Nation;
- Wagmatcook First Nation;
- We'koqma'q First Nation and

- Assembly of Nova Scotia Mi'kmaq Chiefs, and the KMKNO.

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

The Mi'kmaq communities of Millbrook and Sipekne'katik First Nations have registered total populations of 1,926 and 2,734, respectively. As stated above, the two communities have chosen to represent themselves directly in consultation with the Crown. As part of Millbrook First Nation, there are two communities near the Project: Beaver Lake Indian Reserve (IR) I7 with an on-reserve population of about 21 and Sheet Harbour IR 36 with an on-reserve population of about 25 (Statistics Canada 2017). These two communities are both approximately 25 km from the FMS Mine Site.

The Proponent's approach to Mi'kmaq engagement and participation in the development of the EIS has respected the current framework for engaging with the Mi'kmaq in Nova Scotia – providing Project information, draft Mi'kmaq Impact Statement with proposed mitigations measures to the KMKNO, Millbrook and Sipekne'katik First Nations. At the request of the KMKNO, the Pictou Landing First Nation and Paq'tnkek First Nation were also contacted by the Proponent.

The Proponent has used a similar approach to the discussion of potential benefits and opportunities related to the Project – focusing on discussions with the ANSMC/KMKNO, Millbrook and Sipekne'katik First Nation communities.

4.3 Key Engagement Activities

As part of an overall Indigenous Peoples Engagement Plan, the Proponent's approach to Mi'kmaq engagement allows for flexibility to permit adaptation based on discussions and feedback from the Mi'kmaq and ongoing development of the Proponent's projects.

The Proponent uses the following methods, depending on the need, to engage with the Mi'kmaq of Nova Scotia:

- One-window regulatory meetings
- Face-to-face meetings with Mi'kmaq organizations, Chiefs and Councils and communities
- One point of contact for the Mi'kmaq of Nova Scotia
- Phone calls
- Emails
- Dropbox and FTP sites for documentation
- Mi'kmaq community open houses
- Public open houses and town hall meetings
- Site visits and tours
- Newsletters and regular Project Updates
- "Plain Language Project Summaries"
- Website and other digital and social media

In addition to the Proponent's engagement program related to the environmental assessment, the following elements are being discussed to further develop the company's decade-long relationship with the Mi'kmaq of Nova Scotia – one that has been built on mutual understanding and transparency, maintaining flexibility and open lines of communication to adjust implementation as the relationship and Project develops:

Providing opportunities and benefits to all Mi'kmaq in Nova Scotia. Benefits can take the form of, but are not limited to: opportunities for training and capacity building, contracting and procurement, support for education and employment, supporting cultural and traditional activities of the Mi'kmaq of Nova Scotia, and, providing cultural learning exchange opportunities for mining staff.

Engagement to date has been positive and productive; and, the relationship was formalized in a 2014 Memorandum of Understanding (since expired) with the ANSMC. The Proponent initiated the engagement program on FMS in early 2018 with "One Window" regulatory meetings with all potential regulatory agencies, and the Mi'kmaq of Nova Scotia have representation at the "One Window" meetings. Public open houses followed the regulatory meetings to provide general information on the proposed Project to all interested community members. The public open houses were followed by a series of face-to-face meetings with Millbrook and Sipekne'katik First Nations, and the KMKNO through to the end of 2018. All information regarding the EIS and the EA process was shared and discussed during these meetings, including archaeological reports, summaries of potential impacts and mitigations, and other key details of the Project. The Proponent also arranged a tour of the area and invited both Millbrook and Sipekne'katik First Nations to participate in the Community Liaison Committee (CLC).

In 2019, the Proponent held community open houses, and continued to exchange information with the KMKNO, and Millbrook and Sipekne'katik First Nations, and attempted to organize meetings to discuss Project information, traditional and current use of the area by the Mi'kmaq of Nova Scotia, and potential impacts and mitigations. In late 2019, meetings were held to discuss the ongoing engagement process.

The Proponent met with the ANSMC/KMKNO in early 2020, prior to the global pandemic that was declared on March 11, 2020. Since that time, the Proponent continued internal work to further understand any potential impacts of the proposed Project on Mi'kmaq rights, such as ensuring all Indigenous perspectives that have already been shared with the Proponent were considered, and any additional opportunities to understand specific impacts on current and traditional practices and perspectives identified. It is anticipated that these discussions will continue during the EIS review process.

The Proponent suspended all Project-related engagement activities in early March 2020 as everyone began to contend with protection and prevention in communities, and the associated uncertainties and risks. The Proponent kept in contact with communities during Nova Scotia's "lockdown" period from March to June 2020 and moved any engagement activity online. An online/virtual meeting was held with Millbrook First Nation's Chief and Council in early May 2020 to provide an overview of the FMS and other Proponent projects to new council members. In July, the Proponent met with the KMKNO to discuss potential impacts and mitigations, and sought meetings with the Pictou Landing and Paq'tnkek First Nations. In December 2020, an online/virtual meeting was held with Pictou Landing First Nation, Paqtnkek First Nation and KMKNO to review potential impacts, mitigation measures and to request additional current use information.

It is anticipated, both by the Proponent and those representing the Mi'kmaq of Nova Scotia that engagement will continue throughout and beyond the current environmental assessment process. This will require ongoing dialogue regarding potential impacts on Mi'kmaq communities, and the Proponent is committed to continuing those discussions.

A record of all engagement activities conducted between 2018 and the current date is provided in the Summary of Mi'kmaq of Nova Scotia Engagement Activities and Supporting Documentation in Appendix K.2.

4.3.1 Community Liaison Committee

The CLC for the Project has its first meeting in December 2018. These meetings are active and on-going quarterly. The Mi'kmaq were invited to participate but prefer direct engagement with the Proponent. The Proponent continues to welcome Mi'kmaq participation on the CLC either as guests or with full membership.

4.3.2 Other Engagement

As part of the engagement strategy for the Project, the Proponent invited the Mi'kmaq to the 2018 One Window meeting with provincial and federal regulators. The One Window meetings are designed to introduce the Project to regulators and allow for different provincial and federal departments to work together to improve efficiency and reduce overlap to "ensure significant issues are addressed in a thorough and timely manner."[i] By having Mi'kmaq participation as part of the One Window process, it allowed for more transparent communication among rightsholders and regulators.

Representatives from Sipekne'katik First Nation and KMKNO attended the One Window meeting on March 7th, 2018.

4.4 Key Issues Raised by the Mi'kmaq of Nova Scotia and Proponent Responses

As part of submitting the EIS and EARD to respective government authorities, the Mi'kmaq engagement to date associated with the Project was documented, including a summary of key issues raised, Proponent responses and associated adjustments to Project design. This summary also includes general and specific feedback received from the Mi'kmaq of Nova Scotia. Note that Project adaptation will continue, as needed and practicable, through ongoing engagement with the Mi'kmaq.

For each key issue identified in Table 4.4-1, a summary of Proponent response is provided along with reference(s) to sections in this EIS which address the issue.

Table 4.4-1 Summary of Key Issues Raised During Mi'kmaq Engagement

Key Issue	Summary of Proponent Response	Primary EIS Reference
Dust from the FMS Mine Site Infrastructure and potential impacts to traditional practices including ingestion of dust by plants and animals	• Minimization of air emissions with mitigation measures. Monitoring for air quality, including total suspended particulates, will be completed • Commitment to dust suppression (water and chemical treatment if required) to reduce impact • Completion of human health risk assessments to assure the communities that plants and animals are safe to eat and that water is safe for swimming	Section 6.2 Air
Elevated noise and light levels impacting hunting practices near the mines	• The Proponent has worked with communities to understand where they hunt and whether elevated light and noise levels in close proximity to the mines is a concern based on hunting patterns • Implementation of measures to reduce noise and light during operations and from trucks to minimize impact	Section 6.2 Air Section 6.1 Noise Section 6.13 Mi'kmaq of Nova Scotia
Quality of water being discharged into streams, rivers and lakes and potential effect on fish and other aquatic species	• Managing site water to a single point of discharge wherever practicable • Committed to water treatment when needed, prior to discharge • Committed to a robust monitoring program to confirm water quality • Committed to Indigenous participation in monitoring programs including Environmental Effects Monitoring in receiving waters	Section 6.6 Surface Water
Impacts to fish and fish habitat	• Planning to reduce direct and indirect impact. Moving infrastructure to avoid fish habitat – example, waste rock storage area and tailings management facility options at FMS • Predictive modelling to understand how the mine operations may indirectly impact fish habitat so that monitoring can be planned to confirm these predictions and adapt as required • Implementation of the Seloam Brook Realignment to mitigate for lost fish habitat and ensure connectivity from Seloam Brook downstream to Fifteen Mile Stream • Commitment to Offsetting Plans to compensate for lost fish habitat, and Indigenous participation in plan development and implementation	Section 6.8 Fish and Fish Habitat

Key Issue	Summary of Proponent Response	Primary EIS Reference
Reclamation Planning and concerns regarding timing for renewed access to the site after active mining is completed	• The FMS facilities will be removed, the pit will fill with water and disturbed surfaces covered/capped, as required, and then reclaimed with stockpiled topsoil and re-vegetated. The site will be returned to landowner for forestry and recreational use • Access can be regained once active reclamation has been completed (2 years after mining is completed). The landscape at this time will not be equivalent to baseline conditions, as the forested habitat will not have had time to re-establish, but it is expected that traditional practices can resume on the landscape. This conclusion has been shared with the Mi'kmaq, however, to date, no specific feedback has been shared with the Proponent. Dialogue related to this item will continue throughout the EA review process	Section 2 Project Description
Contingency planning for accidents and malfunctions. For example, the Mi'kmaq have shared their concerns regarding dam integrity and safety at the Tailings Management Facility (TMF) The Proponent has developed a pilot Emergency Response Communication Plan with the Mi'kmaq of Nova Scotia	• Hazards have been identified and assessed based on risk. Mitigation measures and contingency planning will be in place to address potential accidents and malfunctions • Regarding dam integrity, the EIS evaluates the potential for an accident and identified a dam breach as a High hazard classification. The TMF has been situated in a position that limits impact to people, wetlands and streams to the maximum practical extent. There are also no residents within 5 km of the TMF • The EIS indicates that should a total breach of the TMF occur, the impacts to the surrounding environment would be high and have a regional geographic extent • Based on the High dam hazard consequence classification and the applied design criteria, the design incorporates increased conservatism to reduce the likelihood of failure • The TMF will be designed by a Design Engineer/Engineer of Record with specific and extensive experience in designing, constructing, operating and monitoring/maintaining such structures • Completion of a Dam Breach Inundation Study for incorporation into an Emergency Response Plan • Development of an Operation, Monitoring and Surveillance Manual (OMS) which provides a documented framework for actions, and a basis for measuring performance and demonstrating due diligence during the operational phase of the Project • Completion of Independent Dam Safety Reviews (DSR), to further monitor operation, maintenance, surveillance, and performance of the dams during Operations and Closure • The TMF dams have been designed to meet Canadian Dam Association (CDA) Dam Safety Guidelines (CDA, 2013 & 2014)	Section 2 Project Description Section 6.17 Accidents and Malfunctions

Key Issue	Summary of Proponent Response	Primary EIS Reference
Habitat loss from Project development, including forest, wetlands, flora and fauna	• There is historical disturbance at the FMS Study Area from forestry activities, and historical mining. • The FMS Mine Site will be reclaimed at end of operation. Existing facilities will be used for processing and tailings management at the Touquoy Mine Site, minimizing new disturbed footprint at the FMS Mine Site • The Proponent will prepare a Wetland Compensation Plan, with participation from Mi'kmaq organizations, to offset wetland losses as a result of Project development • Permitting may be required for Species at Risk, and any monitoring requirements will be determined during permitting, in consultation with NSL&F • The Proponent will prepare a Blue Felt Lichen Translocation Plan • Habitat loss is limited to the temporal scale of the Project (eleven years) and reclamation will take place to revegetate stockpiles, TMF and reclaimed areas	Section 6.9 Habitat and Flora Section 6.12 Species of Conservation Interest and Species at Risk
Impacts to Fish Habitat from the realignment of Seloam Brook	• Disturbance of Seloam Brook and options for realignment. Seloam Brook is a disturbed system impacted by historical mining activities • Commitment to development of the Seloam Brook Realignment consisting of a natural channel/floodplain system that will mimic or improve habitat lost as a result of pit development • The Proponent has shared conceptual plans relating to the proposed Seloam Brook Realignment with Mi'kmaq communities. To date, no specific concerns have been communicated relating to this aspect of the Project, beyond the broader question relating to impacts to fish and fish habitat described above. Dialogue on this topic will continue throughout the EA process	Section 2 Project Description Section 6.8 Fish and Fish Habitat
Legacy contamination issues. Long term storage and safety of tailings and other contamination	• Containment and management of historical tailings within approved on-site storage facilities at the mine sites • Reclamation bonding to ensure long-term monitoring and remediation of mine sites	Section 2 Project Description Section 6.5 Geology, Soils and Sediment

Key Issue	Summary of Proponent Response	Primary EIS Reference
Loss of habitat and access to mine sites to undertake traditional practices, such as hunting, harvesting, fishing	• The loss of access within the FMS Mine Site is for an eleven-year timeframe and has been communicated to the Mi'kmaq. • Reduce mine site footprints through infrastructure placement and planning • Seloam Lake is important for fishing and is used by the Mi'kmaq. The Proponent has planned bypass roads to allow for continued access to Seloam Lake and lands farther east of the FMS Mine Site • Wetland and fish habitat restoration will be completed to compensate for lost wetland and fish habitat • Commitment to reclamation with Mi'kmaq participation in planning and implementation to restore habitats and allow traditional practices to resume within the Mine Site • Re-vegetation with a native mix of plants determined in consultation with Mi'kmaq communities • The Proponent has documented large tracts of available crown land adjacent to the FMS Mine Site that has similar habitat characteristics and access routes to that of the FMS Mine Site. The Proponent has indicated to the Mi'kmaq of Nova Scotia that these tracts of crown land may form suitable alternative lands for the continuation of traditional practices during the temporal window when the lands within the FMS Mine Site are not available. To date, no specific feedback on this proposed mitigation measure has been provided by the Mi'kmaq of Nova Scotia. Dialogue will continue throughout the EA process and the Proponent is committed to on-going adjustments in proposed mitigation measures as requested by the Mi'kmaq of Nova Scotia relating to loss of access	Section 6.13 Mi'kmaq of Nova Scotia
Cumulative loss of area for traditional practices from industrial development along the Eastern Shore Changing landscape within Eskikewa'kik	• Project design to complete processing at existing Touquoy Mine to reduce waste and mine footprints at FMS and BD • Reduce mine site footprints through infrastructure placement and planning • Use of existing transportation routes wherever possible to avoid additional fragmentation of habitats • Evaluation of Crown land loss in Eskikewa'kik from known and planned projects to support project analysis	Section 8 Cumulative Effects Assessment
Request for ongoing engagement with the Mi'kmaq of Nova Scotia	• The Proponent is committed to ongoing Mi'kmaq engagement and participation for the life the Project – prior to, during and post environmental assessment. This includes communication and information sharing, face-to-face meetings, discussion of impacts and mitigations, and any other issues that may arise as the Project develops	Section 4. Indigenous Engagement Section 10 Follow-up and Monitoring

In terms of the development of the EIS, there were no additional VCs included in addition to those identified in the FMS EIS Guidelines (CEAA, 2018) associated with the input from the Mi'kmaq of Nova Scotia. The VCs listed in the Guidelines addressed the issues brought forward to date during engagement. The issues raised during Mi'kmaq engagement activities were incorporated into the design of the Project where possible, and the development of the EIS (Table 4.4-1). The questions and issues raised required additional planning and review by the Proponent in order to work to minimize impacts, and to address Mi'kmaq concerns. Table 4.4-1 above documents how the Proponent addressed, or proposes to address, Mi'kmaq questions and concerns. Commitments identified in Table 4.4-1 have been reviewed with the Mi'kmaq of Nova Scotia and support an overall reduction of Project impact. These commitments allow for opportunities for the Mi'kmaq to continue providing more detail on their traditional use of the area as the Project progresses; participate in planning and implementation of key aspects of the Project, including fish habitat offsetting, wetland restoration, reclamation planning, and the design and implementation of monitoring programs, among others.

As part of the Proponent's engagement of the Mi'kmaq completed to date on the Project, the potential effects and the proposed mitigation measures and monitoring programs provided in the EIS were presented and discussed directly with interested Mi'kmaq communities and organizations. The objective was to provide information on the Project to the Mi'kmaq and for the Proponent to better understand the views of the Mi'kmaq on the potential effects and proposed mitigation measures and monitoring programs; this supported the development of the EIS. Specifically, alongside on-going meetings with the KMKNO and Mi'kmaq communities, documents have been shared, with requests for feedback and input from the Mi'kmaq communities, to support communication of EIS conclusions, summary of technical VC impacts, summary of Mi'kmaq impacts, mitigation measures and proposed monitoring plans. Exchange has also taken place to support Proponent knowledge and learning relating to specificity of traditional use of the land in the area surrounding the Project, and also to support broader understanding of potential effects of the Project on the economic, social and mental well-being of the Mi'kmaq of Nova Scotia.

Information that has been shared directly with the KMKNO, Pictou Landing First Nation, Paq'tnkek First Nation, Millbrook First Nation and Sipekne'katik First Nation (for review and feedback), includes, but is not limited to:

- EIS Technical Poster Boards;
- Draft EIS document submitted to IAAC in October 2019 [subject to conformity review] including MEKS and Archaeological Reports;
- EIS Summary document;
- Questionnaire to support understanding of traditional use of the land, and a broader understanding of potential impacts to the economic, mental and social well-being of the Mi'kmaq of Nova Scotia (Appendix K.2);
- FMS Plain Language Summary (Appendix K.2); and,
- Draft Mi'kmaq Impact Statement (Appendix K.2).

It is the opinion of the Proponent that Mi'kmaq groups engaged were open to the Project as presented with its mitigation measures and monitoring programs; however, the Project team have heard directly from the Mi'kmaq that their views on Project conclusions will be further developed as part of the detailed review of this EIS once released, as part of their participation in the federal and provincial EA processes.

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

4.5 Ongoing Indigenous Peoples Engagement

As mentioned above, the Proponent is committed to ongoing engagement with the Mi'kmaq of Nova Scotia throughout the lifecycle of all of its projects. As part of submitting the EIS and EARD to respective government authorities, the engagement to date associated with the Project was documented, including a summary of issues raised and proponent responses and adjustments to the Project. The Proponent has a broad objective to continue to engage the community and will continue to meet with KMKNO, Millbrook and Sipekne'katik First Nations to continue dialogue on the Project, review proponent conclusions, proposed mitigation measures, and opportunities for Mi'kmaq participation in the EIS. The Project team have heard from the Mi'kmaq that the majority of specific and detailed commentary on EIS summary of impacts and mitigation measures will be provided during EIS review and information request (IR) processes, post submission to IAAC.

Ongoing engagement with the Mi'kmaq of Nova Scotia will include the following activities, in consideration of any adjustments that may be required to address public health requirements relating to COVID-19:

- Request and support the gathering of more detailed information on Mi'kmaq traditional use of the area;
- Request feedback on EIS conclusions;
- Meet (in person or virtually) with any other interested Indigenous organizations and Mi'kmaq communities in Nova Scotia; and,
- Develop potential partnerships with Mi'kmaq environmental groups on specific ecological monitoring and restoration projects.

Engagement planning needs to be flexible. The Proponent will continue to address and respond to additional questions or concerns identified or issues noted as the EA moves forward into Project development, operation and reclamation. The Proponent is strongly committed to continue its engagement with the Mi'kmaq of Nova Scotia in the ongoing spirit of cooperation and with mutual benefit and respect.

5.0 Environmental Effects Assessment Methodology

5.1 Scope of the Environmental Assessment

5.1.1 Designated Project

The Project being assessed through this EIS is a proposed surface gold mine consisting of the construction, operation, and closure of a surface mine and processing facility, known as the Project. The Project will encompass two primary locations spanning from Trafalgar to Moose River Gold Mines, Halifax County, Nova Scotia.

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

<u>Physical Components</u>

- Open pit (ore extraction area);
- Materials storage (including WRSA, till/overburden, topsoil stockpiles);
- ROM and LGO stockpiles;
- Site infrastructure;
- Crusher and concentrator facilities;
- TMF;
- Mine site haul roads;
- Access roads;
- Water management system including water discharge;
- Power spur line;
- Local traffic bypass;
- Seloam Brook Realignment (realignment channel and diversion berm) around open pit; and,
- Touquoy Mine Site (processing of concentrate) and exhausted pit (deposition of tailings)).

<u>Physical Activities</u>

- clearing, grubbing, and grading;
- drilling and rock blasting;
- topsoil, till, and waste rock management;
- watercourse and wetland alteration;

- Seloam Brook Realignment construction and dewatering;
- mine site road construction, including lighting;
- surface infrastructure installation and construction, including lighting;
- collection ditch and water management pond construction, including lighting;
- local traffic bypass road construction;
- culvert and bridge upgrades and construction;
- open pit dewatering;
- ore management;
- waste rock management;
- tailings management;
- surface water management;
- dust and noise management;
- petroleum products management;
- site maintenance and repairs, including lighting;
- ore processing and plant site operations
- concentrate loading and haulage;
- concentrate processing equipment upgrades;
- water treatment and management
- infrastructure demolition;
- site reclamation;
- environmental monitoring; and,
- general waste management.

These components and activities reflect the scope of the Project outlined in Section 3.1 of the FMS EIS Guidelines (CEAA, 2018) and reflect the components and activities that would occur throughout the duration of the Project. The effects assessment outlined in Section 6 of this EIS is formed based on these components and activities.

Refer to Section 2.2 and Section 2.4 of this EIS for additional details regarding Project components and activities. Refer to Table 5.7-1 and Table 5.7-2 for a review of the potential interactions between VCs and the Project components/activities outlined above.

5.1.2 Factors to be Considered

This EIS considers all factors outlined in Section 19(1) of *CEAA 2012* and Section 3.2 of the FMS EIS Guidelines (CEAA, 2018). Specifically, this includes the following:

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

5.1.3 Scope of Factors to be Considered

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

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

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

   ii. aquatic species as defined in subsection 2(1) of the *Species at Risk Act*,

   iii. migratory birds as defined in subsection 2(1) of the *Migratory Birds Convection Act*, 1994, and

   iv. any other component of the environment that is set out in Schedule 2;

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

   i. on federal lands,

   ii. in a province other than the one in which the act or thing is done or where the physical activity, the designated project or the project is being carried out, or

   iii. outside Canada; and

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

  i. health and socio-economic conditions,

  ii. physical and cultural heritage,

  iii. the current use of lands and resources for traditional purposes, or

  iv. any structure, site, or thing that is of historical, archaeological, paleontological, or architectural significance.

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

a) a change, other than those referred to in paragraphs 5(1)(a), (b) of *CEAA 2012* (and above) that may be caused to the environment and that is directly linked or necessarily incidental to a federal authority's exercise of a power or performance of a duty or function that would permit the carrying out, in whole or in part, of the physical activity, the designated project or the Project; and

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

  i. health and socio-economic conditions,

  ii. physical and cultural heritage, or

c) Any structure, site or thing that is of historical, archaeological, paleontological, or architectural significance.

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

5.2 Overview of Approach

The methodology used to conduct the EA and predict the effects of the Project was developed to meet the requirements of the FMS EIS Guidelines issued by CEAA in August 2018. The FMS EIS Guidelines include requirements for EAs under *CEAA 2012* and the Nova Scotia Environmental Assessment Regulations made under the Nova Scotia *Environment Act*. In addition to these requirements, the EA methodology was developed to incorporate:

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

The following sections will describe the methodology used to derive:

- the general rationale in VC selection;
- the spatial, temporal, administrative, and technical boundaries for assessing effects on VCs;

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

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

5.3 Valued Components Selection

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

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

- regulatory guidance and requirements, specifically those outlined in Section 7.3 of the FMS EIS Guidelines provided by CEAA in August 2018 and Section 5 of *CEAA 2012*. Refer to Section 5.1.3 of this EIS for a discussion of *CEAA 2012* Section 5 requirements;
- a review of federal, provincial, and municipal legislation, including an appraisal of species of conservation interest (SOCI) and SAR. Section 3.2.2 of the FMS EIS Guidelines specifically requires consideration of the factors listed in Section 79 of SARA;
- The Environmental Assessment Regulations made under Section 49 of the Nova Scotia *Environment Act* (NSE, 1995) and associated guidance documents including the Guide to Preparing an EA Registration Document for Mining Developments in Nova Scotia (NSE 2002b);
- workshops and discussions with representatives of IAAC, DFO, ECCC, TC, NSE, and NSL&F;
- concerns raised by the public through open house meetings hosted by the Proponent;
- concerns raised by the Mi'kmaq of Nova Scotia, including traditional ecological knowledge obtained through completion of a Mi'kmaq Ecological Knowledge Study (MEKS);
- technical aspects of the Project, including the nature and extent of Project activities;

- the existing physical, biophysical, and socio-economic conditions and characteristics of the Project Area;
- a review of publicly available information and reports submitted in support to nearby and similar environmental assessments; and,
- the professional experience of the EA Study Team.

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

Physical VCs

- noise;
- light;
- air and greenhouse gases;
- geology, soil, and sediment quality;
- groundwater quality and quantity; and,
- surface water quality and quantity.

Biophysical VCs

- wetlands;
- fish and fish habitat;
- habitat and flora;
- terrestrial fauna;
- avifauna; and,
- SOCI and SAR.

Socio-economic VCs

- Mi'kmaq of Nova Scotia;
- physical and cultural heritage; and,
- socio-economic conditions.

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

Table 5.3-1: Rationale for Selection of Valued Components

Environment	Valued Component (VC)	VC Section Rationale							Considerations relating to Selection of Valued Components
		Project-Environment Interaction	Regulatory Requirement (IAAC or NSE)	Biophysical Context	Socio-Economic Context	Potential Human Health Pathway	Cultural	IAAC or Public Concern	
Physical Environment	Air and GHGs	D, I	✓	✓		✓		✓	• Potential for direct and indirect adverse effects to air quality • Indirect potential pathway for adverse effects to surface water quality, wetlands, fish and fish habitat, habitat and flora, avifauna, fauna, SOCI/SAR, Mi'kmaq of Nova Scotia, and human health
	Noise	D, I	✓	✓		✓		✓	• Potential for increases in noise levels • Indirect potential pathway for adverse effects to fauna, avifauna, SOCI/SAR, and Mi'kmaq of Nova Scotia
	Light	D, I	✓	✓				✓	• Potential for increases in ambient light levels • Indirect potential pathway for adverse effects to fauna, avifauna, SOCI/SAR, Mi'kmaq of Nova Scotia and broader human populations
	Geology, Soils and Sediment	D, I	✓	✓				✓	• Potential for direct and indirect adverse effects to sediment quality • Potential for ARD from Halifax Formation Bedrock (addressed in surface water VC) • Indirect potential pathway for adverse effects to surface water quality, wetlands, fish and fish habitat, habitat and flora, fauna, avifauna, SAR/SOCI, Mi'kmaq of Nova Scotia and human health

Environment	Valued Component (VC)	VC Section Rationale							Considerations relating to Selection of Valued Components
		Project-Environment Interaction	Regulatory Requirement (IAAC or NSE)	Biophysical Context	Socio-Economic Context	Potential Human Health Pathway	Cultural	IAAC or Public Concern	
	Groundwater Quality and Quantity	D	✓			✓		✓	• Potential for direct adverse effects to groundwater quality • Potential for direct adverse effects to groundwater quantity • Indirect potential pathway for adverse effects to surface water, wetlands, fish and fish habitat, avifauna, fauna, SOCI/SAR, Mi'kmaq of Nova Scotia, and human health
	Surface Water Quality and Quantity	D, I	✓	✓		✓		✓	• Potential for direct and indirect adverse effects to surface water quality • Potential for direct and indirect adverse effects to surface water quantity • Indirect potential pathway for adverse effects to wetlands, fish and fish habitat, avifauna, fauna, SOCI/SAR, Mi'kmaq of Nova Scotia, and human health
Biophysical Environment	Wetlands	D, I	✓	✓				✓	• Potential for direct and indirect loss and/or adverse effects to wetlands and their function • Indirect potential pathway for adverse effects to surface water quality and quantity, fish and fish habitat, habitat and flora, avifauna, fauna, Mi'kmaq of Nova Scotia, and SOCI/SAR
	Fish and Fish Habitat	D, I	✓	✓		✓		✓	• Potential for direct and indirect adverse effects to fish and fish habitat • Indirect potential pathway for adverse effects to avifauna, fauna, SOCI/SAR, Mi'kmaq of Nova Scotia, and human health

Environment	Valued Component (VC)	VC Section Rationale							Considerations relating to Selection of Valued Components
		Project-Environment Interaction	Regulatory Requirement (IAAC or NSE)	Biophysical Context	Socio-Economic Context	Potential Human Health Pathway	Cultural	IAAC or Public Concern	
	Habitat and Flora	D, I	✓	✓		✓		✓	• Potential for direct loss of habitat • Potential for direct and indirect adverse effects to flora • Indirect potential pathway for adverse effects to the surface water quality and quantity, wetlands, fish and fish habitat, avifauna, fauna, SOCI/SAR, Mi'kmaq of Nova Scotia, and human health
	Fauna	D, I	✓	✓		✓		✓	• Potential for direct and indirect adverse effects to fauna • Indirect potential pathway for adverse effects to avifauna, Mi'kmaq of Nova Scotia, and human health
	Avifauna	D, I	✓	✓				✓	• Potential for direct and indirect adverse effects to avifauna • Indirect potential pathway for adverse effects to fauna, and Mi'kmaq of Nova Scotia
	Species at Risk and Species of Conservation Interest	D, I	✓	✓				✓	• Potential for direct and indirect adverse effects to SOCI/SAR • Indirect potential pathway for potential adverse effects to avifauna and fauna
Socio-Economic Environment	Mi'kmaq of Nova Scotia	D, I	✓		✓	✓	✓	✓	• Potential for direct or indirect adverse effects to the current use of land and resources for traditional purposes, archaeological features and the socio-economic condition and health of the Mi'kmaq of Nova Scotia

Environment	Valued Component (VC)	VC Section Rationale							Considerations relating to Selection of Valued Components
		Project-Environment Interaction	Regulatory Requirement (IAAC or NSE)	Biophysical Context	Socio-Economic Context	Potential Human Health Pathway	Cultural	IAAC or Public Concern	
	Physical and Cultural Heritage	D	✓		✓		✓	✓	• Potential for direct adverse effects to archaeological sites
	Socio-Economic Conditions	D, I	✓		✓		✓	✓	• Employment opportunities • Economic indirect employment opportunities • Contribution to government revenue through taxation
Legend (refer to Section 5.7 for examples) D: Direct Interaction I: Indirect Interaction									

5.4 Project Boundaries

5.4.1 Temporal Boundaries

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

The construction phase will be completed in one year, while the operation phase will last 7 years. Closure activities, commencing with the reclamation stage, will commence after operation has ceased and will likely occur over a two to three year period, followed by the post-closure stage, which includes pit filling, on-going TMF reclamation, and, depending on water quality, requirements for water treatment, and other monitoring requirements. Temporal boundaries for each VC are described in their corresponding subsection within Section 6 of this EIS.

5.4.2 Spatial Boundaries

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

5.4.2.1 Project Area (PA)

The PA encompasses the immediate area in which Project activities may occur and are likely to cause direct and indirect effects to VCs. This area has also been identified as the FMS Study Area for the purposes of baseline investigations. The FMS PA encompasses two primary components from Trafalgar to Moose River Gold Mines, Halifax County, NS. The first component is the FMS Mine Site which will be located east of Highway 374 near Seloam Lake, and the second component is the Moose River Gold Mines, where the Touquoy Mine Site [processing, TMF and exhausted pit (to be used to process and dispose of FMS gold concentrate)] is located. Figure 1.1-1 outlines the PA.

5.4.2.2 Local Assessment Area (LAA)

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

5.4.2.3 Regional Assessment Area (RAA)

The RAA encompasses all Project and VC interactions including diffuse or longer-range effects such as those from Project activities on socio-economic conditions. The RAA may vary in size depending on the VC being considered, and the biological and physical variables present, and is generally larger than direct and indirect effects are expected for each VC. The RAA is used to support cumulative effects assessment (CEA).

Spatial boundaries will vary for each VC. Table 5.4-1 describes the spatial boundaries for each VC, and detailed descriptions and justification for the LAA and/or RAA are provided within the corresponding subsection within Section 6 of this EIS.

5.4.3 Administrative Boundaries

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

5.4.4 Technical Boundaries

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

Table 5.4-1: Spatial Boundary Rationale for Valued Components

Environment	Valued Component (VC)	Project Area	Local Assessment Area	Regional Assessment Area	Spatial Boundary Selection Rationale
Physical Environment	Air and Greenhouse Gases	✓	✓		Effects from the Project on air quality may potentially occur within and immediately adjacent to the PA, therefore, this VC is evaluated at the LAA boundary
	Noise	✓	✓		Effects from the Project on noise may potentially occur within and immediately adjacent to the PA, therefore, this VC is evaluated at the LAA boundary
	Light	✓	✓		Effects from the Project on light may potentially occur within and immediately adjacent to the PA, therefore, this VC is evaluated at the LAA boundary
	Geology, Soils and Sediment	✓	✓		Effects from the Project on geology, soils and sediment may potentially occur within and immediately adjacent to the PA, therefore, this VC is evaluated at the LAA boundary
	Groundwater Quality and Quantity	✓	✓		Effects from the Project on groundwater quality and quantity may potentially occur within and immediately adjacent to the PA, therefore, this VC is evaluated at the LAA boundary
	Surface Water Quality and Quantity	✓	✓		Effects from the Project on surface water quality and quantity may potentially occur within and immediately adjacent to the PA, therefore, this VC is evaluated at the LAA boundary

Environment	Valued Component (VC)	Project Area	Local Assessment Area	Regional Assessment Area	Spatial Boundary Selection Rationale
Biophysical Environment	Wetlands	✓	✓		Effects from the Project on wetlands may potentially occur within and immediately adjacent to the PA, therefore, this VC is evaluated at the LAA boundary
	Fish and Fish Habitat	✓	✓		Effects from the Project on fish and fish habitat may potentially occur within and immediately adjacent to the PA, therefore, this VC is evaluated at the LAA boundary
	Habitat and Flora	✓	✓		Effects from the Project on habitat and flora may potentially occur within and immediately adjacent to the PA, therefore, this VC is evaluated at the LAA boundary
	Terrestrial Fauna	✓	✓	✓	Effects from the Project on fauna may potentially occur within and surrounding the PA and LAA, therefore, this VC is evaluated at the RAA boundary
	Avifauna	✓	✓		Effects from the Project on avifauna may potentially occur within and immediately adjacent to the PA, therefore, this VC is evaluated at the LAA boundary
	Species at Risk and Species of Conservation Interest	✓	✓		Effects from the Project on species at risk and species of conservation interest may potentially occur within and immediately adjacent to the PA, therefore, this VC is evaluated at the LAA boundary
Socio-Economic Environment	Mi'kmaq of Nova Scotia	✓	✓		Effects from the Project on the Mi'kmaq of Nova Scotia will potentially occur within and immediately adjacent to the PA; therefore, this VC is evaluated at the LAA boundary

Environment	Valued Component (VC)	Project Area	Local Assessment Area	Regional Assessment Area	Spatial Boundary Selection Rationale
	Physical and Cultural Heritage	✓			Effects from the Project on physical and cultural heritage are limited to the PA, therefore, this VC is evaluated at the PA boundary
	Socio-economic Conditions	✓	✓	✓	Effects from the Project on the socio-economic conditions may potentially occur over a diffuse area; therefore, this VC is evaluated at the RAA boundary

5.5 Standards or Thresholds for Characterizing and Determining Significance of Effects

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

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

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

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

5.6 Baseline Conditions

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

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

5.7 Anticipated Project-Environment Interaction

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

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

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

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

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

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

Accidents and malfunctions have been considered for every phase of the Project; however, they are separated in the Project-VC interaction table to present the actual accidents and malfunctions that may occur during these phases. Table 5.7-1 presents the anticipated Project component and activities, and VCs interaction for each component of the PA. Interactions noted in are specific to those that relate to new interactions as a result of the Project and not those that pre-exist at Touquoy Mine Site as part of that site's development, operation and proposed reclamation.

Table 5.7-1: Potential Valued Components Interactions with Project Activities at FMS

Project Activities	Valued Components														
	Physical						Biophysical						Socio-economic		
	Noise	Light	Air	Geology, Soil, and Sediment Quality	Groundwater Quality and	Surface Water Quality and	Wetlands	Fish and Fish Habitat	Habitat and Flora	Terrestrial Fauna	Avifauna	SAR	Mi’ kmaq of Nova Scotia	Physical and Cultural Heritage	Socio-economic Conditions
<u>Site Preparation and Construction Phase</u>															
Clearing, grubbing, and grading	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Drilling and rock blasting	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
Topsoil, till, and waste rock management	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Watercourse and wetland alteration	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Seloam Brook Realignment construction and dewatering	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Mine site road construction, including lighting	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Surface infrastructure installation and construction, including lighting	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Collection ditch and water management pond construction, including lighting	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Local traffic bypass road construction	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Culvert and bridge upgrades and construction	✓	✓	✓			✓	✓	✓	✓				✓	✓	✓

Project Activities	Valued Components														
	Physical						Biophysical						Socio-economic		
	Noise	Light	Air	Geology, Soil, and Sediment Quality	Groundwater Quality and	Surface Water Quality and	Wetlands	Fish and Fish Habitat	Habitat and Flora	Terrestrial Fauna	Avifauna	SAR	Mi’ kmaq of Nova Scotia	Physical and Cultural Heritage	Socio-economic Conditions
Environmental monitoring	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓			✓
General waste management	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓			✓
<u>Operations Phase</u>															
Drilling and rock blasting	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓		✓
Open pit dewatering	✓			✓	✓	✓	✓	✓	✓		✓	✓	✓		✓
Ore management	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓		✓
Waste rock management	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓		✓
Tailings management				✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
Surface water management				✓	✓	✓	✓	✓		✓	✓	✓	✓		✓
Dust and noise management	✓		✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓
Petroleum products management			✓	✓	✓	✓	✓	✓	✓			✓	✓		✓
Site maintenance and repairs, including lighting	✓	✓	✓			✓					✓				✓

Project Activities	Valued Components														
	Physical						Biophysical						Socio-economic		
	Noise	Light	Air	Geology, Soil, and Sediment Quality	Groundwater Quality and	Surface Water Quality and	Wetlands	Fish and Fish Habitat	Habitat and Flora	Terrestrial Fauna	Avifauna	SAR	Mi' kmaq of Nova Scotia	Physical and Cultural Heritage	Socio-economic Conditions
Ore processing and plant site operations	✓	✓	✓			✓									✓
Concentrate loading and haulage	✓	✓	✓			✓									✓
Environmental monitoring	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓
General waste management	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓			✓
<u>Closure Phase: Reclamation Stage</u>															
Infrastructure demolition	✓	✓	✓	✓		✓					✓		✓		✓
Water treatment and management					✓	✓					✓		✓		
Site reclamation	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓
Environmental monitoring	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓
General waste management	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓			✓
<u>Closure Phase: Post-closure Stage</u>															
Water treatment and management					✓	✓							✓		
Environmental Monitoring						✓	✓								

Table 5.7-2: Potential Valued Components Interactions with Project Activities at Touquoy

Project Activities	**Valued Components**														
	Physical						**Biophysical**						**Socio-economic**		
	Noise	**Light**	**Air**	**Geology, Soil, and Sediment Quality**	**Groundwater Quality and**	**Surface Water Quality and**	**Wetlands**	**Fish and Fish Habitat**	**Habitat and Flora**	**Terrestrial Fauna**	**Avifauna**	**SAR**	**Mi’ kmaq of Nova Scotia**	**Physical and Cultural Heritage**	**Socio-economic Conditions**
<u>Site Preparation and Construction Phase</u>															
Concentrate processing equipment upgrades	✓	✓													
<u>Operations Phase</u>															
Lighting of facilities and mine site roads		✓									✓				
Concentrate management and processing	✓					✓									
Tailings management					✓	✓		✓	✓	✓	✓	✓			
Site maintenance and repairs, including lighting	✓	✓													
Environmental monitoring	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓			
General waste management	✓	✓				✓	✓	✓	✓	✓	✓	✓			
<u>Closure Phase: Reclamation Stage</u>															
Environmental monitoring					✓	✓	✓	✓	✓	✓	✓	✓			
Water treatment and management					✓	✓		✓							

Project Activities	Valued Components														
	Physical						Biophysical						Socio-economic		
	Noise	Light	Air	Geology, Soil, and Sediment Quality	Groundwater Quality and	Surface Water Quality and	Wetlands	Fish and Fish Habitat	Habitat and Flora	Terrestrial Fauna	Avifauna	SAR	Mi’kmaq of Nova Scotia	Physical and Cultural Heritage	Socio-economic Conditions
<u>Closure Phase: Post-Closure Stage</u>															
Water treatment and management					✓	✓	✓	✓							
Environmental monitoring						✓	✓	✓							

5.8 Effects Prediction

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

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

5.9 Mitigation Measures

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

5.10 Residual Effects and the Determination of Significance

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

- Determine the potential interactions between VCs and Project activities and the effects those interactions will have;
- Asses effect of each mitigation strategy applied to the interactions; and,
- Characterize the extent and nature of the remaining, residual effects after mitigation measures have been applied.

In order to identify if residual effects are significant or not, consideration of the magnitude, geographical extent, duration, frequency, and reversibility is required. Table 5.10-1 provides a description of these effect characteristics and the varying degrees in which they can contribute to the significance of an effect. Where possible, criteria will be described quantitatively. When residual effects cannot be characterized quantitatively, they will be characterized qualitatively.

It should be noted that each of the criteria will also incorporate the social and ecological context, reflecting the importance of the environmental attribute or feature to ecosystem health and function as well as the influence of past and current human activity and the disturbance associated with that activity. Further, timing considerations will be noted in the evaluation of the residual environmental effect for each VC, where applicable or relevant. For example, if the VC has a period of time for sensitive life stages (i.e. breeding/spawning), the VC will provide a description of the timing considerations as part of the evaluation.

Table 5.10-1: Characterization Criteria for Residual Environmental Effects

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Magnitude	The size or degree of the effects compared against baseline conditions or reference levels, and other applicable measurement parameters (i.e., standards, guidelines, objectives)	**Negligible (N)** – Differing from the average value for the existing environment/baseline conditions to a small degree, but within the range of natural variation and below a threshold value **Low (L)** – Differing from the average value for the existing environment/baseline conditions, outside the range of natural variation, and less than or equal to appropriate guideline or threshold value **Moderate (M)** – Differing from the existing environment/ baseline conditions and natural variation, and marginally exceeding a guideline or threshold value **High (H)** – Differing from the existing environment/ baseline conditions and natural variation, and exceeding a guideline or threshold value
Geographic Extent	The geographic area over or throughout which the effects are likely to be measurable	**Project Area (PA)** – the residual environmental direct and indirect **Local Assessment Area (LAA)** – Occurs beyond the PA and within the LAA **Regional Assessment Area (RAA)** – Occurs beyond the PA and LAA and within the RAA
Timing	Considers when the residual environmental effect is expected to occur. Timing considerations are noted in the evaluation of the residual environmental effect, where applicable or relevant.	**Not Applicable (N/A)** — seasonal aspects are unlikely to affect VC's (i.e. fisheries productivity). **Applicable** — seasonal aspects may affect VC's (i.e. fisheries productivity).

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Duration	The time period over which the effects are likely to last	**Short-Term (ST)** – effects are limited to occur from as little as 1 day to 12 months **Medium-Term (MT)** – effects can occur beyond 12 months and up to 7 years **Long-Term (LT)** – effects extend beyond 7 years **Permanent (P)** – valued component unlikely to recover to baseline conditions *Different timeframe definitions may be provided in each VC section depending on specific VC effects.*
Frequency	The rate of recurrence of the effects (or conditions causing the effect)	**Once (O)** – effects occur once **Sporadic (S)** – effects occur at irregular intervals throughout the Project **Regular (R)** – effects occur at regular intervals throughout the Project **Continuous (C)** – effects occur continuously throughout the Project
Reversibility	The degree to which the effects can or will be reversed (typically measured by the time it will take to restore the environmental attribute or feature)	**Reversible (R)** – VCs will recover to baseline conditions before or after Project activities have been completed. **Partially Reversible (PR)** - mitigation cannot guarantee a return to baseline conditions **Irreversible (IR)** – effects to VCs are permanent and will not recover to baseline conditions

In conjunction with the effect characteristics outlined in Table 5.10-1 each VC will be assigned a standard or threshold as described in Section 5.5 of this EIS to determine the significance of an effect caused by the Project. Rationale for the threshold determination and the residual effects characterization will be woven through each VC section to provide the reader with as much understanding of how the Project Team determined the conclusions presented in the residual table for each VC.

5.11 Follow-up and Effects Monitoring

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

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

5.12 Effects of the Environment on the Project

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

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

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

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

6.0 Environmental Effects Assessment

6.1 Noise

6.1.1 Rationale for Valued Component Selection

Noise will be generated throughout the life of the Project at the FMS Mine Site and Touquoy Mine Site (processing and tailings management). Sources of Project-related noise may include heavy machinery during the construction and operation phases and decommissioning and reclamation stage of the closure phases. Additionally, haul trucks, processing equipment, and disposal of waste rock will be sources of noise during the operational phase. During the construction and operation phases of the Project, rock blasting using explosives is a source of generated noise and vibration. No noise concerns are anticipated during the post closure stage of the closure phase as noise sources will be limited to occasional occurrences of light vehicles involved with follow-up and monitoring programs.

Noise and vibration are provincially regulated via the *Occupational Health and Safety Act* (OSHA 1996) and the Pit and Quarry Guidelines (NSDEL 1999), which protects the health of site workers and the general public at the property boundaries of the Project, respectively. Changes to ambient noise levels and the presence of periodic vibrations have the potential to adversely affect fauna and birds by influencing migration and behavioral patterns.

6.1.2 Baseline Program Methodology

6.1.2.1 FMS Study Area Baseline Program Methodology

Noise data was collected at two sample locations over a 24-hour period between November 20th-22nd, 2017 at the FMS Study Area. Noise data was recorded using the A-weighted decibel unit (dBA) scale and presented as a continuous sound level equivalent (L_{eq}). The dBA scale gives greater weight to frequencies of sound to which the human ear is most sensitive. Baseline ambient noise levels were evaluated in representative areas in and surrounding the FMS Study Area using a System 824 Sound Level Meter/Real Time Analyzer and Sound Track Model LxT, both manufactured by Larson Davis Inc. The locations of the noise monitoring stations are provided in Table 6.1-1, and shown in Figure 6.1-1. Sound levels measurements were not undertaken at any additional locations (such as the nearest residence) as ambient noise levels in the vicinity of the FMS Study Area provide a more conservative baseline for comparative purposes.

Table 6.1-1: Baseline Noise Monitoring Locations

Sample Location	UTM Coordinates (Zone 20T)		General Area	Rationale
	Easting	Northing		
Station A	539995	4998537	Approximately 2.5 km east of the FMS pit	Representative area near the eastern extent of the FMS Study Area
Station B	535431	5001152	Approximately 3 km northwest of the FMS pit	Representative area 2 km north of the FMS Study Area and 1 km east of Hwy 374

Ambient noise surveys are not recommended when wind speeds exceed 4 m/s or during precipitation, subzero or high humidity events. The weather observed during the survey period was within these limits and deemed acceptable as further described in Appendix J.1

6.1.2.2 Touquoy Baseline Program Methodology

A baseline acoustic assessment was conducted as part of the 2007 Focus Report (CRA 2007a) for the Touquoy Gold Project. A single location (Location 1) at the Touquoy Mine Site was monitored to understand the noise levels directly around the Touquoy Mine Site and proposed open pit. Location 1 was located north of the Touquoy pit and is shown in Figure 6.1-2.

6.1.3 Baseline Conditions

6.1.3.1 Regional Baseline Conditions

The relatively steady ambient noise of the surrounding area is a conglomeration of distant noise sources including wind in trees, bird and animal noise, rainfall, distant aircraft, logging activities, traffic and all-terrain vehicle use. The acoustic monitoring completed in the vicinity of the FMS Study Area is considered representative of the local baseline conditions.

6.1.3.2 FMS Study Area Baseline Conditions

Noise level measurements for both sample locations near the FMS Study Area were collected and are presented in Table 6.1-2.

Table 6.1-2: Baseline Ambient Noise Levels in the vicinity of the FMS Study Area

Location	Time	Sound Pressure Level (dBA)						NSE Criteria
		Leq	L10	L50	L90	Lmax	Lmin	
Station A	Day	36.3	39.7	34.5	27.3	45.3	21.5	65
	Evening	31.3	34.8	28.3	22.6	41.9	19.7	60
	Night	34.7	37.9	31.7	27.8	50.7	23.9	55
Station B	Day	33.8	38.1	29.3	23.4	47.8	19.7	65
	Evening	30.6	32.0	29.5	25.8	42.4	24.1	60
	Night	27.9	29.1	27.0	24.9	45.0	23.4	55
Average	Day	35.2	39.0	32.6	25.8	--	--	65
	Evening	31.0	33.6	29.0	24.5	--	--	60
	Night	32.5	35.4	30.0	26.6	--	--	55
	24 - Hour	33.9	37.4	31.4	25.9	--	--	--

Sound sources captured by the L_{eq} would include nearby anthropogenic sources such as recreational vehicles, traffic on local roadways and contribution from existing forestry operations. Therefore, the L_{90} noise index is considered the true representation of the background noise level. The L_{90} is defined as the noise level which is exceeded 90% of the time. It is commonly referred to as the residual or background noise when anthropogenic sources of noise are not present. The L_{90} recorded at both monitoring locations met NSE *Pit and Quarry* criteria for all time intervals. The overall (24hr) L_{90} average for the FMS Study Area was 25.9 dBA and has been used in the noise model as the representative background noise level.

No ground vibrations were recorded during the monitoring period nor are expected to naturally occur in the area as no evidence of seismic activity or volcanism has been recorded. Potential anthropogenic sources of vibration such as blasting, heavy machinery movement or seismic exploration were not ongoing during the monitoring event.

6.1.3.3 Touquoy Mine Site Baseline Conditions

The results of the 2007 Focus Report of baseline noise levels at the Touquoy Mine Site are presented in Table 6.1-3.

Table 6.1-3: Average Baseline Sound Equivalent Levels (L_{eq}) Recorded at Touquoy Mine Site in 2007

Monitoring Location	Date	Time	Average Leq Value (dBA)	NSE Criteria (dBA)
Location 1	Jan 9, 2007	19:00 – 22:59	44.8	<60
	Jan 10, 2007	07:00 – 14:59	44.9	<65
		15:00 – 23:59	40.9	<60
	Jan 11, 2007	0:00 – 06:59	40.2	<55
		07:00 – 18:59	42.9	<65
		19:00 – 22:59	41.4	<60
	Jan 11 – 12, 2007	23:00 – 06:59	40.7	<55

Baseline sound level measurements recorded at the Touquoy Mine Site in 2007 were notably above those recorded near the FMS Study Area yet met the NSE Pit and Quarry Guideline criteria for all time intervals.

6.1.4 Consideration of Engagement and Engagement Results

Key issues raised during public engagement and Mi'kmaq engagement relating to noise include mining operations from the Project and potential effect on nearby residents, potential Mi'kmaq traditional usage of the area including elevated noise levels in the forested habitat surrounding the FMS Mine Site potentially resulting in adjustments in wildlife patterns, and recreational usage of the surrounding area.

The results of the public and Mi'kmaq engagement have been considered in the environmental effects assessment, including the Proponent's commitments to mitigation and monitoring measures and proposed compliance and effects monitoring programs, as well as the Proponent's broader commitment to on-going public and Mi'kmaq engagement.

6.1.5 Effects Assessment Methodology

6.1.5.1 Boundaries

6.1.5.1.1 *Spatial Boundaries*

The PA includes two primary components from Trafalgar to Moose River Gold Mines, Halifax County, NS, including the FMS Study Area and Touquoy Mine Site (processing, tailings deposition, and exhausted pit).

The LAA for noise and vibration is defined by a 3 km buffer of the PA.

The RAA for noise and vibration is determined to be a buffer of 5 km of the PA. The boundary-determining factor is that approximately a 5 km radius is required for attenuation of the high level mine related noise to background levels in the surrounding environment.

The extents of the PA, LAA and RAA for noise are also presented in Figure 6.1-3.

The Project is being assessed at the LAA level for noise. The proposed property boundaries are defined as the lands proposed or currently leased or owned by the Proponent for the duration of the Project. The proposed property boundaries are contained by the FMS Study Area. The proposed property boundaries as identified are shown on Figure 6.1-1.

6.1.5.1.2 *Temporal Boundaries*

The temporal boundaries used for the assessment relate to periods when the Project activities are reasonably expected to increase noise levels. The potential impact of noise is assessed for peak periods during construction and operation phases of the Project when activity levels are at their maximum, thus generating the most noise. No distinction is made between daytime, evening or nighttime periods as construction and operational activities will be continuous. For the purposes of this assessment, the temporal boundary for noise includes the construction, operational and closure (active reclamation stage) phases.

6.1.5.1.3 *Technical Boundaries*

A low to moderate confidence level is assigned in the predictive modelling for noise input parameters, due to assumptions made about equipment locations, timing of maximum noise generation, and atmospheric and topographic attenuation. The expected accuracy of the prediction model is ± 5 dBA.

6.1.5.1.4 *Administrative Boundaries*

The assessment of noise is provincially regulated through the acts and guidelines listed below:

- Section 2(c) of the *Environmental Protection Act* of the Province of Nova Scotia
- Guidelines for the Environmental Noise Measurement and Assessment. Nova Scotia Environment and Labour (NSE 1990)
- Pit and Quarry Guidelines. Nova Scotia Environment and Labour (NSDEL 1999); and
- Blasting Safety Regulations made under Section 82 of the *Occupational Health and Safety Act* S.N.S 1996 (OSHA 1996)

For the purpose of this assessment, the criteria established in the Pit and Quarry Guidelines were used, which requires the following sound level limits:

- 55 dBA during nighttime hours (23:00 – 07:00) and all-day Sunday and statutory holidays at the property boundary;

- 60 dBA during evening hours (19:00 – 23:00) at the property boundary;
- 65 dBA during daytime hours (07:00 – 19:00) at the property boundary; and
- 128 dBA within 7 m of the nearest structure outside of the property boundary during blasting

6.1.5.2 FMS Study Area Methodology

The noise prediction model SPM9613 developed by Power Acoustics Inc was used to provide an order of magnitude estimation of the predicted operational noise within the property boundaries of the FMS Mine Site. The prediction model SPM6913 incorporated two subroutines.

- ISO 9613-1 specifically addressing atmospheric attenuation; and
- ISO 9613-2 that specifies an engineering method for calculating environmental noise from a variety of sources.

The model included meteorological parameters, ground attenuation, pit geometry, along with octave sound power levels, proposed locations and 3D dimensions of over 20 significant noise sources. Proposed location and octave sound power levels used in the model of each significant noise source are described in further detail in Appendix J.1. The significant noise sources were modelled to conservatively reflect the worst-case scenario, predicted to be during construction and Year 7 of operations when the largest amount of material (20 Mt) will be mined requiring the most equipment.

A prediction formula developed by Linehan and Wiss (1980) was used to predict the peak air over pressure from a blast. Peak air overpressures were then converted to sound pressure levels in decibels. Formula constants derived for multiple mine sites varied and those that resulted in the highest predicted noise levels were used for the FMS Mine Site to remain conservative. Formulas used to predict and convert noise levels are described in further detail in Appendix J.1.

Effects to birds, wildlife and the current traditional practices of the Mi'kmaq of Nova Scotia from predicted noise are further discussed in Sections 6.10, 6.11, and 6.13.

6.1.5.3 Touquoy Mine Site Methodology

The Datakustik's Cadna A Acoustical Modelling Software was used for an acoustic assessment as part of the 2018 Noise Impact Study (GHD, 2018) in support of the Beaver Dam Mine Project EIS. The 2018 Noise Impact Study focused on sound emissions from noise sources identified at the facility and determining effects on sensitive receptors, including Camp Kidston (3 km to the north), the Scraggy Lake area (2 km to the south) and the nearest residence (5 km to the northwest). Sound level impacts were compared to the Nova Scotia Guidelines for Environmental Noise Measurement and Assessment which are the same as those listed in the Nova Scotia Pit and Quarry Guidelines. A predicted worst-case facility sound level measurement for a 1-hour period was estimated for the property boundary and at each receptor near the Touquoy Mine Site.

Effects to birds, wildlife and the Mi'kmaq of Nova Scotia from predicted noise are further discussed in Sections 6.10, 6.11, and 6.13, respectively.

6.1.5.4 Thresholds for Determination of Significance

Data collected were evaluated against the Pit and Quarry Guidelines as a reference. Sound equivalent level (L_{eq}) thresholds described by the Pit and Quarry Guidelines are provided in Table 6.1-4

Table 6.1-4: Sound Equivalent Level Thresholds as Described Under the Nova Scotia Pit and Quarry Guidelines

Spatial Boundary	Temporal Boundary	Leq Threshold (dBA)
Property Boundary	Daytime (0700 to 1900)	65
Property Boundary	Evening (1900 to 2300)	60
Property Boundary	Nighttime (2300 to 0700) and All day Sunday and statutory holidays	55
7 m from the nearest structure not located in the property boundary	During blasting events	128

A significant adverse effect for the Project in terms of noise is defined as repeated or sustained noise levels being emitted from the FMS and Touquoy Mine Sites that exceeds the NSE Pit and Quarry Guidelines beyond the property boundary of the Project and exceeds maximum noise or vibration limits at fixed dwellings where occupants are present (seasonal or permanent).

For noise, the following logic was applied to assess the magnitude of a predicted change in noise levels:

- Negligible – background noise levels are met the at property boundary and are reversible in nature once mine operation and active reclamation ceases
- Low – elevated noise levels above background levels beyond property boundaries, however, comply with all relevant guidelines at the property boundary and are reversible in nature once mine operation and active reclamation ceases
- Moderate – noise levels exceed guidelines at property boundary, however, comply with guidelines at residential receptors (seasonal or permanent) and are reversible once mine operations and active reclamation ceases.
- High – noise levels exceed guidelines at a residential receptor and are permanent in nature.

For noise, the following logic was applied to assess the timing of a predicted change in noise levels. Timing is applicable because the modelling was completed in consideration of forest cover. Foliage would seasonally adjust noise propagation.

6.1.6 Project Activities and Noise Interactions and Effects

Potential interactions between the Project activities and noise are outlined in Table 6.1-5 and Table 6.1-6.

Table 6.1-5: Potential Interactions with Project Activities and Noise in the FMS Study Area

Project Phase	Duration	Relevant Project Activity
Site Preparation and Construction Phase	1 year	• Clearing, grubbing, and grading • Drilling and rock blasting • Topsoil, till and waste rock management • Watercourse and wetland alteration • Seloam Brook Realignment construction and dewatering • Mine site road construction, including lighting

Project Phase	Duration	Relevant Project Activity
		• Surface infrastructure installation and construction, including lighting • Collection and Settling pond construction, including lighting • Local traffic bypass road construction • Culvert and bridge upgrades and construction • Environmental monitoring • General waste management
Operations Phase	7 years	• Drilling and rock blasting • Open pit dewatering • Ore management • Waste rock management • Dust and noise management • Site maintenance and repairs including lighting • Ore processing and plant site operations • Concentrate loading and haulage • Environmental monitoring • General waste management
Closure Phase: Reclamation Stage	2 – 3 years	• Infrastructure demolition • Site reclamation • Environmental monitoring • General waste management

Table 6.1-6: Potential Interactions with Project Activities and Noise at the Touquoy Mine Site.

Project Phase	Duration	Relevant Project Activity
Site Preparation and Construction Phase	1 year	• Concentrate processing equipment upgrades
Operations Phase	7 years	• Concentrate management and processing • Site maintenance and repairs including lighting • Environmental monitoring • General waste management

6.1.6.1 FMS Study Area

A review of the noise modelling results, using the most conservative temporal inputs (during construction and Year 7 operations) and compared to established guidelines at the FMS Mine Site property boundary and nearest sensitive receptors, was completed with the following results:

- The predicted sound levels at the FMS Mine Site property boundary will be at or below the most restrictive noise goals (nighttime hours of 55 dBA) during all construction and operational hours (day, evening and night) at the property boundary. A noise contour plot, indicating the 55-dBA contour is provided in Figure 6.1-4;
- Sensitive receptors include seasonal camps and residences were identified in the surrounding area with the nearest being 4.9km and 8.7km south of the FMS Study Area respectively. The predicted sound levels resulting from activities in the FMS Study Area will attenuate to background levels (25.9 dBA) over an approximate distance of 4 to 5 km at or before the nearest seasonal or permanent residence. A noise contour plot is provided in Figure 6.1-5;
- During the decommissioning and reclamation stage of the closure phase, less equipment will be active on site resulting in an anticipated lower level of sound propagation than during operations. Therefore, the conclusions relating to operational phase are considered to the reasonable worst-case scenario; and,
- Blasting events may provide a slight spike in the sound levels at distance for a brief period. The 128-dBA threshold is not predicted to be exceeded at the nearest structure from the FMS Study Area (approximately 5 km to the south), using standard blasting methods employed by mining operations. Predicted blasting noise will meet the *Nova Scotia Pit and Quarry Guidelines (NSDEL 1999)* criteria of 128 dBA at approximately 100 metres from the blast location.

6.1.6.2 Touquoy Mine Site

The predicted total sound level range at the Touquoy Mine Site property boundary presented in the 2018 Noise Impact Study completed in support of the Beaver Dam EIS is 39.2 to 53.9 dBA (GHD, 2018), which are below the most conservative threshold (nighttime hours of 55 dBA) set in the Pit and Quarry Guidelines (NSDEL 1999). Ambient baseline sound levels at the Touquoy Mine Site were predicted to be reached at approximately 5 km from the PA. Noise from the Project will be considerably less than that predicted from the Beaver Dam Mine Project, which included fine crushing and processing of all Beaver Dam ore at the Touquoy Mine Site. The Project includes only processing of concentrate (<5% of ore removed from the pit at FMS and transported to Touquoy) at the Touquoy Mine Site and disposal of these concentrate tailings. Thus, noise generated at the Touquoy Mine Site associated with the Project is estimated to be considerably lower than results presented above for the Beaver Dam Mine Project, which already met compliance at the Touquoy Mine Site property boundaries.

The Touquoy Mine Site is currently operational. The primary effect of the continued use of the Touquoy Mine Site for the Project is the continued generation of noise due to haul truck traffic on the site and the processing of FMS concentrate. There are no new or additional effects from noise anticipated to be caused by the processing of concentrate and the management of tailings from the FMS Mine Site. To date, no noise complaints have been received or are anticipated.

6.1.7 Mitigation

The Proponent will control operations and equipment to ensure noise levels are kept within recommended limits for surface mining operations.

Noise from the equipment and lack of effective mufflers are manageable sources of noise. Procurement of equipment that meets best practices in terms of noise emissions, and regular maintenance of the equipment will reduce noise levels. Site workers will be trained to ensure equipment is used in ways that minimize noise and is maintained regularly. As part of the workplace health and safety program, noise monitors may be attached to workers from time to time to measure and monitor noise exposure over a shift.

The majority of mining operations will occur in the pit well below ground surface thereby providing excellent noise shielding, and blasting will be restricted to daytime hours, per the NSE Pit and Quarry Guidelines. The forest cover surrounding the mine will also provide a dampening effect to any noise generated. Topography and distance from receptors will also contribute to a reduction of Project-generated sound at a distance.

This combination of measures will adequately mitigate potential noise impacts.

Mitigation measures for the FMS Study Area are described in Table 6.1-7 and will be implemented by the Proponent. Mitigation measures will be confirmed through the permitting stage through the Industrial Approval. Detailed mitigation measures are provided in the attached Noise Baseline and Predictive Modelling Report (Appendix J.1).

Mitigation measures at the Touquoy Mine Site are already in place and will continue for the additional time required for the processing of FMS concentrate and management of FMS concentrate tailings.

Table 6.1-7: Mitigation for Noise

Project Phase	Mitigation Measures
C	Consider placement of stockpiles and infrastructure to mitigate noise migration from processing equipment
C	Consider the use of natural landforms when available as noise barriers when designing final site details and when placing fixed equipment
C	Noise-reduction as criteria in equipment selection
C,O	Restrict blasting to a specific and regular daytime schedule during weekdays
C,O	Communicate general blasting schedule to the local community
C,O	Regular check by site supervisors for excessive noise on site and in relation to sensitive receptors so that resolution can be timely
C,O	Use equipment that meets appropriate noise emission standards for off-road diesel equipment
C,O	Speed reduction
C,O	Subcontractor agreements will include an obligation to comply with environmental protection including noise reduction
C,O	Site design to minimize need for reversing and vehicle reversing alarms
C,O	A procedure will be developed that will allow the public to register complaints regarding noise concerns and will require the Proponent to respond in a timely and effective manner.
C,O,CL	Implement preventative maintenance plans for all mobile and stationary equipment

Note: C = Construction Phase, O = Operation Phase, CL = Closure Phase

6.1.8 Residual Effects and Significance

The predicted residual environmental effects of Project development and production of noise are assessed to be adverse, but not significant. The overall residual effect of the Project on noise is assessed as not likely to have significant adverse effects after mitigation measures have been implemented as surmised in Table 6.1-8.

Table 6.1-8: Residual Environmental Effects for Noise

Project VC Interactions	Mitigation and Compensation Measures	Nature of Effect	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect
			Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility		
Construction and Operations – FMS Mine Site at Property Boundary	Equipment maintenance, best management practices and minimize blasting events	A	L Meets appropriate guidelines or threshold values at the property boundary and meets guidelines or threshold values at fixed dwellings (seasonal or permanent)	PA Noise levels meet regulatory guidelines within the PA but are elevated above baseline conditions beyond the LAA into the RAA	A VC is affected by timing. Foliage will reduce noise propagation	MT Effects can occur up to 1 year (Construction) and 7 years (Operations)	R Effects will occur regularly within the life of the project	R VC will recover to baseline conditions	Increased ambient noise	Not significant
Construction and Operations – FMS Mine Site at Points of Reception	Equipment maintenance, best management practices and minimize blasting events	A	L Meets appropriate guidelines or threshold values at the property boundary and meets guidelines or threshold values at fixed dwellings (seasonal or permanent)	LAA Noise generated is predicted to meet regulatory requirements within the PA, but above baseline conditions beyond the LAA into the RAA	A VC is affected by timing. Foliage will reduce noise propagation	MT Effects can occur up to 1 year (Construction) and 7 years (Operations)	R Effects will occur regularly within the life of the project	R VC will recover to baseline conditions	Increased ambient noise	Not significant
Operational – Touquoy Mine Site at Property Boundaries	Equipment maintenance and best management practices	A	L Less than or equal to appropriate guidelines or threshold values	PA Noise levels meet regulatory guidelines at PA boundaries and baseline conditions within the LAA	N/A VC is not expected to be affected by timing	MT Effects will occur between 1 and 7 years	R Effects will occur regularly within the life of the project	R VC will recover to baseline conditions	Increased ambient noise	Not significant
Closure – FMS Mine Site at Property Boundary	Equipment maintenance and best management practices	A	L (qualitative assessment only – predicted to be less noise propagation than construction and operations phases described above)	PA Noise levels meet regulatory guidelines at the PA boundary	A VC is affected by timing. Foliage will reduce noise propagation	MT Effects will occur between 2-3 years during active reclamation stage of closure	R Effects will occur regularly within the life of the project	R VC will recover to baseline conditions	Increased ambient noise	Not significant

Legend (Refer to Table 5.10-1 for definitions)

Nature of Effect	Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility
A Adverse	N Negligible	PA Project Area	N/A Not Applicable	ST Short-Term	O Once	R Reversible
P Positive	L Low	LAA Local Assessment Area	A Applicable	MT Medium-Term	S Sporadic	IR Irreversible
	M Moderate	RAA Regional Assessment Area		LT Long-Term	R Regular	PR Partially Reversible
	H High			P Permanent	C Continuous	

A significant adverse effect for noise has not been predicted for the Project for the following reasons, with consideration of the ecological and social context within the LAA of the Project:

- **During Construction:** Noise will be elevated above baseline conditions for short duration (<1 year), extending into the RAA. However, noise levels are expected to remain within established guidelines at the property boundaries and thus the guidelines are also met within the LAA. Given the remote location of the Project, the likelihood of mobile receptors being regularly in close proximity to the FMS Mine Site is low.
- **During Operations:** Noise will be elevated above baseline conditions extending into the RAA. However, noise levels will remain within established guidelines at the FMS Mine Site property boundary. The guidelines are met within the PA. The likelihood of mobile receptors being regularly in close proximity to noise generation sites is low.
- **During Operations:** Predicted blasting noise will meet the *Nova Scotia Pit and Quarry Guidelines (NSDEL 1999)* criteria of 128 dBA at approximately 100 m from the blast location.
- **During Closure:** Noise generation during closure will be less than predicted levels during construction and operation but are expected to still be elevated above baseline conditions potentially extending into the LAA or RAA during decommissioning activities, then drop to baseline conditions for the post closure period.
- Noise effects from the Project are reversible and will dissipate to background concentrations once operations and active reclamation phases are complete.

6.1.9 Proposed Compliance and Effects Monitoring Program

The noise thresholds in the NSE Pit and Quarry Guidelines are predicted to be met at the FMS Mine Site property boundary, and within the Touquoy Mine Site property boundary. As the nearest receptor is located at 4.9 km from the FMS Mine Site, no noise monitoring is recommended to be implemented to verify the predicted environmental effects and the effectiveness of the mitigation measures outlined in Table 6.1-7. A Complaints Protocol will be followed to provide a mechanism to register concerns and discuss them with Project representatives. Additional noise monitoring would occur if directed by regulators or as a result of a complaint.

Under the existing IA for the Touquoy Gold Project, maximum sound levels are prescribed at property boundaries for days, evenings and weekends, and monitoring is only required when requested by NSE in response to a complaint or concern. Mitigation measures will be implemented as necessary where sound levels are a concern, i.e., causing annoyance, and monitoring demonstrates exceedances.

Proposed follow-up and monitoring programs have been reviewed with the Mi'kmaq of Nova Scotia during engagement efforts including meetings, sharing of technical documents (Draft EIS, poster boards, Summary of Mi'kmaq Effects and Proposed Mitigation Measures, Plain Language Summary). On-going engagement with the Mi'kmaq will continue through the EA process and associated permitting relating to follow-up programs and monitoring.

6.2 Air

6.2.1 Rationale for Valued Component Selection

Air quality is included as a VC, due to existing regulations at the provincial and federal level, and because of the effect air quality can have on climate change, as well as human and ecological health. Greenhouse gases (GHG), air pollutants and, dust and particulates are the three primary components assessed to determine impacts to air quality.

Climate change is known to be exacerbated by GHGs, which will be created through the combustion of fuel during equipment operation, blasting within the pit, and vehicle use associated with Project activities. The province of Nova Scotia has committed to a 10% reduction of emission rates from 1990 levels by 2020 as required under the *Environmental Goals and Sustainable Prosperity Act*. GHGs are the focus of provincial policies and regulations for the electricity sector, however, there exists no province-wide standard for GHG emissions on additional industries, including mining.

Important air pollutants, known as Criteria Air Contaminants (CACs), are typically focused on for air quality assessments, due to federal and provincial regulations related to these compounds. These compounds include Nitrogen Oxides (NO_x), Sulphur Dioxide (SO_2), Carbon Monoxide (CO), and Particulate Matter less than 2.5 microns ($PM_{2.5}$). Several of these compounds, such as NO_x, SO_2, and CO are generated through the operation of internal combustion engines associated with Project activities. In addition, other compounds, such as Polycyclic Aromatic Hydrocarbons (PAHs) and Volatile Organic Compounds (VOCs) are also generated through combustion processes. Air pollutants have been identified as a potential risk to human health if found at certain ground level concentrations, typically prescribed under provincial and federal regulatory regimes, although not always (in the case of $PM_{2.5}$).

Dust and particulates (such as larger sized particles, known as Total Suspended Particulate Matter, or TSP; $PM_{2.5}$, which is respirable and PM_{10}, which are particles less than 10 microns in size) are typically considered compounds of concern from mining operations, and can be emitted from blasting/extraction operations, crushing, and especially traffic on unpaved roads. Dust and particulates will be generated throughout the life of the Project. Dust and particulates can contain compounds, such as metals, which are part of the natural composition of the particle, as well as other compounds, such as combustion products which are generated as a result of fuel combustion (PAHs).

Air pollutants, dust and particulates are regulated under numerous regulatory regimes, guidelines and standards of which are compiled and described in further detail in Section 6.2.5.1.4.

Throughout this section, GHGs will be assessed on a provincial scale, separately from air pollutants and dust and particulates which will be assessed on the local scale of the Project.

The primary focus of this section is on assessment of inhalation risks associated with CACs, as well as GHG implications. In addition, a separate human health risk assessment study was conducted on inhalation of metals bound to particulate matter, potential exposures and risks related to dust deposition from the Project onto soils and vegetation, and potential exposures to humans as a result of harvesting various traditional foods, as well as recreational swimming, near the PA. This assessment is presented as Appendix C.1. Specific aspects of the risk assessment study, including the metals on particulate matter, and dust deposition assessment outcomes are discussed in this VC section, with additional details provided in Appendix C.1.

6.2.2 Baseline Program Methodology

6.2.2.1 Greenhouse Gas Baseline Program Methodology

A review of total GHG emissions in Carbon Dioxide equivalents (CO_2e) collected by Environment Canada (2012b) across Nova Scotia and Canada was completed to comprehend the potential effect of Project activities on the GHG emission reduction goals of both the province of Nova Scotia and Canada.

CO_2e provides a method to convert the global warming potential of the three primary GHGs: carbon dioxide (CO_2) methane (CH_4) and nitrous oxide (N_2O), into the same unit (mass of CO_2).

6.2.2.2 FMS Study Area Baseline Program Methodology

Background airborne concentrations of total suspended particulates (TSP), particulate matter with an aerodynamic diameter of 10 µm or less (PM_{10}), arsenic, and mercury were collected at two locations near the FMS Study Area on November 21, 2017. Additional data was also collected in November 2017 in support of the proposed Cochrane Hill Mine Site (40 km east of the FMS Study Area) and is included in this assessment to augment the baseline data set for TSP, PM_{10}, arsenic, and mercury.

As part of the ExxonMobil project in Goldboro, Nova Scotia, data on concentration levels of NO_2 and SO_2 were collected from June 10 to August 10, 2004 in Seal Harbour (70 km east of the FMS Study Area). Similarly, concentrations of particulate matter with an aerodynamic diameter of 2.5 µm or less ($PM_{2.5}$) were collected over three 24-hour periods at Seal Harbour in each of July, August and September 2004. These data were used as the closest rural representative background for $PM_{2.5}$, NO_2 and SO_2 concentration levels. Additionally, data collected in 2016 by the National Air Pollution Surveillance Network (NAPS) in Aylesford, NS was consulted for annual concentration levels of $PM_{2.5}$. The Aylesford station was selected as it is located in the most rural setting of the National Air Pollution Surveillance Network (NAPS) stations found in Nova Scotia.

6.2.2.3 Touquoy Baseline Program Methodology

Data collected through the National Air Pollution Surveillance Network (NAPS) was used to represent baseline concentrations of NO_2, SO_2, Ozone and $PM_{2.5}$. The closest monitoring station (Station #030118) was selected and is located at 1657 Barrington Street, Halifax, NS. This station is located in an urban environment and is considered to have ambient air quality concentration levels above those expected in the rural environment of the Touquoy Mine Site.

Background airborne concentration levels of TSP and PM_{10} were collected at the Touquoy Mine Site in support of the 2007 Focus Report (CRA 2007). TSP measurements were collected on-site from five locations in January 2007. PM_{10} measurements were collected at two locations (referred to in this report as Air 1 TQ and Air 2 TQ) using a Beta Attenuation Monitor in September 2007. Air 1 TQ was located 300 m north of the Touquoy pit and Air 2 TQ was located 18 km south of the Touquoy Mine Site, along Hwy 7. Elevated particulate readings were observed at Air 2 TQ due to a paving project occurring during the monitoring period. As such only the data collected from September 9th – 11th, 2017 (post paving activities) is presented in this report as a representative of ambient baseline conditions.

6.2.3 Baseline Conditions

6.2.3.1 Greenhouse Gas Baseline Conditions

The total GHG emissions in CO_2e across Canada and Nova Scotia are presented in Table 6.2-1 and Table 6.2-2 respectively (EC 2012b).

Table 6.2-1: Greenhouse Gas Emissions: Canada

Canada	1990 Emissions (Mt CO_2e)	2005 Emissions (Mt CO_2e)	2015 Emissions (Mt CO_2e)
Oil and Gas	107	157.9	189.5
Transportation	121.8	163.2	173
Buildings	73.5	85.5	85.6

Canada	1990 Emissions (Mt CO_2e)	2005 Emissions (Mt CO_2e)	2015 Emissions (Mt CO_2e)
Electricity	94.5	116.9	78.7
Heavy Industry	96.6	86	74.6
Agriculture	60.1	74.4	72.8
Waste and others	56.9	54.4	47.6
Total GHG emissions	610.4	738.3	721.8

The oil and gas sector was the largest contributor to GHG emissions in 2015 with approximately 26% of the GHGs emitted in Canada. However, Canada is progressing, albeit slowly, to their goal set under the Paris Agreement of achieving a decrease of 30% from 2005 emission rates by 2030 (Paris Agreement, 2015) having seen a decrease of approximately 2.2% GHG emissions from 2005 to 2015.

Table 6.2-2: Greenhouse Gas Emissions: Nova Scotia

Nova Scotia	1990 Emissions	2005 Emissions	2015 Emissions
Total GHG emissions (kt CO_2e)	19800	23200	16200

Nova Scotia has surpassed their reduction target of reducing GHG emissions to 10% less than 1990 levels by 2020 (*Environmental Goals and Sustainable Prosperity Act*). Nova Scotia has seen an approximate 18% reduction in GHGs from 1990 emission rates in 2015. Between 2005 and 2015, Nova Scotia saw GHG emissions fall by 7,000 kilotonnes (kt) CO2e (approximately 30%).

6.2.3.2 Regional Baseline Air Quality Conditions

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

- Sulphur dioxide (SO_2);
- $PM_{2.5}$;
- volatile organic compounds (VOCs);
- Ozone (O_3); and,
- Oxides of Nitrogen (NO_2, NO, and total NOx).

Data collected at these stations is used by NSE to report the Air Quality Index and by ECCC to report the Air Quality Health Index. There are currently no permanent air monitoring stations within the vicinity of the Project.

The Project is located in a relatively undeveloped rural region of Nova Scotia with very few industrial operations (occasional forestry operations) that would affect air quality. As the NAPS monitoring stations are typically located in areas with local industry, measured concentrations of common air pollutants listed above are likely lower at the Project than at NAPS stations.

The National Pollutant Release Inventory (NPRI) is a publicly accessible inventory of pollutants released in Canada. The total amounts of air pollutants relevant to the Project in Nova Scotia are provided in Table 6.2-3.

Table 6.2-3: Total Amounts of Air Pollutants Emitted in Nova Scotia as reported by the NPRI in 2015.

	TSP	PM_{10}	$PM_{2.5}$	SO_x	NO_x	VOC	CO
Total Emissions (tonnes/year)	319,535	89,809	27,713	68,830	70,744	37,836	142,239

Total dust (TSP) and particulate matter (PM_{10} and $PM_{2.5}$) were the largest contributor to air pollutants in Nova Scotia in 2015. Dust and particulates are predicted to be the greatest source of concern for local air quality as a result of the Project.

6.2.3.3 FMS Study Area Baseline Conditions

Air concentrations of NO2, SO2, and PM2.5 collected in Seal Harbour as part of the ExxonMobil program in 2004, the annual average concentrations of PM2.5 collected at the Aylesford NAPS station collected in 2016, and concentrations of TSP, PM10, arsenic, and mercury collected in 2017 near the FMS Study Area are provided in Table 6.2-4.

Table 6.2-4: Baseline Air Pollutant Concentration Levels in/near the FMS Study Area.

Pollutant	Seal Harbour 24-hour Concentration Levels ($\mu g/m^3$)	NAPS Aylesford Station Annual Concentration Levels ($\mu g/m^3$)	FMS Study Area 24-hour Concentration Levels ($\mu g/m^3$)***
NO_2 *	3.76	---	---
SO_2 *	10.48	---	---
$PM_{2.5}$	4.0	6.0	---
PM_{10}	---	---	9.2 – 9.5
TSP	---	---	9.6 – 14
Arsenic**	---	---	Not detected
Mercury**	---	---	Not detected

* NO_2 and SO_2 results were available in parts per billion (ppb) and converted to $\mu g/m^3$

** Detection limits used in the analysis of Arsenic and Mercury are <0.00071 to <0.0013 µg/m3 and <0.000035 to < 0.000067 µg/m3 respectively.

*** one 24-hour sampling event; two locations

Ambient air concentration levels collected in 2004 in Seal Harbour (NO_2, SO_2 and $PM_{2.5}$), in 2016 at the NAPS Aylesford station ($PM_{2.5}$), and ambient air concentration levels collected onsite (arsenic, mercury, TSP and PM_{10}) were all found to be below the established regulations and objectives listed in Section 6.6.5.1.4. Additional baseline levels of other metals or organic compounds, such as PAHs and VOCs, were not available.

6.2.3.4 Touquoy Mine Site Baseline Conditions

Data collected by the NAPS in 1996 for particulate matter (TSP and $PM_{2.5}$), 2004 (NO_2 and SO_2) and 2005 (Ozone) were available for the 2007 Focus Report. The mean annual concentration levels of NO_2, SO_2, Ozone, TSP and $PM_{2.5}$ from the Halifax monitoring station (Station #030118) and range of 24-hour (PM_{10}) averages for Air 1 TQ and Air 2 TQ are presented in Table 6.2-5.

Table 6.2-5: Ambient Air Concentration Levels at Touquoy Mine Site.

Parameter	Station #030118 (µg/m³)	Air 1 TQ (µg/m³)	Air 2 TQ (µg/m³)
Nitrogen Dioxide	32.9	---	---
Ozone	25.5	---	---
Sulfur Dioxide	18.3	---	---
Total Suspended Particulates	11	10.5 – 16.1*	---
$PM_{2.5}$	6	---	---
PM_{10}	---	5 – 17	8 - 11

* Range of total suspended particulate concentration levels as recorded at five locations throughout the Touquoy Mine Site in proximity to Air 1 TQ.

Ambient air concentration levels collected by the NAPS at the nearest location (Halifax) and ambient air concentration levels collected onsite (TSP and PM_{10}) were all found to be below the established regulations and objectives listed in Section 6.6.5.1.4.

6.2.4 Consideration of Engagement and Engagement Results

Key issues raised during public and Mi'kmaq engagement relating to air include potential dust effects from mining operations at the FMS Mine Site to the landscape for traditional harvesting purposes and any potential effect to surrounding residences.

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

6.2.5 Effects Assessment Methodology

6.2.5.1 Boundaries

6.2.5.1.1 *Spatial Boundaries*

The PA includes two primary components from Trafalgar to Moose River Gold Mines, Halifax County, NS, including the FMS Study Area and Touquoy Mine Site (processing, tailings deposition, and exhausted pit). For the purposes of the assessment for air, the PA only considers the FMS Study Area component.

The LAA encompasses a 1.5 km zone in all directions from the FMS Study Area.

The RAA encompasses a 40 km zone in all directions from the FMS Study Area and encompasses the maximum extent of particulate deposition under reasonable worst-case scenarios, as determined through the modelling assessment.

The effects assessment only considers the FMS Study Area as the continued effects to air at the Touquoy Mine Site are assumed to be less than the currently approved operations. The LAA is the most appropriate spatial boundary for air quality impacts from the Project.

Spatial boundaries including the PA, LAA and RAA are provided in Figure 6.2-1. The proposed property boundaries of the Project are contained within the FMS Study Area. GHGs, as previously mentioned, are assessed at the provincial level separate from other air pollutants and dust.

6.2.5.1.2 *Temporal Boundaries*

The temporal boundaries used for the assessment of effects to air are the construction phase, the operational phase, and the closure phase: reclamation stage.

6.2.5.1.3 *Technical Boundaries*

Predictive air modelling outputs were limited to contributions from 22 primary sources associated with the FMS Mine Site as described in further detail in Appendix J.2.

6.2.5.1.4 *Administrative Boundaries*

Air quality is provincially and federally regulated through the acts and guidelines listed below:

- Sections 25 and 112 of the *Environmental Protection Act* of the province of Nova Scotia;
- The Canadian Council of Ministers of the Environment (CCME) Guidelines; and,
- Canadian Ambient Air Quality Standards (CAAQS).

In addition, since Nova Scotia is lacking air quality guidelines for certain substances of interest, additional air quality guidelines were sought from the Province of Ontario [Ontario Ministry of the Environmental Conservation and Parks Ambient Air Quality Criteria (OMECP AAQC)].

In 2012, Nova Scotia agreed to begin implementing the new CAAQS which will be established as objectives under the *Canadian Environmental Protection Act* and replace the existing CCME guidelines. The CAAQS provide regulation on $PM_{2.5}$ and Ozone. There are no current standards or objectives in Nova Scotia regarding PM_{10}, arsenic or mercury nor a 24-hour average time period for nitrogen dioxide. Therefore, objectives established by the Ontario Ministry of the Environment were used for PM_{10}, arsenic, mercury and 24hr nitrogen dioxide. The criteria established in the above Acts, guidelines and standards have been compiled in Table 6.2-6 as they relate to this assessment.

Table 6.2-6: Air Quality Maximum Permissible Ground Level Concentrations

Pollutant	Average Time Period	Maximum Permissible Levels
Nitrogen Dioxide	1-hour	400 µg/m^3
	24-hour (1)	200 µg/m3
	Annual	100 µg/m3
Sulphur Dioxide	1-hour	900 µg/m^3
	24-hour	300 µg/m^3
	Annual	60 µg/m^3

Pollutant	Average Time Period	Maximum Permissible Levels
Total Suspended Particulate Matter	24-hour	120 µg/m³
	Annual	70 µg/m³
Carbon Monoxide (2)	1-hour	34,600 mg/m³
	8-hour	12,700 mg/m³
Arsenic (1)	24-hour	0.3 µg/m³
Mercury (1)	24-hour	2 µg/m³
PM_{10} (1)	24-hour	50 µg/m³
$PM_{2.5}$ (2)	24-hour	27 µg/m³
	Annual	8.8 µg/m³

(1) Nova Scotia does not currently have regulations, guidelines or standards for PM_{10} arsenic, mercury or a 24 hour concentration average of NO_2 as such criteria establish by the Ontario Minsiters of the Environment were used.
(2) To remain conservative the maximum permissible levels for $PM_{2.5}$ and Carbon Monoxide are established from the more stringent Canadian Ambient Air Quality Standards coming into effect in 2020.

6.2.5.2 Greenhouse Gas Methodology

Ten pieces of heavy equipment operating 24 hours a day, 365 days a year, and eight to eleven haul trucks travelling from the FMS Study Area to the Touquoy Mine Site per day were identified as the primary sources of GHG emissions throughout the operation of the Project. The total annual amount of GHG emissions were estimated for the Project using the following documents:

- South Coast Air Quality Management District Off-road Mobile Source Emissions Factors (Scenario Years 2007-2025), Table C1.1-7 Unmitigated Case: Emission Factors for On-road Diesel Trucks for EMFAC 2007 Model, 2018; and,
- California Air Resources Board. Mobile Source Emissions Inventory – Off Road Diesel Vehicles. SCAB Fleet Average Emission Factors (Diesel), 2018

A list of the predicted emission rates and equipment used in the calculations are provided in Appendix J.2.

6.2.5.3 FMS Study Area Methodology

6.2.5.3.1 *Air Pollutants*

The AERMOD dispersion model was selected for use in this study. In 2005, AERMOD was adopted by USEPA (the U.S. Environmental Protection Agency) and promulgated as their preferred refined regulatory model. It is applicable to rural and urban areas, flat and complex terrain, surface and elevated releases, and multiple sources (including, point, area and volume sources).

The specific model inputs include meteorological data, terrain and building inputs and the various source emissions data.

The model was configured to assess the operation of the facility during normal operations.

Five years of sequential hourly meteorological data were used in the modelling. The dataset of meteorology statistically covers all wind speed and stability conditions that are anticipated to occur in the modelled area. The data source is from the Halifax Airport weather station for the years from 2007 to 2012.

Meteorological, terrain and source emission data used in the model are described in further detail in Appendix J.2.

Benzene and benz(a)pyrene were chosen as surrogate parameters to assess VOCs and PAHs in diesel exhaust. These parameters were chosen since the ambient criteria are the typically the most stringent compared other VOCs and PAHs present in diesel exhaust. Emission rates were calculated based on emission factors provided in Table 3.3-2 Speciated Organic Compound Emission Factors for Uncontrolled Diesel Engines located in Section 3.3 Gasoline and Diesel Industrial Engines, USEPA, AP-42.

6.2.5.3.2 *Metals in Fugitive Dust*

For metals bound to particulate matter, the maximum predicted ground level air concentrations for $PM_{2.5}$ and PM_{10} outside the Property boundary from the AERMOD model were used as a basis of the metals inhalation assessment. Both short term (24 hour) and long term (annual average) assessments were conducted. To estimate the potential metals concentrations on dust, the geochemistry of the predominant source of dustfall from the FMS Mine Site was used. Specific geochemistry fractions were developed based on the available data and are provided in Section 4 of Appendix C.1. These geochemistry fractions were applied to the baseline and predicted future PM_{10} and $PM_{2.5}$ data, to estimate metals-specific ground level air concentrations. See Appendix C.1, Section 6.0, for more details.

6.2.5.4 Touquoy Mine Site Methodology

The effects of fugitive dust production and deposition throughout the operational period of the Project at the Touquoy Mine Site is considered to be insignificant for the following reasons:

- The FMS concentrate has limited exposure to the open atmospheric environment upon arrival at the Touquoy Mine Site;
- Generated dust from site maintenance activities at Touquoy Mine Site is expected to be negligible; and,
- The produced FMS concentrate tailings will be a wet slurry solution and not prone to being dispersed through the surrounding atmospheric environment.

Fugitive dust production, deposition and GHGs at the Touquoy Mine Site is considered to be insignificant during the Project operational period, and therefore, the potential effects of reduced air quality at the Touquoy Mine Site are not further discussed in this assessment. Also, for the same reasons as described above, no evaluation of effects of dust deposition on human exposure (metal concentrations in soils and vegetation and potential exposures related to harvesting) was completed for the Touquoy Mine Site from the Project.

6.2.5.5 Thresholds for Determination of Significance

Due to the varied components assessed for the air VC, three separate thresholds have been identified to determine a significant adverse air quality effect:

- For air pollutants, an effect is considered significant when regulatory objectives are regularly exceeded at the proposed FMS Mine Site property boundaries;

- For GHGs an effect is considered significant when the emissions of greenhouse gases in CO_2e would threaten the currently achieved 2020 reduction goal set by Nova Scotia, defined in this assessment as an increase of (+8%) of the 2015 provincial emissions; or
- For metal concentrations in fugitive dust, an effect is considered significant if the estimated daily human intake (exposure) from pathways considered in the assessment is concluded to pose a risk to human health.

For air, the following logic was applied to assess the magnitude of a predicted change in air quality:

- Negligible – background air levels are met the at FMS Mine Site property boundary and are reversible once mining operations and active reclamation are completed
- Low – elevated air concentrations above background levels beyond the FMS Mine Site property boundaries, however, comply with all relevant guidelines at the property boundary and are reversible once mining operations and active reclamation are completed
- Moderate – air concentrations exceed guidelines at FMS Mine Site property boundary, however, comply with guidelines at residential receptors and are reversible once mining operations and active reclamation are completed
- High – air levels exceed guidelines at a residential receptor and for metal concentrations in fugitive dust, the estimated daily human intake (exposure) from pathways considered in the assessment is concluded to pose a risk to human health.

For air, the following logic was applied to assess the timing of a predicted change in air quality. Timing has been determined to be applicable as the meteorological portion of the model (AERMET) does take foliage into consideration. Timing is applicable because wind directions and weather change significantly depending on the season with winds from the SW quadrant typically in summer and winds from the NE quadrant in the winter. Windspeeds and precipitation also varies throughout the year.

6.2.6 Project Activities and Air Interactions and Effects

Potential interactions between the Project activities and air are provided in Table 6.2-7.

Table 6.2-7: Potential Interactions with Project Activities and Air in the FMS Study Area.

Project Phase	Duration	Relevant Project Activity
Site Preparation and Construction Phase	1 year	• Clearing, grubbing, and grading • Drilling and rock blasting • Topsoil, till and waste rock management • Watercourse and wetland alteration • Seloam Brook Realignment construction and dewatering • Mine site road construction including lighting • Surface infrastructure installation and construction, including lighting • Collection and settling pond construction, including lighting • Local bypass road construction • Culvert and bridge upgrades and construction • Environmental Monitoring • General waste management
Operations Phase	7 years	• Drilling and rock blasting • Ore management • Waste rock management • Dust and noise management • Petroleum product management • Site maintenance and repairs, including lighting • Ore processing and plant site operations • Concentrate loading and haulage • Environmental monitoring • General waste management
Closure Phase: Reclamation Stage	2 - 3 years	• Infrastructure demolition • Site reclamation activities • Environmental monitoring • General waste management

6.2.6.1 Air Pollutants and Metals in Fugitive Dust

A review of the ground concentration levels (GCL) predicted through dispersion modelling to occur at the FMS Mine Site property boundary without any mitigation measures are summarized and compared to the previously established regulatory maximum concentration levels in Table 6.2-8. Benzene and benz(a)pyrene were chosen as surrogate parameter in the assessment of VOCs and polyaromatic compounds (PAHs) in diesel exhaust. These parameters were chosen as they are typically under a more stringent ambient criteria compared to other VOCs and PAHs potentially present in diesel exhaust.

Table 6.2-8: Dispersion Modelling Results for Mine Operations – Maximum Ground Level Concentrations

Pollutant	Averaging Time Period	Normal Operating Conditions Location with the Highest Predicted GLC Site Boundary Locations (X coordinates, Y coordinates)	Normal Operating Conditions – with Mitigation Controls Location with the Highest Predicted GLC Offsite Exceedances (X coordinates, Y coordinates)	Nova Scotia Objectives
NO_2 (µg/m^3)	1 hour	334 (536741,4999377)	none	400
	Annual	1.6 (537350,4999594)	none	100
SO_2 (µg/m^3)	1 hour	0.56 (536741,4999377)	none	900
	24 hour	0.04 (536937,4999429)	none	300
	Annual	0.002 (536937,4999429)	none	60
TSP (µg/m^3)	24 hour	**335** (537907,4997509)	none(1)	120
	Annual	24 (537907,4997509)	none	70
PM_{10} (µg/m^3)	24 hour	**98.8** (537907,4997509)	none(1)	50(2)
$PM_{2.5}$ (µg/m^3)	24 hour	10.1 (536937,4999429)	none	27(3)
	Annual	0.59 (536937,4999429)	none	8.8
Arsenic (µg/m^3)	24 hour	0.05 (537907,4997509)	none	0.3(2)
CO (µg/m^3)	1 hour	133 (536741,4999377)	none	34, 600
	8 hour	14.5 (536937,4999429)	none	12,700

(1) Highest GLC for TSP at site boundary is 100.9 µg/m^3; highest GLC for PM_{10} at site boundary is 32.6 µg/m^3.
(2) OMECP AAQC.
(3) Canadian Wide Standard.

A comparison of maximum GLCs results with Nova Scotia objectives indicates that, with the exception of one area for TSP and PM_{10} to the south of the site, all results are well within the objectives for NO2, SO2, CO and TSP, OMECP AAQCs for arsenic, Canada Wide Standards (CWS) for $PM_{2.5}$.

The off-site particulate exceedances to the south of the FMS Mine Site are located within 500 m of the site boundary in a wooded area. The TSP exceedance (334 µg/m^3) is above the Nova Scotia 24-hour objective of 120 µg/m^3; the $PM_{2.5}$ exceedance (98.8 µg/m^3) is above the OMECP criterion of 50 µg/m^3 for a 24-hour averaging period. **It should be noted that the above-mentioned results represent conditions without dust control mitigation measures applied.** A review of the modelling data determined the estimated total number of exceedances per year to the 24-hour TSP objective and 24-hour PM_{10} criterion is 3 days and 2 days, respectively.

The model was run a second time with a 75% reduction in road emissions for the 3.65 km section of road from the plant to Highway 375; 75% reduction for the 1.3 km road from the open pit to the plant and a 55% reduction on the remainder of the site roads. There were no off-site exceedances with these reductions applied (see Figures 6.2-2 and 6.2-3). As previously mentioned, the need to control emissions on onsite roads will be required an estimated three times per year when weather and onsite operations are unfavourable and may cause offsite exceedances. Based on a literature review, Environment Canada states if an unpaved road is watered twice a day a 55% reduction in particulate emissions can be achieved (Environment Canada, 2018 as referenced in Appendix J.2). Further reductions (to 75%) in particulate emissions can be achieved using magnesium chloride or other equivalent dust suppressant, as required. These mitigation measures will reduce off-site impacts to below the Nova Scotia 24-hour objective for TSP and OMECP for PM_{10}. The use of mitigation measures will also further reduce impacts from other similar particulate emission parameters, such as arsenic, that are associated with dust generation from the site.

With respect to possible exposures to metals on particulate matter through inhalation, predicted concentrations of metals on PM_{10} and $PM_{2.5}$ at the FMS Mine Site property boundary were compared to regulatory ambient air quality guidelines from Ontario (24 hour exposure durations), due to a lack of metals guidelines in Nova Scotia. All predicted concentrations were below the guidelines, and hence, predicted exposure levels are not considered to represent a risk for people spending time near the FMS Mine Site property boundary (see Table 6-2 and 6-3; Appendix C.1). Similarly, when assessed on a long-term basis, predicted metals levels on annual $PM_{2.5}$ were within regulatory guidelines, and hence, risks are considered to be within acceptable levels (see Table 6-4; Appendix C.1).

Table 6.2-9 provides a summary of predicted air dispersion modelling results compared to the Nova Scotia ambient air quality objective for TSP, Ontario MECP criterion for PM_{10} and the CWS for $PM_{2.5}$ for blasting activities. These results represent impacts from the Project alone and do not include baseline information.

Table 6.2-9: Dispersion Modelling Results for Blasting – Maximum Ground Level Concentrations

Pollutant	**Averaging Time Period**	**Normal Operating Conditions Location with the Highest Predicted GLC Offsite Exceedance**	**Normal Operating Conditions Location with the Highest Predicted GLC Site Boundary Locations**	**Normal Operating Conditions – 50% Mitigation Controls Location with the Highest Predicted GLC Offsite Exceedance**	**Nova Scotia Objectives ($\mu g/m^3$)**
TSP ($\mu g/m^3$)	24 hour	none	1.97 (536937,4999429)	none	120
PM_{10} ($\mu g/m^3$)	24 hour	none	1.01 (536937,4999429)	none	50(1)
$PM_{2.5}$ ($\mu g/m^3$)	24 hour	none	0.26 (536937,4999429)	none	27(2)

(1) OMECP AAQC.
(2) Canadian Wide Standard.

All predicted results were below their respective ambient air guidelines during the blasting scenario.

Table 6.2-10 provides a summary of predicted air dispersion modelling results compared to the Ontario MECP criteria for benzene and benzo(a)pyrene for 24 hour averaging periods. The benzene and benzo(a)pyrene were chosen as surrogate parameters to assess volatile organic compounds (VOCs) and polyaromatic compounds (PAHs) in diesel exhaust. These parameters were chosen since the ambient criteria are the typically the most stringent compared other VOCs and PAHs present in diesel exhaust. These results represent impacts from the Project alone and do not include baseline information.

Table 6.2-10: Dispersion Modelling Results for Diesel Emissions – Maximum Ground Level Concentrations

Pollutant	Averaging Time Period	Normal Operating Conditions Location with the Highest Predicted GLC Offsite Exceedance	Normal Operating Conditions Location with the Highest Predicted GLC Site Boundary Locations	Normal Operating Conditions – 50% Mitigation Controls Location with the Highest Predicted GLC Offsite Exceedance	Ontario MECP AAQC ($\mu g/m^3$)
Benzene(1) ($\mu g/m^3$)	24 hour	none	0.02 (536937,4999429)	none	0.23(2)
Benzo(a)pyrene(1) ($\mu g/m^3$)	24 hour	none	0(3) (536937,4999429)	none	0.00005(2)

(1) Emission rates were calculated based on emission factors provided in Table 3.3-2 Speciated Organic Compound Emission Factors for Uncontrolled Diesel Engines. Section 3.3 Gasoline and Diesel Industrial Engines, USEPA, AP-42.
(2) OMECP AAQC.
(3) Concentration provided by AERMOD is calculated so low it is displayed as 0 in the model results.

Table 6.2-11 provides a summary of predicted air dispersion modelling deposition results, and an estimate of the monthly and annual particulate and metals deposition.

Table 6.2-11: Deposition Modelling Results for Mine Operations

Pollutant	Averaging Time Period	Predicted Typical Deposition Levels at Site Boundary	Predicted Typical Deposition Levels at 1 km from Site Boundary	Ontario MECP AAQC (g/m^2)
TSP (g/m^2)	Monthly	0.1	0.02	7
	Annual	1.4	0.35	4.6
Arsenic (g/m^2)	Annual	$2x10^{-4}$	$4x10^{-5}$	-(2)

(1) OMECP AAQC.
(2) « -« denotes not available.

Table 6.2-12 provides the cumulative deposition results for the life of the Project.

Table 6.2-12: Cumulative Deposition Results for the Life of the Project

	Year										Total
	1	2	3	4	5	6	7	8	9	10	
Estimated Annual % Production	0	3.75	95	100	100	100	100	100	70.4	0	
Annual Deposition Contribution - TSP (g/m^2)	0	0.05	1.3	1.4	1.4	1.4	1.4	1.4	0.99	0	9.34
Annual Deposition Contribution - As (g/m^2)	0	0	$8x10^{-6}$	$1.8x10^{-4}$	$2x10^{-4}$	$2x10^{-4}$	$2x10^{-4}$	$2x10^{-4}$	$1.4x10^{-4}$	0	$1.1x10^{-3}$

Table 6.2-12 also provides an estimate of the total deposition of metals for the life of the Project at the FMS Mine Site property boundary. This estimate is considered worst case and deposition amount will decrease further from the site; the deposition amount will decrease by an estimated 75% one km from the FMS Mine Site property boundary.

The dispersion modelling provided a worst case one-year estimate for deposition. Information from the Project production schedule was used to estimate the amount of material handled in each year of operation. Table 6.2-12 provides the estimated total metals deposition based on the estimated production rates. The total estimated metals deposition for the life of the Project is 1.1 x 10- 3 g/m^2 for arsenic.

Potential risks to people in areas near the FMS Mine Site property boundary were further assessed in a human health risk assessment study (Appendix C.1). Methods used to conduct the risk assessment followed Health Canada (2012; 2016a; 2016b; 2018 as referenced in Appendix C.1). Metals adhered to dusts released by the Project could deposit on soils, vegetation and berries in the area, and be taken up by plants, or wildlife in their foraging activities. People spending time in the area conducting activities such as harvesting, hunting, swimming or camping could be exposed through a number of different pathways. Total human exposure to metals adhered to dusts (identified as Chemicals Of Potential Concern or COPCs) was calculated by summing the estimated daily intakes from the following potential exposure pathways, based on maximum predicted dust deposition rates at the FMS Mine Site property boundary, as well as 1 km from the property boundary:

- Exposure from the ingestion of berries;
- Exposure from the ingestion of leafy vegetation;
- Exposure from the ingestion of game meats;
- Exposure from the ingestion of fish;
- Exposure from the incidental ingestion of soils;
- Exposure from the inhalation of dust; and,
- Exposure from the ingestion and contact with surface water through recreational water use (swimming).

Intrinsik concluded that adverse health effects from COPCs, either non-carcinogens or carcinogens, are not anticipated and considered negligible respectively. This is based on the COPC composition of the dust and particulate source material, worst-case dust deposition rates throughout the lifetime on the Project and estimated daily intake by humans. Further detail on the assumptions and calculations used in this conclusion are provided in Appendix C.1.

6.2.6.2 Greenhouse Gas Emissions

The Project is predicted to generate a total of 35 kt of carbon dioxide annually as described in Table 6.2-13.

Table 6.2-13: Estimated Annual Greenhouse Gas Emissions – Proposed FMS Mine Site Operations (Tonnes/Year)

Activity	Equipment	CO_{2e}
Production Drilling	Two 110 mm DTH Drills	3385.3
Bench Scale Exploration	Two 135 mm RC Drills	5376.7
Production Loading	Three Hydraulic Excavators	3436.9

Activity	Equipment	CO_{2e}
Production Loading Stockpile Re-handle	One Wheel Loader	498.8
Production Hauling	Nine Haul Trucks	17241.4
Trucking	Eleven Trucks per day from FMS Mine Site to Touquoy Mine Site	3352.2
Articulated Haul Trucks	Two Articulated Haul Trucks	1724.1
TOTAL CO_2e		**35,015.4**

As previously described in Table 6.2-2, in 2015 the estimated GHG emissions generated in Nova Scotia was 16,200 kt CO2e. The Project is expected to generate an estimated 35 kt of carbon dioxide, which would result in an increase in carbon dioxide emissions of approximately 0.2% to the Provincial levels. Therefore, the contribution of GHG emission from the Project does not threaten the currently achieved 2020 GHG reduction goal set by the province of Nova Scotia.

6.2.7 Mitigation

The control of dust from the mining operations will focus on provision of moisture control measures, such as spraying with water as required. In-pit operations will not generally have much direct off-site impact but could contribute to general dust levels at critical times if not controlled. The FMS concentrate stockpile at the Touquoy Mine Site will be stored indoors to minimize wind and rain erosion; stockpiles will not be covered at the FMS Mine Site and may contribute to airborne dust. Dust control requires careful and consistently applied mitigation measures throughout the Project to ensure non-compliant or nuisance levels are avoided. The proposed mitigation measures for various process components are outlined below. These are similar to measures routinely used at most other Nova Scotia surface mine operations that allow for compliance with air quality guidelines at residential receptors.

Wind erosion from elevated waste rock piles containing finely divided material can be a major source of dust at mine sites. To prevent this occurrence, slopes on inactive stockpiles will be stabilized with mulching and/or vegetation, where appropriate. Waste rock piles will be sprayed with water as necessary to minimize fugitive dust.

Preventative measures to minimize dust produced by the Project:

- Wet suppression controls on unpaved surfaces (twice daily watering during dry seasons and possible application of magnesium chloride or other appropriate chemical dust suppressant);
- Hardened surfaces where practical;
- Speed reduction to keep dust levels at minimum;
- Dust will be minimal during transportation due to specialize covered hoppers to store concentrate between the FMS and Touquoy Mine Sites; and
- Stabilized slopes and cover inactive stockpiles, where practicable.

Mitigation measures used to reduce and control air pollutants during construction, operation, and closure phases are outlined in Table 6.2-14 and will be implemented by the Proponent. Mitigation measures will be confirmed through the permitting stage through the Industrial Approval.

Mitigation measures at the Touquoy Mine Site (as required by the IA) are anticipated to continue throughout the operations phase of the Project.

A complaint from the public and/or the Mi'kmaq of Nova Scotia will be a trigger to evaluate mitigation options. The Proponent will be responsible for consideration of preventative mitigative actions listed here and in Table 6.2-14.

Table 6.2-14: Mitigation for Air

Project Phase	Mitigation Measure
C, O	Utilize paved surfaces where available
C, O	Speed reduction
C, O	Apply dust suppressants, when and where practicable, to target 55% effectiveness (twice daily watering of roads during dusty periods) and 75% effectiveness (chemical dust suppressants) on main site road from pit to plant and from plant to Highway 374
C, O	Use mechanical sweeper on paved surfaces to prevent dust from remobilizing
C, O, CL	A procedure will be developed that will allow the public to register complaints regarding dust concerns and will require the Proponent to respond in a timely and effective manner.
O	Apply stabilized covers on inactive stockpiles, where necessary
O	Size and select haul vehicles appropriately to minimize trip frequency
O	Implement appropriate dust suppression measures for crusher trains and associated activities/stockpiles
O	Minimize dust during transportation through use of specialized hoppers (fully contained) for concentrate between the FMS and the Touquoy Mine Sites
O	Implement Fugitive Dust Management Plan, which is included in the EMS Framework Document (Appendix L.1)
CL	Stabilize slopes on inactive stockpiles to a safe and long-term angle of repose
CL	Use soil and organics stockpiles for final capping and stabilization. Hydroseed as required

Note: C = Site Preperation and Construction Phase, O = Operation Phase, CL = Closure Phase.

6.2.8 Residual Effects and Significance

The predicted residual environmental effects of Project development and production on air quality are assessed to be adverse, but not significant. The overall residual effect of the Project on air quality is assessed as not likely to have significant adverse effects after mitigation measures have been implemented as described in Table 6.2-15 below.

Table 6.2-15: Residual Environmental Effects for Air

Project VC Interactions	Mitigation and Compensation Measures	Nature of Effect	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect
			Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility		
FMS Mine Site- Construction and Closure, – Dust and Air Pollutant concentrations at Property Boundary	Dust suppressants targeting 55% and 75% effectiveness; Regular equipment maintenance	A	L (qualitative assessment only – predicted to be less air pollution generated than during peak operations phases described below)	LAA Dust and Air pollutant concentrations are predicted to meet regulatory guidelines at the property boundary and meet background within the LAA	A VC will be affected by timing – drier periods will create dusty conditions	MT Effect will occur between 1 and 7 years.	R Effects will occur regularly within the life of the project	R VC will recover to baseline conditions	Increased ambient dust and air pollutants	Not significant
FMS Mine Site - Operational – Dust and Air Pollutant concentrations at Property Boundary		A	L Less than or equal to appropriate guidelines or threshold values	LAA Dust and Air pollutant concentrations are predicted to meet regulatory guidelines at the property boundary and meet background within the LAA	A VC will be affected by timing – drier periods will create dusty conditions	MT Effects can occur between 1 and 7 years	R Effects will occur regularly within the life of the project	R VC will recover to baseline conditions	Increased ambient dust and air pollutants	Not significant
FMS Mine Site - Construction, Operation and Closure – GHG emission levels	Regular equipment maintenance	A	N Within the range of natural variability of baseline conditions	RAA GHGs generated are predicted to extend beyond the PA and the LAA	N/A VC is not expected to be affected by timing	LT Effects can occur for 11 years	R Effects will occur regularly within the life of the project	R VC will recover to baseline conditions	Increased GHG emissions	Not significant
FMS Mine Site - Construction and Closure, – Human Exposure to COPC from Dust Deposition at Property Boundary and 1 km from Property Boundary	Dust suppressants targeting 55% and 75% effectiveness	A	L Qualitative assessment only – predicted to be less dust generated than during peak operations phases described below	LAA Human exposure to COPC concentrations are predicted to meet guidelines within the LAA.	N/A VC is not expected to be affected by timing	MT Effect will occur between 1 and 7 years	R Effects will occur regularly within the life of the project	R VC will recover to baseline conditions	Increased Human Exposure to COPCs	Not significant
FMS Mine Site - Operational – Human Exposure to COPC from Dust Deposition at Property Boundary and 1 km from Property Boundary		A	L Less than or equal to appropriate guidelines or threshold values	LAA Human exposure to COPC concentrations are predicted to meet guidelines within the LAA	N/A VC is not expected to be affected by timing	MT Effects can occur between 1 and 7 years	R Effects will occur regularly within the life of the project	R VC will recover to baseline conditions	Increased Human Exposure to COPCs	Not significant

Legend (refer to Table 5.10-1 for definitions)

Nature of Effect	Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility
A Adverse	N Negligible	PA Project Area	N/A Not Applicable	ST Short-Term	O Once	R Reversible
P Positive	L Low	LAA Local Assessment Area	A Applicable	MT Medium-Term	S Sporadic	IR Irreversible
	M Moderate	RAA Regional Assessment Area		LT Long-Term	R Regular	PR Partially Reversible
	H High			P Permanent	C Continuous	

A significant adverse effect for air has not been predicted for the Project for the following reasons, with consideration of the ecological and social context within the LAA of the Project:

- During Construction and Closure: Air concentrations will be elevated above baseline conditions for limited periods but for short duration (<1 year for construction and 2-3 years for the reclamation stage of the Closure Phase), extending into the LAA. However, air concentrations will remain within established guidelines at the FMS Mine Site property boundaries, and thus the guidelines are also met within the LAA. Air effects are reversible once mining operations and active reclamation activities are completed.
- During Operations: Air concentrations will be elevated above baseline conditions extending into the LAA. However, air concentrations levels will remain within established guidelines at the FMS Mine Site property boundaries and thus the guidelines are also met within the LAA. Air effects are reversible once mining operations and active reclamation activities are completed.
- During Operations: Human Exposure to COPC from Dust Deposition for the FMS Mine Site are predicted to meet guidelines within the LAA. Adverse health effects from COPCs, either non-carcinogens or carcinogens, are not anticipated and considered negligible respectively. Air effects are reversible once mining operations and active reclamation activities are completed.

6.2.9 Proposed Compliance and Effects Monitoring Program

The listed guideline thresholds for air have been predicted to be met at the FMS Mine Site property boundary when the mitigation measures listed in Table 6.2-14 are implemented. The nearest receptor is located at 4.9 km from the FMS Study Area. Air monitoring at the FMS Mine Site property boundary will be completed as determined through the IA process. Frequency and specific details of air monitoring will be determined in consultation with regulatory agencies and will be described in the application for an IA for the site development following the EA process. A Complaints Protocol will be followed to provide a mechanism to register concerns and discuss them with Project representatives.

Air quality monitoring is currently ongoing at the Touquoy Mine Site as required through the IA and will continue throughout the operation phase of the Project. The data collected will be used to better understand potential effects and refine mitigation and monitoring requirements prior to the processing of FMS concentrate and management of associated tailings.

Proposed follow-up and monitoring programs have been reviewed with the Mi'kmaq of Nova Scotia during engagement efforts including meetings, sharing of technical documents (Draft EIS, poster boards, Summary of Mi'kmaq Effects and Proposed Mitigation Measures, Plain Language Summary). On-going engagement with the Mi'kmaq will continue through the EA process and associated permitting relating to follow-up programs and monitoring.

6.3 Light

6.3.1 Rationale for Valued Component Selection

Light level limits are not directly regulated through the provincial or federal regulatory regime. Changes (i.e., increases or changes to occurrence timing) to ambient light levels have the potential to adversely affect fauna and birds, as well as increase the level of light experienced by the general public or specific populations. As a result, light has been considered as a Valued Component for the purposes of this EIS.

6.3.2 Baseline Program Methodology

6.3.2.1 FMS Study Area Baseline Program Methodology

Ambient light data was collected at four representative sample locations on the night of September 9th, 2018 in or in proximity to the FMS Study Area. Light data was comprised of ambient light levels (illuminance) and sky brightness recordings at each location using a Digi-Sense data logging electronic photometer and a Unihedron Sky Quality Meter (model SQM-LU-DL-V) respectively. Illuminance was recorded in lumens per square meter (lux) and sky brightness in magnitudes per square arcsecond (mag/arcsec^2). Light data was collected under the most conservative conditions (new moon, clear skies and no snow cover) which represents the lowest ambient light conditions for comparison to post-construction development conditions. The locations of the light monitoring stations are provided in Table 6.3-1 and presented in Figure 6.3-1.

Table 6.3-1: Baseline Light Monitoring Locations

Sample Location	UTM Coordinates (Zone 20 T)		General Area	Conditions
	Easting	Northing		
Light 1	535910	4998952	Within the FMS Study Area approximately 1.5 km west of the proposed pit.	• 0/10 cloud cover and no sources of light interference. • Full horizon was not visible due to tree cover
Light 2	539562	4998399	Within the FMS Study Area approximately 2 km east of the proposed pit.	• 0/10 cloud cover • Subtle light on horizon to SW possibly form Sheet Harbour • Full horizon was not visible due to tree cover
Light 3	538085	4999935	Within the FMS Study Area approximately 1 km northeast of the proposed pit.	• 1/10 cloud cover • Exploratory drill light located to south was likely to far away to affect the assessment results • Full horizon was not visible due to tree cover

Sample Location	UTM Coordinates (Zone 20 T)		General Area	Conditions
	Easting	Northing		
Light 4	534814	5001866	Outside of the FMS Study Area approximately 4 km northwest of the proposed pit.	• 0/10 cloud cover • Subtle light on horizon to north, west and northeast possibly from Upper Musquodoboit or New Glasgow • Full horizon was visible

Baseline ambient light measurements are compared to descriptive zones established by the Commission Internationale de l'Eclairage (CIE) for reference. The descriptive zones are described in further detail in Table 6.3-2.

Table 6.3-2: Description of Lighting Environmental Zones

Sky Brightness ($mag/arcsec^2$)	Illuminance (lux)	CIE Classification	Description
21.7 - 22.0	< 0.6	E0*	Excellent truly dark skies are characterized by skies completely free of artificial light sources on a moonless night. Typical of UNESCO Starlight Reserves and Dark Sky Parks
21.5 – 21.7	0.6 – 0.8	E1	Typical, truly dark skies are characterized by mostly dark ground cover but where objects protruding into the sky are discernible
20.4 – 21.5	0.8 - 3	E2	Rural skies are characterized by some to moderate light pollution visible on the horizon
18.0 – 20.4	3 - 25	E3	Suburban Skies are characterized by obvious light pollution domes up to 35 degrees from the horizon
< 18.0	> 25	E4	City Skies are characterized by obvious and bright light pollution zones up to the zenith. Typical of major city centers such as Toronto or Montreal

*E0 is not a true CIE Classification but was added to represent truly dark skies associated with reserves and parks.

6.3.2.2 Touquoy Baseline Program Methodology

A baseline ambient light assessment was conducted as part of the 2007 Focus Report (CRA 2007) for Illuminance at the Touquoy Mine Site on the night of August 23, 2007. Four sample locations were monitored surrounding the Touquoy Mine Site using a Skeonic L-358 flash meter to understand the ambient light conditions of the area. Baseline sky glow conditions were not assessed for as part of the 2007 Focus Report. The location of baseline light monitoring locations surrounding the Touquoy Mine Site are presented in Figure 6.3-2.

6.3.3 Baseline Conditions

6.3.3.1 Regional Baseline Conditions

The Project is located in a remote, rural and mostly wooded area with very low industrial activity and population density. Therefore, the ambient light environment in the surrounding area of both mine sites can be characterized as a natural/rural environment.

6.3.3.2 FMS Study Area Baseline Conditions

At all sample locations, ambient light measurements were under exposed, indicating ambient light levels were too low to be measured (<0.01 lux).

Sky brightness ranged across the monitoring sites from 21.5 to 21.7 mag/arcsec^2 indicative of a low-light rural environment. The baseline sky brightness results for each monitoring location are provided in Table 6.3-3.

Table 6.3-3: Baseline Sky Brightness surrounding the FMS Study Area

Monitoring Location	Brightness (mag/arcsec^2)	CIE Classification
Light 1	21.7	E1 (Intrinsically Dark)
Light 2	21.6	E1 (Intrinsically Dark)
Light 3	21.5	E1 (Intrinsically Dark)
Light 4	21.5	E1 (Intrinsically Dark)

The FMS Study Area consists of intrinsically dark night skies which are characteristic and similarly found in wilderness or park sites.

6.3.3.3 Touquoy Mine Site Baseline Conditions

At all locations where baseline measurements were taken at the Touquoy Mine Site, ambient light measurements were under exposed, indicating ambient light levels were too low (<0.01 lux) to be measured (CRA, 2007). No data was collected to support determination of CIE Classification for Sky Brightness.

6.3.4 Consideration of Engagement and Engagement Results

Key issues raised during public and Mi'kmaq engagement relating to ambient light include potential concern with light levels surrounding the FMS Mine Site and potential effect on wildlife and Mi'kmaq traditional practices and more general recreational usage of the land by the Mi'kmaq and local residents in the area.

The results of the public engagement and Mi'kmaq engagement have been considered in the environmental effects assessment, including the Proponent's commitments on mitigation and monitoring measures and proposed compliance and effects monitoring programs, as well as the Proponent's broader commitment to ongoing public and Mi'kmaq engagement.

6.3.5 Effects Assessment Methodology

6.3.5.1 Boundaries

6.3.5.1.1 *Spatial Boundaries*

The spatial boundaries used in the assessment of light are the PA, LAA and RAA.

The PA encompasses two primary components from Trafalgar to Moose River Gold Mines, Halifax County, NS. The primary component is the FMS Study Area which will be located east of Highway 374 near Seloam Lake, and the second component is the Moose River Gold Mines, where the Touquoy Mine Site (processing of concentrate and tailings management) is located.

The LAA for light has been defined as a 2 km buffer from the PA. At the FMS Mine Site, the boundary-determining factor at this distance is the elevation of surrounding topographical features that will effectively block any visible light trespass (background light levels). At the Touquoy Mine Site, the boundary was defined based on the nearest modelled receptor (person canoe at Scraggy Lake).

The RAA for light is defined such that it encompasses the nearest residential receptors for the FMS Mine Site and the Touquoy Mine Site. The RAA was determined to encompass a buffer of 5 km from the PA.

The LAA is the appropriate spatial boundary to evaluate potential effects from light on the Project.

The PA, LAA and RAA boundaries are provided in Figure 6.3-3.

6.3.5.1.2 *Temporal Boundaries*

The temporal boundaries used for the assessment of effects of ambient light are the construction phase, operational phase and active decommissioning and reclamation stage of the closure phase of the Project.

6.3.5.1.3 *Technical Boundaries*

No technical boundaries were identified for the effects assessment of light.

6.3.5.1.4 *Administrative Boundaries*

The assessment of light is not provincially or federally regulated through any legislation or acts.

The Institute of Lighting Engineers have produced suggested maximum guidelines on Obtrusive Lighting Limitations for Exterior Lighting Installations (ILE, 2005), which were consulted in the assessment of the Project. The thresholds for light trespass (into windows) for each CIE Classification is presented in Table 6.3-4.

Table 6.3-4: International Lighting Engineers Obtrusive Light Limitations for Exterior Lighting Installations

CIE Classification	Night-time Light Trespass Threshold into Windows (lux)
E1	1*
E2	1
E3	2

CIE Classification	Night-time Light Trespass Threshold into Windows (lux)
E4	5

*From public road lighting installations only

Measured sky brightness results in an E1 classification for the FMS Mine Site. As a result, a 0 lux threshold has been conservatively assigned for light trespass into windows (residential receptors). For the Touquoy Mine Site, sky brightness was not calculated. To be conservative, an E1 classification is assumed and a 0 lux threshold has been assigned for light trespass into windows (residential receptors).

6.3.5.2 FMS Study Area Methodology

Predictive effects of light spill are determined by "line of sight" methodology and use elevation contours for impact limits. This is used to represent the 0.1 lux light level which is otherwise considered the limit of possible impact. The possible impact from light extent was also evaluated through a light attenuation assessment through the use of the inverse-square law to determine potential effects at the nearest receptors (Appendix J.3).

Effects to birds, wildlife and the Mi'kmaq of Nova Scotia from predicted light are further discussed in Sections 6.10, 6.11, and 6.13.

6.3.5.3 Touquoy Mine Site Methodology

In the 2007 Focus Report (CRA 2007), the impacts of the proposed lighting installations at the Touquoy Mine Site were quantified and compared with guidelines published by the Institution of Lighting Engineers (ILE) in the document entitled "Guidance Notes for the Reduction of Obtrusive Light" (ILE 2005). A threshold of 1 lux was determined to be the limit of noticeable impact from light. 1 lux is equivalent to the light provided by a full moon on a clear night. The extent of the 1 lux threshold was compared to nearby sensitive receptors to determine potential effects. Sensitive receptors included Camp Kidston (3 km to the north), the Scraggy Lake Area (2 km to the south) and the nearest residence (5 km to the northwest).

Effects to birds, wildlife and the Mi'kmaq of Nova Scotia from predicted light are further discussed in Sections 6.10, 6.11, and 6.13.

6.3.5.4 Thresholds for Determination of Significance

For the purpose of this assessment, the threshold of determination of significant effects from light at the FMS Study Area was determined to be 0 lux light trespass into windows at the nearest receptor. This was determined as a result of the baseline environmental light classification of E1 at the FMS Study Area.

For light, the following logic was applied to assess the magnitude of a predicted change in light levels:

- Negligible – background light levels (0.1 lux) are met at the property boundary
- Low – increased light trespass above background levels beyond property boundaries, however, comply with relevant guidelines for light trespass into windows at the residential receptors
- Moderate – increased light trespass above background levels beyond property boundaries, however, exceed relevant guidelines for light trespass (0 lux) into windows at the residential receptors up to 1 lux.
- High – increased light trespass above background levels beyond property boundaries, however, exceed guidelines for light trespass (0 lux) into windows at a residential receptor above 1 lux.

For light, the following logic was applied to assess the timing of a predicted change in light levels. Timing has been determined to not be applicable because the modelling was completed assuming no foliage. Foliage would seasonally decrease light trespass, and thus results are conservatively high. Light trespass during daylight hours would be negligible and thus, this assessment focusses on dark or nighttime conditions.

6.3.6 Project Activities and Light Interactions and Effects

Potential interactions between the Project activities and light are outlined in Table 6.3-5 and Table 6.3-6.

Table 6.3-5: Potential Interactions with Project Activities and Light in the FMS Study Area

Project Phase	Duration	Relevant Project Activity
Site Preparation and Construction Phase	1 year	• Clearing, grubbing, and grading • Drilling and rock blasting • Topsoil, till and waste rock management • Mine site road construction and maintenance including lighting • Surface infrastructure installation and construction including lighting • Collection and settling pond construction, including lighting • Local traffic bypass road construction • Culvert and bridge upgrades and construction • Environmental monitoring • General waste management
Operations Phase	7 years	• Drilling and rock blasting • Ore management • Waste rock management • Site maintenance and repairs, including lighting • Ore processing and plant site operations • Concentrate loading and haulage • Environmental monitoring • General waste management
Closure Phase: Reclamation Stage	2 – 3 years	• Infrastructure demolition • Site reclamation • Environmental monitoring • General waste management

Table 6.3-6: Potential Interactions with Project Activities and Light at the Touquoy Mine Site.

Project Phase	Duration	Relevant Project Activity
Site Preparation and Construction Phase	1 year	• Concentrate process equipment upgrades
Operations Phase	7 years	• Lighting of facilities and mine site roads • Site maintenance and repairs including lighting • Environmental monitoring • General waste management

6.3.6.1 FMS Study Area

The effects of light impact from the FMS Study Area were assessed for impacts from light spill (two methodologies) and sky glow. Light spill is defined as the extent which light will travel before being obscured by a barrier. Sky glow is the observable brightness of the night sky caused by light spill above the horizontal plane or reflected into the night sky.

The predicted extent of light spill is provided in Figure 6.3-4. Light propagation extends between 0 and 2 km from the FMS Mine Site property boundary. A significant removal of trees or significant elevation change at the receptor or source would be needed for light spill to be noticeable at the residential receptors.

Utilizing the inverse square methodology, for each source at the site, the total wattage of lighting was summed based on estimations or manufacturer specifications where available. The wattage of each source was converted to lumens utilizing the luminous efficacy from published sources (US DOE, 2017 as referenced in Appendix J.3) for comparable lighting types. Luminous efficacy considers the sensitivity of the human eye to the wavelength of light produced. All sources were conservatively treated as a single source at the point of infrastructure closest to the nearest residence.

On the south side of the site, nearest the receptors, the typical extent of light spill (< 0.1 lux) is expected to be approximately 500 metres from the south edge of infrastructure (Figure 6.3-4). A total light output of 6,527,000 lumens was used as an assumption for the whole site emitting from the nearest point of infrastructure to the nearest receptor. The calculation of 0.10 lux at 500 metres takes into account the known physical obstacles such as trees, berms, or local topography, between the Project and the light receptors by using a 99.6% attenuation factor.

While an approximation, the effect is that even a few stands of trees or a hill of sufficient height can substantially reduce light spill, which is supported by roadside observations carried out near the FMS Mine Site. With 1.35 lux for light vehicles added to the lux for all other light sources, this summation gives a resultant illuminance at Receptor 1 (located 4.9km south of the FMS Mine Site) of 0.001 lux. Receptors 2, 3 and 4 are further from the sources and would have, therefore, notably lower illuminance. All residences identified are expected to have CIE-acceptable “E1” illuminance levels during construction and operation phases.

Additionally, site infrastructure and equipment will be sources of light that are not anticipated to produce a significant area of illumination (sky glow). Therefore, the effects of sky glow are anticipated to be limited to within 2 km of the FMS Study Area and not likely noticeable at the nearest receptor.

Effects to birds, wildlife and Mi’kmaq of Nova Scotia from light are further discussed in Sections 6.10, 6.11, and 6.13.

6.3.6.2 Touquoy Mine Site

The predicted light spill anticipated to occur at the identified points of reception (Camp Kidston, Scraggy Lake Area and the nearest residence) ranges between 0.0587 and 0.294 lux, well below the established 1 lux threshold used at the Touquoy Mine Site for the Touquoy Gold Project (CRA, 2007).

The primary effect of the continued use of the Touquoy Mine Site is the continued lighting of facilities and vehicular traffic during the processing of FMS concentrate. There are no new or additional effects from light anticipated to be caused by the processing of concentrate and the management of tailings from the Project that would affect the conclusions presented above for the Touquoy Mine Site based on the Touquoy Gold Project evaluation of light.

Effects to birds, wildlife and Mi'kmaq of Nova Scotia from light are further discussed in Sections 6.10, 6.11, and 6.13.

6.3.7 Mitigation

The use of lights will be limited to the amount necessary to ensure safe operation. Light pollution will be reduced by installing downward-facing lights on site infrastructure and mine site roads. Wherever practicable, motion-sensing lights will be installed to ensure lights are not turned on when they are not necessary. Only direct and focused light will be used for worker safety. Practices will be reviewed on an annual basis for BAP, including illumination.

Mitigation measures for the Project are described in Table 6.3-7 and will be implemented by the Proponent.

Table 6.3-7: Mitigation for Light

Project Phase	Mitigation Measure
C, O, CL	Temporary lighting will be directly focused on work areas and shielded where practicable to avoid light trespass
C, O, CL	Use of only downward-facing lights on site infrastructure and mine site roads
C, O, CL	Install motion-sensing lights, where practicable
C, O, CL	All floodlights will employ full horizontal cut-off, as appropriate
C, O, CL	Only use direct and focused light when needed for worker safety
C, O, CL	Lighting not in use will be turned off, whenever practicable
C, O, CL	Site perimeter lighting will be directed to minimize offsite light trespass
C, O, CL	A procedure will be developed that will allow the public to register complaints regarding light concerns and will require the Proponent to respond in a timely and effective manner.
C, O, CL	Utilize efficient sources of light, such as LED, to reduce overall magnitude of light, wherever practicable

Note: C = Construction Phase, O = Operation Phase, CL = Closure Phase.

6.3.8 Residual Effects and Significance

The predicted residual environmental effects of Project development and production of light are assessed to be adverse, but not significant. Quantitative modelling was completed for the operations phase of the Project as this phase was predicted to be the worst-case scenario for light propagation. The overall residual effect of the Project on light is assessed as not likely to have significant adverse effects after mitigation measures have been implemented as presented in Table 6.3-8.

Table 6.3-8: Residual Environmental Effects for Light

Project VC Interactions	Mitigation and Compensation Measures	Nature of Effect	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect
			Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility		
Construction and Closure – FMS Mine Site	Limited vegetation clearing. Minimize lighting (downward facing lighting, motion sensor lights, light positioning away from property boundaries where practical)	A	L (qualitative assessment only – predicted to be less light propagation than operations phase described below)	LAA Lighting impacts will extend beyond the PA	N/A Seasonal aspects were not considered during modelling (assumed no foliage)	MT Effects can occur up to 1 year (Construction) and 3 years (reclamation stage of closure)	R Effects will occur regularly throughout the life of the Project	R VC will return to baseline conditions	Increased ambient light	Not significant
Operation – FMS Mine Site and Touquoy Mine Site	Minimize lighting (downward facing lighting, motion sensor lights, light positioning away from property boundaries where practicable)	A	L Less than or equal to appropriate guidelines or threshold values	LAA Lighting impacts will extend beyond the PA	N/A Seasonal aspects were not considered during modelling (assumed no foliage)	MT Effects may occur between 1 and 7 years	R Effects will occur regularly throughout the life of the Project	R VC will return to baseline conditions	Increased ambient light	Not significant

Legend (refer to Table 5.10-1 for definitions)

Nature of Effect	Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility
A Adverse	N Negligible	PA Project Area	N/A Not Applicable	ST Short-Term	O Once	R Reversible
P Positive	L Low	LAA Local Assessment Area	A Applicable	MT Medium-Term	S Sporadic	IR Irreversible
	M Moderate	RAA Regional Assessment Area		LT Long-Term	R Regular	PR Partially Reversible
	H High			P Permanent	C Continuous	

A significant adverse effect for light has not been predicted for the Project for the following reasons, with consideration of the ecological and social context within the LAA of the Project:

- During Construction: Light will be elevated above baseline conditions potentially extending into the LAA. However, light spill will be limited by surrounding topography prior to reaching the nearest receptors. Given the remote location of the Project the likelihood of mobile receptors being regularly in close proximity to light generation sites is very low. Light trespass has been qualitatively assessed during construction and is predicted to be lower than during operations, which was modelled and is described below.
- During Operations: Light spill is predicted to extend a maximum of 2 km from the FMS Mine Site into the LAA for the Project. However, light levels will be limited by surrounding topography prior to reaching the nearest receptors and given the remote location of the Project the likelihood of mobile receptors being regularly in close proximity to light generation sites is very low.
- During Closure: Light levels will be elevated above baseline conditions potentially extending into the LAA during decommissioning activities, then drop to baseline conditions for the post closure period. Light trespass has been qualitatively assessed during Closure and is predicted to be lower than during operations, which was modelled and is described above.

6.3.9 Proposed Compliance and Effects Monitoring Program

The thresholds for light are expected to be met within 2 km of the PA. As the nearest receptor is located beyond this distance at 3 km (Camp Kidston) from the PA (Touquoy Mine Site) and 4.9 km from the PA (FMS Mine Site), light monitoring is not recommended to verify the predicted environmental effects and the effectiveness of the mitigation measures outlined in Table 6.3-7. A Complaints Protocol will be followed to provide a mechanism to register concerns and discuss them with Project representatives. Additional ambient light monitoring would occur if directed by regulators or as a result of a complaint.

Proposed follow-up and monitoring programs have been reviewed with the Mi'kmaq of Nova Scotia during engagement efforts including meetings, sharing of technical documents (Draft EIS, poster boards, Summary of Mi'kmaq Effects and Proposed Mitigation Measures, Plain Language Summary). On-going engagement with the Mi'kmaq will continue through the EA process and associated permitting relating to follow-up programs and monitoring.

6.4 Geology, Soils and Sediment

6.4.1 Rationale for Valued Component Selection

The subject of Geology, Soil and Sediment is selected as a VC due to:

a) the potential for minerals in the ore, waste rock and tailings to generate metal leaching/acid rock drainage (ML/ARD) upon exposure to oxygen and precipitation. ARD in turn can damage surface and groundwater resources by inducing changes to acidity and through the transportation of heavy metals. The potential environmental effects of ARD are evaluated under Groundwater and Surface Water, Sections 6.5 and 6.6.

b) the potential for mining activities to contaminate soil, vegetation and watercourses. Degraded soil, vegetation and water quality may expose humans to contaminants via exposure pathways such as ingestion, dermal contact, and inhalation. The potential environmental effects of dust deposition and associated exposure pathways to humans are evaluated under Air Quality, Section 6.2. The environmental effects of recreational swimming from dermal contact and accidental ingestion of surface water are evaluated in Section 6.15. Mi'kmaq traditional practices are evaluated in Section 6.13.

c) the potential for construction and mining activities, including the relocation of historic mine waste rock and tailings, to discharge sediment to nearby watercourses. Increased sediment loads can degrade water quality, smother benthic habitats and transport heavy metals and other pollutants. These contaminants in turn may negatively affect biota. The potential environmental effects of sediment discharge are evaluated within this section.

6.4.2 Baseline Program Methodology

6.4.2.1 FMS Study Area Baseline Program Methodology

A total of 12 sediment grab samples were collected on October 5, 2018 along Seloam Brook and within a tributary to East Lake located in the southeast corner of the FMS Study Area. Six additional sediment samples were collected later in October 2018 from Anti-Dam Flowage, a two-kilometer long lake located immediately downstream of the FMS Study Area. The samples were analyzed for metals, grain size distribution, and organic matter content to obtain baseline sediment quality data prior to site preparation and construction. Sample locations are shown on Figure 6.4-1.

Analytical results were compared to the Canadian Council of Ministers of the Environment (CCME) Sediment Quality Guidelines for the Protection of Aquatic Life (Freshwater Interim Sediment Quality Guidelines (ISQGs) and Probable Effect Level (PEL)). The CCME PELs represent a concentration above which adverse effects are expected to occur. ISQGs represent a concentration in surficial sediments (i.e. top 5 centimeters), which may be associated with adverse effects. The analytical results were also compared to the Nova Scotia Tier 1 Environmental Quality Standards (NSEQS) for Freshwater Sediment, which are generally equivalent to the PEL guidelines from the CCME. The analytical results are presented in Appendix G.9 and are summarized in Section 6.4.3.4 below.

Baseline sediment quality data will be used for comparison with samples obtained during the routine sediment sampling program to be undertaken during construction and operation. The data will be used in assessing sediment quality variations resulting from construction, operation and closure.

Stantec also completed a comprehensive historical review of past mine workings through a series of Phase I and Phase II Environmental Site Assessments and issued management options and recommendations to further delineate and control waste rock and tailings (Appendix I.1 – I.3).

6.4.2.2 Touquoy Baseline Program Methodology

Sediment quality at the Touquoy Mine Site will not be affected by activities associated with the Project and so no assessment of the potential effects on sediment quality at the Touquoy Mine Site was conducted. The Touquoy Mine Site will receive, and process, FMS concentrate from the Project. Tailings generated from the processing of FMS concentrate will be deposited in the exhausted Touquoy pit; surplus water will be decanted to the Moose River only once water quality meets MDMER discharge criteria and applicable guidelines at the compliance point within the Moose River (please see Surface Water, Section 6.6 for more details on water management at the Touquoy Mine Site). Construction of the spillway at Touquoy Mine Site will not result in any interactions with sediment quality in the Moose River.

6.4.3 Baseline Conditions

6.4.3.1 Topography and Soils

The Project is located within the Eastern Ecoregion of the Acadian Ecozone. Ecoregion boundaries are defined in part by regional climate patterns; climatic influences are in turn expressed through distinctive combinations of soil and vegetation types (Neily et al. 2005; Webb and Marshall 1999).

The Eastern Ecoregion is underlain primarily by quartzite and slate of the Meguma Supergroup, the geological name for this assemblage of ancient metamorphosed sedimentary rocks. Throughout this region, Meguma rocks are intruded by younger granites and related igneous rocks. A variety of landforms are found in this ecoregion, including forest-covered rolling glacial till plains, drumlin fields, extensive exposed bedrock, and wetlands.

Ecoregions are further subdivided into ecodistricts, which are characteristic groupings of relief, landforms, geology, soil, vegetation, water bodies and fauna. The Project is located within one of the largest ecodistricts, the Eastern Interior Ecodistrict, which extends from Halifax in the west to Guysborough County in the east. This ecodistrict is characterized by exposed or thinly covered bedrock with alternating ridge-and-valley topography. Where glacial till cover is thicker, the ridged topography is muted and covered by thick softwood forests (Neily et al. 2005).

Glacial till thickness ranges from 1 - 10 m but averages less than 3 m within this ecodistrict. Approximately 9% of the ecodistrict has been scraped clean by glaciers exposing large areas of bedrock; near Seloam Lake over 20% of the land area is exposed bedrock. The predominant soils are sandy loams, often quite stony and well drained, on glacial till derived primarily from quartzites (Neily et al. 2005).

The FMS Study Area site is bisected by Seloam Brook, which flows northeast to west from the dammed outlet of Seloam Lake to the brook's confluence with Fifteen Mile Stream (Figure 6.4-1). At the extreme western edge of FMS Study Area approximately 500 m downstream of the confluence, Fifteen Mile Stream turns abruptly southward discharging into Anti-Dam Flowage near the southern edge of the FMS Study Area. Anti-Dam Flowage is the lowest elevation at the FMS Study Area; water levels are at approximately 100masl.

The topography north of Seloam Brook is relatively flat, hosting numerous wetlands and intermittent watercourses. Elevations north of Seloam Brook range from 110 to 120 masl. South of Seloam Brook, the topography is rolling, wetlands are fewer, and elevations rise to 175 masl. This region also hosts occasional drumlins - teardrop shaped landforms of sand and gravel (glacial till) created as glaciers advanced across the landscape.

Vegetation is dominated by stands of balsam fir, spruce, tamarack and hemlock with isolated occurrences of hardwood. Logging has been widespread, including recent clear cutting in the immediate vicinity of the mineral deposit.

Apart from areas that host historic tailings and waste rock (see section 6.4.3.4) soil cover at lower elevations around Seloam Brook is almost entirely composed of Danesville series (Dv) soil containing pockets of peat associated with poor drainage (Figure 6.4-2). The topography of Danesville soils is described as ‘undulating’ while the soils themselves are ‘excessively stony – non-arable, too stony for cultivation’ (MacDougall et al. 1963). These soils consist of dark greyish brown sandy loam over yellowish brown sandy loam derived primarily from quartzite. They exhibit ‘imperfect drainage’ and support spruce, balsam fir, hemlock and birch along with an understory of Labrador tea, lambkill and blueberry. Although they are not typically used for agriculture, they can be used to restore disturbed areas to forest cover. The depth to the C horizon is on the order of 40+ cm.

Halifax series (Hx) soils dominate at higher elevations. These soils are brown sandy loams over yellowish sandy loams, also derived from quartzite bedrock. Their topography is characterized as ‘rolling’ and drainage is ‘good to excessive’. The soils are described as ‘often shallow and usually stony and porous and the profile is strongly leached’. Halifax series soils are typically too stony for crop agriculture but sufficiently fertile for mine reclamation since they ‘support good forest vegetation and this is their best use’ (MacDougall et al. 1963). The depth to the C horizon is typically 40+ cm.

Wolfville (Wv) series soils are also present at the FMS Study Area although these soils are much less common than either Danesville or Halifax series soils. Wolfville soils are dark reddish-brown loam to sandy clay loam over strong brown loam to sandy clay loam derived from shale and sandstone. Within the FMS Study Area site these soils comprise two drumlins located near the western site boundary and are proposed for sources of clay for mine development. These soils have ‘good drainage’. Although they are described as ‘very stony’, Wolfville series soils are considered suitable for agriculture and thus for mine reclamation. In forested areas, the depth to the mineralized C horizon is typically 50-75 cm (MacDougall et al 1963).

Background soil quality across the Maritimes was assessed by Friske et al (2014a, 2014b). Of the dozens of samples collected, eight samples nearest the FMS site are presented in condensed form in Table 6.4-1 and Table 6.4-2 below. All samples were prepared using the US Environmental Protection Agency method EPA3050B and analyzed using inductively coupled mass spectrometry-emission spectroscopy (ICP MS&ES).

Table 6.4-2 shows that average background arsenic concentrations in offsite forest soils surrounding the FMS Study Area are at or exceed federal soil quality guidelines (12 mg/kg) but do not exceed provincial Tier 1 Environmental Quality Standards (EQS) for an industrial site with non-potable groundwater use and coarse-grained soil (31 mg/kg).

Table 6.4-1: Background Soil Sample Characteristics

Site ID	Year	Ecoregion	Latitude (NAD83)	Longitude (NAD83)	Deposition	Vegetation	Soil Order
NS071017	2007	NS Highlands	45.34247	-62.66901	Till (morainal)	Coniferous forest	podzolic
NS071032	2007	South-central NS Uplands	45.02242	-62.44527	Till (morainal)	Mixed forest	podzolic
NS071033	2007	South-central NS Uplands	45.19685	-62.71466	Till (morainal)	Deciduous forest	podzolic
NS071036	2007	Nova Scotia Highlands	45.39088	-62.08444	Till (morainal)	Coniferous forest	podzolic
NS071042	2007	Atlantic Coast	44.98490	-62.26555	Till (morainal)	Coniferous forest	podzolic
NS081069	2008	South-central NS Uplands	45.08446	-62.84583	Till	Coniferous Forest	Ferro Podzol
NS081070	2008	Atlantic Coast	44.84208	-62.68604	Till	Mixed Forest	Humo Ferric Podzolic
NS081071	2008	South-central NS Uplands	45.26642	-62.20420	Till poss. fluvial	Coniferous Forest	Ferro Podzol

Table 6.4-2: Background Soil Quality - Mean and Average Total Metal Concentrations

	Ag	Al	As	Cd	Cr	Cu	Fe	Hg	Ni	Pb	Sb	Se	Zn
MEAN (mg/kg)													
A Horizon	0.12	17,333	11.34	0.09	20.22	9.12	32,713	0.11	9.04	16.51	0.31	1.80	39.19
B Horizon	0.10	22,751	11.23	0.02	25.36	11.98	34,851	0.10	12.71	13.44	0.23	1.81	49.32
C Horizon	0.03	no data	12.53	0.02	21.93	18.72	30,399	0.04	18.67	13.37	0.26	0.91	60.30
AVERAGE													
A Horizon	0.14	18,280	13.38	0.11	21.08	9.47	33,900	0.15	9.60	18.18	0.32	1.96	52.52
B Horizon	0.13	23,986	12.79	0.06	26.33	12.83	36,129	0.12	14.34	14.52	0.26	1.91	61.44
C Horizon	0.05	19,814	14.47	0.04	22.69	19.64	32,343	0.04	20.16	15.41	0.30	0.96	72.01
CCME SQG*	40	no data	12	22	NA	91	no data	50	89	600	300	3	410

*Canadian Council of Ministers of the Environment Soil Quality Guidelines for the Protection of Environmental and Human Health (Industrial Site)
NA = not applicable (CCME gives guidelines for chromium species rather than total chromium)

6.4.3.2 Surficial Geology

Surficial geology consists of glacier-derived stony till plains and drumlins with minor organic deposits in low lying, poorly drained areas (Stea et al. 1992). Glacial till is a heterogeneous mixture of unconsolidated clay, sand, gravel and boulders formed as glaciers move across a landscape, lifting, mixing and grinding bedrock to form till deposits. Till plains in eastern Nova Scotia range from 2-20 m thick while drumlins can be thicker, rising to 30+ m above bedrock. As noted above, two apparent drumlins are located near the western property boundary (Figure 6.4-3).

6.4.3.3 Bedrock Geology and Historical Mining

The FMS Study Area is underlain by fine-grained metamorphosed sedimentary rocks of the Meguma Supergroup, which were originally deposited approximately 500 million years ago in a low energy marine environment. Meguma rocks are divided into the underlying (older) Goldenville Group, composed primarily of silty sandstones (called greywacke) and the overlying finer-grained Halifax Group slates (called argillite). These sediments were subsequently metamorphosed and deformed into a series of tight, northeast-trending regional folds (anticlines and synclines). These regional folds can be traced for 100 km or more and their wavelengths are on the order of 10 km (Sangster 1990). The folds typically show upright to overturned geometry and are frequently doubly plunging at shallow angles resulting in elongate domal structures (Horne 2016). Northwest-trending faults are also common throughout the Meguma Terrane, particularly in the Eastern Shore area.

Rocks at the FMS Study Area are from the Goldenville Group, and comprise the Taylor Head Formation, a grey colored thickly bedded metamorphosed sandstone, and the Governor Lake Formation, a metasandstone with minor siltstone which hosts the mineralization (White and Scallion 2011). The Governor Lake Formation has also been called the Fifteen Mile Stream Formation (e.g., Graves et al, 2012) as shown on Figure 6.4-4.

Mineralization at the FMS Study Area occurs within the overturned Fifteen Mile Stream Anticline, a typical elongated dome structure. Gold is found both within bedding-parallel quartz veins and disseminated throughout the host mudstones (now argillite). Alteration associated with gold mineralization includes carbonate minerals and arsenopyrite (Graves et al. 2012).

The FMS Mine Site has been mined on several occasions beginning in 1868; since then exploration work has included geophysical and soil geochemical surveys accompanied by tens of thousands of meters of diamond drilling. From 1868 to 1941, the Fifteen Mile Stream Gold District produced 20,328 oz of gold from 48,896 tonnes of ore (Graves et al. 2012). More recently, NovaGold Resources Inc. began an exploration program in 1985 including trenching, geophysical and geological surveys, and diamond drilling. Bulk sampling programs were undertaken in 1987 and in subsequent years. The property was later investigated by prospector Budd MacKenzie in the early 1990s and later by MacNaughton (1998), Baillie (2002) and Grant (2002, 2005 and 2006). The mineral claims at the FMS Study Area were acquired by Atlantic Mining NS Corp. (now Atlantic Mining NS Inc) in 2014.

6.4.3.4 Historic Tailings, Waste Rock and Current Sediment Quality

Current soil and sediment quality throughout the FMS Study Area is affected by the presence of historic waste rock and tailings, which are prevalent in the FMS Study Area and overprint 'natural' soil and sediment chemistry. To map, characterize and eventually manage historic waste rock and tailings, Stantec completed a comprehensive historical review of past mine workings through a series of Phase I and Phase II Environmental Site Assessments and issued management options and recommendations to further delineate and control waste rock and tailings (Appendix I.1 – I.3).

Mine tailings consisting of finely crushed, sand-sized rock particles appear to be concentrated in and along Seloam Brook and range in thickness from 1.5 to 2.0 m. At least three historic tailings deposits have been mapped (Appendix I.3). Mine tailings can be associated with elevated arsenic and mercury and cyanide concentrations, since these compounds were historically used to extract gold during processing. Stantec estimates 51,000 t of tailings were produced between 1860 and the 1940 (Appendix I.1). This is consistent with estimates in Parsons et al. (2012) who indicate 51,052 t of ore was crushed between 1897 and 1988.

Unprocessed waste rock is much more widespread within the FMS Study Area than tailings; more than a dozen distinct waste rock piles have been mapped (Appendix I.1). Waste rock is associated with elevated concentrations of common heavy metals such as arsenic, iron and lead, since these elements are found in minerals associated with gold deposits. A historical waste rock area is present in the southwestern portion of the proposed open pit (Appendix I.3). The storage area covers an approximate area of 12,500 m^2 and consists of several large piles of waste rock. Waste rock was also identified along several trenches located to the south and east of the proposed open pit and along the access road west of the proposed open pit (Appendix I.3).

In late 2018, Stantec sampled historic tailings and waste rock from 21 test pits excavated within the FMS Study Area (Appendix I.3). Possible tailings were visually observed at nine of the 21 test pits. Analytical results of 22 soil samples were compared to the Tier 1 EQS for an industrial site with non-potable groundwater use and coarse-grained soil. The results indicate:

- Metals (except for arsenic, lead, and mercury) were either not detected above the laboratory detection limits or were detected at concentrations that did not exceed the Tier 1 EQS, where such guidelines exist;
- Arsenic concentrations in 19 of the 22 soil samples were found to exceed the Tier 1 EQS of 31 mg/kg. Arsenic concentrations detected in the 19 samples ranged from 46 mg/kg to 38,000 mg/kg;
- Lead concentrations in two of the 22 samples were found to exceed the Tier 1 EQS of 740 mg/kg. Lead concentrations in the two samples were 750 mg/kg and 1,400 mg/kg; and,
- Mercury concentrations in two of the 22 samples were found to exceed the Tier 1 EQS of 99 mg/kg. Mercury concentrations in the two samples were 140 mg/kg and 290 mg/kg.

The report concludes that elevated arsenic concentrations are expected to be present across the FMS Study Area since the gold is associated with the mineral arsenopyrite. Concentrations of arsenic detected in soil samples collected from certain test pits only marginally exceeded the Tier 1 EQS and are potentially indicative of background (pre-mining) soil concentrations (i.e., 40-200 mg/kg). Soils near an ore body would be expected to be mineral-enriched relative to the soils described in the previous section that are more distant from the mineralized zone.

These results are generally consistent with studies undertaken on historical tailings at the former Cochrane Hill gold mine approximately 40 km due east of the FMS Study Area. Geochemical analyses indicate the tailings contain 280 - 41,000 mg/kg of arsenic and 21-63,000 µg/kg of mercury (Mosher 2004).

In an effort to characterize soil quality near historic Nova Scotia mining sites, Parsons and Little (2015) collected samples of the full soil profile from 46 sites near Montague, NS and 39 sites near Goldenville, NS. Results show that the concentrations of arsenic and mercury in all soil horizons are generally higher 'down-ice' (i.e., in the direction of glacier movement – southeasterly) of the ore zones in both districts, reflecting glacial erosion and transport of mineralized bedrock. Analysis of the top 0–5 cm of soils shows the following ranges in arsenic (As) and mercury (Hg) concentrations (<2 mm size fraction):

- Montague: As, 4–273 mg/kg (median 42 mg/kg); Hg, 72–490 µg/kg (median 164 µg/kg); and,
- Goldenville: As, 2–140 mg/kg (median 13 mg/kg); Hg, 39–312 µg/kg (median 114 µg/kg).

In general, the concentrations of arsenic are highest in the B and C horizons, whereas mercury concentrations are highest in humus (Parsons and Little 2015).

At the FMS Study Area, the 2018 baseline sediment sampling program identified elevated concentrations of certain heavy metals in sediments from the FMS Study Area, in particular, arsenic and mercury. Table 6.4-3 summaries the key findings; the full analyses for metals, grain size distribution and organic matter content are presented in Appendix G.9. The concentration range of each metal below significantly exceeds metal concentrations in background soils (Table 6.4-2 above), suggesting the FMS Study Area sediments have been negatively affected by past mining activities. On-going exploratory work is being completed by Stantec Consulting to support Phase I and Phase II Environmental Site Assessments. Additional sediment quality results obtained by Stantec as part of this on-going work are provided in Section 6.8 (Fish and Fish Habitat).

Table 6.4-3: 2018 Baseline Sediment Quality - Summary

Parameter	CCME ISQG(1)	CCME PEL(2)	Tier 1 EQS (3)	Seloam Brook	Tributary to East Lake	Anti-Dam Flowage
Arsenic (mg/kg)	5.9	17	17	24-120,000	61-5000	32-45
Cadmium (mg/kg)	0.6	3.5	3.5	<0.3-6.7	0.32-0.62	<0.30-0.61
Mercury (mg/kg)	0.17	0.486	0.486	<0.10-61.0	0.50-4.40	0.11-0.50
Iron (mg/kg)	ns (4)	Ns	43,766	15,000-160,000	4,900-27,000	5,800-28,000
Selenium (mg/kg)	ns	ns	2.0	<1.0-4.2	<1.0-3.6	<1.0-2.7

1Canadian Council of Ministers of the Environment Interim Sediment Quality Guidelines (Freshwater)
2Canadian Council of Ministers of the Environment Interim Probable Effect Limit
3Tier 1 Environmental Quality Standards (provincial)
4ns – no standard

6.4.3.5 Geology of the Ore Deposit

Much of the information below is reprinted in condensed form from the 2018 NS 43-101 Technical Report prepared for Atlantic Gold Corporation (Atlantic Gold, 2018) unless otherwise referenced. Additional information was sourced from the Proponent's website accessed February 8th, 2019 (http://www.atlanticgoldcorporation.com/projects/fifteen_mile_stream_project/).

6.4.3.5.1 *Ore Deposit Geology*

The FMS deposit is hosted in folded and faulted strata of the Moose River Formation within the axis and limbs of a north-dipping, overturned regional anticline. In this area, the anticline is commonly referred to as the Fifteen Mile Stream anticline; however, it may be equivalent to the Moose River–Beaver Dam anticline that hosts the Touquoy and Beaver Dam gold deposits to the southwest (Figure 6.4-5).

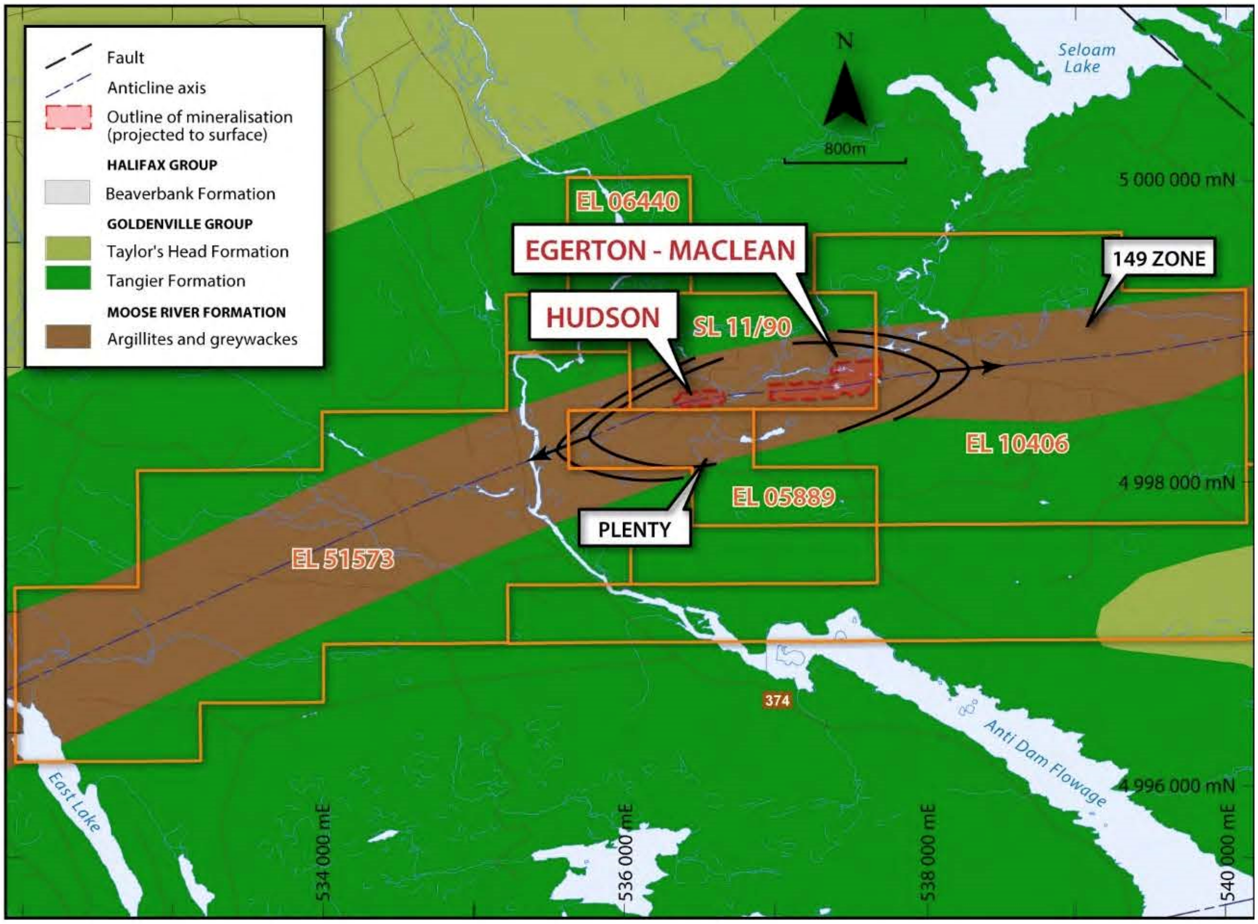


Figure 6.4-5 Geology Plan, Fifteen Mile Stream (Prepared by Atlantic Gold, 2017)

At the FMS Study Area, the Moose River Formation is subdivided into several distinct units, which from youngest to oldest are:

1. Hanging Wall Turbidites: interbedded meta-sandstone and lesser meta-mudstone, locally hosting bedding-parallel quartz veins;
2. Orient Mudstone: green-grey, typically planar-bedded, silty meta-mudstone and siltstone, locally hosting pyrrhotite, arsenopyrite, and quartz veins;
3. McLean Sandstone: meta-sandstone with minor interbedded meta-mudstone; the latter commonly hosting quartz veins;
4. Seigel Mudstone: light to dark grey planar-bedded, silty meta-mudstone that commonly hosts quartz veins and high concentrations of pyrrhotite and, locally, arsenopyrite;
5. Footwall Turbidites: meta-sandstone beds with minor mudstone intervals that locally host bedding-parallel quartz veins.

The Orient and Seigel mudstones are the principal mineralized units, with lesser mineralization hosted by the McLean Sandstone and localized mineralization in folded Hanging Wall and Footwall Turbidites.

The rocks at the FMS Study Area have undergone regional chlorite–biotite greenschist facies metamorphism. Localized, hornfelsic, biotite porphyroblasts in meta-mudstone suggest that the rocks have also undergone localized contact metamorphism.

6.4.3.5.2 *Structure*

The Project anticline is the dominant structure on the property. The anticline is isoclinal with an approximately east–west-trending axis that dips at about 65–75º to the north and plunges in both east and west, defining a dome. The north limb dips at approximately 50–60° northward, whereas the south limb consists of more steeply north dipping to vertical (~70–90º) overturned strata. At the eastern end of the anticline, in the Egerton–McLean Zone, the fold has an average plunge of approximately 20° east, based on the interpreted fold geometry defined by stratigraphic and structural data from drill core. The overturned southern limb is also cut by a series of approximately northeast–southwest-trending faults dipping at about 55– 65º to the north, resulting in the structural repetition of the mineralized axis and southern limb of the fold.

Numerous decimetre- to decametre-scale parasitic folds have been identified within thick mudstone units in the broader hinge zone. Together with localized faulting, this has resulted in structural thickening and repetition of mineralized mudstone units (Orient, Siegel), and thus a wide zone of potentially bulk-mineable mineralization. Metre to decametre-scale, bedding-parallel quartz veins have also been identified at and near the hinge of the fold axis, and may represent saddle-reef veins. The fold in the Hudson Zone area is tight with a narrow, angular hinge that lacks the parasitic folds present in the Egerton–McLean Zone. The lack of folding in the hinge area results in a smaller mineralized zone due to the lack of structural repetition.

Two well defined faults (the Seigel fault and the Serpent fault) have been interpreted to intersect the proposed open pit. Based on the Proponent 2017/2018 exploration program, the Seigel fault is a 30-50 m thick zone with a least two discrete laterally-extensive, north-dipping bounding fault surfaces. The fault zone and bounding fault planes strike approximately east – west and dip at 55º – 60º to the north, transecting the southern end of the Egerton-Maclean and Hudson pits and the southern limb of the Fifteen Mile Stream Anticline (Figure 6.4-6). Hanging-wall shearing results in relatively low rock quality designation (RQD) values, commonly 0 – 30%. Rock-quality designation (RQD) is a rough measure of the degree of jointing or fracture in a rock mass, measured as a percentage of the drill core in lengths of 10 cm or more. High-quality rock has an RQD of more than 75%, low quality of less than 50%.The southern footwall, by comparison, is relatively competent with RQD >40%. Where the fault intersects greywacke, brecciation and crude carbonate stockwork veining is common. Subsidiary shear surfaces, enhanced fracturing, carbonate and local sericite alteration are common elsewhere throughout the shear zone. Localized 1 – 80 cm thick quartz veins, parallel to shear planes and/or bedding, are also common throughout the fault zone. The oldest movement along the Seigel fault reportedly occurred during or shortly after folding.

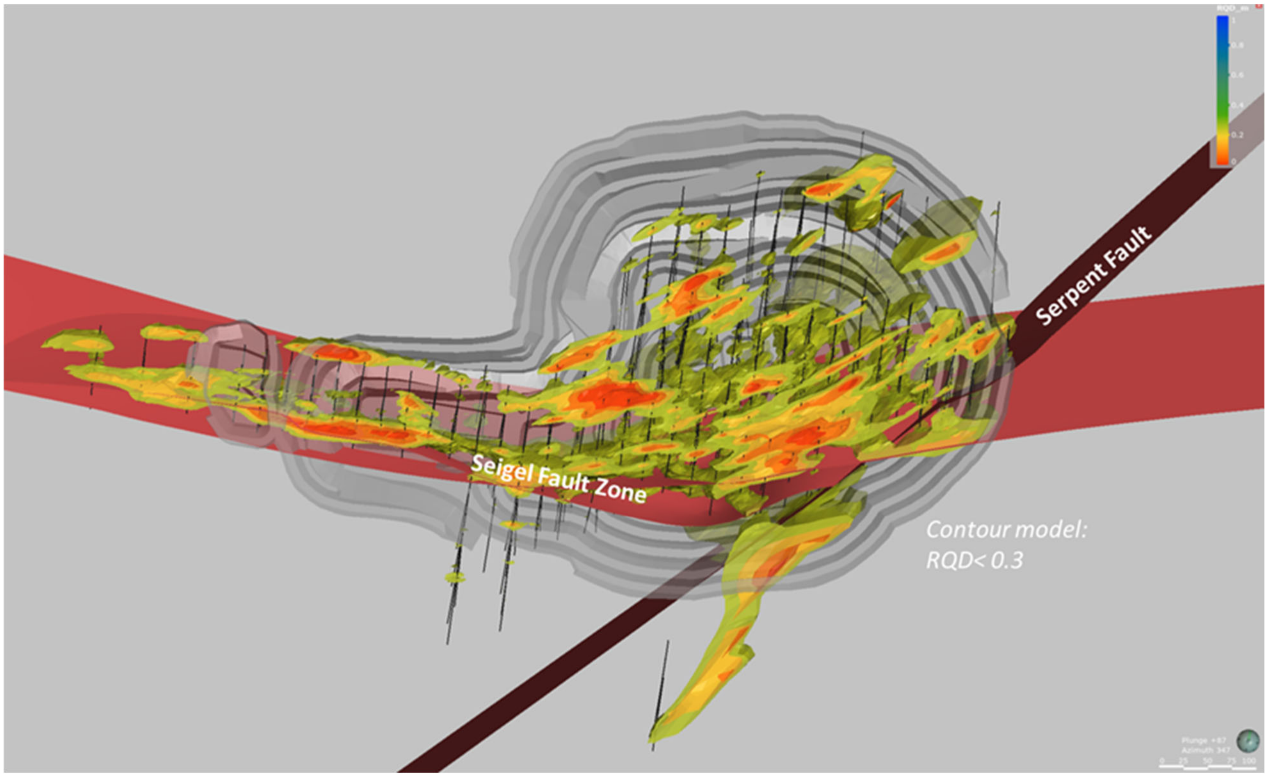


Figure 6.4-6: Plan view of the Egerton-MacLean fault model, superimposed on the current reserve pit and contours of RQD values (warm colours are low RQD, refer to scale on top right).

The Serpent Fault Zone is comparably narrow – typically only 5-10 m thick – and consists of one to three fault surfaces striking roughly southwest-northeast and dipping approximately 78º to the northwest. The fault surfaces are characterized by strong, steeply plunging slickened lineation and are in places accompanied by graphitic fault gouge, <1 cm to 5 cm thick. Local subsidiary shearing, fractures and faults occur on both the hanging wall and footwall of the Serpent Fault (Figure 6.4-7).

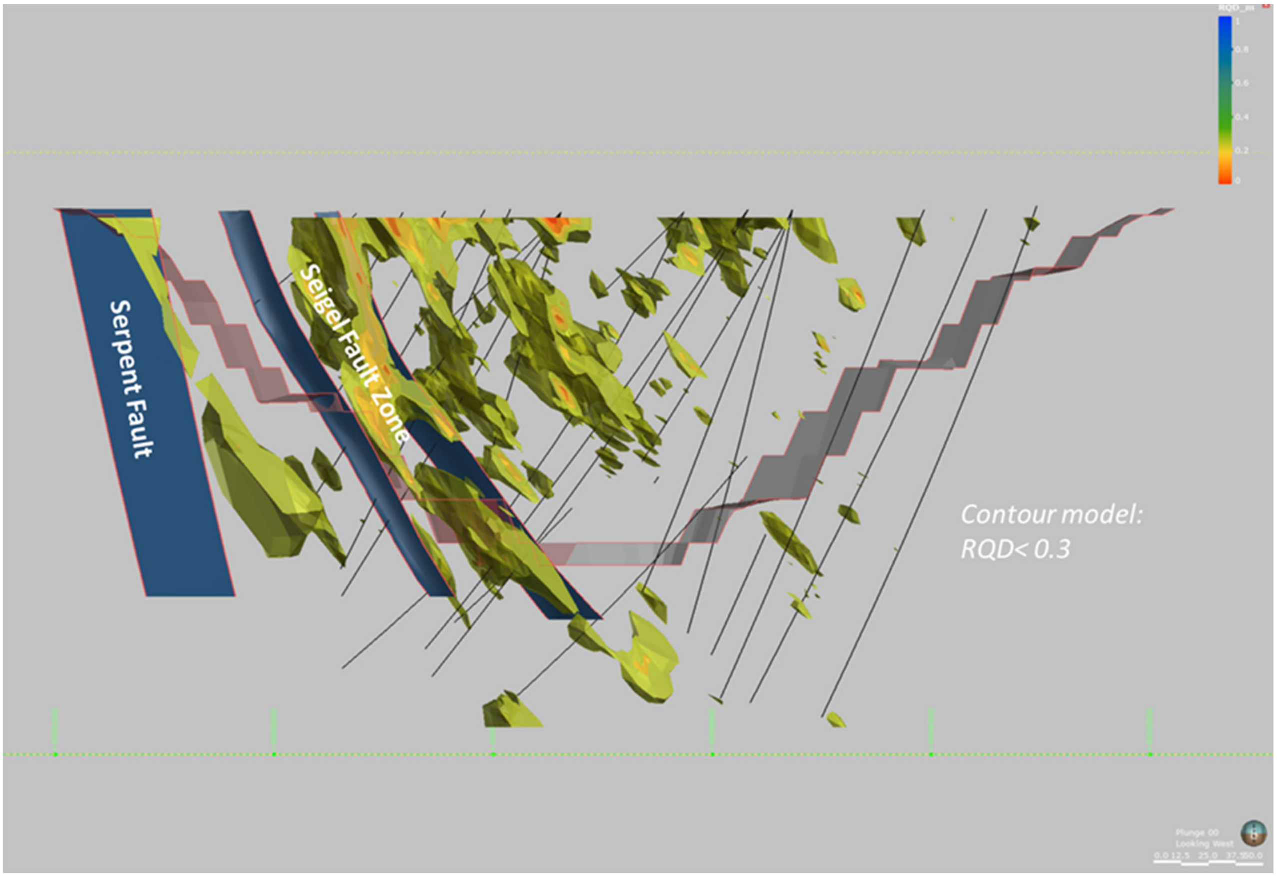


Figure 6.4-7: North-South cross-section of the Egerton-MacLean Zone located art 13450E on the local FMS grid. Pit outline and RQD (model as above).

The hydraulic conductivity of the Seigel Fault (Appendix B.8) is calculated at $3x10^{-7}$ m/s (9.5 m/year).

6.4.3.5.3 *Mineralization*

Parasitic folding and small-scale faulting in the Fifteen Mile Stream hinge zone are focused in the thick, comparatively incompetent and penetratively-foliated metamudstone units (e.g., Orient, Siegel), rather than in the more competent metasandstones. As a result, gold mineralization and bedding-parallel quartz veins are mainly confined to these meta-mudstone intervals.

Meter-scale saddle-reef quartz veins also commonly occur within meta-mudstone units in the hinge zone, including a thick bedding-parallel quartz vein referred to as the 'Big Bull Vein' in the centre of the property. However, these veins are generally barren, with mineralization instead focused in metamudstone wall rock and in thinner bedding-parallel quartz veins. Gold mineralization the Egerton–McLean Zone is generally disseminated and hosted by folded and structurally-thickened meta-mudstone within the anticline hinge-zone. However, coarse visible gold (about 0.1–3 mm diameter, rarely larger) and anomalous gold values also commonly occur within buckled and folded bedding-parallel quartz veins enclosed within mineralized and folded meta-mudstone. Quartz veins are either massive and milky white, or smoky and laminated, the latter containing vein-parallel wall rock inclusions.

Wall rock alteration associated with veins include disseminated carbonitization and, local sericitization. Coarse (visible) gold also rarely occurs directly in folded and/or faulted meta-mudstone, typically within sulphides formed at the intersection between axial-planar cleavage and bedding or in shear zones. Sulphide minerals associated with gold mineralization in meta-mudstone and quartz veins include arsenopyrite, pyrite, and pyrrhotite. Rare trace amounts of galena and chalcopyrite also occur with gold and other sulphide minerals in bedding-parallel quartz veins.

Mineralization in the Hudson Zone is confined to the Egerton–McLean stratigraphy, i.e., within folded meta-mudstone units (Orient and Siegel mudstones) in the Fifteen Mile Stream anticline, and comprises disseminated gold in altered folded and faulted metamudstone and coarse gold in quartz veins. The lack evidence of parasitic folding and thus structural thickening in the Hudson Zone may limit the overall thickness of the mineralized zone relative to the Egerton–McLean Zone. The Plenty Zone, located about 400 m southeast of the Egerton-McLean area, consists of a succession of steeply-dipping (~75°) overturned silty meta-mudstone and metasandstone strata, possibly representing the overturned south limb of the Fifteen Mile Stream anticline. Disseminated gold mineralization occurs in meta-sandstone, with anomalous coarse gold in bedding-parallel quartz veins.

A cross-section through the deposit is presented in Figure 6.4-8.

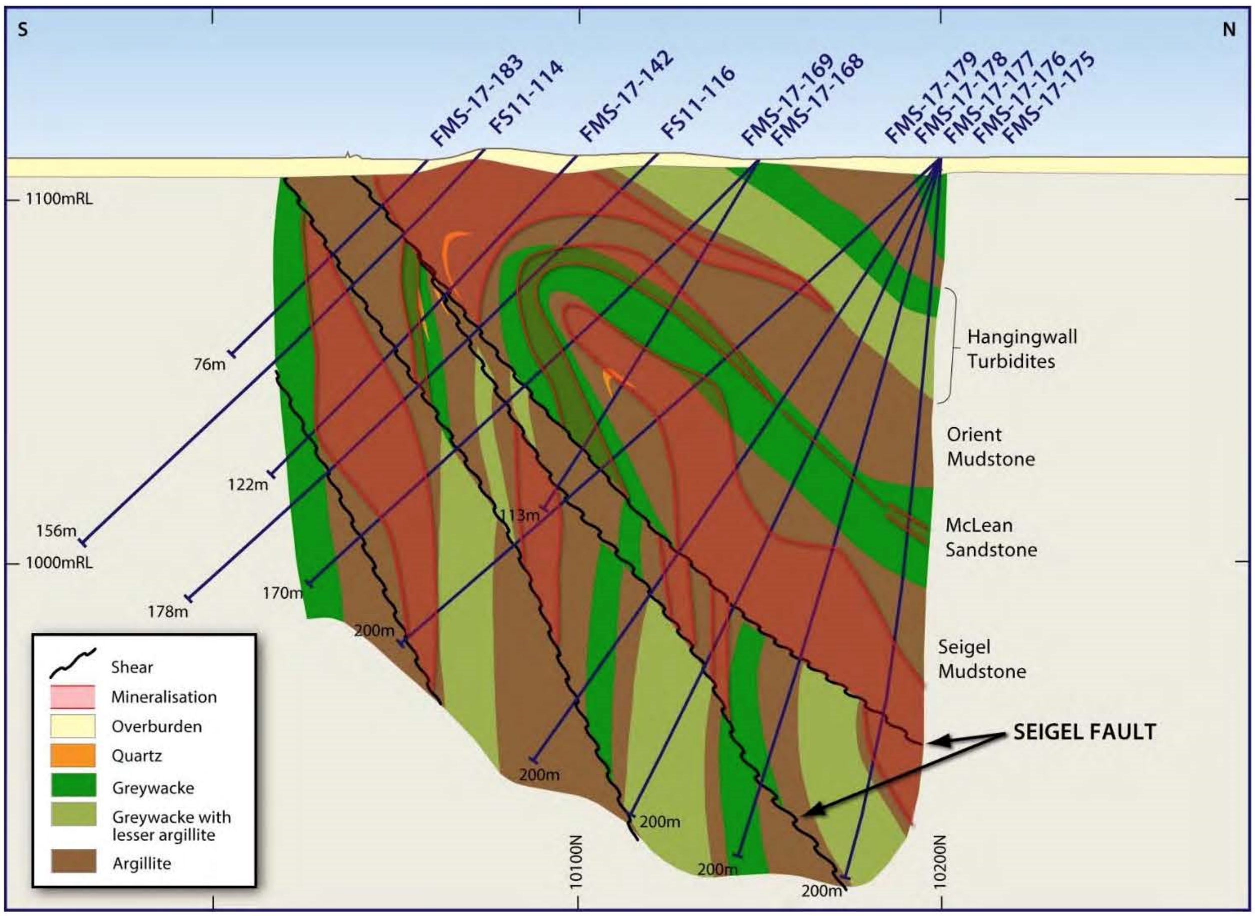


Figure 6.4-8: Cross Section, Fifteen Mile Stream (Prepared by Atlantic Gold, 2015)

6.4.3.6 Metal Leaching and Acid Rock Drainage

On behalf of the Proponent, Lorax (2019) analyzed mine ore, waste rock and tailings to determine the ML/ARD properties of these materials). ML/ARD is a natural process that results from the weathering, primarily through oxidation, of sulphide-bearing rocks and overburden. When these materials are exposed to oxygen and water, metal sulphide minerals oxidize which results in the release of acidity and dissolved metals into contact water. If not neutralized, this process can lead to low pH conditions and elevated metal concentrations in mine drainage.

The ML/ARD full assessment report is presented in Appendix F.2 while results are summarized below. For reference in subsequent sections:

- Mineralogical analyses are used to determine the forms of acid producing minerals (*i.e.*, sulphides) and acid neutralizing minerals (*i.e.*, carbonates and silicates) present in a sample.

- Acid-base accounting (ABA) tests are used to evaluate the acid rock drainage potential. Acidic drainage is typically generated from the oxidation of sulphide minerals, whereas neutralization is provided by the dissolution of carbonate minerals and, to a lesser degree, certain silicates. The relative amounts of neutralization potential (NP) and acid potential (AP) of a sample can be used to classify a geologic material as either PAG (potentially acid generating) or NAG (non-acid generating). Materials with a net potential ratio (NPR = NP/AP) of less than 2 are classified as PAG, while samples with an NPR ≥ 2 are designated as NAG (Price 2009).

- Metal contents measured in short-term leach tests provide a measure of the mass of readily soluble metals which will be immediately available for leaching upon exposure to precipitation.

- Particle size distribution analyses are used to quantify the relative distribution of grain sizes of material placed in the humidity cell tests. It is important to have an estimate of the specific surface area of the humidity cell samples because the rate at which a material will react is in part dependent on the surface area of the particles in the sample.

- **Humidity cell testing** is used to mimic the natural weathering processes that act on crushed rock or tailings. The results are used to predict geochemical loading rates from these materials when stored in surface facilities under oxidizing conditions.

6.4.3.6.1 *Mine Rock*

A total of 60 Project drill core samples were subjected to geochemical assessment. Static tests, including ABA and solid phase element analyses, were carried out on all samples, and based on these results, a subset of samples was selected for kinetic tests (humidity cells). The humidity cell subsamples were also assessed for mineralogy, particle size distribution, and short-term leaching potential via shake flask extractions. Additional drill core intervals were selected for a field bin analysis. A subsample from the material used to fill the field bin was submitted for ABA, solid phase elements, and mineralogy.

The objective of the kinetic testing program is to quantify sulphide oxidation and leaching rates of representative materials that can be used as input for the geochemical source term model. Five humidity cells (HC1 through HC5) were initiated using crushed drill core material covering median to 75th percentile sulphur contents for each of the four lithologies and ore material. The four lithologies are argillite (AR), argillite-greywacke (AG), greywacke-argillite (GA) and greywacke (GW). One field bin was filled with manually split drill core selected from the four main lithologies in order to represent the expected proportions in the waste rock pile.

6.4.3.6.2 *Tailings*

Four tailings samples were selected from the metallurgical testing conducted on FMS samples. These metallurgical tests simulated a split circuit utilizing a hydroflotation and conventional rougher flotation. Additional metallurgical testing was conducted in late 2018 and more representative tailings material was provided for environmental static and kinetic testing.

<u>Summary of Results</u>

1. The FMS mine rock is composed primarily of the quartz, feldspars, muscovite, biotite and chlorite. Pyrrhotite is the main sulphide mineral (up to 2.4 wt.%); however, significant pyrite is also present. Calcite is the main carbonate mineral present; humidity cell HC4 contained significant calcite (9.8 wt.%) while the field bin subsample calcite content is 2.7%.

2. Arsenic (As) is present as arsenic sulphide (arsenopyrite).

3. The total sulphur (S) contents of the mine rock samples vary from 0.020% to 1.1%, including the ore samples. The median total S content of the ore samples is slightly higher relative to the median total S for the four main rock types (0.44 wt.% and 0.28 wt.% average, respectively). The majority of the total S is present as sulphide (Lorax 2019 Table 4.3).

4. The sulphide S contents, excluding the ore samples, range from 0.020% in a greywacke sample up to a maximum of 0.88% in an argillite sample, with median values falling between 0.18% (GW samples) and 0.35% (AR samples). In the ore samples, the sulphide S contents range from 0.12% to 1.0% (median: 0.42%).

5. The greywacke (GW) samples have the highest median modified NP value at 31 kg $CaCO_3$/t, while the argillite (AR) samples have the lowest median modified NP value (12 kg CaCO3/t). The ore samples have a median modified NP of 16 kg $CaCO_3$/t (Lorax 2019 Table 4.3), while the field bin subsample has a modified NP of 27 kg $CaCO_3$/t (Appendix F.1; Table 4.4).

6. Samples from the GW unit are generally non-potentially acid generating but samples from the other three lithologies and from the ore samples include PAG rock. There is a clear relationship of PAG% with the relative amount of argillite contained within the rock type: the argillite unit (<5% greywacke interbeds) shows the highest PAG proportion of 88%, while none of the greywacke samples are classified as PAG.

7. Elements of potential concern based on the solid phase elemental analysis include Ag, As, Cu, Pb, Sb, and Zn. These elements, excluding Cu and Zn, are enriched by a factor greater than 10x above the average upper continental crust abundance (AUCCA) in one or more samples. Arsenic is elevated above 10x the AUCCA in all lithologies.

8. The shake flask extraction (SFE) results indicate that As and Al are potential parameters of concern in runoff from the mine rock. Other parameters highlighted in the solid phase analyses were not above the federal water quality guidelines in the SFE leachate.

9. Modelling results suggest that the NP will be depleted from the FMS mine rock between approximately 6 and 15 years. A conservative estimate for time to NP depletion for the static test samples indicates that approximately 50% of the PAG samples will become acidic within 10 years. This estimate does not consider the slower sulphide oxidation rates in colder temperatures, which would be expected to delay the onset of acid generation.

10. The four tailings samples have variable but relatively low total S (0.085% to 0.25%), present dominantly as pyrrhotite. Using total S as a proxy to calculate acid potential, only one tailings sample is classified as potentially acid generating.

11. Arsenic is the main parameter of concern in the tailings due to elevated concentrations in both the solid phase elemental analysis and in the SFE leachate. Arsenic concentrations increased over 18-week saturated column leachate test. The maximum As concentrations reached (0.35 mg/L) are 7x the CCME guideline.

6.4.3.7 Geochemical Characterization

The drainage chemistry from the various FMS facilities is influenced by a variety of geochemical and physical factors. The overarching controls that will govern the water quality associated with any facility that contains exposed mine materials, include:

- Mineralogy and geochemistry of the exposed material;
- Reactive surface area;
- Water-to-rock ratio;
- Depositional environment (*e.g.*, saturated versus unsaturated conditions); and,

- Temperature.

The prediction of both the elemental concentrations in contact water from the WRSA, till and ore stockpiles, pit walls, and the TMF was completed by Lorax (Appendix F.1) using a combination of kinetic test results as well as site monitoring and analogue data from the operational Touquoy Gold Project.

Blasting of waste and ore rock will result in the coating of particle surfaces with N species (ammonia, nitrite, nitrate) from explosives by-products. In waste rock and ore storage facilities, this process is generally responsible for the release of these species into the receiving environment. A source term model in consideration of the explosives type, water/rock ratios was generated separately in order to predict drainage chemistry specific to nitrogen.

Details relating to methodology and source term derivations are presented in Appendix F.1. Source terms were generated for:

- PAG and NAG portions of the WRSA;
- Low-grade ore stockpile;
- Pit wall run-off;
- Nitrogen concentrations predicted for drainage from the WRSAs, pit walls, and the TMF embankment at EOM (The PC scenario involves an annual nitrogen depletion rate rather than absolute concentrations);
- Base Case FMS tailings process water (supernatant);
- TMF beach run-off;
- Long-term TMF pore water; and,
- Till and topsoil stockpiles,

Source terms are used as inputs into surface and groundwater quality modelling (Sections 6.5 and 6.6). Recommendations for additional work associated with updating the source terms are provided in Section 6.4.9 (Compliance and Effects Monitoring Program) and detailed in Appendix F.1.

6.4.3.8 Seismic Activity

The North American tectonic plate has a stable interior; however, relatively low-level seismic activity occurs regularly on its eastern margin. Each year, approximately 450 earthquakes occur in eastern Canada, of which four will exceed magnitude 4, 30 will exceed magnitude 3, and 25 events will be reported as 'felt'. A given decade will likely include three earthquake events greater than magnitude 5 (GSC, 2003). Magnitudes of intensity less than 3 are not felt by people except under especially favourable conditions and cause no damage to buildings.

Earthquakes on Canada's east coast are not caused by tectonic movement along active plate boundaries, as is commonly the case on the west coast. It is thought that seismic activity in this region is related to the large scale, regional stress fields (GSC 2003) and slumping of sediment at the edge of the continental shelf into deeper water below.

Nova Scotia has 'low' seismic activity (GSC 2015) with records since 1925 showing a maximum magnitude of 3.5 (Yarmouth - 2015). Most of the earthquake activity in the province occurs in southwest Nova Scotia.

Figure 6.4-9 displays the distribution and magnitude of earthquakes recorded in eastern Canada over 400 years (Lamontagne et al. 2018). Figure 6.4-10 displays the relative earthquake hazards of Nova Scotia (GSC, 2015).

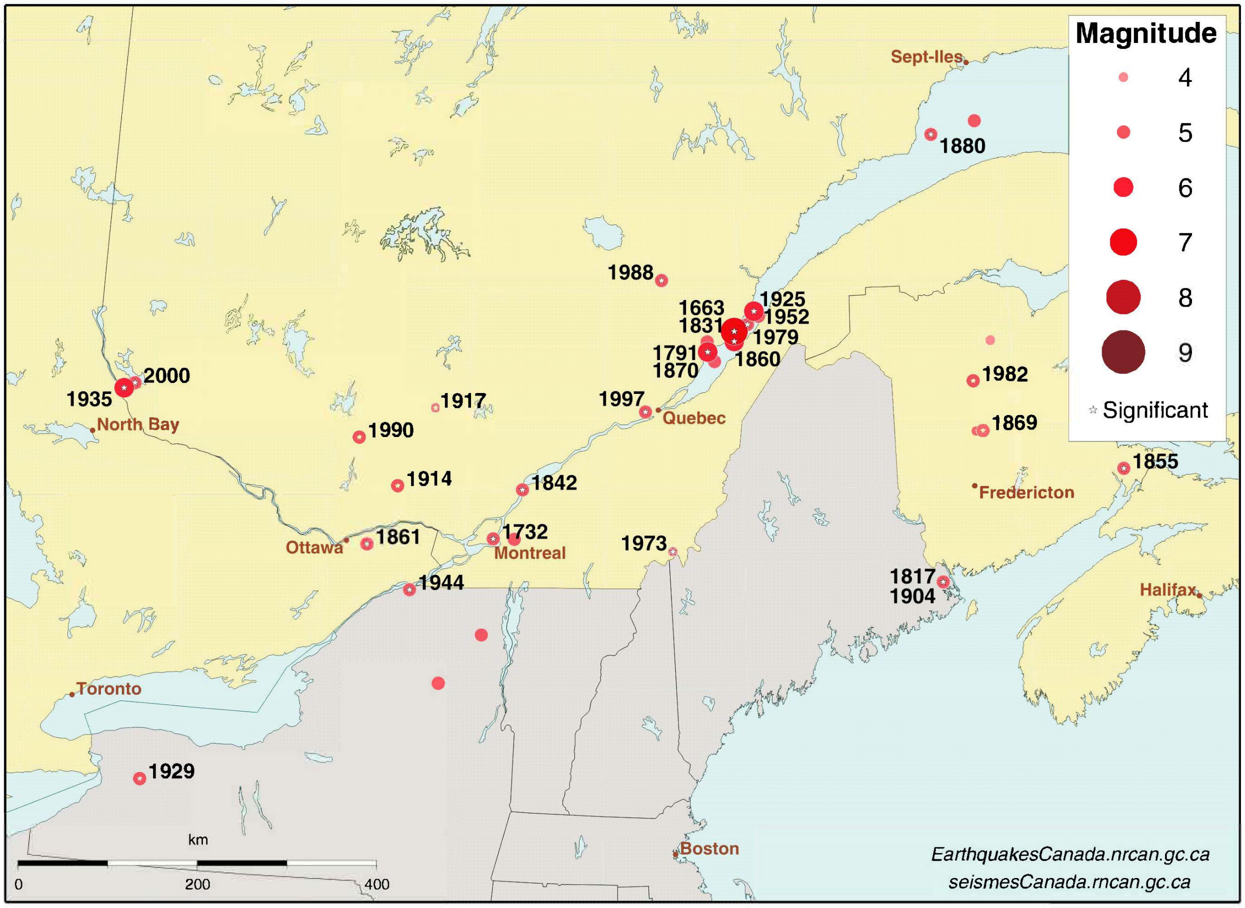


Figure 6.4-9: Significant earthquakes in or near southeastern Canada, 1663-2006 (Lamontagne et al. 2018)

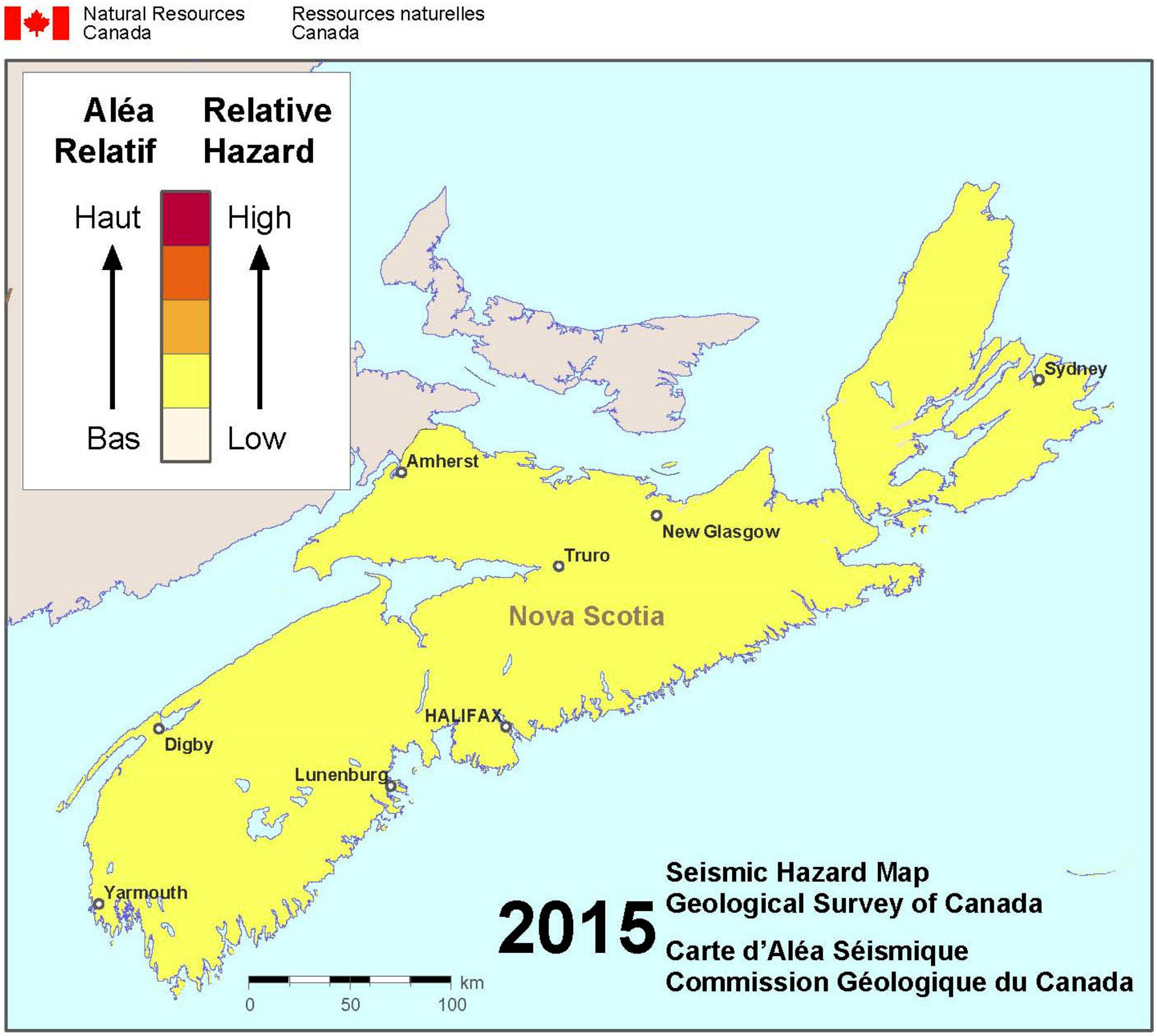


Figure 6.4-10: Relative Earthquake Hazards in Nova Scotia (GSC 2015).

A seismic hazard analysis conducted for the Project recommended specific design parameters for the TMF and other structures using the National Building Code of Canada (2015) specifications (Appendix D.1).

Site specific seismic ground motion parameters were determined for the Project site using the probabilistic seismic hazard database of Natural Resources Canada (NRC). The results included the peak horizontal ground accelerations (PGAs) and spectral accelerations for earthquake events having return periods from 100 years to 2,475 years (the maximum return period provided by NRC). The PGA for a return period of 475 years is only 0.023 g, indicating the Project is located in a region of low seismic hazard (Appendix D.1). A site-specific probabilistic seismic hazard analysis was undertaken to provide seismic parameters for return periods of up to 10,000 years. Based on this analysis, an earthquake magnitude of 7.25 was recommended for seismic design studies of site infrastructure (Appendix D.1).

If an earthquake were to occur, the Project may experience slight infrastructure damage caused by ground vibrations and secondary impacts such as fires from spilled materials or broken natural gas conduits. The Project is sufficiently far inland to remain unaffected by potential tsunamis. Given that Nova Scotia is located in a low earthquake hazard zone, the potential risk of seismic activity affecting the Project is very low.

6.4.3.9 Isostatic Uplift and Subsidence

Sea level rise affecting coastal communities and ecosystems results from the effects of (a) climate change-induced rising global sea levels and (b) the added effect of regional or "isostatic" subsidence of the Earth's crust. Uplift and subsidence are the crust's secondary response to the removal through melting of the glaciers that covered much of Nova Scotia at the end of the last ice age, approximately 10,000 years ago.

At their peak, glaciers centered in New Brunswick and Newfoundland were several thousand meters thick. The immense weight of these ice concentrations depressed the crustal rocks beneath them. At the same time as the crust beneath the glaciers was depressed, rocks further away from this center of mass were flexed upward. The following analogy effectively describes this: when a person sits upon a seat cushion the cushion edge is displaced upward even as the centre of the cushion is pushed downward by the weight of the person. Once the weight of the glaciers was removed, the crust beneath the former glacier began to rise to its pre-glacial position, while the crust located further way began to subside as a secondary effect. This subsidence that followed isostatic rebound continues today. In much of Nova Scotia, crustal subsidence is exacerbating the effects of global sea level rise (Fader 2005; King and Fader 1988; Shaw et al. 2006).

Given the Project is located approximately 30 km from the coast and elevation is on the order of 100 masl, it is unlikely the effects of isostatic rebound and sea level rise will impact the Project.

6.4.3.10 Landslides, Slope Erosion and Ground Stability

The general lack of surficial deposits on the site limits the potential of these materials to fail (i.e., cause a landslide) during a seismic or heavy precipitation event. In addition, much of the surficial material overlying bedrock will be stripped away before beginning infrastructure construction and mining, and thus will not be susceptible to slumping.

6.4.4 Consideration of Engagement and Engagement Results

Limited geology-related issues were raised during the engagement sessions, with the exception of general questions relating to management of historical tailings and the potential for these tailings to effect downstream surface water resources, and general questions relating to the potential for acid rock drainage.

The results of the public and Mi'kmaq engagement have been considered in the environmental effects assessment, including the Proponent's commitments on mitigation and monitoring measures and proposed compliance and effects monitoring programs, as well as the Proponent's broader commitment to ongoing public and Mi'kmaq engagement. The discussion relating to the effect of historical tailings and downstream sediment release is found within the following environmental effects assessment, and details can be found relating to the technical work completed to support this EIS in Appendix I.1 – I.3 (Phase I ESA, limited Phase II ESA and Historical Tailings and Waste Rock Management Plan).

6.4.5 Effects Assessment Methodology

The potential environmental effects of sediment discharge are evaluated within this section. The effects of ARD and dust deposition are evaluated in other VC sections, as described in Section 6.4.1.

6.4.5.1 Boundaries

6.4.5.1.1 *Spatial Boundaries*

The spatial boundaries used for effects assessment on sediment are the PA (FMS Study Area component only), the LAA, and the RAA. Because Project effects to sediments will occur primarily from runoff from mine related activities, most of the potential effects will occur in wetlands and watercourses within the FMS Study Area component of the PA (Figure 6.4-11).

In certain cases, sediment may be transported downstream from the FMS Study Area, so the tertiary watershed limit was selected as the most appropriate 'outer' spatial boundary to assess sediment impacts. The tertiary watershed boundary for the FMS Study Area corresponds to the LAA (Figure 6.4-11).

The RAA in the context of Geology, Soil and Sediment is defined by the East River Sheet Harbour secondary watershed boundary (Figure 6.4-11).

Assessment of Geology, Soil and Sediment will be completed in consideration of the LAA as the primary spatial boundary. All spatial boundaries will help to identify the direct or indirect impacts to Geology, Soil and Sediment and the effects of the Project on sediment transport.

6.4.5.1.2 *Temporal Boundaries*

With respect to potential discharge of sediment-laden water at the FMS Mine Site, Project-related impacts may occur during the 12 month construction phase, 7 year operational phase and the 2-3 year closure phase: reclamation stage. Project-related activities that can negatively affect sediments may occur during the construction phase when soils are disturbed and mineralized rock is exposed, during the operations phase via the management of stormwater runoff, and during site closure and reclamation when soils are again disturbed as the site is dismantled and prepared for revegetation.

6.4.5.1.3 *Technical Boundaries*

No technical boundaries were identified for the assessment of Project impacts to sediments.

6.4.5.1.4 *Administrative Boundaries*

Contaminated soil and sediment and are provincially regulated under the Contaminated Sites Regulations and associated Ministerial Protocols.

Sediment suspended in water (total suspended solids) is listed in CCME (1999a) Water Quality Guidelines for the Protection of Aquatic Life (Freshwater). Sediment quality itself is compared to the CCME (1999b) Sediment Quality Guidelines for the Protection of Aquatic Life (Freshwater Interim Sediment Quality Guidelines (ISQG)/ and Probable Effect Level (PEL).

6.4.5.2 Thresholds for Determination of Significance

With respect to sediment quality, a significant effect would be a release of total suspended solids in excess of the maximum values listed in the CCME (1999b) Water Quality Guidelines for the Protection of Aquatic Life (Freshwater) (as described in Section 6.6) and/or the discharge of sediment with contaminant concentrations in excess of this stipulated in the CCME (1999b) Sediment Quality Guidelines for the Protection of Aquatic Life (Freshwater Interim Sediment Quality Guidelines (ISQG)/ and PEL.

Sediment quality is also gauged by comparison to Nova Scotia's 2013 Ministerial Protocols regarding contamination; specifically, Table 2 Tier 1 Environmental Quality Sediments (Freshwater).

For sediment, the following logic was applied to assess the magnitude of a predicted change in sediment quality:

- Negligible – the concentrations are elevated above baseline (<10%), and below the applicable CCME FAL, CCME ISQG/PEL, established background concentrations, and NSEQSs;
- Low- the concentration is elevated above baseline (>10%), and within applicable CCME FAL, CCME ISQG/PEL, established background concentrations, and NSEQSs;
- Moderate – the concentrations are marginally (<10%) greater than the applicable CCME FAL, CCME ISQG/PEL, established background concentrations, and NSEQSs; and,
- High - the concentrations are greater (>10%) than the applicable CCME FAL, CCME ISQG/PEL, established background concentrations, and NSEQSs.

For sediment quality, the following logic was applied to assess the timing of a predicted change to sediment quality. Timing has been determined to be applicable as the effect would be more significant during low flow conditions (August/September) and/or sensitive spawning windows for fish (October/November for salmonid family spawning window and April/May for spring spawning window).

Soil quality thresholds are not provided within this section. Soil quality will only be evaluated in the context of historical tailings management as is fully described in the processes defined in the Phase I ESA, limited Phase II ESA, and the Historical Tailings and Waste Rock Management Plan (Appendix I.1 – I.3). All other soil related potential Project effects will be mitigated through erosion prevention and sediment control features, and measured through TSS discharge (Surface Water Section 6.6) and sediment quality to the receiving environment (wetlands and surface water) (herein).

6.4.6 Project Activities and Geology, Soils and Sediment Interactions and Effects

6.4.6.1 FMS Study Area

Construction will require the removal and storage of overburden, topsoil, existing mine waste and historical tailings, as well as the realignment of Seloam Brook north of the future open pit through the Seloam Brook Realignment. Mine site haul roads and drainage ditches will be constructed, culverts installed, and buildings erected. Construction will require blasting for quarrying on-site in multiple locations, and site preparation. The TMF will also be constructed. These construction activities will occur over a 12 month period and have the potential to release sediments via surface runoff to Seloam Brook as well as nearby unnamed watercourses and wetlands. Sediments that exhibit elevated metal concentrations and/or sediments as suspended solids within the water column may be generated during construction activities.

Operations including mining, crushing, transporting and the stockpiling of low grade ore and waste rock also have the potential to generate particulates that may become sediments if they are transported to nearby watercourses and wetlands. In addition, tailings stored in the above-ground TMF may become sediments in the event of a breach or overtopping of the TMF during operation or post closure.

Sediments may be generated during site closure and reclamation as buildings are dismantled, infrastructure is removed, and topsoil replaced in preparation for revegetation.

Overburden and topsoil will be stored in designated areas south of the open pit for later reused during site reclamation.

All historical tailings and waste rock, in locations where mining infrastructure is planned, will be delineated and characterized in accordance with the methodologies provided in the Historical Tailings and Waste Rock Management Plan (Appendix I.1). This would include tailings identified in soil and also within linear watercourses and waterbody sediments, where applicable.

With respect to the management of existing waste rock and historic tailings, four options have been examined by Stantec (Appendix I.1) on behalf of the Proponent:

1. Reprocessing followed by residuals storage within the FMS TMF;
2. Short term storage if the material does not exceed industrial Tier 1 EQS followed by reuse during reclamation;
3. Long term storage within the TMF; and
4. Offsite transport and disposal.

The Proponent is currently evaluating these options with respect to waste rock and tailings chemistry, potential environmental impacts of each option, the risk to human and ecological health, cost and feasibility. In their 2019 Historical Tailings and Waste Rock Management Plan for the FMS Mine Site, Stantec proposed a series of mitigation measures to ensure these materials are managed appropriately during excavation. These measures include additional sampling, stormwater management, monitoring, remedial verification, documentation and reporting (Appendix I.1).

During construction, the first step will be to build berms and complete the Seloam Brook Realignment and re-route water around the proposed pit development area. This will allow for an "in the dry" working area for the pit. However, based on topography and delineated wetlands and open water sections within the proposed pit area, water management is expected to be required during pit development. There is elevated arsenic and potentially mercury within this development area documented in surface water and sediment. Water management ponds (lined with geosynthetic liner) will be built for the proposed WRSA first and will be used to manage construction water from the pit development area. A modular treatment plant for water will be available during construction if required. This system can be adapted and utilized throughout the life of mine, as required based on site effluent quality.

During operations, runoff from low grade ore stockpile will be directed to seepage collection ditches and/or the excess water pond. Runoff from the active mine areas will be collected in ditches, directed to the site management pond and discharged to the receiving environment or conveyed to the TMF supernatant pond if unsuitable for discharge and used as process water.

Potential interactions between the Project activities and geology, soil and sediment quality are outlined in Table 6.4-4: Potential Interactions with Project Activities and Geology, Soil and Sediment Quality in the FMS Study Area.

Table 6.4-4: Potential Interactions with Project Activities and Geology, Soil and Sediment Quality in the FMS Study Area

Project Phase	Duration	Relevant Project Activity
Site Preparation and Construction Phase	1 year	• Clearing, grubbing, and grading • Drilling and rock blasting • Topsoil, till and waste rock management • Watercourse and wetland alteration • Seloam Brook Realignment construction and dewatering • Mine site road construction, including lighting • Surface infrastructure installation and construction, including lighting • Collection and settling pond construction, including lighting • Local traffic bypass road construction • Environmental monitoring • General waste management
Operations Phase	7 years	• Drilling and rock blasting • Open pit dewatering • Ore management • Waste rock management • Tailings management • Surface water management • Dust and noise management • Petroleum products management • Environmental monitoring • General waste management
Closure Phase: Reclamation Stage	2 – 3 years	• Infrastructure demolition • Site reclamation • Environmental monitoring • General waste management

6.4.6.2 Touquoy Mine Site

Activities associated with the Project will not result in sediment discharge at the Touquoy Mine Site.

6.4.7 Mitigation

The actions provided in Table 6.4-5 will be implemented by the Proponent where potential indirect impacts to sediment quality are possible. The methods used to mitigate against sediment discharge consist of standard erosion and sediment control measures during construction and reclamation (NSDEM, 1988) and stormwater management best practices during the construction and operations phases. An Erosion Prevention and Sediment Control Plan will be developed to support the FMS Framework Document (Appendix L.1), and will be updated and detailed prior to construction, once the detailed design phase has been completed.

During construction, settling pond(s) with geosynthetic liners, will be constructed near the location of the WRSA in order to manage construction water during pit development. A modular treatment plant will be available to treat water during the construction phase, if required. This system can be adapted and utilized throughout the life of mine, as required based on site effluent quality.

A plant site management pond will be constructed and located adjacent to the plant facilities during operations. Water collection ditches will be established surrounding the facilities area, as well as the ROM ore stockpile, that will divert collected surface water to this water management pond. The earthworks are designed with enough relief that contact surface water will run by gravity into these surrounding collection ditches, and into the water management pond. Settled water will be pumped to the TMF for use as process water or released to the environment if of suitable quality.

Berms surrounding the open pit will direct clean surface water away from the open pit and into the surrounding drainage basin. An in-pit water diversion ditch will be established along the top bench of the open pit to intercept any surface water that makes it through the berm and comes into contact with the open pit. This ditch will direct water to in-pit sumps for collection, where it will be pumped out of the pit and to the TMF. Where necessary, sub-horizontal drain holes will be established in the final open pit walls as they are exposed. On the active bench floor, the water that is collected from these drain holes, along with surface runoff, will be directed to a sump.

All collected ground and surface water in the pit will be handled by high lift skid mounted pumps installed in each active pit bottom as part of the in-pit pumping system. The mine sump pumps will be connected to semi-permanent and permanent piping systems to convey water through a HDPE pipe directly to the TMF located east of the open pit. The in-pit sumps will be installed with each box cut as the benching is advanced.

To ensure that discharges meet maximum limits listed in the applicable guidelines described above, as well as in the provincial operating permit that will be required for this Project, stormwater pond discharges will be monitored on an as-needed basis, as stipulated in the provincial permit, or directed to the TMF.

The Seloam Brook Realignment will be designed to accommodate excessive flow volumes. Modeling indicates that the maximum velocities along the berm during the 1-in-200 year, 24-hour precipitation event are in the range of 0.5-0.7 m/s (Appendix D.4). The modeling suggests that certain areas along the berm may require additional bank protection from erosion, which will be considered when final designs for the realignment channel are submitted to NSE.

The quality of potentially contaminated sediments in Seloam Brook, and the volume of contaminated sediments, will be further assessed through additional sampling prior to beginning the Seloam Brook Realignment. This will be completed during the final engineering design phase of the Realignment. To minimize sedimentation, work to reroute the brook will be completed in the dry. Construction techniques, erosion and sediment control measures, and a sediment monitoring program for the receiving environment will be described in the Erosion Prevention and Sediment Control Plan which will be developed to support the EMS Framework Document (Appendix L.1).

Table 6.4-5: Geology, Soil, and Sediment Mitigation Measures

Project Phase	Mitigation Measure
C, O, CL	Implement Erosion Prevention and Sediment Control Plan, which will be developed to support the EMS Framework Document (Appendix L.1)
C, O, CL	Complete pre-construction site meetings for all relevant staff/contractors related to working around wetlands and watercourses and communicate the importance of implementing the Erosion Prevention and Sediment Control Plan
C, O, CL	Construct site management ponds, and direct all site contact water into these ponds and to the TMF during operations, and to the pit during closure
C, O, CL	Re-vegetate slopes adjacent to wetlands and watercourses to limit erosion and sediment release
C	Construct settling pond(s) with geosynthetic liners at appropriate locations around the site that will facilitate the management of contact water during pit and other infrastructure development.
C	A modular treatment plant for contact water will be available during construction if required
C	Complete the Seloam Brook Realignment "in the dry" to, in part, reduce likelihood of erosion and sediment releases. Certain areas along the diversion berm may require additional bank protection from erosion, which will be considered when final designs for the Realignment are submitted to NSE as part of the IA application process.
C	Monitor stormwater pond discharges on a regular schedule, as stipulated in the provincial permit, prior to discharge (where practicable based on water quality).
C, O	Direct runoff through natural vegetation, wherever practicable
C, O	Conduct vegetation management (cutting and clearing) in or near wetlands and watercourses in accordance with applicable guidelines

Note: C= Construction Phase O= Operation Phase CL= Closure Phase

6.4.8 Residual Effects and Significance

Residual effects are presented in Table 6.4-6. Significant residual effects on sediment quality are not anticipated since erosion and sediment control, along with stormwater management best practices, are standard, proven techniques that have long been used in mining and construction contexts. The soils and sediments of the site are already disturbed through past mining activity. Moreover, historic tailings and waste rock, and associated surface water, that are currently situated near watercourses will be managed and moved to more appropriate storage facilities, reducing their current effects on water and sediment quality. Monitoring programs will be developed in collaboration with environmental regulators to ensure mitigation measures are implemented and functioning as designed.

Table 6.4-6: Residual Environmental Effects for Geology, Sediment and Soils

Project VC Interactions	Mitigation and Compensation Measures	Nature of Effect	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect
			Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility		
Construction, Operations and Closure – FMS Mine Site Sediment discharge to watercourses/wetlands	Erosion and sediment control measures and stormwater management measures including system design described in EMS and monitored during site construction	A	L Sediment transport is typically limited in slow moving, braided watercourses	LAA Sediment transport is possible into the LAA, although with mitigation measures employed, is likely limited to the FMS Mine Site	A VC is expected to be affected by timing. The effect would be more significant during periods of low flow or during sensitive spawning windows	LT VC interaction will occur during construction, operations and closure phases	S VC interaction may occur in a sporadic fashion	R Sediment accumulations can be removed and aquatic ecosystems restored	Sediment Release	Not significant
Construction, Operations and Closure – FMS Mine Site Removal of historic waste rock and tailings	Erosion and sediment control measures and stormwater management measures including system design described in EMS and monitored during site construction	P	M Best management practices reduce the magnitude of potential impact; permanent removal from banks of Seloam Brook results in long term positive effects	LAA Sediment transport is possible into the LAA, although with mitigation measures employed, is likely limited to the FMS Mine Site	A VC is expected to be affected by timing. The effect would be more significant during periods of low flow or during sensitive spawning windows	P VC interaction will occur during construction phase but the effect is permanent	O Interaction will occur once	IR Positive effect remains at the end of the activity	Removal of contaminant source	Not significant, Moderately positive

Legend (Refer to Table 5.10-1 for definitions)

Nature of Effect	Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility
A Adverse	N Negligible	PA Project Area	N/A Not Applicable	ST Short-Term	O Once	R Reversible
P Positive	L Low	LAA Local Assessment Area	A Applicable	MT Medium-Term	S Sporadic	IR Irreversible
	M Moderate	RAA Regional Assessment Area		LT Long-Term	R Regular	PR Partially Reversible
	H High			P Permanent	C Continuous	

A significant adverse environmental effect for geology, soil, and sediment has not been predicted for the Project for the following reasons, with consideration of the ecological and social context of the LAA surrounding the Project:

- During construction, direct impacts to sediment quality in the PA and LAA are not expected, with appropriate mitigation including the use of lined water management ponds, water treatment if required, and other standard erosion and sediment control practices.
- During Operations, potential for indirect impacts to sediment quality in the PA and LAA will be managed through erosion and sediment control measures, stormwater control, and dust mitigation.
- During Closure, reclamation will allow for site restoration of a native assemblage of plant communities which will reduce the likelihood of long-term impacts to sediment quality within the PA and LAA from the Project.

6.4.9 Proposed Compliance and Effects Monitoring Program

Sediment control is ensured through effective stormwater and discharge management practices (which are monitored as conditions of an operating permit). Water quality and sediment load will be monitored through the effluent (MDMER) monitoring program.

Construction techniques, erosion and sediment control measures, and a sediment monitoring program for the receiving environment will be described in the Erosion Prevention and Sediment Control Plan, which will be developed to support the FMS Framework Document (Appendix L.1), developed in collaboration with environmental regulators, as part of the Proponent's IA application for the Project.

Surface water quality will be tracked through a comprehensive surface water monitoring program that will include total suspended solids (see Section 6.6, Surface Water). The scope of the surface water monitoring program (sample location, frequency, analytical parameters, etc.) is proposed in this section of the EIS, and will be established in consultation with regulatory agencies and presented in a Surface Water Monitoring Program for the site.

Delineation and subsequent management of historical tailings and waste rock (soil and sediment) will be completed, in advance of commencement of construction, that is located within the footprint of Project infrastructure.

Operational Geochemical Testing Program: Confirmatory testing of open pit blast hole drill cuttings will be completed to confirm geochemical predictions of mine rock at a frequency to be determined by the Project geochemists, geologists, and with consideration of available NRCAN and comparable guidance documents.

Geochemical source term predictions heavily rely on theoretical constraints, representative geochemical test work, and the availability of site analogue data. To close data gaps that would increase the confidence in the geochemical source term predictions for future model iterations, the following recommendations are made:

- Continued operation of FMS PAG humidity cells to assess the long-term effect of metal leaching behaviour in site-specific materials as well as to understand material-specific metal mobility under acidic conditions.
- Additional sampling and static testing of waste rock material to increase the confidence in the sulphur and NP contents as well as PAG proportions within this population, since these parameters have a direct impact on the source term model results.
- Collection of site-specific topsoil samples to understand and assess this material's geochemical variability and in support of topsoil stockpile source terms.

- Continued tracking and reporting of Touquoy WRSA tonnage, footprint, and lithological proportions along with continued waste rock drainage monitoring to allow for better calibration of model and scaling factors which can be applied to the FMS WRSA in future model iterations. This is especially relevant for nitrogen-specific source terms, since nitrogen commonly shows lag times in its release from larger waste rock facilities.
- Concentrate from the FMS processing plant will be shipped to the Touquoy Mine Site where the final ore extraction step will be conducted using cyanidation. It is expected that the relatively small quantity of tailings generated during this process will be co-deposited with Beaver Dam tailings in the Touquoy open pit. To understand the geochemical impact of this tailings disposal plan, it is recommended that this material be tested via ABA and potentially other characterization methods.

Proposed follow-up and monitoring programs have been reviewed with the Mi'kmaq of Nova Scotia during engagement efforts including meetings, and sharing of technical documents (Draft EIS, poster boards, Summary of Mi'kmaq Effects and Proposed Mitigation Measures, Plain Language Summary). On-going engagement with the Mi'kmaq will continue through the EA process and associated permitting relating to follow-up programs and monitoring.

6.5 Groundwater Quality and Quantity

6.5.1 Rationale for Valued Component Selection

Groundwater (quantity and quality) was selected as a VC as it is considered to have ecological value as it is important in the hydrologic cycle and is important for human health (drinking water or other consumption). Groundwater is the water found underground in the cracks and spaces in soil and rock. The groundwater quality and/or quantity may be changed due to the activities associated with the Project construction, operation and closure. Groundwater quality and quantity is provincially regulated via various legislative avenues within the *Environment Act.*

During various project activities, there is a potential for direct adverse effects to groundwater quantity and quality. For example, some Project activities have the potential to lower the groundwater table and subsequently adversely affect the amount of well water available for consumption. Also, during blasting there is the potential for residual nitrate due to incomplete combustion which could increase the nitrate concentrations in groundwater quality.

During various Project activities there is also a potential for indirect adverse effects to groundwater quantity and quality. Via groundwater, there are indirect potential pathways for adverse effects to surface water, and wetlands, fish and fish habitat, birds, fauna, SOCI/SAR, and Mi'kmaq of Nova Scotia.

6.5.2 Baseline Program Methodology

6.5.2.1 FMS Study Area Baseline Program Methodology

Information for the groundwater quality and quantity baseline was collected from a review of the relevant publicly available data sources and also based upon the on-site FMS borehole testing and groundwater quality and quantity monitoring program.

6.5.2.1.1 *Publicly Available Groundwater Data Review*

The review of the NS Well Logs Database (NSE 2018) was carried out to identify water supply wells and private wells in a 15 km radius from the FMS Study Area. The water well record database also supported the characterization of groundwater levels and groundwater flow.

In addition, the nearby Beaver Dam and Touquoy historic and recent data has been reviewed to understand the nearby physical hydrogeologic environment.

Detailed information regarding water sources for Indigenous communities near the Project was not reviewed, as the nearest Mi'kmaq community is located 25 km from the Project. For the purposes of the EIS, sufficient information was deemed to be available from the references listed above to assess the potential effects of the Project on groundwater quantity.

6.5.2.1.1.1 Groundwater Data Collection

There were four site specific field programs (drilling of boreholes) designed to gather geologic and hydrogeologic information. Borehole locations were selected to provide broad coverage of the proposed Project infrastructure including the open pit, TMF, processing facility locations and existing surface water features. Borehole locations were constrained by the existing access road network, property access agreements, and offsets from environmentally sensitive areas. An overview of the programs is provided below.

In 2017, angled geotechnical boreholes were drilled in the FMS Study Area with select boreholes targeting the Egerton-MacLean (GT17-01 through GT17-05) (Golder 2018). These angled boreholes were drilled to depths between 122.17 m to 200.34 m (along dip) at an angle of 53 to 74 degrees. These holes also underwent packer testing to understand the hydraulic conductivity of the open pit area.

The 2018 shallow borehole drilling program was carried out at 14 drilling locations over the FMS Study Area with the exception of one borehole located approximately 1.75 km to the northwest of the FMS Study Area. These vertical boreholes were drilled up to a depth of up to approximately 25 m. At each drilling location, up to two monitoring wells were installed within individual offset boreholes (Appendix B.1). The completed borehole/monitoring well locations are shown on Figure 6.5-1 and listed in Table 6.5-1, below. Borehole locations are denoted as FMS-HG18-01 through to FMS-HG18-16, with the exception of proposed locations FMS-HG18-01 and FMS-HG18-12, which were removed from the scope during the investigation. Packer and single well response tests were completed on all boreholes in order to understand the shallow hydraulic conductivity. These shallow vertical boreholes were installed with monitoring wells which were used to record water levels and collect water quality samples. There were six well nest locations (FMS-HG18-02, FMS-HG18-04, FMS-HG18-05, FMS-HG18-07, -09, and FMS-HG18-10) installed with pressure transducer dataloggers. Manual water levels were recorded at all wells on a monthly basis initially for three months and then quarterly thereafter. In addition, grain size analysis was conducted at 12 locations and was used to determine the hydraulic conductivity of the overburden in the vicinity of the FMS Study Area.

Table 6.5-1: Borehole Locations and Elevations

Borehole / Monitoring Well ID	**Coordinates (UTM Zone 20, NAD83(CSRS))**		**Ground Surface Elevation (m CGVD28)**	**Drilled Depth (mbgs[1])**
	Northing (m)	**Easting (m)**		
FMS-HG18-02A	536074.78	5001177.74	135.97	24.24
FMS-HG18-02B	536073.90	5001174.33	135.85	8.22
FMS-HG18-02X	Abandoned borehole located adjacent to FMS-HG18-02A			
FMS-HG18-03A	537293.47	4999550.33	121.58	12.08
FMS-HG18-03B	537290.61	4999550.81	121.77	7.05
FMS-HG18-04A	535801.11	4998824.55	106.66	25.74
FMS-HG18-04B	535800.77	4998822.68	106.67	7.79
FMS-HG18-05A	537263.21	4998507.48	113.53	13.81
FMS-HG18-05B	537262.41	4998509.10	113.68	6.36
FMS-HG18-06A	537513.23	4998697.25	111.97	8.36
FMS-HG18-07A	537889.27	4998795.88	112.98	12.37
FMS-HG18-07B	537883.79	4998796.17	112.78	4.85
FMS-HG18-08A	537612.69	4997771.11	140.03	13.93
FMS-HG18-08B	537611.40	4997771.21	139.98	6.45
FMS-HG18-09A	538367.38	4999479.78	123.58	12.38

Borehole / Monitoring Well ID	Coordinates (UTM Zone 20, NAD83(CSRS))		Ground Surface Elevation (m CGVD28)	Drilled Depth (mbgs[1])
	Northing (m)	Easting (m)		
FMS-HG18-09B	538367.24	4999477.38	123.62	6.32
FMS-HG18-10A	539251.88	4998600.50	140.31	12.3
FMS-HG18-10B	539248.83	4998600.75	140.19	6.56
FMS-HG18-11A	538575.33	4997758.94	162.38	10.92
FMS-HG18-11B	538573.36	4997760.25	162.41	4.94
FMS-HG18-13A	539918.74	4997839.08	151.29	12.43
FMS-HG18-13B	539918.74	4997839.08	151.33	3.08
FMS-HG18-14A	536802.34	4998352.85	116.89	13.81
FMS-HG18-14B	536804.30	4998352.73	116.97	7.83
FMS-HG18-15A	536367.44	4998746.87	107.46	10.83
FMS-HG18-15B	536367.09	4998743.63	107.56	4.17
FMS-HG18-16A	540442.99	4999567.69	142.17	11.02
FMS-HG18-16B	540445.43	4999567.50	142.19	5.65

Note: 1. meters below ground surface (mbgs)

Groundwater samples were collected from each monitoring well in September 2018, December 2018, March 2019 and June 2019. Prior to the collection of samples, each monitoring well was developed by the removal of ten well volumes of water, or by pumping the well dry and allowing it to recover three times. This development process was completed using a Waterra Hydrolift inertial pump system. To minimize the influence of suspended sediment on the groundwater quality results, all samples were collected using low-flow sampling methodology with a peristaltic pump. This method involved positioning the pump intake approximately one meter below the water surface with the pump allowed to run at a flow rate of approximately 1 L/min.

Analytical bottles for each sample were provided by AGAT Laboratories and were filled directly from the peristaltic pump discharge. Groundwater quality samples were submitted under chain of custody to AGAT Laboratories in Dartmouth, NS. Radium-226 analysis was conducted by the Saskatchewan Research Council, as subcontracted by AGAT. Groundwater quality samples were analyzed for the following parameter suites: Atlantic RBCA Tier 1 Hydrocarbons (including benzene, toluene, ethylbenzene and xylene [BTEX] and petroleum hydrocarbons [PHC]), total and free cyanide, total and dissolved mercury, general chemistry, total and dissolved phosphorous, chemical oxygen demand, dissolved organic carbon, and total suspended solids.

Standard sampling protocols were followed to ensure accuracy and precision of results. This included decontamination procedures, the collection of QA/QC samples, labelling, preserving, completed Chain of Custody forms, and packaging QA/QC procedures in the laboratory.QA/QC sampling was conducted for approximately 10% of samples that were analyzed. Field QA/QC was addressed by collecting blind field duplicates. The results of the QA/QC sampling were used to evaluate the reliability of the sampling and analysis methods.

6.5.2.2 Touquoy Baseline Program Methodology

Peter Clifton & Associates (PCA) (2007) completed a hydrogeological assessment of the Touquoy Mine Site. The report provides an assessment of potential groundwater inflows to the proposed Touquoy pit at the Touquoy Mine Site. This assessment used a series of geotechnical/hydrogeological drill holes that were also sampled for groundwater quality. The holes were purged using an airlift method and then sampled after fully developing and purging the wells to obtain a representative groundwater sample. The water obtained from the drill holes represents groundwater from bedrock at the site. Samples were analyzed for general chemistry and metals. Test pits were also excavated in June 2006 to evaluate groundwater flow in the till between the Touquoy pit and Moose River. Additional assessment work completed in September 2006 included a temperature survey of surface water to determine possible areas of upwelling groundwater.

Jacques Whitford (2008) prepared a Groundwater Monitoring Plan as part of the Industrial Approval 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), and groundwater monitoring has been ongoing at the Touquoy Mine Site to characterize the groundwater conditions in the overburden and bedrock (water levels and chemistry). The baseline groundwater conditions are described in the 2017 Annual Report of Surface Water and Groundwater Monitoring (Internal report for AMNS 2018).

The historic and recent data from the Touquoy Mine Site provided a thorough picture of the physical hydrogeology of the Touquoy Mine Site as well as possible interactions that were examined as part of the groundwater VC. Based on the observed hydrogeologic conditions at the site, a hydrogeologic conceptual site model (CSM) was developed to describe groundwater and surface water interactions at the site. The CSM for the Touquoy Mine Site is presented in Appendix I.4.

A three-dimensional groundwater flow model was developed based on the CSM in accordance with the BC Guidelines for Groundwater Modelling to Assess Impacts of Proposed Resource Development Activities (Wels et al. 2012). The Touquoy Mine Site numerical groundwater flow model (Touquoy Model) was applied to simulate baseline groundwater quantity conditions for the disposal of the FMS concentrate tailings and the blended FMS and Beaver Dam tailings into the Touquoy pit. Baseline conditions correspond to the fully dewatered conditions at the end of mine life, which provide a basis of comparison for predicted groundwater quantity conditions during closure (i.e., as the Touquoy pit is filling) and post closure (i.e., after the groundwater conditions have stabilized following the filling of the Touquoy pit). The Touquoy Model is also applied to improve understanding of hydrogeologic interactions and to simulate transport of constituents of concern at the Touquoy Mine Site. Detailed documentation of the Touquoy Model, including background information, conceptual site model development, model construction, model calibration and model application is included in Appendix I.4.

6.5.3 Baseline Conditions

6.5.3.1 FMS Study Area Baseline Conditions

This section provides a summary of the existing environment for groundwater based on review of publicly available information; results from the 2017 investigation and the 2018 hydrogeological investigation carried out for the FMS Study Area. Refer to Section 6.4 for an overview of physiography, geology, topography and soils related to the FMS Study Area. In addition, the hydrogeology technical support document (Appendix B.1) has the detailed drilling, monitoring well installation details, groundwater levels and groundwater quality monitoring results from the 2018 hydrogeology field program.

6.5.3.1.1 *Nova Scotia Well Records*

The Nova Scotia Well Logs Database (NSE 2018) was queried to find well records near the FMS Study Area. No wells were identified close to the FMS Study Area, with the nearest wells located approximately 15 km to the north and south (Figure 6.5-2). Table 2.1-1 describes the closest field confirmed structures to the FMS Study Area and observations of potable wells (as was visible from public vantage points, e.g., public roads). A seasonal dwelling, Structure ID #1, is located 4.9 km south of the FMS Study Area (Lowe property). A site visit confirmed, via visual observation, that this seasonal dwelling has no observable dug or drilled well. During the open house, a resident indicated they have a cabin, Structure ID #3, that is used seasonally and may become permanent, which has a dug well and is located approximately 8.7 km south of the FMS Study Area (Crowell property). A third seasonal property, Structure ID #4 (Rutledge property), is also located south approximately 8.7 km of the FMS Study Area. This property does not have a dug or drilled well (confirmed via direct conversation with landowner, MEL April 2019). Figure 2.1-2 shows the locations of these three closest residences in relation to the FMS Study Area. A fourth structure, Structure ID #2, is also listed in Table 2.1-1 and is located 7.9km south of the FMS Study Area. This structure is the old warden's cabin for the Liscomb Game Sanctuary and is not currently habitable (personal communication via email, May 2019 D. Cameron, NS Lands and Forestry) and does not have a potable well.

Provincial scale mapping identifies the FMS Study Area as having a high relative risk of arsenic in groundwater at concentrations exceeding drinking water health guidelines (Kennedy 2017). The FMS Study Area falls within the area mapped as less likely to have groundwater concentrations of uranium (and related radionuclides) that exceed the drinking water health guidelines (O'Reily 2009).

6.5.3.1.2 *Groundwater Levels*

Locally, groundwater flow likely parallels surface topography, particularly adjacent to major river valleys. Groundwater discharge likely provides baseflow to streams and rivers and some wetland features within the vicinity of the FMS Study Area. Recharge of the shallow overburden and bedrock aquifers in the groundwater is likely from precipitation and surface streams or rivers. Recharge would also occur through areas of fractured and jointed exposed bedrock.

Groundwater levels were recorded from August 2018 to June 2019 and the data is presented in Table 6.5-2. The first two rounds of groundwater level monitoring from August 2018 were taken opportunistically following well installation and development. The regular groundwater level monitoring program commenced in September 2018 when the first baseline groundwater quality samples were collected from the wells. Hydrographs for select wells showing the manual and continuous groundwater levels are presented alongside precipitation records in Appendix B.1.

Table 6.5-2: Groundwater levels for FMS 2018 Hydrogeological Boreholes

Borehole	Water Level (mbgs), Collected on Aug. 15, 2018	Water Level (m CGVD28), Collected on Aug. 15, 2018	Water Level (mbgs), Collected on Aug. 20, 2018	Water Level (m CGVD28), Collected on Aug. 20, 2018	Water Level (mbgs), Collected on Sept. 4-6, 2018	Water Level (m CGVD28), Collected on Sept. 4-6, 2018	Water Level (mbgs), Collected on Oct. 9, 2018	Water Level (m CGVD28), Collected on Oct. 9, 2018	Water Level (mbgs), Collected on Nov. 17-18, 2018	Water Level (m CGVD28), Collected on Nov. 17-18, 2018	Water Level (mbgs), Collected on Dec. 11, 2018	Water Level (m CGVD28), Collected on Dec. 11, 2018	Water Level (mbgs), Collected on Mar. 21-22, 2019	Water Level (m CGVD28), Collected on Mar. 21-22, 2019	Water Level (mbgs), Collected on Jun. 4, 2019	Water Level (m CGVD28), Collected on Jun. 4 2019
FMS-HG18-02A	3.56	132.41	3.60	132.37	3.69	132.28	3.66	132.31	2.77	133.20	2.94	133.03	2.87	133.10	4.22	132.74
FMS-HG18-02B	3.35	132.5	3.34	132.51	3.42	132.43	3.55	132.30	2.59	133.26	2.76	133.09	2.65	133.20	3.95	132.87
FMS-HG18-03A	4.48	117.1	4.68	116.9	4.79	116.79	4.51	117.07	3.33	118.25	3.61	117.97	3.39	118.19	4.95	117.67
FMS-HG18-03B	4.07	117.7	4.68	117.09	4.85	116.92	4.52	117.25	3.44	118.33	3.72	118.05	3.52	118.25	4.89	117.75
FMS-HG18-04A	1.98	104.68	2.07	104.59	2.23	104.43	1.98	104.68	1.40	105.26	1.42	105.23	1.60	105.06	2.53	105.16
FMS-HG18-04B	2.88	103.79	2.04	104.63	3.23	103.44	2.74	103.93	2.20	104.47	2.42	104.24	2.37	104.30	2.96	104.68
FMS-HG18-05A	2.28	111.25	2.12	111.41	2.46	111.07	2.12	111.41	1.85	111.68	2.05	111.48	1.99	111.54	2.82	111.64
FMS-HG18-05B	2.09	111.59	2.00	111.68	2.28	111.40	1.81	111.87	1.22	112.46	1.59	112.09	1.61	112.07	2.30	112.44
FMS-HG18-06A	1.41	110.56	1.46	110.51	1.50	110.47	1.36	110.61	1.22	110.75	1.35	110.62	1.36	110.61	2.19	110.72
FMS-HG18-07A	0.45	112.53	0.41	112.57	0.50	112.48	0.44	112.54	0.28	112.70	0.35	112.63	Frozen, inaccessible.	Frozen, inaccessible.	1.29	112.59
FMS-HG18-07B	0.29	112.49	0.29	112.49	0.32	112.46	0.24	112.54	0.13	112.65	0.21	112.57	Frozen, inaccessible.	Frozen, inaccessible.	1.16	112.6
FMS-HG18-08A	2.60	137.43	2.48	137.55	2.79	137.24	2.46	137.57	2.11	137.92	2.32	137.71	2.24	137.79	3.08	137.83
FMS-HG18-08B	2.17	137.81	2.32	137.66	2.69	137.29	2.26	137.72	1.55	138.43	1.86	138.12	1.61	138.37	2.45	138.38
FMS-HG18-09A	2.16	121.42	2.06	121.52	2.35	121.23	1.93	121.65	1.39	122.19	1.62	121.97	1.49	122.09	2.43	122.1
FMS-HG18-09B	1.59	122.03	1.44	122.18	1.87	121.75	1.36	122.26	0.62	123.00	0.87	122.76	0.68	122.94	1.58	122.96

Borehole	Water Level (mbgs), Collected on Aug. 15, 2018	Water Level (m CGVD28), Collected on Aug. 15, 2018	Water Level (mbgs), Collected on Aug. 20, 2018	Water Level (m CGVD28), Collected on Aug. 20, 2018	Water Level (mbgs), Collected on Sept. 4-6, 2018	Water Level (m CGVD28), Collected on Sept. 4-6, 2018	Water Level (mbgs), Collected on Oct. 9, 2018	Water Level (m CGVD28), Collected on Oct. 9, 2018	Water Level (mbgs), Collected on Nov. 17-18, 2018	Water Level (m CGVD28), Collected on Nov. 17-18, 2018	Water Level (mbgs), Collected on Dec. 11, 2018	Water Level (m CGVD28), Collected on Dec. 11, 2018	Water Level (mbgs), Collected on Mar. 21-22, 2019	Water Level (m CGVD28), Collected on Mar. 21-22, 2019	Water Level (mbgs), Collected on Jun. 4, 2019	Water Level (m CGVD28), Collected on Jun. 4 2019
FMS-HG18-10A	1.60	138.71	1.34	138.97	1.60	138.71	1.27	139.04	0.96	139.35	1.14	139.17	1.07	139.24	2.00	139.25
FMS-HG18-10B	1.34	138.85	1.24	138.95	1.45	138.74	1.20	138.99	0.88	139.31	1.19	138.99	1.09	139.10	2.98	139.23
FMS-HG18-11A	3.90	158.48	4.07	158.31	4.18	158.20	3.74	158.64	3.20	159.18	3.57	158.82	3.28	159.10	4.22	159.05
FMS-HG18-11B	3.33	159.08	3.24	159.17	3.57	158.84	2.97	159.44	1.98	160.43	2.62	159.79	2.30	160.11	2.85	160.52
FMS-HG18-13A	3.67	147.62	3.50	147.79	4.04	147.25	3.50	147.79	2.93	148.36	3.15	148.14	3.06	148.23	3.99	148.27
FMS-HG18-13B	1.79	149.54	1.57	149.76	2.26	149.07	1.50	149.83	0.36	150.97	0.80	150.53	0.54	150.79	1.50	150.88
FMS-HG18-14A	4.75	112.14	4.72	112.17	4.83	112.06	4.60	112.29	3.92	112.97	3.14	113.76	4.11	112.78	5.23	112.63
FMS-HG18-14B	4.71	112.26	4.68	112.29	4.80	112.17	4.55	112.42	3.76	113.21	4.00	112.97	3.98	112.99	5.16	112.8
FMS-HG18-15A	0.66	106.8	0.61	106.85	0.82	106.64	0.59	106.87	0.48	106.98	0.56	106.90	Frozen, inaccessible.	Frozen, inaccessible.	1.52	106.94
FMS-HG18-15B	0.92	106.64	0.93	106.63	1.07	106.49	0.87	106.69	0.78	106.78	0.85	106.71	0.80	106.76	1.84	106.75
FMS-HG18-16A	2.79	139.38	2.79	139.38	3.07	139.10	2.86	139.31	0.84	141.33	1.14	141.04	1.51	140.66	2.44	140.61
FMS-HG18-16B	3.39	138.8	3.44	138.75	3.60	138.59	2.45	139.74	0.84	141.35	1.17	141.02	1.58	140.61	2.48	140.59

The groundwater levels measured were shallow, ranging from 0.13 to 4.95 mbgs. Groundwater elevations ranged from 103.44 m to 160.52 m (relative to CGVD28). In general, the groundwater elevations are similar, with less than 2 m difference, when comparing the nested well locations for: bedrock (A) and bedrock-soil interface (B) wells. Groundwater elevations at most borehole locations indicate slight downward or nearly neutral gradients. Upward gradients between A/B well pairs were observed at locations FMS-HG18-04, FMS-HG18-07, FMS-HG18-15, and FMS-HG18 -16.

The hydrographs for wells at FMS-HG18-02, FMS-HG18-04, FMS-HG18-05, FMS-HG18-07, FMS-HG18-09, and FMS-HG18-10 (Appendix B.1) generally show consistent groundwater levels over the monitoring period to date. Some fluctuation in groundwater levels is apparent, likely related to seasonal variation and precipitation events. The precipitation data shown on the hydrographs is from the Malay Falls weather station, located approximately 18 km from the FMS Study Area. Groundwater level monitoring from these wells will continue at a quarterly basis.

6.5.3.1.3 *Hydraulic Conductivity*

The hydraulic conductivity of the subsurface materials within the FMS Study Area and vicinity was estimated by packer tests, single well response tests (SWRT), and grain size analyses. The results are presented in the below sections.

6.5.3.1.4 *2018 FMS Packer Testing*

The results of the packer testing program are summarized in Table 6.5-3. The tests were analyzed using the Hvorslev methods for constant and variable head conditions (Hvorslev 1951). The results show a wide range of hydraulic conductivity across the area tested, ranging from 7×10^{-8} m/s to 6×10^{-5} m/s.

Table 6.5-3: Packer Testing Results for FMS 2018 Hydrogeological Boreholes

Borehole	Test Number	Test Interval (mbgs)	Test Interval (m CGVD28)	Test Type	Hydraulic Conductivity (m/s)
FMS-HG18-02A	Test 1	6.83 - 24.24	129.14 - 111.73	CRI	7E-08
FMS-HG18-03A	Test 1	9.38 - 12.08	112.20 - 109.50	FHT	2E-07
FMS-HG18-04A	Test 1	19.46 - 25.74	87.20 - 80.92	CRI	2E-07
FMS-HG18-04A	Test 2	7.39 - 25.74	99.27 - 80.92	CRI	7E-08
FMS-HG18-05A	Test 1	6.00 - 13.81	107.53 - 99.72	CRI	6E-06
FMS-HG18-05A	Test 2	8.57 - 13.81	104.96 - 99.72	CRI	6E-06
FMS-HG18-07A	Test 1	4.65 - 12.37	108.33 - 100.61	CRI	4E-07
FMS-HG18-08A	Test 1	4.16 - 13.93	135.87 - 126.10	CRI	1E-05
FMS-HG18-08A	Test 2	7.39 - 13.93	132.64 - 126.10	CRI	2E-06
FMS-HG18-09A	Test 1	6.10 - 12.38	117.48 - 111.20	CRI	5E-07
FMS-HG18-10A	Test 1	5.02 - 12.30	135.29 - 128.01	CRI	1E-05

Borehole	Test Number	Test Interval (mbgs)	Test Interval (m CGVD28)	Test Type	Hydraulic Conductivity (m/s)
FMS-HG18-10A	Test 2	7.94 - 12.30	132.37 - 128.01	CRI	1E-06
FMS-HG18-11A	Test 1	3.16 - 10.92	159.22 - 151.46	CRI	3E-06
FMS-HG18-13A	Test 1	8.09 - 12.43	143.20 - 138.86	CRI	1E-06
FMS-HG18-14A	Test 1	4.10 - 13.81	112.79 - 103.08	CRI	6E-05
FMS-HG18-14A	Test 2	6.04 - 13.81	110.85 - 103.08	CRI	2E-06
FMS-HG18-14A	Test 3	11.52 - 13.81	105.37 - 103.08	FHT	1E-06
FMS-HG18-15A	Test 1	5.12 - 10.83	102.34 - 96.63	CRI	2E-07
FMS-HG18-16A	Test 1	7.48 – 11.02	134.69 - 131.15	CRI	3E-07

The results of the packer tests are also plotted on Figure 6.5-3 with the intervals tested relative to depth below top of bedrock and the resulting hydraulic conductivity estimate for each test.

6.5.3.1.4.1 2017 Packer Testing Results of the Open Pit

The open pit deep angle borehole permeability testing indicates hydraulic conductivity in the 10^{-8} m/s to 10^{-7} m/s range, and a geometric mean hydraulic conductivity of $7{\times}10^{-8}$ m/s. The results are presented in Figure 6.5-4 along with the 2018 packer testing results.

Based on these preliminary observations, the in-pit water management requirements for the Egerton-MacLean pit can be expected to be like the Touquoy pit; a sump system that is designed to manage direct precipitation and runoff will manage seepage incidentally.

Hydraulic conductivity results are presented along with core logging results on summary logs in Appendix B.8. A summary of hydraulic conductivity results from wireline packer testing in section is presented in Appendix B.8.

6.5.3.1.5 *Single Well Response Tests*

The results of the 2018 rising head SWRT are summarized in Table 6.5-4 and the analysis sheets are provided in Appendix B.1. Analyses of the SWRT were carried out using the Hvorslev method (Hvorslev 1951). The estimated hydraulic conductivities of the ‘A’ wells installed into the bedrock ranged from $6{\times}10^{-8}$ m/s to $1{\times}10^{-5}$ m/s. The estimated hydraulic conductivities of the ‘B’ wells installed across the overburden-bedrock interface ranged from $1{\times}10^{-7}$ m/s to $4{\times}10^{-5}$ m/s. The results are presented in Figure 6.5-5.

Table 6.5-4: Single Well Response Test Summary

Well ID	Top of Test Interval (mbgs)	Bottom of Test interval (mbgs)	Top of Test Interval (m CGVD28)	Bottom of Test Interval (m CGVD28)	Hydraulic Conductivity (m/s)
FMS-HG18-02A	17.36	20.41	118.61	115.56	6E-08
FMS-HG18-02B	3.36	7.03	132.49	128.82	1E-06

Well ID	Top of Test Interval (mbgs)	Bottom of Test interval (mbgs)	Top of Test Interval (m CGVD28)	Bottom of Test Interval (m CGVD28)	Hydraulic Conductivity (m/s)
FMS-HG18-03A	8.93	11.98	112.65	109.60	3E-07
FMS-HG18-03B	4.42	6.89	117.35	114.88	2E-06
FMS-HG18-04A	14.88	20.98	91.78	85.68	3E-07
FMS-HG18-04B	4.07	7.12	102.60	99.55	1E-07
FMS-HG18-05A	9.17	13.70	104.36	99.83	1E-05
FMS-HG18-05B	2.84	5.89	110.84	107.79	5E-07
FMS-HG18-07A	7.68	10.73	105.30	102.25	1E-06
FMS-HG18-07B	1.71	4.76	111.07	108.02	5E-06
FMS-HG18-08A	10.29	13.34	129.74	126.69	2E-06
FMS-HG18-08B	2.56	5.96	137.42	134.02	9E-06
FMS-HG18-09A	8.98	12.03	114.60	111.55	4E-07
FMS-HG18-09B	3.14	6.19	120.48	117.43	3E-06
FMS-HG18-10A	9.22	12.27	131.09	128.04	5E-07
FMS-HG18-10B	1.90	6.47	138.29	133.72	4E-06
FMS-HG18-11A	7.87	10.92	154.51	151.46	2E-06
FMS-HG18-11B	3.59	4.90	158.82	157.51	1E-06
FMS-HG18-13A	9.38	12.43	141.91	138.86	2E-06
FMS-HG18-13B	2.52	5.57	148.81	145.76	1E-06
FMS-HG18-14A	9.55	12.60	107.34	104.29	3E-06
FMS-HG18-14B	4.74	6.43	112.23	110.54	3E-06
FMS-HG18-15A	7.73	10.78	99.73	96.68	4E-07
FMS-HG18-15B	1.03	4.08	106.53	103.48	7E-07
FMS-HG18-16A	7.86	10.91	134.31	131.26	4E-07
FMS-HG18-16B	3.35	5.47	138.84	136.72	4E-05

Note:Test intervals based on well screens except where the static water level was below the top of the screen in which case the static water level was considered the top of the test interval.

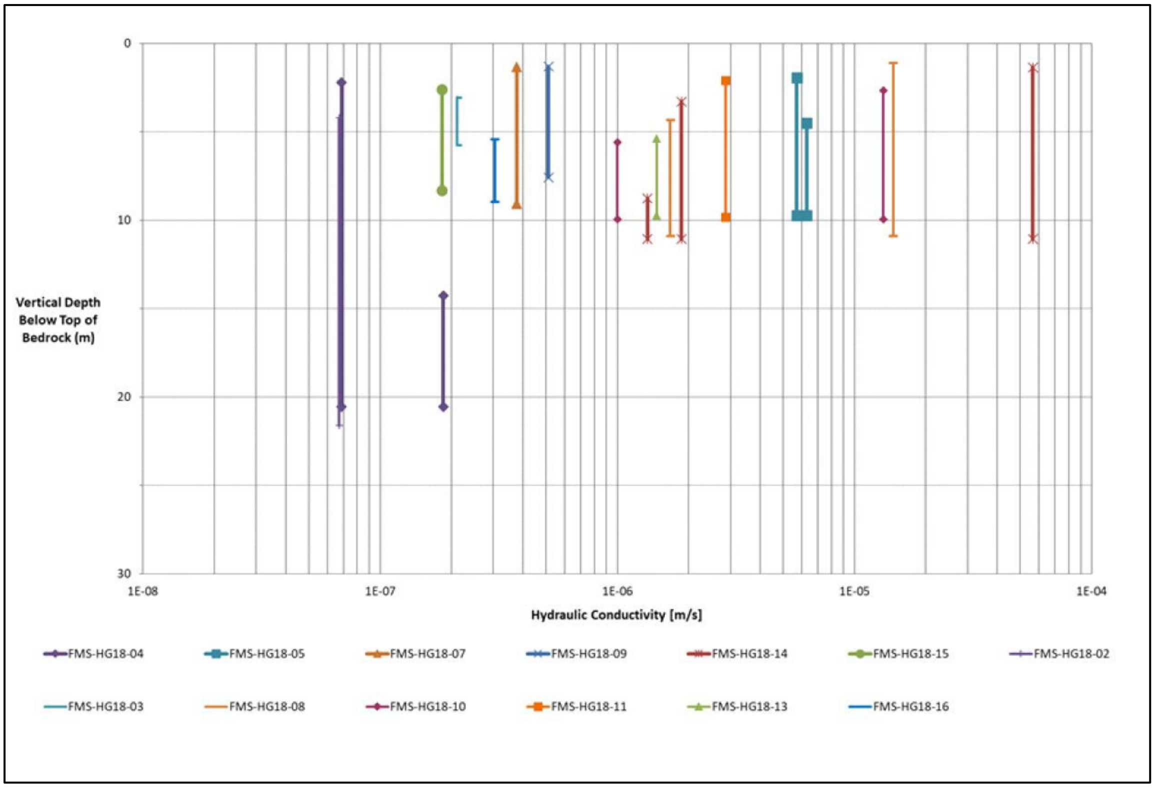


Figure 6.5-3: Hydraulic Conductivity Profile for the 2018 Borehole Series Packer Testing Results (Prepared by Golder 2019)

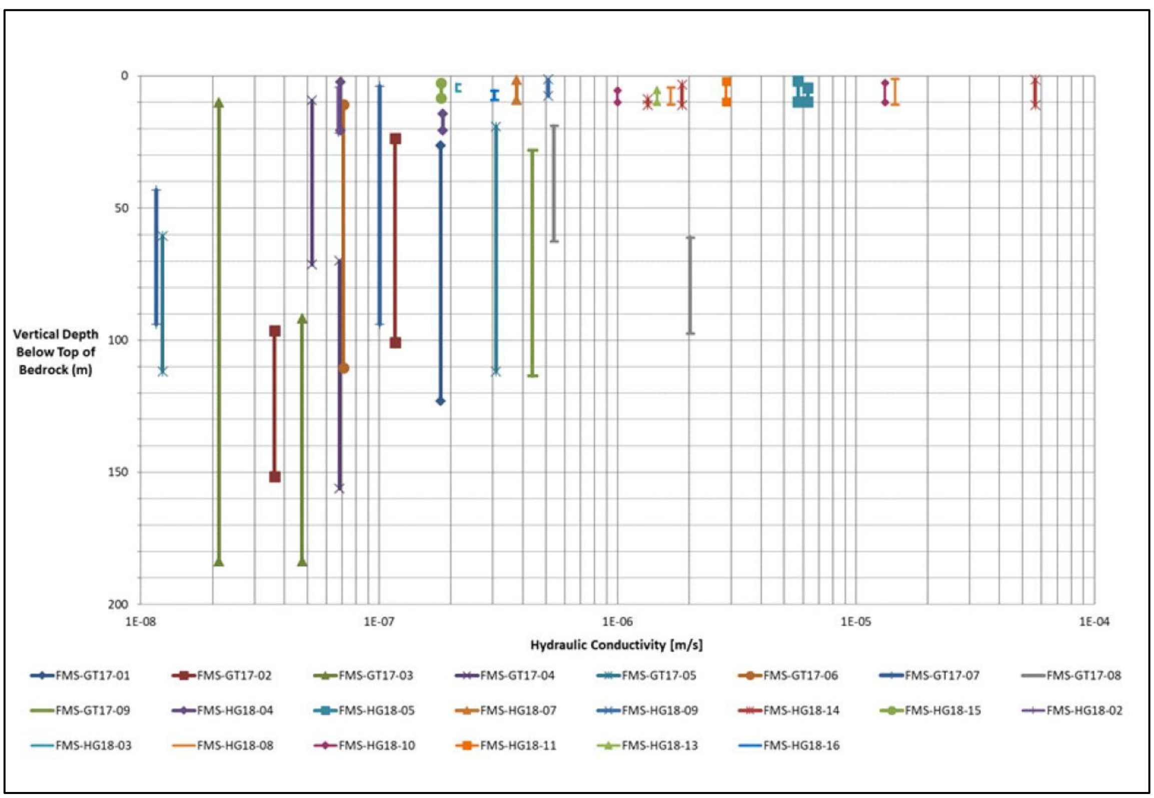


Figure 6.5-4: Hydraulic Conductivity Profile for the 2017 and 2018 Borehole Series Packer Testing Results (Prepared by Golder 2019)

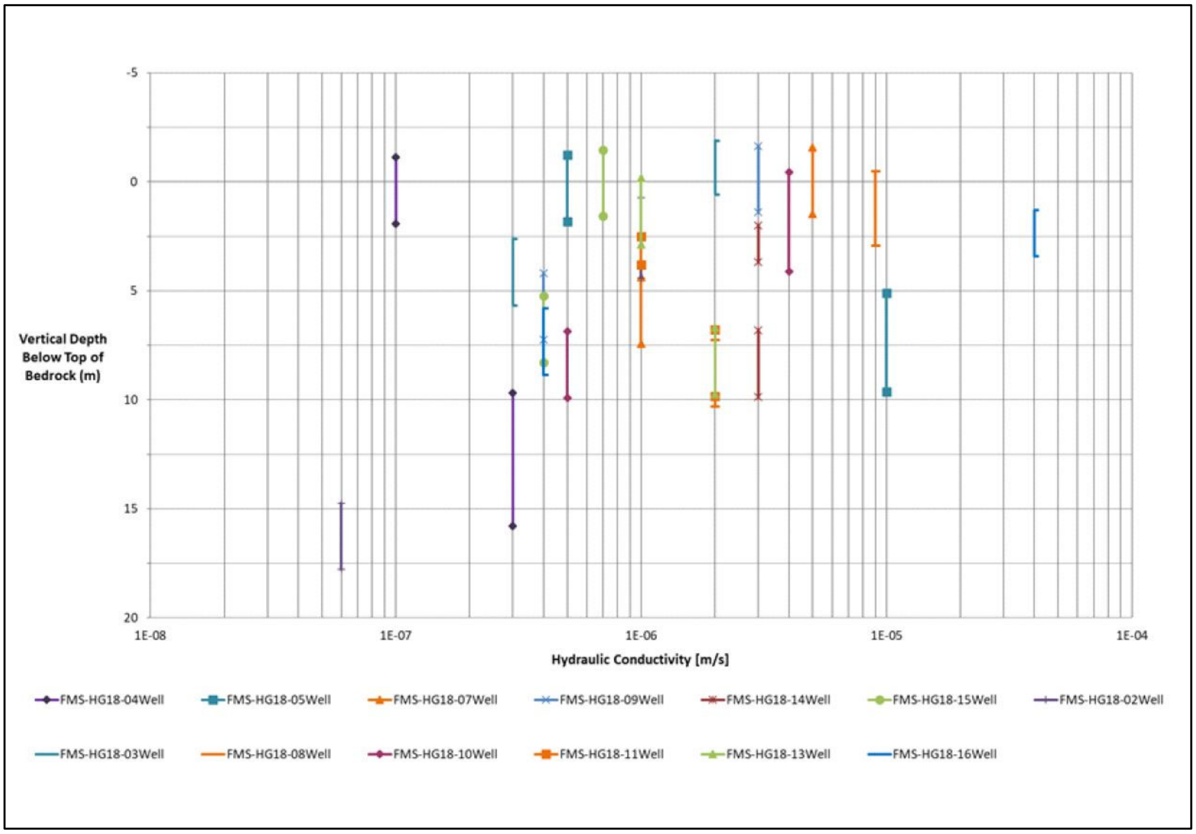


Figure 6.5-5: Hydraulic Conductivity Profile for the 2018 Borehole Series Single Well Response Tests Results (Prepared by Golder 2019)

6.5.3.1.6 *Grain Size Estimates*

Estimates of hydraulic conductivity of glacial till soil samples were made based on the grain size analyses using the Hazen approximation (Hazen 1911). A summary of the results is provided on Table 6.5-5 and in Appendix B.1. The estimates range from 4×10^{-9} m/s to 4×10^{-6} m/s.

Table 6.5-5: Hydraulic Conductivity Estimates Based on Soil Grain Size

Borehole	Sample No.	Representative Sample Depth (mbgs)	Soil Type	D10: Grain size at 10% (wt%) passing (mm)	Estimated hydraulic Conductivity (m/s)
FMS-HG18-02X	SS2	0.70	SILTY SAND and GRAVEL	0.0140	2E-06
FMS-HG18-03A	SS1	0.31	sandy SILTY GRAVEL	0.0110	1E-06
FMS-HG18-03A	SS3	1.09	sandy SILTY GRAVEL	0.0110	1E-06
FMS-HG18-03A	SS7	3.99	SILTY GRAVEL and SAND	0.0120	1E-06
FMS-HG18-03A	SS8	6.23	SILT, some sand, trace gravel	0.0043	2E-07
FMS-HG18-04A	SS3	2.11	sandy GRAVEL and SILT	0.0007	5E-09
FMS-HG18-04A	SS5	3.69	sandy GRAVEL and SILT	0.0006	4E-09
FMS-HG18-05A	SS1B	0.32	sandy SILTY GRAVEL	0.0170	3E-06
FMS-HG18-05A	SS3	1.84	gravelly SILTY SAND	0.0080	6E-07
FMS-HG18-05A	SS5	3.36	gravelly SAND and SILT	0.0064	4E-07
FMS-HG18-06A	SS3	1.84	SILTY SAND and GRAVEL	0.0090	8E-07
FMS-HG18-07A	SS2	0.92	sandy SILTY GRAVEL	0.0110	1E-06
FMS-HG18-07A	SS4	2.75	gravelly SILTY SAND	0.0090	8E-07
FMS-HG18-08A	SS2	0.80	SILTY GRAVEL and SAND	0.0130	2E-06
FMS-HG18-09A	SS3	1.80	sandy SILTY GRAVEL	0.0080	6E-07
FMS-HG18-09A	SS5	4.32	sandy SILTY GRAVEL	0.0095	9E-07
FMS-HG18-10A	SS2	0.92	sandy SILTY GRAVEL	0.0210	4E-06
FMS-HG18-13A	SS3	1.41	gravelly SILTY SAND	0.0090	8E-07
FMS-HG18-14A	SS2	0.84	SILTY GRAVEL and SAND	0.0080	6E-07
FMS-HG18-14A	SS3	1.86	gravelly SILTY SAND	0.0080	6E-07

Borehole	Sample No.	Representative Sample Depth (mbgs)	Soil Type	D10: Grain size at 10% (wt%) passing (mm)	Estimated hydraulic Conductivity (m/s)
FMS-HG18-16A	SS1	0.31	gravelly SILTY SAND	0.0024	6E-08
FMS-HG18-16A	SS3	1.64	SILTY GRAVEL and SAND	0.0040	2E-07

6.5.3.1.7 *Fault Hydraulic Conductivity*

The Seigel fault and Serpent fault have been interpreted to intersect the proposed open pit (See Section 6.4). Based on the hydraulic conductivity testing data included in Appendix B.1, and the three-dimensional fault mapping provided by the Proponent (See Section 6.4) the hydraulic conductivity value determined from the test that intersected the Seigel Fault (FMS-GT-17-05) was $3×10^{-7}$ m/s. A second test (at FMS-GT-17-01) intersected the Serpent fault, and resulted in a hydraulic conductivity of $2×10^{-7}$ m/s. In both cases the tested interval was greater than 50 m in length and may not fully represent the hydraulic conductivity of the fault zone. However, within the vertical resolution of the groundwater model these ranges to not suggest significantly enhanced hydraulic conductivity within the fault zone.

6.5.3.1.8 *Groundwater Quantity Conceptual Model*

Based on the baseline data provided above, the following section presents the groundwater quantity conceptual model. Due to the relatively shallow depth to bedrock, and the low hydraulic conductivity of the bedrock unit, groundwater flow within the FMS Study Area is conceptualized as occurring mainly within the till, and upper (contact) portion of the bedrock. Site specific groundwater levels indicate that the water table is generally within the till or the upper few meters of the bedrock, supporting this conceptualization. Given the prevalence of wetlands and surface drainage features throughout the area, and the excess of the annual rainfall relative to evaporation, groundwater is likely to follow short localized flow paths, discharging to surface water features within proximity to areas of groundwater recharge. Detailed discussion of the hydrostratigraphy of the FMS Study Area is included in the groundwater modelling report in Appendix B.2.

Based on this study and previous studies of the hydrogeology of this deposit and others in the area, the degree of hydraulic connection amongst the smaller bedrock fracture systems is likely poor to moderate. Based upon the current drilling records it is our understanding that there are no large regional fault systems in the vicinity of the Project, and the Seigel and Serpent faults are smaller and do not appear to be capable of transmitting or storing large amounts of water based on the limited testing to date.

Groundwater can be expected to seep into the open pit developed at the FMS Mine Site through the surficial deposits and the upper (contact) bedrock unit. Within the deeper and less conductive bedrock units, groundwater flow to the open pit is through fractures and structures in the bedrock (which are not represented explicitly in the numerical model). As dewatering progresses and groundwater levels in the vicinity of the open pit are lowered, some surface water bodies which are currently groundwater discharge areas may become areas of groundwater recharge.

6.5.3.1.9 *Groundwater Quality Results*

The following section provides the analytical results for the groundwater quality sampling conducted quarterly at FMS Study Area from September 2018 to June 2019.

All groundwater quality results were compared to the Guidelines for Canadian Drinking Water Quality (CDWQ) and the Nova Scotia Environment Pathway Specific Standards for Groundwater (NSE PSS) for groundwater discharging to surface water (0-10 m from a fresh water body). Groundwater quality results are shown compared to the CDWQ and the NSE PSS in the laboratory results provided in Appendix B.2.

The results of the laboratory analysis are summarized as follows:

- PHC/BTEX, and total and free cyanide were not detected in any of the samples collected. Total mercury exceeded the NSE PSS in wells FMS-HG18-06A and FMS-HG18-11B in September 2018, and total and dissolved mercury exceeded the NSE PSS in well FMS-HG18-15A in November 2018. Total and dissolved mercury did not exceed the CDWQ in any samples collected in September 2018, November 2018, March 2019, or June 2019.
- Radium-226 did not exceed the health-related maximum acceptable concentration (MAC) provided in the CDWQ in any of the sampling events.
- Table 6.5-6 provides a summary of the groundwater exceedances of the CDWQ MAC for the September 2018, November 2018, March 2019, and June 2019 sampling events. A summary of the exceedances are as follows:
  - Dissolved arsenic exceeded the CDWQ in seven wells (FMS-HG18-03A, FMS-HG18-04A, FMS-HG18-05A, FMS-HG18-06A, FMS-HG18-07A, FMS-HG18-07B, and FMS-HG18-15A) in September 2018. Dissolved arsenic exceeded the CDWQ in six wells in November 2018, all of which also exceeded in September 2018 (FMS-HG18-03A, FMS-HG18-04A, FMS HG18-05A, FMS-HG18-07A, FMS-HG18-07B, and FMS-HG18-15A). Dissolved arsenic exceeded the CDWQ in five wells (FMS-HG18-02A, FMS-HG18-03A, FMS-HG18-04A, FMS-HG18-05A, and FMS-HG18-06A) in March 2019, all of which exceeded in the 2018 sampling with the exception of FMS-HG18-02A. Dissolved arsenic exceeded CDWQ in six wells (FMS-HG18-02A, FMS-HG18-03A, FMS-HG18-04A, FMS-HG18-05A FMS-HG18-07A, and FMS-HG18-07B) in June 2019, all of which exceeded in the previous sampling.
  - Dissolved manganese exceeded the CDWQ in 13 wells (FMS-HG18-03A, FMS-HG18-04A, FMS-HG18-04B, FMS-HG18-06A, FMS-HG18-07A, FMS-HG18-07B, FMS-HG18-09A, FMS-HG18-09B, FMS-HG18-11A, FMS-HG18-11B, FMS-HG18-15A, FMS-HG18-15B and FMS-HG18-16A) in June 2019. Health Canada established a guideline for manganese in May 2019. Previous sampling events were not compared to the new Health Canada CDWQ guideline, however, concentrations reported for the June 2019 sampling event are consistent with manganese concentrations from previous sampling events.
  - No other metals parameters exceeded CDWQ MAC.
  - Aluminum, iron and zinc exceeded aesthetic objectives/operational guidance value in multiple wells during all monitoring events.
- Parameters exceeding the NSE PSS in groundwater for the September 2018, November 2018, March 2019, and June 2019 sampling events are presented in Table 6.5-7 Metals parameters exceeding the NSE PSS included total mercury and dissolved aluminum, arsenic, cadmium, cobalt, copper, iron, manganese, mercury, selenium, silver, and zinc. It should be noted that the laboratory detection limit for dissolved cadmium (0.017 µg/L) is greater than the NSE PSS (0.01 µg/L). Detected concentrations of dissolved cadmium are presented in Table 6.5-7.

Table 6.5-6: Groundwater Concentrations Exceeding the CDWQ MAC

Monitoring Well ID	Groundwater Concentrations Exceeding the MAC			
	September 2018	November 2018	March 2019	June 2019
FMS-HG18-02A	None	None	Dissolved arsenic	Dissolved arsenic
FMS-HG18-02B	None	None	None	None
FMS-HG18-03A	Dissolved arsenic	Dissolved arsenic	Dissolved arsenic	Dissolved manganese
FMS-HG18-03B	None	None	None	None
FMS-HG18-04A	Dissolved arsenic	Dissolved arsenic	Dissolved arsenic	Dissolved arsenic and manganese
FMS-HG18-04B	None	None	None	Dissolved manganese
FMS-HG18-05A	Dissolved arsenic	Dissolved arsenic	Dissolved arsenic	Dissolved arsenic
FMS-HG18-05B	None	None	None	None
FMS-HG18-06A	Dissolved arsenic	None	Dissolved arsenic	Dissolved manganese
FMS-HG18-07A	Dissolved arsenic	Dissolved arsenic	Not sampled as well frozen	Dissolved arsenic and manganese
FMS-HG18-07B	Dissolved arsenic	Dissolved arsenic	Not sampled as well frozen	Dissolved arsenic and manganese
FMS-HG18-08A	None	None	None	None
FMS-HG18-08B	None	None	None	None
FMS-HG18-09A	None	None	None	Dissolved manganese
FMS-HG18-09B	None	None	None	Dissolved manganese
FMS-HG18-10A	None	None	None	None
FMS-HG18-10B	None	None	None	None
FMS-HG18-11A	None	None	None	Dissolved manganese
FMS-HG18-11B	None	None	None	Dissolved manganese
FMS-HG18-13A	None	None	None	None
FMS-HG18-13B	None	None	None	None
FMS-HG18-14A	None	None	None	None

Monitoring Well ID	Groundwater Concentrations Exceeding the MAC			
	September 2018	November 2018	March 2019	June 2019
FMS-HG18-14B	None	None	None	None
FMS-HG18-15A	Dissolved arsenic	Dissolved arsenic	Not sampled as well frozen	Dissolved manganese
FMS-HG18-15B	None	None	None	Dissolved manganese
FMS-HG18-16A	None	None	None	Dissolved manganese
FMS-HG18-16B	None	None	None	None

Table 6.5-7: Dissolved Groundwater Concentrations Exceeding the NSE PSS

Monitoring Well ID	Dissolved Groundwater Concentrations Exceeding the NSE PSS			
	September 2018	November 2018	March 2019	June 2019
FMS-HG18-02A	Aluminium and arsenic	Aluminium and arsenic	Arsenic and copper	Arsenic and copper
FMS-HG18-02B	Aluminium, iron, and manganese	Aluminium, cadmium, and copper	Aluminum, cadmium, and copper	Aluminum and copper
FMS-HG18-03A	Arsenic	Aluminium and arsenic	Arsenic	Aluminum and arsenic
FMS-HG18-03B	Cadmium, copper, and zinc	Aluminium	Cadmium, copper, and silver	Silver
FMS-HG18-04A	Aluminium, arsenic, and cadmium	Aluminium and arsenic	Arsenic	Aluminum
FMS-HG18-04B	Cadmium, manganese, and zinc	Cadmium, iron, manganese, and zinc	Cadmium, iron, manganese, and zinc	Cadmium and zinc
FMS-HG18-05A	Aluminium, arsenic, and cadmium	Aluminium and arsenic	Arsenic	Aluminum
FMS-HG18-05B	Aluminium, arsenic, and cadmium	Aluminium, cadmium and copper	Aluminum, cadmium, and copper	Aluminum, cadmium, and copper
FMS-HG18-06A	Aluminium, arsenic, iron, and manganese, and total mercury	Aluminium and cadmium	Aluminum, arsenic, and iron	Aluminum, and cadmium
FMS-HG18-07A	Arsenic	Arsenic	Not sampled as well frozen	Arsenic

Monitoring Well ID	Dissolved Groundwater Concentrations Exceeding the NSE PSS			
	September 2018	November 2018	March 2019	June 2019
FMS-HG18-07B	Aluminium, arsenic, and iron	Aluminium, arsenic, and iron	Not sampled as well frozen	Aluminum, arsenic and iron
FMS-HG18-08A	None	None	None	None
FMS-HG18-08B	Copper	Aluminium and cadmium	Aluminum	Aluminum, cadmium, and silver
FMS-HG18-09A	None	None	None	None
FMS-HG18-09B	Cadmium, silver, and zinc	Cadmium and copper	Cadmium, copper, and iron	Aluminum, cadmium, copper, and iron
FMS-HG18-10A	Cadmium and zinc	Aluminium	Aluminum	Aluminum
FMS-HG18-10B	Aluminium and cadmium	Aluminium	Aluminum and cadmium	Aluminum
FMS-HG18-11A	Cadmium and manganese	Cadmium and manganese	Cadmium and manganese	Cadmium and manganese
FMS-HG18-11B	Aluminium, cadmium, copper, manganese, and total mercury	Aluminium, cadmium, cobalt, copper, iron, and manganese	Aluminum, cobalt, copper, iron, and manganese	Aluminum, cadmium, cobalt, iron, manganese, selenium
FMS-HG18-13A	None	Aluminium	Aluminum	None
FMS-HG18-13B	Aluminium, copper and, silver	Aluminium, copper, and silver	Aluminum, cadmium, copper, and silver	Aluminum, and silver
FMS-HG18-14A	Arsenic and cadmium	Cadmium	Cadmium	Aluminum
FMS-HG18-14B	Cadmium	Aluminium, cadmium, and copper	Aluminum and cadmium	Aluminum and cadmium
FMS-HG18-15A	Aluminium and arsenic	Aluminium, arsenic, and mercury, and total mercury	Not sampled as well frozen	Arsenic
FMS-HG18-15B	None	None	Aluminum	None
FMS-HG18-16A	None	None	Silver	None
FMS-HG18-16B	Aluminium, cadmium, and copper	Aluminium, cadmium, copper, and silver	Aluminum, copper, and silver	Aluminum, cadmium, copper, and silver

Based upon the local geology and fairly shallow water table, exceedances of these metals are expected due to groundwater interaction with the overburden and bedrock.

6.5.3.2 Touquoy Mine Site Baseline Conditions

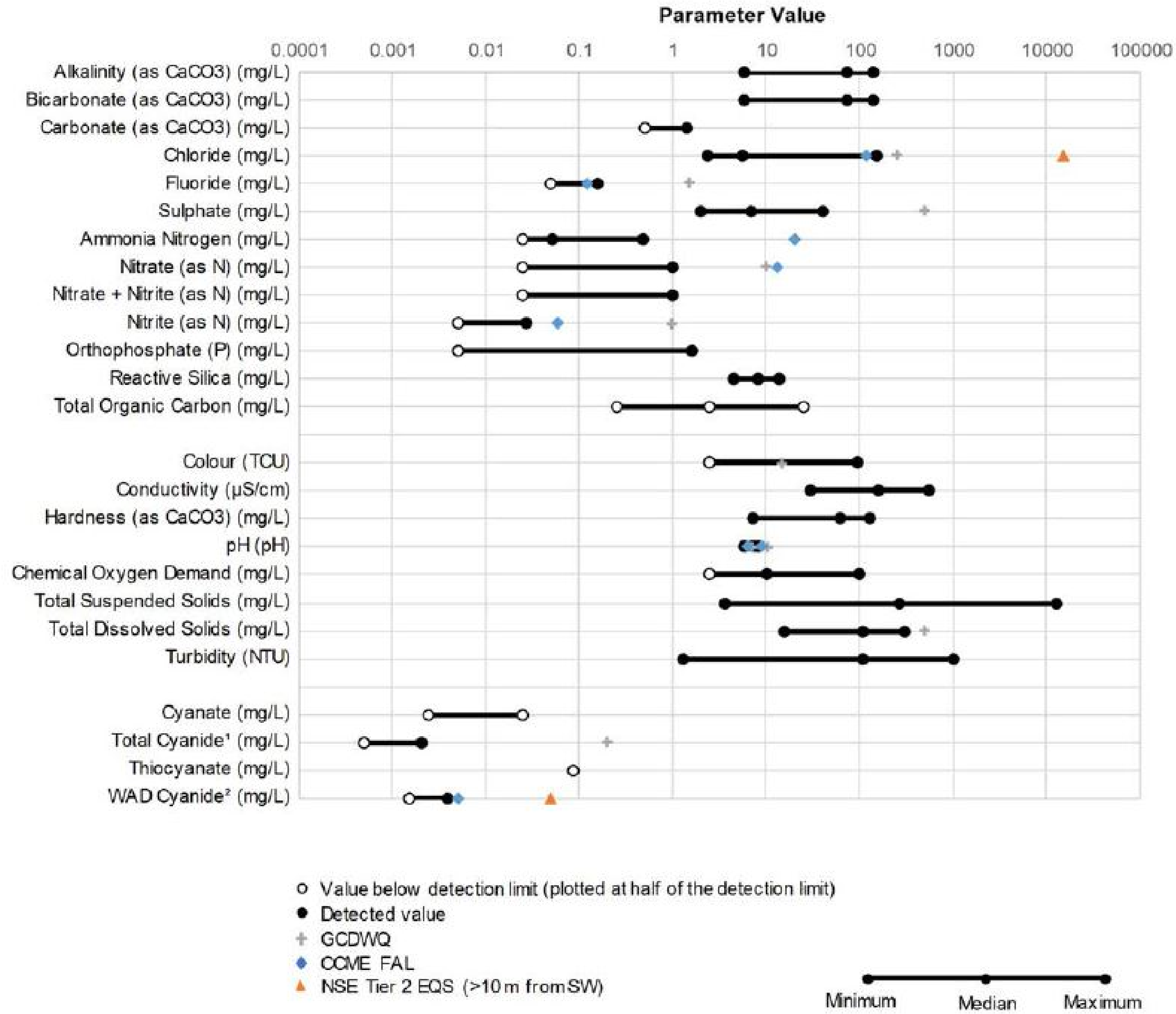
As identified in the Touquoy Gold Project Focus Report (CRA 2007), the Touquoy Mine Site is located within a metamorphic bedrock hydrostratigraphic unit, cross cut by structural features (faults, anticlinal axes) that may represent separate hydrostratigraphic units. Groundwater inflows and outflows will be controlled by these relatively low permeability and fracture-controlled bedrock units. Given the high water table in the Touquoy Mine Site Study Area and combined with the high water surplus and general low permeability of the area, the groundwater flow system can be characterized as a “local” system, with topographic highs representing recharge zones that would discharge into the adjacent topographic lows. The till overburden hydrostratigraphic unit acts as a confining unit that creates non-flowing artesian conditions within portions of the bedrock. Groundwater-surface water interaction is controlled by the presence of the till, with flow rates controlled by the thickness, continuity and permeability of the till. 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} metres per second (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 rock lithologies: argillite and greywacke.

Seepage into the Touquoy pit at the Touquoy Mine Site from the till and bedrock was expected to range from 550 cubic metres per day (m^3/d) to 1,450 m^3/d (PCA 2006). An additional assessment completed as part of the Touquoy Gold Project Focus Report (CRA 2007) to determine the potential linkage between Moose River and the local groundwater system identified that groundwater upwelling was not measured from temperature profiling conducted through the portion of Moose River that lies adjacent to the Touquoy pit. The poor linkage between the Moose River and Touquoy pit has been confirmed to date (Appendix I.4) by ongoing flow monitoring at the site during operations under the Touquoy Gold Project IA.

Under ambient conditions, surface water contribution to groundwater is limited given the thickness, continuity and permeability of the confining till and the relative impermeability of the bedrock.

6.5.3.2.1 *Groundwater Quality at the Touquoy Mine Site*

Baseline groundwater quality monitoring at the Touquoy Mine Site has been conducted at 32 well nests since 2016, two domestic wells and one nested well installed in 2018, at the locations shown on Figure 6.5-6. As presented in Appendix I.4, the groundwater at the Touquoy Mine Site is slightly basic (pH range 7.02 to 8.08) and an elevated hardness (45 to 160 mg/L). Groundwater quality results from samples collected in the vicinity of the Touquoy pit at the Touquoy Mine Site (i.e., the OPM-series wells) are provided on Figure 6.5-7 and Figure 6.5-8. As shown on these figures, the background groundwater quality generally meets the NSE Tier 2 Pathway Specific Standards (PSS) for groundwater greater for wells located more than 10 m from surface water (NSE 2013a). The Guidelines for Canadian Drinking Water Quality (CDWQ, Health Canada 2019) and the Canadian Environmental Quality Guidelines for the Protection of Freshwater Aquatic Life (FAL, CCME 2018) guidelines are also presented on Figure 6.5-7 and Figure 6.5-8 for illustrative purposes, but are not discussed, as the groundwater at the site is not used as a potable water supply, and the NSE PSS already account for groundwater discharging to surface water bodies. The Touquoy groundwater monitoring program results are reported annually to NSE based on the requirements of the IA which regulates operational activities and monitoring for the Touquoy Gold Project.



Notes:

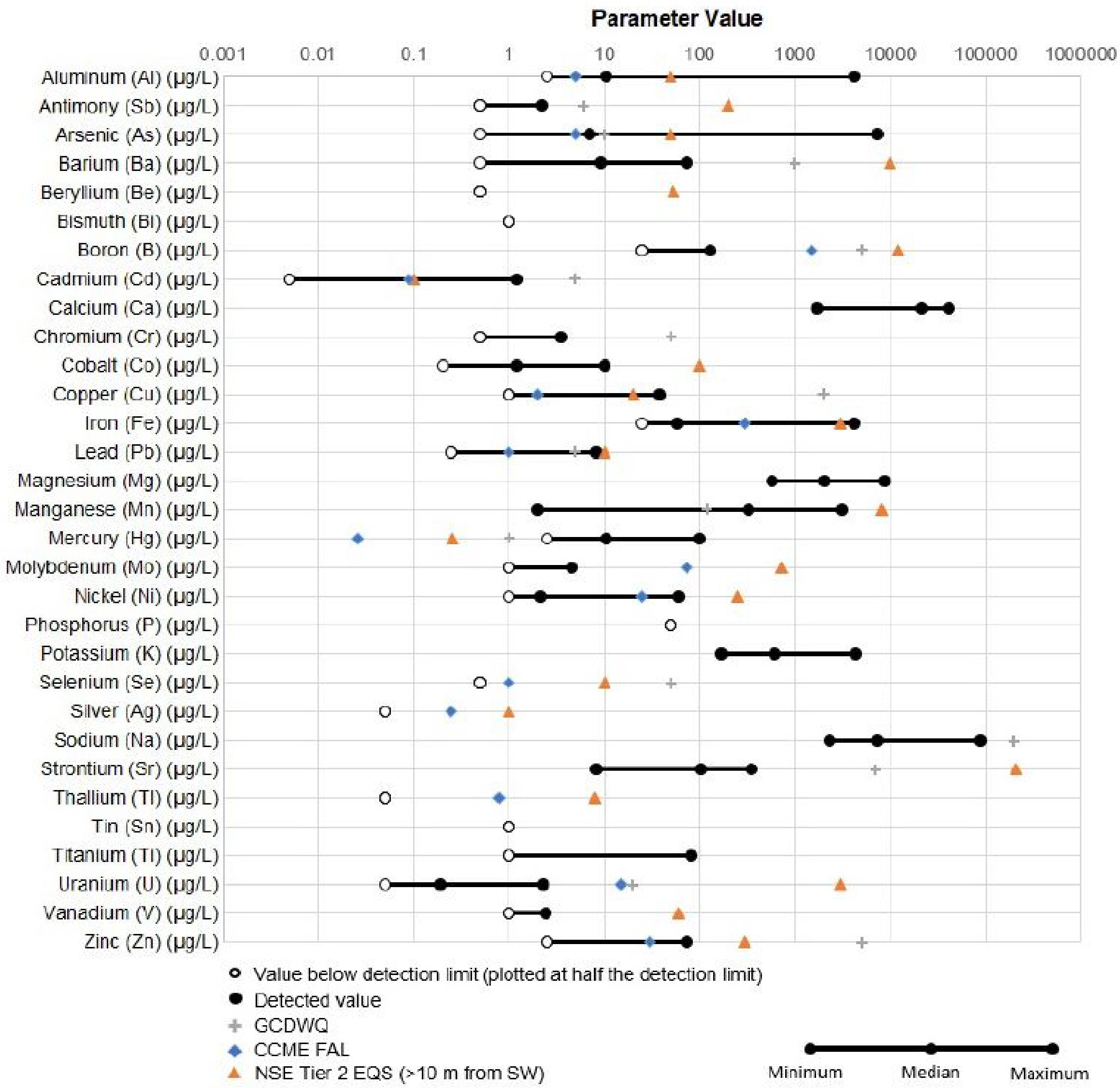
1. Total cyanide reported as Strong Acid Dissociable Cyanide
2. WAD Cyanide = Weak Acid Dissociable Cyanide

GCDWQ = Guidelines for Canadian Drinking Water Quality

CCME FAL = Canadian Environmental Quality Guidelines for the Protection of Freshwater Aquatic Life

NSE Tier 2 EQS (>10 m from SW) = Nova Scotia Environment Environmental Quality Standards, Tier 2 Pathway Specific Standards for groundwater located more than 10 m from surface water

Figure 6.5-7: Summary of Groundwater Quality in the Vicinity of the Open Pit at the Touquoy Mine Site – General Chemistry and Cyanide-related Parameters (Prepared by Stantec 2019)



Notes:

GCDWQ = Guidelines for Canadian Drinking Water Quality

CCME FAL = Canadian Environmental Quality Guidelines for the Protection of Freshwater Aquatic Life

NSE Tier 2 EQS (>10 m from SW) = Nova Scotia Environment Environmental Quality Standards, Tier 2 Pathway Specific Standards for groundwater located more than 10 m from surface water

Figure 6.5-8: Summary of Groundwater Quality in the Vicinity of the Open Pit at the Touquoy Mine Site – Dissolved Metals (Prepared by Stantec 2019)

Groundwater quality exceedances of the NSE PSS were noted in 2017 for aluminum, arsenic, cadmium, copper, iron, mercury, silver, and organics that were common in the 2016 baseline period, and therefore were not attributed to the operation of the mine. In particular, historical (non-Project-related) mining operations at the Touquoy Gold Project appear to have resulted in elevated concentrations of some parameters, including arsenic, mercury, and cyanide species. The development of site-specific criteria for the Touquoy Mine Site could be considered to determine thresholds for water quality that consider the elevated concentrations of parameters under baseline conditions. Until such time as site-specific criteria are developed, the evaluation of potential water quality effects from the operation of the Touquoy Gold Project is based on long-term upward or downward trends in comparison to the baseline levels, and not exclusively on any exceedances of NSE EQS or PSS criteria. The current monitoring record representing operation is too short to distinguish any potential effects of the mine water quality compared to the natural variability, as operation only began in October 2017.

Arsenic was noted to consistently exceed the NSE PSS at OPM-1A/B in both 2016 and 2017. These elevated arsenic concentrations are not attributed to operation and may be from historical tailing piles and/or the Touquoy ore body itself. A remedial action plan is currently underway by the Proponent that involves the delineation, removal, and management of these historical tailings piles around the Touquoy pit area.

Cyanide species were reported in the OPM-series wells at concentrations near the detection limits. These are attributed to historical mining activities or laboratory error as no discharges of cyanide have occurred near the open pit as the result of the Touquoy Gold Project.

The Groundwater Contingency Plan (Stantec 2019) presents contingency action levels for groundwater quality around the mine for indicators of operation-related effluent impacts to groundwater compared to the baseline water quality record. However, the monitoring record for the baseline period is relatively short, therefore, as observed for the upstream surface water quality, the natural variability of groundwater quality may not have been captured in the baseline period, and therefore the action levels defined in the groundwater contingency plan may be overly conservative for evaluating potential mine effects on groundwater quality.

Single, discontinuous groundwater quality results above action levels were identified in the 2016 baseline and 2017 operating data, however, these were not attributed to mine operations, but may be the result of natural variability not captured during the baseline period. Groundwater quality will continue to be monitored closely in 2019 to identify potential indicators of groundwater seepage from mine operations.

6.5.4 Consideration of Engagement and Engagement Results

Key issues raised during public and Mi’kmaq engagement relating to groundwater included potential effects on groundwater levels from open pit mining at the FMS Mine Site and potential groundwater quality impacts associated with Project activities especially tailings deposition into the exhausted pit at the Touquoy Mine Site.

The results of the public and Mi’kmaq engagement have been considered in the environmental effects assessment, including the Proponent’s commitments to mitigation and monitoring measures and proposed compliance and effects monitoring programs, as well as the Proponent’s broader commitment to ongoing public and Mi’kmaq engagement.

6.5.5 Effects Assessment Methodology

6.5.5.1 Boundaries

6.5.5.1.1 *Spatial Boundaries*

The study areas for the groundwater quantity and quality assessments define the spatial boundaries within which the physical works and activities of the Project could cause direct and indirect effects to groundwater quantity and/or quality, as well as potentially have cumulative effects that are compounded spatially and temporally. To evaluate the potential effects on groundwater quantity and quality, a LAA and RAA have been defined for both the FMS Mine Site and the Touquoy Mine Site.

The effects assessment for the groundwater quantity and quality includes numerical predictions of potentially changes that may occur within and immediately adjacent to the FMS Study Area and Touquoy Mine Site, therefore, the PA and LAA are considered.

At the FMS Study Area, the groundwater LAA is defined as the extent of the groundwater numerical model. The change in groundwater has the potential to influence baseflow to groundwater receptors such as wetlands, streams and rivers therefore the groundwater model boundaries were chosen in consultation with the surface water discipline to align to the groundwater model boundaries with the surface water assessment watersheds. The groundwater model boundaries encompass the area within which changes in groundwater quality and /or quantity may occur due to construction, operation and closure.

The LAA and RAA extent is shown on Figure 6.5-9. The extent of the LAA is approximately 3 km which is larger than the 800-setback radius from blasting as required by Nova Scotia.

At the Touquoy Mine Site, the groundwater LAA is defined as the extent of the groundwater numerical model, which corresponds to sub-watershed boundaries for Moose River and Scraggy Lake. The change in groundwater has the potential to influence baseflow to groundwater receptors such as wetlands, streams and rivers therefore the groundwater model boundaries were chosen in consultation with the surface water discipline to align to the groundwater model boundaries with the surface water assessment watersheds. The tertiary watershed boundary encompasses the extent of the groundwater model in which changes in groundwater quality and /or quantity may occur due to operation and closure, and include a buffer in which no changes to the groundwater flow regime or groundwater/surface water interactions are expected as a result of the mine development. The extent of the LAA is shown on Figure 6.5-9.

The RAA for groundwater quality and quantity encompasses the secondary watersheds intersecting the two components of the PA (Fish River and East River Sheet Harbour secondary watersheds) Figure 6.5-9.

The predicted impacts to groundwater quantity and quality are not anticipated to extend beyond the LAA boundaries for both FMS Mine Site and the Touquoy Mine Site, therefore evaluation of Project effects on groundwater will occur at the LAA level.

6.5.5.1.2 *Temporal Boundaries*

The temporal boundaries used for the assessment of effects to groundwater quality and quantity are the construction, operations, and closure phases. The closure phase consists of two stages: reclamation (2-4 years) and post-closure (5+ years). Reclamation is the period when the Reclamation and Closure Plan, which will be developed to support the EMS Framework Document (Appendix L.1) is being implemented, or the construction of the closure works. The post-closure stage is the period after the closure works have been implemented and largely consists of care and maintenance. These temporal boundaries were considered as follows:

- **Construction phase:** This phase will consist of building the site infrastructure and associated facilities prior to the initiation of mining and ore beneficiation. As such, the site infrastructure and facilities will be in the process of being developed and only construction water will need to be managed on site. Changes in groundwater levels that may occur during the construction phase will be associated with development of infrastructure. These changes, if any, will be minor and bounded by changes expected during operations. As such, groundwater numerical predictions using groundwater quantity and quality modelling were not completed for the construction phase. Rather, the potential effects to water quantity and quality during the construction phase is evaluated in qualitative manner. For groundwater impacts this was not modelled instead operations phase used as worst-case scenario.

- **Operations phase:** This phase will be initiated upon the start of ore extraction and processing and will cease once the economical ore reserves have been depleted and the mining processes have ceased. During the operations phase, the potential effects on groundwater quantity and quality are expected to be greatest at the end of mining when the open pit, TMF, and WRSA are fully developed and have reached their ultimate extents. Predictions of changes in groundwater levels associated with dewatering of the full extent of the open pit through operations were developed using the calibrated flow model as described in Appendix B.2. This model was first calibrated to the observed existing conditions and then modified to incorporate the fully excavated open pit FMS mine. During mine operations the groundwater table will decline with the excavation of and pumping from the open pit mine. A rise in groundwater levels may occur in the immediate vicinity of the TMF where saturated tailings and an associated pond are placed on surface. A rise in groundwater levels may also occur in the immediate vicinity of the stockpiles (WRSA, LGO, and overburden); however, for the purposes of numerical modelling, the infiltration rate over the footprint of the adjacent stockpiles was unchanged from current conditions, based on the assumption that surplus infiltration would be collected by the perimeter drain. As the FMS pit is progressively deepened the groundwater levels will continue to decline throughout the operations phase reaching a maximum at the end of mining. Conservatively, numerical predictions of potential effects on groundwater water quality and quality were completed based on fully developed Project components and facilities at the EOM life.

- **Closure phase:** This phase will consist of the reclamation and post-closure stages:

  - **Reclamation:** This stage consists of the construction of the closure works at the site, as presented in Section 2.0. The benefits that the closure strategy will have on groundwater quantity and quality will, in some cases, not have an immediate effect, and these benefits may not be realized until sometime during post-closure. As such, it is likely that groundwater quantity and quality during reclamation will not be much different than the conditions predicted at the end of the operations phase. For the purposes of the groundwater quantity and quality effects predictions, groundwater numerical modelling was not completed for reclamation; rather, the effects assessment for reclamation assumes that the predicted effects on groundwater quantity and quality during the operations phase (EOM) will continue throughout the period of the reclamation activities. Therefore, the effects assessment for reclamation is a worst case scenario as it is assumed to be at the start of reclamation before pit flooding or WRSA cover.

  - **Post-closure:** This stage consists of the period after the reclamation and closure works have been completed. Groundwater levels in the vicinity of the pit are assumed to have risen progressively along with pit water levels and approach pre-mining elevations over much of the area that experienced changes during operations. It is expected that any residual changes in groundwater levels will likely be minor and evident only in the immediate vicinity of the open pits, the TMF or the WRSA. During post-closure phase, it is assumed that the open pit is fully flooded to an elevation of 109 m (CGVD28). Numerical simulations of potential effects on groundwater water quality and quality were completed based on this fully flooded condition.

Such changes in groundwater can have an indirect effect on surface water quality and or quantity. Therefore, changes to baseflow within the surface water assessment catchments were provided to the surface water discipline for used in their effects assessment. The change in groundwater quality and quantity as it influenced the surface water model results are provided in Section 6.6 Surface Water.

6.5.5.1.3 *Technical Boundaries*

No technical boundaries were identified for the effects assessment of groundwater quality and quantity.

6.5.5.1.4 *Administrative Boundaries*

Groundwater quality will be compared to Nova Scotia Environment Pathway Specific Standards for Groundwater (NSE PSS) for groundwater discharging to surface water (0-10 m from a freshwater body). No administrative boundaries were identified for the effects assessment related to groundwater quantity.

6.5.5.2 FMS Study Area Modelling Methodology

6.5.5.2.1 *Groundwater Quantity*

Effects from the Project on groundwater quantity are evaluated based on the results of hydrogeological modelling. The hydrogeological modelling was completed for operations and post-closure to estimate:

- The rate of groundwater inflow to the open pit;
- Changes in groundwater elevations associated with the open pit, TMF, and WRSA;
- The groundwater flow pathways from the TMF and WRSA; and
- The rates of groundwater flow from the TMF and WRSA to downstream receptors.

This was accomplished by constructing a groundwater flow model based on the above outlined geologic and hydrogeologic information, and conceptual model and calibrating it to the existing conditions. It should be noted that this model uses data collected up to June 4th, 2019. As additional baseline information is obtained, the model calibration will be verified against the new data. If required, a model update will be conducted if the model does not reach an acceptable level of calibration when this new data is included. Calibration involved an iterative process where steady-state model runs were completed with adjustments to the model input parameters (within acceptable ranges) until model results provided an acceptable match to observed conditions (groundwater elevations and groundwater flow directions). After an acceptable model calibration was achieved, the calibrated model was modified to represent the FMS Mine Site under operations and post-closure conditions and transient simulations were completed to evaluate the changes in groundwater conditions associated with the Project.

FEFLOW (Finite-Element Simulation System for Subsurface Flow and Transport Processes) (Diersch, 2014) Version 7.1 (October 2017) was used to complete the simulations. Details of the conceptual model development, modelling approach, model extent and discretization, boundary conditions, hydrostratigraphy and parameterization and model calibration are reported in Appendix B.2.

The operations phase of the Project was evaluated with the model as follows:

- The EOM pit was fully extracted at the start of the simulation to a base elevation of -50 m (CGVD28); and,
- The TMF was fully developed to the final TMF pond/tailings elevation of 158 m (CGVD28) at the start of the simulation

For the operations simulation the infiltration rate over the footprint of the WRSA, and LGO and overburden stockpiles was unchanged from the calibrated conditions. It is assumed that any surplus infiltration in these areas would be collected by the perimeter drainage system, and not report to groundwater in operations.

The post-closure phase of the Project was evaluated with the model as follows:

- The pit was flooded to a natural spill elevation of 109 m ASL;
- The TMF boundaries were unchanged from operations conditions, under the assumption that the tailings may remain saturated for an extended period in post-closure; and,
- The PAG portion of the WRSA was assumed to be covered. The infiltration rate through the cover was assumed to be 15% of the total annual water surplus.

The EOM groundwater levels from the operations models were applied as the initial condition for the post closure model. The simulation was run transiently until groundwater inflow to the open pit, and groundwater seepage from the TMF reached steady state (within the first year following the completion of flooding of the open pit). The effects assessment is based on the steady-state groundwater flow conditions in post-closure.

6.5.5.2.2 *Groundwater Quality*

Based on the results of the groundwater flow model, groundwater will report to surface water features in the receiving environment (i.e., East Lake, Seloam Brook, and the open pit). Waste rock and tailings source chemistry and material properties have not yet been characterized to the extent needed to quantify changes in seepage volume or quality through post-closure. As a conservative approach, surface water quality modelling of the receiving environment applied the source-term concentrations for each facility to the groundwater seepage flow in both operations and post-closure (i.e., no attenuation in the groundwater flow pathway was applied). Residual effects from the Project on groundwater quality are also evaluated based on this conservative approach.

6.5.5.2.3 *Prediction Confidence and Uncertainty*

The groundwater flow and solute transport results presented above are based on currently available best-estimates and assumptions of the input parameters and processes affecting groundwater flow and solute transport. Uncertainty in both the groundwater flow and solute transport modelling is recognized and was evaluated through the completion of a sensitivity analysis. The sensitivity analysis included the evaluation of the effect of various model assumptions including:

- Seasonal variation in groundwater recharge;
- Bedrock specific storage;
- The presence of high hydraulic conductivity features (i.e., faults) that intersect that open pit and connect the pit to surface water features; and
- Intersection of historical mine workings during development of the open pit.

In general, effects to groundwater were not sensitive to the range of scenarios evaluated in the sensitivity analysis. Full details of the sensitivity analysis and the results are included in Appendix B.2.

6.5.5.3 Touquoy Mine Site Groundwater Modelling Methodology

A groundwater flow and solute transport model has been developed for the Touquoy Mine Site to evaluate:

- the dewatering rate from the Touquoy pit and changes in groundwater flow conditions and discharges as the initial condition for the deposition of tailings from processing the FMS ore concentrate at the Touquoy Mine Site.

- the groundwater seepage rates to the Touquoy pit as it is filled with FMS concentrate tailings (i.e., during FMS Operations at the Touquoy Mine site) until the Touquoy pit is full (i.e., end of Closure).
- the identification of areas where water in contact with the FMS concentrate tailings disposed in the Touquoy pit are discharged to the receiving environment, and the potential for surface and groundwater interactions (i.e., the Post-Closure period).

The groundwater flow model was based on site-specific and available regional data including surface water features, topography, water well records and geologic information. The scope of work completed by Stantec to develop the groundwater flow model and apply the model to evaluate potential impacts to groundwater and surface water flow regimes included the following:

- Compilation, review, and interpretation of the geologic, groundwater flow, and surface water flow data available for the Touquoy Mine Site and surrounding area.
- Development of a conceptual site model and steady-state 3D groundwater flow model of the Touquoy Mine Site and surrounding area. The groundwater flow model was calibrated under steady-state conditions and the sensitivity of the model calibration was evaluated with reference to model input parameters such as measured groundwater elevations, groundwater flow directions, and estimated baseflow.
- Application of the calibrated groundwater flow model to evaluate potential changes in groundwater quality and quantity with respect to groundwater flow and groundwater interactions with surface water at the Touquoy Mine Site under Baseline (conditions prior to the deposition of FMS concentrate tailings at the Touquoy Mine Site), end of Operations (conditions at the end of deposition of FMS concentrate tailings at the Touquoy Mine Site), and Post-Closure conditions.

The detailed methodology and results of the groundwater flow model for the Touquoy Mine Site are documented in Appendix I.4.

6.5.5.4 Thresholds for Determination of Significance

An effect on the groundwater environment is measured by a change in the groundwater quality and/or quantity due to the project activity. This is an effect that remains after mitigation is put into place (i.e., a residual effect). The significance of such an effect from the Project on groundwater is defined as a change that is likely to cause a negative effect on groundwater quality or quantity. Criteria and/or thresholds are established for determining the significance of residual groundwater effects. These criteria and/or threshold were developed through the following avenues:

- Using applicable guidelines and objectives; and
- Using professional hydrogeologic judgement.

The characterization criteria for the determination of significance of residual environmental effect are magnitude, geographic extent, timing, duration, frequency and reversibility. The significance of the impact is determined through the integration of characterization criteria. The characterization criteria as they relate specifically to groundwater quantity and quality are described below and are provided in Table 5.10-1.

6.5.5.4.1 *Groundwater Quantity*

- The criteria for determining the magnitude of residual effects of Project activities on groundwater quantity is a change in the groundwater table such that it has a negative effect on a groundwater receptor such as drinking water wells or surface water features such as streams and/or wetlands.

- The geographic extent of the residual effects on groundwater quantity considers the distance of the drawdown of the water table within which effects are likely to be measurable. The geographic extents relevant for groundwater quantity is the LAA; as described in Section 6.5.5.1 above. The effects assessment is based upon groundwater numerical modeling outlined in Section 6.5.5.2.
- The timing of residual effects of groundwater quantity considers when the residual environmental effect to the water table is expected to occur, considering seasonal aspects.
- The duration of residual effects of groundwater quantity considers when the water table is likely to revert back to baseline water levels.
- The frequency of residual effects considers the rate of recurrence of the lowering of the water table.
- The reversibility of residual effects considers the time required for the water table to recover to baseline conditions, or whether the changes to water levels are permanent and recovery to baseline conditions is not expected.

Overall, based on the above list and integration of professional hydrogeologic judgement, for the Project groundwater quantity the residual effect of the change in groundwater quantity is considered significant if the water table is not expected to return to near baseline water levels (i.e., not reversible).

6.5.5.4.2 *Groundwater Quality*

- The criteria for determining the magnitude of residual effects of Project activities on groundwater quality is a change in that quality relative to the following guidelines:
    - Although no groundwater well users were noted in the LAA, in order to be conservative, a drinking water groundwater quality guideline is used for comparison to the groundwater samples collected from the FMS monitoring wells installed within the LAA. This guideline is Health Canada. (2017) *Guidelines for Canadian Drinking Water Quality Summary Table*. This guideline is applied for groundwater that crosses property boundaries to be protective of existing or potential future off-site users downgradient of the Project.
    - Given that some of the streams and wetlands are anticipated to receive groundwater seepage, at least seasonally, the Nova Scotia Environment (2013) *Remediation Levels Protocol. Table 3, Pathway Specific Standards for Groundwater* are also used for comparison of the groundwater samples collected from the FMS monitoring wells installed within the LAA.
- The geographic extent of the residual effects on groundwater quality considers the geographic area over which these effects are likely to be measurable. The geographic extent relevant for groundwater quality is the LAA; as described in Section 6.5.5.1.1. The effects assessment is based upon solute- transport modeling outlined in Section 6.5.5.2.
- The timing of residual effects of groundwater quality considers when the residual environmental effect to water quality is expected to occur, considering seasonal aspects.
- The duration of residual effects of groundwater quality considers when the residual environmental effect to water quality is likely to revert back to baseline concentrations.
- The frequency of the residual effects considers the rate of recurrence of the effects.
- The reversibility of residual effects considers the time required for groundwater quality to recover to baseline conditions, or whether the changes to groundwater quality are permanent and recovery to baseline conditions is not expected.

For groundwater quality, the following logic was applied to determine if the residual effect of the change in groundwater quality is significant or not significant:

- If the magnitude of the effect is negligible, low or moderate, the residual effect is considered to be not significant as this groundwater will likely be reporting to a surface water body that will likely moderate the potential effect on overall water quality. It should be noted that the existing baseline condition for some parameters (arsenic, aluminum and iron) is greater than the guideline for these parameters therefore a predicted concentration greater than the guideline is not considered a significant residual effect.

Overall, if the change in groundwater quality is not reversible then that residual effect of the change in groundwater quality is considered significant.

6.5.6 Project Activities and Groundwater Interactions and Effects

6.5.6.1 FMS Study Area Groundwater Interactions

Prior to mitigation measures being put in place, the Project activities that have the potential to interact with groundwater during all phases of the Project are summarized in Table 6.5-8.

Table 6.5-8: Potential Groundwater Interactions with Project Activities at FMS Mine Site

Project Phase	Duration	Relevant Project Activity
Site Preparation and Construction Phase	1 year	• Clearing and grubbing of vegetation • Drilling and rock blasting • Topsoil, till and waste rock management • Watercourse and wetland alteration • Seloam Brook Realignment construction and dewatering • Mine site road construction, including lighting • Surface infrastructure installation and construction, including lighting • Collection ditch and water management pond construction, including lighting • Local traffic bypass road construction • Environmental monitoring
Operations Phase	7 years	• Drilling and rock blasting • Open pit dewatering • Ore management • Waste rock management • Tailings management • Surface water management • Petroleum products management • Environmental monitoring

Project Phase	Duration	Relevant Project Activity
Closure Phase: Reclamation Stage	2-3 years	• Water treatment and management • Site reclamation • Environmental monitoring
Closure Phase: Post-closure	3+ years	• Water treatment and management

These interactions are based upon a potential change in groundwater quantity and quality from baseline conditions as outlined below.

Quantity changes may be caused by:

- **Hardening of surfaces therefore reducing recharge:** during earth works such as construction of access roads, buildings and stockpiles. These activities will lead to hardening of surfaces through compaction of subsurface soils. This will reduce the area in the LAA that is available for groundwater recharge and cause a temporary lowering of the groundwater table relative to the baseline water levels (while taking seasonal fluctuations into account).
- **Increased recharge thereby potentially increasing groundwater table levels:** Vegetation clearing will take place for construction. Mechanical clearing of vegetation may temporarily increase recharge to shallow groundwater tables in higher permeability areas, thereby potentially causing a slight increase in local groundwater levels. This rise in water table will eventually re-equilibrate to the baseline water level as the increase in recharge area is limited (less than 7% of the LAA). A negligible effect on groundwater quantity is anticipated due to vegetation clearing, and no effect on maintenance of existing groundwater quantity (including recharge and flow) is expected.
- **Open pit dewatering** will cause a lowering of the groundwater table and therefore reducing groundwater contribution to water wells and surface water resources (such as wetlands and streams) that are within the modelled potential groundwater radius of influence.
- **Blasting** of the open pit bedrock may increase the fracture frequency around the blast hole.

Quality changes may be caused by:

- **Incomplete combustion of blast materials:** Use of explosives during construction and pre-production has the potential to affect groundwater quality. Specifically, ammonium nitrate type explosives to remove bedrock have the potential to leave nitrogen residual substances (e.g., nitrogen) that can leach into groundwater. This residual is often due to incomplete combustion of the explosive.
- **Existing contaminated soils:** The extent of the existing historical mine tailings in the FMS Study Area has been delineated by Stantec (Appendix I.3). The Proponent is committed to removing the historical tailings that may be disturbed as a part of site construction and operation. This tailings removal will be conducted during the construction phase. Therefore, a change in groundwater quality due to the inadvertent disturbance of existing historical mine tailings is not anticipated and therefore not assessed as a potential impact to groundwater quality.
- **Rock-water interaction:** precipitation falling onto waste rock or tailings may affect run off water quality that may infiltrate the ground and affect groundwater quality for shallow aquifers.

6.5.6.2 Touquoy Mine Site

Prior to mitigation measures being put in place, the Project activities that have the potential to interact with groundwater during the operational, and post closure phases of the Project is summarized in Table 6.5-9.

Table 6.5-9: Potential Groundwater Interactions with Project Activities at Touquoy Mine Site

Project Phase	Duration	Relevant Project Activity
Operations Phase	7 years	• Tailings management • Environmental monitoring
Closure Phase: Reclamation stage	2-3 years	• Environmental monitoring • Water treatment and management
Closure Phase: Post-closure	3+ years	• Water treatment and management

These interactions are based upon a potential change in groundwater quantity and quality from baseline conditions as outlined below.

The processing of the FMS concentrate will result in the generation of tailings (FMS concentrate tailings) that will be deposited into the Touquoy pit. The deposition of tailings into the exhausted pit has the potential to interact with groundwater quality around the Touquoy pit, and the water quality in Moose River from groundwater seepage into the river.

The FMS concentrate will be processed at the Touquoy mill and the FMS concentrate tailings will be deposited into the exhausted pit, which will have been dewatered as part of the Touquoy Gold Project. Therefore, the dewatering of the Touquoy pit will be the initial condition for the Project. The groundwater conditions associated with the dewatered Touquoy pit were simulated with the groundwater model described in Appendix I.4. The dewatering of the Touquoy pit, prior to tailings deposition, is predicted to occur at an annual average rate of 768 m^3/d, and will result in drawdowns around the Touquoy pit, as shown on Figure 6.5-10. The extent of the anticipated zone of influence of the Touquoy pit dewatering, as delineated by the 0.5 m drawdown contour, extends approximately 600 m south of the limits of the Touquoy pit and about 50 m west of the Touquoy pit toward Moose River. This represents the maximum extent of the drawdown cone.

Camp Kidston, which operates only in the summer months, is located 3.5 km northeast of the Touquoy Mine Site. According to the Proponent, the nearest permanent full-time occupied residences are located approximately 5.8 km to the north of the Touquoy pit along Caribou Road. The next closest permanent residences to the Touquoy processing and TMF are approximately 7.4 km to the northwest and 11.7 km to the southeast. The limited extent of the predicted drawdown (i.e., to a maximum of 600 m from the Touquoy pit) is not predicted to interact with any nearby groundwater users.

Compared to the pre-development conditions, the dewatering of the Touquoy pit is anticipated to reduce the flow in Moose River by 549 m^3/d. This accounts for approximately 0.6% of the mean annual flow at Moose River, as estimated 99,360 m^3/d (1.15 m^3/s) at SW-2. In the summer months, the dewatering of the Touquoy pit at a rate of 444 m^3/d, which is anticipated to reduce the flow in Moose River by 339 m^3/d. This accounts for approximately 1.7% of the mean summer flow at Moose River of 18,938 m^3/d at SW-2.

The groundwater inflow rates to the Touquoy pit during the filling of the pit with FMS concentrate tailings and water (i.e., FMS Operation Period) were predicted with the groundwater flow model. As described in the Touquoy groundwater model report (Appendix I.4), the filling of the Touquoy pit was simulated by adding tailings to the model, and then predicting the inflow rates to the Touquoy pit lake above the tailings over time. The predicted inflow rates compared to the Touquoy pit lake stage are presented on Figure 6.5-

11. As shown, the inflow rates decrease from 768 m^3/d when the Touquoy pit stage is at an elevation of -25 m relative to the Canadian Geodetic Vertical Datum of 2013 (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 a spillway.

The drawdown at the end of pit filling (i.e., when the pit lake stage elevation is 108 m CGVD2013, representing the end of the FMS Closure Period) was simulated using the Touquoy groundwater model, and is shown on Figure 6.5-12. As presented on Figure 6.5-11, the groundwater flow to the Touquoy pit remains at 373 m^3/d because the 108 m CGVD2013 level is below the natural groundwater elevation within the footprint of the Touquoy pit. However, at this elevation, there are both groundwater inflows to and outflows from the Touquoy pit that are not observed with the fully dewatered Touquoy pit where no outflows are observed.

During the Post-Closure period, the deposition of FMS concentrate tailings in the Touquoy pit will degrade the water quality in the pit, including the pore water quality in the tailings within the Touquoy 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 Touquoy pit to Moose River. As described in Appendix I.4, 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 (Appendix I.4) for the parameters of primary concern (POPC) in the Touquoy pit to predict the concentrations and mass loadings to the receiving environment over time. The distributions of the concentrations after 50 years are shown on Figure 6.5-13, and after 500 years on Figure 6.5-14. The average concentrations of arsenic discharged to Moose River over the 500-year simulation period are shown on Figure 6.5-15. As shown on Figure 6.5-15, the average concentrations in the discharge to the river stabilize after about 150 years. Off-site migration of the plume south of Moose River is shown on Figures 6.5-13 and 6.5-14. However, the concentration of all parameters at the property line after 500 years of travel are predicted to be less than the CDWG, as shown in Table 6.5-10.

Table 6.5-10: Potential Groundwater Interactions with Project Activities at Touquoy Mine Site

Parameter	**Source Term Concentration (mg/L)**	**Simulated Concentration at South-western Property Line (mg/L)**	**Canadian Drinking Water Quality Guideline (mg/L)**
Sulphate	897	0.018	500
Aluminum	0.0469	9×10^{-7}	0.1
Silver	0.00001	2×10^{-10}	-
Arsenic	3.07	6×10^{-4}	0.01
Calcium	86.9	0.002	-
Cadmium	0.00002	4×10^{-10}	0.005
Cobalt	0.0262	5×10^{-7}	-

Parameter	Source Term Concentration (mg/L)	Simulated Concentration at South-western Property Line (mg/L)	Canadian Drinking Water Quality Guideline (mg/L)
Chromium	0.0002	4×10^{-9}	0.05
Copper	0.00937	2×10^{-7}	2
Iron	0.0326	6×10^{-7}	0.3
Mercury	0.000005	1×10^{-10}	0.001
Magnesium	14.8	0.0003	-
Manganese	0.37	7×10^{-6}	0.12
Molybdenum	0.0603	1×10^{-6}	-
Nickel	0.00685	1×10^{-7}	-
Lead	0.0000248	5×10^{-10}	0.005
Tin	0.00604	1×10^{-7}	-
Selenium	0.000193	4×10^{-9}	0.05
Tellurium	0.0000154	3×10^{-10}	-
Uranium	0.00203	4×10^{-8}	0.02
Zinc	0.0096	2×10^{-7}	5
Weak Acid Dissociable Cyanide	0.005	1×10^{-7}	0.2
Total Cyanide	0.087	2×10^{-6}	0.2
Nitrate (as N)	0.053	1×10^{-6}	10
Nitrite (as N)	0.11	2×10^{-6}	1

Parameter	Source Term Concentration (mg/L)	Simulated Concentration at South-western Property Line (mg/L)	Canadian Drinking Water Quality Guideline (mg/L)
Ammonia (as N)	34	0.0007	-

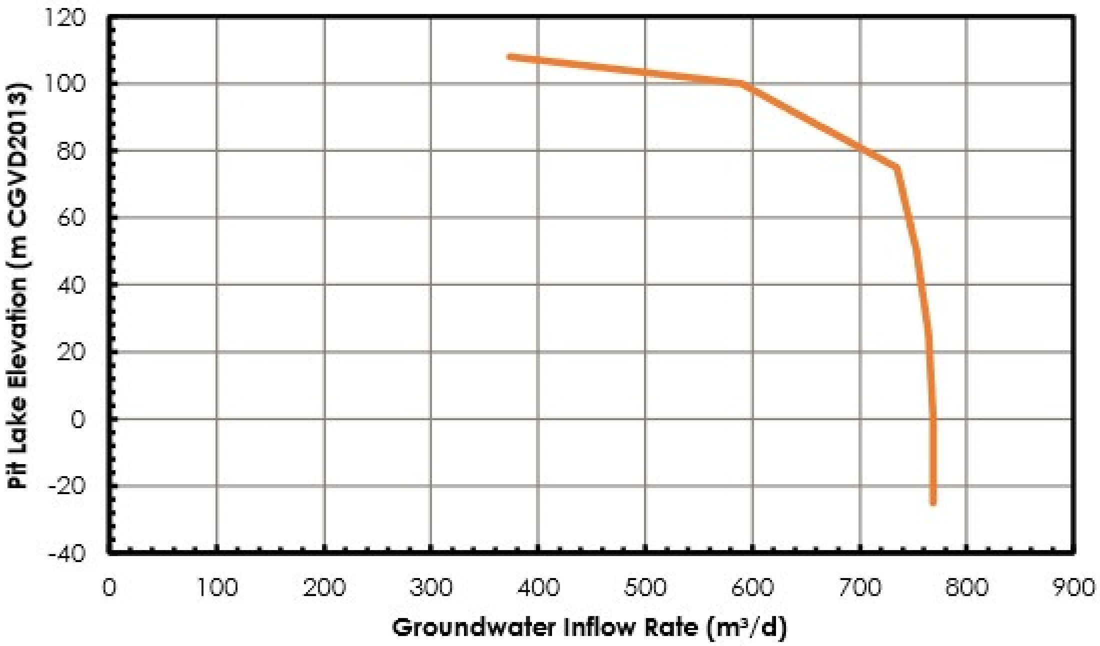


Figure 6.5-11: Groundwater Inflow Rates to the Touquoy Pit During the Filling of the Touquoy Pit (Prepared by Stantec 2021)

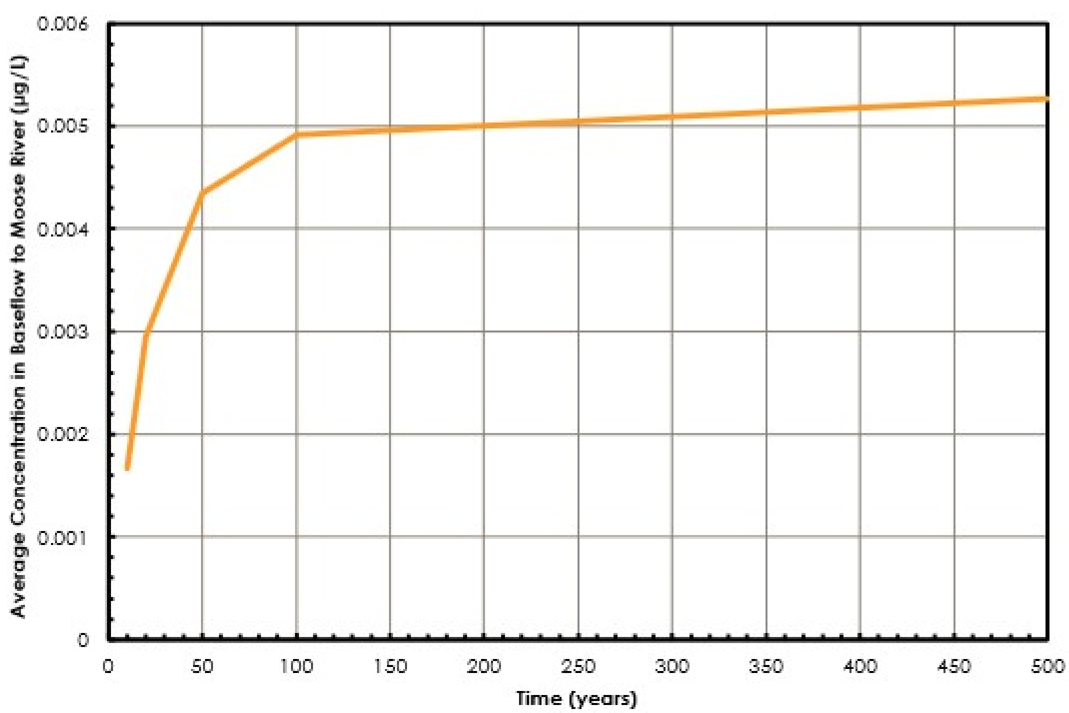


Figure 6.5-15: Simulated Average Concentrations of Arsenic Discharged to Moose River in Groundwater Seepage (Prepared by Stantec 2021)

A sensitivity analysis of the assumed porosity of the bedrock (Appendix I.4) was shown to affect the timing of the solute to arrive at the river, but did not alter the maximum concentration or underlying groundwater flow rates to the stream.

Section 6.6 provides a discussion and effects assessment of the modelled POPC in surface water originating from groundwater seepage. This groundwater seepage into the Moose River is an input into the surface water quality modelling and analysis of the assimilative capacity of the Moose River.

6.5.6.3 Touquoy Mine Site Summary

- Water levels in the vicinity of the Touquoy pit will be depressed at the beginning of FMS operations as the Touquoy pit is forecast to be dewatered at a rate of approximately 768 m^3/d at end of mining.
- Water levels in the vicinity of the Touquoy pit will recover slightly at the end of FMS operations, but will continue to be depressed relative to baseline conditions as the final water level in the Touquoy pit will be at 108 m CGVD2013. At this stage, there will be both groundwater inflows to and outflows from the filled Touquoy pit, with a net groundwater discharge of 373 m^3/d.
- Groundwater in the filled Touquoy pit will seep to Moose River during Post Closure. 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. These concentrations are considered and evaluated through surface water modelling in Section 6.6.

6.5.7 Mitigation

6.5.7.1 Groundwater Quantity

6.5.7.1.1 *Mitigation*

The groundwater quantity effects assessment was completed taking into account several mitigation measures that will be included in the design of the Project, specifically:

- During operations and closure at the FMS Mine Site, the TMF water management includes a toe drain or equivalent, which collects seepage and gravity drains to seepage collection ponds.
- During operations and closure at the FMS Mine Site, water management system collects stockpile and WRSA runoff and infiltrated water that exceeds baseline concentrations via a perimeter ditch system.
- During operations at the FMS Mine Site, the open pit water is collected via sumps and is directed to the TMF.
- During operations at the FMS Mine Site, the groundwater flow from bedrock -overburden contact up-gradient of the pit is managed via a cut off trench located below top of rock. This groundwater flow from bedrock-overburden contact gets directed to the TMF with the pit water.
- During closure at the FMS Mine Site, a cover system over the PAG portion of the WRSA will be implemented to reduce infiltration thereby reducing groundwater seepage quantity.
- During closure at the FMS Mine Site, the size of the TMF pond will be minimized which reduces the seepage through the tailings.
- No specific mitigation is required at the Touquoy Mine Site to support the Project relating to groundwater quantity.

6.5.7.2 Groundwater Quality

6.5.7.2.1 *Mitigation*

The groundwater quality effects assessment was completed taking into account several mitigation measures that will be included in the design of the Project, specifically:

- During closure at the FMS Mine Site, a cover system will be implemented over the PAG portion of the WRSA to reduce infiltration and oxidation thereby reducing acid generation potential.
- During closure at the FMS Mine Site, the size of the TMF pond will be minimized which in turn minimizes tailings water interaction.
- No specific mitigation is required at the Touquoy Mine Site to support the Project relating to groundwater quality.

The actions provided in Table 6.5-11 will be implemented by the Proponent where potential direct and indirect impacts to groundwater quality and quantity are possible.

Table 6.5-11: Mitigation for Groundwater

Project Phase	Mitigation Measure
C. O, CL	Implement a Surface Water and Groundwater Management and Contingency Plan, which is included in the EMS Framework Document (Appendix L.1)
C, O, CL	Construct the TMF water management to include a toe drain or equivalent, which collects seepage and gravity drains to seepage collection ponds
C, O, CL	Construct a water management system to collect stockpile and WRSA runoff and infiltrated water that exceeds baseline concentrations via a perimeter ditch system.
O	Collect open pit water via sumps and direct to the TMF
O	Manage groundwater flow from bedrock -overburden contact via a cut off trench up-gradient of the pit located below top of rock. Direct this groundwater flow from bedrock-overburden contact to the TMF with the pit water
CL	Implement a cover system over the PAG portion of the WRSA to reduce infiltration and thereby by reducing groundwater seepage quantity, also reducing oxygen thereby reducing acid generation potential
CL	Minimize the size of the TMF pond to reduce seepage through the tailings and minimizing tailings water interaction

Note: C= Construction Phase O= Operations Phase CL = Closure Phase

6.5.8 Groundwater Effects FMS Mine Site (Post-Mitigation Modelling Results)

For the FMS Mine Site, the predicted impacts on groundwater quantity and quality within the groundwater LAA as predicted by the numerical model are outlined below, once mitigation measures described above were included in the modelling efforts. Following the implementation of mitigation, if impacts to groundwater quality and or quantity remained as described below, then these were further addressed in Section 6.5.9. No additional summary is provided for the Touquoy Mine Site, as modelling results were provided in Section 6.5.6.3 and no mitigation measures were applied to the modelling efforts.

For the purpose of the effects assessment at the FMS Mine Site, it is assumed that operation phase represents EOM with the open pit fully dewatered. The closure phase represents the open pit in a fully flooded state, a cover system installed over the WRSA, the TMF reclaimed and with any ponded water pumped to the open pit.

The main findings of the operations and post-closure simulations at the FMS Mine Site are discussed in detail in Appendix B.2 and summarized below:

<u>During operations:</u>

- Groundwater inflow to the open pit was 655 m^3/day at steady state. This steady-state inflow was reached after approximately 1 year.
- The steady-state extent of drawdown due to dewatering of the open pit (based on the 1 m drawdown contour) extended a maximum of 830 m from the open pit. Increases in groundwater elevations associated with the TMF extended to a maximum of 100 m from the centerline of the berm, and 240 m to the south of the pond (in the area where the berm terminates) at steady state. Figure 6.5-16 shows the change in groundwater elevations associated with the TMF and open pit in operations.
- The rate of groundwater seepage from the TMF was 6 m^3/day to the East Lake Catchment and 75 m^3/day to the catchment to the north of the TMF. Figure 6.5-16 illustrates the particle tracking results delineating these seepage pathways.
- Both the operational drawdown due to dewatering and the groundwater seepage are further evaluated in the Surface Water Section 6.6 and associated biophysical sections (fish and fish habitat and wetlands).

<u>During post-closure:</u>

- Groundwater inflow to the open pit was 270 m^3/day at steady state.
- The steady-state extent of residual drawdown due to the flooded pit lake (based on the 1 m drawdown contour) extended a maximum of 140 m from the open pit. Increases in groundwater elevations associated with the TMF extended to a maximum of 100 m from the centerline of the berm, and 240 m to the south of the pond (in the area where the berm terminates) at steady state (consistent with the operations phase simulation). A slight increase in groundwater elevations occurred within the footprint of the WRSA representing the long-term potential for slight mounding of groundwater within the WRSA. Figure 6.5-17 shows the change in groundwater elevations associated with the TMF, WRSA and open pit in post-closure.
- The rate of groundwater seepage from the TMF was 6 m^3/day to the East Lake Catchment and 75 m^3/day to the catchment to the north of the TMF. These results reflect an assumption that the tailings will remain at or near saturation in the long term. This assumption may be refined through ongoing design. The rate of groundwater seepage from the WRSA to the flooded open pit was 175 m^3/day (of which 90 m^3/day originates from the PAG portion of the WRSA). Figure 6.5-17 illustrates the particle tracking results delineating these seepage pathways.
- Both the post-closure drawdown due to dewatering and the groundwater seepage are further evaluated in the Surface Water Section 6.6.

6.5.8.1 Groundwater Quantity

6.5.8.1.1 *Construction Phase*

The construction phase will consist of the development of site facilities and infrastructure in preparation of the start of open pit mining. Some Project components, such as the TMF, will not be in operation, while other components, such as the WRSA, will be in the early stages of development. The diversion berm will be constructed to facilitate the removal of direct watershed inflows to the open pit footprint and to complete the Seloam Brook Realignment. The effect of these activities on groundwater recharge and therefore the groundwater levels is anticipated to be minimal; therefore, there are no expected changes to groundwater magnitude, duration or reversibility that are in excess of those analyzed during the operations phase analysis.

6.5.8.1.2 *Operations Phase*

Changes in groundwater levels and groundwater quality can occur during the operations phase as a result of the activities on the FMS site, such as blasting, pit dewatering, construction of stockpiles, and operation of the TMF. The changes to baseflow and groundwater seepage rates from the hydrogeology assessment are used in development of the site surface water quantity and quality estimates (see Section 6.6).

A numerical model (FEFLOW) was used to predict groundwater flow seepage rates into the open pit. The results of this modelling are presented in Appendix B.2. Model results estimate a steady state groundwater seepage rate into the fully mined FMS pit of 655 m^3/day. These values influence the site water model, overall site discharge and overall site water quality. Drainage of rock exposed at the pit perimeter will release a significant volume of water (described as storage), during early mining primarily because of the higher volume of water stored in the upper fractured rock relative to the less fractured rock at greater depth. Groundwater inflows of greater than 655 m^3/d could be experienced during early mining. As excavation progresses below the upper fractured zone, the amount of water draining from the pit perimeter will decrease as the amount of fracturing decreases. Thus, groundwater inflows from storage will decrease with the progressive excavation of the open pit.

The steady-state extent of drawdown due to dewatering of the open pit (based on the 1 m drawdown contour) extended a maximum of 830 m from the open pit. Increases in groundwater elevations associated with the TMF extended to a maximum of 100 m from the centerline of the berm, and 240 m to the south of the pond (in the area where the berm terminates) at steady state. Figure 6.5-16 shows the change in groundwater elevations associated with the TMF and open pit during operations. If unmitigated, a portion of the seepage losses from the TMF, WRSA, and other stockpiles will discharge to surface. During operations there is a water management system in place to collect seepage from the site facilities including the WRSA and the TMF. The rate of groundwater seepage from the TMF that may bypass this seepage collection system was predicted to be 6 m^3/day in the direction of the East Lake Catchment and 75 m^3/day to the catchment to the north of the TMF. Seepage from the WRSA and other stockpiles is not expected to bypass the water management system during the operations phase, but any seepage that did bypass would report to the open pit. Figure 6.5-16 illustrates the particle tracking results from the TMF and WRSA delineating these seepage pathways over the 7-year operational period.

During construction and operation, a change in water level may affect potential groundwater receptors which have been identified as private well users, if present, and surface water features (wetlands, streams, rivers) that receive groundwater during some portion of the year.

As identified above the cone of depression during operations (as defined by the 1 m drawdown contour) extends a maximum distance of 830 m from the pit perimeter and underlies a portion of the WRSA and till stockpiles (Figure 6.5-16).

The NSE well database shows that the nearest private well is 15 km northward and southward, and field surveys have identified the nearest seasonal dwelling with a potable well (dug) (Structure ID #3) 8.7km south of the FMS Study Area, while the predicted groundwater radius of influence (ROI) is only 830 m from the edge of the FMS pit. Therefore, no effect on groundwater users is anticipated. There are no confirmed Mi'kmaq uses of groundwater within or directly surrounding the FMS Study Area. Refer to Section 6.13 for additional evaluation of the Mi'kmaq of Nova Scotia.

Within the area of the cone of depression, groundwater levels have been predicted to be lowered by pit dewatering resulting in a potential reduction in some local streams and /or brooks and wetlands. The majority of streams and wetlands in close proximity to the open pit will be lost (wetlands) or diverted (streams) to accommodate pit development and re-routed into the Seloam Brook realignment channel. Additional streams that will remain during the operational phase are perennial in nature. Some wetland habitat will remain within the cone of depression during operations. Further discussion of the effect of drawdown on these streams and wetlands is contained in Section 6.6 and Section 6.7 respectively.

Drilling and blasting of holes in bedrock may create and extend fractures in the bedrock around each blast hole. The permeability of the rock may increase if new open discontinuities are formed in the rock, existing discontinuities are extended or dilated, and these link to provide new flow paths from a water source. It is anticipated that there will be a negligible effect on the permeability of the rock mass surrounding the blast. Using ANFO, the increased permeability in the bedrock around the blast hole may extend to within 10m for a well-executed blast. Overall, blasting may result in a permanent effect to groundwater quantity within less than 10 m of a blast hole which may locally increase the permeability. Therefore, there is a net effect on the maintenance of existing groundwater quantity that is low in magnitude and is irreversible given that the water level in the less than 10 m radius will likely be permanently changed within the Project footprint. This effect is further characterized in Section 6.5.9.

Groundwater inflows to the pit will be managed utilizing in-pit sumps. The berm will be keyed into the bedrock to prevent shallow groundwater flow and/or surface water from entering the surface mine. An in-pit water diversion ditch will be established along the top bench of the pit to intercept any surface water that infiltrates the berm and flows into the pit. This ditch will direct water to in-pit sumps where it will be pumped out of the pit. Sub-horizontal drain holes will likely be established in the pit walls as they are exposed. On the active bench floor, the water that is collected from these drain holes will be directed to a sump where it can be pumped from the pit. Ditches will be constructed into pit benches to collect the water and direct it to a sump in an area where the bench is sufficiently wide. The water from subsequent sumps will be drained to the next bench below and collected into another sump. Generally, there will be a sump on the active pit floor. Drainage from the berms above will be down the pit ramp towards the sump. Existing shallow vertical boreholes will be monitored for groundwater levels and if required additional vertical boreholes can be drilled at the pit crest and progressively on some benches as the mine is developed; piezometers will be installed to monitor groundwater levels as needed.

All water entering the pit will be handled by pumps installed in each active pit bottom as part of the flexible and moveable bench scale pumping system. The mine sump pumps will be connected to semi-permanent and permanent HDPE piping systems to convey water directly from the open pit into the ore stockpile collection pond, prior to being pumped to the TMF pond.

The in-pit sumps will be installed with each box cut as the benching is advanced.

6.5.8.1.3 *Closure Phase*

6.5.8.1.3.1 Reclamation

The reclamation period of the closure phase will consist of the implementation of the closure concept presented in Section 2.0. That is, the reclamation period is the commencement of closure planning and site reclamation activities.

For the purposes of the groundwater quantity effects predictions, the numerical model results for the operations phase (EOM) are considered to be also applicable to the reclamation phase of closure. Using the EOM operations model as a surrogate for completing the numerical modelling of the reclamation period is a reasonable approach because of the following:

- The operations model simulates the EOM with the site facilities at the ultimate extent (fully developed conditions) therefore, site conditions will be similar to the last year of operations with the exception of additional ground disturbance due to the closure works.
- closure effects will be less than the EOM effects as at closure the open pit will be allowed to flood over the reclamation stage. The effects of end of mine life which has the pit fully dewatering is outlined above as worst-case scenario of closure effects.

It is anticipated that as the WRSA is recontoured and mine site infrastructure covered with soil, sloped and hydroseeded and the pit is filling the groundwater table will continue to recover to near the baseline levels observed in 2017 through 2019 during baseline monitoring.

Streams and wetlands adjacent to the pit will again receive base flow at least on a seasonal basis. Although the water table is expected to recover into the future, some of the groundwater dependent features such as wetlands, streams and rivers within the ROI may not fully recover to pre-mining conditions during reclamation. These effects are discussed in the Surface Water and Wetlands sections 6.6 and 6.7 respectively of this EIS.

6.5.8.1.3.2 Post-Closure Effects Assessment

Post-closure activities are defined as a fully flooded pit with the water from the TMF pond and the WRSA being pumped or fed into the open pit. During post-closure, the WRSA will be covered.

Post-closure model results show that beyond 140 m of the pit wall, the groundwater table is anticipated to recover to within 1 m of baseline water level which is expected to be within seasonal variation. However, within 140 m of the pit wall, the water table is not anticipated to recover to baseline water level as the pit will only flood to 109 m (CGVD28) which is the lowest point of the pit wall. Flooding to 109 m (CGVD28) means that the water recovery for at least 85% of the pit perimeter will be up to 5 m lower than baseline water table level. This lower water table may have an effect on groundwater receivers such as streams, rivers and wetlands which are assessed in Sections 6.6 and 6.7. It is noted that the model also showed a small rise in groundwater table within WRSA footprint in post-closure.

During post-closure an increase in groundwater table due to placement of saturated tailings on surface during operations are anticipated to drain over a long period of time. The numerical modelling shows 85% of TMF seepage will be collected via gravity drain; however the 15% will be allowed to enter the groundwater flow system (i.e., bypass the collections system) and will discharge to East Lake southeast of the TMF and/or Watercourse 12 (tributary to Seloam Brook) north of the TMF. A water level rise of about 16 m is expected to be confined to within approximately 100 m from the centerline of the TMF berm and 240m from the southern extent of the tailings which is adjacent to berm termination. Water levels within this 100m are anticipated to be lowered from the rise of 16 m above baseline water table level during operations to a drop to near baseline groundwater level. The lowering of this water table may take more than 100 years and the groundwater level is anticipated to remain above baseline water levels. The rate of groundwater seepage from the TMF was 6 m^3/day to the East Lake Catchment and 75 m^3/day to the catchment to the north of the TMF. The rate of groundwater seepage from the WRSA to the flooded open pit was 175 m^3/day (of which 90 m^3/day originates from the PAG portion of the WRSA).

This change in water table may have an effect on groundwater receivers such as streams, rivers and wetlands which are assessed in Sections 6.6 and 6.7.

6.5.8.1.4 *Summary of groundwater quantity effects*

With the exception of blasting during operation, all anticipated changes in groundwater levels and flow due to the Project during operation and closure are not directly affecting any groundwater receptors, therefore all indirect effects are assessed in the Surface Water and Wetland Sections 6.6 and 6.7. The effects of blasting on groundwater quantity are assessed in Section 6.5.9.

6.5.8.2 Groundwater Quality

6.5.8.2.1 *Construction Phase*

The construction phase will consist of the development of site facilities and infrastructure in preparation of the start of open pit mining. Some Project components, such as the TMF, will not be in operation, while other components, such as the WRSA, will be operational in the early stages of development. There will be limited contact water generated at the site during construction. Contact water that is generated will be treated if and as required. The Project site is not expected to be developed sufficiently to influence site groundwater quality in this phase. The effect of these activities on groundwater quality is anticipated to be minimal; therefore, there are no expected changes to in groundwater magnitude, duration or reversibility that are in excess of those analyzed during the operations phase analysis.

6.5.8.2.2 *Operation Phase*

The operation phase will consist of the development of groundwater seeping directly into the open pit and groundwater seepage from the TMF. Waste rock infiltration through the pile that reports to groundwater table directly below the pile is not anticipated to reach the groundwater table during operations and is therefore not assessed during operations.

A change in groundwater quality due to operations results in following changes in water quality that indirectly affects groundwater quality contribution to surface water and/ or wetlands:

- In the open pit, groundwater seeps directly into the open pit and also receives precipitation into the open footprint. Therefore, the groundwater receptor is the open pit sump collecting all water that reports to the pit. The concentration of this groundwater seepage is used in the surface water mixing model therefore the effect of the groundwater is assessed as a part of the Surface Water assessment (see Section 6.6).

- Groundwater seepage from TMF into East Lake to the southeast and Watercourse 12 to the north of TMF is in the surface water mixing model. Therefore, the effect of this identified groundwater seepage is assessed as a part of the Surface Water assessment (see Section 6.6).

- Use of explosives during construction, pre-production and operations has the potential to affect groundwater quality. Specifically, ammonium nitrate type explosives which had the potential to leave nitrogen residual substances that can leach into groundwater. This residual is often due to incomplete combustion of the explosive. Blasting will be conducted using ANFO when blast holes are dry. A mixed emulsion type of explosive will be used when the blast holes are wet. These nitrogen residuals may be present on the pit walls, the waste rock located in the WRSA pile and in the TMF embankments which are made from the waste rock. This groundwater will be collected and ultimately discharged to surface water. This change in surface water quality due to groundwater contribution is assessment in the Surface Water assessment in Section 6.6.

6.5.8.2.3 *Closure Phase*

6.5.8.2.3.1 Reclamation

The reclamation period of the closure phase will consist of the implementation of the closure concept presented in Section 2.0. That is, the reclamation period is the commencement of closure planning and site reclamation activities.

For the purposes of the groundwater quality effects predictions, the numerical model results for the operations phase (EOM) are considered to be also applicable to the reclamation phase of closure. Using the EOM operations model as a surrogate for completing the numerical modelling of the reclamation period is a reasonable approach because of the following:

- The operations model simulates the EOM with the site facilities at the ultimate extent (fully developed conditions) therefore, site conditions will be similar to the last year of operations with the exception of additional ground disturbance due to the closure works.
- Closure effects will be less than the EOM effects as at closure the open pit will be allowed to flood over a 5.5-year period. The effects of end of mine life which has the pit fully dewatering is outlined above as worst-case scenario of closure effects.

It is anticipated that as the PAG portion of the WRSA is covered and recontoured, and mine site infrastructure covered with soil, sloped and hydroseeded and the pit is filling, the groundwater table will continue to recover to near the baseline levels observed in 2017 through 2019 during baseline monitoring. While it is anticipated that as the pit begins to flood the groundwater levels that had been depressed due to dewatering will rise back to near static levels.

Streams and wetlands adjacent to the pit will receive base flow at least on a seasonal basis. Although the water table is expected to recover into the future, some of the groundwater dependent features such as wetlands, streams and rivers within the ROI may not recover to pre-mining conditions, therefore the groundwater quality feeding these features may also vary from baseline concentrations. These effects are modelled as part of the post closure phase modelling and discussed in the Surface Water section of this EIS (Section 6.6).

6.5.8.2.3.2 Post-Closure

During the post-closure phase, the TMF seepage collection system will remain in place. Contact water from the TMF seepage collection ponds, the TMF beach and embankments, the open pit walls and seepage from the covered WRSA will report to the flooded open pit.

A change in groundwater quality due to post-closure results in the following changes in water quality that indirectly affects groundwater quality contribution to surface water and/ or wetlands:

- Waste rock infiltration is anticipated to reach the groundwater table during post-closure with a cover as the source term is constant. This groundwater will discharge to the open pit as groundwater seepage. The concentration of this groundwater seepage is used in the surface water mixing model therefore the effect of the groundwater is assessed as a part of the surface water assessment (see Section 6.6).
- Groundwater seepage from TMF into East Lake to the southeast and Watercourse 12 north of TMF is in the surface water mixing model. Therefore, the effect of this identified groundwater seepage is assessed as a part of the Surface Water assessment (see Section 6.6).
- Use of explosives during construction, pre-production and operations has the potential to affect groundwater quality. Specifically, ammonium nitrate type explosives which has the potential to leave nitrogen residual substances that can leach

into groundwater. This residual is often due to incomplete combustion of the explosive. These nitrogen residuals may be present on the pit walls, the waste rock located in the WRSA pile and in the TMF embankments which are made from the waste rock. During post-closure this groundwater will ultimately discharge to surface water (i.e. the open pit, East Lake, and Watercourse 12). This change in surface water quality due to groundwater contribution is assessed in the Surface Water assessment in Section 6.6.

6.5.8.2.4 *Summary of groundwater quality effects*

All anticipated changes in groundwater quality due to the Project operation and closure are not directly affecting any groundwater receptors therefore all indirect effects are assessed in the Surface Water, and Wetland Sections 6.6 and 6.7. Groundwater seepage modelling results from the WRSA and the TMF shows that seepage does not travel beyond the Project proposed site property boundary. Therefore, no groundwater quality effects remain for residual effects assessment and are not further assessed in Section 6.5.9 below.

6.5.9 Residual Effects and Significance

With the exception of blasting during operation at the FMS Mine Site, all anticipated changes in groundwater quantity and quality due to the Project operation and closure are not directly affecting any groundwater receptors. Therefore all indirect effects are assessed in the surface water and wetland sections.

A summary of the characterization of the adverse net effects of the Project on groundwater quantity is provided in Table 6.5-12. Net effects were described after the implementation of effective mitigation measures, and summarized according to magnitude, geographic extent, timing, duration, frequency, and reversibility of the effect occurring following the methods described in Section 6.5.5 above.

The predicted net effect of blasting on groundwater quantity is:

- High in magnitude as the increase in permeability is greater than naturally occurring fracture frequency variation;
- The extent of this effect occurs within the FMS Study Area portion of the PA;
- The timing is adverse as the groundwater that is collected in the open pit due to this enhanced permeability is conveyed away via the water management system. This discharge will be managed in accordance with aquatic habitats and reproduction;
- The duration is permanent because, even with the use of appropriate impact management measures, blasting may create and extend fractures in the bedrock around each borehole, thereby increasing permeability and potentially increasing the connectivity of groundwater to the open pit face;
- The change in permeability is continuous; and,
- The effect on groundwater quantity is irreversible as the permeability of the rock will not reverse back to what it was before blasting occurred.

This change in groundwater quantity is not significant as the increase in permeability is limited to about 20 m from the open pit face and this increased permeability is within the modeled groundwater ROI where such effects on potential groundwater receptors such as streams and wetlands are being evaluated within the EIS.

Table 6.5-12: Residual Effects for Groundwater for FMS Study Area

Project - VC Interactions	Mitigation and Compensation Measures	Nature of Effect	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect
			Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility		
Construction/Operation FMS Study Area Groundwater Quantity Increased permeability in the bedrock around the blast holes used to create the open pit	Groundwater collected in the open pit due to this enhanced permeability is conveyed away via the water management system	A	H Using ANFO the increased permeability in the bedrock around the blast hole may extend out to less than 10m for a well-executed blast. This is high because it is greater than naturally occurring fracture frequency variation	PA	A Discharge to be managed in accordance with aquatic habitats and reproduction	P Change in permeability is permanent	C Change in permeability is continuous	IR Permeability of the rock will not reverse back to what it was before blasting occurred	Enhanced rock permeability adjacent to the open pit	Not Significant

Legend (refer to Table 5.10-1 for definitions)

Nature of Effect	Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility
A Adverse	N Negligible	PA Project Area	N/A Not Applicable	ST Short-Term	O Once	R Reversible
P Positive	L Low	LAA Local Assessment Area	A Applicable	MT Medium-Term	S Sporadic	IR Irreversible
	M Moderate	RAA Regional Assessment Area		LT Long-Term	R Regular	PR Partially Reversible
	H High			P Permanent	C Continuous	

6.5.10 Proposed Compliance and Effects Monitoring Program

As the Project moves forward, monitoring programs will gather pre-construction groundwater baseline data. Monitoring programs will continue during construction, operations, and closure phases to verify the results of the effects assessment for groundwater quantity and quality.

Since August 2018, groundwater level monitoring has been completed at least on a quarterly basis across the LAA. This baseline groundwater level monitoring program will continue during 2019 and during all Project phases. Since September 2018, groundwater quality monitoring has been completed on a quarterly basis across the FMS LAA. This baseline groundwater sampling program will include the newly drilled wells and will continue during 2019 and during all Project phases. Groundwater monitoring commenced at the Touquoy Mine Site in late 2016 and is ongoing and will continue during all Project phases.

A change in the groundwater table was predicted in the numerical model to extend out to a maximum distance of 830 m from the open pit wall. The only direct groundwater user identified are private users that are located 5 km and farther south of the FMS Mine Site. The FMS Study Area has a network of 27 monitoring wells located within the LAA. Based upon the predicted groundwater effects, the Proponent has committed to install additional monitoring wells in two areas within the FMS LAA (see Figure 6.5-18):

1. Two additional monitoring well nests will be located adjacent to the open pit to confirm the predicted groundwater radius of influence towards the south of the open pit.
2. Several additional monitoring well nests will be placed around the TMF to monitoring groundwater levels.

Groundwater monitoring will be conducted from all on-site FMS Study Area wells with water levels being collected monthly and chemistry samples collected quarterly throughout construction/pre-production and operations.

The Proponent has also committed to installing an additional groundwater well southeast of the Touquoy pit (see Figure 6.5-6). The monitoring scope and schedule currently required through the Touquoy Gold Project IA will continue to support the FMS Project, with the inclusion of this additional proposed well location.

The objectives of the groundwater monitoring programs are to:

- Verify effects predicted in the EIS;
- Confirm the continuing effectiveness of mitigation measures;
- Allow for adaptive management and identify the need for any new mitigation measures; and
- Confirm compliance with regulatory approvals and requirements.

The closure phase will be carried out at the same frequency, locations and parameters and, if the data supports this, a reduction in monitoring may occur until such time that the Proponent is released from its monitoring requirements. The details of the closure phase groundwater quantity and quality monitoring programs will be determined in consultation with regulatory agencies and will be described in the application for an IA for the FMS site operations following the EA process. High-level detail is needed in this application and would be subject to regulatory review. An EMS framework document has been developed for the Project that confirms the responsibility and system of accountability for the compliance and effects monitoring program. This EMS Framework is attached as Appendix L.1.

Proposed follow-up and monitoring programs have been reviewed with the Mi'kmaq of Nova Scotia during engagement efforts including meetings, sharing of technical documents (Draft EIS, poster boards, Summary of Mi'kmaq Effects and Proposed Mitigation Measures, Plain Language Summary). On-going engagement with the Mi'kmaq will continue through the EA process and associated permitting relating to follow-up programs and monitoring.

6.6 Surface Water Quality and Quantity

6.6.1 Rationale for Valued Component Selection

Surface water (quality and quantity) was selected as a VC for its significance to hydrological, ecological and socio-economic systems. Through hydrological and hydrogeological processes, surface water feeds into various water systems (e.g., rivers, lakes, oceans). In some areas of Nova Scotia, surface water resources can be socially and economically important to the municipal, agricultural, industrial and recreational sectors. 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 (quality and quantity) was selected as a VC for the following reasons:

- Aquatic species require surface water features for habitat;
- Terrestrial species rely on accessible water sources for their survival;
- Stormwater conveyance and geomorphology considerations;
- Hydroelectric power generation reliance on the local watersheds and surface water flow systems; and,
- Surface water (quality and quantity) was identified as being important based on feedback received during the consultation and engagement activities conducted by the Proponent.

6.6.2 Baseline Program Methodology

6.6.2.1 Project Watersheds

6.6.2.1.1 *FMS Study Area*

The FMS Study Area lies within the East/West Sheet Harbour primary watershed (1EM), and the East River Sheet Harbour secondary watershed (1EM-1). This primary watershed is bordered by the Liscomb River watershed to the east, St. Mary's River watershed to the north, the Shubenacadie and Musquodoboit watersheds to the northwest, and the Tangier watershed to the west. The secondary watershed sits within the Guysborough Quartzite Barrens and the Granite uplands, underlain by Goldenville and Halifax formation bedrock geology (NSPI 2009). The FMS Study Area lies within the 1EM-1-B tertiary watershed. Tertiary watersheds in Nova Scotia are un-named, so for the purpose of this report, this tertiary watershed will be referred to as the 1EM-1-B tertiary watershed (based on the outlet location). At the outlet of this tertiary watershed, Fifteen Mile Stream converges with Twelve Mile Stream at the northern extent of Marshall Flowage.

The topography is generally flat to rolling, with drumlins scattered throughout. Within the Quartzite Barrens, the topography is defined by bedrock outcrops in a ridge, swamp, swale pattern. Drumlins are scattered throughout the watershed. Elevation within the FMS Study Area ranges from 100-150 masl. The bedrock formation underlying much of the East River Sheet Harbour watershed makes the area susceptible to acid rain, as the till and soil are generally thin, and the bedrock formations provide limited buffering capacity. The site's surficial geology presents moderate limitations to crop use, based on stoniness, well-drained soil, erodibility and high water tables.

The FMS Study Area lies within the Liscomb Game Sanctuary, and within 250m of the Toadfish Lakes Wilderness Area (Figure 2.1-4). Figure 6.6-1 shows the location of the East River Sheet Harbour secondary watershed, the relevant Project tertiary watershed and the FMS Study Area in a regional context.

6.6.2.1.2 *Touquoy Mine Site*

The Touquoy Mine Site is in the Tangier River Primary Watershed (1EL), and the Fish River-Lake Charlotte Secondary Watershed (1EL-5). The primary watershed is bordered by the East/West River Sheet Harbour watershed to the east, and the Musquodoboit River watershed to the north and west. The majority of the Touquoy Mine Site lies within a tertiary watershed which is referred to in the Touquoy Gold Project EARD as The Moose River Drainage Basin (1EL-5-P). The topography surrounding the site can be characterized by rolling till plains, drumlin fields, extensive rock land, and numerous freshwater lakes, streams, bogs and wetlands in the headwaters and the relatively low relief, hummocky terrain. This basin ultimately drains to the south via Moose River, into Fish River and Lake Charlotte before flowing into the ocean.

The regional bedrock-controlled topography is undulating to rolling, with local landforms dominated by northeast to southwest trending glacial drumlin hills with intervening wetlands or watercourses. Forests are predominantly coniferous with red and black spruce (CRA, 2007). Local ground surface elevations at the Touquoy Mine Site range from 102 to 145 m relative to the Canadian Geodetic Vertical Datum of 2013 (CGVD2013).

The Touquoy Mine Site is approximately 10 km northwest of the Tangier Grand Lake Wilderness Area. This protected area consists of 16,000 ha of predominantly coniferous forest and has abundant lakes, wetlands, and waterways. The waterbodies within the wilderness area are contained within a separate watershed from that of the Touquoy Mine Site, which lies in the Fish River Watershed. Figure 6.6-1 shows the location of the Fish River-Lake Charlotte secondary watershed, the relevant Project tertiary watersheds and the Touquoy Mine Site in a regional context.

The Touquoy Mine Site is an active mine site that commenced operation on October 11th, 2017, subject to an Industrial Approval to operate issued by NSE (Touquoy Gold Project IA). A Class I Environmental Assessment under the *Nova Scotia Environment Act* and Environmental Assessment Regulations for the Project was approved in 2008, subject to approval conditions. Existing conditions with respect to surface water within the watershed are based on the available data collected as part of the 2007 Touquoy Gold Project EARD (CRA, 2007), 2013 LiDAR survey of topography (Leading Edge Geomatics), the Water Management Plan (Stantec, 2017b) for operation, the Reclamation Plan (Stantec 2017a) for reclamation and closure, and the surface water quality and quantity monitoring reported in the 2017 annual report (Stantec 2018a).

6.6.2.2 Watercourse and Waterbody Identification

6.6.2.2.1.1 FMS Study Area

Watercourse and waterbody delineation and descriptions were completed throughout the FMS Study Area in conjunction with wetland delineation and evaluation. This occurred between 2016-2020. The *Environment Act (*NSE) defines a watercourse as: "Any creek, brook, stream, river, lake, pond, spring, lagoon, or any other natural body of water, and includes all the water in it, and also the bed and the shore (whether there is actually any water in it or not)".

Prior to completing field evaluation, MEL reviewed all NSTDB mapped watercourses and waterbodies, provincial flow accumulation data, and depth to water table mapping to identify potential surface water features within the FMS Study Area. During the field evaluation, MEL used NSE guidance on watercourse determinations to identify provincially recognized watercourses (NSE 2015a). The following parameters were used to define watercourses:

- Presence of a mineral soil channel;
- Presence of sand, gravel and/or cobbles evident in a continuous patter over a continuous length with little to no vegetation;
- Indication that water has flowed in a path or channel for a length of time and rate sufficient to erode a channel or pathway;

- Presence of pools, riffles or rapids;
- Presence of aquatic animals, insects or fish; and,
- Presence of aquatic plants.

According the guidance provided by NSE, any surface feature which meets two of the criteria above meets the definition of a regulated provincial watercourse. Using these criteria, regulated watercourses were mapped in the field using either a Geneq SX Blue II GPS (capable of sub-1m accuracy) or a handheld GPS unit (capable of sub-5m accuracy). Watercourses were flagged using blue flagging tape, and a watercourse description form was completed for each representative reach of a watercourse. Watercourse reaches were determined based on the similarity of physical characteristics, regardless of the length of the reach.

The flow regime was described for each regulated watercourse. Flow regimes were determined based on observation of flow at the time of the assessment, but in some cases, several visits were required to make a determination of flow regime. Perennial watercourses have year-round flow, with water supplied from smaller upstream waters or groundwater. Intermittent watercourses are seasonal in nature, which flow during certain times of the year. Flow in seasonal watercourses is from upstream waters, supplemented by runoff or rainfall. Ephemeral watercourses are rain dependent streams that only flow following precipitation. Runoff from rainfall is the primary source of water in these watercourses.

Further to this initial characterization, fish habitat surveys were completed across the FMS Study Area in appropriate habitat, and a detailed fish habitat survey was completed at each identified 100 m length electrofishing site, including the identification of physical units (i.e., run, riffle, or pool), designation of substrate type, depth and width (wetted and bankfull) of the linear section of the watercourse. The presence or absence of over-head vegetative cover, undercut banks, and woody debris was also recorded since these habitat features affect the ability of the watercourse and associated wetland habitat to support fish communities.

Waterbodies observed within the FMS Study Area were described for physical characteristics including overall size, depth, littoral zone description, potential to support SAR and SOCI, shoreline characterization, and substrate. These descriptions were supported with a desktop review of the Nova Scotia Department of Fisheries and Aquaculture (NSDFA) Lake Inventory data (when available) and a review of the East River Sheet Harbour Hydro System Relicensing Report (NSPI 2009).

Following field delineation of all wetlands, provincially designated watercourses, MEL completed a GIS evaluation of open water features to differentiate between linear features and open water features. These open water features were delineated to support evaluation of Project effects to fish habitat. Wetland and watercourse delineation and assessment occurred throughout the growing season and verified where necessary during high flow, while open water determination was based on low flow. As such, this was completed using photo interpretation during low-flow periods, supported by field notes and drawings taken in the field during wetland and watercourse evaluations. Regulated watercourses were then evaluated to determine potential fish habitat. Not all regulated watercourses were considered for detailed fish habitat surveys, if connectivity to downstream fisheries resources was confirmed to not be present.

6.6.2.2.2 *Touquoy Mine Site*

Linear watercourses present within the Touquoy Mine Site were delineated and characterized by MEL in 2015 to support the provincial permitting process prior to construction of the Touquoy Gold Project. The same methods described for watercourse determination and delineation at the FMS Study Area were used at the Touquoy Mine Site.

Moose River is the largest watercourse adjacent to the Touquoy Mine Site; it flows along the western border of the open pit. An unnamed tributary to the Moose River flows south through the Touquoy Mine Site, between the pit and the tailing management area (WC4). A first order unnamed tributary to WC4 starts south of the proposed pit and flows southward. Fish River drains Square Lake to Scraggy Lake and both lakes are part of the Fish River Watershed which flows west and then south into Lake Charlotte, eventually emptying into Ship Harbour. Moose River's riparian area is a mixture of upland and wetland habitats. Streambanks are relatively stable, and the river provides habitat for snapping turtle, Atlantic salmon, brook trout, American eel, white sucker, and a variety of forage fish species.

According to the Touquoy Gold Project EARD, Scraggy Lake is a large lake (644.5 ha) with an abundance of coves and islands, and approximately 52,558 m of shoreline. The outlet of the lake is dammed, and the lake is relatively shallow with a maximum depth of 13 m. Approximately 87% of the lake is less than 6 m deep. This flooded shallow basin created by the dam has a low flushing rate of 1.8 times per year. Scraggy Lake has high water temperatures, good to fair dissolved oxygen levels, low conductivity and it is slightly acidic. It supports an assemblage of species such as Atlantic salmon, American eel, white sucker, white perch, brown bullhead, and a variety of forage fish (CRA 2007).

6.6.2.3 FMS Study Area Surface Water Quantity

Hydrological baseline data collection consisted of desktop analyses and in-field techniques; these are summarized herein and further detailed in Appendix G.11 and B.3.

6.6.2.3.1 *Regional Climate*

Knight Piésold (KP) completed a Preliminary Engineering Hydrometeorology Report (Appendix D.1) that summarized the regional climate of the FMS Study Area and recommended historical monitoring locations applicable to the Project. The ECCC climate monitoring stations summarized in Table 6.6-1 were selected as potentially representative, with a period of record of at least three years and a maximum distance of 50 km from the Project (Appendix D.1).

Table 6.6-1: Potential Representative Regional Climate Monitoring Stations

ECCC Climate Monitoring Station Name	ECCC ID	Active/ Inactive	Years of Record	Latitude and Longitude	Elevation (masl)
Collegeville	6329	Inactive	101 (1916-2016)	45.5ºN, 62.0ºW	76.2
Malay Falls	6399	Inactive	51 (1950-2000)	45.0ºN, 62.5ºW	39.6
Malay Falls	30668	Active	20 (1999-2018)	45.0ºN, 62.5ºW	39.6
Stillwater	6481	Inactive	65 (1915-1979)	45.2ºN, 62.0ºW	17.1
Stillwater Sherbrooke	6482	Inactive	38 (1967-2004)	45.1ºN, 62.0ºW	14
Upper Stewiacke	6495	Inactive	91 (1915-2005)	45.2ºN, 63.0ºW	22.9
Upper Stewiacke RCS	6466	Inactive	13 (2005-2018)	44.9ºN, 62.5ºW	9.1
Halifax Stanfield International Airport	6358	Inactive	60 (1953-2012)	44.9ºN, 63.5ºW	145.4
Halifax International Airport	71395	Active	7 (2012-2018)	44.9ºN, 63.5ºW	145.4

6.6.2.3.2 *Regional Hydrology*

The FMS Study Area is in the northeastern portion of the East River Sheet Harbour Secondary watershed, which drains in a generally southern direction from headwaters north of the Project to the Atlantic Ocean (Figure 6.6-1). The East River Sheet Harbour is the primary drainage feature in this watershed, and the Fifteen Mile Stream is a tributary of the East River Sheet Harbour (Figure 6.6-2). Fifteen Mile Stream flows along the southwestern boundary of the FMS Study Area.

A small portion of the FMS Study Area resides in the Moser River watershed, which drains to the southeast and eventually to the Atlantic Ocean via the Moser River (Figure 6.6-2). This small portion was included in the FMS Study Area during the iterative process of determining the site infrastructure layout. Under current design, no infrastructure is planned in this portion of the Moser River watershed. As such, direct and indirect impacts to the Moser River Watershed are not predicted and have not been considered in the effects assessment.

The Fifteen Mile Stream and East River Sheet Harbour form a component of the provincial hydroelectric system in NS, specifically the East River Sheet Harbour Hydro System (NSPI 2009). There are seven water control features and/or hydroelectric generating stations along this river system, and the water control structures in close proximity to the FMS Study Area are located on Seloam Reservoir (also termed Sloane Reservoir) and the Anti Dam Flowage (also termed Anti-Dam Reservoir) (Figure 6.6-3). For the purposes of this report, Seloam Reservoir and Seloam Lake are used interchangeably.

As with the climatological stations, regional hydrological monitoring stations from ECCC that were potentially representative of the Project, based on a period of record of at least 30 years and a maximum distance of 50 km from the Project, were selected and presented in Table 6.6-2 (as described in Appendix D.1).

Table 6.6-2: Regional Hydrological Stations

ECCC Hydrological Monitoring Station Name	ECCC ID	Active/Inactive	Watershed Area (km^2)	Years of Record
St. Mary's River at Stillwater	01EO001	Active	1,350	104
Musquodoboit River at Crawford Falls	01EK001	Inactive	650	82
Liscomb River at Liscomb Mills	01EN002	Inactive	389	35

MEL collected hydrological data for the Project watersheds in 2018. Five locations have been monitored for streamflow (Table 6.6-3 as shown on Figure 6.6-10). At each of these monitoring locations, a datalogging water level sensor and manual staff gauge have been installed to record changes to water level. Discharge measurements have been recorded approximately monthly beginning in 2018, using the mid-section stream current method, where stream velocity is recorded along segments of a cross section of the stream. Hydrologic data collection is on-going to support Project development.

Table 6.6-3: Project Watersheds Hydrological Monitoring Locations

Station ID	Description	Rationale
SW2	Seloam Lake (outlet)	Seloam Lake is a regulated headwater lake, upstream of the FMS Study Area, and was one of the two options to receive the discharge of treated effluent and the proposed water withdrawal location for start up and process fresh water requirements
SW5	Seloam Brook	Stream flows from Seloam Lake southwest and west through the FMS Study Area and converges with surface water flows from the majority of the FMS Study Area
SW6	Anti-Dam Flowage (outlet)	Anti-Dam Flowage is a regulated reservoir downstream of the FMS Study Area and one of the two options to receive the discharge of treated effluent

Station ID	Description	Rationale
SW14	Fifteen Mile Stream	Stream is located west of the FMS Study Area and downstream of SW-5
SW15	East Lake (outlet)	East Lake drains to a tributary east of the FMS Study Area and reports to the Anti-Dam Flowage

6.6.2.4 Touquoy Mine Site Surface Water Quantity Baseline Methodology

The Touquoy Mine Site is currently in operation and will be used for the processing of FMS concentrate and deposition of the associated tailings. As such, the baseline conditions for the Touquoy Mine Site for the Project operations will be the conditions expected near the end of the Touquoy ore processing operations.

Baseline flow in Moose River and Scraggy Lake at the end of Touquoy operations are assumed to be similar to the existing conditions prior to the development of the Touquoy Gold Project. The flow conditions in Moose River are represented by a stage-discharge curve derived based on an annual hydrometric monitoring program at stations SW-2 and SW-11. Baseline flow statistics on Moose River were generated based on a regional analysis of thirteen representative ECCC (ECCC 2018) hydrometric stations, prorated to the Moose River catchment area at SW-2. The record of daily average flow for each station was fitted to the Log Pearson Type III distribution and prorated to the site based on catchment area. The log relationship of catchment area and flow was graphically plotted to establish a relationship between the catchment area and the average spring flow (April), summer flow (June/July/August), and low flow (July).

A water balance model has been developed to simulate the quantity of runoff at the existing mine facilities under existing conditions, and for future conditions and various climate scenarios. Results of the monthly water balance model at the end of processing of Touquoy ore is used to represent the baseline conditions for the use of the Touquoy Mine Site for the Project. Details of the modelling are presented in the Touquoy Integrated Water and Tailings Management Plan included in Appendix I.6.

6.6.2.5 FMS Study Area Surface Water Quality Baseline Methodology

Surface water quality baseline data collection methods and results are summarized herein and further detailed in Appendix G.11 and B.5.

The objective of the surface water quality baseline work is to establish the surface water quality conditions within the FMS Study Area prior to development of the Project. The baseline water quality data will be used to compare the surface water quality during the different Project phases.

Surface water quality baseline monitoring was completed commencing in 2018 on a quarterly frequency at stations selected with the objective of capturing upstream, midstream, and downstream surface water quality in relation to the Project. The baseline surface water quality program comprises a total of 15 stations (see Table 6.6-4 and Figure 6.6-4). Surface water baseline water quality data collection is on-going to support Project development.

Table 6.6-4: Surface Water Quality Baseline Monitoring Stations

Station ID	Description	Rationale
SW1	Unnamed stream (WC42)	Stream flows through the FMS Study Area before it converges with Fifteen Mile Stream
SW2	Seloam Lake (outlet)	Seloam Lake is a headwater lake, upstream of the FMS Study Area

Station ID	Description	Rationale
SW3	Unnamed depression adjacent to WL43	Depression is within the FMS Study Area and the footprint of the proposed TMF
SW4	Unnamed stream (WC7)	Stream flows through the FMS Study Area and the proposed open pit footprint
SW5	Seloam Brook	Stream flows from Seloam Lake southwest and west through the FMS Study Area and converges with surface water flows from the majority of the FMS Study Area
SW6	Anti-Dam Flowage (outlet)	Anti-Dam Flowage Reservoir is downstream of the FMS Study Area and the proposed receiver of the discharge of treated effluent
SW7	Unnamed stream	Small stream converges with Fifteen Mile Stream downstream of the FMS Study Area
SW8	Fifteen Mile Stream	Reference station located to the northwest (upstream) of the FMS Study Area
SW9	Seventeen Mile Stream	Reference station located to the northwest (upstream) of the FMS Study Area
SW10	Grassy Lake	Reference station located to the northwest (upstream) of the FMS Study Area
SW12	East Lake	Small lake located in the southeast corner of the FMS Study Area and downgradient of the proposed TMF footprint
SW11	Moser Lake	Reference lake located to east of the FMS Study Area and within a separate watershed (not expected to be influenced by the Project)
SW13	Anti-Dam Flowage (profile)	Anti-Dam Flowage is downstream of the FMS Study Area and the proposed receiver of the discharge of treated effluent
SW14	Fifteen Mile Stream	Stream is located west of the FMS Study Area and downstream of SW5 and SW7
SW 16	Seloam Brook	Station located northwest of proposed site facilities.

The surface water samples were stored at cool temperatures and shipped under chain-of-custody to Maxxam Analytics, in Bedford, NS. Samples were submitted immediately after sample collection (i.e., same day) in order to meet the minimum hold times for laboratory analysis.

The baseline surface water quality results are compared to aquatic and drinking water quality guidelines as follows:

- Canadian Council of Ministers of the Environment (CCME), Canadian Environmental Quality Guidelines, Canadian Water Quality Guidelines for the Protection of Aquatic Life (CWQGs);
- Nova Scotia Environmental Quality Standards (NSEQS) for Contaminated Sites (Tier 1) for Surface Water (Fresh Water); and,
- Environment Canada Federal Environmental Quality Guideline (FEQG) for cobalt (ECCC 2017a).

The complete analyte list and comparison criteria for the surface water quality baseline are provided in Appendix B.5. In addition to guidelines, a Site-Specific Water Quality Objective (SSWQO) for arsenic of 0.03 mg/L has been developed as an aquatic risk-based comparator (Appendix C.2).

6.6.2.6 Touquoy Mine Site Surface Water Quality Baseline Methodology

The Touquoy Mine Site is currently in operation and will be used for the processing of FMS concentrate and deposition of the associated tailings. As such, the baseline conditions for the Touquoy Mine Site for the Project operations will be the conditions expected near the end of the Touquoy ore processing operations. However, the surface water quality in Moose River is not anticipated to be adversely affected by the operation of the Touquoy Mine Site. Therefore, the baseline conditions in Moose River for the Project at the Touquoy Mine Site are anticipated to be similar to the existing conditions.

Existing surface water quality monitoring locations at the Touquoy Mine Site are shown in Figure 6.6-5 and on Table 6.6-5. Surface water monitoring locations SW-1 SW-11, and SW-2 are located on Moose River. SW-1 and SW-11 are identified as "background" as they are located upstream from the Touquoy Mine Site and are not expected to be affected by the Touquoy Gold Project or the Project. Surface water quality monitoring station SW-2 is located downstream of the project on Moose River and is used to identify potential impacts from the Project by comparison to the upstream monitoring stations. Surface water quality results both in 2016 and 2017 are used to represent the baseline conditions at these monitoring locations.

Surface water quality in WC4 and Scraggy Lake are predicted to have different water quality at the end of Touquoy operations (Stantec 2016a). These predictions are used as the baseline conditions for the Project at the Touquoy Mine Site in these watercourses. Surface water locations SW-12 located at the outlet of Square Lake, and SW-23 located on WC4 are identified as "background" as they are located upstream from the Touquoy Mine Site and are not expected to be affected by the Touquoy Gold Project or the Project. Water quality predictions are made at downstream locations SW-3 on WC4, and SW-13 on Scraggy Lake.

Table 6.6-5: Surface Water Monitoring Locations at Touquoy Mine Site

Site ID	Location	Rationale	Location Description
SW1	504325E, 4981604N	Background	Moose River – adjacent to site and upstream of Moose River road culvert and Touquoy pit
SW2	504378E, 4980703N	Downstream – Near-field	Moose River – downstream of the Touquoy pit and upstream of Bridge
SW3	505587E, 4980396N	Downstream – Near-field	WC4 (unnamed tributary to Moose River) downstream of Site, east of the Tailings pond
SW11	504140E, 4982529N	Background	Moose River – upstream of the site to represent relatively un-impacted conditions upstream of the facility
SW12	506060E, 4982420N	Background	Outlet from Square Lake
SW13	507950E, 4976355N	Downstream – Far-field	Outlet from Scraggy Lake at Dam
SW14	506380E, 4980022N	Final Discharge Point	Final liquid effluent discharge point (MDMER) located at outfall from polishing pond
SW15	506397E, 4979832N	Downstream – Near-field	Outlet of unnamed tributary to Scraggy Lake, at confluence with Scraggy Lake
SW18	501475E, 4974281N	Downstream – Far-field	Fish River north of pughole and upstream of bridge
SW19	505333E, 4981589N	Downstream – Near-field	WC4 (unnamed tributary to Moose River) – upstream of the tailings pond, adjacent to the waste rock storage area

Site ID	Location	Rationale	Location Description
SW20	506931E, 4980433N	Downstream – Near-field	East of the tailing's impoundment on an unnamed tributary to Scraggy Lake
SW21	506349E, 4979823N	Downstream – Near-field	In Scraggy Lake, at outlet of polishing pond emergency spillway
SW23	505369E, 4982094N	Background	WC4 (unnamed tributary to Moose River) upstream of site to represent relatively un-impacted upstream conditions

6.6.3 Baseline Conditions

6.6.3.1 Surface Watercourse and Waterbodies

6.6.3.1.1 *FMS Study Area*

Forty-two (42) linear watercourses and their associated open water systems, two waterbodies (Anti-Dam Flowage, East Lake), and 274 wetlands were identified and evaluated within the FMS Study Area. Fish habitat potential was determined at locations where connectivity to downstream fisheries resources was possible during field identification/evaluation and collection of physical characteristics of each watercourse/wetland. The physical characteristics of each watercourse/watercourse reach described during initial identification and evaluation are provided in Table 6.6-6. An additional ten watercourses were delineated to the north of the current FMS Study Area during a previous iteration of the FMS Study Area boundary. As a result, the following watercourse numbers are not present within the current FMS Study Area: 28, 29, 31-37 and 46.

There are two waterbodies located completely or partially within the FMS Study Area. East Lake is located in the southeast corner of the FMS Study Area, and Anti-Dam Flowage is located within the southwest corner of the Study Area. Seloam Lake, although located just outside the FMS Study Area to the north, has also been included for evaluation due to its contiguity with the major surface water system within the FMS Study Area (Seloam Brook) and the proposed plan to withdraw start up water and process water during operations from this lake. In addition, an extended evaluation of East Brook (the outlet of East Lake Study) was conducted to include reaches of the watercourse that fall outside of the FMS Study Area but within the aquatic LAA, based on predicted downstream impacts from Project infrastructure. These waterbodies are described in Table 6.6-7. NSDAF bathymetry maps for Anti-Dam Flowage and Seloam Lake are provided in Appendix G.1. All watercourses, waterbodies and wetlands are shown on Figure 6.6-6 (see Figure 6.7-1 for a focus on wetlands) and a photo log is provided in Appendix G.10.

Table 6.6-6: Habitat Characteristics of Linear Watercourses in the FMS Study Area

WC	Coordinates				Length (m)	Flow[1]	Stream Order[2]	Habitat Types (%)	Substrate	Depth Range (cm)	Bankfull Width (cm)	Bank Height (cm)	Coarse Woody Debris[3]	In-stream Vegetation (% cover)	Riparian Habitat	Comments[4]
	Upstream		Downstream													
	Easting	Northing	Easting	Northing												
1.1	538096	4999018	538035	4999003	70	P	3*	Run 90 Pool 10	Large boulder, cobble	10-110	1200	170	L	5	Alder-dominated shrub swamp	B
1.2	537960	4998958	537756	4998870	250	P	3*	Flat 100	Fines, large boulder	50-150	850	60	L	5	Alder-dominated shrub swamp	C, E
1.3	537756	4998870	537516	4998798	250	P	3*	Flat 50 Riffle 30 Pool 20	Fines, pebble, rubble, small boulder, large boulder	30-100	260-420	100	M	5	Softwood upland forest; shrub swamp	A
1.4	537382	4998739	537313	4998736	100	P	3*	Flat 100	Large boulder, cobble	10-40	240	90	M	4	Mixed-wood treed swamp	B, I
1.5	537364	4998748	537310	4998750	60	P	3*	Glide 60 Pool 20 Run 10 Cascade 10	Large boulder, cobble, gravel	10-100	280	130	M	4	Mixed-wood treed swamp; shrub swamp	I
1.6	536855	4998648	536536	4998685	400	P	3*	Flat 60 Riffle 30 Pool 10	Fines, pebble, rubble, small boulder, large boulder	30-100	250-1000	30-50	L	30	Mixed-wood upland forest; low shrub fen	F
2	536570	4998340	536622	4998637	350	P	1	Flat 90 Riffle 10	Fines, gravel, rubble, small boulder	10-50	150	20	M	15	Low shrub fen	B
3	536630	4997965	536543	4998100	150	I	1	Run 90 Pool 10	Fines, small boulder	2-15	120	10	M	5	Softwood-treed swamp	D, G
4	537112	4998997	536918	4998673	400	P	3*	Flat 90 Riffle10	Fines/sand, pebble, rubble, small boulder	3-300	170-1000	20	M	10	Shrub swamp	A
5	537212	4998533	536833	4998577	400	I	1-2	Flat 80 Riffle 20	Fines, small boulder	10-50	75	20	M	60	Mixed-wood treed swamp; alder-dominated shrub swamp	E
6	537685	4998422	537481	4998624	350	I	1	Flat 90 Riffle 10	Fines, gravel, cobble	20-35	30-50	40	M	35	Mixed-wood swam; mixed-wood upland forest	B, D, I

WC	Coordinates				Length (m)	Flow[1]	Stream Order[2]	Habitat Types (%)	Substrate	Depth Range (cm)	Bankfull Width (cm)	Bank Height (cm)	Coarse Woody Debris[3]	In-stream Vegetation (% cover)	Riparian Habitat	Comments[4]
	Upstream		Downstream													
	Easting	Northing	Easting	Northing												
7	537621	4998667	537254	4998745	400	P	1-2*	Flat 50 Run 49 Riffle 1	Fines, small boulder, rubble	30-70	50-400	30	L	45	Shrub swamp (highly disturbed by historic mining activities; mixed-wood treed swamp	B, I
8	537748	4999138	537609	4998909	300	P	3*	Flat 100	Fines	50-100	400	50	L	10	Shrub swamp	F
9	537627	4998902	537552	4998817	100	P	3*	Run 100	Fines, rubble, cobble, pebble, gravel, small boulder	15-50	100	40	L	15	Shrub swamp	B
10	537641	4998897	537615	4998842	60	P	3*	Run 100	Fines, rubble, cobble, pebble, gravel, small boulder	15-50	125	40	M	5	Shrub swamp	B
11	537748	4999138	537798	4998949	175	P	3*	Flat 100	Fines, small boulder	0-100	50-400	10	L	5	Shrub swamp	F
12.1	539717	4998908	539637	4998950	150	I	1	Flat 80 Run 20	Fines, rubble	2-30	150	30	L	15	Mixed-wood forested swamp	D
12.2	539535	4999087	539341	4999131	220	I	1	Flat 80 Run 20	Cobble, fines	2-25	200	30	L	40	Mixed-wood forested swamp	D
12.3	539240	4999158	539181	4999149	100	I	1	Flat 100	Fines, large boulder	4-150	75-300	15	L	30	Softwood treed swamp; open bog	C
12.4	539347	4998993	539265	4999036	80	I	1	Flat 100	Fines, small boulder	5-50	40-150	30	M	60	Alder-dominated shrub swamp	C, D
12.5	538948	4999190	538784	4999044	120	I	1-2	Flat 100	Fines, small boulder, large boulder	10-75	10-200	20	L	85	Tall shrub fen	C
12.6	538698	4998909	538066	4999003	750	P	2	Flat 100	Fines, rubble	5-100	100-200	30	L	2	Tall shrub fen; alder-dominated shrub swamp	A
13	538188	4998999	538118	4999016	75	I	1	Flat 100	Rubble, cobble	5-30	25-300	5	L	5	Softwood treed swamp	F
14	538177	4999021	538129	4999030	50	I	1	Flat 100	Large boulder, fines	10-70	300	70	L	20	Softwood treed swamp	D, F
15	538487	4999967	538288	4999770	350	P	1	Run 100	Large boulder, small boulder, rubble	5-25	100	20	M	10	Softwood upland forest	B

WC	Coordinates				Length (m)	Flow[1]	Stream Order[2]	Habitat Types (%)	Substrate	Depth Range (cm)	Bankfull Width (cm)	Bank Height (cm)	Coarse Woody Debris[3]	In-stream Vegetation (% cover)	Riparian Habitat	Comments[4]
	Upstream		Downstream													
	Easting	Northing	Easting	Northing												
16	537108	4997756	536785	4997661	100	I	1	Flat 90 Pool 10	Fines, Rubble	10-20	30	100	H	20	Mixed-wood treed swamp	D
17	535776	4998332	535710	4998322	100	I	1	Flat 70 Glide 25 Riffle 5	Fines	2-35	35	30	L	0	Graminoid fen	H
18	536758	4997708	536613	4997559	200	I	1-2	Flat 80 Pool 20	Fines, rubble	10-20	30	20	M	30	Softwood upland forest	G
19	539146	4998004	539338	4997991	200	E	1	Flat 100	Fines, small boulder	0-15	100	30	L	0	Shrub swamp; mixed-wood upland forest	G
20.1	538369	5000021	538296	4999917	150	P	3*	Run 70 Pool 20 Riffle 10	Small boulder, large boulder, rubble	25-100	450-1300	50	L	5	Mixed-wood upland forest	F
20.2	538145	4999719	538094	4999537	250	P	3*	Flat 100	Fines, large boulder, small boulder	100-200	1000-4000	10	L	5	Mixed-wood upland forest	A
21	538094	4999537	537980	4999185	400	P	3*	Run 85 Riffle 15	Large boulder, small boulder, fines	10-100	160	100	L	10	Mixed-wood upland forest	B
22	538012	4999405	537747	4999139	450	P	3*	Run 45 Flat 30 Riffle 15 Glide 10	Fines, large boulder, small boulder	30-115	210-510	10-100	L	5	Mixed-wood upland forest; shrub swamp	B, C
23	537808	4999342	537906	4999220	150	I	3*	N/A (dry)	Large boulder, small boulder, fines	0-10	100	30	H	20	Shrub swamp	C
24.1	537751	4999369	537550	4999364	200	I	3*	Flat 80 Glide 10 Riffle 10	Large boulder, small boulder, fines, cobble	0-30	400	40	M	5	Softwood treed swamp; shrub swamp	C
24.2	537416	4999348	537390	4999283	130	I	3*	Flat 100	Fines, large boulder	40-60	400-600	50-60	L	50	Shrub swamp; softwood upland forest	C

WC	Coordinates				Length (m)	Flow[1]	Stream Order[2]	Habitat Types (%)	Substrate	Depth Range (cm)	Bankfull Width (cm)	Bank Height (cm)	Coarse Woody Debris[3]	In-stream Vegetation (% cover)	Riparian Habitat	Comments[4]
	Upstream		Downstream													
	Easting	Northing	Easting	Northing												
24.3	537390	4999283	537281	4999281	130	I	3*	Pool 30 Run 70	Large boulder, small boulder	5-35	600-1000	30-40	H	5	Shrub swamp; softwood upland forest	C
25	537679	4999402	537771	4999371	175	I	1	Flat 100	Fines, larger boulder, small boulder	0-150	800	20	L	70	Graminoid fen	D
26	536738	4997581	536514	4997552	100	I	1	Cascade 5 Pocket-water 60 Riffle 10 Pool 25	Fines, rubble, small boulder	10-30	75	20	H	15	Softwood upland forest; mixed-wood treed swamp	D
27	535911	4999131	535912	4999051	100	I	5*	N/A (dry)	Large boulder, small boulder, fines	N/A (dry)	150	50	M	0	Softwood upland forest	Overflow channel
30	540308	4997749	540334	4997813	65	P	1	Flat 100	Fines, small boulder	10-125	50	25	L	20	Shrub swamp	H
38	540644	4997972	540573	4997910	120	P	2	Flat 100	Fines	60-100	100-150	5	L	2	Low shrub fen	H
39	539406	4997786	539477	4997886	75	E	1	Flat 95 Riffle 5	Small boulder, fines	0-40	150	30	M	0	Mixed-wood treed swamp; mixed-wood upland forest	G
40	536031	4999661	536098	4999435	300	P	5*	Flat 60 Pool 20 Riffle 20	Fines/sand, small boulder, pebble	30-200	300-1000	50	L	10	Softwood upland forest; softwood-treed swamp	H
41	538324	4998222	538296	4998245	60	E	1	Run 93 Riffle 7	Fines, cobble, large boulder	2-15	45-175	25	L	0	Softwood upland forest	D, G
42.2	536905	4999711	537014	4999595	200	P	2	Flat 95 Riffle 5	Fines, small boulder, large boulder	15-80	60-200	30	M	30	Low shrub fen	H
42.3	537055	4999555	537319	4999105	650	P	2-3*	Flat 100	Fines, small boulder, large boulder	30-150	200-1400	25	L	15	Softwood upland forest; low shrub fen	A, H
42.4	537319	4999105	537171	4999041	175	P	3*	Glide 80 Riffle 10 Pocket-water 10	Large boulder, small boulder, cobble, gravel	10-75	320	100	M	40	Softwood upland forest	B
42.5	537171	4999041	536456	4999015	850	P	3*	Flat 100	Fines, small boulder, large boulder	30-100	200-350	35	L	15	Shrub swamp	A

WC	Coordinates				Length (m)	Flow[1]	Stream Order[2]	Habitat Types (%)	Substrate	Depth Range (cm)	Bankfull Width (cm)	Bank Height (cm)	Coarse Woody Debris[3]	In-stream Vegetation (% cover)	Riparian Habitat	Comments[4]
	Upstream		Downstream													
	Easting	Northing	Easting	Northing												
43.1	539715	4998110	539807	4998042	70	I	1	Flat 100	Fines	10-40	250	20	L	5	Softwood-treed swamp; shrub swamp	D
43.2	539888	4998041	540360	4998114	600	I - P	1-2	Flat 100	Fines, small boulder	0-50	30-150	10	L	30	Shrub swamp	D
44	536466	4999523	536246	4999479	200	I	1	Run 85 Pocket-water 10 Flat 5	Fines, large boulder	2-50	120	40	M	10	Softwood upland forest; shrub swamp	D, H
45	537298	4999361	537255	4999328	55	I	1	Flat 100	Large boulder, small boulder, fines	5-30	100-120	20-30	H	0	Softwood upland forest	D
47	535879	4997638	535856	4997546	115	I	1	Flat 90 Run 10	Fines, cobble, small boulder	2-10	30	20	L	30	Shrub swamp; shrub bog	H
48	535629	4997511	535648	4997531	30	E	1	N/A (dry)	Rubble, small boulder, gravel, sand	N/A (dry)	150	40	M	0	Mixed-wood upland forest	
49	541115	4998005	540941	4998043	180	P	1-2	Run 20 Pool 80	Fines, small boulder	15-60	80	20	M	40	Shrub swamp	G
50	540644	4998252	540617	4998139	60	P	1	Flat 100	Fines	5-30	70	10	L	60	Low shrub fen	G
51	540939	4998220	540933	4998036	225	I	1	Run 100	Fines, small boulder	0-10	75	30	L	40	Shrub swamp	G
East Brook (EB) 1	540774	4997462	540796	4997220	400	P	2	Flat 100	Fines, large boulder*	Up to 150*	400	40	M	0	Mixed-wood upland forest; mixed-wood treed swamp	A
EB2	540796	4997220	540834	4997087	150	P	2	Run 40 Riffle 40 Pool 15 Cascade 5	Large boulder, small boulder, cobble, gravel, sand, bedrock	20-60	300-700	Water at bankfull height during assessment	M	2	Soft-wood swamp; mixed-wood upland forest	F
EB3	540913	4996979	541220	4996897	375	P	2	Flat 50 Run 35 Riffle 10 Pool 5	Fines, large boulder, bedrock, cobble	20-80	250-800	Water at bankfull height during assessment	M	5	Mixed-wood upland forest; mixed-wood treed swamp	A, F
EB4	541197	4996843	541093	4996759	200	P	2	Flat 100	Fines, large boulder*	Up to 200*	500-1000	10	L	30	Low shrub fen	A

WC	Coordinates				Length (m)	Flow[1]	Stream Order[2]	Habitat Types (%)	Substrate	Depth Range (cm)	Bankfull Width (cm)	Bank Height (cm)	Coarse Woody Debris[3]	In-stream Vegetation (% cover)	Riparian Habitat	Comments[4]
	Upstream		Downstream													
	Easting	Northing	Easting	Northing												
EB5	541093	4996759	541124	4996712	80	P	2	Cascade 100	Large boulder, small boulder	10-70	650	100	M	0	Mixed-wood upland forest	H

[1]P: Perennial = Year-round streams. Water is supplied from smaller upstream waters or groundwater while runoff from rainfall or other precipitation is supplemental. I: Intermittent = Seasonal streams. Flow during certain times of the year, with runoff from rainfall or other precipitation supplementing flow. E: Ephemeral = Rain-dependent streams that flow only after precipitation. Runoff from rainfall is the primary source of water.
[2]Seloam Brook and its associated tributaries (*) are highly impacted by historic activities on the landscape. Stream order does not reflect conditions of typical streams of the same order based on level of disturbance.
[3]Coarse Woody Debris: H:10+ woody debris per 20 m, M: 10-5 woody debris per 20 m , L: less than 5 woody debris per 20 m.
[4]A = Beaver dam(s) present, B = Historic diversion channel and/or evidence of straightening/constructed bank, C = Boulder-bed, D = Contains sections of subterranean flow, E = Side channel(s) present, F = Braided channel, G = No surface connection to downstream fish-bearing system, H = Watercourse continues outside of the FMS Study Area, I = Expected historic tailings storage

Table 6.6-7: Waterbodies in the FMS Study Area

Waterbody	Size (ha)	Depth (m)	Shoreline Characteristics	Littoral Zone Characteristics	Substrate
Seloam Lake	306.9	Mean: 3.8 Max: 12	NSE mapped wetlands surround approximately 80% of the Seloam Lake shoreline. These wetlands are identified primarily as narrow fringe freshwater marshes. The shorelines of Seloam Lake are completely undeveloped with the exception of an NSPI dam located at the outlet which regulates the lake water levels.	The littoral zone is gently sloped, and unshaded by any forest canopy cover. Emergent vegetation is concentrated along the southern and eastern lake edge. The water in Seloam Lake is drawn down over the winter and early spring, and further over the summer after spring runoff. The reservoir is refilled over the fall.	The majority of the substrate is moderate in size (gravel, pebbles and rubble) with some areas dominated by organic matter, sands and small boulders
East Lake	6.2	Range: 1-5	Organic peatlands surround approximately 50% of the northern half of the lake (WL65). Adjacent to open water, the wetland is dominated by low, ericaceous shrubs. Mature, softwood-dominated forest surrounds the southern half of the lake. The shoreline of the lake is completely undeveloped. A beaver dam is present on the outflow tributary of East Lake.	Littoral zone is gently sloped, and unshaded by any forest canopy cover. Floating peatland extends slightly into the waterbody along the eastern edge of the lake. Emergent vegetation, primarily Leatherleaf and Sweet Gale, is restricted to areas of floating fen vegetation. Littoral zone near upland, forested habitat is abrupt and generally lacking vegetation.	Majority of the substrate is large, angular boulders, with some areas dominated by sand and organic material.
Anti-Dam Flowage	201.9	Mean: 4.5 Max: 14	The shorelines of Anti-Dam Flowage are primarily undeveloped upland habitat, with the exception of a small boat launch and an NSPI dam located at the outlet which regulates the lake water levels. Hwy 374 follows along the southwestern shoreline of Anti-Dam Flowage, but a natural forested buffer remains. Upland shorelines are generally abrupt with rocky cliffs.	The littoral zone is moderately sloped, and unshaded by any forest canopy cover. Large water fluctuations caused by the opening/closing of the NSPI Dam regularly expose large expanses of the littoral zone, especially during the summer months when the dam is generally fully opened to allow run of river flow.	The majority of the substrate is moderate in size (gravel, pebbles and rubble) with some areas dominated by organic matter, sands and small boulders.

The FMS Study Area is located between Seloam Lake to the northeast and Fifteen Mile Stream to the west. Seloam Brook connects these two waterbodies, flowing through the FMS Study Area from northeast to west/southwest. The FMS Study Area is located within the East River Sheet Harbour Watershed (1EM-1), which has been largely inaccessible to anadromous fish since the 1920s due to a series of water storage and hydroelectric dams (O'Neil et al. 1997). Dams are present along Fifteen Mile Stream including upstream of the FMS Study Area at Seloam Lake, and directly downstream of the FMS Study Area at the Anti-Dam Flowage. Further downstream, there are several dams on the East River Sheet Harbour: Marshall Falls, Malay Falls, Ruth Falls and the Barrier Dam. Downstream fish passage is provided at Ten Mile, Antidam, Marshall, Malay and Ruth Falls dams. No upstream fish passage is present within this watershed. Project infrastructure is located entirely within the 1EM-1-B tertiary watershed. Historical mining activity around Fifteen Mile Stream and Seloam Brook dates back to 1878 (Drage 2015). This, in addition to watercourse management for hydroelectricity and forestry activities, has resulted in alterations to watercourse morphology, location, and flow, resulting in broad alteration to fish habitat quality within the FMS Study Area.

Seloam Brook system commences as it flows out of Seloam Lake as WC 20, through an NSPI dam. It is joined by a small tributary (WC15) approximately 285m downstream of Seloam Lake, and then they continue to flow through Wetland 240. Downstream of Wetland 240, the watercourse continues as a series of braided channels, largely through large wetland complexes with intact riparian buffers. Within these wetland habitats, (i.e. WLs 219, 14, 240 and the upstream extent of WL2), the habitat consists of a mixture of open water, wetland habitat which is accessible to fish during high flow, and wetland habitat which provides supporting habitat for fish but is not directly accessible to fish during any time of the year. Seloam Brook has several main tributaries, including WC5-7 and 12. WC12 originates as drainage from Wetland 27, flowing west to Seloam Brook. The upstream reaches of WC12 are intermittent, and only periodically channelized, draining subsurface through boulder fields between wetland habitat. The watercourse channelizes in Wetland 20 (reach 12.5), then flows southwest below a 150 m boulder field between Wetland 20 and 18, eventually re-channelizing in Wetland 18. The watercourse is only contiguous during high flow events. Figure 6.6-6 shows the specific aquatic features of this system through the FMS Study Area.

Boulder fields (i.e., boulder-bed channels) are common throughout the Seloam Brook system. These features are associated with slow gradient streams and characterized by stable relict boulders of glacial origin, planar roughened channel surface, and braided/subsurface flows contingent on catchment area and seasonality. The bed material consists of boulders with limited fine sediments (cobbles, gravels, sand) or evidence of sediment transport and deposition, with boulder surfaces mostly covered by moss.

Continuing through Wetland 2, Seloam Brook diverges and converges into many smaller watercourses including WC 8-11, 13-14 and multiple small ditched anthropogenic channels within the area of historic mine workings. Habitat is variable within this system, ranging from wide open still waters, to watercourses with natural riffle-run-pool sequences, to straightened man-made ditches and channels which provide only passage for fish. This portion of Seloam Brook falls within the proposed Seloam Brook Realignment to allow for development of the open pit. Fish habitat quality within this area is generally low to medium quality habitat based on physical parameters, presence of historical tailings and waste rock, and water quality measurements previously described. Historic mine workings and the deposition of tailings from historic mine activities result in further degradation of fish habitat quality as described in (Sections 6.4 and 6.8).

East Lake is located within the southeastern extent of the FMS Study Area. This aquatic system drains south and outside of the FMS Study Area, eventually draining into Anti-Dam Flowage. Three tributaries within the East Lake catchment have been delineated within the FMS Study Area, comprising WC30, 38, and 43. WC30 and 38 originate outside of the FMS Study Area, draining northeast and southwest, respectively, through Wetland 65 (the shoreline riparian wetland) to East Lake. WC43 is a first-order headwater stream that commences inside the FMS Study Area and drains surface water through Wetland 65 (WL65) east to East Lake. The watercourse originates within the western extent and shrub swamp portion of the wetland complex from pockets of standing water. Here, the watercourse disperses through the wetland and underground in sections, eventually forming a channel which flows east through a main (southern) culvert under a gravel logging road. East of the road, WC43 splits and disperses through treed swamp habitat, eventually re-channelizing through bog habitat. A 30 m section of subsurface flow was documented within the watercourse and has been assessed as a seasonal barrier to fish passage during both low and average flow conditions, based on the consistent absence of surficial flow at some times of the year. Downstream of the seasonal barrier, the watercourse re-channelizes and continues to East Lake. Fish habitat quality associated with East Lake and its tributaries has been qualitatively assessed as low based on a lack of habitat complexity and water quality constraints (low pH and DO). East Brook serves as the sole outlet of East Lake and commences at the southern extent of the lake. The watercourse, which drains water south outside of the FMS Study Area within the aquatic LAA, was delineated for approximately 1.5 km. This first reach of East Brook (EBO1) is characterized as a flat, having been impounded by beaver activity. Flow is further impeded in this reach by two collapsed culverts at the gravel logging road south of the lake; East Brook had flooded the road during assessments conducted in fall 2019. East Brook continues south of the road (EBO2) through natural riffle-run sequences and then empties into an open water wetland complex, which has also been impounded by beaver activity. East Brook re-channelizes at the southeast corner of the wetland complex and continues east for approximately 375 m. Habitat within this reach (EBO3) is variable, with flats resulting from multiple beaver dams connected by riffle-run sequences. The reach eventually empties into another open water wetland complex contiguous with Grassy Lake. East Brook re-channelizes within this wetland (low shrub fen), flowing slowly west, then exits the wetland complex south. Here, the watercourse gradient increases, with channel morphology characterized by a series of cascades that last for approximately 80 m. This system is described in further detail in Section 6.8. Figure 6.6-6 shows the location of all surface water features identified within the FMS Study Area and surrounding aquatic LAA.

6.6.3.1.2 *Touquoy Mine Site*

As shown in Figure 6.6-7, the Touquoy Mine Site comprises approximately 176 ha, of which the existing Touquoy pit is approximately 40 ha. The Touquoy pit is located between Moose River on the west and WC4 on the east that each flow from north to south adjacent to the limits of the Touquoy pit. The existing pit is 70 m from Moose River channel bank at the nearest location. The catchment area of Moose River is 3,904 ha at surface water monitoring station SW-2 draining from topographical highs of 180 m to 110 m in elevation (CGVD2013) at the banks of Moose River (Figure 6.6-7). Moose River flows south approximately 2.3 km downstream of SW-2 where it joins the Fish River. WC4 has a catchment area of 136.3 ha at surface water monitoring station SW- 3 and flows south between the existing Touquoy pit and TMF to Moose River and eventually to the Fish River (Figure 6.6-7). Additional watercourse and wetlands field identified by MEL in 2015 and 2016 at the Touquoy Mine Site are identified on Figure 6.6-8.

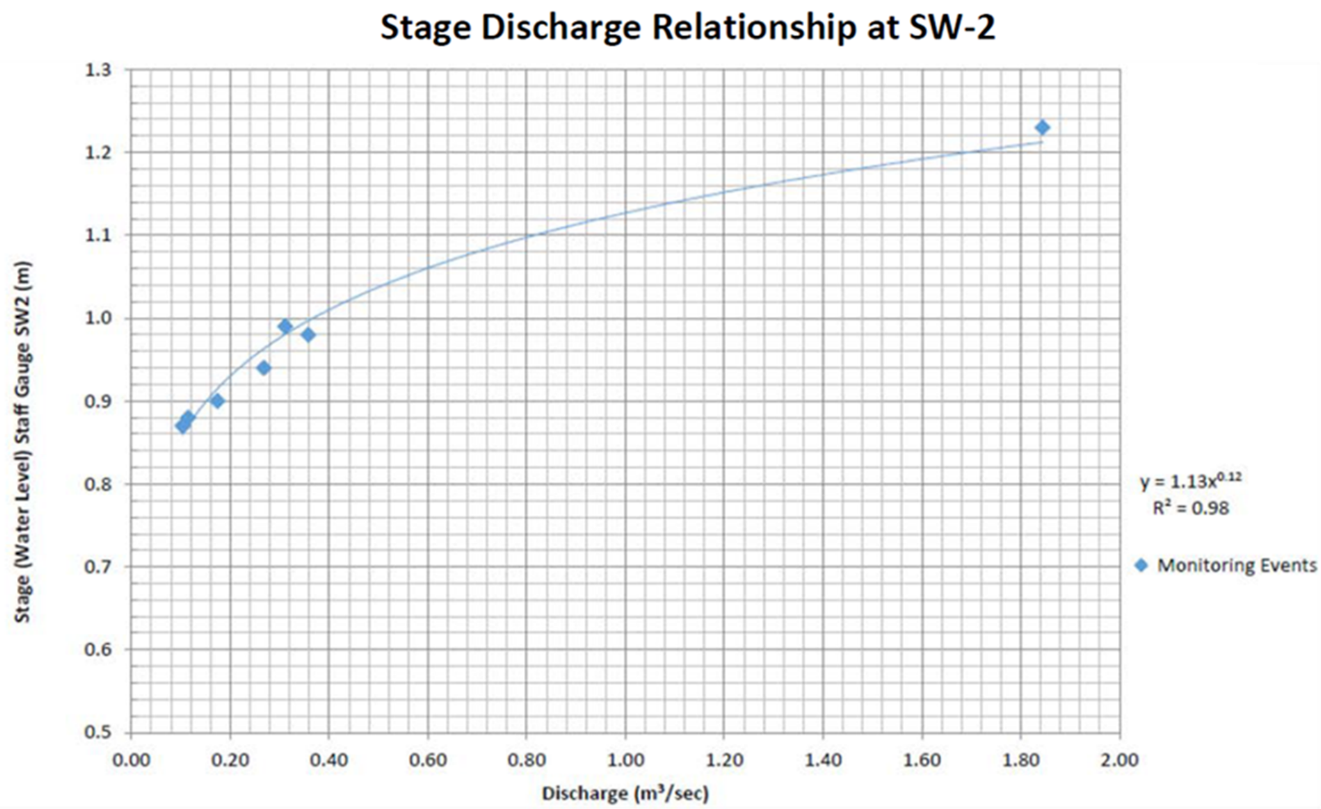
The existing Touquoy pit is actively dewatered and pumped to the TMF. Based on the groundwater flow model (Appendix I.4), the Touquoy pit acts as a groundwater sink resulting in groundwater inflows at an average rate as described in the groundwater Section 6.5 and groundwater flow model. Water in the TMF is decanted to the effluent treatment plant for treatment at an average rate of 300 m^3/hr. Effluent then drains to the polishing pond through a series of geobags, then to a constructed wetland where water infiltrates through the berm and finger drains to Scraggy Lake, the receiving water body for the Mine Site. The approved Touquoy Gold Project EARD stated that the exhausted Touquoy pit would be allowed to fill naturally with water over a period of time through the collection of direct precipitation, surface flow and groundwater inflow. No change to this method is planned for the deposition of FMS concentrate tailings associated with the Project, except that the time frame for refilling will be shorter given the decrease in available volume taken by the tailings.

The existing Touquoy Gold Project operates at an average milling rate of 6,133 tpd. The existing tailings pond is operated to manage water in the facility such that the Touquoy TMF has adequate capacity at all times to store, route, or otherwise handle runoff from extreme precipitation events. Water enters the tailings pond as process water in the tailing's slurry, direct precipitation, and runoff from surrounding un-diverted catchments. Some of the water is lost in the tailings deposit as pore water in the tailing's voids, and to evaporation and seepage. Process water is reclaimed through a floating barge and associated pipeline from the TMF to the mill for operation at an average rate of 8,431 m^3/d. Freshwater make-up of approximately 512 m^3/d is pumped from Scraggy Lake under an existing surface water withdrawal permit, which is also the receiving waterbody for the mine effluent discharge. Based on the results of the water balance model under climate normal conditions, the Touquoy TMF is decanted in the wet months of April and May at a total volume of 500,000 m^3 and finally to Scraggy Lake.

A water balance model of the Touquoy Mine Site has been prepared available to simulate the quantity of runoff at the Touquoy Mine Site under existing conditions. The water balance model development includes multiple revisions to reflect the changes to the mine site during design, construction, commissioning, and operation of the Touquoy Gold Project that have improved the accuracy of the model. Inputs to the model include groundwater inflows, surface runoff, direct precipitation, and Touquoy pit dewatering for Touquoy ore processing. Precipitation in the water balance model was based on the Environment and Climate Change Canada Middle Musquodoboit climate station (ID 8205990) and evaporation based on the Truro climate station (ID 8205990). The proportion of the precipitation that contributes to runoff collected in the Touquoy pit was estimated in the model through a runoff coefficient, with 100% of direct precipitation on the pond and 85% of precipitation as runoff on natural ground. Runoff from the WRSA captured in the collection ponds is assumed to increase from 5% to 30% of precipitation by the end of Touquoy Gold Project mine life.

Scraggy Lake is part of the Moose River drainage system. It has an area of 6.4 km^2 (Stantec 2018b) and forms two major basins which are separated by islands and peninsulas. Scraggy Lake is the freshwater make-up supply for the active Touquoy mill process. Water flows into Scraggy Lake from approximately twenty-two inlets consisting of mapped watercourses or adjacent waterbodies. Water flows out of Scraggy Lake over the Fish River Dam and into the Fish River. The Fish River drains Square Lake located north of the existing Touquoy waste rock area to Scraggy Lake. Both lakes are part of the Fish River Watershed which flows west and then south into Lake Charlotte, eventually emptying into Ship Harbour (Atlantic Ocean).

Moose River is proposed as a second point of final discharge near SW-2 under closure of the exhausted Touquoy pit once the pit has filled with water. At SW-2, Moose River is a third order watercourse with an approximately 12.5 m bankfull width as measured in the 2017 hydrometric program. The substrate was noted in the 2017 hydrometric monitoring report (Atlantis 2017) as characteristically muddy consisting predominantly of cobbles and small boulders, silt/sand with gravel. Figure 6.6-9 presents a bathymetric cross section of Moose River at SW-2 measured from west to east as part of the ongoing hydrometric monitoring program for operation of the Touquoy Mine Site. This cross section was presented to represent the physical characteristics of Moose River near the final discharge point. As part of the hydrometric monitoring program, water levels (stage) and river flows (discharge) were measured. The data was plotted, and the best fit regression was fitted to the data. Figure 6.6-9 presents the 2017 stage discharge curve at SW-2.



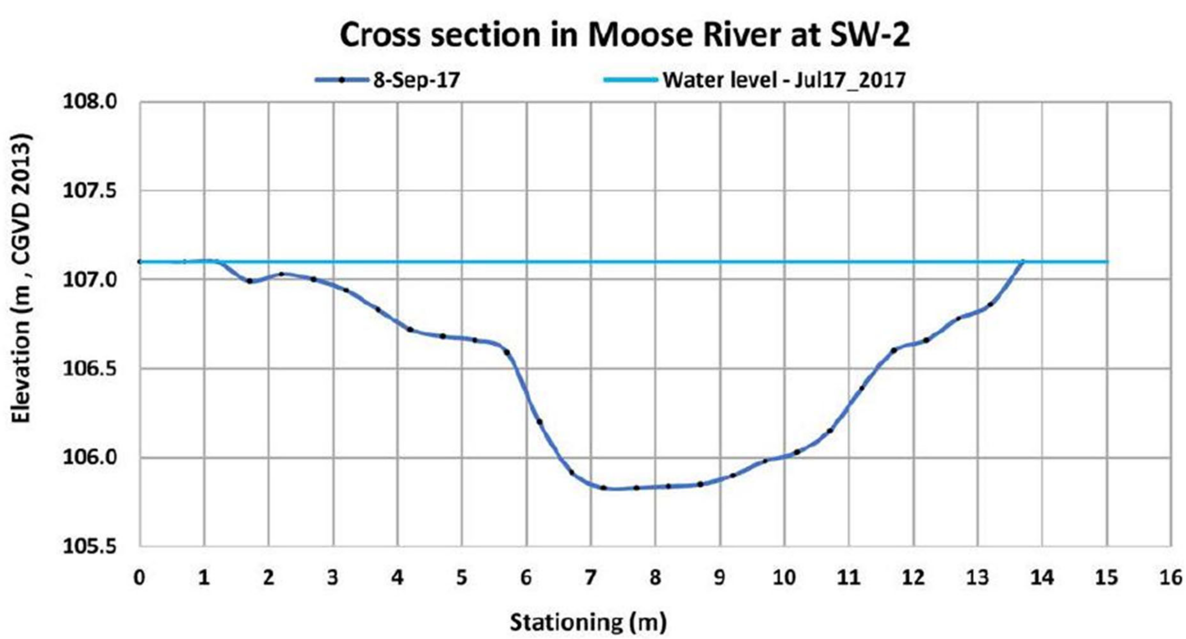


Figure 6.6-9: Moose River Hydrometric Data at Station SW-2 (Prepared by Stantec 2019)

6.6.3.2 Surface Water Quantity

6.6.3.2.1 *FMS Study Area*

6.6.3.2.1.1 Regional Climate

The Halifax International Airport climate monitoring station was selected as representative of the Project (Appendix D.1). A monthly summary of climate analysis is provided in Table 6.6-8.

Table 6.6-8: Monthly Regional Climate – Fifteen Mile Stream

Month	Average Temperature (°C)	Total Precipitation (mm)	Percent Total Precipitation as Snow	Wind Speed (m/s)	Wind Direction	Potential Evapotranspiration[1] (mm)
January	- 5.8	138	41%	4.9	NW	0
February	-5.6	118	46%	5.1	NW	0
March	-1.5	122	34%	5.1	N	0
April	3.9	113	17%	5.1	N	23
May	9.8	108	2%	4.6	S	64
June	14.9	97	0%	4.2	S	99
July	18.7	93	0%	3.9	S	126
August	18.6	99	0%	3.7	S	116
September	14.5	103	0%	4	S	78
October	8.9	134	1%	4.4	W	43
November	3.5	150	9%	4.9	NW	14
December	-2.4	164	29%	5.1	NW	0
Annual	6.5	1,440	17%	4.6	S	564

[1] Potential Evaporation as calculated by KP using the Thornthwaite Heat Index method (Thornthwaite and Mather 1957)

In general, the climate of the Project is characterized by a relatively moderate 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, and the proportion of snowfall in winter months is less than 50%, further indicating moderate climate conditions at the FMS Study Area. Potential evapotranspiration is about 40% of the total precipitation received on an average annual basis.

6.6.3.2.1.2 Wet and Dry Year Precipitation

A normal distribution curve was applied to the average annual total precipitation from Halifax Airport data to develop return periods for wet and dry conditions at the Project (Table 6.6-9) (as described in Appendix D.1).

Table 6.6-9: Wet and Dry Year Total Annual Precipitation

Wet/Dry	Return Period	Annual Total Precipitation (mm)
WET	1 : 100 year	1,912
	1 : 50 year	1,856
	1 : 20 year	1,773
	1 : 10 year	1,700
MEAN	1 : 2 year	1,440
DRY	1 : 10 year	1,180
	1 : 20 year	1,107
	1 : 50 year	1,024
	1 : 100 year	968

The total variation between these return periods is greater between the mean (1:2 year return period) and the 1:10 year return period (260 mm difference) than between other analyzed periods (e.g., between a 1:20 year and 1:50 year return). The total variation between a 100-year dry year and a 100-year wet year was estimated to be 944 mm.

6.6.3.2.1.3 Regional Hydrology

The ECCC St. Mary's River at Stillwater hydrological monitoring station was selected as the most representative regional station for hydrology at the Project, based on proximity and record length (Table 6.6-10) (Appendix D.1).

Table 6.6-10: Average Monthly Discharge

Description	Unit	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Recorded Discharge	m^3/s	50.3	40.8	56.3	88.8	54	24.2	14.7	14.8	17.7	34.6	58	60	42.9
Unit Discharge	$L/s/km^2$	37.3	30.2	41.8	65.8	40.1	17.9	10.9	11	13.2	25.8	43.2	44.3	31.8
Runoff[1]	mm	100	73	112	170	107	46	29	29	34	69	111	119	1,002

[1]Runoff calculated using watershed area of 1,350 km^2.

Records from this regional hydrological station indicate that the lowest flows occur during the summer months, which coincide with less precipitation and higher potential evapotranspiration (Table 6.6-10). The consistency of flows through the winter months is supported by the presence of rainfall throughout the winter that moves water through the watersheds rather than storing precipitation in snowpack. The average annual runoff estimated at this station is 1,002 mm, or about 70% of the total annual precipitation.

6.6.3.2.1.4 Dam Operations and Water Management

There are seven controlled reservoirs within the Sheet Harbour Hydro System which capture a drainage area of 573.9 km^2: Governor Reservoir, Ten Mile Reservoir, Sloane (Seloam) Reservoir, Anti-Dam Reservoir, Marshall Reservoir, Malay Falls Headpond, and Ruth Falls Headpond (Figure 6.6-3). Governor Reservoir and Ten Mile Reservoir are located at the headwaters of Twelve Mile Stream and Ten Mile Stream, respectively. Seloam Reservoir is located near the headwaters of Fifteen Mile Stream. These three systems eventually flow into Marshall Reservoir, the principle reservoir for the Sheet Harbour Hydro System. Malay Falls Headpond and Generating Station is directly downstream from Marshall Reservoir. Flow discharges from Malay Falls Generating Station into Ruth Falls Headpond and Generating Station. Downstream of the Ruth Falls Generating Station, water returns to the original East River Sheet Harbour channel. The East River Sheet Harbour Relicensing Report (NSPI 2009) provides the following summary of major components of the hydro system:

- Two Generating Stations: Malay Falls Generating Station and Ruth Falls Generating Station;
- Six generating units with an installed capacity of 10.6 MW;
- Five earth fill dams at: Governor Reservoir, Ten Mile Reservoir, Marshall Reservoir, Malay Falls Headpond, and Ruth Falls Headpond;
- One rock fill dam at Anti-Dam Reservoir;
- One timber core earth fill dam at Sloane Reservoir;
- Five storage reservoirs: Governor Reservoir, Ten Mile Reservoir, Sloane Reservoir, Anti-Dam Reservoir, and Marshall Reservoir;
- Two headponds: Malay Falls Headpond and Ruth Falls Headpond;
- One canal with rock and over burden cut section and an earth fill dyke section into Malay Falls Power house; and,
- One canal with dykes along both banks into Ruth Falls Power house (NSPI 2009).

Within the East River Sheet Harbour Hydro System and in the vicinity of the Project are the Seloam Reservoir and the Anti-Dam Flowage (see Figure 6.6-3). These reservoirs help to regulate the East River Sheet Harbour river system but do not have hydroelectric generating stations associated with them. Specific details of the reservoirs and the dam structures at the outlet of these reservoirs are shown in Table 6.6-11.

Table 6.6-11: Water controlling structures near the FMS Mine Site

Dam Name	Storage Capacity (m^3)	Spillway Crest Elevation (masl)	Dam Crest Elevation (masl)	Low Flow Feature
Seloam (Sloane) Reservoir	4.54×10^6	128.4	129.6	Gated Sluiceway
Anti-Dam Flowage	7.43×10^6	95.0	97.1	Gated Sluiceway

These reservoirs are operated according to specific guidelines that are intended to balance the Public and Employee Safety, Regulatory Requirements, Hydroelectric Power Generation and Recreational Use (NSPI 2009). As such, the reservoirs are actively monitored for water levels and flows, and adjustments are made to the outflow rate of these structure to maintain these objectives.

6.6.3.2.1.5 Local Watersheds

To refine the regional hydrology to those in close proximity to the FMS Study Area, local watersheds were delineated based on the upstream areas contributing to each surface water monitoring location (Figure 6.6-10). A summary of local watersheds is shown in Table 6.6-12.

Table 6.6-12: Local Watersheds

Watershed ID	Watershed Description	Drainage Area (km^2) [1]
SW2	Seloam Lake Outlet	18.8
SW5	Seloam Brook near confluence with Fifteen Mile Stream	9.5
SW6	Anti-Dam Flowage Outlet	48.7
SW14	Fifteen Mile Stream	97.4
SW15	East Lake Outlet	2.8

1 Note: drainage area excludes upstream areas (e.g. SW6 excludes SW5 and SW2 areas).

Project infrastructure is proposed within the SW5, SW6, and SW15 local watersheds (plus access road and transmission line construction within SW14). Within local watersheds SW5 and SW6, MEL also identified baseline local catchment areas (LCAs) using 1m contour lines and field delineated wetlands and watercourses (Table 6.6-13 and shown on Figure 6.6-6). These local catchment areas will be used to identify potential indirect impacts to wetlands, watercourses and fish habitat at the smaller scale, based on construction of Project infrastructure and proposed water management during the operations and closure phases.

Table 6.6-13: FMS Local Catchment Areas

Sub-tertiary Watershed	Local Catchment Area	Drainage Area (ha)
SW6	WC26	41.57
SW5	WC2	57.39
	WC5	13.69
	WC7	85.99
	WC12	293.15

6.6.3.2.1.6 Local Streamflow

Streamflow measurements were initiated in early 2018 and supplemented with additional stations in summer 2018 (Table 6.6-14). Streamflow measurements were intended to gather data on the variability of streamflow in both larger systems (e.g. SW6, Anti-Dam Flowage outlet) and small tributaries (e.g. SW15; East Lake outlet).

Table 6.6-14: Streamflow Measurements (m^3/s)

Date	Flows (m^3/s)				
	SW2	SW5	SW6	SW14	SW15
April 2, 2018	0.8	0.9	Not yet installed		
May 2, 2018	1.7	2.4	Not yet installed		
June 18 ,2018	0.3	0.3	Not yet installed		
August 10, 2018	0.5	0.3	5.3	0.7	<0.1
August 28, 2018	0.4	0.2	1.0	0.5	<0.1
September 11, 2018	0.2	0.2	0.4	0.3	<0.1
October 17, 2018	<0.1	0.5	0.5	8.5	0.3
November 18, 2018	1.4	1.0	n/a[1]	6.1	0.1
December 14, 2018	0.5	n/a[1]	6.9	n/a[1]	<0.1
January 15, 2019	1.2	0.7	6.7	n/a[1]	<0.1
February 19, 2019	0.6	0.4	n/a[1]	n/a[1]	0.1
March 15, 2019	0.6	0.4	4.6	n/a[1]	<0.1
April 11, 2019	2.3	1.5	7.5	5.1	<0.1
May 25, 2019	0.7	0.5	4.5	2.9	<0.1
June 7, 2019	0.7	1.0	n/a[1]	n/a[1]	0.4

[1]measurement not completed due to safety concerns

Using pro-rated flows from watersheds to the collected and simulated flows (as described later), an estimate of the existing flows and local catchments within SW5 is presented in Table 6.6-15. Potential changes to the hydrological regime (flow, velocity, level) in these smaller waterways are further described in later sections.

Table 6.6-15: Estimated Streamflow (m^3/s)

Season	Flow (m^3/s)			
	WC2	WC5	WC7	WC12
Winter	0.4	0.3	0.9	0.6
Spring	0.3	0.2	0.6	0.4
Summer	0.1	0.1	0.2	0.1

Season	**Flow (m^3/s)**			
	WC2	**WC5**	**WC7**	**WC12**
Fall	0.3	0.2	0.6	0.4
Average	0.3	0.2	0.6	0.4

For Seloam Brook downstream of Trafalgar Creek, collected field data and modelled hydrological conditions was extrapolated to estimate discharge and stream velocities. As described in the background section (Section 6.6.3.1.1) Seloam Brook is characterized by boulder bed channels and wetland features. Further details on the existing conditions in these waterways is described in Appendix B.3.

6.6.3.2.2 *Touquoy Mine Site*

Surface water quantity in the Moose River is based on the statistical analysis of the regional flow record. As presented on Figure 6.6-11, strong linear trends exist between the average monthly flow rates of the selected monitoring stations and drainage area for April, August, and June to August with a correlation coefficient (R^2) of 0.98, 0.93, and 0.96, respectively. From these regional relationships, it can be inferred that the average April and August flows for SW-2 in Moose River (catchment area of 39.03 km^2) are estimated to be 2.42 m^3/s and 0.45 m^3/s, respectively. Results of the analysis indicated that generally the peak and low flow events occur in April and August, respectively.

A water balance model of the exhausted Touquoy pit was developed to simulate the quantity of runoff at the Touquoy Mine Site under existing conditions. The water balance model was developed through multiple iteration and revisions during design, construction, commissioning, and operation of the Touquoy Gold Project to improve accuracy. Model inputs accounted for groundwater inflows, surface runoff, direct precipitation, and Touquoy pit dewatering for Touquoy ore processing.

As described in more detail in Section 6.6.5 and the technical report (Appendix I.6), the water balance was refined to simulate the existing conditions (water quantity and water quality) at the start of processing FMS concentrate prior to discharging tailings into the exhausted Touquoy pit. Model assumptions include:

- the Touquoy TMF dam is at the maximum elevation of 130 m with an emergency spillway at 128.5 m in elevation;
- the maximum tailings capacity in the Touquoy TMF is reached in April/May 2022 and the pond water level is at normal operating water level. Until maximum capacity is reached, the FMS concentrate tailings will be deposited into the TMF;
- the Touquoy pit is exhausted and empty; and
- the Touquoy waste rock area is fully developed and reached the maximum capacity.

The Touquoy Mine Site was divided into five sub-catchment areas based on the available LiDAR topography (Leading Edge Geomatics 2013), provincial topographic database (PNS 2018) and the water management at the Touquoy Mine Site. The catchment areas for each of the mine facilities include the mill site (13.8 ha), Touquoy TMF (94.0 ha), Touquoy pit (40.4 ha), waste rock area (55.1 ha), and polishing pond (16.9 ha).

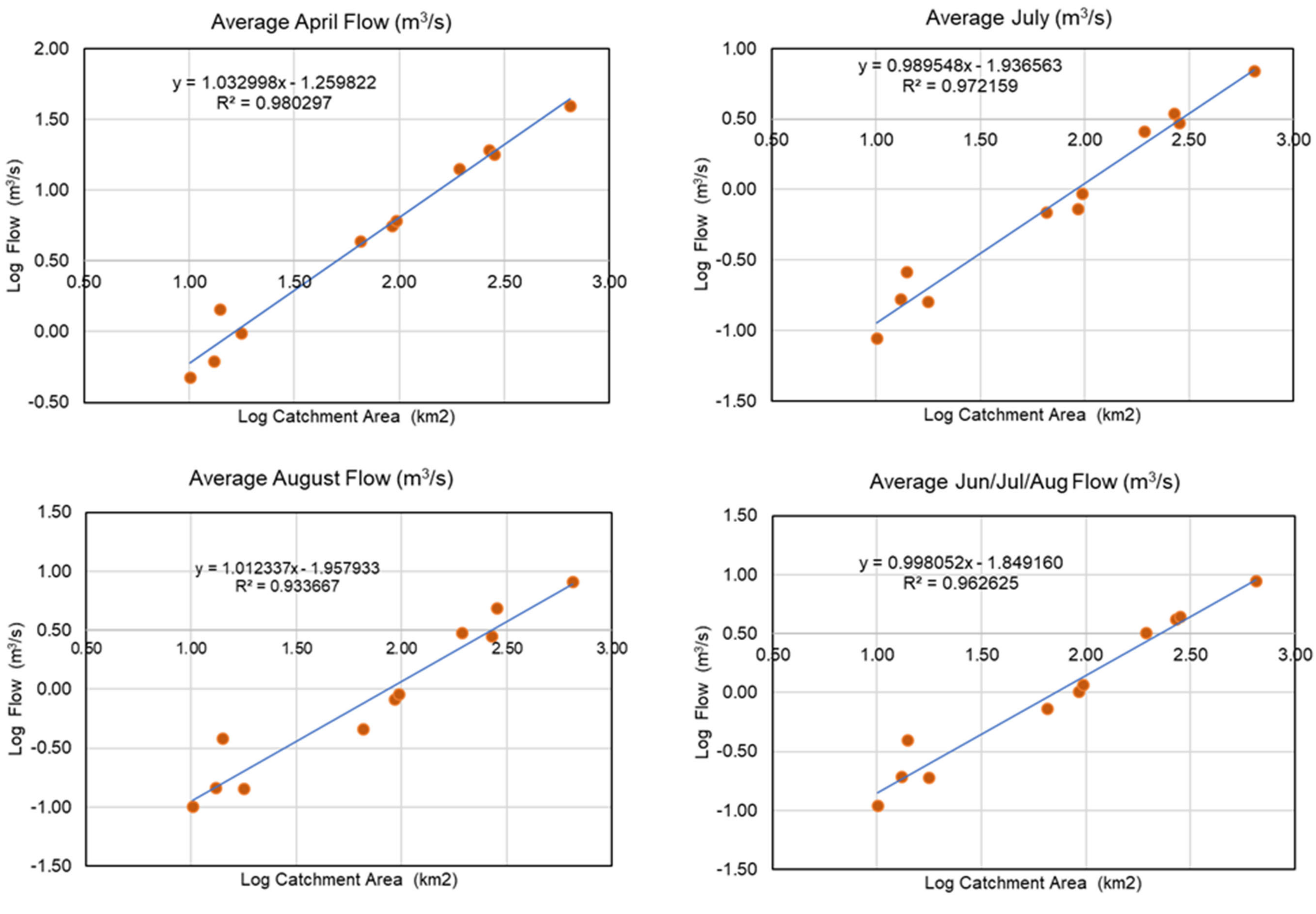


Figure 6.6-11 Regional Regression Analysis (Prepared by Stantec 2019)

6.6.3.3 Surface Water Quality

6.6.3.3.1 *FMS Study Area*

The surface water quality observed in the FMS Study Area is typical of lakes and watercourses that are present within the geological terrain of the southern mainland of Nova Scotia. The geology within this region is dominated by Cambrian-aged bedrock and the hydrology is strongly controlled by bedrock outcrops that create irregular flow patterns. As drainage moves through the watersheds within this region, the surface water is subjected to water-rock interactions and weathering processes associated with the bedrock and overburden – these natural processes influence the baseline water quality.

The baseline surface water quality at the stations monitored in the FMS Study Area can be generally characterized as having acidic to near-neutral pH, low alkalinity and hardness, and low concentrations of nutrients. The baseline water quality dataset is presented in detail in Appendix B.5. Concentrations of most parameters were observed to be consistently below the CCME CWQGs and NSEQSs. However, concentrations of aluminum were observed to be greater than surface water quality guideline criteria in all samples, arsenic was greater than criteria in 35% of samples, iron was greater than criteria in 18% of samples, zinc was greater than criteria in 10% of samples and copper and mercury were greater than criteria in 2% of samples. Background environmental baseline concentrations of some parameters exceeding surface water quality criteria is not uncommon, including within areas that are relatively pristine and not disturbed. A summary of surface water data comparisons to criteria is presented in Table 6.6-16.

Table 6.6-16: Summary of Surface Water Quality Data Comparisons to Criteria

Parameter	Criteria (mg/L)		Number of Samples	Samples Values not Meeting Criteria		Location
	CCME CWQG Chronic[1]	NSEQS[2]		CCME CWQG Chronic[1]	NSEQS[2]	
Field pH	6.5 – 9.0	-	111	n=105 95%	-	All Stations
Lab pH	6.5 – 9.0	-	120	n=115 96%	-	All Stations
Total Aluminum	0.10 - 0.0050[3]	0.0050	120	n=120 100%	n=120 100%	All Stations
Total Arsenic	0.0050	0.0050	120	n=22 18%	n=22 18%	SW-4, SW-5, SW-6, SW-14
Total Copper	0.002[3]	0.002	120	n=2 2%	n=2 2%	SW-1, SW-4
Total Iron	0.30	0.30	120	n=42 35%	n=42 35%	SW-1, SW-4, SW-5, SW-6, SW-7, SW-8, SW-10, SW-11, SW-12, SW-13, SW-14

Parameter	Criteria (mg/L)		Number of Samples	Samples Values not Meeting Criteria		Location
	CCME CWQG Chronic[1]	NSEQS[2]		CCME CWQG Chronic[1]	NSEQS[2]	
Total Lead	0.0010	0.0010	120	n=1 1%	n=1 1%	SW-4
Total Manganese	-	0.82	120	-	n=1 1%	SW-4
Dissolved Zinc	0.0070	-	61	n=6[4] 10%	-	SW-1, SW-4, SW-8, SW-14
Total Mercury	0.000026	0.000026	120	n=2 2%	n=2 2%	SW-4

Notes:
1. Canadian Council of Ministers of the Environment (1999, updated in 2018). Canadian Environmental Quality Guidelines (CEQG) for the Protection of Aquatic Life
2. Nova Scotia Environmental Quality Standards for Surface Water, Table 3 (2013)
3. Criteria varies with pH or hardness
4. Four of six values are suspect due to the dissolved zinc concentration reported at greater than 2x the total zinc concentration

Baseline concentrations of aluminum were consistently observed to be greater than the CCME CWQG and NSEQS (0.005 mg/L), whereas concentrations of iron were observed to be occasionally greater than the CCME CWQG and NSEQS (0.3 mg/L). Naturally occurring concentrations of aluminum and iron that are greater than the CCME CWQGs and NSEQSs can be attributed to aluminum and iron being key elements that are associated with common mineral phases in bedrock and overburden.

Baseline concentrations of arsenic were observed to be greater than the CCME CWQG and NSEQS (0.005 mg/L) at locations directly adjacent to or downstream from the ore deposit (SW4, SW5, SW6, SW13 and SW14). Naturally occurring concentrations of arsenic greater than the CCME CWQG and NSEQS can be attributed to naturally occurring processes associated with surface water/groundwater interactions with weathered bedrock containing arsenic-bearing sulphides (e.g., arsenopyrite). The presence of historical mine tailings and waste rock along Seloam Brook may also affect the baseline concentrations at monitoring stations along this watercourse. A SSWQO for arsenic of 0.03 mg/L has been developed for the Project (Appendix C.2), which is a risk-based benchmark that is protective of fish and other aquatic life. Baseline arsenic concentrations greater than the SSWQO have been observed at SW4, SW5 and SW14.

6.6.3.3.2 *Touquoy Mine Site*

The geology at the Touquoy Mine Site is situated in the Meguma Group Goldenville Formation. This formation is closely related to historical and current gold production and exploration operations. This formation is also known to be high in natural concentrations of arsenopyrite which is found associated with gold deposits in Nova Scotia. As a result, natural concentrations of arsenic in groundwater in this formation have been found to naturally exceed Nova Scotia Tier 1 Guidelines for arsenic. As groundwater is a pathway to surface water, these elevated concentrations of arsenic will also be common in local watercourses.

The Touquoy Mine Site is in an area of historic gold mining activity, with a network of small underground workings and Touquoy pits dating from as far back as 1866. Gold production from Moose River Gold Mines, near the Touquoy Mine Site, commenced around

1877. A field sampling plan of the Touquoy Mine Site area identified historical tailings at the mines to have elevated concentrations of arsenic and mercury that may have altered the surface water quality.

Water management at the currently operating Touquoy Mine Site includes directing all wastewater and surface runoff that comes in contact with the ore to the existing TMF for treatment. Treatment includes the addition of ferric sulphate to the effluent to precipitate arsenic, hydrated lime to adjust pH, and coagulant polymer to facilitate the removal of colloidal sized suspended matter. The treated effluent is then directed into the polishing pond where additional settling will occur before being released into a constructed wetland for subsequent discharge into the northwestern end of Scraggy Lake. At the point of final discharge, the effluent meets MDMER water quality criteria.

Based on a review of the 2017 baseline 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 NSE Tier 1 EQS. Table 6.6-17 summarizes parameter exceedances by monitoring location. In addition, cobalt, manganese, silver and mercury exceeded the Canadian Council of Ministers of the Environment guideline for the protection of freshwater aquatic life (CCME 2018). 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. Site-specific standards have been developed for the Touquoy Mine Site to establish thresholds for surface water quality that include the elevated concentrations of parameters under baseline conditions (Appendix C.2).

As reported in the 2017 groundwater and surface water monitoring report (Stantec 2018a), spatial trends were not apparent between conductivity and the observed Tier 1 EQS exceedances, or between background and downstream monitoring locations to indicate an effect of a specific mine facility (i.e., TMF, waste rock pile, Touquoy pit) on surface water resources during construction. Arsenic was noted to consistently exceed the Tier 1 EQS at SW-2 downstream of the Touquoy pit in both 2016 and 2017. As no trends in water quantity or quality were identified between baseline and operation, these elevated arsenic concentrations are not attributed to operation and may be from historical tailing piles and/or the Touquoy ore body itself. A remedial action plan is currently underway by the Proponent that involves the delineation, removal, and management of these historical tailings piles around the Touquoy pit area.

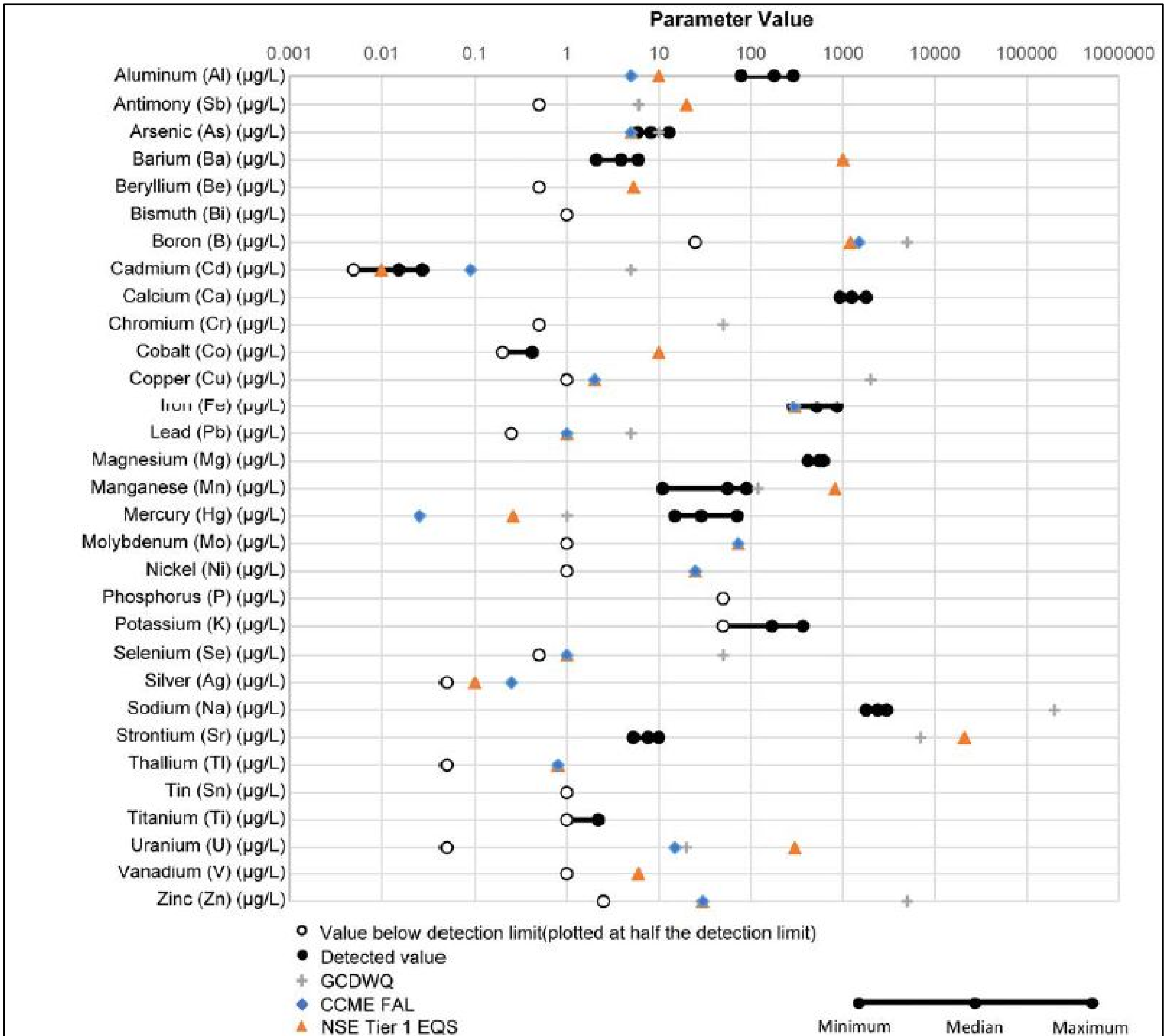
Table 6.6-17: Summary of Baseline 2016/2017 Surface Water Quality for Touquoy Mine Site Parameter Exceedance

Water Quality Parameter	SW-1*	SW-2*	SW-3	SW-11*	SW-12	SW-13	SW-15	SW-18	SW-19	SW-20	SW-21	SW-23	No. of Stations with Parameter Exceedance
Exceedance of Tier 1 EQS													
pH	20	20	6	22	20	20	10	19	18	16	16	9	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

Water Quality Parameter	SW-1*	SW-2*	SW-3	SW-11*	SW-12	SW-13	SW-15	SW-18	SW-19	SW-20	SW-21	SW-23	No. of Stations with Parameter Exceedance
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	12

Note: Surface water quality parameter is listed if there is at least 1 exceedance in 2016/2017 monitoring.
*= Indicates exceedance of CCME guideline

Figures 6.6-12 to 6.6-15 present box plots that summarize the baseline surface water quality in Moose River for both the background and downstream locations at the Touquoy Mine Site. The minimum, mean, and maximum concentration or value for the parameters are presented on a logarithmic scale. Values below the detection limits are flagged in the plots, as are the relevant guidelines or discharge limits. For example, in Figure 6.6-12, all values for total bismuth in the background data set (i.e., SW-1 and SW-11) are below the detection limit. In Figure 6.6-12 for the background data set, the minimum cadmium value is below the detection limit, the mean and maximum value is above Tier 1 EQS and below CCME FAL guideline. Overall, the water quality is similar between background and downstream surface water quality presented in the 2017 monitoring report (Stantec 2018a).



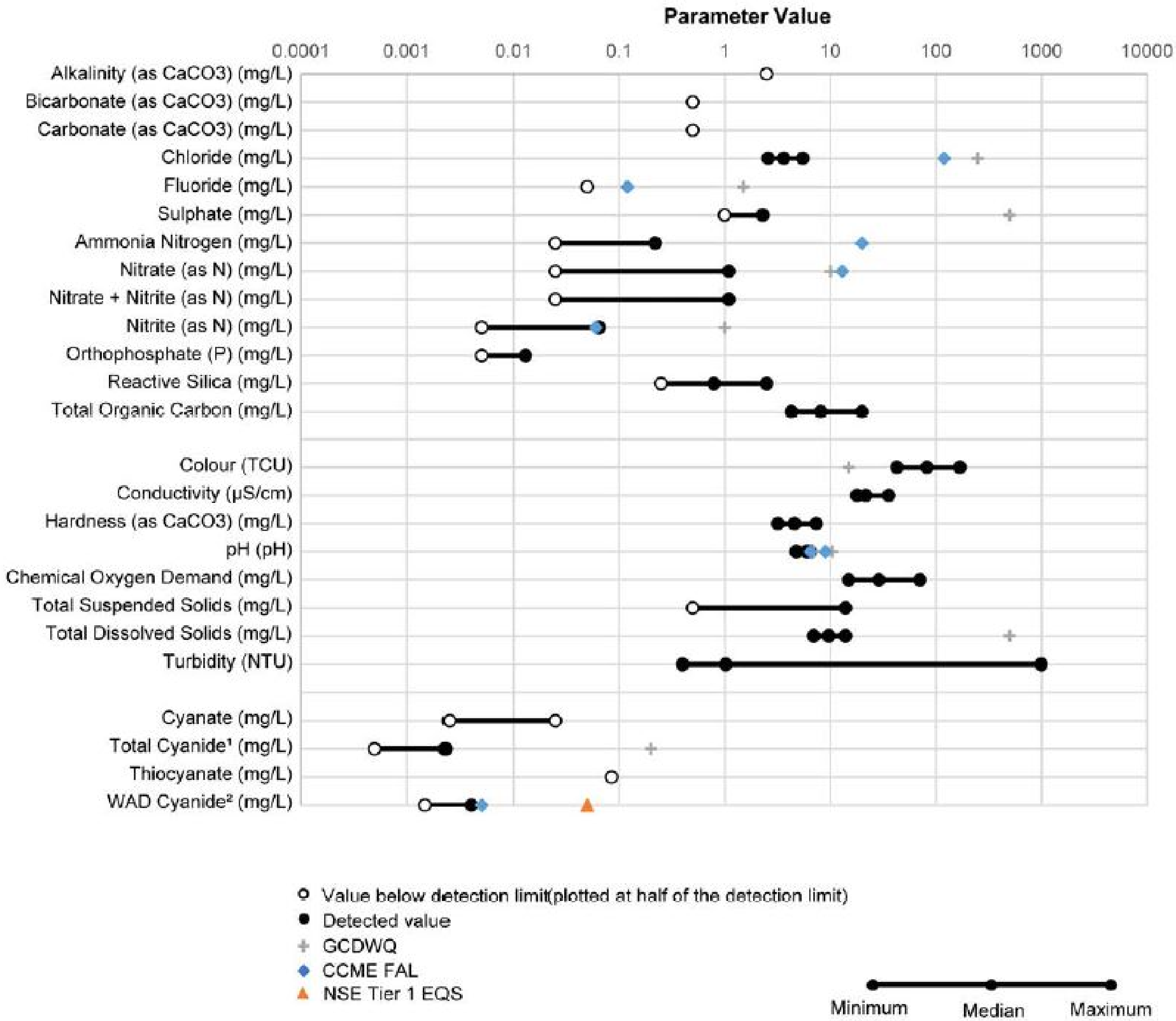
Notes:

GCDWQ = Guidelines for Canadian Drinking Water Quality

CCME FAL = Canadian Environmental Quality Guidelines for the Protection of Freshwater Aquatic Life

NSE Tier 1 EQS = Nova Scotia Environment Environmental Quality Standards, Tier 1 Environmental Standards for surface water

Figure 6.6-12: Background Water Quality at Touquoy -Metal Parameters (Prepared by Stantec 2019)



Notes:

1. Total cyanide reported as Strong Acid Dissociable Cyanide
2. WAD Cyanide = Weak Acid Dissociable Cyanide

GCDWQ = Guidelines for Canadian Drinking Water Quality

CCME FAL = Canadian Environmental Quality Guidelines for the Protection of Freshwater Aquatic Life

NSE Tier 1 EQS = Nova Scotia Environment Environmental Quality Standards, Tier 1 Environmental Standards for surface water

Figure 6.6-13: Background Water Quality at Touquoy - General Chemistry, Cyanide, and Petroleum Hydrocarbons (Prepared by Stantec 2019)

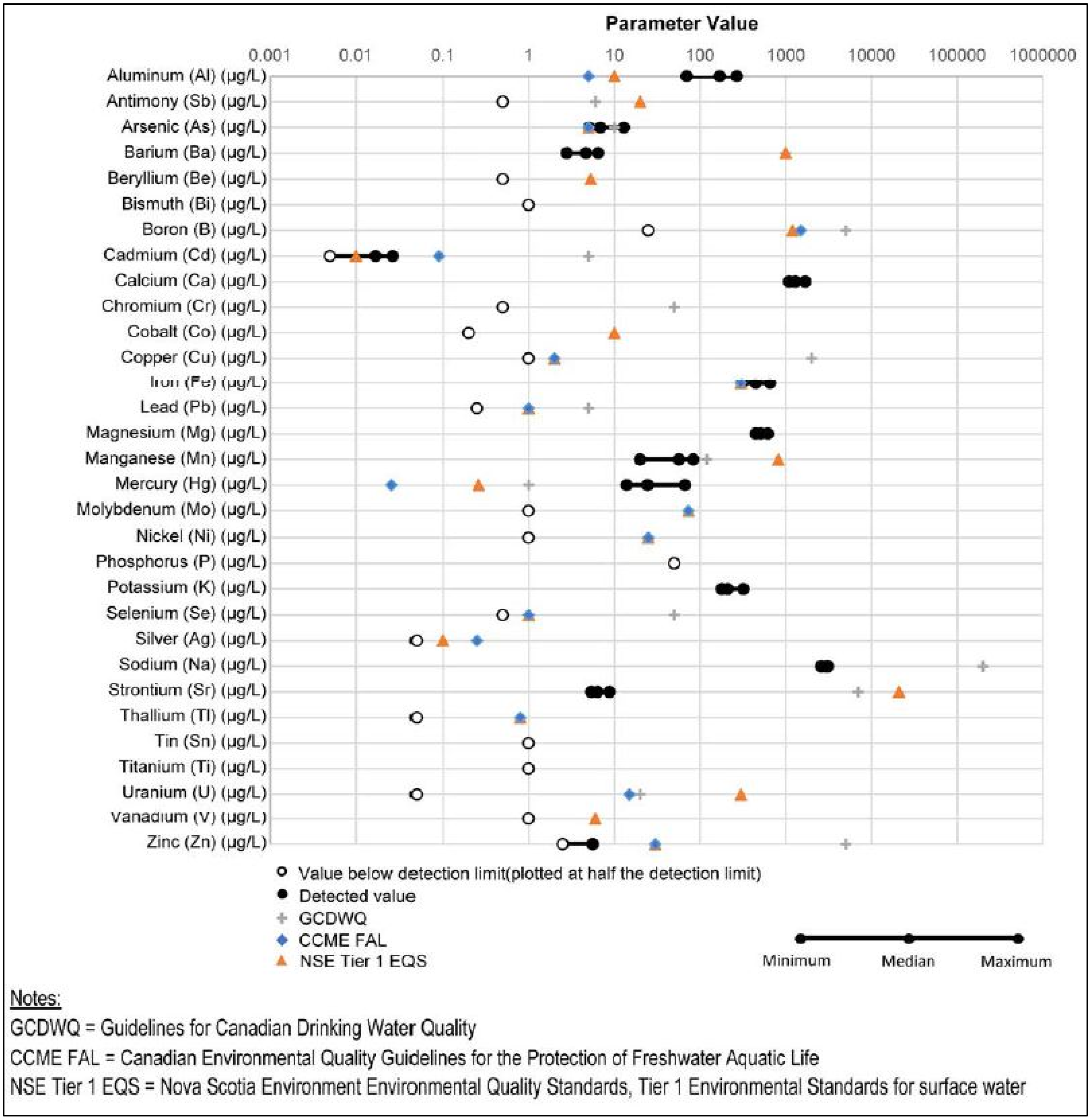
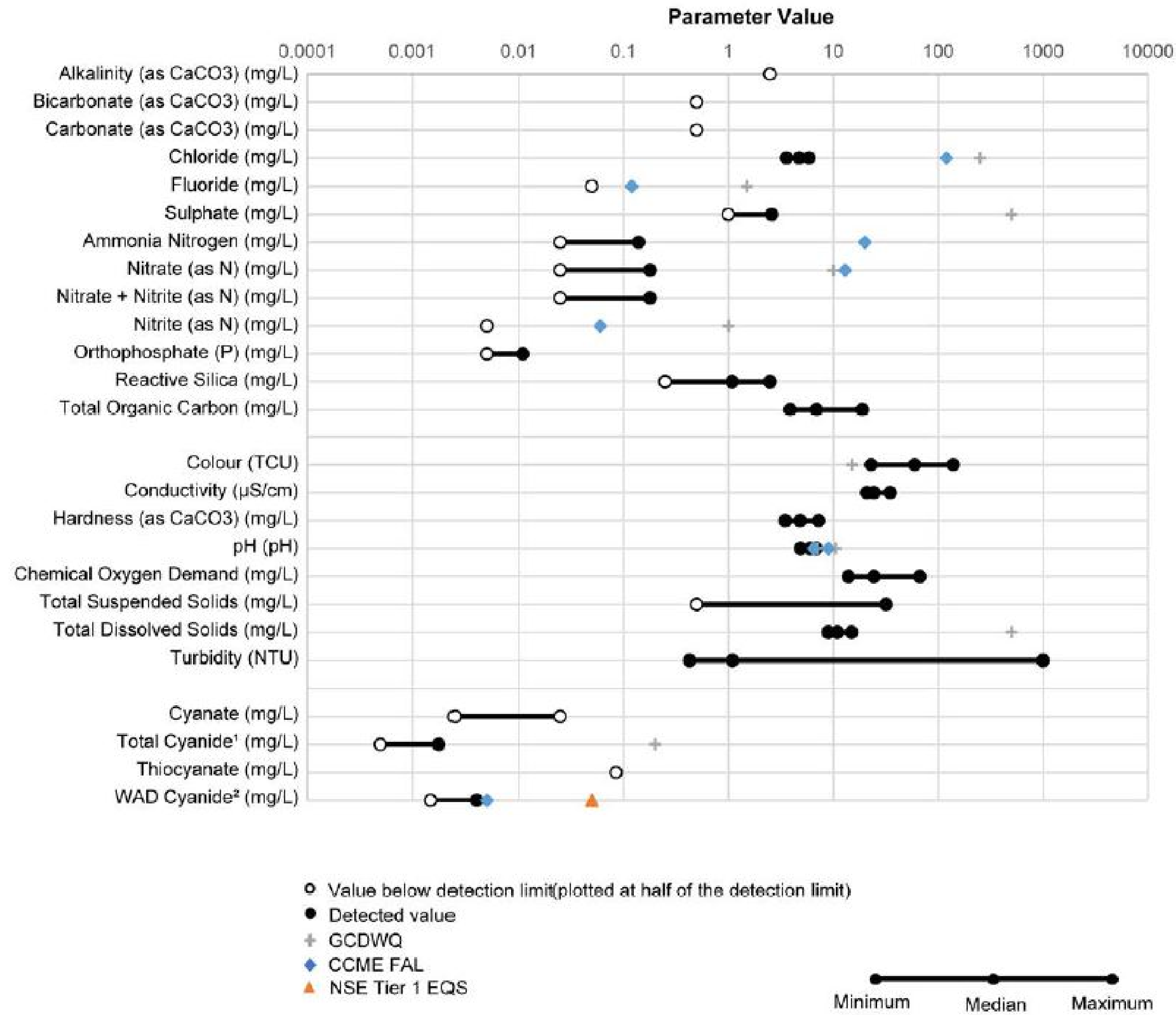


Figure 6.6-14: Downstream Water Quality at Touquoy – Metal Parameters (Prepared by Stantec 2019)



Notes:

1. Total cyanide reported as Strong Acid Dissociable Cyanide
2. WAD Cyanide = Weak Acid Dissociable Cyanide

GCDWQ = Guidelines for Canadian Drinking Water Quality

CCME FAL = Canadian Environmental Quality Guidelines for the Protection of Freshwater Aquatic Life

NSE Tier 1 EQS = Nova Scotia Environment Environmental Quality Standards, Tier 1 Environmental Standards for surface water

Figure 6.6-15: Downstream Water Quality at Touquoy – General Chemistry, Metals, and Petroleum Hydrocarbons (Prepared by Stantec 2019)

Complete water quality results for the locations sampled in 2016 and 2017 are presented in the 2017 groundwater and surface water monitoring report (Stantec 2018a).

As discussed in Section 6.6.2.6, the baseline water quality in WC4 and Scraggy Lake are not based on the existing conditions, as they will be changed by the Touquoy Gold Project. Therefore, the baseline water quality in these waterbodies are based on predictions presented by Stantec (2016b). These predictions assume mixing of effluent from the Touquoy Gold Project with the baseline water quality in these features. The water quality predictions at SW-3 in WC4 and at SW-13 in Scraggy Lake are presented on Table 6.6-18.

Table 6.6-18: Predicted Baseline Water Quality in Scraggy Lake and Watercourse No. 4

Parameter	GCDWQ	CCME FAL	MDMER		Predicted Concentrations (mg/L)	
			Monthly Average	Grab Sample	Scraggy Lake	Watercourse No. 4
Silver (Ag)	-	0.00025	-	-	0.0000525	0.0000614
Aluminum (Al)	-	0.1	-	-	**0.181**	**0.626**
Arsenic (As)	0.01	0.005	0.5	1	0.00192	**0.00903**
Calcium (Ca)	-	-	-	-	15.7	5.61
Cadmium (Cd)	0.005	0.00009	-	-	0.0000183	0.0000194
Chloride (Cl)	250	120	-	-	5.54	8.31
Cobalt (Co)	-	-	-	-	0.0158	0.00547
Chromium (Cr)	-	0.0089	-	-	0.00446	0.00109
Copper (Cu)	1	0.002-0.004	0.3	0.6	**0.00689**	0.00172
Iron (Fe)	0.3	0.3	-	-	0.241	**1.13**
Potassium (K)	-	-	-	-	4.97	2.44
Magnesium (Mg)	-	-	-	-	1.04	0.925
Manganese (Mn)	0.05	-	-	-	0.0508	0.318
Sodium (Na)	200	-	-	-	47.5	12
Total Ammonia as N (NH_4+NH_3)	-	-	-	-	1.33	0.524
Unionized Ammonia	-	0.019	-	-	**0.051**	**0.020**
Nickel (Ni)	-	-	0.5	1	0.00134	0.00138
Nitrate as N (NO_3)	10	13	-	-	0.0531	0.0586

Parameter	GCDWQ	CCME FAL	MDMER		Predicted Concentrations (mg/L)	
			Monthly Average	Grab Sample	Scraggy Lake	Watercourse No. 4
Lead (Pb)	0.01	0.001-0.007	0.2	0.4	0.000388	0.00117
Phosphorous (P)	-	0.004-0.1	-	-	0.016	0.0618
Antimony (Sb)	0.006	-	-	-	0.00159	0.000858
Selenium (Se)	0.05	0.001	-	-	0.000548	0.000552
Sulfate (SO_4)	500	-	-	-	99.2	17.5
Uranium (U)	0.02	0.015	-	-	0.00022	0.000249
Zinc (Zn)	5	0.03	0.5	1	0.013	0.00489
Total Cyanide (CN_{Total})	-	-	1	2	0.0655	0.0964
WAD Cyanide (CN_{WAD})	0.2	0.005 (for free CN)	-	-	0.00192	0.000701

Notes:
All statistics calculated using values half of the reported detection limit for values below detection limits
Unionized ammonia is calculated as 0.039 * total ammonia concentration, assuming pH = 6.0 and temperature of 20ºC.
0.000 = Exceeds CCME Freshwater Aquatic Life Guidelines (CCME FAL)
<u>0.000</u> = Exceeds Guidelines for Canadian Drinking Water Quality (GCDWQ)

6.6.4 Consideration of Engagement and Engagement Activities

Key issues raised during public and Mi'kmaq engagement relating to surface water quality and quantity include potential effect from ARD, historical tailings, effluent discharge, suspended solids and leached metals from the Fifteen Mile Stream Mine Site activities. At the Touquoy Mine Site, questions arose about potential effects on Moose River from placement of tailings in the exhausted pit.

Questions were identified on potential effects on receiving waters in the event of unplanned releases due to accidents and malfunctions, specifically during operations. Potential effects on traditional uses of land and resources by the Mi'kmaq were noted, including importance of clean water to support the natural environment, including fish, flora, fauna and drinking water.

The results of the public and Mi'kmaq engagement have been considered in the environmental effects assessment, including the Proponent's commitments to mitigation and monitoring measures and proposed compliance and effects monitoring programs, as well as the Proponent's broader commitment to ongoing public and Mi'kmaq engagement.

6.6.5 Effects Assessment Methodology

6.6.5.1 Boundaries

6.6.5.1.1 *Spatial Boundaries*

The study areas for the surface water quantity and quality assessments define the spatial boundaries within which the physical works and activities of the Project could cause direct and indirect effects to surface water quantity and/or quality, as well as potentially have cumulative effects that are compounded spatially and temporally. To evaluate the potential effects on surface water quantity and quality, a PA, LAA, RAA have been defined. The PA consists of the FMS Study Area and the Touquoy Mine Site (Figure 6.6-16).

The effects assessment for surface water quantity and quality includes numerical predictions of change within the LAA from the Project. The LAA is defined by the tertiary watersheds that encompass or intersect the PA, and contains surface water features upstream, downstream, and within the PA (Figure 6.6-16). The lakes and watercourses that are included as part of the baseline programs and/or predictions of effects are located within the LAA boundary.

The RAA in the context of surface water quality and quantity encompasses the secondary watersheds which overlap the PA (East River Sheet Harbour and Fish River) (Figure 6.6-16).

The potential effects on surface water quantity and quality are not expected to extend greatly beyond the tertiary watersheds encompassed by LAA. Therefore, a numerical assessment of changes to surface water quantity and quality have not been completed for the RAA. Effects assessment conclusions are based on numerical-based effects assessment on the surface water features present in the LAA for both the FMS Study Area and the Touquoy Mine Site.

6.6.5.1.2 *Temporal Boundaries*

The temporal boundaries used for the assessment of effects to surface water quality and quantity are the construction, operations, and closure phases. The closure phase consists of two stages: reclamation and post-closure. Reclamation is the period when closure planning is being implemented, or the construction of the closure works. The post-closure stage is the period after the closure works have been implemented, and largely consists of care and maintenance. These temporal boundaries were considered as follows:

- **Construction phase (1 year)**: This phase will consist of building the site infrastructure and associated facilities prior to the initiation of mining and ore beneficiation. As such, the site infrastructure and facilities will be in the process of being developed and only construction water will need to be managed on site. With the implementation of best management practices to manage construction water and associated suspended sediments, the construction works are expected to have less of an influence on water quantity and quality relative to the potential effects that may occur during the operations phase. Therefore, numerical predictions using water quantity and quality modelling were not completed for the construction phase. Rather, the potential effects to water quantity and quality during the construction phase is evaluated in qualitative manner.

- **Operations phase (7 years)**: This phase will be initiated upon the start of ore extraction and processing and will cease once the economical ore reserves have been depleted and the mining processes have ceased. During the operations phase, the potential effects on water quantity and quality are expected to be greatest at the end of mining when the open pit, TMF, PAG stockpile and NAG stockpile are fully developed and have reached their ultimate extents. Conservatively, numerical predictions of potential effects on water quality and quality were completed based on fully developed Project components and facilities at the EOM life.

- **Closure phase**: This phase will consist of the reclamation and post-closure stages:

    - **Reclamation (2-3 years)**: This stage consists of the construction of the closure works at the site, as presented in Section 2.0. The benefits that the closure strategy will have on surface water quantity and quality will, in some cases, not have an immediate effect, and these benefits may not be realized until sometime during post-closure. As such, it is likely that surface water quantity and quality during reclamation will not be much different than the conditions predicted at the end of the operations phase. For the purposes of the water quantity and quality effects predictions, numerical modelling was not completed for reclamation; rather, the effects assessment for reclamation assumes that the predicted effects on surface water quantity and quality during the operations phase

(EOM) will continue throughout the period of the reclamation activities. Therefore, the effects assessment for reclamation is discussed in a qualitative manner.

- **Post-closure (3+ years)**: This stage consists of the period after the reclamation and closure works have been completed. Based on the geochemical characteristics of waste rock, a proportion of the waste rock will be potentially acid generating and an engineered cover system will likely need to be applied to the PAG stockpile (for the purposes of the post-closure modelling it is assumed that the PAG stockpile is covered with a clay cover and the NAG stockpile will remain uncovered). The post-closure models also assume that the TMF will be covered with material sourced from the topsoil and till stockpiles. The active reclamation of the TMF will extend into the Post Closure Stage of Closure. Water treatment of some site effluents, if required, will occur until such a time that the site effluents are of a quality that meets regulatory requirements for discharge to the environment. Conservatively, numerical predictions of potential effects on water quantity and quality were completed based on conservative conditions expected during post-closure – this includes accounting for the ARD conditions that are expected from the PAG rock over the longer term through the application of upper case geochemical source terms in addition to the base case source terms.

The prediction of surface water quantity and quality effects was completed for the construction, operations, and closure phases of the Project using a combination of qualitative analyses and numerical modelling. The effects predictions for the construction phase were evaluated qualitatively, as changes to the surface water regime will be similar in construction and operations/ closure. Furthermore, the water quality concerns during the construction phase are largely related to earth works and the control of suspended sediment. For the operations and closure phases, a numerical model was used to simulate the water flow through watersheds and from the site water management, and to estimate the surface water quality of effluent from key site facilities/components and potential changes to the quality of the receiving and downstream surface water environment. The surface water quality model results for the operations phase are also applicable to the effects assessment for the reclamation stage of the closure phase – this is a reasonable approach to the effects assessment because, during the reclamation activities, it is expected that site effluents will continue to be managed, and treated if needed, prior to discharge to the environment.

6.6.5.1.3 *Technical Boundaries*

No technical boundaries were identified for the effects assessment of surface water quality and quantity.

6.6.5.1.4 *Administrative Boundaries*

Effluent discharges from the water treatment plant to the environment will be required to adhere to the MDMER and the associated maximum allowable concentration limits, as well as any applicable guidelines set forth as part of the provincial permitting process. The surface water quality monitoring results from the receiving environment will be compared to the CCME CWQGs, NSEQSs, FEQG (for cobalt) and SSWQO (for arsenic), and the receiver-specific 95th percentile baseline concentration, as applicable.

6.6.5.2 FMS Study Area Surface Water Quantity Effects Assessment Methodology

Water management during operations and closure phases will be completed in accordance with the site water balance approaches described in detail in Appendix D.2.

6.6.5.2.1 *Complementary Hydrological Components*

To complement the watershed modelling efforts described below, additional analysis was completed on the following finer scale project interactions:

- Seloam Brook Realignment: To assess the potential change in stream flow through the Seloam Brook system (i.e. Seloam Brook and tributaries within the SW5 watershed boundaries), as a result of realignment of Seloam Brook around the open pit, the following was carried out
  - Optimization and feasibility level design of the Seloam Brook Realignment; and,
  - Analysis of the predicted flooded extent downstream of the realignment, velocities and water depth.
- Groundwater - Surface Water Interaction: Through the comparison of contributions to streamflow from groundwater (i.e. the hydrogeological model) and surface water (i.e. the hydrological model) during existing, operations and closure phases.

6.6.5.2.2 *Regional Modelling Approach*

A hydrological model was developed using GoldSim Version 12.1, which is a graphical, object-oriented numerical model where input parameters and functions are defined by the user and are built as individual objects or elements linked together by mathematical expressions. The object-based nature of the model is designed to facilitate understanding of the various factors that influence an engineered or natural system, which allows for forecasting potential changes to the hydrological system.

Details on the modelling approach, methods, assumptions and limitations are discussed in the report on the Hydrological Modelling (see Appendix B.4). Briefly, the hydrology model incorporated:

- Long-term climate;
- Watershed areas;
- Watershed composition (surficial geology, lake, reservoir and wetland area);
- Reservoir bathymetry and dam structure (features/structures/design) and operational rules; and,
- Predicted operational water management (site water storage and water conveyance).

Separate models were constructed for the existing conditions, operations and closure phases, in order to directly compare the predicted change in flows as a result of the Project. A long-term (54 year) climate record was used as input to the hydrology numerical model, and was applied stochastically, where the model randomly selected climate data from a monthly distribution of climate inputs. A total of 1000 realizations of the model were simulated, which provided for a wide range of climate input conditions (wet, dry and typical climates). This stochastic modelling approach provided a framework for the range of probabilistic climate conditions for the FMS Study Area.

Runoff from the watersheds integrated the climatic variability and was simulated using the methodology of Holmes and Robertson (1959) where excess water not removed by evaporation was held in storage (soil or lake/reservoir) or was discharged as surplus water provided to the groundwater or surface water system. Groundwater flows through the natural system that report to surface water (baseflows) and seepage from mine site components were integrated from the concurrent hydrogeological model (Section 6.5). In the cases of Seloam Lake and the Anti Dam Flowage, water storage was estimated from bathymetric mapping (Appendix G.1) and outflows from these reservoirs was based on the dimensions of the outfall structures and the operating rules for discharge.

The predicted infrastructure footprints, catchment areas and volumes of water taking, and effluent discharge were applied to the hydrological model as either changes to watershed areas, or process water additions and removals. The proposed water balance flow schematics for operations and closure (as described in Appendix D.2) are provided as Figures 6.6-17 and 6.6-18.

As a consequence of the stochastic climate variability, a broad range of resultant flows through the environment were available for the existing conditions, operations and closure phases. The average (mean) monthly discharge values are presented herein, with additional statistical output available in Appendix B.4

6.6.5.2.3 *Surface Water Quantity Assessment Locations*

Surface water quantity assessment locations were selected to be aligned generally with, or downstream of, the existing hydrological monitoring locations. Assessment locations and rationale are provided in Table 6.6-19.

Table 6.6-19: Water Quantity Model Assessment Locations

Assessment Point Location ID	Description	Rationale
SW2	Seloam Lake Outflow	Downstream of Seloam Lake, where process water will be withdrawn
SW5	Seloam Brook at Fifteen Mile Stream	Downstream of major project infrastructure
SW6	Anti Dam Flowage Outflow	Outflow of the preferred treated effluent discharge and downstream of the project infrastructure footprint
SW14	Fifteen Mile Stream Upper Reaches	Natural runoff from the upper reaches of the Fifteen Mile Stream, upstream of project infrastructure footprint
SW14A	Abraham Lake	Natural runoff from the Abraham Lake watershed
SW15	East Lake outlet	Drains to tributary from eastern portion of the Project infrastructure towards Anti Dam Flowage

6.6.5.2.4 *Local Surface Water Quantity Approach and Receiving Environment Components*

The effects of the Project on the water quantity were evaluated within LCAs based on water balance predictions for the Operational Phase and Closure Phase of the Project. Further predictions for WC12 and downstream of the diversion channel were completed by Golder and KP and followed a specific methodology described in Appendix B.7 and Appendix D.4, respectively. The other LCAs predictions were completed through a change in drainage area assessment methodology as described in Section 6.6.8.1.1.

6.6.5.2.5 *Seloam Brook Realignment Design: Low Flow, Mean Annual Discharge and Flood Events*

KP completed a feasibility level design for the Seloam Brook Re-alignment project, to support the EIS. This design included:

- The Seloam Brook diversion berm;
- The Seloam Brook realignment channel (realignment channel);
- The haul road from the Open Pit to the Organics Stockpile;
- The associated culvert at the road crossing; and,
- Potential relevant fish features for the Realignment Channel.

This design was completed in part to demonstrate that the planned realignment is technically feasible and that the realignment channel (as well as the upstream and downstream watercourses) will remain stable over the long term since the Seloam Brook Realignment is permanent. This design included a preliminary design of the realignment channel including an assessment of NSPI dam operational scenarios and consideration of those requirements and procedures in the design, and a description of construction methods and materials.

The Realignment is required to provide conveyance of flood flows and prevent flooding of the open pit while enabling low flow conductivity around the diversion berm. The realignment channel will provide fish passage under normal and low flow conditions. The channel is also required to remain stable throughout the operational life of the Project and in the long-term following closure.

The haul road crossing the Realignment provides access from the Open Pit area to the Organics Stockpile. The road is required to provide single lane traffic for approximately 5 m wide haul trucks, including appropriately sized safety berms on either side of the road.

The culvert design is based on the requirement to pass the 1 in 200 year flood event (Q200) without overtopping the haul road or the diversion berm. The probability of a 200 year flood occurring during the seven-year mine life is 3.4%, or 0.5% in any year of operations. The culvert will also provide fish passage under normal and low flow conditions. Additional considerations for the culvert include a requirement for an energy dissipation pool at the outlet (Nova Scotia 2015), and sufficient clearance to allow construction crews to work inside the culvert to construct any required fish friendly features.

The Seloam Brook Realignment design was an iterative process that included flow modelling used to confirm or modify the sizing of the realignment channel, haul road culvert, required riprap, and heights for the diversion berm and the haul road. A two-dimensional (2D) flow model was developed for the realignment channel, road crossing, culvert, and surrounding area to support the design. The model was developed using the HEC-RAS 2D modelling software (Version 5.0.7). The 2D mesh in HEC-RAS 2D was set to a 10 x 10 m grid within the floodplains, a 5 x 5 m grid within the natural channels, and a 2 x 2 m grid within the realignment channel. A four second computational timestep was used to calculate the results.

Four flow scenarios were modelled to assess the functionality of the Seloam Brook Diversion.

- 1 in 20 year Annual Dry condition: Modelled to confirm flow conveyance is achieved under low flow conditions.
- Mean Annual Discharge (MAD): Modelled to confirm flow conveyance is achieved under normal operating conditions.
- Q10 (1 in 10 year flood event): Modelled to confirm the channel design provides sufficient flow capacity under 10 year flood conditions.
- Q200 (1 in 200 year flood event): Modelled to assess the inundation around the Diversion Berm and the haul road, evaluate whether overtopping would occur, and support the riprap sizing for the channel to remain stable under these flood conditions.

Model inputs include data representing the terrain, roughness or resistance to flow, and hydrology (inflows).

A Digital Elevation Model (DEM) was generated from the terrain data based on Light Detection and Ranging (LiDAR), sourced from the provincial database. Typically, LiDAR data do not provide sufficient information for defining the bed elevations for stream channels and other water bodies (e.g., lakes, wetlands), as the data cannot be collected below the water surface. In order to model the incoming tributaries and other waterbodies, a channel bed was manually cut into the terrain approximating the natural systems based on Google Earth imagery of the area.

The Manning's n roughness coefficient was assumed to be 0.06 within the natural channels that contribute flows to the realignment channel, and 0.1 within the overbank areas. This was considered to be a reasonable approximation based on available photos of the stream channels and surrounding area.

Manning's n for the Seloam Brook realignment channel was estimated to be 0.035 based on the modified channel method (Chow, 1959), using the following equation:

$$n = (n_0 + n_1 + n_2 + n_3 + n_4)*m$$

where

n_0 is a base value of n based on the channel surface (assumed 0.026 for a gravel channel)

n_1 is a correction factor for the effect of surface irregularities (assumed 0 as this is a constructed riprap channel, that will prevent bed and bank erosion)

n_2 is a correction factor for variations in the shape and size of cross-sections (assumed 0.003, as several pools will be implemented within the channel, which will vary the channel cross-section)

n_3 is a correction factor for the effect of obstructions (assumed 0.006 for obstructions like logs of boulders occupying between 5% and 15% of the channel cross-section area)

n_4 is a correction factor for the effect of vegetation (assumed 0 as instream or overbank vegetation are not expected in a riprapped channel)

m is a correction factor for the effect of the meandering of the channel (assumed 1.00 as the channel does not meander much)

The modelled inflows were determined by scaling the regional return period unit runoffs developed for the Project, as presented in the Preliminary Engineering Hydrometeorology Report (Appendix D.1), along with flood estimates generated with a rainfall runoff model developed using the HydroCAD stormwater modelling software. Flows in Seloam Brook represent the outflows from the Seloam Reservoir that are regulated by the Seloam Reservoir Dam. The mean annual discharge developed for the Seloam Reservoir outflows is within the range of observed Seloam Reservoir outflows from 2007 to 2018 as provided by Nova Scotia Power (NSP 2018).

The available information regarding the Seloam Reservoir operations was used for flood flow modelling in this study (NSP 2009). The spillway outflows from the reservoir for various return period flood events were estimated in the developed HydroCAD model, which accounts for the reservoir and spillway characteristics (NSP 2009) and includes the estimated attenuation of the lake. A 15% climate change factor was also applied to the peak flow estimates in order to account for potential future increases in storm intensity as a result of climate change, as recommended in the Preliminary Engineering Hydrometeorology report (Appendix D.1).

The resulting discharge inputs are summarized in Table 6.6-20. The Seloam Reservoir inflow node includes the flow from the reservoir outlet and the incremental inflow that is estimated to contribute to the realignment channel between the Seloam Reservoir inflow node and the Trafalgar Creek inflow node.

Table 6.6-20: Seloam Brook Realignment Inflows for 2D Modelling Scenarios

Scenario Modelled	Inflow Node	Discharge Input (m^3/s)
1 in 20 Year Annual Dry	Seloam Reservoir	0.22
	Southeast Inflow	0.02
	Trafalgar Creek	0.04
Mean Annual Discharge (MAD)	Seloam Reservoir	0.64
	Southeast Inflow	0.07
	Trafalgar Creek	0.11
Q10	Seloam Reservoir	4.8
	Southeast Inflow	2.5
	Trafalgar Creek	3.8
Q200	Seloam Reservoir	11.2
	Southeast Inflow	4.4
	Trafalgar Creek	6.6

6.6.5.2.6 *Seloam Brook Realignment Section Modelling*

Wood was retained to provide a Fish Habitat Offset Plan: Preliminary Concept Update (Appendix J.7). Offsetting alternatives were developed that are consistent with DFO guidance policy for Applying Measures to Offset Adverse Effects on Fish and Fish Habitat under the *Fisheries Act*. A key aspect of the development of offsetting alternatives was the consideration of available on-site mitigation measures to reduce overall impacts to fish and fish habitat. To this end, Wood worked to further envision the Seloam Brook Realignment from that engineered by KP (Appendix D.4) and described in Section 6.6.5.2.5. This vision included an integrated floodplain and natural channel design principles to develop highly suitable fish habitat with biological features to mitigate a large portion of the habitat losses within Seloam Brook and avoid additional HADD. Habitat design will incorporate features to mimic characteristics within the existing habitat that will be lost but will also include increased species-specific spawning habitat to provide greater productivity potential. The realignment channel will have a defined flow path to improve fish passage through the reach and mitigate the braided configuration of the existing habitat, caused by past mining activities, and will utilize the consolidated flow to maximize habitat stability and suitability.

To support the fish offset concept and to build from the KP design, Wood has completed preliminary flow design estimates of the Seloam Brook Realignment habitat considering the integrated floodplain and natural channel design principles. The modelling that was completed uses existing hydrological data generated from the KP realignment channel design to estimate the flow parameters (water depth, velocity, and wetted perimeter) within the conceptual realignment channel. The estimates generated will provide greater certainty to the design team and regulators that the concept can convey the anticipated flows and can be sustainable beyond the life of mining operations (Appendix J.5).

The concept considers that the stream channel will be the primary fish habitat and will contain the anticipated principle flows while the flood plain will allow high-flow events such as spring freshets and extreme storm events to pass, similar to a natural wetland/flood plain ecosystem. The channel and floodplain would both be designed to provide substrates, morphology and cover in the high suitability range for the fish species known to exist in the system and to provide ecological function for other species of wildlife that depend on creek corridors.

The flows used to design the stream channel and floodplain have been based on previous analytical work completed by KP during the initial design phase of the Seloam Book Realignment. While the KP diversion design was less habitat-focused, the flows estimated from historic hydrologic records and measures remain valid and were used in the revised integrated floodplain design. The initial realignment channel design provided general conditions at the realignment location such as overall slope and measures of existing, local stream conditions. These were also incorporated into the habitat design where required. Details of the modelling efforts to support the integrated floodplain and channel realignment are provided in Appendix J. 5.

6.6.5.2.7 *Hydraulic Modelling Downstream of Realignment Channel*

A site-specific Hydraulic Engineering Centre River Analysis System (HEC-RAS) model was developed for the Seloam Brook watershed. This model is specific to the Seloam Brook Realignment and the downstream receiving waterways that drain to Fifteen Mile Stream (Appendix B.9). The model incorporated site details and design details from the conceptual development of the Seloam Brook Realignment (as described by KP and Wood) in order to model potential changes to the downstream receiving environment from the Seloam Brook Realignment. This model was completed in order to further investigate the conceptual placement of features downstream of the constructed channel that could reduce stream energy (velocity) and provide additional aquatic habitat.

The net effect of the Realignment will be to route the main channel of Seloam Book and inflows from WC-12 to alternate receiving waterways within the Seloam Brook watershed. The purpose of the hydraulic modelling completed by Golder is, therefore, to simulate the discharge pathways and water velocity for the receiving waterways downstream of the Realignment and to provide conceptual options for stream energy dissipation in the downstream environment.

At the outlet of the Realignment, flow diverges via a “North Channel” and a “South Channel”. The North Channel flows west before its confluence with the main Seloam Brook reach, while the South Channel flows south to join with the main Seloam Brook reach.

A site-specific Hydraulic Engineering Centre River Analysis System (HEC-RAS) model was developed for the Realignment and downstream environment to the discharge of Seloam Brook to Fifteen Mile Stream. The model incorporated:

- High-level design details from KP (2020), such as slope, dimensions, and outlet energy dissipation pad.
- Estimated downstream (North Channel, South Channel, and Seloam Brook) stream and flood plain dimensions and stream bed roughness.

The Realignment design, as revised by Wood, was not modelled, rather, the range of stream velocity estimated through the revised design (Wood 2020) was compared from those modelled using the KP (2020) design for applicability to this downstream hydraulic assessment.

In order to assess the North Channel and South Channel, the hydraulic model was simulated with the following conditions:

- Baseline Conditions: An estimated existing discharge through the North Channel and South Channel.
- Operations Conditions: An estimated future discharge through the North Channel and South Channel and downstream Seloam Brook, with the Realignment and several conceptual downstream energy dissipation features incorporated.

The dimensions of the channel, as proposed by KP, were used in the model and are detailed in Appendix B.9. The model input data used for the natural channels are also detailed in Appendix B.9.

For consistency with EIS hydrology documentation, the hydraulic model was simulated for the average annual and the 95th percentile stream discharge conditions. Hydrological modelling completed for the EIS simulated flows at the outlet of Fifteen Mile Stream and, so, these flows were pro-rated by contributing upstream watershed size as inputs to the North Channel and South Channel from the Realignment. For the Operations Conditions scenario, the Realignment, and associated changes to watersheds as a result of infrastructure were accounted for.

6.6.5.3 Touquoy Mine Site Surface Water Quantity Effects Assessment Methodology

The Project is being developed as a satellite deposit to the Touquoy Mine Site with haulage of ore concentrate from the FMS Mine Site for processing at the Touquoy mill. The prediction of surface water quantity effects was completed for the operations and closure phases of the Project at the Touquoy Mine Site using a water balance model to simulate the water and tailings management at the Touquoy Mine Site during and after the processing of the FMS concentrate.

The calibrated water balance model at Touquoy was used to simulate the overall operational water management of the Project at Touquoy by month, as part of a water and tailings management plan. The model was run based on the processing of FMS concentrate beginning in 2023. FMS concentrate tailings will be deposited in the exhausted pit. Water surplus in the existing Touquoy TMF will be reclaimed from the existing TMF for the remainder of the FMS concentrate processing.

The Touquoy Mine Site water balance model simulates the water surplus in the exhausted Touquoy pit from both groundwater inflows, surface runoff, direct precipitation and slurry discharge and the estimated time to fill the pit under various climate scenarios. Water quality was assigned to each of the inputs to simulate the monthly water quality and the gradual improvement overtime until effluent discharge from the pit. The main objective of the water balance model is to assess the water quantity changes associated with activities during operation, reclamation, and closure of the Project.

Model inputs to account for the Project are consistent with the Touquoy Gold Project with the exception of the following changes to the existing Touquoy Mine Site water model scenario:

- Tailings deposition in the exhausted Touquoy pit assuming an average deposited dry density of 1.3 t/m^3 for subaqueous tailings deposition
- Process water decant from the existing Touquoy TMF during start-up until pond volumes are depleted
- Existing decant barge relocated to exhausted Touquoy pit for reclaim throughout the remainder of operation
- Natural filling of the Touquoy pit over time to create a pit lake overtop of the tailings
- Groundwater inflow to the pit varies from 768 m^3/day at elevation -25m, decreasing to 373 m^3/d when water elevation is at 108 m
- A spillway in the Touquoy pit at the crest elevation of 108 m to prevent overtopping and a conveyance channel to Moose River
- The prediction of water quality in the Touquoy pit using a batch reactor model of mixing in the pit

6.6.5.4 FMS Study Area Surface Water Quality Effects Assessment Methodology

6.6.5.4.1 *Modelling Approach*

The surface water quality effects predictions were completed qualitatively or using a numerical model to estimate the effluent quality from key site facilities/components and potential changes to the surface water quality of the receiving and downstream environments. The numerical model was developed using GoldSim Version 12.1, which is a graphical, object-oriented mathematical model where all input parameters and functions are defined by the user and are built as individual objects or elements linked together by mathematical expressions. The object-based nature of the model is designed to facilitate understanding of the various factors that influence an engineered or natural system, which allows for forecasting the potential changes to surface water quality.

The objective of the water quality modelling is to predict the combined-net effect that the Project components and activities may have on the quality of the surface water environment. The modelling approach used for the surface water quality predictions is a mass-balance mixing cell model with a number of site-specific components, consisting of both natural components (e.g., natural runoff, rainfall) and site components (e.g., treated effluent discharge, seepage), that are linked together to form a series of mixing cells. Each mixing cell has two or more sources of mass load that are combined to determine a "mixed" or combined water quality. The surface water quality model was constructed by building upon the GoldSim hydrology model, whereby geochemical source-terms and baseline water quality inputs were integrated with flow rates to calculate mass loading rates. The flow logic, which forms the basis of the water balance interconnectivity, is used to configure the model linkages, including determining the direction of mass movement along the flow paths and defining the location of mass mixing points. Greater detail on the modelling approach, modelled parameters, methods, assumptions and limitations is discussed in the report on the Surface Water Quality Modelling (Appendix B.6).

As a consequence of the stochastic climate variability, a broad range of resultant flows and water quality through the environment were available for the operations and post-closure phase. Statistical output and annual and monthly results are presented in Appendix B.6 and summarized herein. With respect to the water quality model receiver predictions, the average model results are assumed to represent typical conditions while the 5^{th} and 95^{th} percentile results are assumed to represent lower and upper end conditions.

6.6.5.4.2 *Project Site Components*

Source-term effluent quality predictions were completed for site components that have the potential to affect the overall site water quality; these are:

- Open pit wall runoff;
- PAG stockpile drainage;
- NAG stockpile drainage;
- LGO stockpile drainage;
- Topsoil stockpile drainage;
- Till stockpile drainage;
- Process water (water associated with the tailings from the plant site);
- TMF tailings beach runoff;
- TMF embankment runoff; and

- Tailings seepage.

The geochemical source-terms that were input into the surface water quality model are presented in the report on Geochemical Source Term Predictions for Waste Rock, Low-Grade Ore, Tailings and Overburden (Appendix F.1). The water quality modelling used both the base case and upper case source terms as inputs. As described in Appendix F.1, the base case source terms are based on the 50^{th} percentile results from applicable humidity cell testing data, while the upper case source terms are based on the 90^{th} percentile. For the purposes of the water quality modelling, the base case source terms are assumed to represent typical conditions while the upper case source terms are assumed to represent more conservative conditions.

During the operations phase, non-contact water (i.e., natural runoff from undisturbed catchments) will be diverted directly to the environment; where required this natural runoff will be directed north of the open pit and west through Seloam Brook. To manage contact water (i.e., drainage that has come into contact with disturbed rock or overburden), a series of water management ponds will be used to collect and control the flow across the Site – these are: ore and open pit pond, NAG waste rock pond, till pond. The runoff and seepage that enters the open pit will be collected in sumps and then pumped to the ore and open pit pond. The drainage from the LGO stockpile will also report to the ore and open pit pond. Drainage from the NAG and PAG stockpiles will report to the NAG waste rock pond. Drainage from the PAG stockpile will drain to the NAG and till stockpile ponds. Drainage from the till stockpile will report to the till pond. The water from the ore and open pit pond, NAG waste rock pond, and till pond will report to the TMF pond. These ponds are shown on Figure 2.1-5.

During the operations phase, the process water (water associated with the tailings) will be discharged from the plant site to the TMF pond. Tailings beach and TMF embankment runoff will collect in the TMF pond. Water that infiltrates into the subsurface will in part become groundwater and flow toward the perimeter of the TMF. A seepage collection system, comprising the north and east seepage collection ponds, will be constructed that captures seepage and returns the water back into the TMF pond via a pumpback system. The surplus in the TMF pond will be treated, if determined to be required, prior to discharge to the environment. Effluent discharge from the water treatment plant will meet the federal MDMER requirements as per the *Fisheries Act*. The flow of effluent to the environment is based on the KP site waste and water management design (Appendix D.2). The operations water quality model assumes that the TMF pond effluent flow rate will be actively controlled; in this model, the monthly effluent flow rate from the KP site waste and water management design is applied. TMF seepage that bypasses the seepage collection system will enter the adjacent surface water environment at the SW5 and SW15 catchments.

During the post-closure phase, the tailings beach will be covered with material sourced from the till and topsoil stockpiles. The TMF seepage collection system will remain in place. Contact water from the TMF seepage collection ponds and embankments, the open pit walls and seepage from the covered PAG stockpile will report to the open pit. Non-contact runoff from reclaimed former infrastructure areas (former plant site, former LGO stockpile, former till stockpile), runoff from the covered PAG stockpile, runoff from the NAG stockpile, pit catchment runoff, groundwater inflow and precipitation will also report to the open pit. The surplus in the flooded open pit will be discharged to Anti-Dam Flowage. The effluent will be treated, if determined to be required, prior to discharge to the environment. The post-closure water quality model assumed that effluent from the open pit will flow passively to the environment; in this model, the total annual effluent flow from the KP site waste and water management design is allocated monthly in accordance with the seasonal discharge pattern within the receiver (see Hydrological Modelling Appendix B.4 for additional detail).

TMF seepage that bypasses the seepage collection system will enter the adjacent surface water environment at the SW5 and SW15 catchments.

The excavation of mine rock and the development of the open pit results in the rock face of the pit walls being exposed to atmospheric conditions. The blasting of the rock typically results in a "damaged zone" of rock that consists of shallow fractures that extend into the bedrock from the face of the pit wall. The surfaces of the fractures in the damaged zone are also exposed to atmospheric conditions. The exposed rock surfaces are susceptible to weathering processes that can lead to the mobilization of constituents through oxidation and dissolution reactions. Water that comes into contact with the exposed rock surfaces (i.e., direct precipitation, groundwater inflow and runoff from the open pit catchment area) can therefore transport soluble constituents into the pit sump and affect its water quality. Because the ore and open pit pond reports to the TMF pond during operations, and the open pit discharges to the environment during the post-closure stage of the closure phase, weathering of exposed rock surfaces in the open pit can affect the water quality of the discharge to the environment.

The storage of waste rock and LGO in their respective stockpiles results in exposure to atmospheric conditions. The exposed rock surfaces, in particular the fine-grained portions, are susceptible to weathering processes that can lead to the mobilization of constituents through oxidation and dissolution reactions. Water that infiltrates into the WRSA and LGO stockpile can interact with the weathered rock surfaces and mobilize constituents that are by-products of mine rock oxidation. The runoff and seepage water that is collected at the NAG waste rock pond, till stockpile pond and the ore and open pit pond will therefore be influenced by the constituents that are mobilized from the mine rock through weathering processes. Because the ore and open pit pond and NAG waste rock ponds report to the TMF pond during operations, the weathering of exposed rock surfaces in the WRSA can affect the water quality in the TMF pond discharge to the environment during the operations phase. During the post-closure stage of the closure phase, seepage from the uncovered NAG stockpile and the covered PAG stockpile can affect the water quality in the open pit discharge to the environment.

Explosive agents, including emulsion-based explosives and potentially also ANFO, will be used during mining of the open pit. The detonation of explosives, and the consumption of its agents, is not 100% efficient; this results in the presence of undetonated blasting residues within mine rock, LGO and within the open pit. The explosive residues contain nitrate and ammonia, which are soluble and can be mobilized upon contact with water. As such, the WRSA, LGO stockpile and open pit walls are sources of nitrogen species that may have effects on water quality.

Tailings (and associated entrained process water) will be stored in the TMF, which is a subaerial facility. The subaerial deposition of tailings results in exposure to atmospheric conditions, and the tailings are therefore susceptible to weathering processes, such as oxidation and dissolution reactions. Runoff across the surface of the tailings and seepage water that infiltrates through the tailings pore space can mobilize constituents that are by-products of tailings oxidation. During the operations phase, the TMF beach runoff that reports to the TMF pond and the TMF seepage water that is collected at the TMF seepage collection ponds will be influenced by the constituents that are leached from the tailings; this can affect the water quality in the TMF pond discharge to the environment. During the post-closure stage of the closure phase the tailings beach will be covered. Water that is collected at the TMF seepage collection ponds can affect the water quality in the open pit discharge to the environment.

During the operations phase, surplus water from the TMF pond will be discharged to the environment (Anti-Dam Flowage). During the post-closure stage of the closure phase, surplus water from the flooded open pit will be discharged to the environment at Anti-Dam Flowage with necessary water treatment. Discharge from the PAG portion of the WRSA and/or water within the pit will be treated at an on-site water treatment plant, if required, such that concentrations meet federal and provincial requirements and regulations. The discharge of treated effluent from the TMF pond and the flooded open pit has the potential to affect water quality of the receiving and downstream surface water bodies.

When water quality is acceptable and treatment is no longer required, the Proponent intends to allow for a direct and passive release of surface water from the pit west into Seloam Brook, as part of the final Closure and Reclamation Plan.

6.6.5.4.3 *Regional Surface Water Receiving Environment Components*

The potential effects of the Project on surface water quality were simulated at key surface water features that are within and directly downgradient/downstream of the Project footprint. For surface water features within the LAA where there will be no changes from baseline conditions due to the Project, such as water bodies that are located upstream and upgradient of the Project footprint, numerical simulations to predict changes to surface water quality were not completed.

Predicted effects on receiving environment surface water quality were simulated at the locations presented in Table 6.6-21 and shown on Figure 6.6-20. For each watershed, the locations presented in Table 6.6-21 are listed in order from upstream to downstream, rather than by station number.

Table 6.6-21: Surface Water Quality Effects Assessment Locations

Assessment Location Point ID	Description	Rationale
SW5	Seloam Brook	Location is downstream of Seloam Lake, and collects drainage from an area that is north, and in part downgradient, of the PA. This location is a potential receiver of seepage from the TMF that bypasses the seepage collection system.
SW15	WC43 and East Brook	Location is in a stream system that includes the collection of drainage from an area located immediately southeast and downgradient of the TMF. This location is a potential receiver of seepage from the TMF that bypasses the seepage collection system.
EMZ-1	Seloam Lake	Location is within Seloam Lake at a point that is positioned 100 m downstream of a potential discharge location for treated effluent (end of the mixing zone for option #1 or EMZ-1); this is one of two options being assessed as part of the alternatives analysis for discharge of treated effluent
EMZ-2	Anti Dam Flowage	Location is within Anti-Dam Flowage at a point that is positioned 100 m downstream of a potential discharge location for treated effluent (end of the mixing zone for option #2 or EMZ-2); this is one of two options being assessed as part of the alternatives analysis for discharge of treated effluent. This location is carried through to effects assessment within this section.
SW6	Anti-Dam Flowage (outlet)	Far-field assessment location that is positioned at a point downstream of all receiving surface water bodies that have the potential to be affected by the Project

6.6.5.4.4 *Local Surface Water Quality Approach and Receiving Environment Components*

The effects of the Project on the water quality were evaluated within LCAs. Groundwater seepage predictions from the TMF and WRSA have been assessed to understand predicted effects of groundwater seepage and potential discharge into surface water systems within LCAs. The predictions for WC12 were completed by Golder and followed the methodology as described in Appendix B.7. The other LCAs predictions were completed through a qualitative evaluation of infrastructure locations and water balance requirements as described in Section 6.6.8.1.1.

6.6.5.5 Touquoy Mine Site Surface Water Quality Effects Assessment Methodology

The prediction of surface water quantity effects was completed for the operations and closure phases of the Project at the Touquoy Mine Site using qualitative and numerical modelling to simulate the water and tailings management at the Touquoy Mine Site during and after the processing of the FMS concentrate.

Water quality in Scraggy Lake and WC4 were evaluated qualitatively, as the FMS concentrate processing and deposition to the exhausted pit are not expected to change the water quality in the TMF, nor downstream.

Numerical modelling was conducted to assess the water quality effects in Moose River. A water quality model was prepared from the water balance model described in Section 6.6.5.3. Flow terms in the water balance were assigned water quality source terms

(Appendix F.1) to simulate the overall water quality of metal parameters and nitrogen species including cyanide, ammonia, nitrate, and nitrite in the Touquoy pit during operation and post closure. Mixing of the discharge from the Touquoy pit through the spillway at SW-2 at post-closure with Moose River was conducted using an assimilative capacity model (Appendix I.5).

The objectives of numerical modelling are to predict the period of time that water treatment will be required prior to the pit water effluent discharge to Moose River, and the water quality of effluent discharge to Moose River at biological monitoring stations in place to assess environmental effects.

Water quality modelling considered the pore water quality in the tailings and the groundwater inflow quality in the pit floor/ walls, dilution from surface runoff, direct precipitation, and process water surplus, and the geochemistry of the individual water quality parameters. As discussed in the source terms memo (Appendix F.1), the pore water quality in the tailings and pit walls/floor was based on geochemical source term predictions that were derived from upscaling of kinetic tests and Touquoy monitoring data. The kinetic test and Touquoy monitoring data are considered representative for FMS concentrate processing as the mined ore originates from the same geologic formation with similar sulphur content. These source terms were coupled with the inflow rates for the various components of inflow to the Touquoy pit and mixed to predict the water quality in the pit over time. The volume in the pit increased until discharge is predicted to occur. Further details of the modelling can be found in the water and tailings management plan (Appendix I.6).

As summarized in the assimilative capacity study of Moose River (Appendix I.5), a CORMIX (Doneker & Jirka 2017) mixing zone model was run to predict the length of Moose River until full mixing is achieved. Based on mass balance, water quality in Moose River is a result of the climate-driven effluent discharge and the continuous seepage input from the pit at the post closure phase. Several climate statistics were run to identify the worst-case dilution ratio between effluent discharge and flow volume in Moose River that would result in the highest metal and nitrogen species concentrations at the MDMER biological monitoring stations located at 100 m and 200 m downstream of the effluent discharge point. As full mixing of discharge effluent in Moose River is achieved in less than 30 m downstream of the discharge point, water quality was predicted for only 100 m downstream, assuming 200 m downstream has similar or better water quality. Effluent discharge water quality from the pit was assumed to meet MDMER discharge criteria for an existing mine in 2021 prior to discharge to Moose River.

6.6.5.6 Threshold for Determination of Significance

6.6.5.6.1 *Surface Water Quantity*

The general thresholds for the determination of significance of effect for water quantity are summarized in Table 5.10-1 and detailed herein. Specifically, predicted or simulated surface water flows that are beyond the existing natural variability in the studied watersheds were considered as at greater risk for changes to the physical properties of the waterways, primarily through changes in the potential for erosion or sedimentation. Additionally, the changes to the quantity of surface water discharged through the watersheds can affect the corresponding aquatic habitat, terrestrial habitat and water quality, and as such the hydrology results were also provided for consideration in those respective effects assessments.

A significant adverse effect from the Project on surface water quantity is defined as an effect that results from unmitigated and irreversible hydrological and geomorphological changes to watercourses resulting in an unmitigated loss of fish habitat. Specifically, predicted or simulated surface water flows that are beyond the existing natural variability in the studied watersheds were considered as at greater risk for changes to the physical properties of the waterways, primarily through potential changes in water level and the potential for erosion or sedimentation.

For surface water quantity, the following logic was applied to assess the magnitude of a predicted change in surface water flow:

- **Negligible** – No change in the predicted average monthly discharge from the range of simulated existing intra-annual variation.
- **Low** – Change in the average monthly discharge that is outside of, but within 10% of, the existing simulated intra-annual variation of monthly flow, of the existing simulated intra-annual variation of monthly flow. An error of 10% in streamflow measurements and discharge calculations is reasonable (Harmal et al 2006; Di Baldassarre and Montanari 2009).
- **Moderate** – Change outside of, but greater than 10% and less than 25% of, the existing simulated intra-annual variation of monthly flow.
- **High** - Change outside of the existing simulated intra-annual variation of monthly flow, greater than 25% of the existing simulated intra-annual variation of monthly flow.

The geographic extent of the residual effects in surface water quantity, if identified, considers the geographic area over which the effects are likely to be measurable. The geographic extents relevant for surface water quantity are the FMS Study Area, and the LAA as described in Section 6.6.5.1.

The timing of residual effects for water quantity considers when the residual environmental effect is expected to occur, considering seasonal aspects. The duration of residual effects considers the time frame over which the effects are likely to last, ranging from short-term to permanent. The frequency of residual effects considers the rate of recurrence of the effects, ranging from once to continuous. The reversibility of residual effects considers the time required for surface water quantity to recover to baseline conditions, or whether the changes to surface water quantity, if identified, are permanent.

Effects of the Project on surface water quantity in the LCAs have been assessed using the same thresholds described above. Given that the predictive modelling of water quantity occurred at a regional scale (sub-tertiary watersheds), rather than at each individual LCA, the assessment of significance is qualitative in nature. The effects assessment takes into account mitigation, monitoring and expected residual effects similar to the quantitative assessment presented at the sub-tertiary level.

6.6.5.6.2 *Surface Water Quality*

The characterization criteria for the determination of significance of residual environmental effects are: magnitude, geographic extent, timing, duration, frequency and reversibility (Table 5.10-1); the significance of the impact is determined through the integration of characterization criteria. The characterization criteria as they relate specifically to surface water quality are described below.

A significant adverse effect from the Project on surface water quality is defined as an unmitigated, permanent, irreversible effect (average concentrations in the receiver being greater than 95th percentile baseline concentration and the applicable water quality guideline) resulting from unauthorized discharge of deleterious substances into waters frequented by fish.

The surface water quality criteria for determining the magnitude of residual effects of effluent discharge in the receiving environment are the CCME CWQGs, the NSEQS, the FEQG, the SSWQO and the receiver-specific 95th percentile baseline concentration– these are only applied to the receiving environment. It should be noted that the NSEQS is only applied as a comparator when there is no CCME CWQG for that parameter (antimony, manganese) or where the NSEQS is more conservative than the CCME CWQG (boron). In the cases where the CCME CWQG or the FEQG is more conservative than the NSEQS (for cadmium, cobalt, uranium and zinc), the CCME CWQG or FEQG is applied as the comparator. No known surface water potable water users are present within 4 km of the FMS Study Area.

For surface water quality, the following logic was applied to assess the magnitude of a predicted change in surface water quality:

- **Negligible** – the predicted average concentrations are below the 95th percentile baseline concentration and the applicable CCME CWQGs, NSEQSs, FEQG and SSWQO.
- **Low** – 1) the predicted average concentrations are greater than the 95th percentile baseline concentration but lower than the applicable CCME CWQGs, NSEQSs, FEQG and SSWQO, or 2) the predicted average concentration is greater than the applicable CCME CWQGs, NSEQSs, FEQG and SSWQO but is lower than the 95th percentile baseline concentration (in cases where the 95th percentile baseline concentration is already greater than the applicable CCME CWQGs, NSEQSs, FEQG and SSWQO in the absence of input from the Project).
- **Moderate** – the predicted concentrations are greater than the 95th percentile baseline concentration, and concentrations greater than the applicable CCME CWQGs, NSEQSs, FEQG and SSWQO are limited to the 95th percentile receiver predictions (i.e., predictions based on infrequent climate conditions). The average receiver predictions are lower than the applicable CCME CWQGs, NSEQSs, FEQG and SSWQO.
- **High** – the predicted concentrations are greater than the 95th percentile baseline concentration, and concentrations greater than the applicable CCME CWQGs, NSEQSs, FEQG and SSWQO occur for both the average and the 95th percentile predicted receiver concentrations.

The geographic extent of the residual effects of effluent discharge, if identified, considers the geographic area over which the effects to surface water quality are likely to be measurable. The geographic extents relevant for surface water quality are the FMS Study Area and the LAA; as described in Section 6.6.5.1.1.

The timing of residual effects of effluent discharge, if identified, considers when the residual environmental effect to water quality is expected to occur, considering seasonal aspects.

The duration of residual effects considers the time frame over which the effects of effluent discharge, if identified, are likely to last, ranging from short-term to permanent.

The frequency of residual effects considers the rate of recurrence of the effects of effluent discharge, if identified, ranging from once to continuous.

The reversibility of residual effects considers the time required for surface water quality to recover to baseline conditions, or whether the changes to surface water quality are permanent and recovery to baseline conditions is not expected.

Effects of the Project on surface water quality in the LCAs are assessed using the same thresholds described above. Given that the predictive modelling of water quality occurred at a regional scale (sub-tertiary watersheds), rather than at each individual LCA, the assessment of significance is qualitative in nature. The effects assessment takes into account mitigation, monitoring and residual effects similar to the quantitative assessment presented at the sub-tertiary level.

6.6.6 Project Activities and Surface Water Interactions and Effects

During preliminary modelling for surface water quality for the Project, initial predictions indicated the probable need for mitigative measures. Options were considered for mitigation and evaluated for their effectiveness. Mitigation has been considered in modelling and as a result, mitigation commitments are described in this surface water section in advance of provision of predicted conclusions relating to surface water quality and quantity in the receiving environment (during both the operations phase and the closure (post-closure) phase). Predicted groundwater seepage from site infrastructure (waste rock pile, stockpiles and TMF at the FMS Mine Site) and predicted groundwater seepage from the exhausted pit at the Touquoy Mine Site has been incorporated into the predicted surface water modelling efforts described in this Section. This section of the EIS should be read in sequence after Section 6.5.

6.6.6.1 FMS Study Area

The potential interactions between the Project activities and surface water quantity and quality at the FMS Study Area are summarized in Table 6.6-22.

Table 6.6-22: Potential Surface Water Interactions with Project Activities at FMS Mine Site

Project Phase	Duration	Relevant Project Activity
Site Preparation and Construction Phase	1 year	• Clearing, grubbing and grading • Drilling and rock blasting • Topsoil, till and waste rock management • Wetland and watercourse alteration • Seloam Brook Realignment construction and dewatering • Mine site road construction, including lighting • Surface infrastructure installation and construction, including lighting • Collection ditch and water management pond construction, including lighting • Local traffic bypass road construction; • Culvert and bridge upgrades and construction • Environmental monitoring • General waste management
Operations Phase	7 years	• Drilling and rock blasting • Open pit dewatering • Ore management • Waste rock management • Tailings management • Surface water management • Dust and noise management • Petroleum products management • Ore processing and plant site operations • Concentrate loading and hauling • Environmental monitoring • General waste management

Project Phase	Duration	Relevant Project Activity
Closure Phase: Reclamation Stage	2-3 years	• Infrastructure demolition • Water treatment and management • Site reclamation • Environmental monitoring • General waste management
Closure Phase: Post-closure Stage	3+ years	• Water treatment and management • Environmental monitoring

These Project components, or the activities or processes associated with these Project components, have the potential to have an effect on the surface water VC. Potential project interactions are further described below.

As outlined in Table 6.6-23, 13 linear watercourses, 15 open water features, and one wetland complex will be directly impacted by the mine development. Specific impacts to watercourses and open water features that comprise fish habitat are presented in Section 6.8 (Fish and Fish Habitat). Provincial watercourse alteration permitting for those watercourses listed in Table 6.6-23 will be required to support mine development and will form part of the IA process prior to construction.

Table 6.6-23: Direct impacts to Surface Water Features

Surface Water Feature	Mine Infrastructure	Impact to Surface Water Features (m^2)
Watercourse 1	Open Pit, Diversion Berm	5,257
Watercourse 3	Potential Borrow Pit	200
Watercourse 5	Open Pit, Diversion Berm	397
Watercourse 6	Ditching, Open Pit	135
Watercourse 7	Open Pit	1005
Watercourse 8	Open Pit, Diversion Berm	920
Watercourse 9	Open Pit	102
Watercourse 10	Open Pit	56
Watercourse 11	Diversion Berm	916
Watercourse 12	Tailings Management Facility Berm only, Waterline, Ditching	314
Watercourse 19	Tailings Management Facility	200
Watercourse 22	Realignment Channel	490

Surface Water Feature	Mine Infrastructure	Impact to Surface Water Features (m^2)
Watercourse 39	Tailings Management Facility	140
Watercourse 42	Realignment Channel	509
Watercourse 43	Tailings Management Facility and Berm, Water Management Pond, Ditching	2,332
Open Water G	Diversion Berm	872
Open Water H	Diversion Berm	2,208
Open Water I	Diversion Berm	931
Open Water J	Diversion Berm, Open Pit	5,877
Open Water L	Open Pit	1,021
Open Water M	Open Pit	375
Open Water N	Open Pit	114
Open Water O	Open Pit	243
Open Water P	Open Pit	221
Open Water Q	Open Pit	2,073
Open Water R	Open Pit	1,105
Open Water S	Open Pit	831
Open Water T	Diversion Berm, Open Pit	3,242
Open Water II	Crusher Pad	996
Open Water JJ	Waste Rock Storage Area	120
Total:		33,202

This total direct impact to surface water features is in consideration of all potential watercourse alteration, but not specific to fish and fish habitat. Specific details relating to total expected impact to fish and fish habitat is described in detail in Section 6.8 and is a smaller impact than is described in Table 6.6-23.

The realignment of Seloam Brook to support pit development will result in potential release of sediment, degraded surface water as a result of historical tailings and waste rock, flooding of wetlands and physical adjustments to fish habitat. Details relating to these Project interactions and potential effects can be found in Section 6.4 (Geology/Soil/Sediment), Section 6.7 (Wetlands) and Section 6.8 (Fish and Fish Habitat).

6.6.6.2 Touquoy Mine Site

Potential interactions between the Project activities and surface water at the Touquoy Mine Site are outlined in Table 6.6-24.

Table 6.6-24: Potential Surface Water Interactions with Project Activities in the Touquoy Mine Site

Project Phase	Duration	Relevant Project Activity
Operations Phase	7 years	• Concentrate management and processing • Tailings management • Environmental monitoring • General waste management
Closure Phase: Reclamation Stage	2-3 years	• Water treatment and management • Environmental monitoring
Closure Phase: Post-closure Stage	3+ years	• Water treatment and management • Environmental monitoring

The primary potential effect of the continued use of the Touquoy facility on surface water quality is the use of the exhausted Touquoy pit for tailings storage with possible groundwater seepage degrading surface water quality in receiving environments and the potential for Accidents and Malfunctions as described in Section 6.17. Deposition of tailings in the exhausted Touquoy pit for the Project will accelerate the time to naturally fill the pit during reclamation. However, as water in the pit is planned to be treated to meet regulatory discharge limits, this does not change the environmental effects predicted for the reclamation and closure plans for the existing Touquoy Mine Site, it simply changes the total time for the pit to fill. Project effects are discussed further in Section 6.6.8.3 and 6.6.8.4.

Groundwater seepage has been predicted from the exhausted Touquoy pit (refer to Section 6.5) and has been carried forward into predictive modelling for surface water quantity and quality.

There are no further effects to surface water quality or quantity anticipated to be caused by the processing of FMS concentrate and the management of concentrate tailings from the Project. Surface water quality and quantity will continue to be monitored over the life of the Touquoy facility as part of existing approval for the Touquoy Gold Project and the revised approval for the proposed extended life of the Touquoy Mine Site associated with the Project.

6.6.7 Mitigation

6.6.7.1 FMS Study Area and Touquoy Mine Site Mitigation

The surface water quantity and quality effects assessment were completed taking into account several mitigation measures that will be included in the design of the Project – at the FMS Study Area, these include:

- Engineered facilities complying with physical stability requirements will be constructed to store waste rock (PAG and NAG stockpiles), LGO stockpile, and TMF.
- Develop and implement Surface Water and Groundwater Management and Contingency Plan to support the EMS Framework Document (Appendix L.1) during pre-construction, and construct engineered water management systems to

collect run-off and seepage from the PAG and NAG stockpiles, LGO stockpile, and TMF during operations and closure phases.

- A Mine Rock Management Plan has been developed by Lorax Environmental Services Ltd. (Appendix F.3). This plan formalizes monitoring procedures as well as provides guidance to the Proponent with respect to best practice mine rock mitigation strategies that may be considered should the results from the monitoring program indicate mitigation is necessary. To that end, this document is intended to serve as a geochemical reference guide for the various different activities at the mine that have a direct or indirect impact on ML/ARD-related processes.

- Erosion and sediment control will be implemented through an Erosion Prevention and Sediment Control Plan, which will be developed in accordance with the EMS Framework Document (Appendix L.1) implemented during the construction, operations, and closure phases. The Erosion Prevention and Sediment Control Plan will be based on BMPs to limit erosion, promote settling of sediments, and mitigate the mobilization and migration of suspended solids into nearby surface water features. BMPs for erosion and sediment control may include: the use of earthwork methods to minimize slope length and grade, ditching, sediment ponds/traps, flocculent plant (contingency use only), channel and slope armouring, use of natural vegetation buffers, re-vegetation of disturbed soil, and runoff controls (i.e., sediment fencing and small check dams).

- Explosive use (blasting) BMPs will be implemented to decrease the quantities of water-soluble residual explosives in the open pit, WRSA, and LGO stockpile. Therefore, the BMPs will assist with mitigating the presence of high levels of nitrogen species in effluents from these facilities. The BMPs may include using emulsion-based explosives (rather than ANFO) and blast design optimizations to improve blasting efficiency and reduce the blast waste rate.

- Contact water (effluent) that is comprised of inflows and runoff from the pit walls, runoff and seepage from the WRSA, runoff and seepage from the TMF will be collected and treated, if determined to be required, prior to discharge to the environment during the operations and post-closure phases. During the closure and the early years of post-closure, contact water that is collected on site will be pumped to the open pit to assist with reducing the flooding time. The runoff from the PAG stockpile will be treated (if determined to be required), prior to discharge into pit and subsequent discharge to the environment.

- Effluent will meet federal metal mining sector (MDMER) effluent limits and aquatic toxicity requirements prior to being discharged to the environment.

- Effluent outfall design will follow BMPs to optimize mixing and minimize disturbance to the surface water receiver.

- A TMF seepage collection system will be designed/implemented.

- An Emergency Response Plan will be developed to support the EMS Framework Document (Appendix L.1) and implemented, as required, to provide information on incident prevention, response procedures, training, isolation and disposal of contaminants.

- During the reclamation stage of the closure phase, the PAG stockpile will be covered with an engineered cover.

- During the reclamation stage of the closure phase, the TMF will be covered with material sourced from the till and topsoil stockpiles.

- The Seloam Brook Realignment will include a routing analysis and engineered controls downstream of the realignment channel to balance hydrological and ecological plans and to maintain stability in the upstream and downstream environment (Appendix B.9, Appendix D.4, and Appendix J.5).

- A berm will be designed and installed along the eastern end of the organic stockpile to protect it from predicted flood events.

The surface water quantity and quality effects assessment were completed taking into account mitigation measures that will be included in the design of the Project – at the Touquoy Mine Site, these include:

- Effluent will meet federal metal mining sector (MDMER) effluent limits and aquatic toxicity requirements prior to being discharged to the environment.

The actions provided in Table 6.6-25 will be implemented by the Proponent where potential direct and indirect impacts to surface water quality and quantity are possible.

Table 6.6-25: Mitigation for Surface Water

Project Phase	Mitigation Measure
C, O, CL	Develop and implement Surface Water and Groundwater Management and Contingency Plan to support the EMS Framework Document (Appendix L.1) during pre-construction, and construct engineered water management systems to collect run-off and seepage from the PAG and NAG stockpiles, LGO stockpile, and TMF during operations and closure phases
C, O, CL	Development and Implement an Erosion Prevention and Sediment Control Plan, to support the EMS Framework Document (Appendix L.1)
C	Construct engineered facilities complying with All applicable regulatory and technical requirements to store waste rock (PAG and NAG stockpiles), ore stockpiles, and tailings (TMF)
C	Develop a routing analysis and engineering controls to balance hydrological and ecological plans for the Seloam Brook Realignment Project
C	Design and install a berm along the eastern end of the organic stockpile to protect it from predicted flood events
C, O, CL	Implement the Acid Rock Drainage Prediction and Mine Rock Management Plan (Appendix F.3 and L.1) including best practice mine rock mitigation strategies that may be considered should the results from the monitoring program indicate mitigation is necessary
O	Implement explosive use (blasting) BMPs to decrease the quantities of water-soluble residual explosives in the open pit, PAG and NAG stockpiles, and LGO stockpile
O	Collect and treat (if determined to be required) contact water (effluent) that is comprised of inflows and runoff from the pit walls, runoff and seepage from the PAG and NAG stockpiles, and runoff and seepage from the TMF, prior to discharge to the environment
CL	Treat the runoff from the PAG stockpile (if determined to be required), prior to discharge into pit and subsequent discharge to the environment
O, CL	Effluent will meet federal metal mining sector (MDMER) effluent limits and aquatic toxicity requirements prior to being discharged to the environment (FMS Mine Site and Touquoy Mine Site)
O, CL	Follow BMPs for effluent outfall design to optimize mixing and minimize disturbance to the surface water receiver
O, CL	Design and implement a TMF seepage collection system

Project Phase	Mitigation Measure
C, O, CL	Develop and implement an Emergency Response Plan (ERP), to support the EMS Framework provided in Appendix L.1 to provide information on incident prevention, response procedures, training, isolation and disposal of contaminants
CL	Implement an engineered cover system over the PAG stockpile portion of the WRSA
CL	Cover the TMF with material sourced from the till and topsoil stockpiles

Note: C= Construction Phase O= Operation Phase CL= Closure Stage

6.6.8 Residual Effects and Significance

The predicted residual environmental effects of the Project on surface water are assessed to be adverse, but not significant. The determination of significance was based on overall residual effect of the Project following the implementation of appropriate mitigation measures for example water treatment (if/as required), sediment and erosion controls (if/as required) and fisheries offsetting. Residual effects and assignment of significance of the Project is summarized in Table 6.6-24. Further detail on the mitigations is provided in Section 6.8.7 (Fish and Fish Habitat). The following sections provide additional context for the characterization of surface water quantity and quality residual effects at the FMS Study Area and the Touquoy Mine Site (post-mitigation measures as described to predict water quality and quantity for each site).

The results presented in these sections represent post-mitigation predicted conditions for surface water quantity and quality at the FMS Mine Site and also be reminded that groundwater seepage, as predicted in Section 6.5, has been included in predictive modelling efforts at the FMS Mine Site and Touquoy Mine Site for surface water quantity and quality. Residual effects predicted for surface water are further addressed in biophysical sections specifically Wetlands (Section 6.7) and Fish and Fish Habitat (Section 6.8).

The key mitigations considered in predictive modelling for the FMS Mine Site include:

- during the reclamation stage of the Closure Phase, the PAG stockpile will be covered with an engineered cover; and,
- during the reclamation stage of the Closure Phase, the TMF will be covered with material sourced from the till and topsoil stockpiles;
- Conceptual engineering controls (check dams) have been incorporated into modelling downstream of the Seloam Brook Realignment; and,
- A Mine Rock Management Plan has been developed by Lorax Environmental Services Ltd. (Appendix F.3).

Table 6.6-26: Residual Effects for Surface Water – FMS Study Area

Project - VC Interactions	Direct or Indirect Effect	Mitigation and Compensation Measures	Nature of Effect	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect
				Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility		
Construction FMS Mine Site – Surface Water Quality Ground disturbance associated with earthworks increases transport of suspended solids to adjacent surface water bodies Reduction in surface flow within local catchment areas	Direct	Best Management Practices (BMPs) for erosion/ sediment control	A	L Best management practices reduce the magnitude of impact, receiver concentrations will be below MDMER and the CCME CWQGs/NSEQSs/SSC (water quality guideline)	PA (FMS Mine Site) Effects confined to FMS Mine Site PA	A Effect would be more significant during low flow conditions and/or sensitive spawning windows	ST Duration of construction is less than or equal to 1 year	R Effect occurs regularly throughout construction phase	PR Effect is partially reversible	Change in Water Quality	Not Significant
Operations FMS Mine Site – Surface Water Quality Discharge of effluent from the TMF pond to Anti-Dam Flowage Reservoir increases parameter concentrations in the receiver (assessment point EMZ-2 and SW6)	Direct	BMPs for erosion/sediment control BMPs for explosives use Engineered water management systems to collect runoff and seepage Remedial action (i.e., water treatment) (if warranted) triggered by monitoring	A	L With mitigation strategies, predicted receiver concentrations are below the water quality guideline, or the 95th percentile baseline concentration for parameters where the baseline is greater than the water quality guideline	LAA Effects extend to Anti-Dam Flowage Reservoir	A Effect would be more significant during low flow conditions and/or sensitive spawning windows	LT Unlikely to recover to baseline conditions by the end of operations (7 years)	R Effect occurs regularly throughout operations phase	PR Effect is partially reversible	Change in Water Quality	Not Significant
Operations FMS Mine Site – Surface Water Quality Seepage from the TMF that bypasses the collection system and reports to assessment points SW5 (Seloam Brook) and SW15 (East Lake) increases parameter concentrations in the receivers	Direct	Engineered water management systems to collect runoff and seepage	A	L With mitigation strategies, predicted receiver concentrations are below the water quality guideline, or the 95th percentile baseline concentration for parameters where the baseline is greater than the water quality guideline	LAA Effects extend to Anti-Dam Flowage Reservoir	A Effect would be more significant during low flow conditions and/or sensitive spawning windows	LT Unlikely to recover to baseline conditions by the end of operations (7 years)	C Effect occurs continuously throughout operations phase	PR Effect is partially reversible	Change in Water Quality	Not Significant

Project - VC Interactions	Direct or Indirect Effect	Mitigation and Compensation Measures	Nature of Effect	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect
				Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility		
Operations FMS Mine Site – Surface Water Quality Seepage from the TMF that bypasses the collection system and potentially reports to WC12 increases parameter concentrations in the receiver	Direct	Engineered water management systems to collect runoff and seepage	A	L With mitigation strategies, predicted receiver concentrations are below the water quality guideline, or the 95th percentile baseline concentration for parameters where the baseline is greater than the water quality guideline	PA (FMS Mine Site) Effects in Watercourse 12.	A Effect would be more significant during low flow conditions and/or sensitive spawning windows	LT Unlikely to recover to baseline conditions by the end of operations (7 years)	C Effect occurs continuously throughout operations phase	PR Effect is partially reversible	Change in Water Quality	Not Significant
Reclamation FMS Mine Site– Surface Water Quality Ground disturbance associated with earthworks increases transport of suspended solids to adjacent surface water bodies	Direct	Best Management Practices (BMPs) for erosion/ sediment control Engineered water management systems to collect runoff and seepage and direct to open pit	A	L Best management practices reduce the magnitude of impact, receiver concentrations will be below water quality guideline	PA (FMS Mine Site) Effects confined to FMS Mine Site	A Effect would be more significant during low flow conditions and/or sensitive spawning windows	MT The duration of reclamation is 2-3 years	R Effect occurs regularly throughout reclamation phase	PR Effect is partially reversible	Change in Water Quality	Not Significant
Post-Closure FMS Mine Site – Surface Water Quality Discharge of effluent from the flooded open pit to Anti-Dam Flowage Reservoir increases parameter concentrations in the receiver (EMZ-2 and SW6)	Direct	Engineered water management systems to collect runoff and seepage Placement of cover over the PAG stockpile Placement of cover over the tailings beach Treatment of discharge from PAG portion of WRSA prior to discharge to environment (if/as required)	A	M With mitigation strategies, the 95th percentile predicted receiver concentrations (based on upper case geochemical source terms) are greater than the water quality guideline for cadmium, cobalt and zinc	LAA Effects extend to Anti-Dam Flowage Reservoir	A Effect would be more significant during low flow conditions and/or sensitive spawning windows	P VC interaction is permanent	R Effect occurs regularly throughout post-closure phase	IR	Change in Water Quality	Not Significant

Project - VC Interactions	Direct or Indirect Effect	Mitigation and Compensation Measures	Nature of Effect	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect
				Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility		
Post-Closure FMS Mine Site – Surface Water Quality Seepage from the TMF that bypasses the collection system and reports to assessment points SW5 (Seloam Brook) and SW15 (East Lake) increases parameter concentrations in the receivers	Direct	Engineered water management systems to collect runoff and seepage Placement of cover over the tailings beach	A	L With mitigation strategies, predicted receiver concentrations are below the water quality guideline, or the 95th percentile baseline concentration for parameters where the baseline is greater than the water quality guideline	LAA Effects extend to Anti-Dam Flowage Reservoir	A Effect would be more significant during low flow conditions and/or sensitive spawning windows	P VC interaction is permanent	C Effect occurs continuously throughout post-closure phase	IR	Change in Water Quality	Not Significant
Post-Closure FMS Mine Site – Surface Water Quality Seepage from the TMF that bypasses the collection system and reports to WC12 increases parameter concentrations in the receiver	Direct	Engineered water management systems to collect runoff and seepage	A	L With mitigation strategies, predicted receiver concentrations are below the water quality guideline, or the 95th percentile baseline concentration for parameters where the baseline is greater than the water quality guideline	PA (FMS Mine Site) Effects in watercourse 12.	A Effect would be more significant during low flow conditions and/or sensitive spawning windows	LT Unlikely to recover to baseline conditions by the end of operations (7 years)	C Effect occurs continuously throughout operations phase	PR Effect is partially reversible	Change in Water Quality	Not Significant
Construction FMS Mine Site – Surface Water Quantity Construction of Open Pit perimeter berms redirects Seloam Brook	Indirect	Selection of realignment channel routing to minimize upstream standing water and maintain habitat downstream. Further described in Wetlands, Fish and Fish Habitat sections	A	H Change to the existing flow path and quantity of water discharged through Seloam Brook tributaries. Further described in Wetlands, Fish and Fish Habitat sections	PA (FMS Mine Site) Further described in Wetlands, Fish and Fish Habitat sections	A Effect would be more significant during low flow conditions and/or sensitive spawning windows Further described in Wetlands, Fish and Fish Habitat sections	P	C	IR	Change in hydrological conditions	Not Significant (in the context of geomorphological effects to the stream system). Effects are further described in Wetlands, Fish and Fish Habitat sections

Project - VC Interactions	Direct or Indirect Effect	Mitigation and Compensation Measures	Nature of Effect	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect
				Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility		
Construction/Operations – FMS Mine Site Clearing and grubbing, altered hydrology, and altered surface water quality Sediment loading and resulting change in geomorphology of channels downstream of the Seloam Brook Realignment	Indirect	Sediment and erosion control, best management practices, spill preparedness, and engagement in the watercourse permitting process Seloam Brook Realignment downstream water control structures	A	L Simulated stream velocity under baseline and operation conditions have sufficient energy to mobilize finer particles such as silts and clays	PA (FMS Mine Site)	A Effect would be more significant during high flow conditions Further described in Wetlands, Fish and Fish Habitat sections	P	S	IR	Disturbance	Not Significant (in the context of geomorphological effects to the stream system) Effects are further described in Wetlands, Fish and Fish Habitat sections
All Phases FMS Mine Site – Surface Water Quantity Reduction in flow in LCA for WC12	Direct	Monitoring to confirm	A	L Within this LCA, the reduction of surface flow is expected to fall within the natural variability of 10% change Further described in Wetlands, Fish and Fish Habitat sections	PA (FMS Mine Site) Further described in Wetlands, Fish and Fish Habitat sections.	A Effect would be more significant during low flow conditions and/or sensitive spawning windows Further described in Wetlands, Fish and Fish Habitat sections	P	C	IR	Change in hydrological conditions	Not Significant
All Phases FMS Mine Site– Surface Water Quantity Reduction in flow in LCA for WC26	Direct	Monitoring to confirm	A	M Within this LCA, the reduction of surface flow is expected to fall above the natural variability of 10% change, but below 25% Further described in Wetlands, Fish and Fish Habitat sections	PA (FMS Mine Site) Further described in Wetlands, Fish and Fish Habitat sections.	A Effect would be more significant during low flow conditions and/or sensitive spawning windows Further described in Wetlands, Fish and Fish Habitat sections	P	C	IR	Change in hydrological conditions	Not Significant (in the context of geomorphological effects to the stream system) Effects are further described in Wetlands, Fish and Fish Habitat sections
All Phases FMS Mine Site – Surface Water Quantity Reduction in flow in LCA for WC2	Direct	Monitoring to confirm	A	H Within this LCA, the reduction of surface flow is expected to fall above 25%. Further described in Wetlands, Fish and Fish Habitat sections	FMS Study Area Further described in Wetlands, Fish and Fish Habitat sections	A Effect would be more significant during low flow conditions and/or sensitive spawning windows Further described in Wetlands, Fish and Fish Habitat sections	P	C	IR	Change in hydrological conditions	Not Significant (in the context of geomorphological effects to the stream system) Effects are further described in Wetlands, Fish and Fish Habitat sections

Project - VC Interactions	Direct or Indirect Effect	Mitigation and Compensation Measures	Nature of Effect	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect
				Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility		
Operations FMS Mine Site – Surface Water Quantity Change in surface water flow quantity to assessment locations SW2, SW5, SW6 and SW14		Monitoring to confirm	A	L (Month outside the natural variability and within 10% change)	RAA	A Effect would be more significant during low flow conditions and/or sensitive spawning windows	MT	R	PR	Change in hydrological conditions	Not significant
Operations FMS Mine Site– Surface Water Quantity Change in surface water quantity to assessment location SW15	Indirect	Monitoring to confirm	A	H (>25%), limited to July outside of the existing intra-annual variability. Water level change in East Lake 5 cm, further described in Wetlands, Fish and Fish Habitat sections	LAA	A Effect would be more significant during low flow conditions and/or sensitive spawning windows Further described in Wetlands, Fish and Fish Habitat sections.	P	R	IR	Change in hydrological conditions	Not Significant (in the context of geomorphological effects to the stream system) Effects are further described in Wetlands, Fish and Fish Habitat sections
Operations/Reclamation/Post-Closure FMS Mine Site – Surface Water Quantity Change in groundwater contribution to streamflow		Monitoring to confirm	A	L (<10% change)	LAA	A Effect would be more significant during low flow conditions and/or sensitive spawning windows	MT	C	PR	Change in hydrological conditions	Not significant
Reclamation FMS Mine Site – Surface Water Quantity Change in surface water quantity to assessment location SW5, SW14, SW6 During pit filling		Monitoring to confirm	A	L (Month outside the natural variability and within 10% change)	RAA	A Effect would be more significant during low flow conditions and/or sensitive spawning windows	MT	R	PR	Change in hydrological conditions	Not significant
Reclamation FMS Mine Site– Surface Water Quantity Change in surface water quantity to assessment location SW15 During pit filling		Monitoring to confirm	A	H (>25%), limited to July outside of the existing intra-annual variability Water level change in East Lake, 5 cm, further described in Wetlands, Fish and Fish Habitat sections	PA (FMS Mine Site)	A Effect would be more significant during low flow conditions and/or sensitive spawning windows Further described in Wetlands, Fish and Fish Habitat sections	MT	R	IR	Change in hydrological conditions	Not Significant (in the context of geomorphological effects to the stream system). Effects are further described in Wetlands, Fish and Fish Habitat sections

Project - VC Interactions	Direct or Indirect Effect	Mitigation and Compensation Measures	Nature of Effect	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect
				Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility		
Reclamation FMS Mine Site – Surface Water Quantity Change in groundwater contribution to streams during pit filling		Monitoring to confirm	A	L (<10% change)	LAA	A Effect would be more significant during low flow conditions and/or sensitive spawning windows	MT	C	PR	Change in hydrological conditions	Not significant
Closure FMS Mine Site – Surface Water Quantity Change in surface water flow quantity to assessment locations SW5, SW6 and SW14		Monitoring to confirm Mitigation in place to maintain stability of stream environment upstream and downstream of Seloam Seloam Brook Realignment	A	L (Month outside the natural variability and within 10% change)	LAA (SW6)	A Effect would be more significant during low flow conditions and/or sensitive spawning windows	P	R	IR	Change in hydrological conditions	Not significant
Closure FMS Mine Site – Surface Water Quantity Change in surface water quantity to assessment location SW15		Monitoring to confirm	A	H (>25%), limited to July outside of the existing intra-annual variability Water level change in East Lake, 5 cm, further described in Wetlands, Fish and Fish Habitat sections	LAA	A Effect would be more significant during low flow conditions and/or sensitive spawning windows Further described in Wetlands, Fish and Fish Habitat sections	P	R	IR	Change in hydrological conditions	Not Significant (in the context of geomorphological effects to the stream system). Effects are further described in Wetlands, Fish and Fish Habitat sections
Closure FMS Mine Site– Surface Water Quantity Change in surface water quantity to assessment location SW5 and SW6 post treatment as required and direct discharge to Seloam Brook		Monitoring to confirm	A	L (<10% change) (SW6) M (> 10%, < 25%) SW5, July, Aug, Sept elevated above moderate threshold (increased flow)	LAA	A Effect would be more significant during low flow conditions and/or sensitive spawning windows (increased water into Seloam Brook)	P	R	IR	Change in hydrological conditions	Not significant
Closure FMS Mine Site – Surface Water Quantity Change in groundwater contribution to streamflow		Monitoring to confirm	A	L (<10% change)	LAA	A Effect would be more significant during low flow conditions and/or sensitive spawning windows	MT	C	PR	Change in hydrological conditions	Not significant

Project - VC Interactions	Direct or Indirect Effect	Mitigation and Compensation Measures	Nature of Effect	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect
				Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility		
Closure Touquoy Mine Site – Water Quality Discharge into Moose River	Change in water quality in the Moose River	Water Treatment as required Monitoring to confirm	A	L With mitigation strategies, predicted receiver concentrations are below the site-specific water quality objective	LAA	A Effect would be more significant during low flow conditions and/or sensitive spawning windows	P VC interaction is permanent	C Effect occurs continuously throughout post-closure phase	IR	Change in Water Quality	Not Significant
Closure Touquoy Mine Site – Water Quantity Discharge into Moose River and groundwater seepage	Change in hydrograph of Moose River	Monitoring to confirm	A	L (<10% change)	LAA	A Effect would be more significant during low flow conditions and/or sensitive spawning windows	P VC interaction is permanent	R	IR	Change in hydrological conditions	Not Significant

Legend (refer to Table 5.10-1 for definitions)

Nature of Effect	Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility
A Adverse	N Negligible	PA Project Area	N/A Not Applicable	ST Short-Term	O Once	R Reversible
P Positive	L Low	LAA Local Assessment Area	A Applicable	MT Medium-Term	S Sporadic	IR Irreversible
	M Moderate	RAA Regional Assessment Area		LT Long-Term	R Regular	PR Partially Reversible
	H High			P Permanent	C Continuous	

6.6.8.1 FMS Mine Site Surface Water Quantity

6.6.8.1.1 *Construction Phase*

The construction phase will consist of the development of Project facilities and infrastructure in preparation of the start of open pit mining. Some Project components, such as the TMF, will not be in operation, while other components, such as the PAG and NAG stockpiles, will be in the early stages of development. The realignment berms will be constructed to facilitate the removal of direct watershed/stream inflows to the open pit footprint and the Seloam Brook Realignment will be completed. Water withdrawal from Seloam Lake will be initiated. Water management during this stage will therefore transition flows from the natural regime (i.e., the existing conditions) to the operations phase, without effluent discharge to Anti-Dam Flowage. Water management within the open pit development area will be completed as required, in consideration of potential elevated surface water concentrations from historical tailings and waste rock presence in this area. Site water management ponds associated with the WRSA will be constructed first for use during this construction stage. A modular effluent treatment plant will be available should surface water in these ponds require treatment prior to discharge to the receiving environment. This system can be adapted and utilized throughout the life of mine, as required based on site effluent quality.

Therefore, the expected changes to changes in flow magnitude, duration or reversibility during the construction phase are limited to those that result from i) the initiation of water withdrawal from Seloam Lake and ii) the realignment of Seloam Brook and its tributaries to facilitate open pit mining. The initial withdrawal of water (300,000-500,000 m^3) from Seloam Lake will be short in duration (approximately three months) and was considered not significant as an effect, and will require an NSE Water Withdrawal Permit Approval (expected NSE Category 2 withdrawal).

The Seloam Brook Realignment will result in:

- An increase in the extent of standing water upstream of the eastern berm, to facilitate the re-routing of a tributary northward around the open pit.
- An increase in discharge through tributaries that had previously discharged via the primary Seloam Brook channel.

The combined magnitude of these changes was considered as High, given the increased flows and water levels throughout the realignment path relative to the current hydrological regime. Further, these changes are intended to be in place through the operations and closure phases and were therefore considered to be a long-term, frequent and permanent change to the Seloam Brook flow system. Conversely, the realignment will provide potential habitat to offset that lost in the infrastructure footprints, will provide habitat that isn't affected by tailings and waste rock piles from historical mining and their resulting elevated metals levels in water and sediment, and the potential for erosion will be mitigated through engineering controls such as streambank armouring or riffle/pool features, to be identified during the detailed design of the realignment.

Hydrological and hydraulic modelling was completed for the Seloam Brook Realignment to estimate velocities within, and downstream of the feature. The modelling simulated the channel and the addition of conceptual engineering controls, such as check berms, downstream of the realignment to mitigate the potential for velocity changes due to the increase in flows immediately downstream of the realignment. With the addition of these conceptual engineering controls energy was simulated to be reduced to the baseline range of simulated velocities. Further evaluation on the hydrological regime and downstream mitigation related to the Seloam Brook Realignment are provided in Appendix B.9.

Discharge from the realignment will rejoin Seloam Brook upstream of its existing confluence to Fifteen Mile Stream, and the overall potential change for watershed flows is quantified in the operations phase assessment. Given these mitigating factors, the realignment of Seloam Brook is not likely to cause significant adverse effects in the context of surface water quantity. Changes in flow and water levels relating to potential biophysical effects are further assessed in the Wetlands and Fish and Fish Habitat VC sections (Section 6.7 and 6.8).

Hydrology was also evaluated at the outlet of the WC12 feature, upstream of the inflows from Seloam Lake / Reservoir, as a result of construction of site infrastructure, mainly the TMF and stockpiles. The change in average discharge was predicted as a change that is outside of, but within 10% of, the existing simulated intra-annual variation of monthly flow in the month of July, which is considered a low magnitude change in hydrology for this system. Table 6.6-27 summarizes this estimated change.

Table 6.6-27: WC12 Estimate Monthly Change in Average Discharge

Month	Baseline (m^3/day)	Operations (m^3/day)	Reclamation (m^3/day)	Post Closure (m^3/day)
January	10,000	7,400	7,400	7,600
February	9,100	6,700	6,700	7,000
March	15,000	11,100	11,100	11,300
April	13,800	10,200	10,200	10,400
May	4,600	3,500	3,500	3,700
June	2,200	1,800	1,800	2,000
July	1,300	1,200	1,200	1,300
August	1,500	1,300	1,300	1,500
September	1,700	1,500	1,500	1,700
October	4,200	3,200	3,200	3,400
November	10,800	7,800	7,800	8,100
December	12,000	8,700	8,700	9,000

Within each additional local catchment area, MEL identified site infrastructure which will require ditching and management of water (mine contact water) to calculate the percent of each LCA's flow which would be redirected due to infrastructure construction/placement and mine operation. Site facilities, such as buildings, were not considered to remove water from that local catchment area, nor were site roads and haul roads. It is expected that appropriate cross drainage measures (culverts) will allow passage of water to cross under roads where necessary. Water collection ditches will be established surrounding the bases of the PAG and NAG stockpiles and other stockpiles. Relief is designed into these facilities so that surface water that comes into contact with them will run to the surrounding collection ditches by gravity, wherever practicable. By overlaying proposed infrastructure with each LCA, MEL calculated the approximate area of each local catchment area that would no longer provide surface water flow to the receiving environment due to infrastructure construction and water re-direction to collection ponds and the TMF. The area of each LCA expected to be adjusted due to Project development is presented in Table 6.6-28 below.

Table 6.6-28: Local Catchment Area % Decrease from Project Development

Sub-tertiary Watershed	Local Catchment Area	Drainage Area (ha)	Total Area lost (ha) from Project development	Percent of LCA Adjusted from Project Development and Resulting Estimate of Loss of Stream Flow
SW6	WC26	41.57	6.57	16%
SW5	WC2	57.39	16.42	29%
	WC5*	13.69	6.66	49%
	WC7*	85.99	60.60	70%

*Complete alteration of WC5 and WC7 is proposed to allow for construction of the open pit.

As a result of this analysis, WC2 and WC26 are estimated to experience reduced stream flow as described in Table 6.6-28. WC5 and WC7 are not further considered, as both these watercourses will be physically altered to support pit development. A water balance assessment uses the principals of conservation of mass in a closed system, whereby any water entering a system (i.e., precipitation) must be transferred into either evaporation (or evapotranspiration), surface runoff (eventually streamflow) or storage/infiltration into the ground. The change in drainage area can be used to simplify the assessment of change in streamflow to receiving watercourses as described in Table 6.6-28, based on the following assumptions:

- Precipitation rates remain constant over time (i.e. will not drastically change over the next 50+ years);
- Streamflow rates will be affected by the changes to contributing drainage area only. No modifications to land use or drainage patterns are elevated to areas outside of the proposed infrastructure; and,
- Evapotranspiration rates remain constant over time (i.e. will not change drastically over the next 50+ years).

Considering the assumptions listed above, the drainage area method is applicable to this local catchment area assessment because the only change to the water balance calculation is the contributing drainage areas. Furthermore, a conservative approach to determining the reduction in streamflow based on contributing drainage changes is to assume the ratio change will be equal to (i.e., percent change in local catchment area equals percent change in streamflow). According to Harmal and others (2006) and DiBaldassarre and Montanari (2009), a <10% error in streamflow measurements and discharge calculations is considered reasonable. A change in streamflow of <10% is considered low magnitude as it is within natural variability. Reduction in streamflow between 10% and 25% is considered moderate in magnitude. The upper limit of 25% is based on the potential for fish stranding during low flow periods. Anticipated streamflow reductions within this range is predicted in the WC26 LCA.

Reduction in streamflow above 25% is considered high in magnitude. Predicted streamflow reductions within this range is expected in the WC2 LCA.

Further evaluation of these losses within WC2 and WC26 is provided in subsequent biophysical sections (Wetlands Section 6.7 and Fish and Fish Habitat Section 6.8). No additional effects are expected from this predicted loss of stream flow within the stream systems, with the exception of those potentially associated with wetland habitat and fish habitat.

6.6.8.1.2 *Operations Phase*

Changes in surface water quantity at the FMS Mine Site are predicted as a result of several interactions between water and Project activities, with consideration of mitigation measures described in Section 6.6.7. Evaluation of these effects are described in the subsequent sections below including:

- Regional watershed realignment due to Project infrastructure
- Seloam Brook Realignment and associated potential upstream and downstream effects
- Flood events
- Local watershed realignment within the FMS Mine Site
- Groundwater-surface water interaction

6.6.8.1.2.1 Regional Watershed Realignment

The results of the surface water quantity (hydrological) modelling for the operation phase are provided in Table 6.6-29. Changes to the monthly average flow through watersheds are a consequence of:

- Watershed realignment due to Project infrastructure
- Collection, treatment and discharge of process and site water through collection ponds and direction of the contact water to the TMF (unless suitable for direct release to the receiving environment)

Table 6.6-29: Simulated Change in Surface Water Discharge, Operations Phase

Month	Seloam Lake Outlet (SW2)				Seloam Brook (SW5)				Upper Reaches Fifteen Mile Stream (SW14)				East Lake Outlet (SW15)				Anti-Dam Flowage (SW6)			
	Existing Conditions (m^3/day)	Operations Phase (m^3/day)	Change in Discharge (m^3/day)	Change (%)	Existing Conditions (m^3/day)	Operations Phase (m^3/day)	Change in Discharge (m^3/day)	Change (%)	Existing Conditions (m^3/day)	Operations Phase (m^3/day)	Change in Discharge (m^3/day)	Change (%)	Existing Conditions (m^3/day)	Operations Phase (m^3/day)	Change in Discharge (m^3/day)	Change (%)	Existing Conditions (m^3/day)	Operations Phase (m^3/day)	Change in Discharge (m^3/day)	Change (%)
January	61,900	61,400	-500	-1	93,500	84,400	-9,100	-10	433,200	424,200	-9,000	-2	8,900	5,400	-3,500	-39	595,200	592,300	-2,900	0
February	57,500	57,000	-500	-1	86,200	77,900	-8,300	-10	394,300	386,100	-8,200	-2	8,100	4,900	-3,200	-40	563,600	560,700	-2,900	-1
March	89,200	88,700	-500	-1	136,700	123,200	-13,500	-10	645,800	632,300	-13,500	-2	13,400	8,100	-5,300	-40	788,700	784,200	-4,500	-1
April	87,800	87,400	-400	0	131,400	119,000	-12,400	-9	598,700	586,300	-12,400	-2	12,300	7,400	-4,900	-40	**814,300**	**841,700**	**27,400**	**3**
May	38,500	38,300	-200	-1	53,200	49,000	-4,200	-8	209,100	204,800	-4,300	-2	4,100	2,500	-1,600	-39	424,200	446,100	21,900	5
June	24,100	24,000	-100	0	31,200	29,100	-2,100	-7	103,400	101,300	-2,100	-2	1,900	1,100	-800	-42	215,700	232,800	17,100	8
July	19,300	19,300	0	0	**23,400**	**22,200**	**-1,200**	**-5**	**63,700**	**62,500**	**-1,200**	**-2**	**1,100**	**600**	**-500**	**-45**	98,400	105,000	6,600	7
August	19,200	19,000	-200	-1	24,000	22,600	-1,400	-6	74,600	73,200	-1,400	-2	1,300	800	-500	-38	95,200	101,100	5,900	6
September	**19,000**	**18,900**	**-100**	**-1**	24,600	22,900	-1,700	-7	85,800	84,100	-1,700	-2	1,600	1,000	-600	-38	115,500	122,900	7,400	6
October	23,300	23,000	-300	-1	37,000	33,000	-4,000	-11	191,500	187,500	-4,000	-2	4,000	2,500	-1,500	-38	227,600	236,800	9,200	4
November	47,000	46,100	-900	-2	81,500	71,400	-10,100	-12	461,000	451,000	-10,000	-2	10,000	6,100	-3,900	-39	502,700	512,000	9,300	2
December	65,500	64,800	-700	-1	103,400	92,300	-11,100	-11	512,300	501,000	-11,300	-2	10,700	6,500	-4,200	-39	648,400	648,100	-300	0
Average Annual (m^3/day)	46,000	45,700	-300	-1	68,800	62,300	-6,500	-9	314,500	307,900	-6,600	-2	6,500	3,900	-2,600	-40	424,100	432,000	7,900	2
Annual Monthly Maximum (m^3/day)	89,200	88,700	-500	-1	136,700	123,200	-13,500	-10	645,800	632,300	-13,500	-2	13,400	8,100	-5,300	-40	**814,300**	**841,700**	**27,400**	**3**
Annual Monthly Minimum (m^3/day)	**19,000**	**18,900**	**-100**	**-1**	**23,400**	**22,200**	**-1,200**	**-5**	**63,700**	**62,500**	**-1,200**	**-2**	**1,100**	**600**	**-500**	**-45**	95,200	101,100	5,900	6

*Note: SW14A (Abraham Lake) assessment point not shown, no change predicted at this subwatershed. Bold values indicate discharge outside of the existing simulated intra-annual range of flows.

The net effect of these changes is described for each of the assessed locations as follows:

SW2 (Seloam Lake): The operational outflow from Seloam Lake decreases by an annual average of 500 m^3/day (excluding start up water described above), consistent with the planned process volume removal. The simulated Operations Phase average monthly discharge in September (18,900 m^3/day) is less than the minimum monthly average flow in the existing conditions (19,000 m^3/day). This is a 1% decrease in flow and a low magnitude result, and therefore is not likely to cause significant adverse effect.

SW5 (Seloam Brook): The outflow through the Seloam Brook was simulated to decrease as a result of the Project footprint and the upstream removal from Seloam Lake. The minimum monthly average flow in July (23,400 m^3/day in existing) was simulated to decrease to 22,200 m^3/day, corresponding to a 5% decrease in this month (i.e. low magnitude). Therefore, this reduction is not likely to cause significant adverse effects.

SW14 (Upper Reaches, Fifteen Mile Stream): The outflow through this watershed decreases as a result of the changes to the SW2 and SW5 catchments. However, the effect of these upstream changes is dampened by the relatively large headwaters contributing to Fifteen Mile Stream upstream of the FMS Study Area, and the minimum flow in July simulated during operations (62,500 m^3/day) represents a 2% decrease in minimum monthly average flow (i.e. a low magnitude). Therefore, this reduction in flow does not result in a significant effect. Note that at assessment point SW14A, watershed area does not change and is not affected by the operations phase (negligible in magnitude) and therefore is not likely to cause significant adverse effect related to water quantity change.

SW15 (East Lake Outlet): The area contributing to the East Lake watershed is reduced due to the construction of the TMF. Consequently, the minimum monthly average flow of 1,100 m^3/day (July) was simulated to be reduced to 600 m^3/day (July), a decrease of approximately 45%. This potential for a 45% decrease in flow beyond the natural range is a High magnitude result. The watershed loss that causes this change (TMF footprint) is limited to within the LAA, is regularly occurring and is a long duration, permanent change in this watershed. However, this predicted streamflow decrease is unlikely to result in an alteration to the morphology of the existing low energy/gradient stream, and corresponds to a water level change on the order of less than 5 cm within East Lake.

This reduction of 5 cm within East Lake has been estimated based on the following assumption – that the lake level is generally flat from the lake itself to the outlet SW15 location, which corresponds with field observations (ignoring the observed beaver dam which was present, which is temporary in nature). The method to determine this estimated vertical drop in water level within the lake therefore correlates with a drop at SW15. This reduction was estimated based on a generated flow rating curve comparison (subtraction) of simulated existing average (0.0013 m^3/s) corresponding water level and the simulated operations average flow (0.006 m^3/s) corresponding level.

The potential for this change to affect habitat is discussed in the Wetland and Fish and Fish Habitat VC sections (Sections 6.7 and 6.8), and regular monitoring of this location is proposed to continue from the on-going baseline program.

SW6 (Anti-Dam Flowage): The Anti-Dam Flowage incorporates the upstream changes in the previously described watersheds and receives the mine water effluent. The resultant discharge through the Anti-Dam Flowage generally increases, indicating the mine water management and discharge from the FMS Study Area has a greater influence on this system than the overall Project footprint change. The predicted flow increases in the Anti-Dam Flowage, approximately 7,900 m^3/day on an average annual basis, are generally within the simulated existing conditions range. The exception to this is during April, when discharge increases by approximately 27,400 m^3/day, or about 3%. This corresponds to a low magnitude classification, and therefore is not likely to cause significant adverse effect.

6.6.8.1.2.2 Seloam Brook Realignment upstream and downstream effects

The KP engineering design (Appendix D.4) and subsequent work by Wood (Appendix J.5) to envision and model a natural primary fish habitat channel with an associated natural wetland/floodplain ecosystem was completed for the Seloam Brook Realignment. The flow modelling completed by KP confirmed that the channel, as designed, is capable of passing the design flow from the upstream environment through the channel and culvert without overtopping. The results for MAD and the 1 in 20 year dry flows confirm that the channel design is sufficient to convey average and low flows, providing sufficient depth for fish passage.

As described in Section 6.6.5.2.6, Wood worked to further envision the Seloam Brook Realignment from that engineered by KP (Appendix D.4) and described in Section 6.6.5.2.5. This vision included an integrated floodplain and natural channel design principles to develop highly suitable fish habitat with biological features to mitigate a large portion of the habitat losses within Seloam Brook and avoid additional HADD. Habitat design will incorporate features to mimic characteristics within the existing habitat that will be lost but will also include increased species-specific spawning habitat to provide greater productivity potential. The realignment channel will have a defined flow path to improve fish passage through the reach and mitigate the braided configuration of the existing habitat, caused by past mining activities, and will utilize the consolidated flow to maximize habitat stability and suitability.

The Wood modelling results (Appendix J.5) are described in Table 6.6-30. The main stream channel was modified to ensure it would contain the Mean Annual Flow (MAF). The main stream channel was designed with a bottom width of 1.5 m and side slopes of 1:2.

Table 6.6-30: Model Output at Identified Flow Conditions Within the Seloam Brook Realignment Preliminary Design

Flow Condition (m^3/s)	Estimated Model Discharge (m^3/s)	Wetted Width (m)	Mean Water Velocity (m/s)	Mean Water Depth (m)	Maximum Water Depth (m)
1:20 Dry Annual (0.28)	0.28	2.16	0.47	0.28	0.33
MAF (0.82)	1.05	2.90	0.68	0.53	0.70
Q10 (11.1)	11.32	42.19	0.49	0.55	1.53
Q200 (22.2)	22.26	44.03	0.62	0.82	1.85

As shown in Table 6.6-30, an estimated flow of around 1.0m^3/s will remain within the main channel before overtopping into the flood plain. The width of the stream at this flow is estimated at 2.90 m. The model outputs also indicate that a mean water depth within the main stream channel will remain near 0.25-0.30 m during the 1:20 Dry Annual flow if the channel is designed similar to existing habitat.

Flows in excess of 1.0m^3/s are shown to overtop the main stream channel into the flood plain mimicking the function of a natural channel condition. The modelled results show that flows as high as the 200-year event would easily be contained within the conceptual flood plain, and or within a combination of constructed channel and natural topography, as was modelled by KP.

As shown by the Wood model results for the preliminary channel design, an overall general flood plain width of 40-45 m will easily contain the predicted 1:200 year flood event and that a main channel of 1.5 m in bottom width and overall total wetted width of 3.0 m would be capable of providing fish habitat similar to existing channel conditions. Greater detail regarding final channel design, 2-D extent of extreme flows, and possible use of existing topography to provide more natural flood conditions will be completed during the Fisheries Act authorization process.

6.6.8.1.2.2.1 Downstream Predicted Effects

A site-specific Hydraulic Engineering Centre River Analysis System (HEC-RAS) model was developed by Golder (Appendix B.9) for the realignment and downstream environment to the discharge of Seloam Brook to Fifteen Mile Stream.

Baseline Conditions

While discharge provides an estimate of the total water moving through the system, it is the velocity of the water that drives the energy potential that leads to changes in stream morphology (sediment transport and deposition). Therefore, the focus of these results is on velocity in the receiving waterways.

Under mean discharge rates, simulated baseline water velocities through the North Channel ranged from 0.7 m/s to less than 0.1 m/s, with an average of approximately 0.2 m/s. Through the South Channel, simulated baseline stream velocity ranged from 0.6 m/s to less than 0.1 m/s, with an average of 0.2 m/s under mean discharge rates (Table 6.6-31) as described in Appendix B.9.

For the 95th percentile discharge rate, simulated baseline stream velocity in the North Channel ranged from 0.8 m/s to less than 0.1 m/s, with an average of 0.3 m/s. For the South Channel simulated baseline stream velocity ranged from 0.7 m/s to less than 0.1 m/s, with an average of 0.3 m/s (Table 6.6-31).

Table 6.6-31: Baseline Conditions Stream Velocity

	Baseline Conditions					
	Mean Discharge			**95th Percentile Discharge**		
	Maximum – Velocity (m/s)	**Average – Velocity (m/s)**	**Minimum – Velocity (m/s)**	**Maximum – Velocity (m/s)**	**Average – Velocity (m/s)**	**Minimum – Velocity (m/s)**
North Channel	0.7	0.2	<0.1	0.8	0.3	<0.1
South Channel	0.6	0.2	<0.1	0.7	0.3	<0.1

Operations Conditions

Through an iterative process, energy dissipation features were added to the model domain that were intended to reduce stream velocity in the North Channel and South Channel. These features were conceptually considered to be check berms that would span the channel and floodplain. The optimization of the size, composition, and shape of these features will require additional study and collaboration with aquatic habitat disciplines. Conceptual placement of these structures is provided on Figure 6.8-6.

For the mean discharge scenario, simulated stream velocity through the North Channel ranged from 0.7 m/s to less than 0.1 m/s, with an average of approximately 0.2 m/s (Table 6.6-32). Through the South Channel, simulated stream velocity ranged from 0.3 m/s to less than 0.1 m/s, with an average of 0.1 m/s (Table 6.6-32).

For the 95th percentile discharge rate, simulated stream velocity in the North Channel ranged from 0.8 m/s to less than 1 m/s, with an average of 0.3 m/s (Table 6.6-32). In the South Channel, simulated stream velocity ranged from 0.5 m/s to less than 0.1 m/s, with an average of 0.2 m/s (Table 6.6-32).

Table 6.6-32: Operations Conditions Stream Velocity

	Operations Conditions					
	Mean Discharge			95th Percentile Discharge		
	Maximum – Velocity (m/s)	Average – Velocity (m/s)	Minimum – Velocity (m/s)	Maximum – Velocity (m/s)	Average – Velocity (m/s)	Minimum – Velocity (m/s)
North Channel	0.7	0.3	0.1	0.8	0.3	<0.1
South Channel	0.3	0.1	<0.1	0.5	0.2	<0.1

The range in simulated velocity along the channel lengths in Baseline Conditions and Operations Conditions are summarized in Figure 6 through Figure 9 of Appendix B.9. Stream velocity simulated along the North Channel and South Channel in the Operation Conditions were similar to those simulated in the Baseline Conditions.

Stream velocity estimated for within the revised realignment plan (as described in Appendix J.5) are in the same order of magnitude of the analysis completed herein. These estimates were for within the channel and not reflective of the plunge pool/dissipation basin incorporated in the KP realignment (as described in Appendix D.4). Therefore, it is likely that the conceptual placement and applicability of these downstream features remain consistent with this hydraulic modelling.

Flooding Extent

Under the Operation Conditions, the flood extent was also simulated with the addition of the structures. The resulting simulated flood extents for the mean average discharge rates and the 95th percentile of discharge rates are displayed on Figure 10 and Figure 11 of Appendix B.9, respectively, and shown on Figure 6.8-6. In both scenarios, the flood extent was simulated with depths ranging from 1.8 m within the channel to a maximum depth of approximately 0.4 m in the floodplain.

Sediment Mobility

Simulated stream velocity was equal to or above 0.1 m/s for the North Channel and South Channel under Baseline and Operational Conditions (Appendix B.9). Typically, water velocity above 0.1 m/s have sufficient energy to mobilize finer particles such as silts and clays. With geomorphic analysis underway on these water features, additional detail will be collected on the composition and potential mobility of sediments and the stability of the existing stream system. In turn, this work can inform the appropriate design of the Seloam Brook Realignment and the downstream energy dissipation features.

Conclusions

The South Channel and North Channel of the Seloam Brook watershed were simulated within a hydraulic model. The model was simulated for under Baseline Conditions and Operations Conditions and for a mean discharge scenario, and a 95th percentile discharge scenario.

An increase in discharge (and stream velocity), as a result of the realignment through tributaries of Seloam Brook, were simulated to be mitigated by the placement of energy dissipation features in the North Channel and South Channel. These conceptual features decrease overall simulated stream velocity (energy and sediment transport capability) to those simulated under Baseline Conditions. As a trade off, the flooded extent of the channels may occur. Therefore, additional studies are planned that consider the optimization of the size, placement, and design of these features and associated additional potential aquatic habitat.

6.6.8.1.2.2.2 Upstream Predicted Effects

Upstream of the realignment channel, flooding is not predicted to occur under the MAD flow scenario (Appendix D.4). Water levels may increase slightly in the immediate vicinity of the diversion berm; detailed design work for the realignment channel and diversion berm will occur to reduce or eliminate water level increases, both adjacent to the realignment, and in WL2 upstream of the realignment channel.

6.6.8.1.2.3 Q200 Flood Flow Scenario for the Seloam Brook Realignment

The results of the Q200 flood flow scenario, completed by KP (Appendix D.4) indicate that there is sufficient freeboard along the haul road and the diversion berm such that neither is overtopped during the modeled peak flood event. Figure 4.2 of Appendix D.4 shows the estimated water depth at the approximate chainage of 0+300 m and 0+700 m (as described in Appendix D.4).

As shown by the Wood model results for the preliminary channel design (Appendix J.5), an overall general flood plain width of 40-45m will easily contain the predicted 1:200 year flood event and that a main channel of 1.5m in bottom width and overall total wetted width of 3.0m would be capable of providing fish habitat similar to existing channel conditions. Greater detail regarding final channel design, 2-D extent of extreme flows, and possible use of existing topography to provide more natural flood conditions will be completed during the Fisheries Act authorization process.

In addition to the water depths, shear stress was calculated to estimate the size of material that would mobilize under the peak flow scenario. The calculated shear stresses were then used to confirm that the specified riprap size within the channel that would remain stable under the design flood conditions.

Shear stress is defined as follows:

$$\tau = \gamma_w R S$$

where:

- τ – shear stress (units of force per unit area)
- γ_w – unit weight of water (units of force per unit volume)
- R – hydraulic radius or wetted cross-sectional area / wetted perimeter (units of length)
- S – channel slope (dimensionless, units of length / length)

The critical shear stress required to mobilize bed material of a given size can be estimated using the Shields equation:

$$\tau_c = \tau^*(\rho_s - \rho_w)gD$$

where:

- τ_c – critical shear stress (units of force per unit area)
- τ^* – non-dimensional critical shear stress (selected representative values range from 0.03 to 0.06)
- ρ_s, ρ_w – density of bed material and water (units of mass per unit volume)

- g – gravitational acceleration (units of length per unit time squared)
- D – characteristic bed material grain size (units of length)

Riprap armor with a D_{50} = 75 mm is specified within the realignment channel (Drawing FM-C1001), in consideration of modelled shear stresses that indicate material between 2 mm and 64 mm in diameter may be mobilized. As a result, it is expected that the specified riprap is sufficiently large to withstand the shear stresses expected during the Q200 flood event, with potential for minimal channel repair required following such an event.

6.6.8.1.2.4 Local Watershed Realignment

Impacts to water quantity at the LCA scale are expected to remain similar to those discussed in the construction phase. Contact water collection ditches will be complete prior to commencement of operation, so even though infrastructure such as the PAG and NAG stockpile will continue to expand through the operation phase, the conveyance of water through collection ditches will be established prior to commencement of operations. Therefore, any alterations to flow at the LCA scale will have similar effects between the construction and operations phases as described in Section 6.6.8.1.1.

6.6.8.1.2.5 Groundwater – Surface Water Interaction

Groundwater contributions through the studied watersheds was assessed to comprise less than 15% of the total streamflow under existing conditions (Table 6.6-33). This relationship was not substantially altered during the operations phase (Table 6.6-33). Consequently, the proportion of water (and surface water temperature) are not expected to measurably change, and therefore the magnitude of change was designated as low, and therefore potential changes to groundwater contributions to surface waters during operations are not likely to cause significant adverse effect. Given the limited predicted change in groundwater contributions to surface waters, this interaction is not carried forward into Wetlands Section 6.7 and Fish and Fish Habitat Section 6.8, with the exception of the predicted drawdown (groundwater radius of influence) associated with pumping within the active pit during operations.

Table 6.6-33: Groundwater – Surface Water Interaction – Operations Phase

Watershed Name	Watershed ID	Existing Conditions			Operations Phase		
		Total Discharge[1] (m^3/day)	Groundwater Contribution[1] (m^3/day)	Groundwater Contribution (%)	Total Discharge (m^3/day)	Groundwater Contribution (m^3/day)	Groundwater Contribution (%)
Seloam Lake outlet	SW2	46,000	6,520	14	45,700	6,520	14
Seloam Brook	SW5	68,800	9,260	13	62,300	8,470	14
Upper Reaches Fifteen Mile Stream	SW14	314,500	33,500	11	307,900	32,650	11
East Lake outlet	SW15	6,500	680	10	3,900	370	9

Watershed Name	Watershed ID	Existing Conditions			Operations Phase		
		Total Discharge [1] (m^3/day)	Groundwater Contribution[1] (m^3/day)	Groundwater Contribution (%)	Total Discharge (m^3/day)	Groundwater Contribution (m^3/day)	Groundwater Contribution (%)
Anti Dam Flowage outlet	SW6	424,100	46,440	11	432,000	45,240	10

Note: [1] total discharge and groundwater contributions are average annual values, and are cumulative through the flow systems.

6.6.8.1.3 *Closure Phase*

6.6.8.1.3.1 Reclamation Stage

During the Reclamation stage of the Closure Phase, site water will be directed to the open pit in order to facilitate the filling of the pit. Consequently, site effluent discharge to Anti-Dam Flowage will cease during this stage. In addition, process water will cease to be removed from Seloam Lake. The overall Project footprint will remain as per Operations during the Reclamation stage. During post-closure, pit filling will be complete, and the open pit will operate in a surplus. The water balance model (Appendix D.2) predicts the timing of the pit filling and the volume of the surplus.

Results are shown for a range of variable climate conditions: 5th, 50th, and 95th percentiles. Under 50% percentile conditions, the open pit reaches its maximum fill volume in 41 months; however, the predicted range of pit filling times for the 5th to 95th percentiles are 35 to 47 months.

The open pit surplus during post-closure is reported as annual volumes (i.e., not cumulative volumes) and represents the surplus of the FMS Mine Site each year. Under the median climate case, the annual surplus is approximately 3.6 Mm^3 and under the 95th percentile case, the annual surplus is approximately 4.6 Mm^3.

The results of the surface water quantity (hydrological) modelling for the reclamation stage are provided in Table 6.6-34.

Table 6.6-34: Simulated Change in Surface Water Discharge, Closure Phase Reclamation Stage

Month	Seloam Lake Outlet (SW2)				Seloam Brook (SW5)				Upper Reaches Fifteen Mile Stream (SW14)				East Lake Outlet (SW15)				Anti-Dam Flowage (SW6)			
	Existing Conditions (m^3/day)	Reclamation Stage (m^3/day)	Change in Discharge (m^3/day)	Change (%)	Existing Conditions (m^3/day)	Reclamation Stage (m^3/day)	Change in Discharge (m^3/day)	Change (%)	Existing Conditions (m^3/day)	Reclamation Stage (m^3/day)	Change in Discharge (m^3/day)	Change (%)	Existing Conditions (m^3/day)	Reclamation Stage (m^3/day)	Change in Discharge (m^3/day)	Change (%)	Existing Conditions (m^3/day)	Reclamation Stage (m^3/day)	Change in Discharge (m^3/day)	Change (%)
January	61,900	61,900	0	0	93,500	84,900	-8,600	-9	433,200	424,800	-8,400	-2	8,900	5,400	-3,500	-39	595,200	591,600	-3,600	<1
February	57,500	57,500	0	0	86,200	78,300	-7,900	-9	394,300	386,400	-7,900	-2	8,100	4,900	-3,200	-40	563,600	560,700	-2,900	<1
March	89,200	89,200	0	0	136,700	123,600	-13,100	-10	645,800	632,600	-13,200	-2	13,400	8,100	-5,300	-40	788,700	782,300	-6,400	<1
April	87,800	87,800	0	0	131,400	119,400	-12,000	-9	598,700	586,700	-12,000	-2	12,300	7,400	-4,900	-40	814,300	809,300	-5,000	<1
May	38,500	38,500	0	0	53,200	49,200	-4,000	-8	209,100	205,100	-4,000	-2	4,100	2,500	-1,600	-39	424,200	422,600	-1,600	<1
June	24,100	24,100	0	0	31,200	29,300	-1,900	-6	103,400	101,500	-1,900	-2	1,900	1,100	-800	-42	215,700	214,400	-1,300	<1
July	19,300	19,300	0	0	**23,400**	**22,300**	**-1,100**	**-5**	**63,700**	**62,600**	**-1,100**	**-2**	**1,100**	**600**	**-500**	**-45**	98,400	97,700	-700	<1
August	19,200	19,200	0	0	24,000	22,700	-1,300	-5	74,600	73,300	-1,300	-2	1,300	800	-500	-38	**95,200**	**94,600**	**-600**	**<1**
September	19,000	19,000	0	0	24,600	23,100	-1,500	-6	85,800	84,300	-1,500	-2	1,600	1,000	-600	-38	115,500	115,000	-500	<1
October	23,300	23,300	0	0	37,000	33,400	-3,600	-10	191,500	187,900	-3,600	-2	4,000	2,500	-1,500	-38	227,600	226,600	-1,000	<1
November	47,000	47,000	0	0	81,500	72,200	-9,300	-11	461,000	451,700	-9,300	-2	10,000	6,100	-3,900	-39	502,700	499,700	-3,000	<1
December	65,500	65,500	0	0	103,400	93,100	-10,300	-10	512,300	501,600	-10,700	-2	10,700	6,500	-4,200	-39	648,400	644,200	-4,200	<1
Average Annual (m^3/day)	46,000	46,000	0	0	68,800	62,600	-6,200	-9	314,500	308,200	-6,300	-2	6,500	3,900	-2,600	-40	424,100	421,600	-2,500	<1
Annual Monthly Maximum (m^3/day)	89,200	89,200	0	0	136,700	123,600	-13,100	-10	645,800	632,600	-13,200	-2	13,400	8,100	-5,300	-40	814,300	809,300	-5,000	<1
Annual Monthly Minimum (m^3/day)	19,000	19,000	0	0	**23,400**	**22,300**	**-1,100**	**-5**	**63,700**	**62,600**	**-1,100**	**-2**	**1,100**	**600**	**-500**	**-45**	**95,200**	**94,600**	**-600**	**<1**

*Note: SW14A (Abraham Lake) assessment point not shown, no change predicted at this subwatershed. Bold values indicate discharge outside of the existing simulated intra-annual range of flows.

Predicted changes at Reclamation, relative to the existing conditions simulations, are summarized in the residual effects table (Table 6.6-34) and further described as follows:

SW2 (Seloam Lake outlet): The outflow from Seloam Lake returns to the existing conditions flow regime with the cessation of process water removal (i.e., no change from average flows and the natural variability). This is a negligible change and therefore is not likely to cause significant adverse effect.

SW5 (Seloam Brook): The outflow through Seloam Brook at Fifteen Mile Stream was simulated to decrease as a result of the continued collection of water across the Project footprint. The minimum monthly average flow in July (23,400 m^3/day in existing) was simulated to decrease to 22,300 m^3/day, corresponding to a 4% decrease in this month. This change was assigned a Low magnitude and therefore is not likely to cause significant adverse effect.

SW14 (Upper Reaches, Fifteen Mile Stream): The outflow through this watershed decreases as a result of the water management strategy in the SW5 catchments. However, the effect of these upstream changes is dampened by the relatively large headwaters contributing to Fifteen Mile Stream upstream of the LAA, and the minimum flow in July simulated during Reclamation (62,600 m^3/day) represents approximately 2% decrease in minimum monthly average flow from the Existing Conditions (63,700 m^3/day). This predicted decrease in flow was classified as Low magnitude and therefore is not likely to cause significant adverse effects.

SW15 (East Lake outlet): The reductions in the East Lake outflow were simulated to continue in the closure phase, reclamation stage as per operations.

SW6 (Anti-Dam Flowage): At the reclamation stage of the Closure Phase, effluent discharge from the Project site is not discharged to Anti Dam Flowage. Consequently, flow through the reservoir decreases relative to existing conditions and operations phase. The lowest simulated discharge in existing conditions was predicted in August (95,200 m^3/day); this was predicted to decrease to 94,600 m^3/day during the reclamation stage (less than 1% change). This was a Low magnitude predicted change and therefore is not likely to cause significant adverse effect.

WC12 (local catchment): At both the reclamation and the post closure stages of the Closure Phase, the loss in this catchment is consistent with construction and operations, resulting in a change in average discharge within existing variability in streamflow of <10% resulting in a low magnitude predicted change and therefore is not likely to cause significant adverse effect.

WC2 and WC26 (local catchments): At both the reclamation and the post closure stages of the Closure Phase, the loss in this catchment is consistent with construction and operations, resulting in a reduction of stream flow of 29% for WC2, resulting in a high magnitude predicted change, and a reduction of 16% for WC26, resulting in a moderate magnitude predicted change. Effects of these reductions in flow on the corresponding biophysical VCs are addressed in Sections 6.7 and 6.8.

During the closure phase of the Project, water management systems will shift the direction of surface water flow to facilitate pit filling. At the LCA level, this will not result in any changes from the operational phase related to surface water quantity.

<u>Groundwater – Surface Water Interaction</u>

As with the operations phase, the contribution of groundwater to surface water was not substantially altered during the reclamation stage of the Closure Phase (Table 6.6-35). Consequently, the magnitude of change was designated as Low, and therefore is not likely to cause significant adverse effect.

Table 6.6-35: Groundwater – Surface Water Interaction – Closure Phase, Reclamation Stage

Watershed Name	**Watershed ID**	**Existing Conditions**			**Closure Phase: Reclamation Stage**		
		Total Discharge[1] (m^3/day)	**Groundwater Contribution[1] (m^3/day)**	**Groundwater Contribution (%)**	**Total Discharge (m^3/day)**	**Groundwater Contribution (m^3/day)**	**Groundwater Contribution (%)**
Seloam Lake outlet	SW2	46,000	6,520	14	46,000	6,520	14
Seloam Brook	SW5	68,800	9,260	13	62,600	8,470	14
Upper Reaches Fifteen Mile Stream	SW14	314,500	33,500	11	308,200	32,650	11
East Lake outlet	SW15	6,500	680	10	3,900	370	9
Anti Dam Flowage outlet	SW6	424,100	46,440	11	421,300	45,240	11

Note: [1] total discharge and groundwater contributions are average annual values, and are cumulative through the flow systems.

6.6.8.1.3.2 Post-Closure Stage

At the post-closure Stage of the Closure Phase, water management will continue in the same manner as during the reclamation stage, with the exception that the open pit will be flooded, and treated (as required) effluent from the open pit will once again be directed to the Anti-Dam Flowage. As such, the primary change is in the SW6 watershed (Anti Dam Flowage). At this assessment location, discharge increases beyond the annual variability in a similar magnitude as during operations. Average discharge in April under Post-Closure increases to 827,700 m^3/day from an existing condition of 814,300 m^3/day, representing a 3% increase (Table 6.6-36). This results in a Low magnitude change and therefore is not likely to cause significant adverse effect.

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Table 6.6-36: Simulated Change in Surface Water Discharge, Closure Phase Post-Closure Stage

Month	Seloam Lake Outlet (SW2)				Seloam Brook (SW5)				Upper Reaches Fifteen Mile Stream (SW14)				East Lake Outlet (SW15)				Anti-Dam Flowage (SW6)			
	Existing Conditions (m^3/day)	Post-Closure Stage (m^3/day)	Change in Discharge (m^3/day)	Change (%)	Existing Conditions (m^3/day)	Post-Closure Stage (m^3/day)	Change in Discharge (m^3/day)	Change (%)	Existing Conditions (m^3/day)	Post-Closure Stage (m^3/day)	Change in Discharge (m^3/day)	Change (%)	Existing Conditions (m^3/day)	Post-Closure Stage (m^3/day)	Change in Discharge (m^3/day)	Change (%)	Existing Conditions (m^3/day)	Post-Closure Stage (m^3/day)	Change in Discharge (m^3/day)	Change (%)
January	61,900	61,900	0	0	93,500	84,800	-8,700	-9	433,200	424,500	-8,700	-2	8,900	5,400	-3,500	-39	595,200	603,900	8,700	1
February	57,500	57,500	0	0	86,200	78,300	-7,900	-9	394,300	386,400	-7,900	-2	8,100	4,900	-3,200	-40	563,600	571,800	8,200	1
March	89,200	89,200	0	0	136,700	123,600	-13,100	-10	645,800	632,600	-13,200	-2	13,400	8,100	-5,300	-40	788,700	808,100	19,400	2
April	87,800	87,800	0	0	131,400	119,400	-12,000	-9	598,700	586,700	-12,000	-2	12,300	7,400	-4,900	-40	**814,300**	**827,700**	**13,400**	**2**
May	38,500	38,500	0	0	53,200	49,300	-3,900	-7	209,100	205,200	-3,900	-2	4,100	2,500	-1,600	-39	424,200	429,700	5,500	1
June	24,100	24,100	0	0	31,200	29,500	-1,700	-5	103,400	101,700	-1,700	-2	1,900	1,100	-800	-42	215,700	220,800	5,100	2
July	19,300	19,300	0	0	**23,400**	**22,600**	**-800**	**-3**	**63,700**	**62,900**	**-800**	**-1**	**1,100**	**600**	**-500**	**-45**	98,400	100,500	2,100	2
August	19,200	19,200	0	0	24,000	23,000	-1,000	-4	74,600	73,500	-1,100	-1	1,300	800	-500	-38	95,200	97,300	2,100	2
September	19,000	19,000	0	0	24,600	23,300	-1,300	-5	85,800	84,500	-1,300	-2	1,600	1,000	-600	-38	115,500	117,900	2,400	2
October	23,300	23,300	0	0	37,000	33,200	-3,800	-10	191,500	187,700	-3,800	-2	4,000	2,500	-1,500	-38	227,600	232,000	4,400	2
November	47,000	47,000	0	0	81,500	71,600	-9,900	-12	461,000	451,300	-9,700	-2	10,000	6,100	-3,900	-39	502,700	511,300	8,600	2
December	65,500	65,500	0	0	103,400	92,800	-10,600	-10	512,300	501,600	-10,700	-2	10,700	6,500	-4,200	-39	648,400	659,400	11,000	2
Average Annual (m^3/day)	46,000	46,000	0	0	68,800	62,600	-6,200	-9	314,500	308,200	-6,300	-2	6,500	3,900	-2,600	-40	424,100	431,700	7,600	2
Annual Monthly Maximum (m^3/day)	89,200	89,200	0	0	136,700	123,600	-13,100	-10	645,800	632,600	-13,200	-2	13,400	8,100	-5,300	-40	**814,300**	**827,700**	**13,400**	**2**
Annual Monthly Minimum (m^3/day)	19,000	19,000	0	0	**23,400**	**22,600**	**-800**	**-3**	**63,700**	**62,900**	**-800**	**-1**	**1,100**	**600**	**-500**	**-45**	95,200	97,300	2,100	2

***Note:** SW14A (Abraham Lake) assessment point not shown, no change predicted at this subwatershed. Bold values indicate discharge outside of the existing simulated intra-annual range of flows.

During the closure phase of the Project, starting with the active reclamation stage and continuing into the post-closure stage, water management systems will re-direct surface water flow to facilitate pit filling and discharge to Anti-Dam Flowage as required. When water quality is acceptable for direct discharge, a passive water discharge will be established from the pit west into Seloam Brook. At the LCA level, this will not result in any changes from the prediction described in the operational phase related to surface water quantity within these local catchments.

Once the pit is full, and water quality is acceptable for direct discharge to the receiving environment, the discharge lines to Anti-Dam Flowage will be decommissioned and a passive water discharge will be established from the pit directly west into Seloam Brook. Design of this passive discharge has not been finalized at this stage, but is expected to consist of a rock lined channel to reduce the potential for erosion and sediment release into Seloam Brook and will be sized to accommodate predicted flow rates. This passive discharge will be finalized as part of the Closure and Reclamation Plan. The effect on regional water quantity from this change in discharge location has been considered in Table 6.6-37 below.

Table 6.6-37: Post Closure Passive Pit Discharge to Seloam Brook

Month	Seloam Brook (SW5)				Anti-Dam Flowage (SW6)			
	Existing Conditions (m³/day)	Post-Closure Stage (m³/day)	Change in Discharge (m³/day)	Change (%)	Existing Conditions (m³/day)	Post-Closure Stage (m³/day)	Change in Discharge (m³/day)	Change (%)
January	93,500	98,800	5,300	6	595,200	603,900	8,700	1
February	86,200	91,000	4,800	6	563,600	571,800	8,200	1
March	136,700	144,400	7,700	6	788,700	808,100	19,400	2
April	131,400	138,600	7,200	5	814,300	827,700	13,400	2
May	53,200	56,000	2,800	5	424,200	429,700	5,500	1
June	31,200	32,800	1,600	5	215,700	220,800	5,100	2
July	23,400	24,600	1,200	5	98,400	100,500	2,100	2
August	24,000	25,300	1,300	5	95,200	97,300	2,100	2
September	24,600	26,000	1,400	6	115,500	117,900	2,400	2
October	37,000	39,300	2,300	6	227,600	232,000	4,400	2
November	81,500	86,500	5,000	6	502,700	511,300	8,600	2
December	103,400	109,300	5,900	6	648,400	659,400	11,000	2

Month	Seloam Brook (SW5)				Anti-Dam Flowage (SW6)			
	Existing Conditions (m^3/day)	Post-Closure Stage (m^3/day)	Change in Discharge (m^3/day)	Change (%)	Existing Conditions (m^3/day)	Post-Closure Stage (m^3/day)	Change in Discharge (m^3/day)	Change (%)
Average Annual (m^3/day)	68,800	72,700	3,900	6	424,100	431,700	7,600	2
Annual Monthly Maximum (m^3/day)	136,700	144,400	7,700	6	814,300	827,700	13,400	2
Annual Monthly Minimum (m^3/day)	23,400	24,600	1,200	5	95,200	97,300	2,100	2

*Note: SW14A (Abraham Lake) assessment point not shown, no change predicted at this subwatershed. Bold values indicate discharge outside of the existing simulated intra-annual range of flows.

Groundwater – Surface Water Interaction

As with the reclamation stage, the contribution of groundwater to surface water was not substantially altered during the post-closure stage of the closure phase (Table 6.6-38). Consequently, the magnitude of change was designated as Low, and therefore is not likely to cause significant adverse effect.

Table 6.6-38: Groundwater – Surface Water Interaction – Closure Phase: Post-Closure Stage

Watershed Name	Watershed ID	Existing Conditions			Post-Closure Stage		
		Total Discharge[1] (m^3/day)	Groundwater Contribution[1] (m3/day)	Groundwater Contribution (%)	Total Discharge (m^3/day)	Groundwater Contribution (m^3/day)	Groundwater Contribution (%)
Seloam Lake outlet	SW2	46,000	6,520	14	46,000	6,520	14
Seloam Brook	SW5	68,800	9,260	13	62,600	8,800	14
Upper Reaches Fifteen Mile Stream	SW14	314,500	33,500	11	308,200	33,040	11
East Lake outlet	SW15	6,500	680	10	3,900	370	9

Watershed Name	Watershed ID	Existing Conditions			Post-Closure Stage		
		Total Discharge[1] (m^3/day)	Groundwater Contribution[1] (m3/day)	Groundwater Contribution (%)	Total Discharge (m^3/day)	Groundwater Contribution (m^3/day)	Groundwater Contribution (%)
Anti-Dam Flowage outlet	SW6	424,100	46,440	12	431,700	45,650	11

[1] total discharge and groundwater contributions are average annual values and are cumulative through the flow systems.

6.6.8.1.4 *FMS Surface Water Quantity Summary*

Water Quantity at the Project was assessed through the integration of facility designs, baseline data and the development of a numerical model to simulate the watersheds encompassing the Project footprint. The watersheds model was developed to simulate the existing conditions, and to compare those stream flows with that resultant from the Operations and Closure phases of the Project. As an overall conclusion, the Project footprint and site water management strategies have a low magnitude effect on the macro-scale overall discharge through the receiving watersheds. Similarly, the proportion of groundwater and surface water contributions was assessed as unlikely to be altered over the life cycle of the Project.

On a smaller scale, the flow through East Lake will be decreased as a result of the footprint of the TMF; the overall effect of this flow change is an approximate 5 cm decrease in water level within the lake itself. The outflow from East Lake is predicted to see a reduction in flow of 45%. The flow through the WC2 system will also be decreased as a result of the infrastructure footprints, which has a high magnitude effect in the system. The flow through the WC12 system will also be decreased as a result of the infrastructure footprints, which has a low magnitude effect in the system. Finally, the flow through the WC26 system will be decreased as a result of the infrastructure footprints, which has a moderate magnitude effect in the system.

The Seloam Brook Realignment will be implemented during the construction phase of the Project. The realignment has been modelled for four flow scenarios initially by KP, and then additionally by Wood to consider a concept that allows the stream channel to be primary fish habitat containing the principle flows, while the floodplain will allow high-flow events such as spring freshets and extreme storm events to pass similar to a natural wetland/floodplain ecosystem. These modelling efforts have confirmed that an estimated flow of approximately 1.0m3/s will remain within the main channel before overtopping in the floodplain and that the mean water depth within the main stream channel will remain near 0.25-0.30m during the 1:20 dry annual flow. Flows in excess of 1.0m3/s are shown to overtop the main stream channel into the floodplain mimicking the function of a natural channel condition. The modelled results show that flows as high as the 200-year event would easily be contained within the conceptual floodplain, and or within a combination of constructed channel and natural topography.

The significance of these changes as it relates to the potential effect on wetlands and fish and fish habitat is described in Sections 6.7 and 6.8.

6.6.8.2 FMS Mine Site Surface Water Quality

The residual effects and significance assessment for surface water quality is summarized in Table 6.5-12. A discussion of the residual effects and significance assessment for each Project phase is discussed below.

6.6.8.2.1 *Construction Phase*

The construction phase will consist of the development of Project facilities and infrastructure in preparation of the start of open pit mining. Some Project components, such as the TMF, will not be in operation, while other components, such as the PAG and NAG stockpiles, will be in the early stages of development. Therefore, there will be limited contact water generated at the site, if any at all, and the FMS Mine Site is not expected to be developed sufficiently to influence site water quality, with the exception of within the pit development area where historical tailings and waste rock are present, during the construction of the diversion berms and realignment of Seloam Brook.

A key surface water quality consideration related to the construction phase is the ground disturbance that is associated with the earthworks.

The removal of vegetation and the ground disturbance increases the potential for erosion and transport of suspended solids into the adjacent surface water features. The implementation of BMPs for control of erosion and sediment transport during construction will consist of contingency planning, monitoring, erosion control measures, runoff management, sediment control measures, and maintenance. The BMPs for erosion and sediment control are therefore expected to mitigate releases of suspended solids to the adjacent surface water bodies and to limit potential changes to the concentrations of suspended solids. The BMPs for sediment control will continue to be used during the operations and closure phases, as required. By appropriately implementing the BMPs for sediment control, the surface water quality of the surface water receivers is expected to remain within the range of concentrations observed under existing (baseline) conditions. The BMPs for erosion and sediment control that have been assumed as part of the effect assessment are listed in Section 6.6.7.

The successful implementation of BMPs for erosion and sediment control is expected to result in runoff exiting the site having suspended solids concentrations less than the MDMER effluent limit (15 mg/L). By complying with the MDMER effluent limit for suspended solids, the implementation of the BMPs will result in concentrations in the surface water receivers less than CCME CWQGs, NSEQSs, FEQG and SSWQO. During clear flow, concentrations in the surface water receiving environment are expected to be no greater than 25 mg/L above background levels for any short-term exposure (e.g., 24-h period), and no greater than 5 mg/L from background levels for longer term exposures (e.g., inputs lasting between 24 h and 30 d). During high flow, concentrations in the surface water receiving environment are expected to be no greater than 25 mg/L from background levels at any time when background levels are between 25 and 250 mg/L, and no greater than 10% of background levels when background is equal to or greater than 250 mg/L.

Because suspended solids concentrations are expected to comply with effluent limits and water quality guidelines, the Project activities during the construction phase are not likely to cause significant adverse effects to surface water quality when mitigation measures are taken into account. Care will be taken to evaluate water quality within on-site water management ponds during construction given the confirmed presence of historical tailings and waste rock piles within the pit development area. A modular effluent treatment plant will be available should treatment be required for construction water during pit development. This system can be adapted and utilized throughout the life of mine, as required based on site effluent quality.

Impacts to water quality at the LCA scale in WC2, WC12 and WC28 are not expected to be significant during the construction phase. Erosion and sediment control measures will be implemented to reduce impact of TSS to aquatic ecosystems. During this phase, collection ditches will be constructed to allow for conveyance of contact water to their appropriate collection ponds. This will allow for collection and treatment prior to release during the operational phase.

6.6.8.2.2 *Operations Phase*

A key surface water quality consideration related to the operations phase is the presence of major ions, metals and nitrogen species in contact water associated with the Project components that reports to the receiving surface water environment.

Contact water from the ore and open pit pond, NAG waste rock pond, and till stockpile pond, process water from the plant site, runoff from the tailings beach and embankments and collected TMF seepage from the north and east seepage collection ponds will report to the TMF pond, unless suitable for direct release to the receiving environment. Effluent from the TMF pond will be discharged to Anti-Dam Flowage.

The predicted TMF pond effluent quality was derived from the geochemical source terms for the contributing sources (Appendix F.1) and the site water management plan (Appendix D.2); this quality was used as the model input for the effluent discharge to Anti-Dam Flowage. The predicted TMF pond effluent quality (using both base case and upper case geochemical source terms as model inputs) is presented in Table 6.6-39 and compared to the MDMER maximum monthly mean concentrations for new mines. The predicted TMF pond effluent concentrations using base and upper case source terms are predicted to be lower than the MDMERs.

Table 6.6-39: Water Quality Model Results, Operations Phase – Predicted Tailings Management Facility Pond Effluent Quality

Parameter	**MDMER (mg/L)** (1)	**Tailings Management Facility Pond Effluent Concentration (mg/L)** (2)	
		Base Case (3)	**Upper Case** (4)
Aluminum	-	0.028	0.031
Ammonia (total)	-	0.31	0.82
Ammonia (un-ionized) (5)	0.5	0.00012	0.00033
Antimony	-	0.00032	0.00038
Arsenic	0.1	0.0081	0.010
Boron	-	0.047	0.064
Cadmium	-	0.000011	0.000025
Calcium	-	25	26
Chromium	-	0.00033	0.00046
Cobalt	-	0.00035	0.00093
Copper	0.1	0.00055	0.00085
Iron	-	0.078	0.081
Lead	0.08	0.00015	0.00033
Magnesium	-	4.1	4.8
Manganese	-	0.066	0.11
Mercury	-	0.0000071	0.0000074
Molybdenum	-	0.0080	0.0092
Nickel	0.25	0.0054	0.012

Parameter	MDMER (mg/L) (1)	Tailings Management Facility Pond Effluent Concentration (mg/L) (2)	
		Base Case (3)	Upper Case (4)
Nitrate	-	2.4	4.6
Nitrite	-	0.058	0.12
Potassium	-	17	18
Selenium	-	0.00046	0.00069
Silver	-	0.000027	0.000033
Sodium	-	36	39
Sulphate	-	228	278
Thallium	-	0.000025	0.000038
Uranium	-	0.0018	0.0027
Zinc	0.4	0.0058	0.0062

Bold − Denotes a value that is greater than (or outside of the range of) the applicable MDMER effluent limits.
'(1) Maximum monthly mean concentrations for new mines, as per the Metal and Diamond Mining Effluent Regulations (MDMER), Canada Fisheries Act. 2018.
'(2) The effluent concentration in the TMF pond was calculated based on the site water balance (Knight Piesold 2019) and the base case and upper case geochemical source terms (Lorax 2019).
'(3) TMF pond effluent concentration predicted using base case geochemical source terms provided by Lorax (2019).
'(4) TMF pond effluent concentration predicted using upper case geochemical source terms provided by Lorax (2019).
'(5) For the purposes of comparing effluent quality to MDMER, a temperature of 20oC and a pH of 6 was assumed for calculation of un-ionized ammonia. Receiver un-ionized ammonia is predicted in the GoldSim model for each timestep based on effluent total ammonia concentrations and seasonal field pH and field temperature.

The operations phase water quality model conservatively assumes that 14% of seepage that exits from the TMF at perimeter locations will bypass the perimeter seepage collection system and enter the adjacent surface water environment at the SW5 catchment, and 1% will enter the adjacent surface water environment at the SW15 catchment. It should be noted that while the groundwater modelling results indicate that seepage will not report to SW5 and SW15 during the operations phase, the operations phase water quality model conservatively applies the seepage mass load to these receivers. Thus, groundwater seepage has been considered in the predictions generated by the surface water quality modelling effort. Furthermore, groundwater seepage has been considered in predictions for WC12 at the local catchment level, as described below under Local Catchment Predictions – Water Quality.

The water quality model for the operations phase assumed that the quality of the TMF seepage that bypasses the collection system and reports to SW5 and SW15 is represented by the geochemical source term for process water (Appendix F.1). The TMF seepage concentrations using both base and upper case source terms are predicted to be lower than the MDMERs for all parameters.

Predicted effects on receiving environment surface water quality were simulated by the operations phase (EOM) water quality model at SW5, SW15, EMZ-2 and SW6 for the Anti-Dam Flowage effluent discharge location for a range of flow conditions in accordance with the hydrology model. Predictions were completed using both base case and upper case geochemical source terms as model inputs. Predicted annual concentrations of these parameters (average, 5th percentile and 95th percentile) in the receiving surface water environment are presented in Table 6.6-40 and Table 6.6-41 and compared to the 95th percentile baseline concentrations and the CCME CWQGs, NSEQSs, FEQG and SSWQO, as applicable (as described in Section 6.6.5.6.2). In addition to the annual average statistical summary, predicted monthly concentrations for key parameters (average, 5th percentile and 95th percentile) are presented graphically in the Surface Water Quality Modelling Report (Appendix B.6) and discussed below.

Table 6.6-40: Water Quality Model Results, Operations Phase – Predicted Concentrations In Receiver Water Bodies (Using Base Case Source Terms)

Parameter	CCME CWQG [1] (mg/L)	NSEQS [2] (mg/L)	FEQG [3] (mg/L)	SSWQO [4] (mg/L)	95th Percentile Baseline Concentrations (mg/L) [5]				Predicted Concentration (mg/L) [6]											
					SW5	EMZ-2 [7]	SW15 [8]	SW6	SW5			EMZ-2			SW15			SW6		
									average	5%	95%	average	5%	95%	average	5%	95%	average	5%	95%
Aluminum	0.0050 [9]	0.0050	-	-	**0.29**	**0.29**	**0.36**	**0.29**	**0.18**	**0.18**	**0.18**	**0.20**	**0.19**	**0.21**	**0.24**	**0.23**	**0.24**	**0.21**	**0.20**	**0.21**
Ammonia (total)	-	-	-	-	0.025	0.079	0.069	0.025	0.025	0.025	0.025	0.047	0.038	0.058	0.035	0.035	0.035	0.043	0.037	0.05
Ammonia (un-ionized)	0.019	-	-	-	0.000010	0.000016	0.000017	0.000013	0.00000056	0.00000056	0.00000056	0.0000011	0.00000086	0.0000013	0.00000078	0.00000078	0.00000079	0.0000010	0.00000081	0.0000011
Antimony	-	0.020	-	-	0.00050	0.00050	0.00050	0.00050	0.00050	0.00050	0.00050	0.00049	0.00048	0.00050	0.00050	0.00050	0.00050	0.00049	0.00049	0.00050
Arsenic	0.0050	0.0050	-	0.03	**0.066**	**0.026**	0.0012	**0.015**	**0.025**	**0.025**	**0.025**	**0.0062**	**0.0062**	**0.0063**	0.00070	0.00064	0.00074	**0.0056**	**0.0054**	**0.0058**
Boron	1.5	1.20	-	-	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.026	0.025	0.027	0.025	0.025	0.025	0.026	0.025	0.026
Cadmium	0.000040 [10]	- [11]	-	-	0.000018	0.000024	0.000030	0.000024	0.000012	0.000012	0.000012	0.000017	0.000016	0.000017	0.000017	0.000017	0.000017	0.000017	0.000017	0.000017
Calcium	-	-	-	-	0.84	0.88	1.3	0.88	0.75	0.72	0.77	1.9	1.1	2.8	0.93	0.81	1.0	1.6	1.0	2.2
Chromium	0.0089	-	-	-	0.00080	0.00078	0.00050	0.00050	0.00056	0.00055	0.00056	0.00054	0.00053	0.00055	0.00050	0.00050	0.00050	0.00054	0.00053	0.00054
Cobalt	-	0.010	0.00078 [12]	-	0.00049	0.00020	0.00051	0.00020	0.00026	0.00026	0.00026	0.00021	0.00020	0.00021	0.00034	0.00033	0.00034	0.00022	0.00021	0.00022
Copper	0.0020 [10]	0.0020	-	-	0.0010	0.0010	0.0010	0.0010	0.00086	0.00086	0.00087	0.00076	0.00075	0.00077	0.00084	0.00084	0.00084	0.00077	0.00077	0.00078
Iron	0.30	0.30	-	-	**0.78**	**0.87**	**1.2**	**1.0**	**0.39**	**0.39**	**0.39**	**0.35**	**0.34**	**0.36**	**0.58**	**0.58**	**0.59**	**0.37**	**0.36**	**0.38**
Lead	0.0010 [10]	0.0010	-	-	0.00025	0.00045	0.00058	0.00055	0.00025	0.00025	0.00025	0.00028	0.00028	0.00029	0.00037	0.00037	0.00037	0.00029	0.00029	0.00030
Magnesium	-	-	-	-	0.36	0.44	0.49	0.45	0.34	0.33	0.34	0.54	0.41	0.68	0.37	0.35	0.38	0.49	0.40	0.58
Manganese	-	0.820	-	-	0.11	0.085	0.087	0.076	0.073	0.073	0.073	0.067	0.067	0.067	0.056	0.056	0.057	0.066	0.066	0.067
Mercury	0.000026	0.000026	-	-	0.000019	0.0000091	0.0000065	0.000010	0.0000095	0.0000095	0.0000095	0.0000070	0.0000070	0.0000070	0.0000065	0.0000065	0.0000065	0.0000070	0.0000070	0.0000070
Molybdenum	0.073	0.073	-	-	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0013	0.0011	0.0016	0.0011	0.0010	0.0011	0.0013	0.0011	0.0014
Nickel	0.025 [10]	0.025	-	-	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0012	0.0011	0.0014	0.0010	0.0010	0.0010	0.0012	0.0011	0.0013
Nitrate	3	-	-	-	0.057	0.059	0.025	0.048	0.0050	0.0050	0.0050	0.12	0.040	0.21	0.0050	0.0050	0.0050	0.088	0.035	0.15
Nitrite	0.060	-	-	-	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0075	0.0058	0.010	0.0050	0.0050	0.0050	0.0068	0.0057	0.0082
Potassium	-	-	-	-	0.37	0.33	0.33	0.33	0.35	0.31	0.38	1.1	0.52	1.7	0.43	0.27	0.54	0.87	0.48	1.3

Parameter	CCME CWQG (1) (mg/L)	NSEQS (2) (mg/L)	FEQG (3) (mg/L)	SSWQO (4) (mg/L)	95th Percentile Baseline Concentrations (mg/L) (5)				Predicted Concentration (mg/L) (6)											
					SW5	EMZ-2 (7)	SW15 (8)	SW6	SW5			EMZ-2			SW15			SW6		
									average	5%	95%	average	5%	95%	average	5%	95%	average	5%	95%
Selenium	0.0010	0.0010	-	-	0.00050	0.00050	0.00050	0.00050	0.00050	0.00050	0.00050	0.00050	0.00050	0.00050	0.00050	0.00050	0.00050	0.00050	0.00050	0.00050
Silver	0.00025	0.00010	-	-	0.000050	0.000050	0.000050	0.000050	0.000050	0.000050	0.000050	0.000049	0.000048	0.000050	0.000050	0.000050	0.000050	0.000049	0.000049	0.000050
Sodium	-	-	-	-	2.5	3.4	2.9	3.4	2.4	2.3	2.4	4.5	3.4	5.8	2.6	2.3	2.9	4.0	3.2	4.9
Sulphate	-	-	-	-	1.0	2.1	1.0	2.6	1.3	1.1	1.4	12	4.6	21	1.9	1.2	2.3	9.1	4.0	15
Thallium	0.00080	0.00080	-	-	0.000050	0.000050	0.000050	0.000050	0.000050	0.000050	0.000050	0.000049	0.000048	0.000050	0.000050	0.000050	0.000050	0.000049	0.000049	0.000050
Uranium	0.015	0.30	-	-	0.000050	0.000050	0.000050	0.000050	0.000050	0.000050	0.000050	0.00013	0.000076	0.00020	0.000051	0.000050	0.000051	0.00011	0.000072	0.00016
Zinc	0.007 (13)	0.030	-	-	0.0025	0.0025	0.0049	0.0025	0.0025	0.0025	0.0025	0.0027	0.0026	0.0028	0.0030	0.0030	0.0030	0.0027	0.0026	0.0027

0.1 Bolding indicates a concentration greater than the CCME CWQG.
0.1 Grey shading indicates a concentration greater than the NSEQS.
0.1 Double outline indicates a concentration greater than the FEQG.
0.1 Bold outline indicates a concentration greater than the SSWQO.
0.1 Underlining indicates a concentration greater than the 95th percentile baseline concentration.

Notes
(1) - Canadian Council of Ministers of the Environment (1999 updated in 2019). Canadian Environmental Quality Guidelines for the Protection of Aquatic Life. Accessed February 6, 2019.
(2) - Nova Scotia Environment Environmental Quality Standards for Surface Water, Table 3 (July 2013).
(3) - Environment Canada Federal Environmental Quality Guideline: Cobalt (May 2017).
(4) - Site-specific water quality objective for arsenic (Intrinsik 2019).
(5) - Statistics calculated from the available surface water quality baseline dataset (June 2017 to June 2019).
(6) - Predicted annual concentration calculated from the GoldSim stochastic model using the base case geochemical source terms (Lorax 2019); statistics presented are the mean, 5th percentile and 95th percentile.
(7) - Baseline water quality for EMZ-2 is derived from the available dataset for SW14 and SW6.
(8) - Baseline water quality for SW15 is derived form the available dataset for SW12.
(9) - Guideline is variable and dependent on pH values. Refer to CCME (2019) for method of calculation.
(10) - Guideline is variable and dependent on hardness concentrations. Refer to CCME (2019) for method of calculation.
(11) - The NSEQS for cadmium is based on a 2007 CCME CWQG and is not considered herein; rather, the updated 2014 CCME CWQG is used as the comparison criteria.
(12) - Guideline is variable and dependent on hardness. Refer to Environment Canada (2017) for method of calculation.
(13) - Guideline is for dissolved zinc; guideline is variable and dependent on hardness, dissolved organic carbon, and pH. Refer to CCME (2019) for method of calculation.

Table 6.6-41: Water Quality Model Results, Operations Phase – Predicted Concentrations In Receiver Water Bodies (Using Upper Case Source Terms)

Parameter	CCME CWQG [1] (mg/L)	NSEQS [2] (mg/L)	FEQG [3] (mg/L)	SSWQO [4] (mg/L)	95th Percentile Baseline Concentrations (mg/L) [5]				Predicted Concentration (mg/L) [6]											
					SW5	EMZ-2 [7]	SW15 [8]	SW6	SW5			EMZ-2			SW15			SW6		
									average	5%	95%	average	5%	95%	average	5%	95%	average	5%	95%
Aluminum	0.0050 [9]	0.0050	-	-	**0.29**	**0.29**	**0.36**	**0.29**	**0.18**	**0.18**	**0.18**	**0.22**	**0.21**	**0.22**	**0.24**	**0.23**	**0.24**	**0.22**	**0.22**	**0.22**
Ammonia (total)	-	-	-	-	0.025	0.079	0.069	0.025	0.025	0.025	0.025	0.071	0.046	0.10	0.035	0.035	0.035	0.061	0.043	0.081
Ammonia (un-ionized)	0.019	-	-	-	0.000010	0.000016	0.000017	0.000013	0.00000056	0.00000056	0.00000056	0.0000016	0.0000010	0.0000022	0.00000078	0.00000078	0.00000079	0.0000014	0.0000009	0.0000018
Antimony	-	0.020	-	-	0.00050	0.00050	0.00050	0.00050	0.00050	0.00050	0.00050	0.00049	0.00049	0.00050	0.00050	0.00050	0.00050	0.00050	0.00049	0.00050
Arsenic	0.0050	0.0050	-	0.03	**0.066**	**0.026**	0.0012	**0.015**	**0.025**	**0.025**	**0.025**	**0.0063**	**0.0062**	**0.0065**	0.00070	0.00064	0.00074	**0.0057**	**0.0055**	**0.0059**
Boron	1.5	1.20	-	-	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.027	0.026	0.028	0.025	0.025	0.025	0.026	0.025	0.027
Cadmium	0.000040 [10]	-[11]	-	-	0.000018	0.000024	0.000030	0.000024	0.000012	0.000012	0.000012	0.000017	0.000017	0.000018	0.000017	0.000017	0.000017	0.000017	0.000017	0.000017
Calcium	-	-	-	-	0.84	0.88	1.3	0.88	0.75	0.72	0.77	1.9	1.1	2.9	0.93	0.81	1.0	1.6	1.0	2.3
Chromium	0.0089	-	-	-	0.00080	0.00078	0.00050	0.00050	0.00056	0.00055	0.00056	0.00055	0.00055	0.00055	0.00050	0.00050	0.00050	0.00054	0.00054	0.00054
Cobalt	-	0.010	0.00078 [12]	-	0.00049	0.00020	0.00051	0.00020	0.00026	0.00026	0.00026	0.00023	0.00021	0.00026	0.00034	0.00033	0.00034	0.00024	0.00022	0.00025
Copper	0.0020 [10]	0.0020	-	-	0.0010	0.0010	0.0010	0.0010	0.00086	0.00086	0.00087	0.00077	0.00077	0.00078	0.00084	0.00084	0.00084	0.00078	0.00078	0.00079
Iron	0.30	0.30	-	-	**0.78**	**0.87**	**1.2**	**1.0**	**0.39**	**0.39**	**0.39**	**0.35**	**0.34**	**0.36**	**0.58**	**0.58**	**0.59**	**0.37**	**0.36**	**0.38**
Lead	0.0010 [10]	0.0010	-	-	0.00025	0.00045	0.000583	0.00055	0.00025	0.00025	0.00025	0.0002904	0.0002891	0.0002921	0.00037	0.00037	0.00037	0.00030	0.00030	0.00030
Magnesium	-	-	-	-	0.36	0.44	0.49	0.45	0.34	0.33	0.34	0.57	0.42	0.74	0.37	0.35	0.38	0.51	0.41	0.63
Manganese	-	0.820	-	-	0.11	0.085	0.087	0.076	0.073	0.073	0.073	0.069	0.068	0.071	0.056	0.056	0.057	0.068	0.067	0.069
Mercury	0.000026	0.000026	-	-	0.000019	0.0000091	0.0000065	0.000010	0.0000095	0.0000095	0.0000095	0.0000070	0.0000070	0.0000070	0.0000065	0.0000065	0.0000065	0.0000070	0.0000070	0.0000070
Molybdenum	0.073	0.073	-	-	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0014	0.0011	0.0017	0.0011	0.0010	0.0011	0.0013	0.0011	0.0015
Nickel	0.025 [10]	0.025	-	-	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0015	0.0012	0.0020	0.0010	0.0010	0.0010	0.0014	0.0011	0.0017
Nitrate	3	-	-	-	0.057	0.059	0.025	0.048	0.0050	0.0050	0.0050	0.22	0.07	0.40	0.0050	0.0050	0.0050	0.16	0.062	0.28
Nitrite	0.060	-	-	-	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.010	0.0067	0.015	0.0050	0.0050	0.0050	0.0090	0.0064	0.012
Potassium	-	-	-	-	0.37	0.33	0.33	0.33	0.35	0.31	0.38	1.1	0.54	1.8	0.43	0.27	0.54	0.9	0.49	1.4
Selenium	0.0010	0.0010	-	-	0.00050	0.00050	0.00050	0.00050	0.00050	0.00050	0.00050	0.00051	0.00050	0.00052	0.00050	0.00050	0.00050	0.00051	0.00050	0.00051

Parameter	CCME CWQG [1] (mg/L)	NSEQS [2] (mg/L)	FEQG [3] (mg/L)	SSWQO [4] (mg/L)	95th Percentile Baseline Concentrations (mg/L) [5]				Predicted Concentration (mg/L) [6]											
					SW5	EMZ-2 [7]	SW15 [8]	SW6	SW5			EMZ-2			SW15			SW6		
									average	5%	95%	average	5%	95%	average	5%	95%	average	5%	95%
Silver	0.00025	0.00010	-	-	0.000050	0.000050	0.000050	0.000050	0.000050	0.000050	0.000050	0.000049	0.000049	0.000050	0.000050	0.000050	0.000050	0.000049	0.000049	0.000050
Sodium	-	-	-	-	2.5	3.4	2.9	3.4	2.4	2.3	2.4	4.6	3.4	6.0	2.6	2.3	2.9	4.1	3.3	5.0
Sulphate	-	-	-	-	1.0	2.1	1.0	2.6	1.3	1.1	1.4	14	5.3	25	1.9	1.2	2.3	11	4.7	18
Thallium	0.00080	0.00080	-	-	0.000050	0.000050	0.000050	0.000050	0.000050	0.000050	0.000050	0.000049	0.000049	0.000050	0.000050	0.000050	0.000050	0.000050	0.000049	0.000050
Uranium	0.015	0.30	-	-	0.000050	0.000050	0.000050	0.000050	0.000050	0.000050	0.000050	0.00018	0.00009	0.00028	0.000051	0.000050	0.000051	0.00014	0.000083	0.00021
Zinc	0.007 [13]	0.030	-	-	0.0025	0.0025	0.0049	0.0025	0.0025	0.0025	0.0025	0.0027	0.0026	0.0028	0.0030	0.0030	0.0030	0.0027	0.0026	0.0028

0.1	Bolding indicates a concentration greater than the CCME CWQG.
0.1	Grey shading indicates a concentration greater than the NSEQS.
0.1	Double outline indicates a concentration greater than the FEQG.
0.1	Bold outline indicates a concentration greater than the SSWQO.
0.1	Underlining indicates a concentration greater than the 95th percentile baseline concentration.

Notes

(1) - Canadian Council of Ministers of the Environment (1999 updated in 2019). Canadian Environmental Quality Guidelines for the Protection of Aquatic Life. Accessed February 6, 2019.
(2) - Nova Scotia Environment Environmental Quality Standards for Surface Water, Table 3 (July 2013).
(3) - Environment Canada Federal Environmental Quality Guideline: Cobalt (May 2017).
(4) - Site-specific water quality objective for arsenic (Intrinsik 2019).
(5) - Statistics calculated from the available surface water quality baseline dataset (June 2017 to June 2019).
(6) - Predicted annual concentration calculated from the GoldSim stochastic model using the upper case geochemical source terms (Lorax 2019); statistics presented are the mean, 5th percentile and 95th percentile.
(7) - Baseline water quality for EMZ-2 is derived from the available dataset for SW14 and SW6.
(8) - Baseline water quality for SW15 is derived form the available dataset for SW12.
(9) - Guideline is variable and dependent on pH values. Refer to CCME (2019) for method of calculation.
(10) - Guideline is variable and dependent on hardness concentrations. Refer to CCME (2019) for method of calculation.
(11) - The NSEQS for cadmium is based on a 2007 CCME CWQG and is not considered herein; rather, the updated 2014 CCME CWQG is used as the comparison criteria.
(12) - Guideline is variable and dependent on hardness. Refer to Environment Canada (2017) for method of calculation.
(13) - Guideline is for dissolved zinc; guideline is variable and dependent on hardness, dissolved organic carbon, and pH. Refer to CCME (2019) for method of calculation.

6.6.8.2.2.1 Base Case Source Terms

Based on the predicted annual average concentrations during the operations phase, using the base case geochemical source terms, the key results are as follows:

- At SW15, average concentrations of molybdenum and uranium are predicted to be greater than the 95th percentile baseline concentration but lower than the applicable CCME CWQG and NSEQS;
- At EMZ-2, average concentrations of nitrite, nitrate, boron, cobalt, molybdenum, nickel, uranium and zinc are predicted to be greater than the 95th percentile baseline concentration but lower than the applicable CCME CWQG, NSEQS and FEQG;
- At SW6, at the downstream end of the LAA, average concentrations of nitrite, nitrate, ammonia (total), boron, chromium, cobalt, molybdenum, nickel, uranium and zinc are predicted to be greater than the 95th percentile baseline concentration but lower than the applicable CCME CWQG, NSEQS and FEQG;
- Average concentrations of aluminum and iron are predicted to be greater than the CCME CWQGs and NSEQSs at SW5, SW15, EMZ-2 and SW6; however, the concentrations are lower than the 95th percentile baseline concentrations for the respective monitoring stations (which are also greater than the CCME CWQGs and NSEQS); and,
- Average concentrations of other modelled parameters are predicted to be lower than the 95th percentile baseline concentration and lower than the applicable CCME CWQGs, NSEQSs or SSWQO.

The monthly concentrations (average, 5th percentile and 95th percentile) of key parameters as compared to the applicable CCME CWQGs, NSEQSs, FEQG and SSWQO are presented graphically in the Surface Water Quality Modelling Report (see Appendix B.6). Using the base case source terms, the monthly average and 95th percentile predicted parameter concentrations are below the applicable CCME CWQGs, NSEQSs, FEQG, SSWQO (with the exception of aluminum and iron, which are below the 95th percentile baseline concentration).

6.6.8.2.2.2 Upper Case Source Terms

Based on the predicted annual average concentrations during the operations phase, using the upper case geochemical source terms, the key results are as follows:

- At SW15, average concentrations of molybdenum and uranium are predicted to be greater than the 95th percentile baseline concentration but lower than the CCME CWQG;
- At EMZ-2, average concentrations of nitrite, nitrate, boron, cobalt, molybdenum, nickel, uranium and zinc are predicted to be greater than the 95th percentile baseline concentration but lower than the applicable CCME CWQG, NSEQS and FEQG;
- At SW6, at the downstream end of the LAA, average concentrations of nitrite, nitrate, ammonia (total), boron, chromium, cobalt, molybdenum, nickel, selenium, uranium and zinc are predicted to be greater than the 95th percentile baseline concentration but lower than the applicable CCME CWQG, NSEQS and FEQG;
- Average concentrations of aluminum and iron are predicted to be greater than the CCME CWQGs and NSEQSs at SW5, SW15, EMZ-2 and SW6; however, the concentrations are lower than the 95th percentile baseline concentrations for the respective monitoring stations (which are also greater than the CCME CWQGs and NSEQS); and,
- Average concentrations of other modelled parameters are predicted to be lower than the 95th percentile baseline concentration and lower than the applicable CCME CWQGs, NSEQSs or SSWQO.

The monthly concentrations (average, 5th percentile and 95th percentile) of key parameters as compared to the applicable CCME CWQGs, NSEQSs, FEQG and SSWQO are presented graphically in the Surface Water Quality Modelling Report (see Appendix B.6). Using the upper case source terms, the monthly average and 95th percentile predicted parameter concentrations are below the applicable CCME CWQGs, NSEQSs, FEQG, SSWQO or 95th percentile baseline concentration.

The residual effect relevant to the surface water quality VC during the operations (EOM) phase is a change in water quality associated with Project activities. The predicted average and 95th percentile concentrations of modelled parameters are below the applicable CCME CWQGs, NSEQSs, FEQG, SSWQO or 95th percentile baseline concentration (as described in Section 6.6.5.6.2) on an annual and monthly basis, using both base case and upper case source terms. The magnitude of the effect on surface water quality during the operations phase ranges from Negligible to Low.

Intrinsik was retained to evaluate the aquatic effects as a result of the Project on the receiving environment (Anti-Dam Flowage). Their complete report is provided in Appendix C.2, outlining methodology and detailed conclusions. A summary of their conclusions relating to predicted water quality in the receiving environment of Anti-Dam Flowage during operations is provided below.

In the Operations scenario, all predicted constituent concentrations based on annual average concentrations in the upper case were consistently below selected water quality benchmarks or baseline, with the exception of iron, which marginally exceeds the respective 75th percentile baseline at SW6 and EMZ-2.

Additional modelling was conducted for all parameters to examine the potential for exceedances on a monthly basis. All parameters, when examined on a monthly basis (5th percentile; average and 95th percentile), were less than the receiving environmental quality guidelines (Appendix B.6). Predicted monthly iron results for the upper case source terms during operations are provided in Figure B-31 of Appendix B.6. The annualized exceedances over baseline identified in Appendix C.2 -Table 3-3 above for EMZ-2 and SW6, remain fairly consistent when considered on a monthly basis (see Figure B-31 of Appendix B.6). While the predicted levels slightly exceed the 75th percentile of baseline, they remain within the range of baseline and are unlikely to pose a risk to aquatic life (Appendix C.2).

The Project activities during the operations phase (EOM) are not likely to cause significant adverse effects to surface water quality.

6.6.8.2.2.3 Local Catchment Predictions – Water Quality

Water quality for WC12 was evaluated at the same assessment point as hydrology and considered the effect of TMF seepage and of topsoil stockpile area drainage.

The water quality model assumed that 15% of the total seepage that exits from the TMF at perimeter locations will bypass the perimeter seepage collection system and enter the adjacent surface water environment (14% to the north toward the WC12 watershed and 1% to the south toward the SW15 watershed). During the operations and post-closure phases, drainage from the topsoil stockpile area will also report to the WC12 watershed.

The water quality model input assumptions are as follows:

- The process water geochemical source term is used to represent TMF seepage for the operations phase;
- The pore water geochemical source term is used to represent TMF seepage for the post-closure phase;
- The topsoil geochemical source term is used to represent topsoil drainage for both the operations and post-closure phases; and,

- Baseline water quality data is not available for WC12; as such, the baseline dataset for SW2 is used to represent the quality of natural runoff associated with the WC12 watershed.

The annual and monthly concentrations at WC12 for the operations and post-closure phase, using both the base case and upper case geochemical source terms, are predicted to be lower than the applicable CCME CWQG, NSEQS, FEQG, and SSWQO for all parameters except aluminum; however, the aluminum concentrations are lower than the SW2 95th percentile baseline concentrations (which are already greater than the CCME CWQGs and NSEQS). Based on the threshold for determination of significance of effects presented in the EIS document, the magnitude of the predicted change in surface water quality at WC12 for the operations and post-closure phases ranges from negligible to low, depending on parameter.

Water management (ditching and collection) will reduce the likelihood of localized water quality impact to WC2 and WC26 within the FMS Mine Site during construction and operations phases of the Project. All mine site contact water will be directed to the TMF, reducing the likelihood of surface run off being directed into WC2 or WC26, and potentially causing a reduction in water quality in these streams.

6.6.8.2.3 *Closure Phase*

6.6.8.2.3.1 Reclamation

The reclamation stage of the Closure Phase will consist of the implementation of the closure concept presented in Section 2.0. That is, the reclamation stage is the implementation of closure planning and active site reclamation activities. A key surface water quality consideration related to reclamation is erosion and transport of suspended solids into the adjacent surface water features due to earthworks and other activities that will disturb soil and overburden. Similar to the construction phase, BMPs for control of erosion and sediment transport will be implemented during reclamation.

The successful implementation of BMPs for erosion and sediment control is expected to result in runoff exiting the site having suspended solids concentrations less than the MDMER effluent limit (15 mg/L). Furthermore, the implementation of the BMPs is expected to result in concentrations in the surface water receivers less than CCME CWQGs. During clear flow, concentrations in the surface water receiving environment are expected to be no greater than 25 mg/L above background levels for any short-term exposure (e.g., 24-h period), and no greater than 5 mg/L from background levels for longer term exposures (e.g., inputs lasting between 24 h and 30 d). During high flow, concentrations in the surface water receiving environment are expected to be no greater than 25 mg/L from background levels at any time when background levels are between 25 and 250 mg/L, and no greater than 10% of background levels when background is equal to or greater than 250 mg/L.

For the purposes of the surface water quality effects predictions, the surface water quality model results for the operations phase (EOM) are considered to be also applicable to the reclamation stage of Closure Phase. Using the EOM operations model as a surrogate for completing the numerical modelling of the reclamation stage is a reasonable approach because of the following:

- The operations model simulates the EOM with the site facilities at the ultimate extent (fully developed conditions) - therefore, site conditions during reclamation will be similar to the last year of operations with the exception of additional ground disturbance due to the closure works.
- Sources of mass load during the reclamation activities will not change considerably from operations.
- Site effluents will continue to be collected and treated, if determined to be required, and the effluent quality will meet the same specifications as during the operations phase - therefore, effluent quantity and quality would be expected to be similar to those as during operations.

Water discharge is not planned for the reclamation stage of the closure phase, as site water will be directed to the pit to facilitate filling. Therefore, the Project activities during the reclamation activities are not likely to cause significant adverse effects to surface water quality in the receiving environment (Anti Dam Flowage).

During the reclamation stage of the closure phase of the Project, water management systems will shift the direction of surface water flow to facilitate pit filling. At the LCA level, this will not result in any changes in water quantity predictions from the operational phase.

6.6.8.2.3.2 Post-closure

Similar to the operations phase, a key surface water quality consideration related to the post-closure stage of the Closure Phase is the presence of major ions, metals and nitrogen species in contact water associated with the Project site components that reports to the receiving surface water environment.

During the post-closure stage of the Closure Phase, the TMF seepage collection system will remain in place. Contact water from the TMF seepage collection ponds, the TMF beach and embankments, the open pit walls and seepage from the uncovered NAG stockpile and the covered PAG stockpile will report to the flooded open pit. For the purposes of modelling, non-contact runoff from reclaimed former infrastructure areas (former plant site, former LGO stockpile, former till stockpile), runoff shed from the uncovered NAG stockpile and the covered PAG stockpile, pit catchment runoff, groundwater inflow and precipitation will also report to the open pit. In practice, this will occur unless water quality is acceptable for direct release to the surrounding environment.

The predicted open pit effluent quality was derived from the geochemical source terms for the contributing sources (Appendix F.1) and the site water management design (Appendix D.2); this quality was used as the model input for the effluent discharge to Anti-Dam Flowage. The predicted quality of the flooded open pit effluent is presented in Table 6.6-42. The predicted open pit effluent concentrations (using both base case and upper case geochemical source terms) are predicted to be lower than the MDMERs for all parameters.

Table 6.6-42: Water Quality Model Results, Post-Closure Phase – Predicted Open Pit Effluent Quality

Parameter	MDMER (mg/L) (1)	Open Pit Effluent Concentration (mg/L) (2)	
		Base Case (3)	Upper Case (4)
Nitrite		0.011	0.017
Nitrate		0.37	0.64
Ammonia (total)		0.073	0.11
Ammonia (un-ionized)	0.5	0.000029	0.000043
Sulphate		134	171
Aluminum		0.036	0.14
Antimony		0.00029	0.00040
Arsenic	0.1	0.0055	0.012
Boron		0.029	0.040

Parameter	MDMER (mg/L) (1)	Open Pit Effluent Concentration (mg/L) (2)	
		Base Case (3)	Upper Case (4)
Cadmium		0.00013	0.00028
Calcium		17	25
Chromium		0.00065	0.00092
Cobalt		0.0037	0.0075
Copper	0.1	0.0030	0.0056
Iron		0.25	0.79
Lead	0.08	0.0015	0.0050
Magnesium		2.6	4.0
Manganese		0.13	0.31
Molybdenum		0.0030	0.0056
Nickel	0.25	0.024	0.044
Potassium		3.7	4.4
Selenium		0.00057	0.00075
Silver		0.000037	0.000042
Sodium		11	12
Thallium		0.000068	0.000089
Uranium		0.00085	0.0017
Zinc	0.4	0.034	0.039
Mercury		0.000016	0.000016

Bold − Denotes a value that is greater than (or outside of the range of) the applicable MDMER effluent limits.
(1) Maximum monthly mean concentrations for new mines, as per the Metal and Diamond Mining Effluent Regulations (MDMER), Canada Fisheries Act. 2018.
(2) The effluent concentration in the flooded open pit was calculated based on the site water balance (Knight Piesold 2019) and the base case and upper case geochemical source terms (Lorax 2019).
(3) Open pit effluent concentration predicted using base case geochemical source terms provided by Lorax (2019).
(4) Open pit effluent concentration predicted using upper case geochemical source terms provided by Lorax (2019).
(5) For the purposes of comparing effluent quality to MDMER, a temperature of 20oC and a pH of 6 was assumed for calculation of un-ionized ammonia. Receiver un-ionized ammonia is predicted in the GoldSim model for each timestep based on effluent total ammonia concentrations and seasonal field pH and field temperature.

During the post-closure stage of the Closure Phase, the surplus in the flooded open pit will be discharged to Anti-Dam Flowage. Prior to discharge to the environment, the open pit effluent will be treated, if required, to a concentration such that the resultant water quality in the receiver (at EMZ-2) meets the applicable CCME CWQGs, NSEQSs, FEQG or SSWQO; this mitigation measure is described in Section 6.6.7.

The water quality model for the post-closure stage of the Closure Phase assumes that 14% of seepage that exits from the TMF at perimeter locations will bypass the perimeter seepage collection system and enter the adjacent surface water environment at the SW5 catchment at WC12 and 1% will enter the adjacent surface water environment at the SW15 (East Lake) catchment. The water quality model assumed that seepage quality is represented by the geochemical source term for TMF pore water (Appendix F.1). The TMF seepage concentrations using both base and upper case source terms are predicted to be lower than the MDMERs for all parameters.

Predicted effects on receiving environment surface water quality were simulated by the post-closure water quality model at SW5, SW15, EMZ-2 and SW6 for the Anti-Dam Flowage effluent discharge for a range of flow conditions in accordance with the hydrology model. Predictions were completed using both base case and upper case geochemical source terms as model inputs. Predicted annual concentrations of these parameters (average, 5th percentile and 95th percentile) in the receiving surface water environment are presented in Table 6.6-43 and Table 6.6-44 and compared to the 95th percentile baseline concentrations and CCME CWQGs, NSEQSs, FEQG and SSWQO as applicable (as described in Section 6.6.5.6.2). In addition to the annual average statistical summary, predicted monthly concentrations for key parameters (average, 5th percentile and 95th percentile) are presented graphically in the Surface Water Quality Modelling Report (see Appendix B.6) and discussed below.

Table 6.6-43: Water Quality Model Results, Post Closure Phase – Predicted Concentrations In Receiver Water Bodies (Using Base Case Source Terms)

Parameter	CCME CWQG (1) (mg/L)	NSEQS (2) (mg/L)	FEQG (3) (mg/L)	SSWQO (4) (mg/L)	95th Percentile Baseline Concentrations (mg/L) (5)				Predicted Concentration (mg/L) (6)											
					SW5	EMZ-2 (7)	SW15 (8)	SW6	SW5			EMZ-2			SW15			SW6		
									average	5%	95%	average	5%	95%	average	5%	95%	average	5%	95%
Aluminum	0.0050 (9)	0.0050	-	-	**0.29**	**0.29**	**0.36**	**0.29**	**0.18**	**0.18**	**0.18**	**0.20**	**0.20**	**0.21**	**0.24**	**0.23**	**0.24**	**0.21**	**0.20**	**0.21**
Ammonia (total)	-	-	-	-	0.025	0.079	0.069	0.025	0.025	0.025	0.025	0.036	0.035	0.037	0.035	0.035	0.035	0.035	0.034	0.04
Ammonia (un-ionized)	0.019	-	-	-	0.000010	0.000016	0.000017	0.000013	0.00000056	0.00000056	0.00000056	0.00000081	0.00000078	0.00000083	0.00000079	0.00000078	0.00000079	0.00000078	0.00000075	0.00000080
Antimony	-	0.020	-	-	0.00050	0.00050	0.00050	0.00050	0.00050	0.00050	0.00050	0.00049	0.00048	0.00050	0.00050	0.00050	0.00050	0.00049	0.00049	0.00050
Arsenic	0.0050	0.0050	-	0.03	**0.066**	**0.026**	0.0012	**0.015**	**0.025**	**0.025**	**0.025**	**0.0061**	**0.0061**	**0.0062**	0.0010	0.00071	0.0011	**0.0056**	**0.0054**	**0.0057**
Boron	1.5	1.20	-	-	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025
Cadmium	0.000040 (10)	-(11)	-	-	0.000018	0.000024	0.000030	0.000024	0.000012	0.000012	0.000012	0.000022	0.000018	0.000026	0.000017	0.000017	0.000017	0.000021	0.000018	0.000023
Calcium	-	-	-	-	0.84	0.88	1.3	0.88	0.79	0.74	0.83	1.5	0.95	2.1	1.0	0.84	1.2	1.3	0.92	1.7
Chromium	0.0089	-	-	-	0.00080	0.00078	0.00050	0.00050	0.00056	0.00055	0.00056	0.00056	0.00056	0.00056	0.00050	0.00050	0.00050	0.00055	0.00054	0.00055
Cobalt	-	0.010	0.00078 (12)	-	0.00049	0.00020	0.00051	0.00020	0.00026	0.00026	0.00026	0.00036	0.00025	0.00049	0.00034	0.00033	0.00034	0.00033	0.00025	0.00041
Copper	0.0020 (10)	0.0020	-	-	0.0010	0.0010	0.0010	0.0010	0.00086	0.00086	0.00087	0.00087	0.00080	0.00095	0.00084	0.00084	0.00084	0.00085	0.00081	0.00090
Iron	0.30	0.30	-	-	**0.78**	**0.87**	**1.2**	**1.0**	**0.39**	**0.39**	**0.39**	**0.35**	**0.35**	**0.36**	**0.58**	**0.58**	**0.59**	**0.38**	**0.37**	**0.38**
Lead	0.0010 (10)	0.0010	-	-	0.00025	0.00045	0.00058	0.00055	0.00025	0.00025	0.00025	0.00034	0.00031	0.00039	0.00037	0.00037	0.00037	0.00034	0.00031	0.00036
Magnesium	-	-	-	-	0.36	0.44	0.49	0.45	0.35	0.34	0.35	0.46	0.39	0.55	0.39	0.36	0.41	0.43	0.38	0.49
Manganese	-	0.820	-	-	0.11	0.085	0.087	0.076	0.073	0.073	0.074	0.070	0.068	0.072	0.058	0.057	0.058	0.068	0.067	0.070
Mercury	0.000026	0.000026	-	-	0.000019	0.0000091	0.0000065	0.000010	0.0000095	0.0000095	0.0000095	0.0000074	0.0000071	0.0000077	0.0000065	0.0000065	0.0000065	0.0000073	0.0000071	0.0000075
Molybdenum	0.073	0.073	-	-	0.0010	0.0010	0.0010	0.0010	0.0011	0.0010	0.0011	0.0011	0.0010	0.0012	0.0013	0.0011	0.0014	0.0011	0.0010	0.0011
Nickel	0.025 (10)	0.025	-	-	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0020	0.0013	0.0029	0.0010	0.0010	0.0010	0.0018	0.0013	0.0023
Nitrate	3	-	-	-	0.057	0.059	0.025	0.048	0.0050	0.0050	0.0050	0.021	0.010	0.034	0.0050	0.0050	0.005	0.017	0.0092	0.025
Nitrite	0.060	-	-	-	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0053	0.0051	0.0055	0.0050	0.0050	0.0050	0.0052	0.0051	0.0053
Potassium	-	-	-	-	0.37	0.33	0.33	0.33	0.37	0.32	0.41	0.45	0.33	0.59	0.48	0.29	0.62	0.40	0.32	0.49

Parameter	CCME CWQG (1) (mg/L)	NSEQS (2) (mg/L)	FEQG (3) (mg/L)	SSWQO (4) (mg/L)	95th Percentile Baseline Concentrations (mg/L) (5)				Predicted Concentration (mg/L) (6)											
					SW5	EMZ-2 (7)	SW15 (8)	SW6	SW5			EMZ-2			SW15			SW6		
									average	5%	95%	average	5%	95%	average	5%	95%	average	5%	95%
Selenium	0.0010	0.0010	-	-	0.00050	0.00050	0.00050	0.00050	0.00050	0.00050	0.00050	0.00050	0.00050	0.00051	0.00050	0.00050	0.00050	0.00050	0.00050	0.00050
Silver	0.00025	0.00010	-	-	0.000050	0.000050	0.000050	0.000050	0.000050	0.000050	0.000050	0.000049	0.000049	0.000050	0.000050	0.000050	0.000050	0.000050	0.000049	0.000050
Sodium	-	-	-	-	2.5	3.4	2.9	3.4	2.4	2.3	2.5	3.3	3.0	3.6	2.8	2.4	3.1	3.1	2.9	3.3
Sulphate	-	-	-	-	1.0	2.1	1.0	2.6	1.5	1.2	1.7	7.2	3.1	12	2.5	1.4	3.2	5.6	2.8	8.9
Thallium	0.00080	0.00080	-	-	0.000050	0.000050	0.000050	0.000050	0.000050	0.000050	0.000050	0.000051	0.000050	0.000051	0.000050	0.000050	0.000050	0.000051	0.000050	0.000051
Uranium	0.015	0.30	-	-	0.000050	0.000050	0.000050	0.000050	0.000050	0.000050	0.000051	0.000086	0.000061	0.00012	0.000051	0.000050	0.000052	0.000076	0.000059	0.000095
Zinc	0.007 (13)	0.030	-	-	0.0025	0.0025	0.0049	0.0025	0.0025	0.0025	0.0025	0.0039	0.0029	0.0051	0.0029	0.0029	0.0030	0.0036	0.0029	0.0043

0.1	Bolding indicates a concentration greater than the CCME CWQG.
0.1	Grey shading indicates a concentration greater than the NSEQS.
0.1	Double outline indicates a concentration greater than the FEQG.
0.1	Bold outline indicates a concentration greater than the SSWQO.
0.1	Underlining indicates a concentration greater than the 95th percentile baseline concentration.

Notes

(1) - Canadian Council of Ministers of the Environment (1999 updated in 2019). Canadian Environmental Quality Guidelines for the Protection of Aquatic Life. Accessed February 6, 2019.
(2) - Nova Scotia Environment Environmental Quality Standards for Surface Water, Table 3 (July 2013).
(3) - Environment Canada Federal Environmental Quality Guideline: Cobalt (May 2017).
(4) - Site-specific water quality objective for arsenic (Intrinsik 2019).
(5) - Statistics calculated from the available surface water quality baseline dataset (June 2017 to June 2019).
(6) - Predicted annual concentration calculated from the GoldSim stochastic model using the base case geochemical source terms (Lorax 2019); statistics presented are the mean, 5th percentile and 95th percentile.
(7) - Baseline water quality for EMZ-2 is derived from the available dataset for SW14 and SW6.
(8) - Baseline water quality for SW15 is derived form the available dataset for SW12.
(9) - Guideline is variable and dependent on pH values. Refer to CCME (2019) for method of calculation.
(10) - Guideline is variable and dependent on hardness concentrations. Refer to CCME (2019) for method of calculation.
(11) - The NSEQS for cadmium is based on a 2007 CCME CWQG and is not considered herein; rather, the updated 2014 CCME CWQG is used as the comparison criteria.
(12) - Guideline is variable and dependent on hardness. Refer to Environment Canada (2017) for method of calculation.
(13) - Guideline is for dissolved zinc; guideline is variable and dependent on hardness, dissolved organic carbon, and pH. Refer to CCME (2019) for method of calculation.

Table 6.6-44: Water Quality Model Results, Post Closure Phase – Predicted Concentrations In Receiver Water Bodies (Using Upper Case Source Terms)

Parameter	CCME CWQG (1) (mg/L)	NSEQS (2) (mg/L)	FEQG (3) (mg/L)	SSWQO (4) (mg/L)	95th Percentile Baseline Concentrations (mg/L) (5)				Predicted Concentration (mg/L) (6)											
					SW5	EMZ-2 (7)	SW15 (8)	SW6	SW5			EMZ-2			SW15			SW6		
									average	5%	95%	average	5%	95%	average	5%	95%	average	5%	95%
Aluminum	0.0050 (9)	0.0050	-	-	**0.29**	**0.29**	**0.36**	**0.29**	**0.18**	**0.18**	**0.18**	**0.21**	**0.20**	**0.21**	**0.24**	**0.23**	**0.24**	**0.21**	**0.21**	**0.21**
Ammonia (total)	-	-	-	-	0.025	0.079	0.069	0.025	0.025	0.025	0.025	0.038	0.035	0.040	0.035	0.035	0.035	0.036	0.034	0.038
Ammonia (un-ionized)	0.019	-	-	-	0.000010	0.000016	0.000017	0.000013	0.00000056	0.00000056	0.00000056	0.00000084	0.00000079	0.00000089	0.00000079	0.00000078	0.00000079	0.00000081	0.00000076	0.00000085
Antimony	-	0.020	-	-	0.00050	0.00050	0.00050	0.00050	0.00050	0.00050	0.00050	0.00050	0.00049	0.00050	0.00050	0.00050	0.00050	0.00050	0.00049	0.00050
Arsenic	0.0050	0.0050	-	0.03	**0.066**	**0.026**	0.0012	**0.015**	**0.025**	**0.025**	**0.025**	**0.0065**	**0.0063**	**0.0067**	0.0013	0.00080	0.0017	**0.0058**	**0.0055**	**0.0060**
Boron	1.5	1.20	-	-	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.026	0.025	0.026	0.025	0.025	0.025	0.026	0.025	0.026
Cadmium	0.000040 (10)	- (11)	-	-	0.000018	0.000024	0.000030	0.000024	0.000012	0.000012	0.000012	0.000027	0.000020	0.000035	0.000017	0.000017	0.000017	0.000024	0.000020	0.000030
Calcium	-	-	-	-	0.84	0.88	1.3	0.88	0.79	0.74	0.83	1.8	1.1	2.7	1.1	0.84	1.2	1.5	1.0	2.1
Chromium	0.0089	-	-	-	0.00080	0.00078	0.00050	0.00050	0.00056	0.00055	0.00056	0.00057	0.00056	0.00058	0.00050	0.00050	0.00050	0.00056	0.00055	0.00057
Cobalt	-	0.010	0.00078 (12)	-	0.00049	0.00020	0.00051	0.00020	0.00026	0.00026	0.00026	0.00052	0.00030	0.00079	0.00034	0.00033	0.00034	0.00045	0.00029	0.00062
Copper	0.0020 (10)	0.0020	-	-	0.0010	0.0010	0.0010	0.0010	0.00087	0.00086	0.00087	0.0010	0.00084	0.0012	0.00084	0.00084	0.00084	0.00094	0.00084	0.0011
Iron	0.30	0.30	-	-	**0.78**	**0.87**	**1.2**	**1.0**	**0.39**	**0.39**	**0.39**	**0.38**	**0.37**	**0.39**	**0.58**	**0.58**	**0.59**	**0.39**	**0.39**	**0.41**
Lead	0.0010 (10)	0.0010	-	-	0.00025	0.00045	0.00058	0.00055	0.00025	0.00025	0.00025	0.00050	0.00035	0.00067	0.00037	0.00037	0.00037	0.00045	0.00035	0.00056
Magnesium	-	-	-	-	0.36	0.44	0.49	0.45	0.35	0.34	0.35	0.52	0.41	0.66	0.39	0.36	0.42	0.48	0.40	0.57
Manganese	-	0.820	-	-	0.11	0.085	0.087	0.076	0.074	0.073	0.074	0.078	0.071	0.087	0.059	0.057	0.060	0.074	0.069	0.080
Mercury	0.000026	0.000026	-	-	0.000019	0.0000091	0.0000065	0.000010	0.0000095	0.0000095	0.0000095	0.0000074	0.0000071	0.0000077	0.0000065	0.0000065	0.0000065	0.0000073	0.0000071	0.0000075
Molybdenum	0.073	0.073	-	-	0.0010	0.0010	0.0010	0.0010	0.0011	0.0011	0.0012	0.0012	0.0011	0.0014	0.0014	0.0011	0.0015	0.0012	0.0011	0.0013
Nickel	0.025 (10)	0.025	-	-	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0029	0.0016	0.0045	0.0010	0.0010	0.0010	0.0024	0.0015	0.0034
Nitrate	3	-	-	-	0.057	0.059	0.025	0.048	0.0050	0.0050	0.0051	0.033	0.014	0.056	0.005	0.0050	0.005	0.026	0.012	0.041
Nitrite	0.060	-	-	-	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0055	0.0052	0.0060	0.0050	0.0050	0.0050	0.0054	0.0051	0.0057
Potassium	-	-	-	-	0.37	0.33	0.33	0.33	0.38	0.33	0.42	0.48	0.34	0.65	0.52	0.29	0.67	0.43	0.32	0.54

Parameter	CCME CWQG (1) (mg/L)	NSEQS (2) (mg/L)	FEQG (3) (mg/L)	SSWQO (4) (mg/L)	95th Percentile Baseline Concentrations (mg/L) (5)				Predicted Concentration (mg/L) (6)											
					SW5	EMZ-2 (7)	SW15 (8)	SW6	SW5			EMZ-2			SW15			SW6		
									average	5%	95%	average	5%	95%	average	5%	95%	average	5%	95%
Selenium	0.0010	0.0010	-	-	0.00050	0.00050	0.00050	0.00050	0.00050	0.00050	0.00050	0.00051	0.00050	0.00052	0.00050	0.00050	0.00050	0.00051	0.00050	0.00051
Silver	0.00025	0.00010	-	-	0.000050	0.000050	0.000050	0.000050	0.000050	0.000050	0.000050	0.000050	0.000049	0.000050	0.000050	0.000050	0.000050	0.000050	0.000050	0.000050
Sodium	-	-	-	-	2.5	3.4	2.9	3.4	2.4	2.3	2.5	3.3	3.0	3.7	2.8	2.4	3.1	3.2	2.9	3.4
Sulphate	-	-	-	-	1.0	2.1	1.0	2.6	1.5	1.3	1.8	8.9	3.6	15	2.6	1.4	3.4	6.8	3.2	11
Thallium	0.00080	0.00080	-	-	0.000050	0.000050	0.000050	0.000050	0.000050	0.000050	0.000050	0.000052	0.000051	0.000053	0.000050	0.000050	0.000050	0.000051	0.000050	0.000052
Uranium	0.015	0.30	-	-	0.000050	0.000050	0.000050	0.000050	0.000050	0.000050	0.000051	0.00012	0.000073	0.00019	0.000051	0.000050	0.000052	0.00010	0.000069	0.000144
Zinc	0.007 (13)	0.030	-	-	0.0025	0.0025	0.0049	0.0025	0.0025	0.0025	0.0025	0.0041	0.0030	0.0055	0.0029	0.0029	0.0030	0.0037	0.0030	0.0046

0.1	Bolding indicates a concentration greater than the CCME CWQG.
0.1	Grey shading indicates a concentration greater than the NSEQS.
0.1	Double outline indicates a concentration greater than the FEQG.
0.1	Bold outline indicates a concentration greater than the SSWQO.
0.1	Underlining indicates a concentration greater than the 95th percentile baseline concentration.

Notes
(1) - Canadian Council of Ministers of the Environment (1999 updated in 2019). Canadian Environmental Quality Guidelines for the Protection of Aquatic Life. Accessed February 6, 2019.
(2) - Nova Scotia Environment Environmental Quality Standards for Surface Water, Table 3 (July 2013).
(3) - Environment Canada Federal Environmental Quality Guideline: Cobalt (May 2017).
(4) - Site-specific water quality objective for arsenic (Intrinsik 2019).
(5) - Statistics calculated from the available surface water quality baseline dataset (June 2017 to June 2019).
(6) - Predicted annual concentration calculated from the GoldSim stochastic model using the upper case geochemical source terms (Lorax 2019); statistics presented are the mean, 5th percentile and 95th percentile.
(7) - Baseline water quality for EMZ-2 is derived from the available dataset for SW14 and SW6.
(8) - Baseline water quality for SW15 is derived form the available dataset for SW12.
(9) - Guideline is variable and dependent on pH values. Refer to CCME (2019) for method of calculation.
(10) - Guideline is variable and dependent on hardness concentrations. Refer to CCME (2019) for method of calculation.
(11) - The NSEQS for cadmium is based on a 2007 CCME CWQG and is not considered herein; rather, the updated 2014 CCME CWQG is used as the comparison criteria.
(12) - Guideline is variable and dependent on hardness. Refer to Environment Canada (2017) for method of calculation.
(13) - Guideline is for dissolved zinc; guideline is variable and dependent on hardness, dissolved organic carbon, and pH. Refer to CCME (2019) for method of calculation.

6.6.8.2.3.2.1 Base Case Source Terms

Based on the predicted annual average concentrations during the post-closure stage of the Closure Phase, using the base case geochemical source terms, the key results are as follows:

- At SW15, average concentrations of molybdenum and uranium are predicted to be greater than the 95th percentile baseline concentration but lower than the applicable CCME CWQG and NSEQS.
- At EMZ-2, average concentrations of nitrite, cobalt, molybdenum, nickel, thallium, uranium and zinc are predicted to be greater than the 95th percentile baseline concentration but lower than the applicable CCME CWQG and NSEQS.
- At SW6, at the downstream end of the LAA, average concentrations of nitrite, ammonia (total), chromium, cobalt, molybdenum, nickel, thallium, uranium and zinc are predicted to be greater than the 95th percentile baseline concentration but lower than the applicable CCME CWQG and NSEQS.
- Average concentrations of aluminum and iron are predicted to be greater than the CCME CWQGs and NSEQSs at SW5, SW15, EMZ-2 and SW6; however, the concentrations are below the 95th percentile baseline concentrations for the respective monitoring stations (which are also greater than the CCME CWQGs and NSEQS).
- Average concentrations of other modelled parameters are predicted to be lower than the 95th percentile baseline concentration and lower than the applicable CCME CWQGs, NSEQSs or SSWQO.

The monthly concentrations (average, 5th percentile and 95th percentile) of key parameters as compared to the applicable CCME CWQGs, NSEQSs, FEQG and SSWQO are presented graphically in the Surface Water Quality Modelling Report (see Appendix B.6). Using the base case source terms, the average and 95th percentile predicted parameter concentrations (with mitigation measures in place) are below the applicable CCME CWQGs, NSEQSs, SSWQO or 95th percentile baseline concentration on a monthly basis.

6.6.8.2.3.2.2 Upper Case Source Terms

Based on the predicted annual average concentrations during the post-closure stage of the Closure Phase, using the upper case geochemical source terms, the key results are as follows:

- At SW5, the average concentration of molybdenum is predicted to be greater than the than the 95th percentile baseline concentration but lower than the NSEQS.
- At SW15, average concentrations of arsenic, molybdenum, uranium and zinc are predicted to be greater than the 95th percentile baseline concentration but lower than the applicable CCME CWQG, NSEQS or SSWQO.
- At EMZ-2, average concentrations of nitrite, boron, cadmium, cobalt, lead, molybdenum, nickel, selenium, thallium, uranium and zinc are predicted to be greater than the 95th percentile baseline concentration but lower than the applicable CCME CWQG, NSEQS and FEQG.
- At SW6, at the downstream end of the LAA, average concentrations of nitrite, ammonia (total), boron, chromium, cobalt, molybdenum, nickel, selenium, thallium and uranium are predicted to be greater than the 95th percentile baseline concentration but lower than the applicable CCME CWQG, NSEQS and FEQG.

- Average concentrations of aluminum and iron are predicted to be greater than the CCME CWQGs and NSEQSs at SW5, SW15, EMZ-2 and SW6; however, the concentrations are lower than the 95th percentile baseline concentrations for the respective monitoring stations (which are also greater than the CCME CWQGs and NSEQS).
- Average concentrations of other modelled parameters are predicted to be lower than the 95th percentile baseline concentration and lower than the applicable CCME CWQGs, NSEQSs or SSWQO.

The monthly concentrations (average, 5th percentile and 95th percentile) of key parameters as compared to the applicable CCME CWQGs, NSEQSs, FEQG and SSWQO are presented graphically in the Surface Water Quality Modelling Report (see Appendix B.6). Using the upper case source terms, the average predicted parameter concentrations are below the applicable CCME CWQGs, NSEQSs, FEQG, SSWQO or 95th percentile baseline concentration on a monthly basis. The 95th percentile monthly receiver concentrations are predicted to be greater than the CCME CWQG or NSEQS as follows:

- At EMZ-2, the 95th percentile cadmium concentration is predicted to be marginally greater than the CCME SWQG of 0.000040 mg/L in May (0.000043 mg/L), October (0.000041 mg/L) and November (0.000049 mg/L);
- At EMZ-2, the 95th percentile cobalt concentration is predicted to be marginally greater than the FEQG (0.00078 mg/L) in January (0.00080 mg/L), February (0.00083 mg/L), April (0.00085 mg/L), May (0.0010 mg/L), October (0.00098 mg/L), November (0.0012 mg/L) and December (0.00083 mg/L);
- At EMZ-2, the 95th percentile zinc concentration is predicted to be marginally greater than the CWQG CCME (0.007 mg/L) in November (0.0078 mg/L); and,
- AT SW-6, the 95th percentile cobalt concentration is predicted to be marginally greater than the FEQG (0.00078 mg/L) in October (0.00084 mg/L) and November (0.00096 mg/L).

It should be noted that cadmium and cobalt predictions are influenced by the upper case source term applied in the model for the tailings beach cover (the average of the till and topsoil stockpile source terms, as described in the Surface Water Quality Modelling Report (Appendix B.6). Using the average of the upper case till source term (which is higher) and the topsoil source term (which is lower) may be overly conservative, as it is expected that the surface of the cover will be topsoil rather than till. As cover design progresses and source terms are refined, these predictions will be reassessed.

The residual effect relevant to the surface water quality VC during the post-closure stage of the Closure Phase is a change in water quality associated with Project activities. With mitigation measures (covers on the PAG stockpile and the tailings beach) in place, and using base case geochemical source terms as model inputs, the predicted average and 95th percentile receiver concentration of the modelled parameters are below the relevant CCME CWQGs, NSEQSs and SSWQO on an annual and monthly basis. Therefore, the magnitude of the effect for the base case ranges from Negligible to Low (depending on parameter).

Using upper case geochemical source terms as the model input, the predicted average receiver concentrations of the modelled parameters are below the relevant CCME CWQGs, FEQG, NSEQSs and SSWQO on an annual and monthly basis. The 95th percentile concentrations of cadmium are predicted to be greater than the FEQG in May, October and November at EMZ-2; this corresponds to a Moderate magnitude for cadmium. The 95th percentile concentrations of cobalt are predicted to be greater than the CCME CWQG in January, February, April, May, October, November and December at EMZ-2 and October and November at SW6; this corresponds to a Moderate magnitude for cobalt. The 95th percentile concentrations of zinc are predicted to be greater than the CCME CWQG in November at EMZ-2; this corresponds to a Moderate magnitude for zinc. It should be noted that these predictions of Moderate magnitude represent a non-typical condition of upper case geochemical source terms combined with infrequent low flow climate conditions.

Intrinsik Corp. (Intrinsik) was retained to evaluate the aquatic effects as a result of the Project on the receiving environment (Anti-Dam Flowage). This complete report is provided in Appendix C.2, outlining methodology and detailed conclusions. A summary of conclusions relating to predicted water quality in the receiving environment of Anti-Dam Flowage during Closure Phase (post-closure stage) is provided below.

In the Post Closure scenario, all predicted constituent concentrations were consistently below selected water quality benchmarks or baseline, when considered on an annual average basis with the exceptions of cobalt, which marginally exceeded the FEQG at EMZ-2, and iron, which marginally exceeded the respective 75th percentile baseline at SW6 and EMZ-2.

Additional modelling was conducted for all parameters to examine the potential for exceedances on a monthly average basis. When examined on a monthly basis, cadmium is predicted to be greater than the CCME water quality guideline at EMZ-2 in the months of May, October and November, based on the 95th percentile predictions (see Appendix C.2 -Table 3-5). In addition, cobalt exceeds the FEQG in January, February, April, October, November and December at EMZ-2, and in October and November at SW6 (see Appendix C.2 -Table 3-6). Zinc also exceeds the CCME water quality guideline at EMZ-2 in the month of November (see Appendix C.2 -Tables 3-7), but no exceedances are predicted in any other month. These exceedances are discussed further as follows:

- **Cadmium:** The predicted 95th percentile concentrations of cadmium at EMZ-2 in the months of May, October, and November (0.000041 – 0.000049 mg/L) exceeded the CCME water quality guideline of 0.00004 mg/L. These 95th percentile predictions represent a non-typical condition of upper case geochemical source terms combined with infrequent low flow climate conditions. Hence, the likelihood of toxicity is considered to be low.
- **Cobalt**: Predicted concentrations of cobalt do not exceed the NSEQS of 0.01 mg/L in any of the prediction nodes. Only the predicted 95th percentile cobalt concentration at EMZ-2 in the months of January, February, April, October, November and December (0.00080 – 0.00125 mg/L) and at SW6 in the months of October and November (0.00084 – 0.00096 mg/L) exceeded the FEQG of 0.00078 mg/L. The 95th percentile concentrations are up to 1.6 times the FEQG of 0.00078 mg/L. The 95th percentile results represent an upper bound scenario, which would only result in the instance that low flow precipitation events occur in conjunction with upper bound source term conditions, which is unlikely. The FEQG considers hardness as a modifying factor, but the SSD model developed by Environment Canada in this guideline setting approach is very conservative, and the data used in the assessment do not fit the selected model of the SSD in the lower quartile of the dataset well (see Figure 1, ECCC, 2017, as discussed in Appendix C.2). This results in the estimated HC5 value being considerably lower than it should be, relative to the toxicity dataset. This indicates that the selected guideline is over predicting toxicity of cobalt, and hence, the marginal exceedances indicated in Table 3-6 of Appendix C.2. are considered to represent a low risk potential, with respect to toxicity to aquatic species, particularly considering that the upper case source terms and precipitation events would have to co-occur in the 95th percentile calculations outlined in Table 3-6 of Appendix C.2.
- **Zinc:** Predicted concentrations of zinc do not exceed the NS Tier 1 standard of 0.030 mg/L in any of the prediction nodes. Only the predicted 95th percentile concentration at EMZ-2 in the month of November (0.0078 mg/L) exceeds the CCME CWQG of 0.007 mg/L. The lowest observed effect concentration (LOEC) listed in the CCME (2018) fact sheet is 0.00989 mg/L (11 week study; development; Chironomid sp.; normalized to 50 mg/L $CaCO_3$ and Dissolved Organic Carbon (DOC) of 0.5 mg/L). Since the predicted exceedance is marginal, relative to the guideline, and only occurs in the month of November, the likelihood of toxicity occurring in the Baseline + Project scenario is considered to be low.
- **Iron:** Figure B-75 of Appendix B.6 provides the monthly predictions for iron in the Post closure, upper case scenario. The exceedances noted in EMZ-2 and SW6 in Table 3-4 of Appendix C.2 remain fairly constant over the monthly intervals, and only marginally exceed the 75th percentile of baseline, and remain within the range of baseline. As per the discussion related to the operations upper case scenario related to iron, these predicted concentrations are unlikely to result in aquatic effects.

6.6.8.2.3.3 Sensitivity Analysis

A sensitivity analysis was conducted to evaluate the potential effects of misclassified PAG waste rock being placed in the NAG WRSA or being used for construction material in the TMF embankment. The sensitivity analysis simulated four scenarios as described below:

- 1% PAG waste rock placed in the NAG WRSA
- 2% PAG waste rock placed in the NAG WRSA
- 1% PAG waste rock placed in the TMF embankment
- 2% PAG waste rock placed in the TMF embankment

Due to the fine interbedding of the PAG (mostly argillite) and NAG (mostly greywacke), it can be assumed that PAG material erroneously deposited with “NAG blasts” are intimately mixed, thereby reducing the potential for localized PAG hotpots. Larger zones/thicknesses of PAG rock are assumed to be effectively segregated and stored in the PAG WRSA. An inclusion of 1% and 2% PAG waste rock in the NAG WRSA corresponds to 4% and 8% of the total PAG inventory being misclassified as NAG, respectively, based on the relative tonnages in the geologic model. For the purposes of a sensitivity analysis these scenarios are modelled; however, a rigorous operational monitoring program will be implemented into the mine plan to minimize the amount of PAG rock being placed in the NAG WRSA or used for construction and misclassification of this degree is considered unlikely and these simulations are considered to be conservative.

The inputs to and methodology for the sensitivity analysis are presented in detail in the Surface Water Quality Modelling Report (see Appendix B.6). The sensitivity analysis was completed by revising the geochemical source terms assigned to the NAG WRSA and TMF embankments as described below. The post-closure phase was modelled, as the waste rock is not expected to generate acid during the period of operations.

6.6.8.2.3.3.1 Base Case Source Terms

Based on the predicted annual average concentrations during the post-closure stage of the Closure Phase, using the base case geochemical source terms and simulating 1% and 2% PAG waste rock in the TMF embankments, the key results are as follows:

- At EMZ-2, average concentrations of boron (2% PAG scenario only) cobalt, molybdenum, nickel, nitrite, thallium, uranium and zinc are predicted to be greater than the 95th percentile baseline concentration but lower than the applicable CCME CWQG and NSEQS.
- At SW6, at the downstream end of the LAA, average concentrations of nitrite, ammonia (total), boron (2% PAG scenario only), chromium, cobalt, molybdenum, nickel, thallium and uranium are predicted to be greater than the 95th percentile baseline concentration but lower than the applicable CCME CWQG and NSEQS.
- Average concentrations of aluminum and iron are predicted to be greater than the CCME CWQGs and NSEQSs; however, the concentrations are below the 95th percentile baseline concentrations for the respective monitoring stations (which are also greater than the CCME CWQGs and NSEQS).
- Average concentrations of other modelled parameters are predicted to be lower than the 95th percentile baseline concentration and lower than the applicable CCME CWQGs, NSEQSs or SSWQO.

The monthly concentrations (average, 5th percentile and 95th percentile) of key parameters as compared to the applicable CCME CWQGs, NSEQSs, FEQG and SSWQO are presented graphically in the Surface Water Quality Modelling Report (see Appendix

B.6). Using the base case source terms, the average parameter concentrations (with mitigation measures in place) are below the applicable CCME CWQGs, NSEQSs, SSWQO or 95^{th} percentile baseline concentration on a monthly basis. The 95^{th} percentile monthly receiver concentrations are predicted to be greater than the CCME CWQG or NSEQS as follows:

- At EMZ-2 for the 1% PAG scenario, the 95^{th} percentile cobalt concentration is predicted to be marginally greater than the FEQG (0.00078 mg/L) in November (0.00079 mg/L). For the 2% PAG scenario, the 95^{th} percentile cobalt concentration is predicted to be marginally greater than the FEQG (0.00078 mg/L) in November (0.00087 mg/L).
- At EMZ-2 for the 1% PAG scenario, the 95^{th} percentile zinc concentration is predicted to be marginally greater than the CWQG CCME (0.007 mg/L) in November (0.0076 mg/L). For the 2% PAG scenario, the 95^{th} percentile zinc concentration is predicted to be marginally greater than the CWQG CCME (0.007 mg/L) in November (0.0078 mg/L).

Based on the predicted annual average concentrations during the post-closure stage of the Closure Phase, using the base case geochemical source terms and simulating 1% and 2% PAG waste rock in the NAG WRSA, the key results are as follows:

- At EMZ-2, average concentrations of cobalt, molybdenum, nickel, nitrite, thallium, uranium and zinc are predicted to be greater than the 95th percentile baseline concentration but lower than the applicable CCME CWQG and NSEQS.
- At SW6, at the downstream end of the LAA, average concentrations of nitrite, ammonia (total), chromium, cobalt, molybdenum, nickel, uranium and zinc are predicted to be greater than the 95th percentile baseline concentration but lower than the applicable CCME CWQG and NSEQS.
- Average concentrations of aluminum and iron are predicted to be greater than the CCME CWQGs and NSEQSs; however, the concentrations are below the 95th percentile baseline concentrations for the respective monitoring stations (which are also greater than the CCME CWQGs and NSEQS).
- Average concentrations of other modelled parameters are predicted to be lower than the 95th percentile baseline concentration and lower than the applicable CCME CWQGs, NSEQSs or SSWQO.

The monthly concentrations (average, 5^{th} percentile and 95^{th} percentile) of key parameters as compared to the applicable CCME CWQGs, NSEQSs, FEQG and SSWQO are presented graphically in the Surface Water Quality Modelling Report (see Appendix B.6). Using the base case source terms, the average parameter concentrations (with mitigation measures in place) are below the applicable CCME CWQGs, NSEQSs, SSWQO or 95^{th} percentile baseline concentration on a monthly basis. The 95^{th} percentile monthly receiver concentrations are predicted to be greater than the CCME CWQG or NSEQS as follows:

- At EMZ-2 for the 1% PAG scenario, the 95^{th} percentile cobalt concentration is predicted to be marginally greater than the FEQG (0.00078 mg/L) in November (0.00079 mg/L). For the 2% PAG scenario, the 95^{th} percentile cobalt concentration is predicted to be marginally greater than the FEQG (0.00078 mg/L) in November (0.00087 mg/L).
- At EMZ-2 for the 1% PAG scenario, the 95th percentile zinc concentration is predicted to be marginally greater than the CWQG CCME (0.007 mg/L) in November (0.0076 mg/L). For the 2% PAG scenario, the 95th percentile zinc concentration is predicted to be marginally greater than the CWQG CCME (0.007 mg/L) in November (0.0079 mg/L).

6.6.8.2.3.3.2 Upper Case Source Terms

Based on the predicted annual average concentrations during the post-closure stage of the Closure Phase, using the upper case geochemical source terms and simulating 1% and 2% PAG waste rock in the TMF embankments, the key results are as follows:

- At EMZ-2, average concentrations of nitrite, boron, cadmium, cobalt, lead, molybdenum, nickel, selenium, thallium, uranium and zinc are predicted to be greater than the 95th percentile baseline concentration but lower than the applicable CCME CWQG, NSEQS and FEQG.

- At SW6, at the downstream end of the LAA, average concentrations of nitrite, ammonia (total), boron, cadmium, chromium, cobalt, molybdenum, nickel, selenium, thallium and uranium are predicted to be greater than the 95th percentile baseline concentration but lower than the applicable CCME CWQG, NSEQS and FEQG.

- Average concentrations of aluminum and iron are predicted to be greater than the CCME CWQGs and NSEQSs; however, the concentrations are lower than the 95th percentile baseline concentrations for the respective monitoring stations (which are also greater than the CCME CWQGs and NSEQS).

- Average concentrations of other modelled parameters are predicted to be lower than the 95th percentile baseline concentration and lower than the applicable CCME CWQGs, NSEQSs or SSWQO.

The monthly concentrations (average, 5th percentile and 95th percentile) of key parameters as compared to the applicable CCME CWQGs, NSEQSs, FEQG and SSWQO are presented graphically in the Surface Water Quality Modelling Report (see Appendix B.6). Using the upper case source terms, the average predicted parameter concentrations are below the applicable CCME CWQGs, NSEQSs, FEQG, SSWQO or 95th percentile baseline concentration on a monthly basis. The 95th percentile monthly receiver concentrations are predicted to be greater than the CCME CWQG or NSEQS as follows:

- At EMZ-2 for the 1% PAG scenario, the 95th percentile cadmium concentration is predicted to be marginally greater than the CCME CWQG of 0.000040 mg/L in January (0.000041 mg/L), February (0.000042 mg/L), April (0.000043 mg/L), May (0.000051 mg/L) and October (0.000048 mg/L). For the 2% PAG scenario, the 95th percentile cadmium concentration is predicted to be marginally greater than the CCME CWQG of 0.000040 mg/L in January (0.000042 mg/L), February (0.000043 mg/L), April (0.000044 mg/L), May (0.000052 mg/L) and October (0.000049 mg/L).

- At EMZ-2 for the 1% PAG scenario, the 95th percentile cobalt concentration is predicted to be marginally greater than the FEQG (0.00078 mg/L) in January (0.00086 mg/L), February (0.00090 mg/L), April (0.00092 mg/L), May (0.0011 mg/L), October (0.0011 mg/L), November (0.0014 mg/L) and December (0.00091 mg/L). For the 2% PAG scenario, the 95th percentile cobalt concentration is predicted to be marginally greater than the FEQG (0.00078 mg/L) in January (0.00092 mg/L), February (0.00097 mg/L), April (0.00099 mg/L), May (0.0012 mg/L), October (0.0012 mg/L), November (0.0015 mg/L) and December (0.00097 mg/L).

- At EMZ-2 for the 1% and 2% PAG scenario, the 95th percentile lead concentration is predicted to be marginally greater than the CCME CWQG (0.001 mg/L) in November (0.00101 mg/L).

- At EMZ-2 for the 1% PAG scenario, the 95th percentile zinc concentration is predicted to be marginally greater than the CCME CWQG of 0.007 mg/L in May (0.0071 mg/L) and November (0.0083 mg/L). For the 2% PAG scenario, the 95th percentile zinc concentration is predicted to be marginally greater than the CCME CWQG of 0.007 mg/L in May (0.0076 mg/L), October (0.0072 mg/L) and November (0.0088 mg/L).

- At SW-6 for the 1% PAG scenario, the 95th percentile cadmium concentration is predicted to be marginally greater than the CCME CWQG of 0.000040 mg/L in October (0.000042 mg/L) and November (0.000047 mg/L). For the 2% PAG scenario, the 95th percentile cadmium concentration is predicted to be marginally greater than the CCME CWQG of 0.000040 mg/L in October (0.000043 mg/L) and November (0.000048 mg/L).

- At SW-6 for the 1% PAG scenario, the 95th percentile cobalt concentration is predicted to be marginally greater than the FEQG (0.00078 mg/L) in October (0.00091 mg/L) and November (0.0010 mg/L). For the 95th percentile cobalt concentration is predicted to be marginally greater than the FEQG (0.00078 mg/L) in October (0.00097 mg/L) and November (0.0011 mg/L).

Based on the predicted annual average concentrations during the post-closure stage of the Closure Phase, using the upper case geochemical source terms and simulating 1% and 2% PAG waste rock in the NAG WRSA, the key results are as follows:

- At EMZ-2, average concentrations of nitrite, boron, cadmium, cobalt, lead, molybdenum, nickel, selenium, thallium, uranium and zinc are predicted to be greater than the 95th percentile baseline concentration but lower than the applicable CCME CWQG, NSEQS and FEQG.
- At SW6, at the downstream end of the LAA, average concentrations of nitrite, ammonia (total), boron, cadmium, chromium, cobalt, molybdenum, nickel, selenium, thallium, uranium and zinc are predicted to be greater than the 95th percentile baseline concentration but lower than the applicable CCME CWQG, NSEQS and FEQG.
- Average concentrations of aluminum and iron are predicted to be greater than the CCME CWQGs and NSEQSs; however, the concentrations are lower than the 95th percentile baseline concentrations for the respective monitoring stations (which are also greater than the CCME CWQGs and NSEQS).
- Average concentrations of other modelled parameters are predicted to be lower than the 95th percentile baseline concentration and lower than the applicable CCME CWQGs, NSEQSs or SSWQO.

The monthly concentrations (average, 5th percentile and 95th percentile) of key parameters as compared to the applicable CCME CWQGs, NSEQSs, FEQG and SSWQO are presented graphically in the Surface Water Quality Modelling Report (see Appendix B.6). Using the upper case source terms, the average predicted parameter concentrations are below the applicable CCME CWQGs, NSEQSs, FEQG, SSWQO or 95th percentile baseline concentration on a monthly basis. The 95th percentile monthly receiver concentrations are predicted to be greater than the CCME CWQG or NSEQS as follows:

- At EMZ-2 for the 1% PAG scenario, the 95th percentile cadmium concentration is predicted to be marginally greater than the CCME CWQG of 0.000040 mg/L in January (0.000041 mg/L), February (0.000043 mg/L), April (0.000043 mg/L), May (0.000051 mg/L) and October (0.000049 mg/L). For the 2% PAG scenario, the 95th percentile cadmium concentration is predicted to be marginally greater than the CCME CWQG of 0.000040 mg/L in January (0.000042 mg/L), February (0.000043 mg/L), April (0.000044 mg/L), May (0.000052 mg/L) and October (0.000049 mg/L).
- At EMZ-2 for the 1% PAG scenario, the 95th percentile cobalt concentration is predicted to be marginally greater than the FEQG (0.00078 mg/L) in January (0.00086 mg/L), February (0.00090 mg/L), April (0.00092 mg/L), May (0.0011 mg/L), October (0.0011 mg/L), November (0.0014 mg/L) and December (0.00091 mg/L). For the 2% PAG scenario, the 95th percentile cobalt concentration is predicted to be marginally greater than the FEQG (0.00078 mg/L) in January (0.00093 mg/L), February (0.00098 mg/L), April (0.00099 mg/L), May (0.0012 mg/L), October (0.0012 mg/L), November (0.0015 mg/L) and December (0.00098 mg/L).
- At EMZ-2 for the 1% PAG scenario, the 95th percentile zinc concentration is predicted to be marginally greater than the CCME CWQG of 0.007 mg/L in May (0.0072 mg/L) and November (0.0083 mg/L). For the 2% PAG scenario, the 95th percentile zinc concentration is predicted to be marginally greater than the CCME CWQG of 0.007 mg/L in May (0.0076 mg/L), October (0.0073 mg/L) and November (0.0089 mg/L).
- At SW-6 for the 1% PAG scenario, the 95th percentile cadmium concentration is predicted to be marginally greater than the CCME CWQG of 0.000040 mg/L in October (0.000042 mg/L) and November (0.000047 mg/L). For the 2% PAG scenario, the 95th percentile cadmium concentration is predicted to be marginally greater than the CCME CWQG of 0.000040 mg/L in October (0.000043 mg/L) and November (0.000048 mg/L).

- At SW-6 for the 1% PAG scenario, the 95th percentile cobalt concentration is predicted to be marginally greater than the FEQG (0.00078 mg/L) in October (0.00091 mg/L) and November (0.0010 mg/L). For the 95th percentile cobalt concentration is predicted to be marginally greater than the FEQG (0.00078 mg/L) in October (0.00098 mg/L) and November (0.0011 mg/L).

It should be noted that cadmium and cobalt predictions are influenced by the upper case source term applied in the model for the tailings beach cover (the average of the till and topsoil stockpile source terms, as described in the Surface Water Quality Modelling Report (Appendix B.6). Using the average of the upper case till source term (which is higher) and the topsoil source term (which is lower) may be overly conservative, as it is expected that the surface of the cover will be topsoil rather than till. As cover design progresses and source terms are refined, these predictions will be reassessed.

The results of the sensitivity analysis for 1% and 2% PAG inclusion in the TMF embankments or the NAG WRSA, using base case source terms, indicate that some 95th percentile concentrations (cobalt and zinc) are predicted to be marginally greater than the CCME CWQG or FEQG at EMZ-2 in one month of the year and would correspond to a Moderate magnitude. Using upper case source terms, some 95th percentile concentrations are predicted to be greater than the CCME CWQG or FEQG at EMZ-2 (cadmium, cobalt, lead and zinc) and SW-6 (cadmium and cobalt) and would correspond to a Moderate magnitude. These 95th percentile predictions represent a non-typical condition of upper case geochemical source terms combined with infrequent low flow climate conditions.

If misclassified PAG waste rock was placed in the NAG WRSA or was used for construction material in the TMF embankment, the modelling predicts that elevated concentrations of cadmium, cobalt, zinc and lead, under the upper case source terms (worst case scenario), could occur. If the predicted concentrations did occur, this circumstance would indicate the need for water treatment for some of the metals during the Closure Phase, as described in section 6.6.8.2.4. Mitigation, as described in the Mine Rock Management Plan (Appendix F.3), is designed to ensure the likelihood of these conditions occurring is very low. If they were to occur, these elevated concentrations would be identified during regular monitoring, and water treatment would be completed prior to discharge to the receiving environment (Anti-Dam Flowage). Mitigation measures would be re-visited and adapted to further reduce the likelihood of occurrence of misclassified PAG waste rock.

6.6.8.2.4 *Proposed Water Treatment – Post Closure Stage of Closure Phase*

Wood Environment & Infrastructure Solutions (Wood) was retained by the Proponent to develop a conceptual treatment process for the Project. Wood also prepared a list of possible chemical reagents and preliminary predicted annual consumption rates for the treatment process. Appendix J.4 provides the Conceptual Mine Water Treatment Design. A summary of the conceptual treatment process is provided below.

Water treatment has not been predicted to be necessary during the Operations or post-closure stage of the Closure Phase of the Project. The Proponent commits to having a modular effluent treatment plant available during construction, which can be adapted and utilized throughout the life of mine. The water quality predictions presented in this EIS do not indicate that treatment of water will be required to meet compliance with the MDMER at end of pipe during Operations or Post-Closure, and to meet compliance at the proposed compliance point (EMZ-2) in Anti-Dam Flowage during Operations, and during Post-Closure with consideration of base case source terms. During Post-Closure, and with consideration of upper case source terms, predictions indicate that there may be elevated cadmium, cobalt, zinc and iron concentrations at the compliance point (EMZ-2) in Anti-Dam Flowage. However, the predicted concentrations of these parameters in Anti-Dam Flowage were considered to represent a low risk potential to aquatic life (Appendix C.2).

The basis for design of the conceptual treatment process (Appendix J.4) is defined by the data provided in the Golder Water Quality and Hydrologic Modellings Assessment Reports (Appendix B.4; Appendix B.6). The approach for treatment design is to provide treatment at the source with the highest concentration to reduce the required volume that needs to be treated and reduce the amount of treatment chemistry required to achieve the effluent requirements. The PAG stockpile has been identified as the catchment on-site which has the largest contribution of loadings to the effluent concentrations potential requiring treatment. The PAG stockpile has been modelled such that the entire catchment is combined prior to treatment and for the purposes of this conceptual plan for treatment, the entire catchment area has been considered for treatment (Appendix J.4).

The seepage from the capped PAG stockpile is a significantly smaller volume and is the largest impacted source of water on-site. In order to capture this flow independently, specific design considerations would have to be included in the design of the underdrain system for the waste rock pile. It may be more cost effective to treat this flow due to the reduced size of the treatment equipment and the treatment efficiencies realized with higher concentrations and lower flowrates.

In the event that the Proponent determined capture of the smaller seepage flow to be feasible, the proposed treatment processes could be utilized to realize similar effluent quality but a higher removal efficiency of the contaminants of concern.

It is expected that the following criteria will inform the design of the mine water treatment process, as may be required:

- Provide sufficient treatment to meet the effluent criteria summarized in this EIS;
- Be sized for the maximum design flow identified in the post closure conditions as determined by KP (Appendix D.2) and presented in the Surface Water Quality Assessment Report (Appendix B.6);
- Include adequate storage capacity in the pit to allow for process downtime and maintenance;
- Automate the main treatment processes to allow un-manned operation during weekends, evenings, and weekdays when an operator is not present;
- Include a centralized control system that can be monitored remotely via an internet connection;
- Provide sufficient chemical storage and containment for at least one week of run time at average conditions;
- Where practicable place critical process tanks and equipment indoors to prevent vandalism and alleviate security concerns;
- Comply with applicable, relevant, or appropriate regulations and standards (federal, provincial, and local); and,
- Comply with appropriate industry, professional engineering, and technical standards.

The approach to the development of a mine water treatment system includes consideration of the requirements to treat mine drainage through the post-closure phase should this be required.

It is noted that the current process at the Touquoy Mine Site utilizes Geotubes for the processing of mine water after mixing and co-precipitation. Although this system appears to be operating well under the current effluent quality management strategy, this technology may not be the best suited for the longer term mine drainage requirement after mine closure. It is noted that for each phase, the characteristics of the mine water requiring treatment will be different.

The proposed treatment strategy developed and documented below consists of:

- A proven conventional physico-chemical treatment approach;
- Continued utilization of the Geotube approach or variant thereof as a stand-alone treatment process and/or in conjunction with components of the conventional physico-chemical treatment method; and,
- Additional treatment utilizing ion exchange for low level removal of metals as required.

The conceptual plan has been prepared based on the information available at the time of submission of the EIS. Changes to the water quality, quantity, process, environmental conditions etc. will have an impact on the requirements of the design and should be verified through additional data gathering, testing, and verification as it becomes available. The process that has been proposed follows typical treatment techniques for the predicted water quality. Details of this proposed treatment system is provided in Appendix J.4, including:

- pumping design and treatment system process design;
- process design, including chemical oxidation (as required) co-precipitation, solids separation, pH adjustment, filtration and adsorption (as required), sludge management, chemical reagent use; and,
- and specific requirements for the building pad, layout and utilities.

6.6.8.2.5 *FMS Surface Water Quality Summary*

During operations, the predicted TMF pond effluent concentrations using base and upper case source terms are predicted to be lower than the MDMERs.

The residual effect relevant to the surface water quality VC during the operations (EOM) phase is a change in water quality associated with Project activities. With mitigation measures in place (i.e., waste rock management plan) the predicted average and 95th percentile concentrations of modelled parameters are below the applicable guidelines and/or background concentrations on an annual and monthly basis, using both base case and upper case source terms. The magnitude of the effect on surface water quality during the operations phase ranges from Negligible to Low.

Intrinsik Corp. further concluded that while the predicted levels in the receiver slightly exceed the 75th percentile of baseline, they remain within the range of baseline and are unlikely to pose a risk to aquatic life. As a result of these predictions, no water treatment is predicted to be necessary during the Operations Phase.

During Post-Closure, the predicted open pit effluent concentrations (using both base case and upper case geochemical source terms) are predicted to be lower than the MDMERs for all parameters.

The residual effect relevant to the surface water quality VC during the post-closure stage of the Closure Phase is a change in water quality associated with Project activities. With mitigation measures (covers on the PAG stockpile and the tailings beach, waste rock management plan) in place, and using base case geochemical source terms as model inputs, the predicted average and 95th percentile receiver concentration of the modelled parameters are below the applicable guidelines and/or background concentrations on an annual and monthly basis. Therefore, the magnitude of the effect for the base case ranges from Negligible to Low (depending on parameter).

Using upper case geochemical source terms as the model input, the predicted average receiver concentration of the modelled parameters is below the applicable guidelines and/or background concentrations on an annual and monthly basis. The 95th percentile concentrations of cadmium are predicted to be greater than the FEQG in May, October and November at EMZ-2; this corresponds to a Moderate magnitude for cadmium. The 95th percentile concentrations of cobalt are predicted to be greater than the CCME CWQG in January, February, April, May, October, November and December at EMZ-2 and October and November at SW6; this corresponds to a Moderate magnitude for cobalt. The 95th percentile concentrations of zinc are predicted to be greater than the CCME CWQG in November at EMZ-2; this corresponds to a Moderate magnitude for zinc. It should be noted that these predictions of Moderate magnitude represent a non-typical condition of upper case geochemical source terms combined with infrequent low flow climate conditions.

Intrinsik Corp. further concluded that, in the Post Closure scenario, all predicted constituent concentrations were consistently below selected water quality benchmarks or baseline, when considered on an annual average basis with the exceptions of cobalt, which marginally exceeded the FEQG at EMZ-2, and iron, which marginally exceeded the respective 75th percentile baseline at SW6 and EMZ-2.

Additional modelling was conducted for all parameters to examine the potential for exceedances on a monthly average basis. When examined on a monthly basis, cadmium is predicted to be greater than the CCME water quality guideline at EMZ-2 in the months of May, October and November, based on the 95th percentile predictions. In addition, cobalt exceeds the FEQG in January, February, April, October, November and December at EMZ-2, and in October and November at SW6. Zinc also exceeds the CCME water quality guideline at EMZ-2 in the month of November, but no exceedances are predicted in any other month. These exceedances are discussed further as follows:

- **Cadmium:** The predicted 95th percentile concentrations of cadmium at EMZ-2 in the months of May, October, and November (0.000041 – 0.000049 mg/L) exceeded the CCME water quality guideline of 0.00004 mg/L. These 95th percentile predictions represent a non-typical condition of upper case geochemical source terms combined with infrequent low flow climate conditions. Hence, the likelihood of toxicity is considered to be low.

- **Cobalt**: Predicted concentrations of cobalt do not exceed the NSEQS of 0.01 mg/L in any of the prediction nodes. Only the predicted 95th percentile cobalt concentration at EMZ-2 in the months of January, February, April, October, November and December (0.00080 – 0.00125 mg/L) and at SW6 in the months of October and November (0.00084 – 0.00096 mg/L) exceeded the FEQG of 0.00078 mg/L. The 95th percentile concentrations are up to 1.6 times the FEQG of 0.00078 mg/L. The 95th percentile results represent an upper bound scenario, which would only result in the instance that low flow precipitation events occur in conjunction with upper bound source term conditions, which is unlikely. The FEQG considers hardness as a modifying factor, but the SSD model developed by Environment Canada in this guideline setting approach is very conservative, and the data used in the assessment do not fit the selected model of the SSD in the lower quartile of the dataset well (see Figure 1, ECCC, 2017, as discussed in Appendix C.2). This results in the estimated HC5 value being considerably lower than it should be, relative to the toxicity dataset. This indicates that the selected guideline is over predicting toxicity of cobalt, and hence, the marginal exceedances indicated in Table 3-6 of Appendix C.2 are considered to represent a low risk potential, with respect to toxicity to aquatic species, particularly considering that the upper case source terms and precipitation events would have to co-occur in the 95th percentile calculations outlined below in Table 3-6 of Appendix C.2.

- **Zinc:** Predicted concentrations of zinc do not exceed the NS Tier 1 standard of 0.030 mg/L in any of the prediction nodes. Only the predicted 95th percentile concentration at EMZ-2 in the month of November (0.0078 mg/L) exceeds the CCME CWQG of 0.007 mg/L. The LOEC listed in the CCME (2018) fact sheet is 0.00989 mg/L (11 week study; development; Chironomid sp.; normalized to 50 mg/L $CaCO_3$ and DOC of 0.5 mg/L). Since the predicted exceedance is marginal, relative to the guideline, and only occurs in the month of November, the likelihood of toxicity occurring in the Baseline + Project scenario is considered to be low.

- **Iron:** Figure B-75 of Appendix B.6 provides the monthly predictions for iron in the Post closure, upper case scenario. The exceedances noted in EMZ-2 and SW6 in Table 3-4 of Appendix C.2 remain fairly constant over the monthly intervals, and only marginally exceed the 75th percentile of baseline, and remain within the range of baseline. As per the discussion related to the operations upper case scenario related to iron, these predicted concentrations are unlikely to result in aquatic effects.

A sensitivity analysis was conducted to evaluate the potential effects of misclassified PAG waste rock being placed in the NAG WRSA or being used for construction material in the TMF embankment (an inclusion of 1% and 2% PAG waste rock in the NAG WRSA corresponding to 4% and 8% of the total PAG inventory being misclassified as NAG, respectively).

Using base case geochemical source terms as the model input, the 95th percentile concentration of cobalt is predicted to be marginally greater than the FEQG in November at EMZ-2; this corresponds to a Moderate magnitude for cobalt. The 95th percentile concentration of zinc is predicted to be marginally greater than the CCME CWQG in November at EMZ-2; this corresponds to a Moderate magnitude for zinc.

Using upper case geochemical source terms as the model input, the 95th percentile concentration of cadmium is predicted to be marginally greater than the CCME CWQG in January, February, April, May and October at EMZ-2 and October and November at SW-6; this corresponds to a Moderate magnitude for cadmium. The 95th percentile concentration of cobalt is predicted to be marginally greater than the FEQG in January, February, April, May, October, November and December at EMZ-2 and October and November at SW-6; this corresponds to a Moderate magnitude for cobalt. The 95th percentile concentration of lead is predicted to be marginally greater than the CCME CWQG in November at EMZ-2; this corresponds to a Moderate magnitude for lead. The 95th percentile concentration of zinc is predicted to be marginally greater than the CCME CWQG in May, October and November at EMZ-2; this corresponds to a Moderate magnitude for zinc. It should be noted that these predictions of Moderate magnitude represent a non-typical condition of upper case geochemical source terms combined with infrequent low flow climate conditions.

If misclassified PAG waste rock was placed in the NAG WRSA or was used for construction material in the TMF embankment, the modelling predicts that elevated concentrations of cadmium, cobalt, zinc and lead, under the upper case source terms (worst case scenario), could occur. If the predicted concentrations did occur, this circumstance would indicate the need for water treatment for some of the metals, as described in section 6.6.8.2.4. Mitigation, as described in the Mine Rock Management Plan (Appendix F.3), is designed to ensure the likelihood of these conditions occurring is very low. If they were to occur, these elevated concentrations would be identified during regular monitoring, and water treatment would be completed prior to discharge to the receiving environment (Anti-Dam Flowage). Mitigation measures would be re-visited and adapted to further reduce the likelihood of occurrence of misclassified PAG waste rock.

<u>Key Summary Messages</u>

These water quality predictions have been formed with consideration of key mitigation measures:

- A waste rock management plan will be in place to minimize the amount of PAG rock being placed in the NAG WRSA or used for construction.
- PAG stockpile is covered during the Closure Phase (with an impermeable till (clay) layer).
- Tailings beach is covered with a mixture of till and topsoil.

Geochemical source terms and water quality predictions through modelling will continue to be refined as more data becomes available.

During operations, surface water modelling does not predict water treatment to be necessary for effluent to meet MDMER discharge requirements, or receiving water quality guidelines for mixed discharge in Anti-Dam Flowage (CCME, NSE Tier I, documented background concentrations or Site Specific Criteria for Arsenic).

During Post Closure, surface water modelling does not predict water treatment to be necessary for effluent to meet MDMER discharge requirements, and although elevated concentrations of zinc, cobalt and cadmium have been predicted above receiving water quality guidelines for mixed discharge in Anti-Dam Flowage (only for upper case source terms and during low flow periods), the analysis by Intrinsik Corp. has concluded that the predicted concentrations of these parameters in Anti-Dam Flowage were considered to represent a low risk potential to aquatic life. Water treatment, if determined to be required during post closure, will be planned for run off from the PAG portion of the WRSA prior to mixing in the pit. There will be a modular effluent treatment plant present on site during the construction phase and this system can be adapted and utilized throughout the life of mine, as required based on site effluent quality.

6.6.8.3 Touquoy Mine Site Surface Water Quantity

6.6.8.3.1 *Accelerated Filling of the Pit*

As originally planned in the approved Touquoy Gold Project Reclamation Plan (Stantec 2017a), the inflow of groundwater, surface flow and precipitation into the pit will naturally fill the pit upon closure of the site. No change to this method is planned to follow the deposition of tailings from the Project, except that the time to fill the pit is accelerated given the decrease in available volume taken by the tailings.

Based on a three-dimensional model of the Touquoy ore body presented in the Integrated Water and Tailings Management Plan (Appendix I.6), the total storage capacity of the exhausted Touquoy pit at the maximum surface water elevation of 108 m (CGVD 2013) is estimated at 8.962 Mm^3. The water balance model predicted the amount of water and tailings stored in the pit over the 20-year simulation period. Based on results of the water balance model and the derived elevation storage relationship, tailings will be deposited in the Touquoy pit for a total of 77 months reaching an elevation in the pit of 17.6 m (CGVD 2013). The water balance model simulations indicate that it would take an additional 88 months following the deposition of the tailings (or a total of 165 months from commencement of operation) to fill the pit to the spillway invert elevation. Figure 6.6-19 illustrate the predicted elevation and storage of tailings and water in the exhausted Touquoy pit over the simulation period.

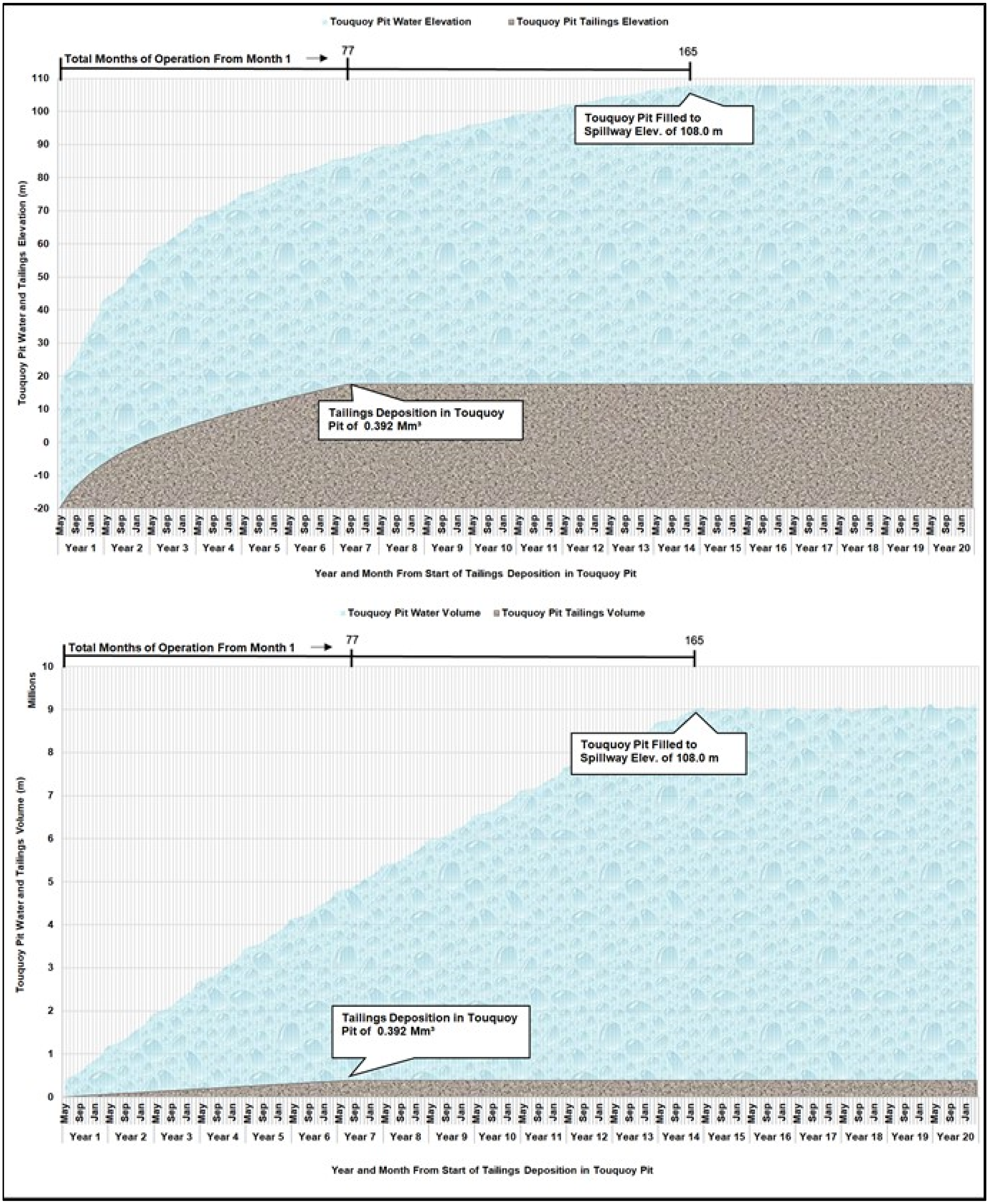

Figure 6.6-19: Tailings and Water Elevation in the Exhausted Touquoy Pit (Prepared by Stantec 2021)

6.6.8.3.2 *Reduction in Freshwater Demand*

FMS concentrate processing will deposit the tailings in the exhausted pit. Process water will continue to be reclaimed from the existing Touquoy TMF at a reclaim lower rate of 275 m³/d until surplus water storage in the existing TMF pond is depleted. Based on results of the water balance model under climate normal conditions, process water surplus will be available from the TMF for the duration of the Project. As an alternative water supply, process water can be reclaimed from the exhausted Touquoy pit at the same rate, recirculated as a closed loop through the mill facility during the remaining period of processing of ore at the Touquoy facility. As the current practice at the Touquoy Mine Site, this water management strategy reduces the quantity of mine contact water at the site and a lower demand on freshwater supplies.

6.6.8.3.3 *Extended Withdrawal from Scraggy Lake*

As discussed above, process freshwater make-up requirements for FMS concentrate processing is similar to existing Touquoy operation. Freshwater make-up requirements are at flow volumes in accordance with the existing Scraggy Lake water withdrawal permit issued by NSE. The use of surface water for industrial purposes is highly regulated in NS and involves a Proponent making application to NSE and providing rationale for the use of the water and information on the lack of impacts associated with the water use. Continued water withdrawal from Scraggy Lake will be required to be extended for the life of processing FMS concentrate. An extension to the existing Water Withdrawal approval will be requested by the Proponent. Incremental effects to surface water quantity at Scraggy Lake are not expected.

6.6.8.3.4 *Water Management in Touquoy Pit*

A spillway is proposed to be installed at elev. 108 m to prevent the pit from overtopping during re-filling. The capacity of the spillway will be sized to accommodate the Canadian Dam Association inflow design flood and associated freeboard requirements for wind run-up and wave set-up. As shown in Figure 2 of Appendix I.6, the spillway will discharge to a conveyance channel that outlets to Moose River, approximately 70 meters downstream of the surface water monitoring station SW-2. As the predevelopment and post development catchment areas draining to the discharge location at Moose River are similar, Moose River is capable of handling the resultant flows.

A geotechnical investigation will be completed prior to the detailed design of the spillway to identify the overburden and bedrock materials that may be encountered during construction of the spillway. Any required erosion and scour protection of Moose River at the discharge location will be considered in design, as well as the roadway crossing. There are no changes in surface water management of the Touquoy pit catchment from tailings deposition in the TMF to tailings deposition in the open pit, with the exception of the timing to discharge to Moose River.

The footprint of the proposed spillway overlaps with an area of delineated historical tailings. The historical tailings encountered within the construction footprint for the spillway will be relocated to an historical tailings containment cell in the existing Touquoy TMF along with other excavated historical tailings prior to the closure of the containment cells. Blasting may be required to construct the proposed spillway. Blasting would be conducted in accordance with DFO guidelines for blasting near a watercourse. A culvert will be installed to facilitate the spillway under the road present in the proposed location of the spillway.

6.6.8.3.5 *Touquoy Surface Water Quantity Summary*

The use of the exhausted Touquoy facility for tailings storage will result in the accelerated filling of the pit from that of the Touquoy reclamation plan.

- Tailings will be deposited in the Touquoy pit for a total of 77 months reaching an elevation in the pit of 10 m (CGVD2013). This amounts to approximately 98 m of water cover over the deposited tailings based on a spillway elevation of 108 m (CGVD 2013) and will limit oxygen, reduce metal leaching conditions and further improve water quality.
- No surface water will be discharged from the exhausted Touquoy pit to Moose River until the pit reaches the spillway elevation in Year 14. Water withdrawal from Scraggy Lake will require to be extended for an additional 7 years for processing of FMS concentrate associated with the Project.

6.6.8.4 Touquoy Mine Site Surface Water Quality

6.6.8.4.1 *Mill Process to Reduce Cyanide Concentrations in Tailings Slurry*

Tailings will be subject to cyanide destruction at the process plant before flowing to the exhausted Touquoy pit. Based on water quality monitoring results at the Touquoy Mine Site for existing operation, cyanide destruction to cyanate is 99.5% effective (Lorax, 2018). Cyanate decomposes harmlessly. The majority of the residual cyanide reagent introduced to the tailings during ore processing will be degraded and hydrolyzed to carbon dioxide and ammonium during storage in the tailings pond. Similarly, this will be expected to occur for the FMS concentrate tailings being stored in the Touquoy pit. Based on the efficiencies of cyanide destruction to cyanate (i.e., cyanide recovery) in the existing Touquoy TMF of 99.5%, there is no expectation that cyanide recovery will be an issue in processing of FMS concentrate. Potential failures related to cyanide recovery and proposed Touquoy pit disposal will be addressed in the Touquoy groundwater contingency plan as required in the Industrial Approval.

6.6.8.4.2 *Degraded Pit Water Quality due to Tailings Deposition*

Mill operation for the Project is planned to be consistent with Touquoy ore processing. A total of 0.534 Mt of FMS concentrate will be processed at the existing Touquoy mill facility, extending operation at the Touquoy Mine Site for approximately an additional 83 months. FMS concentrate processing amounts to approximately 0.411 Mm^3 of tailings deposited sub-aqueously in the exhausted Touquoy pit. Deposition of tailings in the exhausted Touquoy pit is simulated to degrade the water quality in the pit compared to naturally filling of the pit as per the Touquoy reclamation plan (Stantec 2017a).

The water quality model presented in the technical report (Appendix I.4) characterized this change in pit water quality in both the Operation Phase and the post-closure stage of Closure Phase. As described in the source terms report (Lorax 2019) in Appendix F.1, water quality modelling considered the pore water quality in the tailings and the pit floor/ walls, the dilution from surface runoff and direct precipitation in the pit and the water quality of the mixture based on the geochemistry of the individual water quality parameters. For the Project, geochemical source term predictions were derived from upscaling of kinetic tests and Touquoy monitoring data, to represent the pore water quality of pit walls/floor in the water quality model. Pore water is expected to have elevated metal (e.g., arsenic, cobalt, copper), ammonia, nitrate and cyanide concentrations thus reducing pit water quality at the time of discharge. Results of the water quality model in the exhausted Touquoy pit over time for metals, ammonia, and cyanide parameters are presented in the technical report provided in Appendix I.6.

Based on the water balance model results (Appendix I.6), no water will be discharged from the exhausted Touquoy pit until the pit reaches the spillway elevation in Year 14. During pit filling, this allows for many years of water treatment in the pit as a batch reactor with the objective of adjusting the pH to precipitate metals, potentially improving discharge criteria toward MDMER discharge criteria. As an additional benefit of the slow filling of the pit over time, the residence time and exposure to the atmosphere will increase, thus enhancing the natural UV degradation of cyanide and improving water quality in the pit.

The water quality in the Touquoy pit will be monitored during the pit filling and as the pit level approaches the spillway elevation. The water quality will be compared to the MDMER discharge limits and will be treated as required to meet these limits prior to discharge to Moose River. The MDMER discharge limits will decrease from the existing limits to those effective June 2, 2021. The discharge from the Touquoy Mine Site is anticipated to occur after this period, and therefore the lower MDMER limits will apply. At this time, assuming acceptable water quality within the pit for discharge, the spillway to Moose River would allow for passive discharge into the Moose River. However, should the water quality monitoring indicate that the pit lake quality is not recovering as predicted, and is not likely to meet MDMER, pumping from the Touquoy pit during the pit filling period could be directed through the existing treatment plant and released into Scraggy Lake in the short term.

6.6.8.4.3 *Change to Moose River Water Quality from Effluent Discharge and Groundwater Seepage*

The water quality model of Moose River predicts the effluent concentrations under normal discharge from the Touquoy pit combined with the downstream groundwater seepage contributions in Moose River under the same climate conditions. The mass loading to Moose River will primarily be driven by climatic conditions, and April flows were selected in the modelling to represent a worst-case (i.e., lowest) dilution ratio between the effluent discharge from the Touquoy pit and Moose River. This results in conservatively higher estimates of concentration in Moose River from mass loadings from the Touquoy pit.

Based on the groundwater flow model results, the Touquoy pit acts as a sink (i.e., gaining groundwater to the Touquoy pit) when the water level in the pit is below the shallow bedrock, and does not result in groundwater or surface water discharge to Moose River. Therefore, there are no water quality effects to Moose River during this period. As the water level in the Touquoy pit rises above and the shallow bedrock, seepage from the Touquoy pit will migrate towards Moose River. The seepage is expected to increase to a maximum of 258 m^3/d when the water level in the Touquoy pit increases to an elevation of 108 m. This groundwater seepage is considered in surface water modelling predictions in the Moose River. The flow rate in Moose River in April is 230 times this rate, and therefore represents a dilution ratio of approximately 230. Concentrations of cobalt, copper and nitrite in groundwater were predicted in the model above the CCME FAL or NSE EQS (2013) in the untreated pit water at discharge. The groundwater seepage quality was assumed to be consistent with the source terms pore water quality, at an estimated average concentration of 0.0006 mg/L of arsenic to Moose River. Based on the assimilative capacity model in Moose River these parameters meet CCME FAL/NSE EQS after mixing with Moose River 100 m downstream of the discharge point.

The water quality discharged from the pit to Moose River will be treated to meet MDMER discharge/regulatory closure criteria or site-specific guidelines, if required. Without treatment, arsenic concentrations of 0.363 mg/L are predicted to slightly exceed the MDMER discharge criteria of 0.3 mg/L in Year 14 based on climate normal conditions. Therefore, arsenic concentrations in the discharge to Moose River are predicted to be 0.3 mg/L (post treatment). Once mixed with the background water quality in Moose River, the concentration 100 m downstream of SW-2 is predicted to be 0.024 mg/L for arsenic and 0.184 mg/L for aluminum. Although this arsenic concentration is above the NSE Tier 1 and CCME guidelines of 0.005 mg/L, the background levels at SW-2 also exceed the guidelines at 0.018 mg/L. The aluminum concentration is predicted below the 75th percentile receiver quality in Moose River. Based on the CCME guideline (2001), the arsenic concentration is below the reported lowest toxic levels for fish, algae and aquatic plants. A SSWQO was derived for arsenic, following CCME (2007) protocols, using a species sensitivity distribution (SSD) approach. The SSD approach was comprised of identifying chronic toxicity data for species, analyzing the data using a regression approach and selecting the final chronic effects benchmark. The HC5 (i.e., the concentration that is hazardous to no more than 5% of a species in the community) was selected as the final chronic effects benchmark as per CCME (2007) guidance. The resultant guideline using the protocol is 30 µg/L. The details related to the SSWQO for arsenic and the broader aquatic effects assessment for the Project are provided in the Intrinsik Report provided in Appendix C.2. Conclusions relating to aquatic effects of arsenic in the Moose River are summarized below.

While predicted receiving environment concentrations of arsenic at the end of the 100 m mixing zone within Moose River (0.024 mg/L) exceeds the CCME FWAL guideline of 0.005 mg/L, this guideline was derived some time ago using a safety factor applied to the Lowest Observed Effect Level [the 14-day EC50 (growth) of 50 μg/L for the algae *Scenedesmus obliquus* (Vocke et al., 1980), with a safety factor of 0.1 (CCME, 1991) as cited in Appendix C.2]. The Vocke et al. (1980) study was the most sensitive freshwater organism to arsenic identified by the CCME, following consideration of data from 21 different species of fish, 14 species of invertebrates and 14 species of plants. Other regulatory guidelines are also available from other jurisdictions, such as the National recommended water quality criterion known as the Criterion Continuous Concentration (CCC) from the US EPA (US EPA, 2018; arsenic criteria developed in 1995 as cited in Appendix C.2). The CCC is," an estimate of the highest concentration of a material in surface water to which an aquatic community can be exposed indefinitely without resulting in an unacceptable effect". The CCC for arsenic are based on the amount of dissolved metal in the water column and is 150 μ g/L (0.150 mg/L) and was derived on 1995 (Appendix C.2).

Using the CCME protocol for development of water quality guidelines (CCME, 2007), an SSD approach was used to develop a SSWQO. The value developed is 0.030 mg/L (30 μ g/L) and concentrations predicted in receiving environment of Moose River are below this value. The predicted receiving environment concentration of 0.024 mg/L is below any of the no observed effect concentration (NOEC) or LOEC data for arsenic provided in Table A-2 of Appendix C.2 for chronic studies. Hence, risks to aquatic life are anticipated to be low.

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 predicted to be higher than the CCME guideline (free cyanide). This guideline is not a relevant guideline to compare Total cyanide, SAD or even WAD forms of cyanide to, as it is based on the free ion, as opposed to bound forms of cyanide (such as WAD or SAD), which have far lower toxic potential. Conclusions relating to aquatic effects of cyanide in the Moose River are summarized below.

The chemistry of cyanide is complex, and the toxicity of various cyanide complexes varies widely. So, the form of cyanide in the environment greatly affects the toxicity of the compound. The most toxic form of cyanide is free cyanide, which includes the cyanide ion (- CN) and HCN (ICMC, 2018 as cited in Appendix C.2). Cyanide is highly reactive, and readily forms simple salts with earth cations and ionic complexes. The strength of the bonds of these associations vary depending upon the salt, and the pH of the environment. Weak or moderately stable complexes are known as WAD (weak acid dissociable), and typically involve cations such as cadmium, copper and zinc. WAD cyanide is less toxic than free cyanide, but when they dissociate, they release free cyanide and the metal cation. Typically, WAD complexes dissociate and release HCN under mildly acidic conditions such as those ranging from pH 3 – 6 (OI, 2009). Cyanide can also form very stable complexes with gold, mercury, cobalt and iron. The stability of these complexes in the environment depends on pH in the environment, but strong metals-cyanide complexes (SAD) typically require strongly acidic conditions (pH<2) to dissociate and release HCN (OI, 2009 as cited in Appendix C.2). The term "total cyanide" typically refers to the sum of all cyanide species that are converted to HCN following digestion in a strong acid solution (Total cyanide = free cyanide + WAD + SAD). Other cyanide compounds, such as thiocyanate and cyanate, are markedly less toxic than free cyanide (ICMC, 2018 as cited in Appendix C.2).

With this in mind, a measured or estimated Total Cyanide concentration can range from including 100% SAD forms of cyanide, to 100% free cyanide, depending upon the chemistry of the effluent, and the receiving environment. Some SAD forms of cyanide (iron cyanide complexes) can dissociate in sunlight and release free CN (ICMC, 2018). Other environmental fate processes, such as volatilization, wherein the amount of cyanide lost increases with decreasing pH, and biodegradation, where aerobic conditions result in microbial degradation of cyanide to ammonia, and subsequently, nitrate (ICMC, 2018). Therefore, environmental fate of cyanides in the receiving environment is modified by a number of factors.

It is important to note that the NS Tier 1 guideline of 5 µg/L (which is based on the CCME guideline), is for free cyanide. This guideline is not a relevant guideline to compare Total cyanide, SAD or even WAD forms of cyanide to, as it is based on the free ion, as opposed to bound forms of cyanide, which have far lower toxic potential. Based on the receiving environment predictions in Table 4-3 of Appendix C.2, WAD cyanide is approximately half of the Total Cyanide predicted concentration (0.0024 mg/L WAD, compared to 0.0052 mg/L Total). This implies that the half of the Total Cyanide prediction would be SAD, and hence, less likely to dissociate in the receiving environment (mean pH in receiving environment is 6.05; see Table 4-1 of Appendix C.2). Predicted WAD concentrations in the receiving environment are below the NS Tier 1 guideline, indicating acceptable levels of risk to aquatic life. Based on this, risk to aquatic life are predicted to be low.

If required during the Closure Phase, the water level in the Touquoy pit will be maintained through pumping to a water treatment plant at or beneath the permeable bedrock layer at 104 m elev. until water quality improves to meet discharge criteria. This low pit water level will provide more than adequate storage of the inflow design flood and freeboard as the lowest Touquoy pit level at surface is at 110 m elev. As the Touquoy pit has approximately 98 m of water cover 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 Touquoy pit to migrate to Moose River. This water cover over the deposited tailings will limit oxygen thus reducing metal leaching conditions and further improving water quality in the pit.

Based on the predictive modelling conducted, only Total cyanide was predicted to exceed the selected benchmarks. For Total cyanide, the selected benchmark was the NS Tier 1 guideline, which is based on free cyanide, and hence not a relevant benchmark for comparison purposes. Based on the available toxicity data and predictions, Total cyanide is unlikely to be present in concentrations of concern to aquatic life.

As the pit water is planned to be treated to MDMER and any regulatory closure criteria or site-specific guidelines prior to discharge, the magnitude of the effect is expected to be negligible on Moose River quality and downstream tributaries. Discharge and seepage flow from the pit to Moose River during closure will be permanent and will occur regularly based on climate conditions. The change on water quality of Moose River will be irreversible. The environmental effect is considered not significant after mitigation measures have been implemented.

6.6.8.4.4 *Dilution of Pit Water from Freshwater Make-up*

Process freshwater make-up water requirements of approximately 5.8% of production or 503 m^3/d will be sourced from Scraggy Lake. This is a continuation of the existing NSE approved water taking from Scraggy Lake for Touquoy ore processing and will not change the baseline flows in Scraggy Lake. Should additional process make-up water be required in the event of a water reclaim deficit scenario, treated effluent from the existing polishing pond at the Touquoy TMF could be used as a source. As surface water quality in the polishing pond meets the MDMER effluent discharge criteria, the use of make-up water from Scraggy Lake or the polishing pond is not expected to degrade the Touquoy pit water quality, and is likely to improve the water quality in the pit through dilution.

6.6.8.4.5 *Touquoy Surface Water Quality Summary*

The use of the exhausted Touquoy pit for tailings storage from the Project will result in degraded water quality in the pit during filling, and that may discharge to the receiving environment (Moose River) through seepage and effluent discharge. The pit water will be managed and treated as required to MDMER limits regulatory closure criteria, and/or site-specific guidelines prior to discharge. Therefore, the magnitude of the effect is expected to be negligible on Moose River quality and downstream tributaries.

- The predicted receiving environment concentration of arsenic is 0.024 mg/L; risks to aquatic life associated with predicted arsenic concentrations are anticipated to be low.
- The aluminum concentration of 0.184 mg/L for aluminum is predicted below the 75th percentile receiver quality in Moose River.
- Elevated concentrations of cobalt, copper and nitrite in groundwater were predicted in the model to meet CCME FAL/NSE EQS after mixing with Moose River 100 m downstream of the discharge point.

- Predicted WAD concentrations in the receiving environment of 0.0024 mg/L are below the NSE Tier 1 guideline of 0.005 mg/L free cyanide, indicating acceptable levels of risk to aquatic life.

6.6.9 Proposed Compliance and Effects Monitoring Program

6.6.9.1 FMS Mine Site Project Monitoring

Surface water quantity and quality monitoring programs will be implemented for the Project during the construction, operations, and closure phases. The purpose of the monitoring programs will be to confirm the results of the effects predictions and provide information that will allow for management of on- and off-site water management and site effluents, as needed, to mitigate adverse effects on water quality in the receiving surface water environment.

6.6.9.1.1 *FMS Surface Water Quantity Monitoring*

The current hydrological monitoring program was initiated in 2018. Manual measurements of stream discharge coupled with automatic water level datalogging are intended to confirm the natural flow regime for streams around the site, and to monitor the potential change as a result of the Project. As such, the existing hydrological monitoring program will continue during 2019/2020 and subsequently during each of the defined Project phases.

During the construction phase, additional monitoring may be implemented along the Seloam Brook Realignment. The locations and type of hydrological monitoring will be assessed as design progresses and if required will be completed at a frequency that is sufficient to detect changes in surface water velocity and flow and will aim to capture a range of flow conditions. A detailed geomorphological survey has been designed and is being implemented in 2020 to support the Seloam Brook Realignment. With geomorphic analysis underway on these water features, additional detail will become available on the composition and potential mobility of sediments and the stability of the existing stream system. In turn, this work can inform the appropriate design of the Seloam Brook Realignment and the downstream water control structures.

The hydrological monitoring plan will undergo regular reviews, including an evaluation of the need for station locations and frequency of sampling. Changes may result in supplementation or streamlining of the program to focus on site-specific concerns or requirements on an as needed basis to support future adaptive management strategies, if these are required. Final details relating to monitoring locations and frequency of sampling will be submitted as part of the IA application.

6.6.9.1.2 *FMS Surface Water Quality Monitoring*

Since early 2017, the surface water quality baseline sampling events have been completed on a quarterly frequency at stations across the LAA – this includes stations located within the FMS Study Area, as well as upstream and downstream of the FMS Study Area. A baseline surface water quality monitoring program will continue during 2019/2020 and will incorporate baseline MDMER environmental effects monitoring stations, and during all Project phases. Once operations commence, the surface water monitoring program will incorporate additional monitoring stations to collect samples of effluent from key site facilities; these will include stations for the open pit sump, ore stockpile pond, NAG waste rock collection pond, till stockpile collection pond, TMF pond, and north and east TMF seepage collection ponds (Figure 6.6-21). The monitoring program will comply with the requirements of the federal effluent discharge requirements (as per MDMER under the *Fisheries Act*). At monitoring locations that do not have specific regulatory requirements, the occurrence of sampling events will be completed at a frequency that is sufficient to detect changes in surface water quality and will aim to capture a range of flow conditions, as required.

The surface water quality monitoring program will undergo regular reviews, including an evaluation of the need for station locations, parameters, and frequency of sampling. Future changes to the monitoring programs will therefore be evaluated, and changes may result in supplementation or streamlining the programs to focus on site-specific concerns or requirements on an as needed basis to support the adaptive management strategies. The surface water quality station locations will be regularly evaluated to determine each station's significance. For example, once the final Project layout has been designed, the locations of the surface water quality monitoring stations may need to be revised to reflect any changes versus those presented in the Project Description (Section 2). Final details relating to monitoring locations and frequency of sampling will be submitted as part of the IA application.

6.6.9.2 Touquoy Mine Site Project Monitoring

6.6.9.2.1 *Touquoy Mine Site Surface Water Quality Monitoring*

The intention will be to continue with surface water monitoring at receiving watercourses at Moose River and WC4 as specified in the existing Touquoy Gold Project IA approval conditions. In addition, discharge to Moose River will be subject to MDMER monitoring requirements. The Proponent will monitor water quality and quantity in the pit during pit filling with the objective of meeting regulatory discharge criteria prior to discharge through the spillway to Moose River. Final details relating to monitoring locations and frequency of sampling will be submitted as part of an amendment to the current Touquoy Gold Project IA approval.

6.6.9.3 Project Monitoring Program Details

As the Project moves forward, monitoring programs will continue to gather pre-construction surface water baseline data. Monitoring programs will continue during Construction, Operations, and Closure phases to verify the results of the effects assessment for surface water quantity and quality. An EMS and EPP will be developed as part of the Project implementation that will confirm the responsibility and system of accountability for the compliance and effects monitoring program.

The objectives of the surface water monitoring programs are to:

- Verify potential effects and/or changes predicted in the EIS;
- Confirm the continuing effectiveness of mitigation measures;
- Identify the need for additional mitigation measures, if required; and
- Confirm compliance with regulatory approvals and requirements.

The surface water monitoring program will include the following, as well as potentially additional monitoring as determined through discussions with regulatory agencies:

- Surface water quality monitoring at select baseline sampling locations, for frequency and parameters required under applicable federal and provincial regulations;
- The MDMER program would involve detailed surface water quantity and quality sampling, as well as effluent sampling to determine final EEM specifications; and,
- Ongoing surface water quality monitoring at the Touquoy Mine Site.

Locations for monitoring of water quantity and/or water quality at the FMS Study Area through the phases described herein are displayed on Figure 6.6-21 and described Table 6.6-45. The surface water monitoring plan will be regularly reviewed for appropriate frequency, parameters and locations, and adjusted as necessary.

Table 6.6-45: Long-Term Surface Water Monitoring Locations

Station ID	Description	Surface Water Quality	Surface Water Quantity	Rationale
SW1	Unnamed stream	✓		Stream flows through the PA before it converges with Fifteen Mile Stream
SW2	Seloam Lake (outlet)	✓	✓	Seloam Lake is a headwater lake, upstream of the PA, and one of the two options to receive the discharge of treated effluent
SW5	Seloam Brook	✓	✓	Brook flows through the northwest corner of the PA and converges with surface water flows from the majority of the PA
SW5A	Seloam Brook tributary	✓	✓	WC 12 upstream of realignment berms Tributary to Seloam Brook which may receive groundwater seepage.
SW6	Anti Dam Flowage (outlet)	✓	✓	Anti-Dam Flowage Reservoir is downstream of the PA and one of the two options to receive the discharge of treated effluent
SW12	East Lake	✓		Small lake located in the southeast corner of the PA and downgradient of the proposed TMF footprint
SW13	Anti-Dam Flowage	✓		Anti-Dam Flowage Reservoir is downstream of the PA and one of the two options to receive the discharge of treated effluent
SW14	Fifteen Mile Stream	✓	✓	Stream is located west of the PA and downstream of SW5 and SW7
SW15	East Lake outlet	✓	✓	Outflow from East Lake to tributary draining to Anti-Dam Flowage
TBD	TMF pond effluent	✓	✓	Collection of samples of effluent from key site facilities and discharge from the TMF pond.
TBD	Open Pit effluent	✓		Collection of samples of effluent from key site facilities.
TBD	Ore Stockpile Collection Pond	✓		Collection of samples of effluent from key site facilities
TBD	NAG Stockpile Collection Pond	✓		Collection of samples of effluent from key site facilities
TBD	Till Stockpile Collection Pond	✓		Collection of samples of effluent from key site facilities
TBD	TMF North Seepage Collection Pond	✓		Collection of samples of effluent from key site facilities
TBD	TMF East Seepage Collection Pond	✓		Collection of samples of effluent from key site facilities

At the Touquoy Mine Site, continued surface water monitoring at receiving watercourses will occur at Moose River and WC4 as specified in the existing Touquoy Gold Project IA approval conditions. In addition, discharge to Moose River will be subject to MDMER monitoring requirements. The Proponent will monitor water quality and quantity in the pit in operation with the objective of meeting regulatory discharge criteria prior to discharge through the spillway to Moose River.

Proposed follow-up and monitoring programs have been reviewed with the Mi'kmaq of Nova Scotia during engagement efforts including meetings, sharing of technical documents (Draft EIS, poster boards, Summary of Mi'kmaq Effects and Proposed Mitigation Measures, Plain Language Summary). On-going engagement with the Mi'kmaq will continue through the EA process and associated permitting relating to follow-up programs and monitoring.

6.7 Wetlands

6.7.1 Rationale for Valued Component Selection

Wetlands were selected as a VC due to their ecological value in providing habitat for aquatic species and rare plants, the importance of wetlands in the daily lives of terrestrial species, their capacity to store water, managing downstream flooding, improving water quality, and the recharge/discharge of groundwater aquifers. The socio-economic importance of wetlands from a recreational and resource perspective is also noted in the selection of wetlands as a valued component (Section 6.1.4 of the EIS Guidelines and its potential interactions with Project activities).

In Nova Scotia, Wetlands are protected under the *Environment Act* and the Wetland Conservation Policy. The *Environment Act* defines a wetland as "Land referred to as a marsh, swamp, fen, or bog that either periodically or permanently has water table at, near, or above the land surface or that is saturated with water, and sustains aquatic processes as indicated by the presence of poorly drained soils, hydrophytic vegetation, and biological activities adapted to wet conditions".

6.7.2 Baseline Program Methodology

6.7.2.1 FMS Study Area Baseline Program Methodology

6.7.2.1.1 *Desktop Evaluation*

A desktop review of available topographic maps, provincial databases, and aerial photography was completed to aid in the determination of wetland habitat in the FMS Study Area. Mapped wetland areas were identified from the NSE Wetland Inventory Database. The Nova Scotia Wet Areas Mapping (WAM) database was reviewed to identify potential un-mapped wetlands, along with a provincial flow accumulation data set. The Wetland of Special Significance (WSS) geographic information system (GIS) *predictive layer* provided by NSE was consulted for the presence of expected and potential WSS within the FMS Study Area.

6.7.2.1.2 *Field Delineation*

Following the initial desktop review, field surveys were completed within the FMS Study Area from November 2016 (in support of a provincial wetland alteration application to support exploratory drilling) through August 2019. Wetland delineation and assessment generally took place within the growing season (June 1st to September 30th). Wetlands that were assessed outside of this period were revisited within the following growing season to confirm functional assessment conclusions and species assemblages. Wetland characteristics and functional assessments can be completed sufficiently during any time of the growing season, however seasonal factors in the distribution and identification for priority species and accessibility for fish are considered and targeted species surveys were completed within identified wetland habitat to further support functional assessment. Seasonal considerations for each species assemblage within wetlands are described in their respective sections of this EIS (i.e. flow regimes and seasonality of fish movement is described in Section 6.8, seasonal avian surveys are described in Section 6.11, and so on). Targeted surveys were completed within the FMS Study Area where mapped systems were present to confirm and delineate known wetland habitat. Meandering transects were also completed across the FMS Study Area to support efforts to delineate all wetlands present within the FMS Study Area, beyond those identified in the available database resources.

Trained wetland delineators and evaluators completed all field surveys. Isolated wetlands that were confirmed to be <100 m^2 in the field, and not connected to other wetlands by defined watercourses, were not delineated due to the minimum size requirement of a provincially regulated wetland. Wetlands determined to be smaller than 100 m^2 post field evaluation were not included on figures nor were these small wetland areas considered for the effects assessment.

Delineated wetlands that extended outside of the FMS Study Area were only delineated to the FMS Study Area boundary. Details related to functional assessment methods for wetlands which extend outside of the FMS Study Area boundary are described in Section 6.7.2.1.4.

Wetland delineation was conducted in accordance with the Corps of Engineers Wetland Delineation Manual (Environmental Laboratory 1987) and the Regional Supplement to the United States Army Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region (United States Army Corps of Engineers 2011). In each wetland, vegetation, hydrology, and soils data were recorded at both wetland and upland data points on either side of the wetland boundary in accordance with the Corps of Engineers Wetland Delineation Manual (Environmental Laboratory 1987). Wetland types were determined using the Canadian Wetland Classification System (Warner and Rubec 1997).

Wetland boundaries were documented using an SXBlue II GPS receiver unit capable of sub-metre accuracy with a handheld SXPad field computer. In some instances, handheld Garmin GPS 64sx Series units were used, capable of sub-5m accuracy. Any inlet and outlet streams or other features associated with each wetland present within the FMS were marked during the delineation processes, as well as walked and mapped within the boundaries of the wetland. Pink flagging tape was used to mark the boundaries of wetlands and blue flagging tape was used to mark the locations of associated watercourses.

In keeping with the Army Corps of Engineers methodologies for wetland delineation, three criteria are required in order for a wetland determination to be made:

- Presence of hydrophytic (water loving) vegetation;
- Presence of hydrologic conditions that result in periods of flooding, ponding, or saturation during the growing season; and,
- Presence of hydric soils.

Hydrophytic vegetation is defined as the sum total of macrophytic plant life that occurs in areas where the frequency and duration of inundation or soil saturation produce permanent or periodically saturated soils of sufficient duration to exert a controlling influence on the plant species present (Environmental Laboratory 1987). Hydrophytic vegetation should be the dominant plant type in wetland habitat (Environmental Laboratory 1987).

Dominant plant species observed at each data point were classified according to their indicator status (probability of occurrence in wetlands) in accordance with the Nova Scotia Wetland Indicator Plant List. Further relevant information was reviewed in Flora of Nova Scotia (Roland 1998) and Nova Scotia Plants (Munro, Newell & Hill 2014).

If the majority (greater than 50%) of the dominant vegetation at a data point is classified as obligate (OBL), facultative wetland (FACW), or facultative (FAC) (excluding FAC-), then the location of the data point is considered to be dominated by hydrophytic vegetation. Wetland vegetation compositions for wetland types identified within the Study Area during field surveys have been described in Section 6.7.3.1.

A hydric soil is defined as a soil that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part (United States Department of Agriculture 2003). Indicators that a hydric soil is present include soil colour (gleyed soils and soils with bright mottles and/or low matrix chroma), aquic or preaquic moisture regime, reducing soil conditions, sulfidic material (odour), soils listed on the hydric soils list, iron and manganese concretions, organic soils (histosols), histic epipedon, high organic content in surface layer in sandy soils, and organic streaking in sandy soils.

A soil pit was completed at each data point. These pits were excavated to a depth of 50 cm or refusal. The soil in each pit was then examined for hydric soil indicators. The matrix colour and mottle colour (if present) of the soil were determined using the Munsell Soil Colour Charts.

Wetland habitat, by definition, either periodically or permanently, has a water table at, near, or above the land surface or is saturated with water. To be classified as a wetland, a site should have at least one primary indicator or two secondary indicators of wetland hydrology. Examples of primary indicators of wetland hydrology include watermarks, drift lines, sediment deposition, and water stained leaves. Examples of secondary indicators of wetland hydrology include oxidized root channels, dry season water table, and stunted or stressed plants.

Each area of expected wetland habitat was assessed for signs of hydrology through observations across the area and assessment of soil pits at each data point.

Further baseline field surveys were conducted throughout the entire FMS Study Area to assess the suitability of wetland habitat for wetland specific species, especially those considered to be Species at Risk (SAR) and/or Species of Conservation Interest (SOCI). All surveys conducted for SAR and SOCI were completed in suitable habitat throughout the FMS Study Area according to species-specific methodologies. This included, for instance, both early and late season botany surveys, and avian migration, breeding and overwintering surveys. Information on these baseline survey methods, including survey locations and timing, and species observed, can be found in Section 6.12. Priority species were assessed throughout the entire FMS Study Area, and wetland specific species lists will be generated if necessary, at the permitting phase. It should be noted that, while it was not possible to confirm a species' absence from the landscape, all care was taken to identify the presence of preferred habitat within the FMS Study Area (see Section 6.12 for further information). Where suitable habitat was observed for a SAR (particularly SAR fish and turtles), it was presumed to potentially be present, even if presence was not confirmed via observation of that species (or evidence thereof).

6.7.2.1.3 *Wetlands of Special Significance*

The Wetland Conservation Policy was developed by Nova Scotia Environment in 2011 and amended in 2019 (NSE 2019). Its mandate is to provide a framework for the conservation of wetlands. Furthermore, it provides a framework for the identification of Wetlands of Special Significance. According to NSE (2019, p.11-12), the following criteria define Wetlands of Special Significance:

- All salt marshes;
- Wetlands that are within or partially within a designated Ramsar site, Provincial Wildlife Management Area (Crown and Provincial lands only), Provincial Park, Nature Reserve, Wilderness Areas or lands owned or legally protected by non-government charitable conservation land trusts;
- Intact or restored wetlands that are project sites under the North American Waterfowl Management Plan and secured for conservation through the NS-EHJV;
- Wetlands known to support at-risk species as designated under the federal *Species at Risk Act* or the *Nova Scotia Endangered Species Act*; and,
- Wetlands in designated protected water areas as described within Section 106 of the *Environment Act*.

The presence of a sessile or non-mobile (primarily flora) SAR within a delineated wetland triggers the determination of that wetland as a WSS. Mobile species have home ranges that may include wetlands within and beyond the FMS Study Area, which may be used at various times of the year (i.e., used during the breeding season, but not at other times). Given the mobility of some species, an observation of a mobile SAR has not immediately designated these wetlands as WSS. The determination of WSS based on the observation a mobile species is determined on a species-specific and site-specific basis, considering the following factors:

- whether the species was observed within the wetland;
- whether suitable habitat is present within the wetland;

- what is the wetland habitat used for (i.e., does the habitat provided within the wetland provide necessary life functions (i.e., nesting or overwintering habitat)); and,
- the discreteness or specificity of habitat use by the mobile species (i.e., wood turtles have specific and discrete nest beach requirements, compared with the in-discrete and non-specific foraging habitat usage by mainland moose, for example).

Furthermore, the NS Wetland Conservation Policy states that the Province is in the process of developing a system for classifying additional wetlands or wetland types as WSS (NSE 2019). Among the wetland characteristics, functions and services to be considered during the process are whether the area:

- Supports a significant species or species assemblages (e.g., coastal plain flora);
- Supports high wildlife biodiversity;
- Has significant hydrologic value; or
- Has high social or cultural importance.

Currently, a province-wide framework for determination of WSS using Wetland Ecosystem Services Protocol - Atlantic Canada (WESP-AC) has not been developed. It is MEL understanding that the Province is in the process of identifying Wetlands of Special Significance within the WESP-AC framework. Through final implementation of WESP-AC, parameters may be established to help identify significance thresholds for functions listed above (i.e., significant hydrologic value).

NSE developed a WSS predictive GIS layer (September 2020, pers. comm., Ian Bryson, NSE Wetland Specialist), which overlies mapped wetlands with protected areas layers, and rare species observations from ACCDC, among other attributes. According to NSE, this WSS GIS layer is intended to be used as a planning tool, and its contents should be interpreted as potential WSS. The actual determination of WSS status is based on field verification of the parameters or considerations listed above.

This predictive layer was consulted during the desktop evaluation for wetlands prior to initial wetland delineations in 2016, and reconfirmed with the latest WSS layer, provided to MEL by Ian Bryson in September 2020. This predictive layer incorporates all rare species observations, regardless of the species' ranking, accuracy of the data points, observation date, and mobility of species. As such, it is used as a predictive tool only to support WSS determination.

Final determination of WSS will be completed at the permitting phase with guidance from NSE when the framework for determination of WSS has been developed. Until the framework for WSS determination is available, the Project Team will continue to engage with NSE and NSL&F to discuss WSS designation on a site-specific basis.

6.7.2.1.4 *Functional Assessment*

Wetland functional assessment was completed for each wetland using the Wetland Ecosystem Services Protocol - Atlantic Canada (WESP-AC) wetland evaluation technique. The WESP-AC process involves the completion of three forms; a desktop review portion that examines the landscape level aerial conditions to which the wetland is situated, and two field forms. The process serves as a rapid method for assessing individual wetland functions and values. WESP-AC addresses 17 specific functions that wetlands may provide (Table 6.7-1). The specific wetland functions are individually allocated into grouped wetland functions and measured for "function" and "benefit" scores. Wetland function relates to what a wetland does naturally (i.e., water storage), whereas wetland benefits are benefits of the function, whether it is ecological, social, or economic. The highest functioning wetlands are those that have both high 'function' and 'benefit' scores for a given function, however, this does not correlate to the definition of a WSS (see Section 6.7.2.1.3). WESP-AC enables a comparison to be made between individual wetlands within a Province to gain a sense of the importance each has in providing ecosystem services.

Table 6.7-1: Wetland Function Parameters.

Grouped Wetland Function	Specific Wetland Functions
Hydrologic Function	Surface Water Storage
Aquatic Support	Aquatic Invertebrate Habitat
	Stream Flow Support
	Organic Nutrient Export
	Water Cooling
Water Quality	Sediment Retention & Stabilization
	Phosphorus Retention
	Nitrate Removal & Retention
	Carbon Sequestration
Aquatic Habitat	Anadromous Fish Habitat
	Resident Fish Habitat
	Waterbird Feeding Habitat
	Waterbird Nesting Habitat
	Amphibian and Turtle Habitat
Terrestrial Habitat	Songbird, Raptor, & Mammal Habitat
	Pollinator Habitat
	Native Plant Habitat

In addition to the grouped wetland functions above, WESP-AC also measures the following groups, however these are only evaluated by their benefit scores:

- Wetland Condition; and
- Wetland Risk.

The following individual functions are assessed to determine the benefit scores associated with these groups:

- Public Use & Recognition;
- Wetland Sensitivity;
- Wetland Ecological Condition; and

- Wetland Stressors.

Given the presence of historical mining in the area, wetland stressors were identified visually and by consulting the Phase I Environmental Site Assessment and Limited Phase II Environmental Site Assessment – Fifteen Mile Stream (Appendix I.2 and I.3). Adamus (2018) defines wetland stressors as they relate to WESP-AC completion as the degree to which a wetland is or has recently been altered by, or exposed to risk from human activities that degrade its ecological condition and/or reduce its ability to perform its ecological functions. The WESP-AC stressor field form was completed whenever delineators felt a wetland was subject to stress. The field form organizes stressors into four groups: Hydrologic Stress, Water Quality Stress, Fragmentation Stress, and general Disturbance Stress.

For each wetland evaluated, the WESP-AC process calculates the overall score for the seven grouped wetland functions and the 17 specific wetland functions listed in Table 6.7-1 above. One score each is provided for function and benefit. Scores are ranked as 'Lower', 'Moderate', or 'Higher', allowing for analysis of the wetland as compared to baseline wetland scores in Nova Scotia. A 'Higher' WESP-AC score means that wetland has a greater capacity to support those processes as compared to other wetlands in the province. In Nova Scotia, 121 non-tidal wetlands were previously assessed and compiled into a statistical sample, which is used for comparison in analysis (Adamus 2018). A 'Higher' WESP-AC score in both the function and benefits category means the wetland supports the natural ecosystem functions and provides services potentially important to society. For the analysis, MEL ranked the WESP-AC scores to quantitatively compare wetlands. The following ranks were applied to scores for grouped wetland functions and specific wetland functions:

- Lower score = 1 point
- Moderate score = 2 points
- Higher score = 3 points

The WESP-AC functional evaluation technique recognizes that, in many cases, delineation of entire wetlands where they extend outside of a study area is not always feasible or necessary (Adamus 2018). Instead, the field evaluation portion of WESP-AC focuses on the Assessment Area (AA; the wetland or portion of wetland physically walked and assessed by the delineator in the field), while the office form allows for broad functional assessment of NSE mapped wetlands that extend outside of the Study Area.

6.7.2.2 Touquoy Baseline Program Methodology

Wetlands were identified within Touquoy Mine Site as part of the Touquoy Gold Project EARD process via the NSL&F Wetlands Database and air photo interpretation. These wetlands were assessed in September 2006 and in the spring of 2007 (CRA 2007a).

Further wetland surveys were conducted from 2015-2018 by MEL biologists, including delineation and functional assessments as part of the wetland permitting process. Wetland delineation was completed in accordance with the Army Corps of Engineers Wetland Delineation Manual (Environmental Laboratory 1987) and the Regional Supplement to the United States Army Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region (United States Army Corps of Engineers 2011), as described in Section 6.7.2.1 above. Wetland functional assessment was completed for each wetland using the NSE NovaWET 3.0 wetland evaluation technique.

6.7.3 Baseline Conditions

6.7.3.1 FMS Study Area Baseline Conditions

A total of 274 freshwater wetlands were present within the FMS Study Area, as shown on Figure 6.7-1. An additional 62 wetlands were delineated to the north of the current FMS Study Area during a previous iteration of the study area boundary. As a result, the following wetland numbers are not present within the current FMS Study Area: 74-104, 197, 210, 214. 217, 222, 223, 239, 241, 248, 257, 281, 284-303, 306. A summary of wetland numbers, area, flow path and wetland type are provided in Table 6.7-2.

Table 6.7-2. Wetland Delineation Summary Results

Wetland Number	Size (ha)	Water Flow Path*	Wetland Type	Wetland Number	Size (ha)	Water Flow Path*	Wetland Type
1	7.678	Throughflow WC	Complex	**170**	0.525	Outflow D	Bog
2	34.981	Throughflow WC	Complex	**171**	0.042	Isolated	Bog
3	0.844	Outflow WC	Swamp	**172**	0.090	Isolated	Swamp
4	0.031	Outflow D	Swamp	**173**	0.216	Throughflow WC	Complex
5	0.058	Isolated	Swamp	**174**	0.135	Isolated	Swamp
6	0.450	Throughflow WC	Swamp	**175**	0.772	Throughflow WC	Marsh
7	0.417	Throughflow D	Swamp	**176**	0.216	Isolated	Swamp
8	0.140	Throughflow D	Swamp	**177**	0.093	Isolated	Swamp
9	0.092	Outflow D	Swamp	**178**	0.063	Isolated	Swamp
10	0.155	Isolated	Bog	**179**	0.151	Isolated	Swamp
11	1.051	Isolated	Swamp	**180**	4.825	Outflow D	Bog
12	0.812	Isolated	Swamp	**181**	0.051	Isolated	Swamp
13	0.212	Isolated	Complex	**182**	0.703	Isolated	Swamp
14	0.247	Throughflow WC	Complex	**183**	0.233	Isolated	Swamp
15	0.273	Outflow D	Swamp	**184**	0.073	Isolated	Swamp
16	0.045	Isolated	Swamp	**185**	0.090	Isolated	Swamp
17	0.370	Isolated	Swamp	**186**	0.010	Isolated	Swamp
18	5.984	Throughflow WC	Fen	**187**	0.081	Isolated	Complex
19	0.132	Isolated	Bog	**188**	0.030	Isolated	Bog
20	4.222	Throughflow WC	Complex	**189**	0.244	Isolated	Bog
21	0.068	Isolated	Bog	**190**	0.085	Isolated	Bog
22	0.377	Isolated	Swamp	**191**	0.109	Isolated	Swamp

Wetland Number	Size (ha)	Water Flow Path*	Wetland Type	Wetland Number	Size (ha)	Water Flow Path*	Wetland Type
23	1.074	Isolated	Bog	**192**	1.754	Throughflow D	Bog
24	0.135	Isolated	Swamp	**193**	0.049	Inflow D	Bog
25	0.069	Isolated	Swamp	**194**	0.074	Throughflow D	Swamp
26	0.099	Throughflow D	Swamp	**195**	0.703	Isolated	Bog
27	6.900	Outflow WC	Complex	**196**	0.594	Outflow D	Bog
28	0.687	Throughflow D	Swamp	**198**	0.109	Isolated	Swamp
29	0.022	Isolated	Swamp	**199**	0.087	Isolated	Swamp
30	0.027	Isolated	Swamp	**200**	0.092	Isolated	Swamp
31	2.051	Throughflow WC	Complex	**201**	0.464	Isolated	Swamp
32	0.411	Isolated	Bog	**202**	0.365	Isolated	Complex
33	0.249	Throughflow D	Swamp	**203**	0.066	Isolated	Swamp
34	0.130	Isolated	Swamp	**204**	0.054	Isolated	Swamp
35	0.332	Throughflow WC	Complex	**205**	0.111	Throughflow D	Swamp
36	0.295	Throughflow D	Swamp	**206**	0.015	Isolated	Swamp
37	0.285	Isolated	Bog	**207**	3.402	Isolated	Bog
38	0.066	Isolated	Swamp	**208**	0.028	Isolated	Swamp
39	0.091	Isolated	Swamp	**209**	0.104	Isolated	Swamp
40	0.935	Isolated	Bog	**211**	1.087	Throughflow WC	Complex
41	0.296	Throughflow D	Complex	**212**	0.193	Isolated	Bog
42	0.070	Isolated	Bog	**213**	0.128	Isolated	Swamp
43	0.870	Isolated	Swamp	**215**	0.263	Isolated	Swamp
44	0.014	Isolated	Swamp	**216**	0.049	Isolated	Bog
45	0.165	Throughflow D	Bog	**218**	0.111	Isolated	Bog
46	0.271	Isolated	Swamp	**219**	0.320	Throughflow WC	Complex
47	1.992	Outflow WC	Bog	**220**	0.019	Isolated	Swamp

Wetland Number	Size (ha)	Water Flow Path*	Wetland Type	Wetland Number	Size (ha)	Water Flow Path*	Wetland Type
48	0.054	Throughflow WC	Swamp	**221**	0.182	Isolated	Swamp
49	0.317	Isolated	Swamp	**224**	0.195	Isolated	Swamp
50	0.136	Isolated	Swamp	**225**	0.133	Isolated	Swamp
51	0.520	Isolated	Swamp	**226**	0.036	Isolated	Swamp
52	0.737	Isolated	Swamp	**227**	0.012	Isolated	Swamp
53	13.619	Outflow WC	Complex	**228**	0.037	Isolated	Swamp
54	0.118	Isolated	Swamp	**229**	0.045	Isolated	Swamp
55	0.447	Isolated	Swamp	**230**	0.193	Isolated	Swamp
56	0.106	Isolated	Swamp	**231**	0.254	Isolated	Swamp
57	0.060	Isolated	Swamp	**232**	0.269	Isolated	Swamp
58	0.920	Isolated	Swamp	**233**	0.065	Isolated	Swamp
59	0.191	Inflow drainage	Swamp	**234**	0.488	Isolated	Swamp
60	1.377	Throughflow D	Swamp	**235**	0.387	Isolated	Swamp
61	0.045	Isolated	Swamp	**236**	0.045	Isolated	Bog
62	0.013	Isolated	Swamp	**237**	0.091	Isolated	Bog
63	0.076	Outflow WC	Swamp	**238**	0.032	Isolated	Swamp
64	12.376	Throughflow WC	Complex	**240**	2.672	Throughflow WC	Complex
65	31.758	Outflow WC	Complex	**242**	1.906	Isolated	Complex
66	0.103	Isolated	Swamp	**243**	0.117	Isolated	Swamp
67	0.163	Isolated	Swamp	**244**	0.027	Isolated	Bog
68	0.065	Outflow D	Swamp	**245**	0.698	Isolated	Swamp
69	0.019	Isolated	Swamp	**246**	0.053	Isolated	Swamp
70	0.420	Isolated	Swamp	**247**	0.471	Isolated	Swamp
71	0.120	Isolated	Swamp	**249**	0.481	Throughflow WC	Swamp
72	0.075	Isolated	Bog	**250**	0.158	Outflow, WC	Swamp

Wetland Number	Size (ha)	Water Flow Path*	Wetland Type	Wetland Number	Size (ha)	Water Flow Path*	Wetland Type
73	0.046	Throughflow D	Swamp	**251**	0.377	Throughflow WC	Swamp
105	0.200	Isolated	Bog	**252**	1.470	Isolated	Complex
106	1.297	Isolated	Bog	**253**	0.357	Isolated	Bog
107	1.156	Isolated	Bog	**254**	0.041	Isolated	Swamp
108	0.066	Isolated	Swamp	**255**	0.018	Isolated	Swamp
109	0.650	Isolated	Swamp	**256**	0.434	Isolated	Swamp
110	0.410	Isolated	Swamp	**258**	0.055	Isolated	Swamp
111	0.449	Isolated	Swamp	**259**	0.092	Isolated	Swamp
112	0.051	Isolated	Swamp	**260**	0.032	Isolated	Swamp
113	0.041	Isolated	Swamp	**261**	0.077	Throughflow D	Swamp
114	0.790	Isolated	Bog	**262**	0.036	Isolated	Swamp
115	0.723	Isolated	Bog	**263**	0.187	Throughflow D	Swamp
116	0.080	Isolated	Swamp	**264**	0.085	Isolated	Swamp
117	0.372	Isolated	Bog	**265**	0.251	Isolated	Swamp
118	0.372	Throughflow D	Swamp	**266**	0.122	Isolated	Swamp
119	0.175	Throughflow D	Swamp	**267**	0.113	Isolated	Bog
120	4.666	Isolated	Bog	**268**	0.496	Isolated	Bog
121	1.200	Outflow D	Fen	**269**	0.012	Outflow D	Swamp
122	0.132	Isolated	Swamp	**270**	0.202	Throughflow D	Swamp
123	0.145	Isolated	Swamp	**271**	0.078	Isolated	Swamp
124	0.620	Throughflow D	Complex	**272**	0.327	Isolated	Swamp
125	1.221	Isolated	Swamp	**273**	0.055	Isolated	Swamp
126	1.647	Isolated	Bog	**274**	0.401	Isolated	Swamp
127	0.064	Isolated	Swamp	**275**	0.247	Isolated	Swamp
128	1.176	Throughflow D	Complex	**276**	0.050	Isolated	Swamp

Wetland Number	Size (ha)	Water Flow Path*	Wetland Type	Wetland Number	Size (ha)	Water Flow Path*	Wetland Type
129	0.457	Throughflow D	Fen	**277**	0.116	Isolated	Swamp
130	1.018	Inflow D	Swamp	**278**	0.021	Isolated	Swamp
131	0.099	Isolated	Swamp	**279**	2.915	Outflow D	Complex
132	0.466	Isolated	Swamp	**280**	0.070	Inflow	Swamp
133	0.654	Throughflow WC	Complex	**282**	0.040	Isolated	Swamp
134	0.019	Inflow D	Swamp	**283**	0.148	Isolated	Swamp
135	0.037	Inflow D	Swamp	**304**	0.086	Isolated	Swamp
136	0.195	Inflow D	Swamp	**305**	0.066	Outflow D	Swamp
137	0.063	Throughflow D	Swamp	**307**	0.038	Isolated	Swamp
138	0.320	Isolated	Swamp	**308**	0.053	Isolated	Bog
139	0.312	Isolated	Swamp	**309**	0.036	Isolated	Swamp
140	0.136	Isolated	Bog	**310**	0.100	Isolated	Bog
141	0.201	Isolated	Bog	**311**	0.139	Isolated	Bog
142	0.064	Isolated	Bog	**312**	0.422	Isolated	Swamp
143	0.139	Isolated	Swamp	**313**	0.011	Isolated	Swamp
144	0.095	Isolated	Swamp	**314**	0.323	Outflow D	Swamp
145	1.057	Isolated	Complex	**315**	0.010	Isolated	Swamp
146	0.083	Isolated	Bog	**316**	0.074	Throughflow D	Swamp
147	0.053	Isolated	Bog	**317**	0.232	Isolated	Swamp
148	0.062	Isolated	Swamp	**318**	0.010	Outflow D	Marsh
149	0.052	Outflow D	Swamp	**319**	0.057	Isolated	Swamp
150	0.063	Outflow D	Fen	**320**	0.067	Isolated	Swamp
151	0.034	Isolated	Swamp	**321**	0.145	Isolated	Swamp
152	0.241	Isolated	Swamp	**322**	0.454	Isolated	Swamp
153	0.406	Isolated	Swamp	**323**	0.028	Isolated	Swamp

Wetland Number	Size (ha)	Water Flow Path*	Wetland Type	Wetland Number	Size (ha)	Water Flow Path*	Wetland Type
154	0.188	Isolated	Fen	**324**	0.307	Isolated	Swamp
155	0.239	Isolated	Swamp	**325**	0.055	Isolated	Swamp
156	0.080	Throughflow D	Swamp	**326**	0.231	Isolated	Swamp
157	0.047	Isolated	Fen	**327**	0.131	Isolated	Swamp
158	0.026	Isolated	Swamp	**328**	0.083	Throughflow D	Swamp
159	0.798	Isolated	Swamp	**329**	0.047	Isolated	Swamp
160	0.277	Isolated	Swamp	**330**	0.847	Throughflow D	Swamp
161	0.035	Outflow D	Bog	**331**	0.378	Isolated	Swamp
162	0.064	Isolated	Swamp	**332**	0.030	Isolated	Swamp
163	0.133	Throughflow D	Bog	**333**	0.125	Isolated	Swamp
164	0.095	Isolated	Swamp	**334**	0.153	Isolated	Swamp
165	0.015	Isolated	Swamp	**335**	0.183	Isolated	Swamp
166	0.072	Isolated	Bog	**336**	1.811	Isolated	Swamp
167	0.402	Outflow D	Swamp	**337**	0.027	Isolated	Swamp
168	0.128	Isolated	Swamp	**Total 210.537 ha**			
169	0.044	Isolated	Swamp				

Note: *In Water Flow Path, WC indicates connectivity to a regulated watercourse. D indicates that the flow path is driven by drainage which does not form a regulated watercourse. From a regulatory perspective, these wetlands can be considered isolated. The distinction is made because the direction of drainage into or out of a watland may play a role in the determination of effects.

In total, the 274 delineated wetlands account for 210 hectares, representing a land cover of 16.6% of the FMS Study Area. According to the Army Corps of Engineers manual, at least 50% vegetation cover must be present to be classified as wetland, as such, habitats lacking vegetation cover in low flow were described as open water watercourse features. It is important to note that open water (watercourse portion identified using aerial imagery taken during low flow conditions) within delineated wetland boundaries has been removed from the calculation of area, as that habitat is discussed specifically relating to watercourses and fish habitat (Section 6.8). Data determination forms describing dominant vegetation, soil characteristics and hydrology indicators were collected for each wetland and adjacent upland habitat. This data is available to support alteration applications in the permitting phase of the Project.

Wetland vegetation composition for the wetlands identified within the FMS Study Area are presented in Table 6.7-3. Dominant species documented within each wetland type have been identified and grouped by vegetation layer as defined in the Corps of Engineers Wetland Delineation Manual (Environmental Laboratory 1987). Plants have been sorted by abundance, with the most common species appearing at the top of the lists.

Table 6.7-3: Common Wetland Plants by Wetland Type within the FMS Study Area

Wetland Type	Herbs	Shrubs	Trees
Swamps	*Carex trisperma*	*Alnus incana*	*Picea mariana*
	Osmundastrum cinnamomeum	*Abies balsamea*	*Larix laricina*
	Kalmia angustifolia	*Picea mariana*	*Abies balsamea*
	Cornus canadensis	*Ilex mucronata*	*Acer rubrum*
	Glyceria canadensis	*Larix laricina*	*Picea rubens*
	Rhodedendron groenlandicum	*Acer rubrum*	*Betula alleghaniensis*
	Rubus pubesens	*Picea rubens*	*Betula papyrifera*
	Carex echinata	*Virburnum nudum*	*Betula populifolia*
	Carex stricta	*Betula alleghaniensis*	*Pinus strobus*
	Rosa nitida	*Ilex verticillata*	
	Scirpus cyperinus	*Betula papyrifera*	
	Thelypteris noveboracensis	*Kalmia angustifolia*	
	Vaccinium oxycoccus	*Rhodedendron groenlandicum*	
	Glyceria striata	*Viburnum nudum*	
	Chamaedaphne calyculata		
	Coptis trifolia		
	Linnaea borealis		
	Onoclea sensibilis		
	Solidago canadensis		
	Calamagrostis canadensis		
	Juncus effusus		
	Oclemena nemoralis		
	Osmunda regalis		
	Rubus hispidus		
	Spiraea alba		

Wetland Type	Herbs	Shrubs	Trees
Swamps (continued)	*Rubus idaeaus* *Abies balsamea* *Acer rubrum* *Aralia nudicaulis* *Carex crinita* *Carex intumescens* *Carex magellanica* *Dennstaedtia punctilobula* *Doellingeria umbellata* *Dulichium arundinaceum* *Eriophorum virginicum* *Hypericum canadense* *Iris versicolor* *Juncus effusus* *Maianthemum canadensis* *Osmunda claytoniana* *Phegopteris connectillis* *Rhododendron groenlandicum* *Ribes hirtellum* *Sarracenia purpurea* *Solidago rugosa* *Triadenum virginicum* *Typha latifolia*		

Wetland Type	**Herbs**	**Shrubs**	**Trees**
Bogs	*Carex trisperma* *Chamaedaphne calyculata* *Kalmia angustifolia* *Rhododendron groenlandicum* *Glyceria canadensis* *Osmundastrum cinnamomeum* *Rhynchospora alba* *Eriophorum virginicum* *Glyceria striata* *Carex atlantica* *Cornus canadensis* *Dulichium arundinaceum* *Epetrum nigrum* *Eurybia radula* *Oclemena acuminata* *Oclemena nemoralis* *Rubus hispidus* *Scirpus cyperinus* *Solidago uglinosa* *Triadenum virginicum* *Vaccinium myrtilloides* *Vaccinium oxycoccus*	*Picea mariana* *Larix laricina* *Alnus incana* *Ilex mucronata* *Abies balsamea* *Acer rubrum* *Viburnum nudum* *Ilex verticillata*	*Larix laricina* *Picea mariana* *Pinus strobus* *Acer rubrum* *Abies balsamea* *Picea glauca*

Wetland Type	Herbs	Shrubs	Trees
Fens	*Glyceria canadensis* *Calamagrostis canadensis* *Carex stricta* *Carex trisperma* *Dulichium arundinaceum* *Eriophorum virginicum* *Kalmia angustifolia* *Myrica gale* *Oclemena nemoralis* *Carex atlantica* *Carex echinata* *Chamaedaphne calyculata* *Equisetum fluviatale* *Eriophorum angustifolium* *Eurybia radula* *Iris versicolor* *Juncus canadensis* *Lysimachia terrestris* *Rhynchospora alba* *Rosa nitida* *Rubus pubescens* *Spiraea alba* *Vaccinium oxycoccus*	*Alnus incana* *Larix laricina* *Picea mariana* *Ilex mucronata* *Myrica gale*	*Larix laricina* *Picea mariana*

Wetland Type	Herbs	Shrubs	Trees
Marshes	*Typha latifolia* *Juncus effusus* *Sparganium americanum* *Eleocharis tenuis* *Chamaedaphne calyculata*	*Alnus incana* *Larix laricina* *Virburnum nudum* *Picea mariana*	*Larix laricina* *Picea mariana*

Treed and shrub swamps combined represent the most abundant wetland type in the FMS Study Area, accounting for 70% of all wetlands. Swamps identified in the FMS Study Area are consistent with swamp habitats observed throughout the province. They are predominantly coniferous or mixed-wood treed swamps, or tall shrub swamps depending on the level and type of disturbance present. Smaller proportions of deciduous treed swamps were observed within the FMS Study Area. The majority of swamps delineated within the FMS Study Area (97%) are under one hectare in size, and collectively they account for only 20% of the total wetland area. Seventy-eight percent of swamps delineated within the FMS Study Area are isolated, 11% are in a throughflow position, 4% are in a headwater (outflow) position, and 2% receive inflow but lack an outflow.

The vegetative community of swamps within the FMS Study Area is characterized by a diverse herbaceous layer, with swamps displaying the greatest number of dominant herbaceous species out of all wetland types. Within the herbaceous layer, swamps display a variety of graminoids, ferns, and forbs. The most common herbaceous species in swamps are three-seeded sedge (*Carex trisperma),* cinnamon fern (*Osmundastrum cinnamomeum)*, and sheep laurel (*Kalmia angustifolia)*. Coniferous treed swamps are characterized by a prominent tree layer which is largely composed of black spruce (*Picea mariana*), tamarack (*Larix laricina*), and balsam fir (*Abies balsamea*). Mixed-wood treed swamps within the FMS Study Area are also characterized by these species, but have the addition of a relatively equal amount of deciduous species, frequently red maple (*Acer rubrum)* and yellow birch (*Betula alleghaniensis)*. Shrub swamps are typically dominated by speckled alder (*Alnus incana)* and common softwood and hardwood species less than 8 cm diameter at breast height. The tree layer in shrub swamps is considerably reduced from those of treed swamps, while in some shrub swamps, particularly alder-dominated shrub swamps, the tree layer is completely absent.

Bogs account for 18% of all wetlands within the FMS Study Area, and 15% of the total wetland area. They range in size from 0.027 hectares to 4.825 hectares. Bog habitats include both low shrub and treed bogs. Treed bogs are typically dominated by coniferous species, namely black spruce and tamarack. Low shrub bogs, whose tree layers are sparse or absent, are characterized by ericaceous shrubs like leatherleaf (*Chamaedaphne calyculata*), sheep laurel, and Labrador tea (*Rhododendron groenlandicum),* which are adapted to the acidic and nutrient poor soils indicative of bogs. Herbaceous layer diversity within bogs is greatly reduced from that of swamps,

Fens and marshes combined account for 3% of wetlands within the FMS Study Area, and 4% of the total wetland area. These wetland types ranged in size from 0.01 – 5.984 hectares. This is likely an under-representative proportion, however, as the majority of large wetland complexes are dominated by fen habitat (WL1, WL2, WL20, WL27, WL26, WL211, and WL240, for instance). Fen habitats within the FMS Study Area include graminoid and shrub fens. Graminoid fens tend to establish where the water table within the wetland is at or above the surface. The most common, dominant graminoid species in fens within the FMS Study Area are Canada manna grass (*Glyceria canadensis*) and bluejoint reed grass (*Calamagrostis canadensis*). Shrubs, in the form of speckled alder, black spruce, tamarack, mountain holly (*Ilex mucronata),* and sweet gale (*Myrica gale*), become the dominant stratum in drier fens with a lower water table. Trees, when present, are restricted to black spruce and tamarack. The vegetation community within marshes showed the lowest diversity of all wetland types, though this is likely due to the lack of representation of this wetland type within the FMS Study Area. Marsh vegetation predominantly comprises emergent aquatic macrophytes; these are plants that are rooted in shallow water but emerge above the water's surface. Common emergent vegetation includes cattail (*Typha latfolia)*, soft rush (*Juncus effusus*), American burreed (*Sparganium americanum*), and slender spikerush (*Eleocharis tenuis*). The marsh shrub layer has a similar species composition to that of fens, though this stratum, along with the tree layer, are typically restricted to the edges of wetland. Like fens, documented tree species in marshes are restricted to black spruce and tamarack.

While proportions of varying wetland types are incorporated into the WESP-AC functional evaluation, no attempt was made to delineate individual wetland types within wetland complexes. Table 6.7-4 provides a summary of wetlands types identified within the FMS Study Area.

Table 6.7-4. Summary of Wetland Types

Wetland Type	Area					Abundance	
	Average (ha)	Maximum (ha)	Minimum (ha)	Total (ha)	% of all wetland area	# of wetlands	% of wetlands
Swamp	0.217	1.811	0.010	41.588	20%	191	70%
Bog	0.620	4.825	0.027	31.017	15%	50	18%
Fen/Marsh	0.214	5.984	0.010	8.721	4%	8	3%
Complex	5.168	34.970	0.081	129.211	61%	25	9%

In general, hydrological flow within wetlands present within the FMS Study Area follow Seloam Brook from Seloam Lake in the northeast, through the proposed open pit, and continue west towards Fifteen Mile Stream. Wetland 2 is the predominant wetland complex that exists along Seloam Brook. This system is fed by tributaries from the east (WC12, which originates in WL27), and from the south (WC 2, from WL3 and WL1). This system has many side channels and other associated wetlands, including WL219, WL13, WL240, WL133, WL175 and WL173. Two main branches of Seloam Brook converge in WL64 before flowing into Fifteen Mile Stream.

Wetlands within the FMS Study Area have experienced an array of natural and anthropogenic disturbance regimes. Wetlands underlain by the proposed TMF, organic stockpile, WRSA, till and LGO stockpiles are generally intact and natural wetlands with disturbance related to timber harvesting and construction of the associated road network. Wetlands along the Seloam Brook system have experienced higher degrees of disturbance related to historic mining activity; operation of the NSPI hydro facility, historic and ongoing timber harvesting, and associated road networks. Historic mining activities have resulted in deposition of tailings in proximity to the proposed Open Pit. Concentrations exceeding NSE Tier 1 EQS for arsenic, lead and mercury have been recorded within WL2, and elevated arsenic has been documented within wetlands 1, 12 and 130 as well (Appendix I.3)

The proposed TMF lies on a watershed divide, where wetlands to the north drain into Seloam Brook, while wetlands present in the southeast portion of the proposed TMF flow east into East Lake (which eventually flows into Antidam Flowage). Toward the southern extent of the FMS Study Area, one drainage basin collects water from WL47 and WL52, converges in WL249, WL250 and WL251, and continues to drain outside of the FMS Study Area directly into Antidam Flowage. While many wetlands are associated with those main watercourse systems, the vast majority (90.67%, n=243) of wetlands within the FMS Study Area are isolated or are only hydrologically connected to others by drainage instead of regulated watercourses.

Of all delineated wetlands, nineteen (19) out of 274 (7% of all wetlands) extend outside of the FMS Study Area and were assessed by the portion of wetland within the FMS Study Area. When wetlands extend outside of the FMS Study Area, functional assessment in the field is based on the portion of the wetland walked and assessed in the field, while AA (assessment area) for the office form can extend outside of the FMS Study Area to a corresponding NSE mapped wetland, if a corresponding mapped wetland exists. If no corresponding mapped wetland exists, the assessor will define the wetlands AA as the portion assessed in the field.

Twelve of these wetlands (WL213, 216, 221, 251, 274, 283, 314, 316, 320, 322, 329, and 331) were relatively small (ranging from 0.067 ha to 0.489 ha) and did not coincide with an NSE mapped wetland. One wetland measured as having 0.160 ha within the FMS Study Area but extended to a much larger NSE wetland outside of the FMS Study Area (WL334). Three wetlands were relatively large and extended beyond the FMS Study Area and did not coincide with any NSE wetlands outside of the FMS Study Area (WL252, 279 and 330). Finally, three large wetlands (WL53, 65 and 211) extended beyond the FMS Study Area where they coincided with

NSE wetlands. WL53 has proposed alteration for construction of an access road; WL65 has proposed alteration to allow for construction of the TMF, and WL211 is not proposed for alteration.

6.7.3.2 Wetlands of Special Significance

As part of a qualitative wetland assessment, along with a review of the current (June 2020) NSE GIS predictive WSS layer (pers. comm., Ian Bryson, NSE Wetland Specialist, September 2020), each wetland was reviewed to determine if it meets the threshold for a WSS.

Figure 2.1-4 indicates the proximity of the FMS Study Area to (as applicable): Ramsar sites; Provincial Wildlife Management Areas; Provincial Parks; Nature Reserves; Wilderness Areas; Lands owned or legally protected by non-governmental charitable conservation land trusts; intact or restored wetlands under the North American Waterfowl Management Plan; and protected water areas. Game Sanctuaries are excluded from WSS designation under the Nova Scotia Wetland Policy. No wetlands within the FMS Study Area are present within any of these special habitats.

A review of the NSE predictive WSS layer identified a portion of WL2 as a potential WSS within the FMS Study Area is shown on Figure 6.7-2. Wetland 2 is a large wetland complex associated with Seloam Brook. The area that was defined as a potential WSS is dominated by low shrub fen habitat, disturbed by historic mine workings. It is classified as a potential WSS based on an ACCDC record of a common nighthawk (Nova Scotia Endangered Species Act (NSESA) and SARA threatened) (pers. comm. Jeremy Higgins, former NSE Wetland Specialist, March 2019). According to the ACCDC, one adult was observed, a singing male, in suitable nesting habitat, on July 17th, 2009.

When developing the predictive WSS layer, NSE clipped mapped wetlands to ACCDC observations of SAR, without consideration of the positional accuracy of data points, the temporal scale of the observation, or the mobility of the species documented. As such, this layer is to be used as a predictive tool only. The single observation of a mobile species in 2009 does not warrant designation of WL2 as a WSS, which was confirmed during field evaluations. Mobile species, such as avifauna, have home ranges that may include wetlands within and beyond the FMS Study Area, which may be used at various times of the year (i.e., used during the breeding season, but not at other times). Avoidance of these timing windows is further discussed in the mitigation for Section 6.12.

Wetland 2, as mentioned above, is a large wetland complex with disturbed portions consisting of historical mine workings both within the wetland (as small upland inclusions) and immediately adjacent to it. These disturbed areas consist of cleared areas with gravel and cobble substrates which could provide breeding habitat for common nighthawks. This habitat type is not expansive in nature and limited to the area directly surrounding the historic mining activity near the proposed open pit. Common nighthawks are aerial insectivores and the open water portions within this wetland could also provide suitable foraging habitat. No common nighthawks were observed within this wetland during the biophysical surveys in 2017 and 2018, however, during common nighthawk surveys in 2017, two individuals were observed calling from Point Count 3, which is immediately adjacent to WL2. The common nighthawks were heard approximately 200 to 300 m SE and NE from the point count location (see Section 6.11 for more on point count locations).

Although suitable habitat is expected to be lost due to the proposed mine infrastructure, the surrounding areas that have been cleared due to historic mining and timber harvesting, also provide suitable habitat for breeding common nighthawks. This species was observed throughout the FMS Study Area during dedicated surveys and observed incidentally.

In addition to WL2, 26 other wetlands had observations of blue felt lichen or fauna SAR recorded within the wetland during field surveys completed by MEL. Given the mobility of some species, it is MEL's determination that an observation of a mobile Species at Risk would not trigger determination of a wetland as a WSS; unless it is accompanied by suitable habitat that supports a discrete and specific life function (i.e., nest beach for turtles). WSS designation based on the presence or usage of a mobile species would only be determined in consultation with NSE and NSL&F. The wetlands-associated SAR species sightings and the presence of suitable breeding habitat are indicated in Table 6.7-5 below. Sessile or non-mobile species are highlighted in bold, as their presence will trigger determination of a WSS.

Table 6.7-5. Wetlands with Observed SAR

Wetland ID	Wetland Type & Habitat Available	Direct Wetland Alteration Proposed?	Observed SAR	Suitable Habitat Present (Y/N)
WL1	Complex: Low shrub bog, Cattail marsh with open water, Treed swamp, Forested edge habitat present	Partial	Canada Warbler	Y
			Common Nighthawk	N
			Olive-sided Flycatcher	Y
WL2	Complex: Shrub swamp, Shrub fen, Conifer swamp, Historical mine workings with upland gravel inclusions	Partial	Canada Warbler	Y
			Common Nighthawk	Y
			Olive-sided Flycatcher	Y
			Rusty Blackbird	Y
WL7	Swamp: Mixedwood treed swamp	Complete	Canada Warbler	Y
WL8	Swamp: Mixedwood treed swamp	Complete	Canada Warbler	Y
WL10	Bog: Conifer dominant	Complete	Common Nighthawk	N
WL11	Swamp: Mixedwood swamp, Prominent shrub layer	Partial	Canada Warbler	Y
WL18	Complex: Fen, Shrub Swamp	No	Canada Warbler	Y
			Common Nighthawk	N
WL27	Complex: Treed Swamp, Bog, Adjacent cut block present, Forested edge habitat present	Partial	Canada Warbler	Y
			Common Nighthawk	Y
			Blue Felt Lichen	Y
			Olive-sided Flycatcher	Y
WL28	Swamp: Conifer dominant, Prominent shrub layer	Complete	Canada Warbler	Y
WL31	Complex: Bog, Fen, Treed swamp	No	Canada Warbler	Y
WL35	Complex: Treed swamp, Bog, Forested edge habitat present	No	Eastern Wood-pewee	Y
WL40	Bog: Adjacent to roads and clearings	Complete	Common Nighthawk	Y

Wetland ID	Wetland Type & Habitat Available	Direct Wetland Alteration Proposed?	Observed SAR	Suitable Habitat Present (Y/N)
WL42	Bog: Conifer dominant, Adjacent to cut block	Complete	Common Nighthawk	N
WL53	Complex: Bog, Swamp, Adjacent to cut block	Partial	Common Nighthawk	N
WL59	Swamp: Treed swamp, Adjacent to road	Partial	Evening Grosbeak	N
WL60	Swamp: Mixedwood swamp, Prominent shrub layer	Partial	Canada Warbler	Y
WL65	Complex: Treed Swamp, Fen, Prominent shrub layer, Mature hardwoods present with suitable moisture regime for Blue Felt Lichen	Partial	**Blue Felt Lichen**	Y
			Canada Warbler	Y
WL114	Bog: Treed bog, Forested edge habitat present	No	Olive-sided Flycatcher	Y
WL121	Fen: Prominent shrub layer present for browsing	No	Mainland Moose	Y
WL125	Swamp: Shrub swamp, Dense shrub layer, Prominent shrub layer present for browsing	Partial	Mainland Moose	Y
			Canada Warbler	Y
WL128	Complex: Treed Swamp, Fen	Complete	Canada Warbler	Y
WL138	Swamp: Mixedwood swamp	Complete	Canada Warbler	Y
WL159	Swamp: Mixedwood swamp, Forested edge habitat present, Adjacent to cut block	Complete	**Blue Felt Lichen**	Y
WL180	Bog: Prominent shrub layer present at wetland edge, Adjacent to cut block	Complete	Canada Warbler	Y
WL237	Bog: Forested edge habitat present	No	Olive-sided Flycatcher	Y
WL240	Complex: Fen, Treed swamp, Forested edge habitat present, Mature hardwoods present with suitable moisture regime for Blue Felt Lichen	No	**Blue Felt Lichen**	Y
WL252	Complex: Bog, Treed swamp. Observation from historically forested area.	No	Mainland Moose	Y
WL266	Swamp: Forested edge habitat present, Adjacent to cut block	Complete	Mainland Moose	Y

Wetland ID	Wetland Type & Habitat Available	Direct Wetland Alteration Proposed?	Observed SAR	Suitable Habitat Present (Y/N)
WL324	Swamp: historically forested area	No	Mainland Moose	Y
WL331	Swamp: Forested edge habitat present, Adjacent to cut block	No	Mainland Moose	Y
WL337	Swamp: historically forested area, Forested edge habitat present	No	Mainland Moose	Y

Preferred habitat for the noted SAR are described throughout Section 6.12, and habitat provided within each wetland is identified in Table 6.7-5. Species Ranks are as follows: blue felt lichen (SARA/COSEWIC SC, NSESA V, S3), mainland moose (NSESA E, S1), olive-sided flycatcher (SARA T, NSESA T, COSEWIC SC, S2B), evening grosbeak (COSEWIC SC, NSESA V, S3S4B), eastern wood-pewee (SARA/COESWIC SC, NSESA V, S3S4B), rusty blackbird (SARA/COSEWIC SC, NSESA E, S2B), Canada warbler (SARA/COSEWIC T, NSESA E, S3S4B), common nighthawk (SARA, NSESA T, COSEWIC SC, S2B).

Blue felt lichen was observed in four wetlands (WL27, 65, 159 and 240), typically found in swamps or on the edges of wetland complexes growing on mature red maple. Given the size and habitat complexity of WL65, which is a lacustrine fen surrounding East Lake, this wetland has been subdivided into an eastern and western lobe, with the convergence of the inlet watercourse (WC43) into East Lake dividing WL65 into its respective eastern and western lobes. This division into separate lobes is based on landscape position and water source contribution to each portion of the wetland. Blue felt lichen was observed within the eastern lobe only; as such, the western lobe has not been defined as a WSS. The blue felt lichen is ranked as special concern by SARA and COSEWIC, and vulnerable by the NSESA. Due to the presence of blue felt lichen, wetlands 27, 159, 240 and the eastern lobe of WL65 are determined to be WSS, as shown on Figure 6.7-2.

Of the six SAR birds identified in wetlands, the common nighthawk and the evening grosbeak typically do not occupy wetland habitat for breeding purposes, although they do use wetlands for foraging habitat such as water components where insects are present. Wetland 2 includes components of disturbed sites that are more typically used for common nighthawk breeding habitat. The remaining four avian SAR observed do use wetland habitats for breeding purposes, specifically the olive-sided flycatcher, Canada warbler, eastern wood-pewee and rusty blackbird.

Olive-sided flycatchers prefer conifer forests and often edge habitats near meadows and ponds and the Canada warbler prefers wet forests and riparian shrub forests. The eastern wood-pewee are usually found along deciduous and mixedwood forested edges often near lakes, rivers and/or wetlands. Suitable habitat for olive-sided flycatcher, Canada warbler and the eastern wood-pewee is available throughout the FMS Study Area (116 ha, representing 63% of wetland habitat within the PA, as described in Section 6.7.6.3; habitat was not quantified for the eastern wood pewee specifically; however its habitat preferences overlap with olive-sided flycatcher, and to a lesser extent, Canada warbler).

The rusty blackbird also has potential to breed in wetlands within the FMS Study area and prefer coniferous-dominated swamps, bogs, streams and forested areas near beaver ponds. However, the rusty blackbird was only observed during the migration season (spring and fall) and not in the breeding season within the FMS Study Area. Based on these findings, it’s likely the rusty blackbird is occupying habitats for foraging during local migration, and not breeding with the FMS Study Area.

Mainland moose evidence was observed within and/or surrounding WL1, WL121, WL125, WL252, WL266, WL324, WL331, and WL337. Mainland moose forage for aquatic vegetation within wetlands during the summer and suitable habitat is present within wetlands for foraging activities. Further discussion is presented in Section 6.12 (SAR/SOCI) and Section 6.7.5.2 (Wetland CEA)

As described in Section 6.7.2.1.3, the observation of mobile Species at Risk does not require the associated wetland habitat to be designated as a WSS, without additional consideration. For example, evidence of moose scat does not indicate that moose use that wetland to sustain important life history stages. Similarly, habitat used by at-risk avifauna for breeding may be generic and readily available within the Project Area, or within the broader landscape (in this case, the LAA). To support the determination of WSS designation for mobile species at risk, a GIS exercise was completed to identify availability of suitable habitats across the landscape. This exercise is presented in Section 6.7.5.2.2. Through this evaluation, it was identified that suitable wetland habitat for mobile species at risk (moose, Canada warbler, rusty blackbird and olive-sided flycatcher) is readily available throughout the PA and the broader LAA. As such, observations of mobile SAR listed in Table 6.7-5, does not result in determination of that wetland as a WSS, even though the species were observed in suitable habitat.

6.7.3.3 Functional Assessment Results

For the purposes of the EIS, a subsample of wetlands was evaluated for wetland functions using WESP-AC. A proportional representation of wetland types was selected, for a total of 24 wetlands, representing 9% of all wetlands. While these wetlands represent 9% of the total number of wetlands, they represent 53% of the total area of wetlands present within the FMS Study Area (See Figure 6.7-1). Functional evaluation data was collected for all wetlands within the FMS Study Area, to support wetland alteration permitting, as necessary. Detailed WESP-AC analysis is available for all wetlands, if requested. The following is a summary of the analyzed 24 wetlands as they are broken into the Grouped Wetland Functions described in Section 6.7.2.1.4.

6.7.3.3.1 *Hydrologic Function Group*

The hydrological wetland service group evaluates the effectiveness of a wetland to store or delay the downslope movement of surface water. Wetlands that have the highest functions within this group include those that do not have surface water outlets, and instead, are isolated from flowing surface water (see Table 6.7-6). The model does not account for wetland size, and in turn, does not account for larger wetlands having the ability to store more water than smaller wetlands.

Table 6.7-6. Hydrologic Function Group WESP-AC Results

Function	Benefit		
	Low	Moderate	High
Low	WL1, WL2, WL3, WL6, WL18, WL27, WL65	none	none
Moderate	WL23, WL52, WL107, WL118, WL120, WL121, WL126, WL130, WL138, WL139, WL152	WL159, WL180	none
High	WL11, WL12, WL125	WL43, WL52	none

The majority of the analyzed wetlands scored moderate in hydrologic group function and low in benefit. The wetlands that scored moderate and high in these functions are isolated wetlands or those that have drainage; thus they are able to store water without it running off the landscape quickly via a watercourse.

6.7.3.3.2 *Aquatic Support Group*

The aquatic support group comprises four individual functions: stream flow support; aquatic invertebrate habitat; organic nutrient export; and water cooling. The main function of this group is to determine the wetland's ability to support ecological stream functions that promote habitat health, therefore wetlands lying adjacent to or containing flowing water score higher than those that do not (i.e., isolated wetlands). In addition, however, headwater wetlands are crucial for supporting stream flow during the dry season by contributing to water flow via groundwater input and storage capacity (see Table 6.7-7).

Table 6.7-7. Aquatic Support Group WESP-AC Results

Function	Benefit		
	Low	Moderate	High
Low	WL12, WL23, WL52, WL107, WL120, WL121, WL126, WL138, WL139, WL152, WL159, WL180	WL1	none
Moderate	WL11, WL43, WL118, WL125, WL130	WL27, WL65	none
High	none	WL3, WL6, WL18	WL2

The highest scoring analyzed wetlands within the aquatic support group included WL2 (high/high), WL3, WL6, and WL18 (High/Moderate). These wetlands all have a throughflow or outflow watercourse flow path within their boundaries.

6.7.3.3.3 *Water Quality Group*

This wetland function group is compiled from four different functions: sediment retention and stabilization; phosphorus retention; nitrate removal; and carbon sequestration. The main function of this group is to evaluate the wetland's potential to intercept, retain, and filter sediments, particulates, and organic matter. Similar to the hydrologic group, the wetlands that have the highest functions in this regard include those that do not have a surface water outlet, and instead are isolated from flowing surface water. This model also does not account for wetland size and as such, larger wetlands do not necessarily score higher for water purification than small wetlands, although in reality size may factor into this function (see Table 6.7-8).

Table 6.7-8. Water Quality Group WESP-AC Results

Function	Benefit		
	Low	Moderate	High
Low	none	none	WL6, WL27, WL65
Moderate	none	none	WL1, WL2, WL3, WL18
High	none	none	WL11, WL12, WL23, WL43, WL52, WL107, WL118, WL120, WL121, WL125, WL126, WL130, WL138, WL139, WL152, WL159, WL180

Most of the analyzed wetlands scored high in water purification group function and benefit. As with the hydrologic group, high scoring wetlands either had isolated water flow paths or throughflow/outflow via drainage. One exception to this is WL180, which is a bog with outflow via a watercourse; however, despite this aquatic feature, WL180 is positioned in a localized depression that supports its ability to slow water flow, purifying it before it exits the wetland boundaries.

6.7.3.3.4 *Aquatic Habitat Group*

The aquatic habitat group is compiled from five different functions: anadromous fish habitat, resident fish habitat, amphibian and turtle habitat, waterbird feeding habitat, and waterbird nesting habitat. Wetlands that have the highest functions within this group include those that are adjacent to or contain flowing water (see Table 6.7-9).

Table 6.7-9. Aquatic Habitat Group WESP-AC Results

Function	**Benefit**		
	Low	**Moderate**	**High**
Low	none	WL11, WL12, WL43, WL52, WL125, WL130	none
Moderate	none	none	WL1, WL3, WL6, WL23, WL27, WL65, WL107, WL118, WL120, WL121, WL126, WL138, WL139, WL152, WL159, WL180
High	none	none	WL2, WL18

The majority of analyzed wetlands scored moderate aquatic habitat group function and high benefit. The two highest scoring wetlands were WL2 and WL18, both of which are riparian, and have aquatic habitat within their boundaries in the form of watercourses.

6.7.3.3.5 *Terrestrial Habitat Group*

The terrestrial habitat group comprises three different functions: songbird, raptor, and mammal habitat, native plant habitat and pollinator habitat. The main function of the collective group is to evaluate the wetland's ability to support healthy habitat for birds, mammals, and native plants (see Table 6.7-10).

Table 6.7-10. Terrestrial Habitat Group WESP-AC Results

Function	**Benefit**		
	Low	**Moderate**	**High**
Low	none	none	none
Moderate	none	none	WL1, WL11, WL12, WL43, WL130
High	none	none	WL2, WL3, WL6, WL18, WL23, WL27, WL52, WL65, WL107, WL118, WL120, WL121, WL125, WL126, WL138, WL139, WL152, WL159, WL180

Scores for terrestrial habitat group function are either moderate or high, and benefit scores are all high. Analyzed wetlands provide ideal terrestrial habitat, including downed wood, prevalent ground cover, varied microtopography, tree and shrub cover both in and around the wetlands, and naturally vegetated buffer zones. The wetlands analyzed have a variety of woody heights and diverse forms that allow for nesting habitat, perches, and feeding grounds. In addition, the wetlands provide a diverse range of herbaceous vegetation, therefore habitat is generally provided for songbirds, mammals and rare plants.

6.7.3.3.6 *Wetland Condition*

Wetland condition refers to the integrity or health of a wetland as defined by its vegetative composition and richness of native species. Scores are derived from the similarity between the wetland being evaluated and reference wetlands of the same type and landscape setting (Adamus 1996).

All analyzed wetlands scored either moderate or high for wetland condition (average 2.8 score out of a maximum score of 3), indicating that currently these wetlands indicate relatively healthy vegetative communities. This reflects the characterization of unanalyzed wetlands in the FMS Study Area: integrity and wetland health were moderate to high as indicated by vegetative composition which largely lacked invasive species and instead show a richness in native species. There are cut-over and disturbed wetlands within the FMS Study Area, but even these showed an abundance in native species.

6.7.3.3.7 *Wetland Risk*

Wetland risk takes sensitivity and stressors into account by averaging the two. Sensitivity is the lack of intrinsic resistance and resilience of the wetland to human or naturally caused stress (Niemi et al. 1990). The model uses six metrics to measure stress: abiotic resistance, biotic resistance, site fertility, availability of colonizers, and growth rate. Stress relates to the degree to which the wetland is or has recently been altered by humans in a way that degrades its ecological condition. The model applies four stress groups: hydrologic stress, water quality stress, fragmentation stress, and general disturbance stress. Wetlands that are highly resilient may have lower risk scores despite their exposure to multiple stressors. Additionally, wetlands exposed to fewer threats, but with low resilience may have high risk scores. Wetland resilience is tied to multiple factors, but may include size, proximity to natural land cover, and presence of invasive species.

All analyzed wetlands scored either moderate or high for wetland risk (average 2.5 score out of a maximum score of 3), meaning they have moderate to low resilience.

It may be counterintuitive for a wetland to score high for wetland condition (i.e., the wetland has a rich vegetative composition) and high for wetland risk (i.e., low resiliency); this is because they measure different metrics. A wetland may have a variety of species and may even provide habitat to a SAR/SOCI, and therefore have a high wetland condition score, while at the same time have various traits that make it less resilient. These traits may include being far away from a ponded water source, which would cause slower recolonization following an impact (Adamus 2016). The length of the wetland-upland edge also impacts the resiliency score: a wetland is more susceptible to invasive species the longer its wetland-upland edge (Adamus 2016). Traits are outlined in more detail in the WESP-AC calculator available from NSE website (https://novascotia.ca/nse/wetland/education.asp).

6.7.3.3.8 *Functional Assessment Summary*

WESP-AC is a decision-making tool, but its results, although quantitative, must be used qualitatively to form conclusions around wetland functions. As stated in Section 6.7.2.1.4, the highest functioning wetlands are those that have both high function and high benefit scores. It is also necessary to look at the wetlands that scored higher (function and benefit) across function groups. While high benefit and function scores were calculated for various wetlands (referred to in this section as "high/high"), no wetlands scored high/high in all function groups. Fifteen wetlands scored high/high in two of the five functional groups. WL2 and WL18 scored high/high in both the aquatic habitat group and the terrestrial habitat group. WL23, WL52, WL107, WL118, WL120, WL121, WL125, WL126, WL138, WL139, WL152, WL159 and WL180 scored high/high in the water quality group and the terrestrial habitat group. All of these wetlands are isolated from throughflow watercourses, allowing water to fully percolate through the soil, filtering as it does and providing the necessary scores for a high benefit and function rank in the water quality group. The terrestrial habitat group results, for which all wetlands scored either high/moderate or high/high, may actually be an indicator of the general wetland quality of all wetlands within this region. Consequently, these 24 analyzed wetlands are not noteworthy in their functional analysis within this group, instead the entire region's wetlands are particularly strong at supporting terrestrial habitat and thus wetlands other than what was considered in this analysis, and wetlands beyond the FMS Study Area, are likely particularly strong within this function.

Diving further into these results and examining the individual wetland scores (see Appendix G.3), the wetland with the most high/highs is WL18 followed by WL2. These two wetlands scored high/high, high/moderate, or moderate/high in all function groups except for the hydrologic function group. WL2 and WL18 both had observations of SAR and SOCI avifauna. From analyzing the WESP-AC results, it is evident that WL2 and WL18 are the highest functioning wetlands and were therefore considered further during the mitigation process.

In general, wetlands within the FMS Study Area have similar functions to other wetlands within this region of Nova Scotia, and are not unique in their functional roles analyzed by WESP-AC. The majority of wetlands are swamps, many of which have an isolated flow path, and provide relatively similar functions. There are some historical disturbances observed within some wetlands in the FMS Study Area, these are mostly from historical forestry practices, however this has not affected wetland functions in a major capacity. The functions performed by wetlands within the FMS Study Area are a reflection of the functional ability of the region's wetlands overall.

6.7.3.4 Touquoy Mine Site Baseline Conditions

Six wetlands were identified within the Touquoy Mine Site in 2006 as part of the Touquoy Gold Project EARD, five of which were assessed. One of these wetlands was deemed to not be affected from the Project and therefore was not evaluated (CRA 2007a).

A total of 52 wetlands were identified within the Touquoy Mine Site (including the western bypass road) during additional field studies by MEL biologists from 2015 to 2017. These wetlands were identified for the wetland permitting process and functional assessments were completed to support permitting for the Touquoy Gold Project. Evaluation for the purposes of the Project will be limited to riparian wetlands along Moose River, downstream of the proposed discharge location from the exhausted Touquoy pit, once tailings deposition is complete, to identify any potential indirect impacts to riparian wetlands from the Project due to a potential change in flow regime in the Moose River.

6.7.4 Consideration of Engagement and Engagement Results

Key issues raised during public and Mi'kmaq engagement relating to wetlands include direct impacts during construction activities at the FMS Mine Site, as well as potential indirect effects from Project activities. Overall potential effects on habitat loss from direct and indirect wetland impacts was cited as a concern, including potential effects to traditional use by Mi'kmaq peoples for hunting, fishing, trapping, and gathering.

The results of the public and Mi'kmaq engagement have been considered in the environmental effects assessment, including the Proponent's commitments on mitigation and monitoring measures and proposed compliance and effects monitoring programs, as well as the Proponent's broader commitment to ongoing public and Mi'kmaq engagement.

6.7.5 Effects Assessment Methodology

6.7.5.1 Boundaries

6.7.5.1.1 *Spatial Boundaries*

The spatial boundaries used for the assessment of effects to wetlands are the PA, LAA, and RAA (Figure 6.6-16). The PA consists of two project components: the FMS Study Area and the Touquoy Mine Site. A small portion of the FMS Study Area resides in the Moser River watershed, which drains to the southeast and eventually to the Atlantic Ocean via the Moser River (Figure 6.6-2). This small portion was included in the FMS Study Area during the iterative process of determining site infrastructure layout. Under current design, no infrastructure is planned in this portion of the Moser River watershed. As such, impacts to the Moser River Watershed were not considered in the effects assessment.

The LAA consists of portions of downstream aquatic habitats and headwaters where appropriate, depending on Project activities, up to the maximum size of the tertiary watersheds (Figure 6.6-16). The LAA boundaries were defined considering the maximum expected extent of direct and indirect impacts to the aquatic environment as well as the location of project activities across the two project components.

The RAA encompasses the secondary watersheds that the PA is located within (Figure 6.6-16). These watersheds are the East River Sheet Harbour secondary watershed (1EM-1), and the Fish River – Lake Charlotte secondary watershed (1EL-5).

Assessment of wetlands will be completed in consideration of the LAA as the primary spatial boundary. All spatial boundaries will help to identify the direct or indirect impacts to wetlands and the effects of the Project on these habitats.

6.7.5.1.2 *Temporal Boundaries*

The temporal boundaries used for the assessment of effects to wetlands are the construction phase, operational phase, and closure phase.

6.7.5.1.3 *Technical Boundaries*

No technical boundaries were identified for the effects assessment of wetlands.

6.7.5.1.4 *Administrative Boundaries*

Administrative boundaries for the protection and conservation of wetland habitat in Nova Scotia include the Nova Scotia Wetland Conservation Policy (2011b), the *Environmental Goals and Sustainable Prosperity Act* (EGSPA 2007), and the *Environment Act* (1994) and its Activities Designation Regulations (1995). Further wetland protection is provided on a federal level by the Federal Policy of Wetland Conservation (1991).

6.7.5.2 Wetland Cumulative Effects Modelling

A wetland cumulative effects modelling assessment was completed for wetlands losses associated with the Project.

As stated in Section 6.7.2.1, wetland functional assessment was completed for each observed wetland within the FMS Study Area using the WESP-AC wetland evaluation technique. WESP-AC is a tool to evaluate individual wetland functions only and does not evaluate wetland functional loss, either individually or cumulative loss of multiple wetlands within any spatial watershed boundary (sub-drainage basin, tertiary or larger watershed). As such, the purpose of the wetland cumulative effects assessment is to evaluate the cumulative effects associated with the loss of wetlands as a result of developing the Project within a defined spatial boundary.

Through completion of a modelling exercise, wetland loss (including loss of wetland function metrics) has been extrapolated to examine potential cumulative effects.

The wetland cumulative effects modelling assessment was completed by establishing individual wetland function “metrics” and evaluating them as indicators of overall wetland function loss. The following metrics were established:

- Wetland Area;
- Loss of Wetland Habitat Function including: Mainland moose, Canada warbler, olive-sided flycatcher, and rusty blackbird

6.7.5.2.1 *Spatial Boundaries*

The spatial boundaries used for the assessment of cumulative effects of wetland loss (area and habitat function metrics) are the same as those described in Section 6.7.5.1.1. The cumulative effects modelling was completed within the LAA as the primary spatial boundary for the assessment.

6.7.5.2.2 *Wetland Cumulative Effects Methods*

Wetlands play numerous roles in the maintenance of a healthy ecosystem. Among other functions, wetlands improve water quality, control floods, regulate water temperature, retain nutrients, and provide habitat for aquatic and terrestrial species. In order to evaluate the potential cumulative effects of wetland loss and their associated functions, modelling was completed based on the development of the following wetland function metrics:

<u>Wetland Area</u>: A single larger wetland, or multiple moderately sized or smaller wetlands, in a given spatial boundary is likely to provide more wetland functions than smaller and fewer wetlands, in a given spatial boundary. Therefore, for the purposes of the wetland cumulative effects modelling assessment, wetland area has been analyzed as an indicator of potential wetland function loss. In order to effectively determine the direct loss of wetland area the modelling quantified the area of wetland habitat directly impacted by mine development and its associated infrastructure and compared it to predicted wetland area present in the LAA and RAA. This analysis enabled the potential wetland functions loss (based on the wetland area metric), to be compared within the spatial boundaries assessed. Potential indirect impacts to wetlands which could occur as a result of the Project are not evaluated in this modelling exercise because these impacts represent the maximum potential loss (a conservative overestimate) which could bias cumulative effects analysis results.

<u>Loss of Wetland Habitat Function</u>: loss of wetland habitat function was evaluated by considering the loss of habitat provision for specific wildlife species that typically use wetlands for their survival and lifecycle tendencies. The following two habitat metrics used were: moose habitat and bird habitat. These were evaluated using the following species and their requirements:

- Mainland moose
- Birds: Canada warbler, olive-sided flycatcher, and rusty blackbird

These species were chosen because they include SAR (olive-sided flycatcher, SARA Threatened; Canada warbler, SARA Threatened, NSESA Endangered; mainland moose, NSESA Endangered; and rusty blackbird, SARA Special Concern, NSESA Endangered), they use a variety of wetland habitat types for critical biological functions, and they had either been identified within the FMS Study Area during field surveys or have potential to be present in the FMS Study Area based on habitat provision or confirmed observations of the species in close proximity to the FMS Study Area. The eastern wood-pewee is listed as SARA Special Concern and NSESA Vulnerable. This species breeds in wetland habitat and was observed within the FMS Study Area; however its habitat was not modelled specifically in the wetland cumulative effects exercise as its habitat preferences overlap with the olive-sided flycatcher and to a lesser extent, Canada warbler. Furthermore, only a single individual eastern wood-pewee was observed incidentally through all field programs.

It should be noted that while the NSL&F forestry GIS layer does contain information on Canada warbler habitat (i.e., habitat layers denoting dense, deciduous shrub), it is derived from 1:12,500 aerial photographs and lacks the ability to appropriately distinguish reasonable abundance of suitable habitat for this species. Whereas, the NSL&F forestry GIS layer was used to accurately portray coniferous dominated forests for rusty blackbird habitat and beaver flowage for mainland moose habitat, when queried for Canada warbler habitat the results were limited. Thus, an inaccurate, minimalized habitat picture was created, which, based on professional experience, did not portray real Canada warbler habitat abundance on the landscape. Therefore, modeling was not possible for Canada warbler within the LAA, and the species was removed from the model exercise associated with the LAA so as not to bias the outcome. Canada warbler habitat was however determined for the FMS Study Area based on data collected during field programs in combination with desktop resources.

The wetland function metrics were assessed within the spatial and temporal boundaries outlined in Table 6.7-11. In addition, the method of analysis performed on each wetland function metric is provided. For the purposes of this evaluation, Year 0 is considered "prior to any mine development activities" and Year 8 is considered "the completion of mine development" (i.e., complete wetland alteration and at maximum operational footprint/activity).

Table 6.7-11: Spatial and Temporal Assessments for Wetland Function Metrics

Function Metric	Spatial Boundary Assessed	Temporal Boundary Assessed	Method of Data Analysis
Wetland Area	FMS Study Area	Between Year 0 and Year 8	A comparison between wetland area prior to mine development within the FMS Study Area, and wetland area at completion of mine development within the FMS Study Area.
	LAA	Between Year 0 and Year 8	A comparison between Year 8 (completion of mine development) within the FMS Study Area, to the LAA and RAA at Year 0 (prior to mine development).
	RAA		
Mainland Moose	FMS Study Area	Between Year 0 and Year 8	A comparison between predicted moose wetland habitat prior to mine development within the FMS Study Area and predicted moose wetland habitat at completion of mine development within the FMS Study Area.
	LAA	Between Year 0 and Year 8	A comparison between Year 8 (completion of mine development) within the FMS Study Area, to the LAA at Year 0 (prior to mine development).
	RAA	Not assessed	Impact at RAA extent not considered likely.
Birds	FMS Study Area	Between Year 0 and Year 8	A comparison between predicted birds wetland habitat prior to mine development within the FMS Study Area and predicted birds' wetland habitat at completion of mine development within the FMS Study Area.
	LAA	Rusty blackbird and olive-sided flycatcher – Between Year 0 and Year 8 Canada warbler – Not assessed	A comparison between Year 8 (completion of mine development) within the FMS Study Area, to the LAA at Year 0 (prior to mine development). Canada warbler comparison not possible due to insufficient GIS data.
	RAA	Not assessed	Impact at RAA extent not considered likely.

As stated in Section 6.7.5.1.1, the LAA is considered the maximum expected extent of direct and indirect impacts to the aquatic environment. Therefore, the RAA was not assessed for cumulative effects to the wetland habitat of mainland moose and the selected bird species. Wetland area alone was assessed at the RAA level in order to better quantify the magnitude of effects at the secondary watershed level.

Although not considered a quantifiable determination of potential wetland functional loss as a result of the Project, the analysis described in Table 6.7-13, is a valuable tool for identifying and analyzing key habitat variables for each of the modelled species.

It is recognized that wetlands play important water quality and purification functions, however, as a result of the general water management measures being implemented for the mine development, water quality has not been included in this analysis. Refer to Section 6.6 (Surface Water Quality and Quantity), for a detailed description of the potential effects to water quality as a result of mine development, and methods that will be employed to ensure environmental standards are met. These mitigation methods impact the broader water quality within the site and receiving environment and will also mitigate any potential impacts to wetlands from potential changes to water quality from the Project.

Each of the wetland function metrics being evaluated in the cumulative effects wetland modelling exercise required the gathering of datasets which could be used digitally to compare to each other. All metrics evaluated involved a comprehensive desktop review as well as field data collection. Based on scientific literature, valuable wetland habitats were defined as those that support biological requirements for species survival. Determination of these habitats supported the development of the datasets required for the cumulative effects model. The datasets used for the metrics being evaluated in the model within each spatial boundary are provided in Table 6.7-12 and Table 6.7-13.

Table 6.7-12: Metrics and Associated GIS Layers used in the Cumulative Effects Assessment of Wetland Loss

Wetland Area Loss						
Metric	**Value**	**Reference for Habitat Selection**	**FMS Study Area**		**LAA/RAA**	
			GIS Layer	**Attributes Used to Select Suitability**	**GIS Layer**	**Attributes used to Select Suitability**
Wetland Area	Area of all wetlands	WESP-AC	Field delineated wetlands	All wetlands	All NSE database wetland types	All wetlands

Table 6.7-13. Metrics and Associated GIS Layers used in the Cumulative Effects Assessment of Loss of Wetland Function

Loss of Wetland Function							
Metric	**Biological Requirement**	**Habitat that provides for the Biological Requirement**	**Reference for Habitat Selection**	**FMS Study Area**		**LAA**	
				GIS Layer	**Attributes Used to Select Suitability**	**GIS Layer**	**Attributes used to Select Suitability**
Mainland Moose	Foraging and thermo-regulation	Wetlands with access to aquatic vegetation	Action Plan for the Recovery of Eastern Moose (*Alces alces americana*) in Mainland Nova Scotia (Nova Scotia Department of Natural Resources, 2007) and Status Report on The Eastern Moose (*Alces alces americana)* in Mainland Nova Scotia (Parker, 2003)	Field delineated wetlands	Bogs (where aquatic vegetation is likely), marshes, fens with open water. Any type of wetland if adjacent to a waterbody or beaver flowage	NSE wetlands database layer	Bogs (where aquatic vegetation is likely), marshes, fens with open water. Any type of wetland adjacent to waterbodies or beaver flowage
				NSE waterbodies	Waterbodies (i.e., lakes, standing water, ponds)	NSE waterbody database layer	Waterbodies (i.e., lakes, standing water, ponds)
				NSDNR Forestry	Beaver flowage queried as non-forested area that is or has been occupied by beavers	NSL&F forestry layer	Beaver flowage queried as a non-forested area that is or has been occupied by beavers
				Visual aerial inspection	Visual inspection of aerial imagery to identify open waterbodies (i.e., lakes, standing water, ponds)	Visual aerial inspection	Visual inspection of aerial imagery to identify open waterbodies (i.e., lakes, standing water, ponds)
Canada Warbler (CAWA)	Breeding	Forested swamps with dense, deciduous shrub layer	Recovery Strategy for the Canada Warbler (*Cardellina canadensis*) in Canada (ECCC, 2016d)	Field delineated wetlands	Wetlands where CAWA were observed and swamps with a dense, deciduous shrub layer (as per field assessment)	Data unavailable as described above	
Olive-sided Flycatcher (OSFL)	Breeding	Open wetlands with tall snags	Recovery Strategy for the Olive-sided (*Contopus cooperi*) in Canada (ECCC, 2016e)	Field delineated wetlands	Wetlands where OSFL were observed and open wetlands (i.e., bogs, fens) with tall snags (as per field assessment)	NSE wetland database layer.	Bogs, fens
				Visual aerial inspection	Visual inspection of aerial imagery to identify open wetlands (i.e., bogs, fens)	Visual aerial inspection	Visual inspection of aerial imagery to identify open wetlands (i.e., bogs, fens)
Rusty Blackbird (RUBL)	Breeding	Portion of coniferous dominant riparian wetlands that are within 50m of a watercourse or waterbody	Management Plan for the Rusty Blackbird (*Euphagus carolinus*) in Canada (EC, 2014c); and personal communication with Dr. Cynthia Staicer (October 23, 2018)	Field delineated wetlands	Wetlands where RUBL were observed and coniferous dominant treed wetlands adjacent to or within 50m of a watercourse or waterbody (i.e., lake, pond)	NSE wetland database layer	Wetlands intersecting the forestry layer and adjacent to or within 50m of a watercourse or waterbody (i.e., lake, pond)
				NSL&F Wet Areas Mapping Database	Surface water queried as depth to water between 0-0.1m	NSL&F Wet Areas Mapping Database	Surface water queried as depth to water between 0-0.1 m
				Visual aerial inspection	Visual inspection of aerial imagery to identify treed wetlands adjacent to watercourses or waterbodies (i.e., lake, pond)	Visual aerial inspection	Visual inspection of aerial imagery to identify treed wetlands adjacent to watercourses or waterbodies (i.e., lake, pond)
				Field delineated watercourses	All watercourses	NSL&F forestry	Coniferous dominated forests, queried as the main species type being one of the following: Balsam Fir, Black Spruce, Eastern Hemlock, Red Spruce, Eastern Larch, Red and Black Spruce mixed stand, Unclassified Softwood, or other Softwood

Once compiled, the datasets listed in Table 6.7-13 were arithmetically overlaid, superimposing multiple datasets in order to combine geometry and attributes from different layers, for each wetland function metric using ArcGIS (ArcMap version 10.4.1). This created a habitat suitability layer at Year 0 at each geographic scale. The FMS Study Area was also analyzed at Year 8. Habitat suitability layers were clipped to the infrastructure footprint in order to identify direct impacts and calculate predicted losses.

By modeling the impact of the Project and its associated infrastructure on wetland area and the predicted suitable wetland habitat for moose and birds, the extent of impact was determined, and potential loss of these wetland function metrics could be assessed.

6.7.5.2.3 *Modelling Limitations and Assumptions*

The wetland cumulative effects modelling was developed to better understand the potential cumulative effect of wetland area and wetland function metric loss geographically, and where possible, over time. In order to produce a reasonable method to address this issue that falls within the realistic parameters of evaluating potential effects associated with the Project, there were multiple limitations and assumptions built into the modelling process. The following information provides a discussion of these limitations and assumptions, and their impact on the outcome of the assessment.

Certain assumptions were made in the selection of the three wetland function metrics. Initially, they were chosen to represent various wetland characteristics that can play an important role in determining a wetland's function. Wetlands play numerous roles in an ecosystem, and it is difficult to narrow those functions down for the purposes of a modelling exercise. However, for the purpose of this modelling exercise it was necessary to do so. The three wetland function metrics were assessed using available data layers. The biological requirements, habitat descriptions, and representative data layers were chosen using scientific information from peer-reviewed papers, government documents and/or conversations with specialists. To the best of MEL knowledge, they depict an accurate snapshot of the wetland habitat used by each species modelled.

Limitations were observed when it came to compilation of available data, for example, Canada warbler, which use a dense, deciduous shrub layer, was not able to be modeled given the lack of available data. When creating this layer, it was determined that the available GIS datasets narrowed the search too much, resulting in an overly conservative selection of suitable wetland habitat. Furthermore, all GIS layers used are limited by the accuracy and precision of the publicly available data from which they came. For all metrics, field assessments and ground truthing in the FMS Study Area resulted in more accurate data. When comparing this level of detail to the LAA and RAA, where data is far less accurate and less precise, the analysis is underestimated at these larger geographic scales. The analysis performed at the LAA and RAA levels underrepresent predicted suitable wetland habitat, making the comparative area of impacted suitable wetland habitat in the FMS Study Area less than the results of the modelling exercise suggests.

In the context of meeting the objectives of the wetland cumulative effects modelling exercise, the modeling methods were developed to provide the best possible analysis of cumulative effects. However, given the current resources and limitations in available data, a protracted model was not able to be produced. Instead, the study aimed to qualitatively show the potential cumulative effects of the project footprint on wetlands and metrics of their function within the LAA/RAA and over the life of the active mine (6 years) where possible within the FMS Study Area. The mine infrastructure was used in the model to determine area of impact. There are certain limitations around this, as it does not accurately show the potential indirect impacts to upgradient and downgradient wetland habitats, however the maximum spatial extent of indirect impacts to wetlands is defined as the PA. The impacted area assessed only includes the portion of the wetland directly beneath the FMS infrastructure footprint; analysis does not include potential loss of indirectly impacted wetlands.

The intention of this evaluation is to assess landscape level changes in relation to wetland habitat availability for targeted Species at Risk. As previously described, the key limitation is the scale of the input datasets. Even within delineated wetlands in the Study Area, the assessor described vegetation types and habitat availability for SAR, but did not delineate specific habitat types for SAR within each wetland or wetland complex. As such, the predicted habitat availability for SAR used in this evaluation should be considered a conservative overestimate of available habitat within the FMS Study Area. More detailed evaluation of available habitat will be completed at the permitting stage of the projects to support provincial wetland and SAR permitting, as needed.

Lastly, for the purposes of this modeling exercise the study was not able to predict the future landscape changes within the LAA and RAA and how those changes may affect cumulative wetland habitat and functions at that spatial scale.

6.7.5.3 Thresholds for Determination of Significance

A significant adverse effect from the Project on wetlands is defined as:

- A significant adverse effect from the Project on wetland habitat is defined as an effect that results in an unmitigated or uncompensated net loss of wetland habitat as defined under the NSE Wetland Conservation Policy, and its associated no-net loss policy; or,
- an effect to wetlands that is likely to cause a permanent loss of >10% wetland habitat for a SAR species identified in the PA within the LAA, which is defined by the tertiary watershed boundary.

Area of wetlands loss within the FMS Study Area relative to the area of all NSE mapped wetland habitat available within the LAA was used to determine magnitude. This assessment is completed recognizing the fact that wetland habitat outside of the FMS Study Area is underrepresented by provincial wetland databases. Given this assumption, the percent of wetland alteration within the FMS Study Area is conservatively high, as these area calculations are based on field verified wetland boundaries.

The following logic was applied to assess the magnitude of a predicted change in wetland habitat as it relates to the cumulative effects methodology and conclusions:

- Negligible – loss of <1% of NSE mapped wetlands in the LAA;
- Low – loss of 1-5% of NSE mapped wetlands in the LAA;
- Moderate – loss of 5-15% of NSE mapped wetlands in the LAA; and,
- High – greater than 15% loss of NSE mapped wetlands in the LAA.

The timing of residual effects for wetland habitats considers when the residual environmental effect is expected to occur, considering seasonal aspects. The duration of residual effects considers the time frame over which the effects are likely to last, ranging from short-term to permanent. The frequency of residual effects considers the rate of recurrence of the effects, ranging from once to continuous. The reversibility of residual effects considers the time required for wetland habitat to recover to baseline conditions, or whether the changes to wetland habitat, if identified, are permanent.

6.7.6 Project Activities and Wetlands Interactions and Effects

During review of Project activities and their expected direct and potential indirect effects to wetlands, it was determined that wetland alteration authorization would be required to allow for development of the Project. Alternative locations for Project infrastructure were considered, where practicable, focusing specifically on reducing impacts to wetland habitat. The effects of the Project on wetlands were determined considering the effects of the project on groundwater and surface water. This section of the EIS should be read in sequence after Section 6.5 and 6.6.

6.7.6.1 FMS Study Area

Potential interactions between Project Activities and wetland habitat within the FMS Study Area is outline in Table 6.7-14.

Table 6.7-14. Potential Wetland Interactions with Project Activities within the FMS Study Area

Project Phase	Duration	Relevant Project Activity
Site Preparation and Construction Phase	1 year	• Clearing, grubbing, and grading • Drilling and rock blasting • Topsoil, till, and waste rock management • Watercourse and wetland alteration • Seloam Brook Realignment construction and dewatering • Mine site road construction, including lighting • Surface infrastructure installation and construction, including lighting • Collection ditch and water management pond construction, including lighting • Local traffic bypass road construction • Culvert and bridge upgrades and construction • Environmental monitoring • General waste management
Operations Phase	7 years	• Drilling and rock blasting • Open pit dewatering • Ore management • Waste rock management • Tailings management • Surface water management • Dust and noise management • Petroleum products management • Environmental monitoring • General waste management
Closure Phase: Reclamation Stage	2-3 years	• Site reclamation • Environmental monitoring • General waste management
Closure Phase: Post -closure Stage	3+ years	• Environmental monitoring

Development of the Project will cause direct and indirect impacts to wetlands, mostly during the construction phase of the Project. Direct impacts will be associated with clearing, grubbing, infilling and development of the mine and its associated infrastructure. Clay borrow pits will be constructed in upland areas only for use as site construction materials. All efforts will be made to micro-site tower footings outside of wetlands along the transmission spur line corridor. As such, project effects on wetlands associated with construction of the transmission line are expected to be negligible. As micro-siting of tower footings has not yet occurred, those impact areas are not presented herein, and will be assessed at the permitting phase if wetland avoidance is not practicable.

The eastern bypass road alignment was selected based on known environmental constraints (i.e., NSE mapped wetlands), and field evaluations were completed in this area in the summer of 2019 to identify and assess wetlands. This has allowed for micro-siting of the road alignment to avoid wetlands where practicable and permitting to occur for wetland alterations that are not avoidable.

Construction of diversion berms to facilitate the realignment of Seloam Brook will result in direct and indirect impacts to wetlands upstream, downstream, and within the berms, due to alterations in hydrology. The Seloam Brook Realignment will incorporate an integrated floodplain which will mimic natural hydrologic conditions. The realignment is therefore not expected to result in indirect effects to wetland habitat through increasing or decreasing water levels in adjacent wetlands. Other indirect impacts are likely to occur as a by-product of direct impacts associated with the construction activities, as well as potential indirect impacts to wetlands from mine operations (dewatering, blasting and accidents, for example). Table 6.7-15 provides general impacts types and a description of various direct and indirect examples by which these may occur as a result of Project activities. No wetland impacts are proposed outside of the FMS Study Area. For more information about cumulative effects relating to the FMS Mine Site, see Section 8.

Table 6.7-15. Direct and Indirect Wetland Impacts within the FMS Study Area

Impact Type	Direct Impact	Project Phase	Indirect Impact	Project Phase
Alteration of Wetland Hydrology: If the hydrological regime of a wetland is altered, the vegetation, character, and function of the wetland also have potential to change.	Complete dewatering (removing wetland), infilling or flooding of a wetland to facilitate Project development resulting in conversion from wetland to upland habitat.	C	Hydrologically connected upstream wetlands may also be at risk of indirect impacts as a result of downstream alteration activities (e.g., water outflow changes, land elevation changes, blasting, etc. causing dewatering). Inadvertent damming of up-gradient wetlands from construction related infrastructure (e.g., roads with lack of flow through infrastructure).	C
	Alteration of hydrological inputs and outputs into partially altered wetlands has the potential to alter remaining (undeveloped) wetland habitat.	C,O,CL	Removal of on-site outflow and throughflow wetland habitat has the potential to alter the localized hydrology in downgradient wetlands, particularly in relation to construction of the Seloam Brook Realignment.	C,O
			Hydrological changes can affect the use of the wetland by wildlife as habitat.	C
			Blasting adjacent to wetlands has the potential to alter subsurface water flows, especially in fractured rock. This activity has the potential to increase or decrease subsurface hydrological flow to adjacent wetland habitats and can precipitate drier (dewatering) or wetter conditions in those habitats.	C,O
			Groundwater drawdown will reduce groundwater inputs to specific wetlands causing drier conditions (intact or partially altered wetlands within the predicted radius of influence).	O,CL
			Surface water ditching will reduce water inputs to specific wetlands causing drier conditions, as discussed in relation to Local Catchment Area effects.	C,O,CL
Alteration of Water Quality:	Removal (alteration) of wetland from the landscape leading to reduced or no water supply to downgradient aquatic receivers (e.g., streams, additional wetlands, and lakes).	C,O,CL	Alteration of the wetlands increases the risk of downgradient sedimentation.	C,O,CL
			The effects of increased sedimentation as a result of up-gradient activities (e.g., earth moving, removal of vegetation, soil stockpiling) has the capacity to suffocate existing plant life and increase nutrient levels in downgradient wetlands. Dust created as a result of construction activities can have a similar impact.	C,O,CL

Impact Type	Direct Impact	Project Phase	Indirect Impact	Project Phase
			Runoff from potentially acid producing rock exposed during construction and operations activities has the potential for negatively altering water quality within downgradient wetland habitat.	C,O,CL
Vegetative and Habitat Integrity:	Extensive ground works, including activities such as blasting in and adjacent to wetlands has the potential to destabilize land surfaces and the root zone of vegetative areas, including wetland buffers.	C,CL	Introduction of invasive species can occur indirectly into wetlands when equipment or people enter the wetlands or via runoff or dust from the roads. Introduction of mine traffic during construction and operation can elevate this risk. Invasive species, for example purple loosestrife (*Lythrum salicaria*), can severely degrade wetland habitat and function.	C,O,CL
	Loss of vegetative cover decreases wildlife habitat availability and also has the potential to reduce natural surface water drainage.	C	Dust accumulation on vegetation can smother and stress the plants. The dust can also provide minerals and nutrients into the wetland habitat.	C,O,CL
	Seeds and roots of invasive species can be transferred from construction equipment, transportation vehicles, or workers into adjacent wetland habitat during construction and operational activities.	C,O,CL		

Note: C = Construction Phase O = Operation Phase CL = Closure Phase

6.7.6.1.1 *Wetland Impact Extent*

6.7.6.1.1.1 Direct Wetland Impacts within the FMS Study Area

Expected direct impact extent as a result of Project activities during the temporal lifetime of the mine are described in Table 6.7-16 for the FMS Study Area. Indirect hydrological wetland impacts to adjacent wetlands within the FMS Study Area that may be expected as a result of the Project are discussed separately. The following table provides expected direct impacts only. Direct loss includes physical loss of habitat as the result of infrastructure construction. Direct impact types are categorized as partial wetland loss (P) or complete wetland loss (C). Partial alteration is considered to be any alteration which does not directly affect the entire wetland area. Proposed alterations to wetlands are shown on Figure 6.7-3.

Table 6.7-16. Expected Direct Wetland Impacts within the FMS Study Area

Wetland #	Wetland Size (m^2)	Estimated Direct Impact Area (m^2)	Infrastructure	% Alteration Area	Direct Impact Type
WL1	76780.73	6874.00	Collection Ditch, WRSA (NAG Stockpile), Access Road, Potential Borrow Site	9%	P
WL 2	349811.02	184773.80	Potential Borrow Site, Open Pit, Diversion Berm, Haul Road	52%	P
WL 3	8440.33	4452.02	Potential Borrow Site	53%	P
WL 4	305.52	305.52	Potential Borrow Site	100%	C
WL 6	4504.71	4504.71	Haul Road, Open Pit	100%	C
WL 7	4174.90	4174.90	Haul Road, Collection Pond, WRSA (NAG Stockpile)	100%	C
WL 8	1397.75	1397.75	Haul Road, Contractor Laydown	100%	C
WL 9	916.13	916.09	Haul Road, Collection Ditch	100%	C
WL 10	1552.49	1552.49	Collection Pond, Till Stockpile, Haul Road	100%	C
WL 11	10514.76	10514.76	Haul Road, Open Pit, Contractor Laydown	100%	C
WL 12	8123.75	6593.21	Haul Road, Till Stockpile	81%	P
WL 15	2732.55	310.87	Haul Road, Collection Ditch	11%	P
WL 16	446.78	446.78	Haul Road, Diversion Berm	100%	C
WL 19	1315.94	1315.94	TMF	100%	C
WL 21	677.12	677.12	TMF	100%	C
WL 22	3774.45	1050.41	Haul Road	28%	P

Wetland #	Wetland Size (m^2)	Estimated Direct Impact Area (m^2)	Infrastructure	% Alteration Area	Direct Impact Type
WL 23	10735.26	10735.26	TMF	100%	C
WL 24	1345.66	1345.66	TMF	100%	C
WL 25	693.15	693.15	TMF	100%	C
WL 26	991.72	991.72	TMF	100%	C
WL 27	**68997.52**	**48012.82**	**Access Road, Collection Ditch, Collection Pond, TMF**	**70%**	**P**
WL 28	6872.25	6872.25	TMF	100%	C
WL 29	215.92	215.92	TMF	100%	C
WL 32	4109.95	4109.95	TMF, Access Road, Collection Ditch	100%	C
WL 33	2492.82	1161.68	Water Intake Pipe, Access Road	47%	P
WL 37	2847.33	2847.33	Haul Road, Collection Ditch. Water Intake Pipe, Access Road	100%	C
WL 38	664.78	664.78	TMF	100%	C
WL 39	906.07	906.07	TMF	100%	C
WL 40	9353.81	9353.81	TMF	100%	C
WL 41	2958.19	2958.19	TMF	100%	C
WL 42	702.25	702.25	TMF	100%	C
WL 43	8700.63	8700.63	TMF	100%	C
WL 44	137.17	137.17	WRSA (NAG Stockpile)	100%	C
WL 45	1645.97	1645.97	WRSA (NAG Stockpile)	100%	C
WL 46	2714.37	2714.37	WRSA (NAG Stockpile)	100%	C
WL 47	19920.67	6129.41	Access Road, Collection Ditch, WRSA (NAG Stockpile)	30%	P
WL 48	544.67	544.67	WRSA (NAG Stockpile)	100%	C
WL 49	3171.71	1037.00	Collection Ditch, WRSA (NAG Stockpile)	33%	P
WL 50	1357.24	1357.24	WRSA (NAG Stockpile)	100%	C

Wetland #	Wetland Size (m²)	Estimated Direct Impact Area (m²)	Infrastructure	% Alteration Area	Direct Impact Type
WL 51	5201.05	5201.05	Collection Ditch, WRSA (NAG Stockpile)	100%	C
WL 52	7374.34	7374.34	Access Road, WRSA (NAG Stockpile), Collection Ditch, Potential Borrow Site	100%	C
WL 53	136186.08	1260.80	Access Road, Potential Borrow Site	1%	P
WL 59	1906.69	441.65	Access Road	23%	P
WL 64	123764.33	3452.03	Local Traffic Bypass Road	3%	P
WL 65*	317582.09	56732.26	TMF, Access Road, Collection Pond, Collection Ditch	18%	P
WL 66	1034.86	1034.86	TMF	100%	C
WL 67	1628.41	1628.41	TMF	100%	C
WL 68	649.88	649.88	TMF	100%	C
WL 69	190.37	190.37	TMF	100%	C
WL 70	4201.11	4201.11	TMF	100%	C
WL107	11562.19	74.68	Access Road	6%	P
WL 116	802.21	802.21	TMF	100%	C
WL 118	3716.84	3716.84	WRSA (PAG Stockpile), Collection Ditch	100%	C
WL 119	1754.38	1754.38	LGO Stockpile	100%	C
WL 122	1322.69	1322.69	WRSA (PAG Stockpile)	100%	C
WL 124	6197.24	6197.24	Collection Pond, Till Stockpile, Haul Road	100%	C
WL 125	12208.81	12208.81	WRSA (PAG Stockpile)	100%	C
WL 128	11763.62	11763.62	Haul Road, Collection Pond, Till Stockpile	100%	C
WL 130	10181.34	10180.46	WRSA (PAG Stockpile), Haul Road, Collection Ditch	100%	C
WL 132	4661.45	4661.45	Till Stockpile	100%	C
WL 134	189.76	189.76	WRSA (NAG Stockpile)	100%	C
WL 135	373.04	373.04	WRSA (NAG Stockpile)	100%	C

Wetland #	Wetland Size (m^2)	Estimated Direct Impact Area (m^2)	Infrastructure	% Alteration Area	Direct Impact Type
WL 136	1950.57	1950.57	WRSA (NAG Stockpile)	100%	C
WL 138	3200.78	3200.78	WRSA (NAG Stockpile), Collection Ditch, Collection Pond	100%	C
WL 139	3118.37	3118.37	WRSA (PAG Stockpile)	100%	C
WL 140	1363.79	1363.79	WRSA (PAG Stockpile), Collection Ditch	100%	C
WL143	1389.37	93.76	Plant and Ancillary Building Area	7%	P
WL 144	952.51	952.51	WRSA (PAG Stockpile)	100%	C
WL 145	10574.12	10576.41	Plant and Ancillary Building, Access Road, Surplus Water Discharge Pipeline	100%	C
WL 147	533.40	533.40	WRSA (PAG Stockpile)	100%	C
WL 148	616.85	616.85	WRSA (PAG Stockpile)	100%	C
WL 149	517.64	517.64	WRSA (PAG Stockpile)	100%	C
WL 150	634.43	634.43	WRSA (PAG Stockpile)	100%	C
WL 152	2414.36	2414.36	Plant and Ancillary Building, Access Road, Surplus Water Discharge Pipeline	100%	C
WL 153	4058.46	4058.46	Plant and Ancillary Building, Access Road, Surplus Water Discharge Pipeline	100%	C
WL 154	1883.76	1883.76	Plant and Ancillary Building, Haul Road	100%	C
WL 155	2388.53	2388.53	Plant and Ancillary Building	100%	C
WL 156	795.97	795.97	Plant and Ancillary Building	100%	C
WL 157	474.13	475.24	Plant and Ancillary Building, Collection Ditch	100%	C
WL 158	255.61	255.61	Plant and Ancillary Building	100%	C
WL 159	**7981.35**	**7981.35**	**Plant and Ancillary Building**	**100%**	**C**
WL 160	2772.96	2772.96	Plant and Ancillary Building Area, Collection Ditch	100%	C
WL 161	347.61	347.61	Plant and Ancillary Building Area. Haul Road	100%	C
WL 162	640.02	638.39	Plant and Ancillary Building Area, Collection Ditch	100%	C

Wetland #	Wetland Size (m²)	Estimated Direct Impact Area (m²)	Infrastructure	% Alteration Area	Direct Impact Type
WL 163	1334.74	1334.74	LGO Stockpile	100%	C
WL 164	951.95	951.95	Plant and Ancillary Building Area	100%	C
WL 165	152.21	152.21	Collection Ditch	100%	C
WL 166	719.86	719.85	TMF	100%	C
WL 167	4017.07	4017.07	LGO Stockpile	100%	C
WL 168	1280.55	1280.55	Plant and Ancillary Building Area, Access Road	100%	C
WL 169	437.46	437.46	TMF	100%	C
WL 170	5247.60	5247.60	TMF, Collection Ditch, Plant and Ancillary Building Area	100%	C
WL 173	2160.50	247.64	Seloam Brook Realignment	11%	P
WL 178	625.20	625.20	Plant and Ancillary Building Area	100%	C
WL 179	1507.01	1507.01	Plant and Ancillary Building Area, Access Road	100%	C
WL 180	48247.99	48247.99	TMF, Access Road, Plant and Ancillary Building Area	100%	C
WL 184	726.22	726.22	Plant and Ancillary Building Area	100%	C
WL 185	895.68	895.68	Collection Ditch, Access Road, TMF	100%	C
WL 186	99.61	99.61	TMF	100%	C
WL 187	808.98	808.98	Plant and Ancillary Building Area	100%	C
WL 188	301.42	301.42	TMF	100%	C
WL 190	847.05	847.05	TMF	100%	C
WL 192	17540.15	17540.15	TMF	100%	C
WL 193	491.75	491.75	TMF	100%	C
WL 194	739.21	739.21	TMF	100%	C
WL 196	5936.84	5936.84	TMF	100%	C

Wetland #	Wetland Size (m^2)	Estimated Direct Impact Area (m^2)	Infrastructure	% Alteration Area	Direct Impact Type
WL 201	4639.28	4639.28	TMF	100%	C
WL 204	537.98	537.98	TMF	100%	C
WL 205	1106.29	1106.29	TMF	100%	C
WL 207	34016.36	34016.36	TMF	100%	C
WL 208	279.66	279.66	TMF	100%	C
WL 209	1041.08	1041.08	Organic Material Stockpile	100%	C
WL 224	1951.63	1951.63	TMF	100%	C
WL 225	1331.54	1331.54	TMF	100%	C
WL 227	115.22	115.22	TMF	100%	C
WL 228	369.55	369.55	TMF	100%	C
WL 234	4878.43	4878.43	TMF	100%	C
WL 235	3867.13	3867.13	TMF	100%	C
WL 254	407.09	407.09	Topsoil Stockpile	100%	C
WL 256	4342.79	1938.60	Topsoil Stockpile	45%	P
WL 261	765.49	27.26	Surplus Water Discharge Pipeline	4%	P
WL 262	361.97	361.97	TMF	100%	C
WL 263	1870.63	1044.03	TMF, Access Road, Collection Ditch	56%	P
WL 264	846.22	846.22	TMF	100%	C
WL 265	2509.01	2509.01	TMF	100%	C
WL 266	1216.85	1216.62	Collection Ditch, Access Road	100%	C
WL 269	118.01	118.54	Collection Ditch	100%	C
WL 270	2018.92	684.16	Collection Ditch, Access Road	33%	P
WL 304	862.82	862.82	Till Stockpile, Contractor Laydown	100%	C
WL 307	383.65	383.65	TMF	100%	C
WL 308	525.19	525.19	TMF	100%	C

Wetland #	Wetland Size (m^2)	Estimated Direct Impact Area (m^2)	Infrastructure	% Alteration Area	Direct Impact Type
WL 310	1000.73	1000.73	Plant and Ancillary Building Area	100%	C
WL 311	1390.76	1390.76	Plant and Ancillary Building Area	100%	C
WL 312	4224.41	1867.73	Haul Road, Collection Ditch, LGO Stockpile	44%	P
WL 333	1249.00	1249.00	Local Traffic Bypass Road	100%	C
WL 336	18114.60	413.11	Local Traffic Bypass Road	2%	P
Total	153,0116.25	690,817.16			

NOTE: Wetlands of Special Significance (WSS) are in Bold . *Eastern lobe of WL65 is a WSS – alteration is only proposed to occur in the western lobe.

As outlined in Table 6.7-16, 113 wetlands are proposed for complete alteration, and 23 wetlands are expected to be partially altered as a result of Project activities. The total area for direct impacts as a result of Project activities is expected to be 690,817.164 m^2 (69.08 ha), which represents 32.8% of total wetland area within the FMS Study Area (210.5482 ha), and 5.2% of NSE mapped wetlands within the LAA (1,324 ha). Of all 274 delineated wetlands within the FMS Study Area, 138 (50%) will be completely avoided.

Wetland alterations included in the table above include direct impacts from infrastructure. Where a partial alteration is proposed, in some cases, remaining portions of a wetland on either side of infrastructure may not be maintained in a natural condition. These areas were assessed on a case by case basis, considering flow regime, wetland type, and alteration type. If it was determined that the remaining portion of wetland habitat is not likely to maintain condition (i.e., a portion remains between two drainage ditches), the direct alteration area has been expanded to include wetland fragments which lie outside of proposed infrastructure.

Infrastructure has already been planned to avoid wetland impacts wherever practicable (i.e., on-going design of the Seloam Brook Realignment, or adjustments to placement of the TMF in relation to wetlands and fish and wetland habitat). During the wetland alteration permitting phase, additional micro-siting of infrastructure (i.e., road alignment and other supporting infrastructure) will occur where practicable to avoid wetland impacts, and infrastructure-specific buffers will be added to wetland impact areas wherever necessary. Further detailed analysis of the Seloam Brook Realignment may result in a decrease in alteration area, as some portions of the proposed flooded area may not result in a negative alteration of wetland function. The impacts of the Project on fish and fish habitat within wetlands is discussed is Section 6.8. Wetland area that is accessible to fish is directly accounted for in the Fish Habitat Offset Plan (Appendix J.7).

6.7.6.1.1.1.1 Direct Impacts to Wetlands of Special Significance

As described in Section 6.7.3.2, a total of four wetlands are identified as Wetlands of Special Significance (WSS) based on the presence of blue felt lichen (SARA Special Concern, NSESA Vulnerable) within delineated wetlands. Wetland 240 and the eastern lobe of WL65 (which contains the blue felt lichen) will be avoided completely, while two wetlands are proposed to be partially (WL27) or completely (WL159) altered to support Project infrastructure.

A total of 4.80 hectares of impact is proposed within WL27, including the portion of the wetland which contains the blue felt lichen. A detailed alternatives assessment has led to the current placement of the TMF and this infrastructure has been placed in consideration of all valued components and minimization of overall impact. Therefore, avoidance of this portion of the wetland is not practicable. Translocation of the blue felt lichen (detailed in Section 6.12.7.2) is proposed, which will mitigate the impact to this species within the WSS. Complete alteration to WL159 is proposed to support development of the plant and ancillary buildings, including settling ponds.

Further detailed design of these structures may allow avoidance to WL159. However, if avoidance is determined to be impracticable; the blue felt lichen will also be translocated. Measures to avoid, mitigate and compensate effects to WSS are provided in Section 6.7.6.4 and 6.7.7. Potential Indirect Wetland Impacts within the FMS Study Area.

Indirect impacts are described as changes to wetland condition that may occur due to the Project, where wetland habitat is not directly lost, but is changed as the result of the Project (i.e., wetting or drying of wetlands). Indirect impacts may occur as a result of flooding downstream of the Seloam Brook Realignment, or other unintended wetting or drying of wetlands due to Project development (such as groundwater drawdown within the ROI, or loss of surface water flow within Local Catchment Areas, or LCAs). Estimates of potential indirect impacts are provided herein, however it should be noted that these estimates represent the maximum potential impact as a worst-case scenario. Reasonable indirect impacts of the Project will be determined at the permitting phase and through monitoring programs.

6.7.6.1.1.1.2 Seloam Brook Realignment: Upstream and Downstream Flooding

The Seloam Brook Realignment is anticipated to result in flooding of downstream wetlands on the order of 0.1-0.2 m in the north channel floodplain, and 0.3-0.4m in the south channel floodplain. The spatial extent of this potential impact is presented in Table 6.7-17. These water level increases are predicted to represent the new steady-state water level, which varies seasonally similar to natural water levels. As the realignment channel is designed to mimic natural flows, storm surges are expected to be conveyed through this channel in a manner that mimics natural conditions as well (i.e., temporarily increased water levels which naturally subside following storm flows). Further detailed design and regulatory consultation associated with the realignment channel and downstream water control features may result in a decrease in flooded area downstream of the realignment channel, in WL2 (both upstream and downstream of the proposed water control structures), WL64 and WL173.

The Seloam Brook Realignment has been designed to incorporate an integrated floodplain along the realignment channel, as part of the Fish Habitat Offset Plan: Preliminary Concept Update (Appendix J.7). This channel and surrounding integrated floodplain have been designed to convey flow from Seloam Brook, WC12 and Trafalgar Creek around the proposed open pit in a manner which provides low-flow fish passage, enhanced fish habitat functions, and conveyance of high flow. The floodplain will allow high-flow events such as spring freshets and extreme storm events to pass similar to a natural wetland/floodplain ecosystem. This integrated floodplain has been modelled to mimic natural channel conditions. As such, indirect impacts to adjacent wetlands are not anticipated at this time. The conveyance of flow in the integrated floodplain is expected to reduce potential flooding upstream of the realignment channel as well. Upstream of the realignment channel, flooding is not predicted to occur under the MAD flow scenario, and thus no indirect impacts to wetlands upstream of the realignment are predicted under average conditions (Appendix D.4). Water levels may increase slightly in the immediate vicinity of the diversion berm; detailed design work for the realignment channel and diversion berm will occur to reduce or eliminate water level increases, both adjacent to the realignment, and in WL2 upstream of the realignment channel. This wetland complex (WL2) currently experiences water level fluctuations on an annual basis due to management of the NSPI dam infrastructure on Seloam Lake. As a result, these wetlands are likely more able to manage and have adapted to, fluctuating water conditions.

Water level changes in terrestrial habitats can enhance wetland function, promote soil richness, and maintain local flora. Mitsch et al. (2005) ran a 15-year experiment in which they created two riverine wetlands by flooding a previously unflooded area; the wetlands were designed to be sustainable and provide multiple-ecosystem services. By the end of this experiment, both wetlands were performing the functions of natural wetlands including enhancing water quality, ecological community diversity, and carbon sequestration. Nielsen et al. (2013) found that periodic disturbances such as wetting and drying of soils promoted soil richness and its ability to germinate aquatic plants. A final study conducted by Van der Valk et al. (1994) found little change in flora within wetlands when exposed to the following three water level treatments: normal water levels, 30cm above normal, and 60cm above normal. While flora species composition did not change, their abundance and distribution did, which is to be expected as water displaces certain species while creating niches for others. These studies support the hypothesis that the addition of water to Wetland 2 due to the realignment channel, may provide certain ecosystem benefits. While increasing water levels may decrease wetland functions for some attributes (i.e., organic nutrient export and aquatic invertebrate habitat), wetland functions for other attributes may increase. Specifically, WESP-AC functions scores water storage delay, streamflow support, sediment retention and stabilization, resident fish habitat and waterbird feeding habitat may increase through increasing standing water levels in a wetland, based on simply manipulating field-based responses to water-level related questions in the WESP-AC field form (i.e. F28 and F29).

This area of flooding is accounted for as a mitigation measure for fish and fish habitat, as described in Section 6.8.6.1.2.1, as well as the Fish Habitat Offset Plan (Appendix J.7). While this area of increased water level has been identified as a mitigation measure for fish and fish habitat, a wetland monitoring program will be implemented to identify whether the increased water level constitutes a wetland alteration. Through the detailed design and permitting process, the Project Team will review updated functional conclusions for each wetland, and will consult with NSE to identify the likelihood and spatial extent that an alteration will occur as a result of increased water levels.

At this point in the assessment, all wetland areas predicted to receive flooding from the realignment of Seloam Brook are included in the total area of potential indirect impacts as a conservative estimate. Actual impacts will be confirmed through detailed design, wetland permitting process, and monitoring programs.

Table 6.7-17. Potential Indirect Wetland Impacts within the FMS Study Area due to the Seloam Brook Realignment

Wetland #	Wetland Size (m^2)	Estimated Indirect Impact Area (m^2)	Impact Type	% Alteration Area	Indirect Impact Type
2	349,699.33	72,936.11	Flooding	21%	P
64	123,756.61	11,168.60	Flooding	9%	P
173	2,160.49	344.19	Flooding	16%	P
Total	**47,5616.43**	**84,448.90**			

6.7.6.1.1.1.3 Groundwater Drawdown

Indirect impacts to wetlands by groundwater drawdown near the open pit is expected to occur. Groundwater modeling predictions of a lowering of the water table ranging from 13.0 m in areas close to the pit to 1.0 m at the extent of the predicted drawdown area a maximum of 830 m from the pit, during operations. Groundwater levels are predicted to rise on the order of 1.0 m within and surrounding the TMF. These contours are referred to collectively as the radius of influence (ROI), and it is important to clarify that the Pit ROI represents a predicted groundwater drawdown, while the TMF ROI represents a predicted increase in groundwater elevation.

Wetlands regularly undergo seasonal Relative Groundwater Depth (RGWD) fluctuations in response to annual precipitation, seasonal variability and frequency of local precipitation events. Geographically isolated wetlands have been reported to have seasonal fluctuations ranging as high as ±20 cm (Keddy 2010). Keddy (2010) also found that wetlands associated with lakes and watercourses were found to have seasonal variability as high as ± 1.5 m. The US Army Corp (2009) stipulates that wetland hydrology is defined as saturation of soils 20 cm below the surface or groundwater levels within 30 cm of the surface for a period of two consecutive weeks in the growing season.

Drawdown caused by mining can affect all wetlands that have direct connectivity to groundwater (discharge and recharge wetlands). Drawdown can change the hydroperiod of a wetland and reduce water levels which can cause an adverse effect on wetland function

(Mortellaro et al. 1995). Effects include drier conditions, wetter conditions, change in flow direction, changes to vegetation, and changes to wildlife habitat (e.g., fish and amphibians).

Large wetland systems within the radius of influence at the FMS Mine Site that have ample standing water (e.g., WL1 and WL2) are less likely to be affected by drawdown. Conversely, the impact to drier more marginal wetlands (e.g., WL8) are likely to be more severe. If wetlands become drier, organic soils can subside, and plants may become stressed. Most plants, however, can survive dry conditions and reproduce under altered hydrologic conditions. Loss of groundwater can also convert discharge wetlands into recharge wetlands, which in turn reduces surface water levels (Tiner 2005). Changes in surface water quantity can affect downstream wetlands that receive surface water flows, as discussed above, as well as fish and fish habitat (Section 6.8).

Indirect impacts are anticipated from a rise in groundwater level in the TMF ROI where operational and post-closure modelling predict up to a 1.0 m increase in groundwater elevation. To determine the indirect effects of groundwater level increases, wetlands that have direct interactions with groundwater (i.e., wetlands where groundwater is the primary source of wetland hydrology) were identified. Groundwater inputs to wetlands was determined using their topography, wetland type, absence of inflow/through flow, presence of deep organic soils, and the presence of the water table near the soil surface and surface saturation. Wetlands with known or expected groundwater influence are expected to be impacted to a greater extent by changes to groundwater levels (compared with those driven by surface water).

A total of 52 wetlands are present within the operational and post-closure groundwater ROI associated with the TMF. Of the 52 wetlands, three wetlands (WL27, WL65 and WL263) are proposed to have partial direct impact, while four wetlands (WL191, WL198, WL185 and WL276) are not proposed to be directly impacted by Project infrastructure. The other 45 wetlands are accounted for in direct impacts to support construction of the TMF. Of the seven wetlands that fall within the TMF ROI which will be either unaltered or partially altered, none are expected to have wetland hydrology driven by groundwater levels (all are expected to be driven by surface water). As such, no indirect effects of increased groundwater levels within the TMF ROI are expected.

There are 39 wetlands within the predicted ROI surrounding the pit during the most conservative conditions (dry). Changes in hydrology could result in drier conditions and altered wetland characteristics including plant communities within each wetland. A summary of wetlands within the pit ROI is presented herein:

- Complete direct alterations for infrastructure is proposed for 27 wetlands. As these will be completely altered, they are not being considered in the evaluation of indirect effects from groundwater drawdown.
  - Wetlands: WL6, WL7, WL8, WL9, WL10, WL11, WL16, WL44, WL45, WL46, WL48, WL50, WL51, WL125, WL128, WL130, WL134, WL135, WL136, WL138, WL139, WL140, WL144, WL147, WL148, WL157 and WL160.
- Partial direct alterations are proposed to one wetlands, with the unaltered portion falling outside of the pit ROI. The unaltered portion of these wetlands are not considered likely to be impacted by groundwater drawdown.
  - Wetlands: WL12
- Partial direct alterations are proposed for six wetlands, with the unaltered portion falling within the pit ROI. The unaltered portion of these wetlands are being considered in the evaluation of indirect effects from groundwater drawdown.
  - Wetlands: WL1, WL2, WL15, WL47, WL49 and WL173
- No direct effects are proposed for four wetlands which fall within the pit ROI. These wetlands are being considered in the evaluation of indirect effects from groundwater drawdown.
  - Wetlands: WL13, WL55, WL133 and WL146 have no direct or indirect impacts proposed.

Any wetland that is situated within the radius of influence has the potential to be affected from drawdown. Intact or partially intact wetlands within the radius of influence are simulated to experience drawdown on the order of 1.0 m, increasing with proximity to the pit. The likelihood of groundwater interactions within wetland habitat increases with increasing proximity to the pit and wetland type and water flow direction (upward or downward trend of groundwater). The 1.0 m drawdown ROI extends to a maximum of 830 m from the edge of the proposed pit during operations (Figure 6.5-16). In the post closure stage, the predicted groundwater ROI decreases in size around the pit. The maximum distance between the proposed pit and predicted post-closure groundwater drawdown during post-closure is approximately 150 m. All wetland habitat within the 1.0 m post-closure groundwater ROI is proposed for direct impact, with the exception of a portion of Wetland 11.

To determine the indirect effects of groundwater level increases, wetlands have direct interactions with groundwater (i.e., wetlands where groundwater is the primary source of wetland hydrology) were identified. Groundwater inputs to wetlands was determined using their topography, wetland type, absence of inflow/through flow, presence of deep organic soils, and the presence of the water table near the soil surface and surface saturation. Wetlands with known or expected groundwater influence are expected to be impacted to a greater extent by groundwater drawdown (compared with those driven by surface water). Of the 12 wetlands with potential indirect impacts from groundwater drawdown in the pit ROI, only wetland 11 is expected to have a direct interaction with groundwater. Wetland impacts due to groundwater drawdown are expected to be evident in this wetland, if any. It is recommended that this wetland be monitored for indirect impact due to groundwater drawdown through the operational and post-closure phases of the Project to determine if changes to wetland conditions or functions occur. MEL used a reasonable worst-case scenario to estimate potential indirect impacts to wetland 11 from groundwater drawdown (0.46 ha). Further consultation with NSE will occur through the wetland permitting process.

6.7.6.1.1.1.4 Local Catchment Area Flow Reduction

Potential for downgradient, indirect wetland impacts can be expected throughout the FMS Mine Site as a result of up-gradient hydrological alteration. Primarily, the alteration of hydrological conditions in up-gradient wetlands, watercourses and local watershed catchments to manage site contact water, will affect natural inflows, outflows and hydroperiod characteristics in contiguous wetland systems. In addition, where up-gradient alteration is occurring, but a direct hydrological flow is being maintained, potential exists for indirect impacts to downgradient water quality conditions associated with erosion and sedimentation.

To identify the effects of the Project on local surface flows and associated habitats, MEL identified LCAs within each sub-tertiary watershed in which infrastructure is proposed. The methods used to define LCAs are described in detail in Section 6.6 (Surface Water Quality and Quantity). The construction of site infrastructure will require construction of collector ditches surrounding facilities such as the WRSA, stockpiles, and TMF. These collector ditches convey all mine site contact water to site water management facilities for treatment prior to release to the environment. The construction of collector ditches surrounding site infrastructure essentially diverts water away from local surface water features within each relevant catchment or diverts water from one catchment and increases surface flow (post treatment) in another catchment. This can have an indirect effect on wetland habitat at the LCA level. The effects of the Project on surface water quality and quantity at the regional watershed level and the LCA scale are described in detail in Section 6.6.

Alterations of hydrology within each LCA (reduced surface flow) may result in indirect impacts to wetlands. MEL evaluated wetlands within in each LCA, excluding those with expected direct impact, potential indirect flooding impact from the realignment, and those that may be influenced by predicted groundwater drawdown as described in previous sections of this VC effects assessment analysis. A list of all remaining wetland habitats was developed per LCA, to allow for an evaluation of potential indirect impacts from flow reduction in each LCA. Reduction in flow in each LCA affects each wetland differently, depending on that wetland's location in the catchment area, and the proposed direct effects of the Project based on proposed infrastructure locations. As such, some wetlands are being considered to have potential indirect impacts, even in LCAs where the magnitude of flow reduction is predicted to be low or moderate. MEL biologists considered water source, stream association and position both in the LCA and relative to proposed infrastructure, to develop a short list of wetlands with potential indirect impacts from reduced surface flow. To be conservative, MEL used the total remaining (unaltered) wetland area from those in the short list to calculate the potential area of indirect impact. This is expected to represent the reasonable worst-case scenario for potential indirect impacts based on surface flow reduction (Table 6.7-18).

Table 6.7-18: Local Catchment Area Decrease from Project development

Sub-tertiary Watershed	Local Catchment Area	Associated Wetlands	Percent of LCA flow reduction
SW6	WC26	WL47	16%
SW5	WC2	WL1, WL49	29%
	WC12*	WL263	<10%

Note:* Hydrology was evaluated at the outlet of the WC12 feature, upstream of the inflows from Seloam Lake / Reservoir. The change in average discharge was predicted as a change that is outside of, but within 10% of, the existing simulated intra-annual variation of monthly flow in the month of July, which is considered a low magnitude change in hydrology for this system.

Within the LCA for WC2, WL1 and WL49 are anticipated to have direct partial impact from construction of the WRSA. The anticipated reduced flow rate of 29% could potentially result in indirect effects to these wetlands.

Golder Associates conducted a detailed evaluation of the effects on WC12 at the outlet, taking into consideration the effects of flow loss combined with seepage input from the TMF. Combining these two factors, the change in average discharge at the WC12 outlet was predicted as falling outside of the existing variability in streamflow in the month of July, with a decrease of <10%. Wetland 263 is partially directly impacted, and its surface flow is being diverted from the remaining portions of the wetland by the construction of diversion ditches. As such, this wetland is expected to be indirectly affected by catchment area loss.

The LCAs for WC2 and WL12 all fall within the regional catchment area SW5 (Seloam Brook outlet). The outflow through the Seloam Brook was simulated to decrease as a result of the Project footprint and the upstream removal from Seloam Lake. The minimum monthly average flow in July was simulated to decrease by 5% in this month (i.e., low magnitude). Therefore, this reduction is not likely to cause significant adverse effects to associated wetlands.

Within the LCA for WC26, WL47 is anticipated to have partial direct impact from construction of the WRSA and surrounding site ditches. Furthermore, they are in a location that indicates potential indirect effects from a predicted 16% loss of catchment area.

Within the SW15 catchment area, two wetlands may be affected by reduced flow when the TMF is constructed. Wetland 267 is located approximately 10 m down-gradient of the eastern extent of the TMF. This bog is hydrologically isolated. As such, it is not anticipated to be indirectly impacted by the construction of the TMF and surrounding diversion ditches. Similar to WL263 described above, WL270 is proposed to be partially directly impacted, and flow into the remaining unaltered portions of the wetland may be redirected by diversion ditches. As such, the remaining portion of WL270 is anticipated to be indirectly affected by LCA loss.

Wetland 65 is a large wetland complex surrounding East Lake in the SW15 catchment area. Watercourse 43 is the primary inlet into East Lake, through WL65. The banks of WC43 are well defined and entrenched. Outside of the immediate riparian fringe, there is no evidence of bidirectional flow between WC43 and WL65. The same is true for East Lake and WL65. Large portions of WL65, predominantly bog habitat surrounding the northern half of East Lake, are raised and have hydrological regimes driven by precipitation. The hydrological modelling completed by Golder Associates indicates that the water level within East Lake is not anticipated to decrease by more than 5 cm, which is within natural water level fluctuations of fringe fens such as WL65. Furthermore, WL65 will still receive surface flow from large swaths of unimpacted adjacent uplands, including surface flow from two watercourses from the southwest (WC31) and northeast (WC38). As such, the anticipated reduction in surface water flow and reduction in water levels in East Lake is not anticipated to result in any significant effects to the hydrological condition of WL65.

As a result of the evaluation of LCA adjustments, the following wetlands have been determined to be potentially indirectly affected by the Project: WL1, WL47, WL49, WL263 and WL270 for a total potential alteration area of 23,358m^2 (2.34 ha).

6.7.6.1.1.2 Direct and Potential Indirect Wetland Impact Summary

Direct and potentially indirect losses of wetlands will occur as the result of Project development. The Seloam Brook Realignment and construction of Project infrastructure will result in direct loss of wetlands. All wetland losses will require wetland compensation under the Nova Scotia Wetland Conservation Policy. In addition, loss of wetlands accessible to fish are accounted for in the Fish Habitat Offset Plan (Appendix J.7) and discussed in Section 6.8.

Overall, changes in hydrology (i.e., reduced overland flow) due to the placement of Project infrastructure has the potential to affect the functionality of wetlands. On-going detailed infrastructure design will be completed to minimize these impacts. This will be completed at the permitting level. Targeted monitoring for wetlands will also be conducted to verify the accuracy of the predicted environmental effects and the effectiveness of mitigation measures. Refer to Section 6.7.9 for details associated with Wetland Monitoring, and the Preliminary Wetland Compensation Plan (Appendix G.4) for further information.

As is consistent with alteration to all wetlands associated with the Project, protection and viability of connected, unaltered areas of wetland habitat are considered as part of the provincial wetland alteration process. Design of suitable hydrological connectivity structures (e.g., culverts), the implementation of a Project EMS Framework document (Appendix L.1), and erosion prevention and sediment control methods will be employed to ensure that avoidable indirect impacts to upstream or downstream wetlands will not occur as a result of the activities associated with the Project. In addition, post-construction monitoring will be completed as discussed in Section 6.7.9. A preliminary wetland monitoring program is outlined in Section 6.7.9, while a comprehensive wetland monitoring program will be developed to meet the requirements of wetland alteration permits issued for direct and indirect wetland alterations associated with the Project.

To support the effects assessment, MEL employed a reasonable worst-case scenario for determining total potential indirect impacts to wetlands as described in previous sections. Three primary pathways for indirect impacts have been considered in this evaluation of potential indirect effects: Seloam Brook Realignment, Groundwater Drawdown, and Local Catchment Area changes. Two of these have been brought forward and summarized in Table 6.7-19 (as described in Section 6.7.6.1.1.1.3, no effects are anticipated to occur as a result of groundwater drawdown). The maximum extent of potential indirect impact to wetlands is 10.78 ha. This total impact area is used to quantify the magnitude of any potential indirect effects of the Project in the effects assessment portion of this section. As described throughout Section 6.7.6.1.1.2, these indirect effects are only considered as potential at this point, rather than confirmed alteration areas. During the permitting phase of this Project, a detailed wetland monitoring program will be developed, guided by considerations listed in the table below and the detailed design of the mine infrastructure and water management systems, to verify and confirm the extent of any indirect impacts to wetlands.

Table 6.7-19. Summary of potential indirect impacts of the Project on wetlands

Indirect Impact Pathway	Considerations	Reasonable worst-cast scenario impact area
Flooding associated with the realignment channel	Flood extent mapping was used to predict maximum potential indirect impacts to wetlands associated with the realignment of Seloam Brook channel and downstream flooding. Wetlands included: WL2, WL64, WL173	8.44 ha

Indirect Impact Pathway	Considerations	Reasonable worst-cast scenario impact area
Reduction in flow based on infrastructure construction in the LCAs	The reduction in flow per LCA was considered, along with the relative positioning of wetlands, watercourses and surface flow pathways. For instance, wetlands located upgradient of, or cross-gradient of proposed infrastructure are less likely to be impacted by flow reduction. Wetlands included: WL1, WL47, WL49, WL263 and WL270	2.34 ha
Maximum extent of potential indirect effects to wetlands:		**10.78 ha**

In summary, the proposed direct alteration area to wetlands in the FMS Study Area is 69.08 hectares, representing 32.8% of delineated wetlands in the FMS Study Area, and 5.2% of the wetlands in the LAA. The magnitude of this effect is moderate with appropriate mitigation including implementation of wetland compensation. The maximum potential indirect impacts of the project on wetlands, considering groundwater drawdown, Seloam Brook Realignment flooding, and surface flow reduction, is 10.78 hectares. This represents 5.1% of delineated wetlands within the FMS Study Area, and 0.8% of wetlands within the LAA. The magnitude of this effect is considered low. It is anticipated that the actual indirect impacts to wetlands will be substantially lower, given the suite of mitigation measures proposed. This estimate represents the reasonable worst-case scenario of indirect impacts to wetlands.

The combined expected direct impact and potential indirect wetland impact area is 79.86 ha as shown in Figure 6.7-4 which represents 37.9% of delineated wetlands within the FMS Study Area, and 6.0% of wetlands within the LAA. The magnitude of this effect is considered moderate, with appropriate mitigation including implementation of wetland compensation.

6.7.6.2 Touquoy Mine Site

During mine operations, processing of FMS concentrate will occur and tailings generated through processing FMS concentrate will be deposited in the Touquoy exhausted open pit. At post closure and once water quality in the Touquoy Mine Site meets MDMER discharge criteria, water surplus will be released into Moose River via a spillway.

The spillway is proposed to be installed at elevation of 108 m to prevent the pit from overtopping. The capacity of the spillway will be sized to accommodate the CDA inflow design flood and associated freeboard requirements for wind run-up and wave set-up. The spillway will discharge to a conveyance channel that outlets to Moose River, approximately 70 m downstream of the surface water monitoring station SW-2. As the predevelopment and post development catchment areas draining to the discharge location at Moose River are similar, Moose River is capable of handling the resultant flows. Any required erosion and scour protection of Moose River at the discharge location will be considered in design. There are no changes in surface water management of the Touquoy pit catchment from tailings deposition in the TMF to tailings deposition in the open pit, with the exception of the timing to discharge to Moose River.

No indirect impacts to wetlands are expected based on proposed discharge from the pit to the Moose River, as the pre-development and post development catchment areas draining to the discharge location are similar, the Moose River is capable of handling the resultant flows. There are no direct or indirect wetland impacts predicted at the Touquoy Mine Site as a result of the Project (Table 6.7-20).

Table 6.7-20: Potential Wetland Interactions with Project Activities at Touquoy Mine Site

Project Phase	Duration	Relevant Project Activity
Operations Phase	7 years	• Environmental monitoring • General waste management
Closure Phase: Reclamation Stage	2-3 years	• Environmental monitoring
Closure Phase: Post Closure Stage	3+ plus years	• Water treatment and management • Environmental monitoring

6.7.6.3 Wetland Cumulative Effects Modelling Results

The Wetland Cumulative Effects Modelling exercise was completed to support the determination of direct wetland effects associated with FMS Mine Site and its associated infrastructure. The modeling exercise was completed across the three spatial boundaries noted in Section 6.7.5.1.

The modelling has enabled a determination of the following:

- The extent of wetland area loss at the FMS Study Area, LAA, and RAA at Year 0 (i.e., baseline conditions prior to any mine development activities) and Year 8 (i.e., completion of mine development /complete wetland alteration);
- The extent of predicted mainland moose, olive-sided flycatcher and rusty blackbird wetland habitat within the FMS Study Area and LAA at Year 0;
- The maximum extent of predicted mainland moose, Canada warbler, olive-sided flycatcher and rusty blackbird loss in the FMS Study Area between Year 0 and Year 8 based on desktop evaluation only; and,
- The determination of significance on wetland loss, that is defined as an effect to wetlands likely to cause a permanent loss of >10% wetland habitat for a SAR species identified in the PA within the LAA.

Results of the modelling exercise are provided in Table 6.7-21 below: Modelling parameters refer to methods by which wetland function metrics were compared to each other, temporally and spatially.

When reviewing the results of the modelling in the following tables, the reader is reminded of the limitations associated with the modelling completed in the LAA and RAA: i.e., the analysis performed within the LAA and RAA spatial boundaries underrepresent predicted suitable wetland habitat. As such, the predictions are conservative because there is considerable unmapped (under-represented) wetlands within the LAA and RAA that are not accounted for in the calculations. Additionally, all predictions of SAR habitat within the LAA were completed via desktop methodology only and are considered coarse and conservative. Field verification is required prior to permitting to confirm presence of specific habitats that support particular SAR within each wetland.

Table 6.7-21: Wetland Cumulative Effects Modelling Results within the FMS Study Area

Modelling Parameter	Wetland Area Losses	Maximum Predicted Moose Wetland Habitat Losses	Maximum Predicted Bird Wetland Habitat Losses
A comparison between Year 0 (prior to mine development) within the FMS Study Area, and at completion of mine development within the FMS Study Area.	Loss of 32.8% wetland area.	Loss of 23% mainland moose wetland habitat	The loss of 37% Canada warbler wetland habitat.
			The loss of 29% olive-sided flycatcher wetland habitat.
			The loss of 23% rusty blackbird wetland habitat.
A comparison between Year 8 (completion of mine development) within the FMS Study Area, to the LAA at Year 0 (prior to mine development).	Loss of **5.2%** wetland area in comparison to LAA.	Loss of **2.5%** mainland moose wetland habitat in comparison to LAA.	Canada warbler – not assessed.
			The loss of **5.5%** olive-sided flycatcher wetland habitat in comparison to LAA.
			The loss of **0.3%** rusty blackbird wetland habitat in comparison to LAA.
A comparison between Year 8 (completion of mine development) within the FMS Study Area, to the RAA at Year 0 (prior to mine development).	Loss of 1.2% wetland area in comparison to RAA.	N/A – not assessed.	N/A – not assessed.

Note: Values in **Bold** used to deterimine significance, which is defined as a permanent loss of >10% wetland habitat for a SAR species identified in the PA within the LAA. *RAA only used for wetland area.

6.7.6.3.1 *Discussion of Wetland Cumulative Effects Modelling*

Using a combination of field data and desktop resources, the wetland cumulative effects modelling exercise has provided an ability for three wetland function metrics to be predicted within the FMS Study Area, LAA and RAA. The potential loss of the wetland function metrics post Project development has also been evaluated. Development of a predictive future model was beyond the scope and resources available at the time of writing. However, a qualitative approach to assessing the future cumulative effects of the Project on wetland function (by way of evaluating the wetland function metrics) was possible and is discussed below.

The direct and indirect impacts on wetlands within the FMS Study Area will affect the functional abilities of these wetlands (i.e., water quality, water storage capacity, regulation of water temperature, nutrient retention, and provision of wildlife habitat among others) during the Project, and into the future. The mitigation and monitoring actions described in Sections 6.7.7 and 6.7.9 will reduce these impacts and help ensure the integrity of wetlands beyond the FMS Mine Site remain viable.

Direct wetland area loss is expected as a result of the Project. The loss of wetland area will result in changes to all wetland functions (including the metrics discussed above). For example, loss of wetland area would reduce water storage capacity, and could lead to increased risk of flooding in downstream environments. However, despite the loss of wetland area and thus its function within the FMS Study Area, modeling results suggest that when compared to the LAA and RAA wetland area being directly lost as a result of the Project is 5.2% of the modelled LAA wetland area, and 1.2% of the modelled RAA area. As a result, the wetland losses will not result in broader wetland and watershed changes within the LAA (tertiary watershed) and RAA (secondary watershed). Therefore, there is no expected significant adverse effect from the Project on wetland area.

Four wildlife species metrics were also evaluated as part of the modelling exercise, the results of which can be used to highlight other potential wetland functional losses, as a result of the Project. The wildlife species metrics evaluated were; mainland moose, Canada warbler, olive-sided flycatcher, and rusty blackbird wetland habitat.

Mainland moose are a generalist species: instead of occupying a narrow niche they use a variety of habitats. As previously discussed, moose use wetlands with access to aquatic vegetation, a component which was used to model potential wetland habitat within the modeling exercise. However, they have also been found to use large clear-cuts for forage, although this habitat forage availability for moose in a cleared forest doesn't peak until 7-15 years after cutting (Snaith and Beazley 2004). Impact on moose wetland habitat is expected within the FMS Study Area as a result of wetland loss, however clearing of vegetation within the FMS Study Area may eventually provide new habitat for moose, post re-generation in the future. The provision of thermoregulation from mature stands is also required for moose (Snaith and Beazley 2004).

Within the FMS Study Area, there is the potential for direct and indirect impact to wetlands comprising moose habitat that could provide the thermoregulation characteristics moose require; this analysis was conducted by looking at direct impacts only. While moose evidence (i.e., footprints and scat) have been observed in and near wetlands within the FMS Study Area, the existing roads extending through the FMS Study Area reduces the extent of suitable moose habitat within the FMS Study Area. Baseline suitable wetland habitat for moose within the FMS Study Area makes up 54% of all wetlands by area. The modeling exercise determined that the loss of potential moose wetland habitat within the FMS Study Area is 22% of all suitable wetlands by area, representing 2.5% of the predicted suitable moose wetland habitat in the LAA. Therefore, there is no expected significant adverse effect from the Project on wetland habitat for moose.

Impact to songbird wetland habitat is possible as a result of the Project. Three bird species were modelled as part of the cumulative effects assessment: Canada warbler, olive-sided flycatcher, and rusty blackbird. These species were all observed within the FMS Study Area during field surveys and recorded as being present within 7 km of the Project in the ACCDC report. Due to the lack of publicly available habitat data for Canada warbler habitat at a scale fine enough for evaluation (i.e., dense, deciduous shrub), modeling was not available at the LAA scale. Canada warbler habitat was, however, determined for the FMS Study Area based on data collected during field programs in combination with desktop resources. The other two bird species did have available wetland habitat data layers to support modelling at the LAA spatial extent.

Research has shown that some species respond positively to forestry practices and may return to a logged area once the activity is over, especially if it has created open patches that allow for foraging. A study in Alberta showed that the abundance of alder flycatchers, a species with similar foraging requirements to olive-sided flycatcher, increased in a previously cut area (Tittler et al. 2001). Additionally, rusty blackbirds can also tolerate forestry activities as long has their habitat of coniferous dominant trees of varied heights near waterbodies is maintained (pers. comm. C. Staicer 2018). While forestry is different from the development of a Mine Site, similar activities will be occurring (i.e., forest clearing, transport of large trucks, and disturbance of aquatic features). It is therefore feasible to consider that new habitats suitable to support these birds will be created in the future. Baseline suitable wetland habitat for Canada warbler, olive-sided flycatcher and rusty blackbird within the FMS Study Area makes up 33%, 56% and 6% respectively of all wetlands by area. The modelling exercise determined that potential direct habitat loss for the Canada warbler, olive-sided flycatcher and rusty blackbird within the FMS Study Area between Year 0 (pre-mine development) and Year 8 (post mine development) was 37%, 29% and 23% respectively of all suitable wetlands by area. The modelling also determined that the predicted suitable wetland habitat loss within the FMS Study Area post mine development, in comparison to the predicted habitat within the LAA (pre-mine development) for the olive-sided flycatcher and the rusty blackbird is 5.5% and 0.3% respectively, demonstrating that large amounts of equivalent habitat is available to these mobile species in close proximity to the Project. Therefore, there is no predicted significant adverse effect from the Project on wetland habitat for the selected bird species.

Development of the Project may have cumulative effects on wetland loss and wetland functions. For the purpose of the modelling exercise, wetland function loss is represented by three wetland function metrics: wetland area, and habitat provision for moose and birds which will be impacted during the construction activities and mine operations.

The modelling exercise has shown that wetland alteration within the FMS Study Area is expected to result in a loss of wetland function metrics ranging between 23-37% (when comparing pre and post mine development within the FMS Study Area). However, when compared to the LAA, these changes represent smaller percentages of predicted wetland area ranging between 0.3-5.5% when comparing wetland loss in the FMS Study Area (post mine development) to the LAA (pre-mine development). Suitable wetland habitat will be available for mainland moose and Birds within the LAA, regardless of wetland loss within the FMS Study Area.

6.7.6.4 Wetland Avoidance

Due to the location in which the proposed activity can be performed (the location of the pit is fixed by geology), the extent to which the proposed Project can be manipulated to avoid impact to wetland habitat is limited. The TMF has been moved south to avoid wetland and fish habitat within WC12 and its associated wetlands, and the Seloam Brook diversion berm has been redesigned to reduce flooding of wetlands on the upstream (eastern) side. Waste and till stockpiles have been sighted in consideration of limited wetland impact. Another proposed location for the TMF has been removed, based on concerns for impacts to wetlands and fish habitat (to the north of the current FMS Study Area). Several other TMF locations were evaluated early in the Project design and are described in Section 2.0.

Through the desktop evaluation of the predictive NSE WSS database, a portion of WL2 was modelled as a predicted WSS, based on observation of a common nighthawk recorded in 2009. MEL has determined that the observation of a mobile species in 2009 should not trigger designation of this wetland as a WSS. WL2 is a large wetland complex with disturbed and intact portions that provide habitat for species including the common nighthawk. The provision of habitat thus enhances the wetlands functionality, but this does not warrant the designation of WL2 as a WSS due to the mobility of this species. Further consultation with NSE will occur through the permitting phase of this Project.

Evidence of nesting/breeding common nighthawk was observed within WL2 during breeding bird surveys completed within the wetland by MEL. In addition, SAR species and their habitat were identified within 28 other wetlands within the PA (Table 6.7-5). In some cases, suitable habitat for avian SAR was observed and documented, regardless of whether that species was observed (i.e., Canada warbler, common nighthawk, eastern-wood pewee, olive-sided flycatcher, and rusty blackbird). It is not anticipated that these wetlands will be classified as WSS because the SAR birds observed are mobile species and similar suitable habitat is present within the FMS Study Area, LAA and RAA. Further regulatory consultation will occur with NSE at the permitting phase of this Project. The wetlands within the PA do not contain other critical wetland functions that warrant avoidance (e.g., significant fish habitat, presence of critical wildlife habitat, groundwater recharge ability, etc.). The role wetlands play in supporting fish habitat, and the loss of wetlands supporting fish habitat, is discussed in Section 6.8, and fish habitat provision by wetlands is specifically accounted for in the Fish Habitat Offset Plan (in addition to being captured through wetland compensation planning) (Appendix J.7).

Three WSS are proposed for partial or complete alteration as the result of the Project. The location of the TMF and associated impacts to WL27 and WL65 are unavoidable. A broad constraints analysis for the TMF is presented in detail in Appendix J.6 with consideration of environmental, socio-economic, technical and economic parameters. Multiple locations for the TMF have been considered, and the preferred placement as demonstrated in the infrastructure arrangement has been determined to be the optimal placement, in consideration of all parameters. The location of the WRSA has also been optimized considering avoidance of Schedule 2 impacts to fish frequented waters, collection and management of contact water, and placement of other site components such as the pit and Seloam Brook Realignment. Efforts will be made during the final design process to avoid, and reduce impact to, as much wetland habitat as possible. Infrastructure that may offer more flexibility in this regard includes the detailed design of the site roads, settling ponds, and stockpile areas. Specifically, this final design process may result in avoidance or minimization of impacts to

WL159 (WSS). Details associated with micro-sighting and final wetland alteration requirements will be confirmed at the wetland alteration permitting stage of this Project.

6.7.6.5 Summary of Pre-Mitigation Effects

Cumulative effects modelling has shown that direct wetland alteration within the FMS Study Area is expected to result in a loss of wetland function metrics (including wetland area, and wetland habitat for mainland moose, Canada warbler, olive-sided flycatcher, and rusty blackbird) ranging between 23-37% (when comparing pre and post mine development within the FMS Study Area). However, these changes represent much smaller percentages at the LAA where loss represents only 0.3-5.5% of all available wetland at this geographic scale.

Partial or complete alterations are expected for 136 wetlands (113 complete alterations, and 23 partial alterations). Direct impact to 138 wetlands will be avoided under the current design. Expected direct impacts of the Project on wetland habitats (69.08 ha) will result in approximately 5.2% of known mapped wetland area in the LAA (1,324 ha), while the potential indirect impacts may result in alteration of 10.78 ha, or 0.8% of known wetland area in the LAA. The combined expected direct impact and potential indirect wetland impact area is 79.86 ha. The combination of expected direct and potential indirect impacts represents 37.9% of delineated wetlands within the FMS Study Area, and 6.0% of wetlands within the LAA. The magnitude of the expected direct and potential indirect wetland impacts is considered moderate.

The percent of total wetland loss within the project relative to the LAA was used to identify the magnitude of the effect of the Project on wetland habitats more generally. The magnitude of the proposed direct impact to wetland area is anticipated to be low for all species. Using a reasonable worst-case scenario for indirect impacts to wetlands, the magnitude of indirect effects is determined to be low. The likelihood that all potential indirect effects occur is low, considering all proposed mitigation measures. If all reasonable worst-case scenario indirect effects occur along with proposed direct effects, the total magnitude is considered to be moderate. This, in conjunction with the mitigation and monitoring steps (as described in Section 6.7.7 and 6.7.9), result in the determination that adverse effects are occurring as a result of wetland loss, but are not considered significant as it relates to wetlands and their functions within the FMS Study Area.

6.7.7 Mitigation

To mitigate and reduce overall loss of function of wetland habitat, the actions provided in Table 6.7-22 will be implemented by the Proponent within wetlands where direct impacts and potential indirect impacts to wetland habitat are expected. Mitigation measures will be confirmed through monitoring requirements, as described at the permitting stage through the Industrial Approval. The Proponent will apply for approval to alter wetlands from NSE and will abide by all site-specific conditions of that approval, which will specify the timing windows in which alterations are permitted.

Mitigation methods are provided for the pre-construction and construction/operation phases to support Project development.

In addition, the Proponent is committed to engaging in wetland compensation activities for the wetland loss associated with the Project as required by the provincial wetland alteration process. A preliminary Wetland Compensation Plan has been developed and will be submitted to NSE at the time of permitting and can be found in Appendix G.4. This plan includes the following options for compensation, prepared in consultation with CWS, NSL&F and NSE:

- On-the-ground restoration opportunities to meet a minimum 2:1 ratio and to be completed within the FMS Mine Site (in conjunction with proposed fisheries mitigation measures in the Fish Habitat Offset Plan associated with the Seloam Brook Realignment project;

- On-the-ground restoration opportunities to meet a minimum 2:1 ratio and to be completed in a watershed near the Project area to the extent practicable; Translocation of blue felt lichen from wetlands if avoidance is not practicable (as described in Section 6.12.7.2);
- Other secondary forms of compensation that CWS and NSE consider valuable to support the wetland conservation program in Nova Scotia; and
- Collaboration with local community groups and the Mi'kmaq of Nova Scotia to the extent practicable.
- The Proponent will consider inclusion of a conservation allowance in the wetland compensation plan to address restoration of equivalent habitat for wildlife SAR.

Table 6.7-22. Wetland Mitigation Measures

Project Phase	Mitigation Measure
C, O, CL	Complete pre-construction site meetings for all relevant staff/contractors related to working around wetlands and watercourses to minimize unauthorized disturbance, such as the introduction of invasive species
C	Ensure all wetlands are visually delineated (e.g. – flagged)
C	Translocation of blue felt lichen from wetlands where avoidance is not possible
C	Complete detailed design and micro-siting of Project Infrastructure to avoid or minimize wetland impact
C	Acquire and adhere to wetland alteration permits
C	Implement construction methods that reduce the potential to drain or flood surrounding wetlands
C, O	Direct runoff through natural vegetation, wherever practicable
C, O	Minimize erosion of wetland soils by limiting flow velocities by means of hydraulic dissipation techniques
C, O	Minimize the rutting of wetland habitat by limiting the use of machinery within wetland habitat and use of swamp mats/corduroy bridges as required
C, O	Conduct vegetation management (cutting and clearing) in or near wetlands and watercourses in accordance with applicable guidelines
C, O, CL	Development Implement Erosion Prevention and Sediment Control Plan to support the EMS Framework Document (Appendix L.1)
C, O, CL	Maintain pre-construction hydrological flows through wetland habitats and partially altered wetlands, wherever practicable
C, O, CL	Re-vegetate slopes adjacent to wetlands to limit erosion and sediment release
CL	Compensate for permanent loss of wetland function through implementation of the Preliminary Wetland Compensation Plan, subject to NSE approval (Appendix G.4)

Note: C= Construction Phase O= Operation Phase CL= Closure Phase

6.7.8 Residual Effects and Significance

The predicted residual environmental effects of Project development and production on wetlands are assessed to be adverse, but not significant (Table 6.7-23). The overall residual effect of the Project on wetlands is assessed as not significant after mitigation measures have been implemented.

Table 6.7-23. Residual Effects for Wetlands

Project VC Interactions	**Mitigation and Compensation Measures**	**Nature of Effect**	**Residual Environmental Effects Characteristics**						**Residual Effect**	**Significance of Residual Effect**
			Magnitude	**Geographic Extent**	**Timing**	**Duration**	**Frequency**	**Reversibility**		
Construction – FMS Mine Site Direct alteration of wetland habitat	Sediment and erosion control, best management practices, spill preparedness, and engagement in the wetland permitting process	A	M VC interaction causes direct loss of 5% of NSE mapped wetlands in the LAA	PA Potential adverse effect to wetlands inside the PA	A Seasonal aspects may affect VC	P VC unlikely to recover to baseline conditions	O Effects occur once during the construction phase	IR VC will not recover to baseline conditions	Habitat loss and disturbance	Not significant
Construction and Operations – FMS Mine Site Potential indirect impacts to wetlands including groundwater drawdown, Seloam Brook Realignment, flooding and local hydrological alterations	Sediment and erosion control, best management practices, spill preparedness, wetland monitoring and water management	A	L VC interaction predicted to result in indirect loss of <5% of NSE mapped wetlands in the LAA	LAA Potential adverse effect to wetlands outside of the PA	A Seasonal aspects may affect VC	LT Effects may extend beyond 8 years	R Effects occur at regular intervals throughout the project	PR Mitigation cannot guarantee a return to baseline conditions	Disturbance	Not significant
Operations – Touquoy Mine Site Potential indirect impacts to wetlands downstream of proposed discharge location in Moose River	Sediment and erosion control, best management practices, spill preparedness, wetland monitoring and water management	A	N VC interaction is not expected to impact downstream wetlands	LAA Potential adverse effect to wetlands outside of the PA	A Seasonal aspects may affect VC	LT Effects may extend beyond 8 years	R Effects occur at regular intervals throughout the project	PR Mitigation cannot guarantee a return to baseline conditions	Disturbance and change in hydrological conditions	Not significant
Reclamation Stage of Closure – FMS Mine Site Wetland restoration	Sediment and erosion control, best management practices, and spill preparedness	P	L VC interaction restores wetland habitat	PA Potential positive effect confined to the PA	A Seasonal aspects may affect VC	LT Effects may extend beyond 8 years	O Effects occur once during the reclamation phase	PR Mitigation cannot guarantee a return to baseline conditions	Habitat restoration	Not Significant

Legend (refer to Table 5.10-1 for definitions)

Nature of Effect	Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility
A Adverse	N Negligible	PA Project Area	N/A Not Applicable	ST Short-Term	O Once	R Reversible
P Positive	L Low	LAA Local Assessment Area	A Applicable	MT Medium-Term	S Sporadic	IR Irreversible
	M Moderate	RAA Regional Assessment Area		LT Long-Term	R Regular	PR Partially Reversible
	H High			P Permanent	C Continuous	

A significant adverse environmental effect for wetlands has not been predicted for the Project for the following reasons, with consideration of the ecological and social context of the LAA surrounding the Project:

- During construction, direct impacts to wetlands will occur. However, these losses, when considered inside the LAA, represent 5.2% of the total available wetland habitat. One large wetland complex will be altered to support development of the Pit and the Seloam Brook Realignment (WL2, proposed for direct impact to 51% of the area, plus potential indirect effects of flooding related to the Seloam Brook Realignment). The portion of the wetland altered by the Pit and berm construction has been altered by historic mining activity. The realignment of this system will incorporate naturalizing the flow regime and riparian wetlands, and increasing functions related to fish habitat. The majority of wetlands proposed for alteration are common type (swamp habitat), and no loss of wetlands of special significance are proposed. The combined magnitude of effects (proposed direct and estimated indirect impacts) results in a moderate magnitude of effect. Within the LAA there is a predicted cumulative direct loss of wetland habitat for SAR:
  - Mainland moose – 2.5%
  - Olive-sided flycatcher – 5.5%
  - Rusty blackbird – 0.3%
- Impacts are required within two WSS to support Project design, which are designated as WSS due to the presence of a sessile SAR (blue felt lichen). Translocation of the blue felt lichen is proposed. No direct or indirect alteration is proposed within two additional WSS (the eastern lobe of WL65 and WL240).
- During operations, limited impact to wetlands is predicted based on control of surface water flows to mimic baseline hydrologic conditions and implementation of sediment and erosion control measures.
- During Closure, limited impact to wetlands is predicted based on control of surface water flows to mimic baseline hydrologic conditions, water treatment as required, and implementation of sediment and erosion control measures. In addition, there is an opportunity to potentially restore wetland habitat within the PA.
- Wetland compensation will be completed to off-set Project wetland losses. Priority will be given to wetland restoration or creation opportunities within the FMS Mine Site associated with the proposed fisheries mitigation measures (as described in Section 6.8). Additional restoration opportunities will be prioritized within the tertiary watershed or adjacent watersheds wherever practicable.

6.7.9 Proposed Compliance and Effects Monitoring Program

Wetland monitoring will be completed to verify the accuracy of the predicted environmental effects and the effectiveness of the mitigation measures outlined in Table 6.7-22. A detailed Wetland Monitoring Plan will be established through the life cycle of the permitting process and will commit to monitoring during baseline/pre-construction to establish baseline conditions, and through the operational phase, reclamation and post closure (as determined to be required).

Wetland monitoring will be completed for the Project on selected representative wetlands that have been predicted to have direct or indirect effects from project development. Based on predictions presented in this section, the following wetlands are recommended for monitoring, with additional wetlands to be added through the development of the detailed Wetland Monitoring Plan, which will be informed by on-going Project design, detailed permitting, and regulatory consultation:

- Flooding associated with the Seloam Brook Realignment: WL2, WL64 and WL173;

- LCA adjustments: WL1, WL47, WL49, WL263 and WL270;
- SW15 regional catchment: WL65; and,
- A representative sub-group of partially altered and avoided wetlands.

Potential project-related effects of the Project on wetlands were identified in the EIS. Bogs, fens, swamps, marshes, and shallow water wetlands are present within the FMS Study Area, with many wetlands forming complexes consisting of more than one wetland type. The infrastructure layout within the FMS Study Area has been adjusted to minimize impacts to wetlands and watercourses in the area. A total of 274 freshwater wetlands were evaluated, of which 113 are expected to be completely altered to support Project development, and 23 wetlands are expected to require partial alteration to support Project infrastructure and development; two of which are identified as WSS (WL27 and WL159). Two WSS (WL240 and the eastern lobe of WL65) will be avoided. Furthermore, an additional thirteen wetlands have been identified to have potential indirect effects based on hydrological changes (groundwater drawdown, surface water flow reduction and flooding associated with the Seloam Brook Realignment). Wetlands with potential indirect impacts will be incorporated into the detailed wetland monitoring plan.

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 Preliminary Wetland Compensation Plan (Appendix G.4) in consultation with NSE. The Proponent will continue to work with NSE to develop the required mitigation measures including wetland compensation to mitigate any loss of habitat based on function and relative value. Assuming that the proposed compensation and mine site reclamation mitigation measures are applied, and that existing site drainage conditions are maintained, the Project is not likely to have significant adverse effects on wetland functional attributes in the area.

Wetland management aims to describe actions taken to verify the predictions of negligible significant adverse effects on wetland functional attributes, quantify wetland response to project activities and alteration events, examine the effectiveness of mitigation measures taken, and signal a need to implement environmental control measures if monitoring indicates adverse environmental effects are or may be occurring due to activities of the Project.

Wetland management is intended to verify that the Project is not likely to have significant adverse effects on wetland functional attributes in the area. The methods for monitoring will be those submitted within the Wetland Monitoring Plan and Wetland Compensation Plan. The detailed Wetland Monitoring Plan will be developed as part of the permitting process. The Preliminary Wetland Compensation Plan can be found Appendix G.4. A brief description of each is provided below.

Under the Preliminary Wetland Compensation Plan, annual surveys of the FMS Mine Site will be completed to identify land areas disturbed as a result of Project related activities. An annual update will be submitted to NSE indicating actual areas of wetland altered. This update will be provided at the end of each calendar year, as well as an updated schedule for the alteration areas expected for the upcoming year. Refer to the Preliminary Wetland Compensation Plan (Appendix G.4) for further details.

The Wetland Monitoring Plan will outline the methods used to evaluate remaining wetlands and portions of wetlands not altered by infrastructure but exist down-gradient of the FMS Mine Site construction. Notably, larger receiving features which act as receptors from wetlands and watercourses being altered as part of the Project will be a focus. The secondary focus for the Wetland Monitoring Plan will be to monitor for indirect impacts, to determine whether alteration is occurring and to identify any additional compensation requirements. This is particularly relevant for wetlands which sit in catchment areas which will lose drainage (i.e., through collection of water in site ditches around infrastructure such as the TMF), those within the groundwater ROI, and those areas associated with the Seloam Brook Realignment.

Monitoring stations will be established which include shallow water level loggers that collect wetland hydrological data. These data will be combined with SW monitoring data to evaluate any potential post alteration impacts to wetlands. Transects will also be used to evaluate wetland habitat. Monitoring stations will be established in wetland habitat at the FMS Mine Site using similar methods as defined through permitting requirements. Baseline monitoring (pre-construction) of vegetation, topography, hydrology, general assessments and standardized visual observations will take place before construction commences. Post-construction monitoring of these variables will also be completed at the established locations. Conditions recorded during baseline monitoring will be compared to post construction monitoring to determine whether areas of unaltered wetland habitat remain viable, and healthy wetland characteristics are present. Annual monitoring results will be provided to NSE annually.

The wetland monitoring program will include the following assessments:

- Wetland Hydrology: Baseline hydrological conditions within planned partially altered wetlands and wetlands located downgradient of alteration locations (including beyond the PA boundary that fall within the LAA) will be evaluated prior to construction activities. Techniques will range from installation of shallow monitoring wells in combination with automated water level recording equipment to visual qualitative observations of hydrological conditions within remaining wetland habitat in the PA. Monitoring wells equipped with level loggers (Solinst 3001 Edge) have the ability to record water levels twice daily. Standardized visual assessments will occur annually, in conjunction with vegetation surveys. Post-construction monitoring will be compared to baseline conditions to evaluate potential impacts to remaining wetland habitats.

- Wetland Vegetation: Techniques will range from the completion of specified vegetation transects and plots to standardized visual observations. Baseline vegetative conditions will be evaluated before Project commencement. Annual vegetation surveys will be completed in monitored wetlands within the FMS Mine Site. Baseline conditions will be compared with post-construction conditions.

- Other direct and indirect impacts: General observations will be completed pre-construction, during the construction phase, and post-construction to determine whether partially altered wetlands or unaltered adjacent and downgradient wetlands are subject to other direct or indirect impacts. Impacts could include disturbances to wetland surfaces (e.g., rutting, heaving), improper vegetation management, improper access of construction vehicles, sedimentation and erosion, and unplanned changes in hydrological inflow and outflow (e.g., damming, de-watering, disturbance to natural swales and drainage corridors).

Implementation of the strategies discussed above will support the mitigation process associated with wetland protection. A final wetland monitoring plan will be developed prior to construction in conjunction with wetland alteration permitting. The plan will be refined in order to meet the specific activities and timing of activities within the FMS Study Area. Annual reports related to wetland monitoring will include information on actual area of wetland altered that year, a schedule of alteration expected in the upcoming year and updates regarding wetland compensation efforts, options, methods, and any ongoing work to happening satisfy compensation requirements. A wetland awareness program will be implemented to clearly identify boundaries of approved alteration areas and communicate these and all Approval requirements to relevant site personnel.

Should post construction wetland monitoring and/or ongoing construction monitoring indicate a potential issue above normal variation (i.e., atypical wetland responses to adjacent land activities), the Proponent will consult with NSE to identify whether corrective actions or compensation are required. Operations staff will be notified, and an investigation of the possible contributing factors will take place to identify and attempt to rectify the cause. Specific action levels and response procedures will be based on the Project related activity responsible for the variation in wetland conditions being observed. NSE will be contacted and consulted in the instance of direct and/or in-direct wetland response as a result of such activities, and a determination to what degree further action is required will be determined by all parties.

A Preliminary Wetland Compensation Plan (Appendix G.4) has been developed in order to satisfy the Nova Scotia Wetland Conservation Policy's (NSE 2019) objective of preventing no net loss of wetland habitat and function. Wetland compensation will be initiated within three years of wetland alteration.

Proposed follow-up and monitoring programs have been reviewed with the Mi'kmaq of Nova Scotia during engagement efforts including meetings, sharing of technical documents (Draft EIS, poster boards, Summary of Mi'kmaq Effects and Proposed Mitigation Measures, Plain Language Summary). On-going engagement with the Mi'kmaq will continue through the EA process and associated permitting relating to follow-up programs and monitoring.

6.8 Fish and Fish Habitat

6.8.1 Rationale for Valued Component Selection

Habitat that directly or indirectly supports fish may be altered or destroyed as a result of direct or indirect disturbances from the Project. Fish and fish habitat and SAR are protected under federal legislation by the *Fisheries Act* and *Species at Risk Act* (SARA). Any Harmful Alteration, Disruption, or Destruction (HADD) of fish habitat will require authorization under Section 35 of the *Fisheries Act*. Additionally, any deposit of mineral waste (overburden, waste rock, effluent) in waters frequented by fish will require waterbodies to be listed in Schedule 2 of the Metal Diamond Mining Effluent Regulations (MDMER) in accordance with Section 36 of the *Fisheries Act.*

6.8.2 Baseline Program Methodology

This section summarizes the methods used during evaluation of fish and fish habitat conducted by MEL biologists at linear watercourses, waterbodies, and wetlands throughout the FMS Study Area and the Touquoy Mine Site. Watercourse identification and description, as well as wetland delineation and evaluation were completed across the FMS Study Area in 2016, 2017, 2018, and 2019 in accordance with Nova Scotia standards for identification of watercourses and wetlands.

Wetlands and watercourses within the Touquoy Mine Site were originally assessed in 2006 as part of the Touquoy Gold Project EARD process. Further assessments were completed on additional wetlands and watercourses delineated by MEL from 2015-2017 as part of the wetland and watercourse permitting processes for the Touquoy Mine Site.

During initial identification and assessment, each watercourse, waterbody, and wetland was evaluated on the basis of fish habitat and its potential ability to support fish species. Fish survey locations and methods were then determined within reaches of linear watercourses and waterbodies where the potential for fish existed. A variety of surveys were employed based on the types of fish habitat available at each survey location.

Field assessments to complete electrofishing and supporting fish collection were conducted in 2017, 2018, 2019 and 2020. Fishing surveys included: detailed fish habitat assessment surveys; electrofishing within linear watercourse reaches; fish collection via minnow traps, fyke nets and eel pots within watercourses and waterbodies; water and sediment quality surveys; benthic invertebrate communities; and periphyton analysis. The method for each fishing survey is described in detail below.

Methodologies of fish and fish habitat surveys within the FMS Study Area are discussed below. Information pertaining to Touquoy Mine Site has been brought forward from the Touquoy Gold Project EARD and Focus Report (CRA 2007a; CRA 2007b). Methods and results are referred to in subheadings within the applicable sections; however, the data is not being reevaluated. For further information regarding Touquoy Mine Site and specifically the baseline conditions of the Moose River, which is the ultimate receiving environment for the Project with discharge from the pit at Touquoy post-closure, refer to the Touquoy Gold Project EARD (CRA 2007b) and Focus Report (CRA 2007a).

6.8.2.1 FMS Study Area Baseline Program Methodology

6.8.2.1.1 *Aquatic Ecosystem Condition*

Assessment areas for aquatic ecosystem condition surveys were chosen based on delineated watercourses and waterbodies that are anticipated to be directly or indirectly impacted by mine infrastructure. Water quality, sediment quality, benthic invertebrate and periphyton surveys were conducted to describe existing environmental conditions and to support fish habitat evaluations for aquatic ecosystems in the FMS Study Area. These assessment areas are herein referred to as Fish Impact Areas (FIA). Data from initial watercourse assessments were consulted to confirm watercourse homogeneity within each FIA. Evaluations of aquatic ecosystem condition are continuing through the early and late summer of 2020.

Each FIA was confirmed in field for the following:

- Reaches that best represent system characteristics (flow rate, substrate composition);
- Reaches that represent fish habitat types present within the system (riffle, run, pool); and,
- Reaches that provide optimal physical characteristics to meet the requirements of sampling methodologies.

Five FIAs were identified and sampled within the FMS Study Area, comprising four lotic systems (linear watercourses) and one lentic system (Anti-Dam Flowage). Locations of the FIAs and sampling locations within are presented below in Table 6.8-1 and on Figure 6.8-1.

Table 6.8-1: Aquatic Ecosystem Sampling Locations and Details

FIA	Watercourse/ Waterbody ID	Periphyton Sampling Reach Upstream Coordinates (UTM)	Periphyton Sample Reach Downstream Coordinates (UTM)	Benthic, Water & Sediment Sampling Location ID	Benthic, Water & Sediment Sampling Location Coordinates (UTM)
1	1 (Seloam Brook)	536915, 4998674	536720, 4998593	1.1	536916, 4998673
				1.2	536811, 4998594
				1.3	536716, 4995891
2	1 (Seloam Brook)	537473, 4998755	537276, 4998744	2.1	537475, 4998751
				2.2	537369, 4998752
				2.3	537273, 4998755
3	21 (Seloam Brook)	538044, 4999293	538025, 4999244	3.1	538042, 4999295
				3.2	538033, 4999271
				3.3	538020, 4999247
4	43 (inflow to East Lake)	540098, 4998107	540144, 4998111	4.1	540098, 4998107
				4.2	540126, 4998106
				4.3	540144, 4998107
5	Anti-Dam Flowage	N/A	N/A	5.1	537410, 4997064
				5.2	537512, 4997140
				5.3	537483. 4997042
				5.4	537551, 4996945

FIA	Watercourse/ Waterbody ID	Periphyton Sampling Reach Upstream Coordinates (UTM)	Periphyton Sample Reach Downstream Coordinates (UTM)	Benthic, Water & Sediment Sampling Location ID	Benthic, Water & Sediment Sampling Location Coordinates (UTM)
				5.5	537582, 4996828
				5.6	537719. 4996618

6.8.2.1.1.1 Water Quality

Water quality was measured during initial identification and assessment of linear watercourses with a handheld ExStik EC500. Water quality measurements were also recorded for electrofishing and fish collection sites, as well as lotic benthic invertebrate, periphyton, and sediment sampling locations. These water quality measurements were collected using a Horiba multi-probe (W-22XD) or YSI 650 MDS & 600 QS Multi-Probe water quality instrument at the time of the assessment/survey. Parameters recorded include dissolved oxygen (mg/L), water temperature (°C), pH, and total dissolved solids (TDS, g/L). Water quality profiles using the parameters above were also collected at each of the six discrete FIA sampling locations in Anti-Dam Flowage. Parameters were recorded at 1 m intervals from the surface to maximum depth. Additionally, water quality analysis was completed at the six lentic FIA sampling locations, each comprising two discrete samples (one at surface and one at near-bottom depth). Surface water samples were collected as "grab" samples by MEL biologists using laboratory supplied sample bottles. Water samples at depth were collected using a Van Dorn sampler, and then transferred into sample bottles.

As described in Section 6.6.2.5, surface water quality baseline monitoring has been completed on a quarterly basis since 2017. The monitoring program currently comprises a total of 15 stations located in surface water features within and adjacent to the FMS Study Area. The program includes the measurement of field parameters and sample collection for analysis of general chemistry, total and dissolved metals, total and dissolved mercury, and chlorophyll a. In 2018, a water quality profile station was established in Anti-Dam Flowage (SW13). Surface water quality baseline monitoring methodology and results are presented and further discussed in Section 6.6 and Appendix B.5. When applicable, results from the surface water quality baseline monitoring program have been brought forward into this chapter to support the discussion of water quality as it relates fish habitat within the FMS Study Area.

6.8.2.1.1.2 Sediment Quality

Sampling for sediment quality was conducted by MEL biologists in conjunction with benthic invertebrate sampling.

Three sediment samples were collected within each lotic FIA using a shovel. In addition, six samples were collected in Anti-Dam Flowage, including three in the littoral zone, two at mid depth, and one at maximum depth, using an Eckman Dredge. These sample locations are shown on Figure 6.8-1 (FIA). Samples comprising two subsamples per location were held in coolers and were delivered to Maxxam Analytics in Bedford, Nova Scotia for analysis of the following parameters:

- Total Metals;
- Total Mercury;
- Total Organic Carbon, and
- Particle Size.

Additional data related to baseline sediment quality more broadly within the FMS Study Area is presented in Section 6.4.

6.8.2.1.1.3 Periphyton and Primary Productivity

Periphyton, or biofilm, refers to the assemblage of algae, bacteria, and other organisms that attach to submerged substrates (Stevenson et al. 1996). This biofilm comprises primary producers (photosynthetic organisms) who form the basis of food webs within aquatic ecosystems and are considered an indicator of environmental and ecological conditions in lotic systems. The methods to complete periphyton sampling were adopted from the US EPA Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates, and Fish (Barbour et al. 1999). Sampling was conducted by MEL biologists between October 9th and 22nd, 2018.

The Multihabitat Sampling approach (Barbour et al. 1999) was employed for each lotic FIA (FIA 1 – 4). The length of each assessment reach within the FIA was calculated as 30-40 bankfull widths of the linear watercourse. Periphyton samples were collected by scraping periphyton biomass from rocks, woody debris and vegetation at representative locations along the assessment reach and placed into a common container until approximately 200 ml of biomass was collected. Each surface scraped was measured for area and then combined to give a total sample area. A single sample was collected for each lotic FIA, kept on ice, then transported to the field laboratory.

At the field laboratory, each sample was made to be 1.5 L using stream water as required, homogenized with an immersion blender, then transferred into laboratory supplied sample bottles. Samples were delivered to Maxxam Analytics in Bedford, Nova Scotia to be analyzed for chlorophyll a, TSS, and Total Volatile Solids (TVS). Primary productivity for Anti-Dam Flowage (FIA 5) was assessed through the evaluation of several algal biomass related indices, including turbidity, TDS, colour, chlorophyll a, and limiting nutrient (phosphorus and nitrogen) concentrations at surface and near bottom depths. Measured parameters were then used to characterize trophic status based on the Carlson Trophic Status Index (Carlson 1977). Trophic Status Index (TSI) can be calculated from phosphorus concentrations using the following equation:

- TSI = 14.42 (ln P) + 4.15

where: ln = the natural logarithm; and P= total phosphorus concentration (μg/L) (Carlson 1977). The index classifies lakes into one of the three trophic states:

- TSI values between 0 – 40 indicate oligotrophic conditions (i.e. low productivity);
- TSI value between 40 – 60 indicate mesotrophic conditions (i.e. medium productivity), and
- TSI values between 60 – 100 indicate eutrophic conditions (i.e. high productivity).

Seasonal variation of primary productivity in lotic and lentic systems within the FMS Study Area were analyzed through the interpretation of surface water quality baseline monitoring results which were collected on a quarterly basis. Indices and related parameters of primary productivity have been brought forward to describe seasonal variation of primary productivity lotic and lentic systems. Surface water quality baseline monitoring results are discussed further in Section 6.6 and presented in Appendix B.5.

6.8.2.1.1.4 Benthic Invertebrates and Secondary Productivity

Benthic sampling was completed to support fish habitat evaluation as a baseline measurement, as biological parameters may detect impacts to the aquatic ecosystem that the physical and chemical parameters cannot, such as changes in water quantity, presence of invasive species, and habitat degradation. Benthic macroinvertebrates are common inhabitants of streams and lakes and are important in moving energy through food webs as the dominant source of secondary production. Benthic macroinvertebrates have life spans of approximately one to three years, and therefore, can reflect cumulative impacts to aquatic ecosystem.

At each lotic FIA, three benthic community samples were collected using a 12” x 12” Surber Sampler equipped with a 500 μm Nitex Net. Sampling was conducted in shallow riffle locations when available, and habitat type (riffle, run, pool) was noted at each sampling location. Benthic invertebrates were collected in the net by disturbing the area within the 12” x 12” frame, which was placed firmly in contact with the stream bottom. Field staff stood upstream of the Surber Sampler and scrubbed rock, vegetation and woody debris within the frame area, allowing for the current to push dislodged invertebrates into the net. Once scrubbed, larger objects were removed from the frame area and the top 2-5 cm of fine substrate remaining was disturbed to complete sample collection. Sampling within lotic FIAs was conducted by MEL biologists on October 5th, 2018.

Six samples were collected in the lentic FIA 5 (Anti-Dam Flowage), comprising three littoral zone samples, two mid-depth samples, and one maximum depth sample using an Eckman Dredge. Sampling within the lentic FIA was conducted by MEL biologists on October 23rd, 2018. Once collected, samples were transferred to sample jars and preserved in the field using a 99% isopropyl alcohol solution. Samples were delivered to Envirosphere Consultants Ltd. in Windsor, Nova Scotia for biological analysis.

Seasonal variation in secondary productivity was evaluated through a desktop analysis of lotic and lentic environments with similar physical and chemical parameters to aquatic features within the FMS Study Area, taking into account available seasonal data on water quality parameters (see Section 6.6 and Appendix B.5), and seasonal variation in primary productivity (Section 6.8.3.1.6).

All water quality, sediment quality, benthic sampling, and periphyton sampling locations are shown on Figure 6.8-1. All electrofishing and trapping sampling locations are shown on Figure 6.8-2 and 6.8-3.

6.8.2.1.2 *Fish Habitat Assessment*

6.8.2.1.2.1 Desktop Evaluation

A desktop review for potential fish habitat within the FMS Study Area was completed using the Nova Scotia Topographic Watercourse and Wet Areas databases, the Nova Scotia Environment Wetlands database, Nova Scotia WAM database and the provincial Secondary and Tertiary Watershed database. The desktop review also served to identify fish species that may exist within or have access to the FMS Study Area, including Priority Species. This information was collected from the following sources:

- ACCDC Report and Environmental Screening Report (Appendix G.5 and G.7);
- NSL&F Significant Species and Habitats database;
- Fisheries and Oceans Canada;
- Fisheries and Oceans Stock Status Reports;
- Description of Selected Lake Characteristics and Occurrence of Fish Species in 781 Nova Scotia Lakes (Alexander et al. 1986);
- Freshwater Fish Species Distribution Records (NSDFA 2017), and
- East River Sheet Harbour Hydro System Relicensing Report (NSPI 2009).

6.8.2.1.2.2 Fish Habitat Characterization: Qualitative

Fish habitat characterization was completed for each linear watercourse, wetland, and waterbody identified within the FMS Study Area. To support fish habitat assessment, linear watercourses were divided into reaches based on homogenous sections of the watercourse. During field surveys, linear watercourses were often observed to comprise areas of open water habitat and wetland habitat accessible to fish. When these areas were encountered, the field determination of each homogenous section was supplemented by aerial photography. Using aerial photo interpretation during low flow conditions, water features were further divided into linear features, open water features (stillwater areas within riverine systems), or accessible wetland habitat, which was used to advise fish habitat impacts. The methods to complete freshwater habitat characterization were adopted from the Nova Scotia Adopt A Stream Manual (NSLC 2017). This resource was used to develop the watercourse assessment datasheets used to characterized fish habitat in the field. Further detailed fish habitat evaluations in watercourses expected to be directly or indirectly affected by the Project are continuing through the summer of 2020. These detailed habitat evaluations will support HADD permitting and associated offsetting.

For each homogenous section of watercourse, a detailed fish habitat survey was completed which included the identification of physical characteristics (i.e., run, riffle, or pool), designation of substrate type, depth and width (wetted and bankfull) of the linear section of the watercourse. The presence or absence of over-head cover, undercut banks, and woody debris was also recorded since these habitat features affect the ability of the watercourse and associated wetland habitat to support fish communities. This detailed fish habitat survey was also completed at each 100 m length electrofishing site. This information was incorporated into descriptions of fish habitat quality for surface water features within the FMS Study Area.

Fish habitat qualitative descriptions were further supported through the determination of species-specific habitat provisioning within the linear and open water features in the FMS Study Area. The fish species selected to support fish habitat quality determinations were chosen based on the following requirements:

- They are species known or suspected within the watershed as described in the NSPI Relicensing Report (2009), the Freshwater Fish Species Distribution Records (NSDFA 2017), and advised by results of fish collection surveys completed within the FMS Study Area; and,
- Freshwater habitat requirements for these species are well documented within the literature.

Based on requirements listed above, the species selected to qualitatively describe fish habitat within the Study Area were brook trout (*Salvelinus fontinalis*) and white sucker (*Catostomus commersonii).* Of all fish species recorded or suspected within the FMS Study Area, brook trout require the most specific freshwater habitat features. As a coldwater species, brook trout are generally considered intolerant of habitat degradation (Halliwell et al. 1998). In contrast, white sucker are considered habitat generalists whose broad freshwater habitat requirements can serve as an umbrella for other fish habitat generalists known or suspected within the FMS Study Area (primarily forage fishes such as lake chub and pearl dace).

Freshwater habitat preferences for these species for various life stages were established through a desktop literature review. Specific habitat requirements for brook trout and white sucker for spawning, rearing, and overwintering, as described within the HSI models for each species (Raleigh 1982; Twomey et al. 1984) are presented in Table 6.8-2.

Table 6.8-2. Brook Trout and White Sucker Habitat Requirements (Raleigh 1982; Twomey et al. 1984)

Habitat Requirements	**Habitat Type**	**Species**	
		Brook Trout	**White Sucker**
Spawning	Riverine	Clear substrate 3-8 mm in size Limited fines (<5%) Moderate current (25-75 cm/s) Flowing water >15 cm deep Groundwater inflows play important role	Moderate current (30-59 cm/s) Shallow water (15-30 cm water depths optimal) Clean, gravel-sized substrate
	Lacustrine	Gravel substrate along lake shore, or access to inlet streams with spawning area. Upwelling areas important for brook trout spawning, windswept shoreline important for brook trout spawning.	
Juvenile Rearing	Riverine	Cold, moderate, and stable flow Silt-free, rocky substrate optimal Abundance of cover (minimum 15% of total stream area)	Slow (<15 cm/s) water habitat Rocky substrates with an overburden of fines Abundance of pools (40%-75% of stream habitat optimal)
	Lacustrine	No specific habitat requirements identified.	
Overwintering	Riverine	Silt-free, rocky substrate optimal Abundance of cover (minimum 15% of total stream area for juveniles, 25% for adults) Deep pools, groundwater inflow, or moderate flow also play important role	Abundance of slow, deep pools (optimal percentage not reported)
	Lacustrine	No specific habitat requirements identified.	

The table above presents brook trout and white sucker habitat requirements for both riverine (streams) and lacustrine (lake) environments. Compared to lacustrine environments, many more specific indicators of optimal riverine habitat exist for both species. Based on the HSI models, optimal lacustrine environments for both brook trout and white sucker are largely based on similar water quality parameters (clarity, temperature, DO, and pH). Lacustrine spawning habitat has been identified through the HSI models for both species, whereas specific requirements for lacustrine rearing and overwintering is lacking.

Habitat descriptions based on requirements for brook trout and white sucker have been provided for each linear and open water feature within the FMS Study Area. If linear or open water features were hydrologically isolated from other fish-bearing systems, or permanent, year-round barriers were observed preventing fish access, fish habitat provision was determined to be 'nil'. It should be noted that this methodology does not attempt to quantify or model fish habitat; and as such, descriptions should be considered purely qualitative.

6.8.2.1.2.3 Fish Habitat Characterization: Quantitative

The characterization of fish habitat for the purposes of determining HADD to fish habitat and MDMER Schedule 2 waterbodies requires a quantitative process that removes as much subjectivity as possible so that final determinations are defensible in approach and rationale. A revised federal habitat classification and quantification system was developed by DFO Newfoundland and Labrador Region to assist in assessing proposed developments for potential to cause HADD of fish habitat. An overview of the process is provided below based on information contained within McCarthy et al. (2007) and DFO (2012). While developed in a different region of Atlantic Canada, it is adjacent and appropriate for the similar dominant maritime fish complex found within the Project footprint.

There have been many habitat descriptions and habitat survey methodologies developed and used both within Atlantic Canada (e.g., Beak 1980; Scruton et al. 1992; Scruton and Gibson 1993; 1995; Sooley et al. 1998; DFO 2000), elsewhere in North America (e.g., Bisson et al. 1982; Oswood and Barber 1982; Barber et al. 1981; Platts et al. 1983; McCain et al. 1990; Osborne et al. 1991; Nickelson et al. 1992; Newbury and Gaboury 1993; Flosi and Reynolds 1994; Hawkins et al. 1993; Armatrout 1996; McMahon et al. 1996; Bain and Stevenson 1999) and Norway (Borsanyi 1982; Borsanyi et al. 2002), as referenced in Appendix J.7.

The former Beak (1980) method, which has previously been utilized to characterize habitat is limited by its focus on salmonid species, mainly Atlantic Salmon (*Salmo salar*) and to a lesser degree Brook Trout (*Salvelinus fontinalis*), as evident in the descriptions. The revised classification system used within this document attempts to broaden the classification of habitat types to encompass all freshwater species, thereby contributing to a more consistent approach to HADD quantification (DFO 2012) as described in Table 6.8-3.

Each habitat type contains discrete as possible gradient, substrate types, water depth, and velocity ranges which have been determined using the described biological 'preferences' outlined in Grant and Lee (2004). It should be noted that not all habitat parameter descriptions are exclusive of all others (e.g., water depth); however, the combined parameters and the tiered approach to characterization based on gradient initially, then substrate, then water depth/velocity offer a reasonable designation of most habitat types encountered.

Table 6.8-3: Descriptions of riverine habitat classifications (as per DFO 2012).

Habitat Type	Habitat Parameter	Description
Fast Water	**Mean Water Velocity**	**> 0.5m/s**
	Stream Gradient	**Generally, > 4%.**
Rapid	General Description	Considerable white water[1] present.
	Mean Water Velocity	> 0.5 m/s
	Mean Water Depth	< 0.6 m
	Substrate	Usually dominated by boulder (Coarse[2]) and rubble (Medium[2]) with finer substrates (Medium and Fine[2]) possibly present in smaller amounts. Larger boulders typically break the surface.
	Stream Gradient	Generally, 4-7%
Falls/	General Description	Mainly white-water present. The dominating feature is a rapid change in stream gradient with most water free-falling over a vertical drop or series of drops.

Habitat Type	Habitat Parameter	Description
Chute/ Cascade	Mean Water Velocity	> 0.5 m/s
	Mean Water Depth	Variable and will depend on degree of constriction of stream banks.
	Substrate	Dominated by bedrock and/or large boulders (Coarse).
	Stream Gradient	> 7% and can be as high as 100%.
Run	General Description	Relatively swift flowing, laminar[3] and non-turbulent.
	Mean Water Velocity	> 0.5 m/s
	Mean Water Depth	> 0.3 m
	Substrate	Predominantly gravel, cobble and rubble (Medium) with some boulder (Coarse) and sand (Fine) in smaller amounts.
	Stream Gradient	Typically, < 4% (exception to gradient rule of thumb)
Moderate Water	**Mean Water Velocity**	**0.2-0.5m/s**
	Stream Gradient	**>1 and < 4%**
Riffle	General Description	Relatively shallow and characterized by a turbulent surface[4] with little or no white water.
	Mean Water Velocity	0.2 – 0.5 m/s
	Mean Water Depth	< 0.3 m
	Substrate	Typically dominated by gravel and cobble (Medium) with some finer substrates present, such as sand (Fine). A small number of larger substrates (Coarse) may be present, which may break the surface.[5]
	Stream Gradient	Generally, >1 and < 4%
Steady/ Flat	General Description	Relatively slow-flowing, width is usually wider than stream average and generally has a flat bottom.
	Mean Water Velocity	0.2 - 0.5 m/s
	Mean Water Depth	>0.2 m
	Substrate	Predominantly sand and finer substrates (Fine) with some gravel and cobble (Medium).
	Stream Gradient	> 1 and < 4%
Slow Water	**Mean Water Velocity**	**Generally, < 0.2m/s (some eddies can be up to 0.4m/s).**
	Stream Gradient	**< 1%.**

Habitat Type	Habitat Parameter	Description
Plunge / Trench / Debris Pools	General Description	Generally caused by increased erosion near or around a larger, embedded object in the stream such as a rock or log or created by upstream water impoundment resulting from a complete, or near complete, channel blockage. These pool types may be classified as an entire reach (e.g., pools greater than 60% of the stream width) or as sub-divisions of a fast water habitat.
	Mean Water Velocity	< 0.2 m/s
	Mean Water Depth	> 0.5 m depending on stream size (e.g., may be shallower in smaller systems).
	Substrate	Highly variable (i.e., coarse, medium or fine substrates)
	Stream Gradient	Generally, < 1%
Eddy	General Description	Relatively small pools caused by a combination of damming and scour: however, scour is the dominant forming action. Formation is due to a partial obstruction to stream flow from boulders, roots and/or logs. Partial blockage of flow creates erosion near obstruction. It is typically < 60% of the stream width and hence will be a sub-division of a faster-water habitat type (e.g., Run with 20% eddies).
	Mean Water Velocity	Typically, < 0.4 m/s, but can be variable.
	Mean Water Depth	> 0.3 m. May vary depending on obstruction type, orientation, streambed and bank material and flows experienced.
	Substrate	Predominantly sand, silt and organics (Fine) with some gravels (Medium) in smaller amounts.
	Stream Gradient	Variable

1 White water is present when hydraulic jumps are sufficient to entrain air bubbles which disturb the water surface and reduces visibility of objects in the water.

2 Coarse, Medium and Fine substrate types are classified according to the Standard Methods Guide for the Classification/Quantification of Lacustrine Habitat in Newfoundland and Labrador (Bradbury et al. 2001).

3 Laminar describes the surface of the water as smooth and glass-like with no reduced visibility of objects in the water.

4 Turbulence is present if there are local patches of white water or if water movement disturbs a portion of the surface.

5 Pocket water often constitutes an important component of riffles in Newfoundland and Labrador and is characterized by a predominance of larger substrates (e.g., boulders) breaking the surface. The result is a riffle with many eddies around the boulders.

6.8.2.1.3 *Assessment of Fish Passage Barriers*

According to Bourne et al. (2011), and Fullerton et al. (2010), barrier passability for fish can be difficult to define and measure, as it combines the physical characteristics of a barrier with fish physiology in a dynamic environment. Much of the literature surrounding barriers to fish passage is related to anthropogenic features such as culverts (i.e., Bourne et al. 2011; Fisheries and Oceans Canada, 2015), or natural barriers such as waterfalls (i.e., Government of British Columbia 1998), but specific assessments for passability of subterranean watercourses or boulder-fields are limited. Parameters which affect passability for commonly researched barriers such as waterfalls or culverts can be applied to other types of barriers such as subterranean reaches. Features such as the species of interest and their swimming capability, the variability in stream flow, length of the barrier, slope, drop height and outflow pool are all to be taken into consideration when determining the passability of a barrier.

Throughout baseline watercourse mapping and fish habitat surveys, an assessment of potential fish passage barriers was completed. When a potential barrier was encountered, biologists recorded the type of barrier, height and length of the barrier, depth of water, along with an estimate of slope where relevant. The contiguity and spatial relationships of discontinuous pools were described, with the intent of understanding a fish's ability to move and/or jump from one step-pool or isolated pool to another. When discontinuous pools were observed, biologists walked the most obvious flow path based on topography while identifying individual pools. Each pool was marked with a GPS unit, measured (maximum length and width) and water depth was recorded in order to determine the extent and depth of water from which fish would have to jump from one pool to another. In addition, the distance between one pool and the next was measured along the most obvious flow path, with the goal of identifying the distance and vertical height a fish would have to travel to navigate from pool to pool.

If a potential barrier was anthropogenic in nature (i.e., improperly installed culverts), the type of culvert was noted, along with any issues associated with installation that could be remediated to improve passage. The temporal nature of a barrier was noted as well, recognizing that natural and anthropogenic barriers can change with time (i.e., logjams or beaver dams) or remediation (i.e., culvert installation), while others limit passage seasonally (i.e., ephemeral or intermittent streams), and others are permanent barriers (i.e., some waterfalls). Where a barrier was identified but the temporal nature of it was uncertain or if it was dependent on flow regime, multiple site assessments and additional fish sampling were conducted to confirm passability of a barrier. Except in extreme circumstances, logjams and beaver dams are not considered barriers to fish passage.

Further to the typical physical characteristics, the ecological context was used to identify evidence of flow and hydrologic connectivity that would provide passage for fish. NSE guidance for watercourse determination is used to support the discussion of whether a regulated watercourse (i.e., defined, natural channel) is present. This guidance includes identifying whether:

- a mineral soil channel is present;
- there is sand, gravel and/or cobbles evident in a continuous pattern over a continuous length with little to no vegetation;
- there is an indication that water has flowed in a path for a length of time and rate sufficient to erode a channel or pathway;
- there are aquatic plants, animals, or fish; or,
- there is aquatic vegetation.

Hydrology indicators are used to identify evidence of flow if an initial assessment occurs during a period of low flow. Some examples of hydrology indicators used include water marks on trees, sediment deposits, drift deposits, algal mats, sparsely vegetated concave surface, water-stained leaves, surface soil cracks, drainage patterns, or moss trim lines. Vegetation communities can provide indication of flow (or absence thereof) as well. The presence of some species provides evidence of flowing water, even if the water level has subsided. These include, but are not limited to, species such as bur-reed (*Sparganium spp.)*, royal fern (*Osmunda regalis*), and certain species within the genera *Glyceria, Juncus,* and *Carex*, to name a few. Guidance on vegetation species habits was provided by the Wetland indicator Plant List (Reed 1988). Vegetative growth patterns, including growth and species composition of mosses, can provide evidence of water level fluctuations as well. Within the FMS Study Area, bare rocks or boulders have not been considered as a reliable indicator of hydrology, based on deposition of glacial erratics through the FMS Study Area, and presence of bare rocks and boulder fields in both upland, wetland and lotic habitats. As such, the observation of bare rocks is not considered a strong indicator of hydrology.

Understanding the swimming capabilities of fishes is key to determination of fish passage barriers. Swimming capabilities of fishes is dependent upon abiotic factors such as water depth, flow rate, water temperature, height and length of barriers, and biotic factors such as fish species, length, darting speed, behavioral adaptations and life history stage. Plunge-pool depth appears to be a common thread in determining fish passage ability through barriers of various types. In a waterfall scenario, turbulent water in a shallow plunge pool can disorient fish. If a pool is too shallow, fish may not build the appropriate propulsive force to jump out of a pool – regardless of whether that pool is part of a waterfall, a subterranean reach, or another barrier type such as a culvert. Generally speaking, "fish need a pool depth at least two times as deep as the fish is long in order for the fish to achieve maximum leaping ability" (Meixler, Bain and Walter, 2009).

Swimming capabilities herein will be primarily focused on non-forage fish species of, white perch, yellow perch, brook trout, and American eel, as specific detailed studies of forage fish swimming abilities are limited in availability and specificity. White sucker was the only forage fish included in this detailed assessment due to the availability species-specific literature.

6.8.2.1.4 *Electrofishing*

Sampling sites of approximately 100 m in length were selected as representative habitats with potential for fish along sections of linear watercourses identified within the FMS Study Area. The purpose of the electrofishing surveys was to qualitatively describe fish species presence, community composition, and relative abundance within watercourses and associated wetlands within the FMS Study Area. Five electrofishing sites were selected as suitable for electrofishing surveys within the FMS Study Area. These locations are shown on Figures 6.8-2. Fish surveys were completed under Fisheries and Oceans Canada Fishing License # 341208. Seasonal fish collection is continuing through early, mid-, and late summer 2020. This work is being completed to continue to broaden the Project Teams' understanding of seasonal fish usage throughout the Study Area.

Standardized data collection forms developed by the New Brunswick (NB) Aquatic Resources Data Warehouse, the NB Department of Natural Resources and Energy, and the NB Wildlife Council (2002, updated 2006) were adapted for use for field data collection during electrofishing surveys. These standardized data forms were provided to the field biologists during backpack electrofisher (crew leader) certification training provided by the Canadian Rivers Institute, based out of University of New Brunswick. Field data collected included the physical and chemical parameters of the electrofishing site, electrofishing methods and settings, and results of the electrofishing survey.

For sampling conducted in 2017, sites were blocked off with barrier nets (1/8" mesh) that were secured to the stream bed at either end of the 100 m linear reach of watercourse. These sites are considered "closed" to prevent the loss of stunned or frightened fish. Barrier nets have a floating top line and were anchored to the shoreline with rebar or rocks and to the substrate with rocks. Closed sites were used in these locations because sampling efficiency was limited by substrate (angular rocks), high flow, and tannin loads in the water reducing visibility (and therefore catchability) of shocked fish. To increase sampling efficiency and improve information gathering within 1st and 2nd order streams, methodology for sampling in 2018 was adjusted to open-site electrofishing for which barrier nets were not deployed. Fish density tends to be lower in smaller systems than in larger systems; as such, there is a greater chance of setting up a closed site where no fish are present within these systems. In the handbook titled Salmonid Field Protocols Handbook: Techniques for Assessing Status and Trends in Salmon and Trout Populations, Temple and Pearsons describe the use of single-pass electrofishing without barrier nets and provide a summary of academic reports supporting this method (Johnson et al. 2007). Research has found that single-pass electrofishing works well to determine species richness (Simonson and Lyons 1995), and relative abundance (Kruse et al. 1998). While not directly comparable with the open sites, closed sites likely represent an upper limit of abundance in sampled watercourses. For the purposes of fish presence and relative abundance calculations, data for both closed and open sites have been presented together, with site setup methods clearly identified.

The Electrofishing Site Form (NB Aquatic Resources Data Warehouse, NB Department of Natural Resources and Energy, NB Wildlife Council, 2002, updated 2006) was completed to identify and describe the physical and chemical characteristics of the reach to be sampled. This site description helped the electrofishing crew determine the appropriate settings on the electrofishing unit based on physical parameters of the watercourse, conductivity, and species expected to be present. Survey effort (in electrofishing seconds) was also recorded on the Electrofishing Site Form. Water quality measurements were recorded in the field with a Horiba U22 Multi-parameter probe or YSI 650 MDS & 600 QS Multi-Probe.

Fisheries and Oceans Canada's Interim Policy for the Use of Backpack Electrofishing Units (2003) was reviewed and followed by all members of the electrofishing crew. This document provides a detailed list of standard equipment, safety, training, and emergency response procedure requirements for electrofishing. Each electrofishing crew consisted of two individuals, one of which (the crew lead) was a qualified person as defined under the DFO Interim Electrofishing Policy. The crew lead is responsible for operating the backpack electrofisher according to their training and the Policy, and for communicating safety policies and electrofishing procedures to the second crew member.

Fish were sampled within the sampling areas using a Halltech Battery Backpack Electrofisher (HT-2000) with un-pulsed direct current (DC) and a single pass, double, or triple pass depending on the location and sampling efficiency. The operator waded upstream to eliminate the effects of turbidity caused by bottom sediment and probed the anode into likely fish habitat within the site. A second crew member walked alongside the operator to net any stunned fish using a D-frame landing net (1/8" mesh). All captured fish were held in a live well containing ambient stream water, which was kept out of the sun and fish were checked regularly for any signs of stress. At the conclusion of each pass, fish in the live well were identified (species confirmation) and measured (total length and fork length in mm). When possible, status, sex, and maturity were also recorded for individual fish using the Individual Fish Measurement Form (NB Aquatic Resources Data Warehouse, NB Department of Natural Resources and Energy, NB Wildlife Council, 2002, updated 2006). After recuperating, all fish were released back into the watercourse, upstream and outside of the sampling area under closed site condition.

Details of the electrofishing locations, survey dates, and times are provided in Table 6.8-4.

Table 6.8-4: Electrofishing Locations and Details

Electrofishing Location	Survey Date	Survey Type	Upstream Coordinates (UTM)		Downstream Coordinates (UTM)		No of Passes	Survey Effort (secs)		
			Easting	Northing	Easting	Northing		Pass 1	Pass 2	Pass 3
WC 1 Reach 1	July 28, 2017	Closed	537364	4998748	537310	4998750	3	626.3	543.2	504.9
WC 1 Reach 2	August 2, 2017	Closed	535911	4998997	535843	4998985	3	477.0	547.6	351.4
WC 20	August 3, 2017	Closed	538372	5000005	538344	4999958	3	350.3	243.4	375.6
WC 12 Reach 1	June 11, 2018	Open	538357	4998962	538504	4998965	1	779	-	-
WC 12 Reach 2	June 11, 2018	Open	538785	4999132	538788	4999048	1	349	-	-

6.8.2.1.5 *Fish Collection*

During habitat surveys conducted throughout the Study Area, MEL biologists searched for watercourse reaches suitable for electrofishing (i.e., wadeable, with suitable size and flow for electrofishing). Suitable electrofishing reaches were not abundant within the Study Area, so efforts were made to supplement electrofishing with additional methods where electrofishing was not practicable. At each sampling location, MEL biologists placed a fyke net, eel pot, three minnow traps, or any combination thereof depending on physical habitat characteristics to capture and record fish presence to support qualitative descriptions of habitat usage and relative abundance. The fyke nets were fixed in place by stakes driven into the substrate of the watercourse or waterbody through each wing of the net. Eel pots and minnow traps were baited with dog food. At each lentic sampling location, traps were placed in the shallow, in-shore littoral zone.

Details of fish collection locations, survey dates, and times are provided in Table 6.8-5.

Table 6.8-5: Fish Collection Location and Details

Fish Collection Location	Fish Collection Methodology	Survey Location Coordinates		Survey Date	Survey Time
		Easting	Northing		
WC 12 Reach 1	Fyke Net	538513	4998980	June 11-12, 2018	20h07m
	Eel Pot	538529	4998980		20h21m
	Minnow Trap 1	538492	4998962		20h15m
	Minnow Trap 2	538502	4998963		20h16m
	Minnow Trap 3	538512	4998970		20h19m
WC 12 Reach 2	Fyke Net	538808	4999057	June 11-12, 2018	17h52m
	Eel Pot	538802	4999049		18h09m
	Minnow Trap 1	538802	4999053		17h55m
	Minnow Trap 2	538790	4999050		17h55m
	Minnow Trap 3	538785	4999132		17h56m
WC 6	Minnow Trap 1	537508	4998544	June 12-13, 2018	19h28m
	Minnow Trap 2	537532	4998537		19h26m
	Minnow Trap 3	537547	4998523		19h32m
WC 7	Fyke Net	537364	4998672	June 12-13, 2018	19h22m
	Eel Pot	537355	4998676		19h22m

Fish Collection Location	Fish Collection Methodology	Survey Location Coordinates		Survey Date	Survey Time
		Easting	Northing		
Seloam Brook Pond 1	Fyke Net	538304	4999914	June 12-13, 2018	17h32m
	Eel Pot	538280	4999869		17h31m
	Minnow Trap 1	538302	4999901		17h35m
	Minnow Trap 2	538284	4999887		17h35m
	Minnow Trap 3	538280	4999872		17h39m
Seloam Brook Pond 2	Fyke Net	537471	4998754	June 13-14, 2018	23h02m
	Eel Pot	537436	4998734		22h38m
	Minnow Trap 1	537399	4998741		22h48m
	Minnow Trap 2	537409	4998739		22h47m
	Minnow Trap 3	537444	4998744		22h50m
Anti-Dam Flowage	Fyke Net	537556	4997114	June 13-14, 2018	20h24m
	Eel Pot	537519	4997150		20h52m
	Minnow Trap 1	537505	4997168		20h52m
	Minnow Trap 2	537493	4997165		20h58m
	Minnow Trap 3	537481	4997162		20h57m
WC 43	Minnow Trap 1	539891	4998041	July 11-12, 2018	23h24m
	Minnow Trap 2	539910	4998042		23h25m
	Minnow Trap 3	539922	4998046		23h21m
East Lake Outflow	Fyke Net	540684	4997297	July 11-12, 2018	22h27m
	Eel Pot	540740	4997264		22h30m
East Lake	Eel Pot	540447	4997711	July 11-12, 2018	22h50m
	Minnow Trap 1	540456	4997698		22h56m
	Minnow Trap 2	540433	4997724		22h51m
	Minnow Trap 3	540442	4997711		22h52m

Supplementary fish collection to support conclusions relating to impacts to fish habitat from TMF infrastructure was completed in Fall 2019. A request for an extended fish collection license was submitted to DFO and approved on 17 October 2019 (License #357626). This license allowed MEL biologists to complete fish collection via trapping (i.e., minnow traps, fyke nets, and eel pots) within the FMS Study Area from the date of issuance until 31 December 2019. A sampling protocol which outlines survey effort and methods was developed and reviewed in a meeting with DFO on 18 November 2019. License #357626 was reissued to allow continued sampling through high flow in the spring of 2020; through the reissuance of this license MEL was permitted to deploy passive fish traps within the Project Area between April 1 and June 1, 2020. During spring fish sampling, fish traps were often deployed for 3-5 consecutive days, however all traps were checked every 24 hours, in accordance with the scientific license. Trap locations from the 2019-2020 fish collection program are shown on Figure 6.8-3.

Details of fish collection locations, survey dates, and times for the Fall 2019 and Spring 2020 fishing programs are provided in Table 6.8-6 and Table 6.8-7, respectively.

Table 6.8-6: Supplementary Fish Collection Location and Details (Fall 2019)

WC ID*	Fish Collection Methodology	Survey Location Coordinates		Survey Date	Survey Time
		Easting	Northing		
WC43 Reach 1	Minnow trap	539918	4998043	September 17-18, 2019*	20h20m
	Minnow trap				20h20m
	Minnow trap				20h20m
East Lake	Eel pot	540453	4997694		17h25m
	Minnow trap				17h25m
	Minnow trap				17h25m
East Brook Reach 1	Eel pot	540785	4997236		17h00m
	Minnow trap				17h00m
WC43 Reach 1	Minnow trap	539918	4998043	November 7-8, 2019	24h40m
	Minnow trap				24h40m
	Minnow trap				24h40m
	Minnow trap				24h40m
WC43 Reach 2	Minnow trap	540087	4998116		24h45m
	Minnow trap				24h45m
WC43 Reach 1	Minnow trap	539918	4998043	November 20-21, 2019	26h45m
	Minnow trap				26h45m

WC ID*	Fish Collection Methodology	Survey Location Coordinates		Survey Date	Survey Time
		Easting	Northing		
	Minnow trap				26h45m
	Minnow trap				26h45m
WC43 Reach 2	Minnow Trap	540087	4998116		26h40m
	Minnow Trap				26h40m
	Minnow Trap				26h40m
WC43 Reach 1	Minnow Trap	539918	4998043	December 5-6, 2019	26h10m
	Minnow Trap				26h10m
	Minnow Trap				26h10m
	Minnow Trap				26h10m
	Minnow Trap				26h10m
WC43 Reach 2	Minnow Trap	540087	4998116		25h40m
	Minnow Trap				25h40m
	Minnow Trap				25h40m
East Brook Reach 1	Eel Pot	540785	4997236		26h15m
East Brook Reach 2	Fyke Net	540800	4997184		25h50m
WC43 Reach 1	Minnow Trap	539918	4998043	December 16-17, 2019	24h25m
	Minnow Trap				24h25m
	Minnow Trap				24h25m
	Minnow Trap				24h25m
	Minnow Trap				24h25m
WC43 Reach 2	Minnow Trap	540087	4998116		24h25m
	Minnow Trap				24h25m
	Minnow Trap				24h25m
East Brook Reach 1	Eel Pot	540785	4997236		24h35m

WC ID*	Fish Collection Methodology	Survey Location Coordinates		Survey Date	Survey Time
		Easting	Northing		
East Brook Reach 2	Fyke Net	540800	4997184		24h45m

Notes: Fish collecton completed under licence 341208
*WC43 Reach 1: above subterranean section
WC43 Reach 2: below subterranean section
East Brook Reach 1: above road
East Brook Reach 2: below road

Table 6.8-7: Fish collection within the proposed TMF infrastructure continued through the spring of 2020.

WC ID*	Fish Collection Methodology	Survey Location Coordinates		Survey Date	Survey Time
		Easting	Northing		
WC43 Reach 1	Minnow Trap	539918	4998043	April 18-19, 2020	24h20m
	Minnow Trap				24h20m
	Minnow Trap				24h20m
	Minnow Trap				24h20m
	Minnow Trap				24h20m
WC43 Reach 2	Minnow Trap	540087	4998116		23h05m
	Minnow Trap				23h05m
	Minnow Trap				23h05m
East Brook Reach 1	Eel Pot	540785	4997236		22h45m
East Brook Reach 2	Fyke Net	540800	4997184		22h20m
WC43 Reach 1	Minnow Trap	539918	4998043	April 27-28, 2020	23h10m
	Minnow Trap				23h20m
	Minnow Trap				23h15m
	Minnow Trap				23h15m
	Minnow Trap				23h00m
	Eel Pot				23h00m
	Fyke Net				23h00m
WC43 Reach 2	Minnow Trap	540087	4998116		23h45m

WC ID*	Fish Collection Methodology	Survey Location Coordinates		Survey Date	Survey Time
		Easting	Northing		
	Minnow Trap				23h45m
	Minnow Trap				23h45m
East Brook Reach 1	Eel Pot	540785	4997236		23h45m
East Brook Reach 2	Fyke Net	540800	4997184		23h45m
WC43 Reach 1	Minnow Trap	539875	4998043	May 25-29, 2020	93h35m
	Minnow Trap	539844	4998030		46h20m
	Minnow Trap	539836	4998029		93h20m
	Minnow Trap	539830	4998029		93h15m
	Minnow Trap	539822	4998030		93h10m
	Minnow Trap	539803	4998037		93h10m
	Minnow Trap	540052	4998109		94h40m
	Minnow Trap	540042	499811		94h35m
	Minnow Trap	540030	4998119		48h15m
	Minnow Trap	540029	4998106		94h35m
	Minnow Trap	540036	4998117		23h40m
	Minnow Trap	539880	4998043		47h00m
	Minnow Trap	539976	4998045		23h35m
	Minnow Trap	540033	4998087		23h35m
	Minnow Trap	539966	4998047		22h45m
	Minnow Trap	539995	4998081		22h40m
	Minnow Trap	540033	4998115		22h40m
	Eel Pot	539805	4998035		22h40m
	Eel Pot	539810	4998064		94h20m
	Eel Pot	540022	4998104		70h05m
	Fyke Net	539896	4998035		93h25m

WC ID*	Fish Collection Methodology	Survey Location Coordinates		Survey Date	Survey Time
		Easting	Northing		
	Fyke Net	539934	4998046		47h10m
WC43 Reach 2	Minnow Trap	540126	4998105		48h45m
	Minnow Trap	540115	4998108		48h40m
	Minnow Trap	540098	4998105		72h15m
	Minnow Trap	540150	4998107		46h05m
	Minnow Trap	540146	4998105		46h10m
	Minnow Trap	540077	4998119		46h15m
	Minnow Trap	540111	4998102		22h40m
WC19	Minnow Trap	539298	4997991		46h20m
	Minnow Trap	539243	4997990		46h20m
	Minnow Trap	539286	4997990		46h25m
	Minnow Trap	539320	4997995		19h15m
	Minnow Trap	539349	4997987		19h20m
	Minnow Trap	539349	4997888		19h20m
	Minnow Trap	539283	4997996		44h35m
	Minnow Trap	539285	4997993		44h40m
	Minnow Trap	539344	4997989		25h20m
	Minnow Trap	539316	4997991		25h15m
	Minnow Trap	539277	4997999		25h25m
	Minnow Trap	539286	4997996		25h30m
WC39	Minnow Trap	539418	4997843		46h15m
	Minnow Trap	539421	4997876		91h50m
	Minnow Trap	539415	4997823		91h45m
	Minnow Trap	539408	4997822		45h25m
	Minnow Trap	539435	4997843		45h40m

WC ID*	Fish Collection Methodology	Survey Location Coordinates		Survey Date	Survey Time
		Easting	Northing		
	Minnow Trap	539436	4997845		45h30m
WC12	Minnow Trap	539628	4998954		94h20m
	Minnow Trap	539625	4998959		94h20m
	Minnow Trap	539577	4998941		94h15m
	Minnow Trap	539591	4998973		94h10m
	Minnow Trap	539558	4998991		94h15m
	Minnow Trap	539562	4998988		94h15m
	Minnow Trap	539559	4999002		94h15m
	Minnow Trap	539634	4998957		93h40m
	Minnow Trap	539644	4998959		94h05m
	Minnow Trap	539647	4998960		94h05m
	Minnow Trap	539650	4998963		94h00m
	Minnow Trap	539577	4998941		94h00m
	Minnow Trap	539667	4998960		47h45m
	Minnow Trap	539675	4998964		48h20m
	Minnow Trap	539625	4998955		47h45m
	Eel Pot	539632	4998953		93h40m
	Eel Pot	539623	4998959		93h40m
	Fyke Net	539690	4998958		47h45m
WC43 Reach 1	Minnow Trap	539805	4998037	June 1-2, 2020	24h45m
	Minnow Trap	539834	4998034		24h40m
	Minnow Trap	539909	4998043		24h55m
	Minnow Trap	539924	4998045		24h50m
	Minnow Trap	539945	4998049		24h45m
	Minnow Trap	539964	4990050		24h40m

WC ID*	Fish Collection Methodology	Survey Location Coordinates		Survey Date	Survey Time
		Easting	Northing		
	Minnow Trap	539993	4998064		24h35m
	Minnow Trap	539994	4998057		24h30m
	Minnow Trap	540012	4998100		25h10m
	Minnow Trap	540042	4998117		25h05m
	Eel Pot	540031	4998117		25h05m
	Eel Pot	539814	4998064		23h20m
	Fyke Net	539905	4998040		24h55m
WC43 Reach 2	Minnow Trap	540089	4998116		24h55m
	Minnow Trap	540104	4998108		24h55m
	Minnow Trap	540126	4998112		24h50m
	Minnow Trap	540137	4998110		24h50m
	Minnow Trap	540166	4998102		24h45m
	Minnow Trap	540164	4998105		24h45m
WC19	Minnow Trap	539335	4997991		22h40m
	Minnow Trap	539320	4997994		22h45m
	Minnow Trap	539312	4997985		22h35m
	Minnow Trap	539312	4997985		22h30m
	Minnow Trap	539299	4997986		22h30m
WC39	Minnow Trap	539401	4997798		23h20m
	Minnow Trap	539401	4997810		23h20m
	Minnow Trap	539451	4997874		23h10m
	Minnow Trap	539439	4997855		23h15m
	Minnow Trap	539429	4997850		23h10m
WC12	Minnow Trap	539665	4998956		25h55m
	Minnow Trap	539650	4998956		25h50m

WC ID*	Fish Collection Methodology	Survey Location Coordinates		Survey Date	Survey Time
		Easting	Northing		
	Minnow Trap	539648	4998955		25h50m
	Minnow Trap	539646	4998955		25h50m
	Minnow Trap	539640	4998953		25h50m
	Minnow Trap	539638	4998950		25h45m
	Minnow Trap	539627	4998952		25h40m
	Minnow Trap	539580	4998934		25h35m
	Minnow Trap	539566	499900		25h20m
	Minnow Trap	539565	4998997		25h20m
	Minnow Trap	539562	4998983		25h20m
	Minnow Trap	539565	4998993		25h15m
	Minnow Trap	539563	4998992		25h10m
	Minnow Trap	539571	4999009		25h05m
	Minnow Trap	539568	4999012		25h00m
	Eel Pot	539623	4998950		25h35m
	Eel Pot	539629	4998955		25h00m
	Fyke Net	539694	4998955		26h00m
WC43 Reach 1	Minnow Trap	539807	4998057	June 4-5, 2020	25h00m
	Minnow Trap	539817	4998068		25h00m
	Minnow Trap	539844	4998080		24h40m
	Minnow Trap	839846	4998090		24h30m
	Minnow Trap	539884	4998078		24h30m
	Minnow Trap	539891	4998069		24h20m
	Minnow Trap	539917	4998043		24h00m
	Minnow Trap	539925	4998046		23h55m
	Minnow Trap	539929	4998052		23h50m

WC ID*	Fish Collection Methodology	Survey Location Coordinates		Survey Date	Survey Time
		Easting	Northing		
	Minnow Trap	539932	4998051		23h50m
	Eel Pot	539809	4998066		24h40m
	Eel Pot	540023	4998110		23h00m
	Fyke Net	539980	4998040		24h05m
WC43 Reach 2	Minnow Trap	540194	4998109		22h40m
	Minnow Trap	540197	4998109		22h40m
	Minnow Trap	540202	4998110		22h35m
	Minnow Trap	540209	4998106		22h40m
	Minnow Trap	540212	4998109		22h40m
	Minnow Trap	540217	4998109		22h40m
WC19	Minnow Trap	539345	4997989		23h05m
	Minnow Trap	539347	4997984		23h05m
	Minnow Trap	539344	4997986		23h05m
	Minnow Trap	539343	4997988		23h05m
	Minnow Trap	539330	4997991		23h00m
WC39	Minnow Trap	539413	4997836		23h15m
	Minnow Trap	539423	4997840		23h15m
	Minnow Trap	539433	4997847		23h10m
	Minnow Trap	539439	4997849		23h10m
	Minnow Trap	539439	4997851		23h10m
WC12	Minnow Trap	539720	4998965		23h25m
	Minnow Trap	539701	4998949		23h20m
	Minnow Trap	539698	4998952		23h20m
	Minnow Trap	539687	4998959		23h15m
	Minnow Trap	539679	4998964		22h55m

WC ID*	Fish Collection Methodology	Survey Location Coordinates		Survey Date	Survey Time
		Easting	Northing		
	Minnow Trap	539675	4998963		23h10m
	Minnow Trap	539673	4998963		23h10m
	Minnow Trap	539654	4998957		23h05m
	Minnow Trap	539650	4998959		23h00m
	Minnow Trap	539635	4998953		23h00m
	Minnow Trap	539630	4998953		22h55m
	Minnow Trap	539624	4998956		22h50m
	Minnow Trap	539622	4998957		22h30m
	Minnow Trap	539581	4998938		22h30m
	Minnow Trap	539626	4998955		22h25m
	Eel Pot	539665	4998961		23h05m
	Eel Pot	539632	4998953		23h00m
	Fyke Net	539690	4998959		23h20m

Notes: Fish collecton completed under licence 357626
*WC43 Reach 1: above subterranean section
WC43 Reach 2: below subterranean section
East Brook Reach 1: above road
East Brook Reach 2: below road

All captured fish were held in a live well containing ambient lake water, which was kept out of the sun and fish were checked regularly for signs of stress. Fish in the live well were identified to species and measured (fork and total length in mm). After recuperating, all fish were released back into the watercourse or waterbody.

The suite of survey methods (detailed habitat surveys, electrofishing, and fish collection with eel pots, fyke nets, minnow traps and eDNA sample collection) was selected to maximize the identification of the breadth of species diversity present throughout the various habitat types available in the FMS Study Area.

6.8.2.1.6 *Fish Population Characterization*

Fish population characterization was evaluated through catch per unit of effort (CPUE). CPUE is usually assumed to be proportional to abundance and therefore included in stock assessment as a relative index of abundance. CPUE expresses how many fish (all species) are caught by a unit of effort (Hinton and Maunder 2003). CPUE was calculated for each electrofishing survey and fish collection method (fyke net, minnow trap, eel pot) deployed as follows:

- CPUE=Catch (number of fish)/Effort (time)

The catch consists of how many fish were caught in a certain piece of fishing equipment. In the field, each fish was recorded and counted. The effort consists of the wetted time, which is equivalent to the time each piece of equipment was present in the sampling site or total electrofishing effort. The start time and the end time were recorded for each piece of fish collection equipment as they were placed and removed from the waterbody. Survey effort (in electrofishing seconds) was also recorded for all electrofishing surveys.

6.8.2.1.7 *Environmental DNA (eDNA) Survey*

eDNA is a well-established technique developed by Ficetola, Miaud, Pompanon and Taberlet (2008) which identifies environmental or exogenous DNA molecules from aquatic or semi-aquatic organisms from water samples. The premise of eDNA is that all organisms shed genetic material into the environment; water samples are collected, filtered and analyzed using a qPCR (quantitative polymerase chain reaction) technique to extract eDNA and identify organisms present within the aquatic environment. When genetic material found in the collected water sample matches with a known genetic primer for the target species or taxa, a positive result is provided by the production of fluorescence in the qPCR process. Genetic primers can be species-specific (based on matching 20 base pairs of a genetic sequence), or generic (identifying presence of particular taxa such as fish, amphibians, etc., based on a shorter genetic sequence of 10 base pairs). One example of a generic test is the eFish primer, developed by the University of Victoria, and used extensively by Bureau Veritas (BV) Laboratory.

MEL completed a study design through consultation with Wood Environment and Infrastructure, to identify presence of fish in aquatic habitats underlain by the proposed TMF using the eFish primer. Study design was completed to include two sites with confirmed or suspected fish presence, and five sites where fish presence was not expected based on habitat assessments and fish collection completed from September 2019 through April 2020. Sample locations are outlined in Table 6.8-8 and shown on Figure 6.8-4.

Table 6.8-8: eDNA Sample locations

eDNA Sample ID	Sample Location	Sample collection time (25 May 2020)	Coordinates (UTM)		Fish presence known
			Easting	Northing	
1	East Brook	11:00	540799	4997215	Yes
2	WC43 Reach 2	11:40	540096	4998107	No
3	WC43 Reach 1	12:10	540007	4998085	No
4	WC39	13:10	539460	4997875	No
5	WC19	13:30	539348	4997978	No
6	WC12 at road	14:20	538295	4998947	Yes
7	WC12 upstream end	15:15	539559	4999058	No

Typically, sample timelines are chosen to reflect the highest genetic output of the target species. Given that the eFish primer targets the entire taxa rather than an individual species, the sample timing was selected based on flow regimes and highest potential for access into upstream habitats, rather than based on seasonally high genetic output windows for an individual species. The study design involved sample collection during late-May of 2020, based on regional hydrometerological data, which suggests the highest flow regime occurs through April and into May. If fish were to move upstream into these habitats upstream of the subterranean barrier within WC43, or overland into WC19 or WC39, eDNA should be present in the water when sampled in May. This timeframe corresponds with suitable spawning temperatures for white sucker, which is expected to be present in the downstream system (East Brook and Fifteen Mile Stream). Furthermore, May sample collection would detect overwintering salmonid eggs (i.e., brook trout) and any resident populations of forage fishes.

Sample collection was completed on May 25, 2020 by a MEL biologist trained in eDNA protocols for study design, sample collection, and filtration. Standard protocols outlined by the British Columbia Ministry of Environment (MOE) were strictly adhered to for sample collection, labelling, filtration and sanitization between samples at every stage of the process. Sample filtration occurred in the evening of May 25th 2020. Key points of the MOE protocol are as follows:

- Samples were collected in a downstream to upstream order (sample 6 through sample 1), to prevent mobilization and drift of genetic material to downstream sample sites.
- Sample bottles were not reused from previous studies (i.e., they were fresh bottles which had not been exposed to bleach in the sterilization process which follows any previous bottle usage). Sample bottles were triple rinsed in site water prior to collection of the samples.
- Sample bottles were partially labelled prior collection (the day before) with the sample ID and replicate (sites 1-7, replicates A, B, and C for each site), sample date, and collector initials. Once the samples were collected, sample bottles were labelled with the collection time and waypoint.
- Site locations were marked with GPS in the field and photographed. Sample collection time and location were labelled on each sample bottle and recorded in a sample collection logsheet.
- Samples were collected prior to the deployment of any fish traps, which were deployed on the same day by a separate crew.
- Water quality measurements were recorded after the collection of samples, to prevent contamination of the samples from genetic material left on the YSI probe.
- Footwear was sanitized using a 10% bleach spray between sites, and samples were generally collected with gloved hands from the bank without stepping into the water.
- A field blank was completed using distilled water as per the MOE protocol.
- Samples remained on ice between sample collection and filtration.
- Filtration was completed in numerical order, in sets of three replicates per site (i.e. sample 1A, 1B and 1C were filtered individually, but as a group of three). These were filtered one at a time, and placed into pre-labelled coin envelopes (sample ID and replicate, date, and company), with self-indicating silica beads for sample preservation.
- Data transcription was completed by Amber as each individual sample was filtered by Melanie, to ensure chain of custody (CoC) of each sample bottle and its’ filter and coin envelope. This was completed for each replicate for one site (i.e., 1A, 1B and 1C) before moving on to the next site and its’ three replicate samples.

Filtered, preserved eDNA samples were shipped via courier to BV Laboratory in Guelph, Ontario, within a week of sample collection. Samples, once filtered and preserved, remain stable for months, if not longer. A detailed CoC accompanied the samples, and an electronic version of the sample collection and filtration data was provided to Aron Weir (Manager, Product Testing Services, BV Laboratory) via e-mail.

The laboratory completed a quantitative polymerase chain reaction (qPCR) analysis with each sample, using the eFish primer assay to identify presence of fish DNA in each sample. The laboratory assay includes checks for false positive and false negative errors in the laboratory analysis stage. This includes a check for DNA integrity, assay inhibition and contamination using the field blank (negative control).

6.8.2.2 Touquoy Baseline Program Methodology

Touquoy baseline program methodology is presented in the Touquoy Gold Project EARD (CRA 2007b). From 2015 to 2017, MEL biologists conducted further biophysical surveys by delineating and completing functional assessments on wetlands and watercourses within the Touquoy Mine Site in support of the provincial permitting process for wetland alterations and watercourse crossings.

Further to the Touquoy Gold Project EARD and permitting field programs identified above, the Proponent initiated a baseline aquatic sampling program in 2017, which was completed in 2018. The baseline program was designed to establish existing conditions in Scraggy Lake prior to effluent discharge to set the stage for the future environmental effects monitoring (EEM) program, and to support the MDMER regulatory requirements under the federal *Fisheries Act*. It provides details related to fish habitat, fish community, fish tissue analysis, benthic invertebrate community, water quality, and sediment quality.

A desktop review of the above mentioned Touquoy Gold Project EARD and 2017 aquatic sampling program was conducted to support the effects assessment of the Project. Specifically, relevant fish and fish habitat data for the Moose River was reviewed to support the effects assessment of discharge from the exhausted pit at Touquoy Mine Site post-closure.

6.8.3 Baseline Conditions

This section describes the results from fish habitat surveys, supporting electrofishing surveys, fish collection, benthic invertebrate and periphyton sampling, and water and sediment quality surveys within the watercourses, waterbodies, and associated wetland habitat within the FMS Study Area. Based on the physical characteristics of watercourses, waterbodies, and wetlands within the FMS Study Area, and on the results of electrofishing and fish collection surveys, the type and quality of fish habitat present within the FMS Study Area has been described.

A description of baseline fish habitat conditions within the Moose River and Scraggy Lake at the Touquoy Mine Site are also provided to support effects assessment of the Project.

6.8.3.1 Aquatic Ecosystem Condition

6.8.3.1.1 *Water Quality*

Water quality results are reported and discussed as it relates to the chemical characteristics required for suitable fish habitat. Where applicable, water quality sampling results are measured against the CCME Guidelines for the Protection of Aquatic Life (FWALs). Summaries of water quality measurements are presented in Table 6.8-9 and Table 6.8-10 for sampling conducted during initial watercourse identification and description, fish surveys, and aquatic ecosystem sampling in linear watercourses and open water within the FMS Study Area. Water quality profile results for Anti-Dam Flowage as measured during quarterly surface water quality monitoring are presented in Appendix B.5. Water quality measurement sites, which include watercourse reaches, fish survey locations, and FIAs, are presented on Figures 6.8-1 and 6.8-2. A comprehensive baseline water quality program is on-going and is described in detail in Section 6.6.

Table 6.8-9: Water Quality Measurements Recorded within the FMS Study Area

Site	Sampling Date	Water Temp (ºC)	pH	Dissolved Oxygen (mg/L)	TDS (g/L)
Watercourse Identification[1]					
1.1	July 26, 2017	24.7	6.36	-	0.032
1.2	July 27, 2017	20.1	-	-	0.006
1.4	Oct 20, 2016	18.3	5.67	-	0.021
1.5	July 27, 2017	19.7	-	-	0.011
3	Sep 13, 2017	13.4	5.81	-	0.020
8	Nov 6, 2017	12.6	5.67	-	-
12.1	Oct 18, 2017	9.3	6.97	-	-
12.2	Oct 17, 2017	10.4	6.82	-	-
12.3	Oct 18, 2017	12.5	5.11	-	-
12.4	Oct 17, 2017	17.0	6.61	-	0.030
12.5	Aug 9, 2017	17.7	5.17	-	-
12.6	June 27, 2017	18.2	5.06	-	
13	July 20, 2017	23.2	5.20	-	0.013
14	July 20, 2017	16.5	**3.85**	-	0.040
15	June 4, 2018	10.2	5.90	-	-
16	June 7, 2018	9.5	5.67	-	-
17	Sep 14, 2017	25	6.30	-	0.024
18	June 8, 2018	7.9	5.88	-	-
20.1	Nov 14, 2017	23.1	5.43	-	0.010
21	Sep 25, 2017	19	6.40	-	0.011
22	Sep 25, 2017	19.6	5.40	-	0.008
24.1	Sep 25, 2017	11.9	**4.55**	-	0.015
24.2	Oct 31, 2017	11.7	**4.59**	-	0.017

Site	Sampling Date	Water Temp (ºC)	pH	Dissolved Oxygen (mg/L)	TDS (g/L)
24.3	Oct 31, 2017	12.1	5.06	-	0.017
25	Sep 25, 2017	26	5.50	-	0.011
26	June 7, 2018	9.4	5.92	-	-
30	July 4, 2018	18	**4.98**	-	-
38	July 10, 2018	24.6	**4.58**	-	-
39	July 11, 2018	14.3	5.63	-	0.019
40	Aug 1, 2018	24.5	5.74	-	-
41	Oct 20, 2017	11.4	6.06	-	-
42.3	Oct 31, 2017	11.3	5.18	-	-
42.4	Oct 31, 2017	11.6	5.34	-	-
42.5	Oct 31, 2017	12.2	5.12	-	-
43.1	Nov 8, 2017	8.9	**4.95**	-	-
43.2	July 10, 2018	17.4	**4.74**	-	-
44	Nov 1, 2017	10.8	5.24	-	-
45	Nov 1, 2017	9.2	**4.72**	-	0.021
Fish Surveys[2]					
WC 1 R1	Aug 2, 2017	19.7	5.61	6.7	-
WC 1 R2	Aug 2, 2017	21.3	5.86	8.11	0.010
WC 20	Aug 3, 2017	23.6	5.43	7.88	0.010
WC 12 R1	June 11, 2018	11.0	**4.41**	-	0.017
WC 12 R2	June 11, 2018	11.7	**4.28**	-	0.016
WC 6	June 12, 2018	10.1	**4.78**	-	0.017
WC 7	June 12, 2018	15.8	5.40	-	0.024
WC 1 Pond 1	June 12, 2018	15.7	**4.61**	-	0.014
WC 1 Pond 2	June 13, 2018	16.4	**4.51**	-	0.014

Site	Sampling Date	Water Temp (ºC)	pH	Dissolved Oxygen (mg/L)	TDS (g/L)
WC 43	July 11, 2018	15.0	**4.87**	**3.02**	0.016
East Lake Outflow	July 11, 2018	19.9	**4.92**	**4.88**	0.014
East Lake	July 11, 2018	22.3	5.06	6.54	0.013
Benthic Sampling[2]					
FIA 1.1	Oct 5, 2018	14.5	5.76	7.58	0.023
FIA 1.2	Oct 5, 2018	14.5	5.84	8.29	0.021
FIA 1.3	Oct 5, 2018	14.6	5.95	8.46	0.023
FIA 2.1	Oct 5, 2018	14.6	6.54	**5.38**	0.033
FIA 2.2	Oct 5, 2018	15.1	5.01	7.40	0.022
FIA 2.3	Oct 5, 2018	14.7	5.67	7.75	0.022
FIA 3.1	Oct 5, 2018	12.6	5.64	6.94	0.020
FIA 3.2	Oct 5, 2018	12.6	5.69	6.61	0.020
FIA 3.3	Oct 5, 2018	12.6	5.75	7.22	0.019
FIA 4.1	Oct 5, 2018	12.5	**4.51**	**4.56**	0.031
FIA 4.2	Oct 5, 2018	12.6	**4.65**	**4.32**	0.031
FIA 4.3	Oct 5, 2018	12.6	**4.75**	**4.96**	0.032
Spring 2020 TMF Fish Sampling[2]					
WC43 Reach 1	April 18, 2020	5	4.16	6.29	-
WC43 Reach 2	April 18, 2020	2.1	**3.44**	10.11	-
East Brook Reach 1	April 18, 2020	4.3	**3.76**	9.83	-
East Brook Reach 2	April 18, 2020	4.6	**3.67**	11.3	-
WC43 Reach 1	April 27, 2020	3.5	**4.37**	7.54	0.022
WC43 Reach 2	April 27, 2020	4.2	**4.45**	8.41	0.018

Site	Sampling Date	Water Temp (ºC)	pH	Dissolved Oxygen (mg/L)	TDS (g/L)
East Brook Reach 1	April 27, 2020	7.5	**4.72**	8.21	0.018
WC43 Reach 1	May 29, 2020	14.1	**3.77**	**5.45**	0.034
WC19	May 29, 2020	10.1	**4.71**	**4.61**	0.018
WC39	May 29, 2020	10.6	5.01	6.88	0.017
WC12 upstream end	May 29, 2020	13.2	5.44	-	0.016
WC43 Reach 1	June 1, 2020	8.7	5.57	-	0.018
WC19	June 1, 2020	9	5.03	7.92	-
WC39	June 1, 2020	7.5	**4.59**	-	-
WC12 upstream end	June 1, 2020	10.1	5.38	11.81	0.016
WC43 Reach 1	June 4, 2020	8.7	**4.95**	8.4	0.020
WC19	June 4, 2020	10.0	**4.96**	8.3	0.019
WC39	June 4, 2020	9.9	5.5	7.2	0.021
WC12 upstream end	June 4, 2020	10.4	5.52	8.4	0.016
Spring 2020 eDNA sampling[2]					
East Brook	May 25, 2020	11	3.78	8.3	-
WC43 Reach 2	May 25, 2020	7.6	**4.11**	**-**	-
WC43 Reach 1	May 25, 2020	7.9	**4.55**	6.83	-
WC39	May 25, 2020	8	**4.66**	**-**	-
WC19	May 25, 2020	9.1	**4.51**	**-**	-
WC12 at road	May 25, 2020	13	**4.52**	9.39	-
WC12 upstream end	May 25, 2020	8.2	5.19	9.74	-

Notes: Values in bold indicate parameters recorded as below CCME guidelines for the protection of aquatic life, including: dissolved oxygen levels not suitable for any life stage of warm or cold water fish species (<5.5 mg/L) (1999), and pH levels below 5.0 (CCREM 1987). Measurements recorded were based on available parameters on the field measurement device:
[1] Measurements recorded with ExStik EC500

[2] Measurements recorded with Horiba U22 Multi-parameter probe or YSI 650 MDS & 600 QS Multi-Probe.

Table 6.8-10: Water Quality Measurements for Anti-Dam Flowage Recorded During Benthic Surveys (October 23rd, 2018)

Site	Depth (m)	Water Temp (ºC)	pH	Dissolved Oxygen (mg/L)	TDS (g/L)
FIA 5.1	0	7.3	**4.91**	10.3	0.021
	1	7.0	**4.88**	10.6	0.021
	2	6.9	**4.82**	10.5	0.021
FIA 5.2	0	7.4	**4.95**	9.5	0.020
	1	7.1	**4.93**	9.4	0.020
FIA 5.3	0	7.3	**4.93**	10.0	0.021
	1	7.3	**4.92**	10.1	0.021
	2	7.1	**4.90**	10.2	0.021
	3	7.1	**4.90**	10.1	0.021
FIA 5.4	0	7.4	**4.90**	10.2	0.021
	1	7.3	**4.90**	10.2	0.021
	2	7.3	**4.89**	10.1	0.021
	3	7.3	**4.90**	10.1	0.021
FIA 5.5	0	7.1	**4.9**	10.7	0.021
	1	7	**4.89**	10.8	0.021
	2	7	**4.88**	11.1	0.021
	3	7	**4.88**	10.4	0.021
FIA 5.6	0	7.4	**4.10**	10.2	0.021
	1	7.2	**4.12**	9.4	0.021

Notes: Values in bold indicate parameters recorded as below CCME guidelines for the protection of aquatic life, including: dissolved oxygen levels not suitable for any life stage of warm or cold water fish species (<5.5 mg/L) (1999), and pH levels below 5.0 (CCREM 1987).

The Nova Scotia Trout Management Plan (NSDFA 2005) identifies three classes of streams based on water quality and pH for trout species (including brook trout which is present within the FMS Study Area). Class A streams (cool) require the average summer temperature to be <16.5˚C. Class B streams (intermediate) temperature (average summer) ranges from 16.5-19˚C. Finally, Class C streams (warm) require temperatures above 19˚ or pH of <4.7 (NSDFA 2005). The identification, maintenance, protection, and enhancement of instream habitats of class A and class B waters can benefit the trout fishery.

Water temperature affects the metabolic rates and biological activity of aquatic organisms, thus influencing the use of habitat by aquatic biota. There are no CCME guidelines related to temperature and aquatic biota. Temperature preferences of fish vary between species, as well as with size, age, and season.

Trout and salmon are cold-water fish species, meaning they require cold water to live and reproduce. The optimal temperature range for these species (growth of juvenile) is 10-20˚C (The Stream Steward n.d.) to 16-20˚C (Fisheries and Oceans Canada, 2012) (trout and salmon, respectively). Other species observed or believed to be present in the watershed have higher temperature ranges: Yellow Perch 21-24˚C (Brown et al. 2009), and white sucker 19-26˚C (Kelly 2014). American eel have a broader temperature range and can tolerate temperatures from 4 to 25 ºC (Fuller et al., 2019).

Average summer temperatures were not collected as part of baseline surveys completed within each watercourse in the FMS Study Area. Results shown in the tables above provide a snapshot of water temperatures within the streams present within the FMS Study Area. However, streams with elevated temperatures in June (WC7 for example) would likely demonstrate average temperatures above 19 degrees Celsius and be classified as warm streams (lower quality for trout). Watercourse 43.2 and 38, for example, have high temperatures and low pH indicating they are Class C (warm) streams. Watercourse 16, for example, has relatively cool temperatures and suitable pH ranges, indicating potential Class A (cool) streams.

As discussed in Section 6.6, two datalogging water level sensors (Solinst Level Loggers) were installed within Seloam Brook at stations SW2 and SW5, upstream and downstream of the proposed pit, respectively. These Level Loggers were programmed to record temperature in ˚C on an hourly basis. Table 6.8-11 provides a summary of average monthly temperatures and temperature ranges recorded at SW2 and SW5 from April through October 2018. Numbers in bold indicate months where average temperature levels exceed preferred temperature ranges for salmonids. These results indicate that temperatures are elevated above preferred range for salmonids through the entire length of Seloam Brook during the summer months.

Table 6.8-11: Monthly Temperature Recordings at Surface Water Monitoring Stations (2018)

Location		Apr	May	June	July	Aug	Sep	Oct
SW2	Max.	12.4	19.2	23.4	26.8	28	24.1	16.4
	Min.	1.7	9.9	10.9	19.3	21.2	11.7	5.1
	Average	6.7	13.7	16.4	**23.1**	**24.1**	18.8	10.1
SW5	Max.	12	18.3	20.8	25.9	28.8	21.4	14.4
	Min.	0.4	7.2	8.8	16.5	17.9	9.9	3.7
	Average	5.0	12.6	14.4	**21.5**	**21.5**	16.5	9.1

6.8.3.1.2 *pH*

The CCME water quality guidelines for the Protection of Aquatic Life establish that a range of pH from 6.5 to 9.0 is suitable within freshwater habitat. Levels of pH that were reported below the suitable range indicate the presence of acidification within watercourses across the FMS Study Area. Kalff (2002) indicates that the loss of fish populations is gradual and depends on fish species, but decline is evident when pH is <6.5. Kalff (2002) further states that a 10-20% species loss is apparent when pH<5.5.

Table 6.8-9 provides a list of pH measurements recorded during various survey types within the FMS Study Area, with bolded records indicating pH levels below 5.0, the level below which acidity levels are expected to cause harm to the eggs and fry of salmonids

(CCREM 1987). The pH range for linear watercourses sampled within the FMS Study Area was 3.44 to 6.97, with a median pH of 5.15. Only four sampling sites (WC reaches 12.1, 12.2, 12.4, FIA 2.1) exhibited pH levels within CCME recommended range for freshwater aquatic life (6.5-9). Forty-two percent of linear watercourses sampled *in-situ* during watercourse identification, fish collection and benthic invertebrate sampling exhibited pH levels so low (<5.0) as to expect to cause harm to salmonid species.

The survival of juvenile rearing of Atlantic salmon requires freshwater pH >4.7, while a significant mortality of fry occurs at pH levels below 5.0 (Farmer 2000). The Recovery Potential Assessment for salmon completed by Fisheries and Oceans Canada indicates that acidification is an extreme threat to the salmon population (Bowlby, Horsman, Mitchell and Gibson 2014), particularly through watersheds of the Southern Upland area of Nova Scotia. Yellow Perch are found in Ontario lakes with a pH range from approximately 3.9 to 9.5. Yellow Perch are relatively tolerant of low pH, but reproductive success is reduced in lakes with pH < 5.5 (Krieger, Terrell, & Nelson 1983). White sucker have been collected from areas with a pH as low as 4.3 (Dunson and Martin, 1973, as cited in Twomey, Williamson, & Nelson 1984), but Beamish (1972) reported sharp declines in white sucker populations in Canadian lakes when the pH was lowered to 4.5 to 5.0 as a result of acid precipitation. Brook Trout tolerate acidic conditions particularly well, compared with other species. They have been known to survive at pH 3.5 in laboratory settings (Daye and Garside 1975). Raleigh (1982) proposed an optimal pH range for brook trout as 6.5-8.0, with a tolerance range of 4.0-9.5. American eel are also more tolerant of low pH than are many other species, although densities and growth rates may be adversely affected by direct mortalities or declining abundance of prey as productivity declines at low pH (Jessop 1995).

As discussed in Section 6.6 and Appendix B.5, field parameters were measured quarterly during the surface water quality baseline monitoring program at numerous stations throughout and beyond the FMS Study Area. Table 6.8-12 shows pH as measured in-situ at SW12 (East Lake). Acidity levels measured in East Lake consistently fell below the optimal range for brook trout (6.5-8, with tolerance to pH ranges from 4.0-9.5) and white sucker (6-10, with tolerance to pH levels as low as 3.8). While the data below do not indicate that water quality would prevent fish usage, it does indicate that the habitat within this system is sub-optimal.

Table 6.8-12. Field-based pH Measurements Collected at SW12 (East Lake)

Date	pH
October 6, 2017	4.8
December 20, 2017	5.55
April 2, 2018	4.71
September 10, 2018	4.54
March 26, 2019	4.77
June 3, 2019	4.93
September 10, 2019	4.85
December 4, 2019	4.35

Median in situ pH values for streams within the East River Sheet Harbour watershed were measured quarterly from 1997 to 2007 as part of the NSPI re-licensing process for the East River Sheet Harbour hydro system. Median pH ranged from 4.76 to 5.51 across 16 sites within the watershed. Site 39, located at the outlet of Seloam Dam (upmost reach of Seloam Brook), exhibited a median pH of 5.27 (NSPI 2009). The East River Sheet Harbour was classified as a Class B river by Watt (1997), a river with an average pH within the range of 4.7-5.1. In this pH range, “salmon production is considered unstable and only remnant populations may persist”

(Watt 1987). Field measurements within the FMS Study Area, as supported by the literature, demonstrate an overall acidic aquatic environment and is typical for the Southern Upland region of NS.

6.8.3.1.3 *Dissolved Oxygen*

The atmosphere and photosynthesis by aquatic vegetation are the major sources of DO in water (CCME 1999a). However, the amount of oxygen available for aquatic life (i.e., the concentration of oxygen in water) is affected by several independent variables including water temperature, atmospheric and hydrostatic pressure, microbial respiration, and growth of aquatic vegetation; DO can vary daily and seasonally (CCME 1999a). The CCME guidelines for the Protection of Aquatic Life establish a minimum recommended concentration of DO of 9.5 mg/L for early life stages of cold-water biota and 6.5 mg/L for other life stages (CCME 1999a). Eighty-seven percent of DO levels recorded across watercourses within the Study Area were below the minimum CCME recommended concentration of DO for early life stages of cold-water fishes (<9.5 mg/L). Twenty-seven percent (27%) of DO levels recorded for watercourses were below levels suitable for any life stage of warm or cold-water fish species. Low DO concentrations were associated with slow-moving streams whose riparian habitat is dominated by organic wetlands, including WC12, and the inlet and outlet to East Lake (WC 43, FIA 4, and East Lake Outflow). The DO concentration range for Anti-Dam Flowage (9.4 – 11.1 mg/L) falls within the recommended CCME lower limit of 9.5 mg/L for early life stages of cold-water species.

Dissolved oxygen levels recorded during the 2006-2007 NSPI surveys for the East River Sheet Harbour hydro system were acceptable for most aquatic life, measuring from 6.75 mg/L to 9.79 mg/L (NSPI 2009). The DO concentration recorded for Site 39 (below the outlet of Seloam Dam) was 8.92 mg/L. Median *in situ* dissolved oxygen levels (with minimum and maximum ranges) for stream sites measured quarterly from 1997 to 2007 ranged between 9.36 mg/L and 10.51 mg/L (NSPI 2009).

In general, most aquatic sites within the FMS Study Area were measured as having DO concentrations suitable for aquatic life. However, it is likely that DO concentrations within stagnant features such as those associated with riparian peatlands are limiting to fish, at least seasonally, and particularly for cold-water species like salmon and trout.

6.8.3.1.4 *Total Dissolved Solids*

Total Dissolved Solids (TDS) is a measurement of inorganic salts, organic matter and other dissolved materials in water. TDS causes toxicity through increases in salinity, changes in the ionic composition of the water and toxicity of individual ions. TDS field measurements within FMS Study Area watercourses range from 0.006 to 0.04 g/L (6-40 mg/L TDS), and Anti-Dam Flowage sites recorded a steady TDS concentration of 21 mg/L. A study by Weber-Scannell & Duffy (2007) reported a variety of studies that evaluated the effect of elevated TDS on freshwater aquatic invertebrates. These studies reported the commencement of effect at 499 mg/L, and most effects are not observed until >1000 mg/L. With fish, research is limited, but preliminary studies reported in Weber-Scannell and Duffy demonstrated survival rates of salmonid embryos to elevated TDS (38% survival when exposed to 2229 mg/L for brook trout, and 35% survival when exposed to 1395 mg/L). As such, TDS levels measured within the FMS Study Area are acceptable for aquatic life.

Overall, water quality results are indicative of acidic conditions as is typical for the watershed in which the FMS Study Area lies. Low pH levels, elevated temperatures and low dissolved oxygen concentrations in select lotic systems present limiting factors for fish habitat within the FMS Study Area. Further details on water quality are provided in Section 6.6.

6.8.3.1.5 *Sediment Quality*

MEL biologists collected composite fine-grained (i.e., clay, silt, gravel) sediment samples from depositional areas for laboratory analysis during benthic invertebrate surveys in 4 lotic FIAs (1-4) and one lentic FIA (5, Anti-Dam Flowage). Lotic FIAs 1-3 represent conditions sampled downstream, within, and upstream of the proposed pit, respectively, while FIA4 presents conditions within WC43, within the proposed TMF infrastructure. As a result of selective fine-grain sediment sampling, sediment sample grain sizes are not representative of benthic substrate composition within the FIAs (i.e., sites dominated by boulder-sized substrate).

Organic carbon in sediment can stem from many sources, including the natural decomposition of plant and animal matter, terrestrial soils, and from anthropogenic origins like fertilizers and industrial effluents. Organic carbon in sediment can significantly influence water quality by forming complexes with certain trace metals, increasing their availability to fish. In addition, high TOC concentrations can cause decreases in dissolved oxygen by encouraging the growth of microorganisms that consume oxygen. Sediment samples collected for each FIA displayed a range of organic carbon content by weight. Mean total organic carbon content for FIA's are presented below:

- **FIA 1:** 0.74%
- **FIA 2:** 1.19%
- **FIA 3:** 6.33%
- **FIA 4:** 33.00%
- **FIA 5:** 18.28%

High organic carbon concentrations are common in slow-moving streams whose riparian habitat is dominated by wetlands (NRC 2002). The highest percentage of organic carbon was measured in FIA 4 (average 33%, maximum 45% TOC by weight), for which the riparian area is entirely comprised of bog habitat (WL65). In addition, dissolved oxygen concentrations for FIA 4 were the lowest recorded for all FIAs (as noted in Table 6.8-9).

Sediment Quality Guidelines for the Protection of Freshwater Aquatic Life have been established by the CCME (1999a) for a variety of sediment quality parameters. When possible, sediment quality parameters derived from samples collected from FIAs within the Study Area have been evaluated against the PEL, above which adverse biological effects to freshwater aquatic biota are anticipated (CCME 1999a). The measured range of parameters for each FIA with CCME PELs are presented in Table 6.8-13. Ongoing exploratory work is being completed by Stantec Consulting to support Phase I and Phase II Environmental Site Assessments. Sediment quality results obtained by Stantec are provided herein as well (Sites FMS-SS001-SS012). Results for FIA sediment quality are provided in Appendix G.9, and results obtained by Stantec for FMS-SS001 through FMS-SS012 are provided in Appendix I.3. Sample locations for FMS-SS001 through FMS-SS012 are documented in Appendix I.3.

Table 6.8-13: Sediment Quality Parameter Ranges for FIAs with CCME PELs and Tier 1 EQS for freshwater sediment

Site	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Zinc
CCME PEL (mg/kg) and Tier 1 EQS for Sediment	**17**	**3.5**	**90**	**197**	**91.3**	**0.486**	**315**
FIA 1	**1,100-8,600**	<0.30	9.1-9.6	2.8-31	11-28	**1.5-5.1**	29-47
FIA 2	**560-120,000**	<0.30-0.36	5.4-10	9.2-72	**18-430**	**3.9-61**	26-30
FIA 3	**240-1,900**	<0.30-0.37	11-22	7.3-10	17-41	**<0.10-1.2**	36-54
FIA 4	**61-160**	0.32-0.62	4.1-25	14-28	15-39	**0.21-0.50**	20-42

Site	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Zinc
CCME PEL (mg/kg) and Tier 1 EQS for Sediment	**17**	**3.5**	**90**	**197**	**91.3**	**0.486**	**315**
FIA 5	**9,800-17,000**	>0.30-0.61	7.5-15	5.7-18	9.4-28	**0.11-0.50**	24-35
FMS-SS001	**3800**	<0.30	20	79	48	**9.6**	82
FMS-SS002	**44**	<0.30	24	6.6	23	0.42	56
FMS-SS003	3.6	<0.30	8.7	8.9	21	0.41	9.9
FMS-SS004	5.6	1.4	9.0	17	13	0.21	6.4
FMS-SS005	**580**	<0.30	12	20	35	**9.6**	45
FMS-SS006	**1800**	<0.30	10	58	47	**9.3**	42
FMS-SS007	**19**	0.70	12	12	42	0.39	43
FMS-SS008	6.4	<0.30	5.5	11	5.3	0.2	11
FMS-SS009	**18**	<0.30	29	11	14	0.13	38
FMS-SS010 (field duplicate of SS009)	**18**	<0.30	36	12	14	0.15	40
FMS-SS011	**1400**	<0.30	9.9	11	25	**7.1**	39
FMS-SS012	**320**	<0.30	8.4	20	33	**7.4**	23

Note: Sites labelled FIA 1- FIA5 were completed by MEL, Values in bold indicate ranges that exceed the PEL for sediment quality guidelines (CCME 1999).

As shown in Table 6.8-13, PELs are exceeded for Mercury and Arsenic across all FIA sediment samples, and elevated concentrations of lead was observed at FIA2 above the PEL. Stantec Consulting completed sediment sampling on November 25 and 27, 2019 to support on-going Phase II Environmental Site Assessment efforts throughout the FMS Study Area. Arsenic levels exceeded CCME PELs in 8 of the 11 sites (plus the field duplicate), while exceedances of the CCME PELs for mercury were recorded in 5 of the 11 locations. One sample location (FMS-SS006) is within the proposed open pit, approximately 70m downstream of FIA 2. At this location, the arsenic level was recorded as 1800 mg/kg, and mercury also exceeded the CCME PEL guidelines. Elevated arsenic levels were recorded downstream of this location as well (FMS-SS005). This indicates potential suboptimal baseline conditions for aquatic life according to CCME guidelines. Further details on sediment quality are provided in Section 6.4.

6.8.3.1.6 *Periphyton and Primary Productivity*

The evaluation of the primary productivity of streams within the FMS Study Area involved the following measures as indicators of the abundance of periphyton from the sampled reaches:

- Total dry mass (g/m^2): the total amount of material comprising the biofilm;
- Ash-Free Dry Mass (g/m^2): the amount of organic material comprising the total mass of biofilm (loss on ignition); and

- Chlorophyll a (mg/m^2): the amount of photosynthetic matter present in the biofilm.

Sampling was conducted on October 9th and 10th, 2018. Table 6.8-14 provides results of periphyton sampling within lotic FIAs in the FMS Study Area.

Table 6.8-14: Mass and Chlorophyll *a* Content of Periphyton Samples from Lotic FIAs

Site	WC ID (Stream Order)	Periphyton Total Dry Mass (g/m^2)	Periphyton Ash-Free Dry Mass (g/m^2)	Periphyton Chlorophyll a (mg/m^2)
FIA 1	1 (3)	18.82	6.89	3.42
FIA 2	1(3)	16.94	11.29	9.27
FIA 3	21 (3)	17.67	11.99	5.79
FIA 4	43 (1)	6.51	6.05	8.98

Dodds et al. (1998) proposed guidelines for stream trophic state based on benthic chlorophyll concentrations, with an oligotrophic status (low productivity) upper limit of 20 mg/m^2, a mesotrophic status (moderate productivity) upper limit of 70 mg/m^2, and eutrophic status for chlorophyll a concentrations above 70 mg/m^2. Based on this classification, the values for chlorophyll a content suggest a low level of primary productivity for all lotic FIAs.

The ash-free dry mass collected from the four lotic FIAs ranged from 6.05-11.99 g/m^2. These results are similar to values for the ash free dry mass of periphyton collected from reference streams in New England reported by Riskin et al. (2003), which ranged from 1.6 to 17 g/m^2 with a median value of 6.4 g/m^2. The low ash-free dry mass values, like reported chlorophyll a concentrations, suggest a low level of productivity in all of the FIAs.

It is important to note that the values presented only provide a baseline measurement from a snapshot in time. The development of algal biomass of streams is influenced by an array of interconnected factors that affect biomass development and loss. These factors include nutrient and light availability, temperature, flow rates, substrate composition, and grazing from fish and invertebrates, all of which can vary significantly over spatial and temporal scales (Biggs 1996).

As described by Biggs (1996), long-term patterns of algal biomass accumulation in streams can usually be classified into one or more of the following:

- Streams with relatively constant, low algal biomass (streams that are frequently disturbed);
- Streams with algal biomass cycles of accrual and sloughing (streams with a moderate frequency of flood disturbances); and,
- Streams with strong seasonal patterns in algal biomass development (mediated by seasonal disturbance, grazer activity, or light regimes).

Streams with strong seasonal patterns in algal biomass development are typically those with underlying, adequate nutrient resources (i.e., enriched streams) for algal growth. In contrast, streams with consistently low algal biomass may be low in available nutrients, often in combination with frequent flooding events resulting in the removal of biomass from stream substrates (Biggs 1996). Nutrient concentrations measured within surface water features within, upstream, downstream of FMS Study Area were relatively low and homogenous across seasonal sampling events. The highest total phosphorus concentration measured during the surface water monitoring program in a lotic system was 0.031 mg/L (SW4, December 5, 2018), while the highest nitrate concentration was 0.11

mg/L (SW7, September 10, 2018); however, the majority of sample results fell below the detectable limits of the laboratory for these nutrients (refer to Appendix B.5). This is expected, particularly at FIAs 1-3, which are largely regulated by the Seloam Reservoir, whose drawdown is expected to play a substantial role in biomass accumulation through sloughing when water is released from the reservoir. Due to the influence of the Seloam Reservoir on productivity in the lotic FIAs, the periphyton sampling period occurred in the early fall of 2019, at a time of relatively stable flow. As such, it is expected that the low periphyton ash-free dry mass values presented in Table 6.8-14 are reflective of nutrient availability at a time of relatively stable flow.

Based on limited nutrient availability and known physical disturbance of this system from flooding due to dam infrastructure and release of water, broad deviations from the observed low algal biomass accumulation within the FMS Study Area are not expected. However, it is likely that higher temperatures and light attenuation during the warmer, summer months would promote higher primary producer abundance and lead to some intra-annual variability. These results allow for the establishment of baseline conditions that can later be used in a monitoring program to identify potential changes to water quality within these specific environments.

Anti-Dam Flowage was surveyed on October 22nd, 2018 at six FIA substations for water quality parameters indicative of primary productivity in lakes, which have been used to infer the relative trophic status of the reservoir. The parameters measured relate to water chemistry, water clarity, and nutrient concentrations. Results of the sampling program are presented in Table 6.8-15.

Table 6.8-15: Primary Productivity Parameters for Anti-Dam Flowage (October 22nd, 2018)

FIA	**Sample**	**Turbidity (NTU)**	**TDS* (mg/L)**	**Colour (TCU)**	**Chl a (µg/L)**	**Nitrate (mg/L)**	**Phosphorus (mg/L)**	**TSI (P)****
5.1	Surface	0.81	15	63	1.06	<0.050	0.029	52.71
	Depth	1.3	17	69	0.997	0.520	0.026	51.13
5.2	Surface	0.51	15	71	0.84	0.061	0.023	49.36
	Depth	0.95	15	77	1.52	<0.050	0.027	51.68
5.3	Surface	0.16	15	73	1.09	<0.050	0.022	48.72
	Depth	1.1	15	69	0.914	<0.050	0.026	51.13
5.4	Surface	2.2	15	72	1.06	<0.050	0.028	52.20
	Depth	1.0	15	82	0.997	<0.050	0.028	52.20
5.5	Surface	0.89	15	75	0.743	<0.050	0.031	53.67
	Depth	0.73	16	81	0.787	<0.050	0.027	51.68
5.6	Surface	0.95	15	81	0.926	<0.050	0.022	48.72
	Depth	1.2	16	74	0.894	0.075	0.028	52.20
Average		0.98	15	74	0.986	NA***	0.026	51.28
Std. Dev.		0.49	0.65	5.69	0.20	NA	0.003	1.58

FIA	Sample	Turbidity (NTU)	TDS* (mg/L)	Colour (TCU)	Chl a (µg/L)	Nitrate (mg/L)	Phosphorus (mg/L)	TSI (P)**
Range		0.51-2.2	15-17	63-82	0.743 - 1.52	<0.050-0.520	0.022-0.031	48.72-53.67

*TDS: Total dissolved solids.
**TSI (P): Trophic Status Index calculated using phosphorus concentrations
***Average value could not be calculated due to detection limits of parameter.

Anti-Dam Flowage is located in the eastern section of the Sheet Harbour Hydro System drainage area and is the lowest receiving waterbody for the Seloam Brook tertiary watershed. Originally built in 1924, the reservoir regulates flow to lower reaches of Fifteen Mile Stream through one dam. The surface area of Anti-Dam Flowage measures 160.6 km^2, with the maximum depth measured at 6.2 m during 1996 field studies (NSPI 2009), and 8 m during 2018-2019 water quality depth profile surveys. A bathymetry map for Anti-Dam Flowage is provided in Appendix G.1.

Anti-Dam Flowage is a shallow reservoir, with maximum depths observed between 2.5 m and 8 m during the 2018-2019 monitoring period. As noted in Table 6.8-10, DO concentrations for Anti-Dam Flowage measured on October 23rd, 2018 (9.4 – 11.1 mg/L) were relatively homogenous throughout the water column, with the majority of substations exceeding the recommended CCME lower limit of 9.5 mg/L for early life stages of cold-water species. No thermal stratification within the reservoir was observed during the 2018-2019 monitoring period as temperature and dissolved oxygen concentrations remained relatively homogenous throughout the water column, gradually decreasing with depth (tables presented in Appendix B.5). Overall, temperature and dissolved oxygen concentrations throughout the water column on Anti-Dam Flowage were acceptable for aquatic life.

Colour measurements ranged from 63-82 TCU, with an average of 74 TCU across all substations. TDS from in-situ water samples were relatively consistent across all substations, ranging between 15-17 mg/L, while turbidity ranged from 0.16-2.2 NTU.

Mean total phosphorus concentration at Anti-Dam Flowage from surface and depth samples taken on October 22nd, 2018 was 0.026 mg/L. Total phosphorus concentrations were used to characterize the trophic status of the reservoir. Results (mean TSI value of 51.28) indicate mesotrophic conditions on the date sampled. However, nitrate (nitrogen that is available to most aquatic life) ranged below the laboratory detection limit of 0.05 mg/L to 0.52 mg/L. In addition, chlorophyll a concentrations were low, with an average of 0.986 mg/L across sampled substations. These factors, coupled with low TDS and turbidity values, suggests that Anti-Dam is likely exhibiting low primary productivity with moderately rich plant nutrients.

Field studies conducted as part of the NSPI re-licensing process for the East River Sheet Harbour hydro system found that physical and chemical properties within both reservoir and stream environments, including low concentrations of nutrients and low–middle (oligotrophic – mesotrophic) primary production, indicate limited aquatic productivity across the watershed. However, this is typical for the Southern Upland region within which the watershed lies. Like most lakes in the province, the low levels of dissolved solids associated with the underlying bedrock generally results in oligotrophic conditions without the influence of anthropogenic disturbances (Nova Scotia Museum 1996).

Seasonal variation of primary productivity in Anti-Dam Flowage was assessed through the interpretation of surface water quality baseline monitoring results for SW13. Surface water quality baseline monitoring, as discussed in Section 6.6.2.5, was conducted on a quarterly basis (December 5, 2018; April 16, 2019; June 5, 2019; and September 18, 2019) in Anti-Dam Flowage and is on-going through 2020. At SW13, this sampling program comprised one surface and one near-bottom depth sample. Indices and related parameters of primary productivity from discrete samples taken at SW13 have been brought forward to describe the seasonal variation of primary productivity in Anti-Dam Flowage. These results are presented in Table 6.8-16.

Table 6.8-16:Primary Productivity Parameters for SW13 (Anti-Dam Flowage) from 2018-2019

Date	Sample	Turbidity (NTU)	TDS* (mg/L)	Colour (TCU)	Chlorophyll a (µg/L)	Nitrate (mg/L)	Phosphorus (mg/L)	TSI (P)**
December 2018	Surface	0.66	10	76	0.43	<0.050	0.025	50.56
	Depth	0.47	14	82	0.37	<0.050	0.025	50.56
March 2019	Surface	1.10	22	47	2.02	<0.050	0.023	49.36
	Depth	0.99	22	47	1.90	<0.050	0.021	48.05
June 2019	Surface	0.81	29	64	2.36	<0.050	<0.020	47.34***
	Depth	0.80	25	61	1.20	<0.050	<0.020	47.34***
September 2019	Surface	2.30	34	90	4.65	<0.050	0.026	51.13
	Depth	2.40	50	91	4.60	<0.050	0.022	48.72
Range		**0.47-2.4**	**10-50**	**47-91**	**0.37-4.65**	**<0.050**	**<0.020-0.026**	**47.34-51.13**

*TDS: Total dissolved solids.
**TSI (P): Trophic Status Index calculated using phosphorus concentrations
***TSI (P) calculated using Phosphorus detection limit of 0.020 mg/L. Result is an overestimate of actual conditions.

TSI(P) results were relatively stable throughout the sampling period. All sampling events were indicative of mesotrophic conditions; however, total phosphorus concentrations in June 2019 fell below the detectable limit of 0.020 mg/L. TSI(P) was calculated using the detection limit (0.020 mg/L), with the recognition that the result is an overestimate of actual conditions.

Colour, TDS, and turbidity were highest in September 2019, which corresponded to the highest concentration of chlorophyll a measured as 4.65 and 4.60 µg/L at surface and depth, respectively. This peak in chlorophyll a levels in late summer likely reflects an increase in algal growth promoted by higher water temperatures and light conditions during the summer months. Based on Carlson's trophic state gradient (Carlson, 1977), these peak concentrations of chlorophyll a are indicative of mesotrophic conditions within the reservoir, which is analogous to the trophic state index derived from phosphorus concentrations. During all other sampling events, chlorophyll a levels were suggestive of a lower trophic level than that derived from phosphorus (chlorophyll a concentrations below 2.6 µg/L are considered indicative of oligotrophic conditions).

Carlson (1977) noted that phosphorus levels are relatively stable throughout the year and can therefore provide meaningful TSI values during seasons when peak algal biomass is not reached. In instances where chlorophyll a trophic values diverge from that predicted by the phosphorus index, algal biomass is likely being limited by factors other than phosphorus. This was observed in December, March, and June sampling events, when chlorophyll a values were indicative of a lower trophic level (oligotrophic) than phosphorus concentrations (mesotrophic). During these months, primary production is anticipated to be limited mainly by low light and water temperatures.

Results indicate that Anti-Dam reservoir generally exhibits oligo-mesotrophic conditions, with seasonal peaks in primary productivity levels occurring in the summer, and lower productivity levels through the fall and winter. On-going assessments are being completed through 2020 to continue the evaluation of primary productivity and seasonal variation within the FMS Study Area.

6.8.3.1.7 *Benthic Invertebrates and Secondary Productivity*

The total number of animals of each type (taxonomic group) was determined for each sample collected within the FMS Study Area. These numbers were used to calculate several indices of baseline benthic community health and secondary productivity, which can be compared between sites and, with time, at each site. Indices calculated are all commonly used in studies of this kind and include:

- EPT Ratio (ratio of abundance of mayflies (Ephemeroptera), stoneflies (Plecoptera) and caddisflies (Trichoptera) to total numbers of organisms);
- Total Abundance (number of animals in the sample and per unit area);
- Taxon Richness (number of taxa per sample); and
- Biomass (total mass of organisms in a sample per unit area).

All organisms present were included in estimates. Laboratory methods, as well as sediment descriptions for the eighteen samples and species identifications are presented in the report prepared by Envirosphere Consultants Limited (2019), included in Appendix G.2. Total Abundance, Taxon Richness, Biomass, and EPT Ratio, and measures are presented in Table 6.8-17. Lotic and lentic FIA benthic sampling results are discussed separately.

Table 6.8-17: Benthic Invertebrate Community Characteristics

FIA	Sample	Abundance (# individuals/m^2)	Taxa Richness (# of species)	Biomass (g/m^2)	EPT: Total Ratio (%)
1 (downstream of proposed pit)	1.1	4,433	27	3.70	17.37
	1.2	6,171	33	5.35	53.48
	1.3	4,059	24	0.66	11.92
	Average	4,887	28	3.24	27.59
	Std. Dev.	1,127	5	2.38	22.58
2 (within proposed pit)	2.1	2,233	13	0.56	3.94
	2.2	7,865	31	26.10	52.45
	2.3	10,307	21	11.19	24.33
	Average	6,801	21	12.62	26.92
	Std. Dev.	4,140	9	12.83	24.36
3 (upstream of proposed pit)	3.1	3,113	27	2.38	19.49
	3.2	16,786	27	10.26	24.25
	3.3	14,454	29	13.73	16.13

FIA	Sample	Abundance (# individuals/m^2)	Taxa Richness (# of species)	Biomass (g/m^2)	EPT: Total Ratio (%)
	Average	11,451	27	8.79	19.96
	Std. Dev.	7,314	1	5.82	4.08
4 (within proposed TMF)	4.1	13,376	8	4.46	4.93
	4.2	2,607	15	1.82	10.55
	4.3	759	12	8.07	7.25
	Average	5,580	11	4.78	7.58
	Std. Dev.	6,813	3	3.14	2.82
5 (Anti-Dam)	5.1 (littoral north)	474	1	0.19	0
	5.2 (littoral north)	86	1	0.05	0
	5.3 (mid-depth)	73	1	0.04	0
	5.4 (mid-depth)	302	3	0.84	0
	5.5 (max. depth)	431	2	0.05	10.00
	5.6 (littoral south)	1,940	3	0.49	0
	Average	566	2	0.29	1.67
	Std. Dev.	700	0.6	0.33	5.77

6.8.3.1.7.1 Lotic Systems

There are several factors that regulate the distribution and abundance of benthic macroinvertebrates, including current speeds, temperature, altitude, season, substratum, vegetation, dissolved substances (e.g., oxygen), and pH (Hussain & Pandit 2012). In order to illustrate the effects of some of these factors, temperature and pH will be discussed in relation to their effects on benthic macroinvertebrates. The distribution and community structure of benthic macroinvertebrates is limited by their ability to live within a specific temperature range. Temperature affects their emergence patterns, growth rates (Sweeney & Schnack 1977), metabolism (Angelier 2003), reproduction (Vannote & Sweeney 1980), and body size (Sweeney & Schnack 1977). Benthic macroinvertebrates also vary in their sensitivity to pH. Values below 5.0 and greater than 9.0 are considered harmful (Yuan 2004); studies have shown that low pH values are associated with lower diversity of benthic macroinvertebrates (Thomsen & Friberg 2002), and can cause decreased emergence rates (Hall et al. 1980).

All lotic FIA (1-4) samples were numerically dominated by Diptera (midgefly larvae (Chironomidae and Ceratopogonidae)). Caddisfly larvae (Trichoptera) occurred frequently at all FIAs, while Mayfly larvae (Ephemeroptera) and Aquatic Beetles (Coleoptera) were numerous at all sites with the exception of FIA 4. Aquatic worms (oligochaetes) were documented within every FIA. Minor numbers of other groups were documented, including Stonefly larvae (Plecoptera), Springtails (Collembola), Aphids (hemiptera), Moth and

Butterfly larvae (Lepidoptera) (moth and butterfly larvae), Alderfly and Dobsonfly larvae (Megaloptera), Dragon and Damselfly larvae (Odonata), Water Mites (Hydrachnidia) and Mollusca (bivalves Pisidiidae; gastropods Planorbula, Physa and Ferrissia).

Taxon richness indicates the health of the community through its diversity, and increases with increasing habitat diversity, suitability, and water quality. Taxon richness equals the total number of taxa represented within the sample. The healthier the community is, the greater the number of taxa (i.e., diversity of taxa) found within that community. Similarly, a high abundance may indicate a healthier waterbody. Overall abundance was moderate to high for lotic FIA samples (4887-11,451 individuals/m^2), while average taxon richness was moderate for all four lotic FIAs (11-28 taxon).

The EPT index is named for three orders of pollution sensitive aquatic insects that are common in the benthic macroinvertebrate community: Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) and is commonly used as an indicator of water quality (i.e., the greater percentage of the total sample comprised of EPT organisms indicates a healthier site). Generally speaking, the EPT index increases with increasing water quality. However, there are many factors that regulate the distribution and abundance of benthic macroinvertebrates within aquatic environments (as well as biological condition within a waterbody), thus the results of this study only allow for the establishment of baseline conditions that can later be used in a monitoring program to identify potential changes to water quality within these specific environments.

The average EPT ratio was low for FIA 4 (7.58) and moderate (16.1-50.2%) for FIAs1-3. Differences in taxon richness between FIA 4 (11) and FIAs 1-3 (21-28) suggest that overall water quality is low for FIA 4 relative to FIAs 1-3. Accordingly, pH and DO levels for FIA 4 recorded during benthic surveys (Table 6.8-9) were below the acceptable ranges for aquatic life (CCREM 1987; CCME 1999a), whereas pH and DO levels for FIA 1-3 were generally within an acceptable range.

Biomass, or the weight of benthic invertebrates in the sample, is considered a key indicator of secondary production in streams, as benthic invertebrates often dominate the animal biomass that is produced in streams over a given period of time (Hershey et al. 2010). Overall biomass measurements for FIA samples were moderate (FIAs 1, 4, 3; 3.24-8.79 g/m^2) to high (FIA 2; 12.62 g/m^2).

Seasonal variation of benthic macroinvertebrate communities and secondary productivity in lotic environments can occur as a result of seasonal changes in oxygen concentration, temperature, general water chemistry, and flows (Hershey et al. 2010). Aquatic secondary consumers within lotic environments are also subject to seasonal variation in food resources. Benthic macroinvertebrates depend on resources originating from both within (autochthonous resources, i.e., algal biomass accumulation) and outside (allochthonous resources, i.e., leaf litter) the stream. As noted in 6.8.3.1.6, variation in algal biomass accumulation (i.e., primary production) can result from seasonality various physical and chemical characteristics of the stream. Secondary productivity in low-order streams, like those found within the FMS Study Area, is also strongly influenced by the input of leaf litter from the surrounding environment. This detritus can serve as the primary energy source for secondary production (Dodds 2006; Hershey et al., 2010).

In temperate streams, physical conditions (i.e., light, temperature) promote greater rates of primary production in summer than during the winter. Junker and Wyatt (2014) found that within a highly seasonal, temperate stream, that 50% of annual invertebrate production occurred from July to October, which coincided with relatively warm temperatures and the highest rates of primary production. However, during colder months when primary production and metabolic demands were low, the invertebrate production was primarily supported by terrestrial litter. It is expected that secondary production within lotic systems in the FMS Study Area follows similar seasonal patterns to those observed by Junker and Wyatt (2014), However, it is important to note that invertebrate biomass concentrations presented Table 6.8-17 provide an index of secondary production from a snapshot in time, and therefore seasonal variation in production is inferred from the literature. These results allow for establishment of baseline conditions that can later be used in a monitoring program to identify potential changes to water quality within these specific environments. On-going assessments are being completed through 2020 to continue the evaluation of benthic invertebrates and secondary productivity within the FMS Study Area.

6.8.3.1.7.2 Lentic Systems

Samples from FIA 5 contained few animals. Oligochaetes (aquatic worms) were dominant in four of the six subsamples, while Diptera (fly) larvae were most numerous in the remaining two subsamples. Veneroida (bivalve molluscs) and Ephemeroptera (mayfly larvae) were the only other taxonomic groups identified, each present at only one of the six subsamples. Consequently, benthic invertebrate community samples for FIA 5 had low overall abundance, low average taxon richness (2), low biomass (0.29 g/m^2), and low EPT ratio (1.67%). In addition, no obvious trends between biomass in the littoral zone versus mid- and max-depths were observed.

Popp and Hoagland (1995) documented temporal changes in benthic community structure in a reservoir in New England. Over time, the authors found a significant decline in taxon richness, reduction in biomass, and increase in taxon similarity between sample sites. In the study, sample sites displayed a community shift towards a single dominant taxon, aquatic worms, comprising 90% of the total density and biomass of the benthic communities sampled. Comparably, the benthic community structure for Anti-Dam Flowage showed overall low taxon richness and biomass, with most subsamples dominated by aquatic worms. Popp and Hoagland attributed these temporal benthic changes to sediment homogeneity and enrichment from the accumulation of organic matter (1995). In addition, the benthic invertebrate community of Anti-Dam is likely susceptible to disturbance from water level fluctuations which can alter sediment exposure and water temperature, particularly at sample sites with relatively shallow bathymetry. During sampling conducted as part of the surface water quality baseline study (results presented in Appendix B.5), the maximum depth measured in Anti-Dam Flowage (SW13) varied between approximately 4 m in September 2018, corresponding to when the reservoir was drawn down, to over 8 m in December 2018, when the reservoir was refilled. Visual observations of Anti-Dam Flowage by MEL during surface water sampling in periods of draw-down noted large expanses of the littoral zone being exposed, compared to when the reservoir is filled. The benthic community as sampled within Anti-dam Flowage suggests habitat quality within the reservoir is degraded.

Like lotic environments, seasonal variation in secondary productivity in lentic environments is influenced by fluctuations in various physical, chemical, and biotic factors. This includes variation in temperature, food production/quality, oxygen concentration, and substrate characteristics (Downing 1984). In addition, seasonal variability in secondary productivity can be linked to variations in primary productivity, as secondary productivity is ultimately limited by the primary productivity of an ecosystem (Edmondson 1974).

Anti-Dam Flowage is a relatively shallow reservoir with no observed thermal stratification (see Appendix B.5 for water quality profiles). Dissolved oxygen concentrations throughout sampling period were acceptable for aquatic life (7.57 mg/L – 13.18 mg/L) and are therefore not expected to significantly influence seasonal variation in secondary production. Temperature, on the other hand, is anticipated to play a key role in seasonal variation. Aquatic invertebrate production has been demonstrated to be positively correlated with temperature, due to its influence on invertebrate growth rates, amongst a number of other variables (Plante and Downing 1989). Temperature also plays a role in the seasonal variation of primary production, as demonstrated in Section 6.8.3.1.6, which intrinsically limits secondary production.

As shown in Table 6.8-16, chlorophyll a levels within Anti-Dam flowage were observed to peak in September, suggesting that primary production is highest within Anti-Dam Flowage during the warmer, summer months. Secondary production, being highly influenced by temperature and primary productivity, is expected to follow this trend. However, habitat degradation within the reservoir (as suggested by low overall benthic invertebrate abundance, low average taxon richness, low biomass, and low EPT ratio) likely suppresses any significant variation from the low biomass levels observed during the October 2018 sampling period. Popp and Hoagland (1995) demonstrated only a slight seasonal variation in invertebrate biomass in their reservoir, with a range of 0.12 g/m^2 to 0.43 g/m^2 over the course of a year.

6.8.3.2 Fish Habitat Assessment

6.8.3.2.1 *Desktop Evaluation*

A desktop evaluation for priority fish species revealed two priority species, Atlantic salmon and brook trout, documented within 5 km of the FMS Study Area by the ACCDC report (See Section 6.12 for a definition of Priority Species). ACCDC was not able to verify the source or date of the Atlantic salmon range data; however, Atlantic salmon were historically abundant within the East River Sheet Harbour river system, which is potentially why their documented range according to the ACCDC extends into the FMS Study Area. As such, this historic Atlantic Salmon habitat documentation is not considered present within the current PA. No location sensitive species of fish have been identified within 5 km of the FMS Study Area. Priority fish species identified as having an elevated potential to be located within the PA, based on habitat preferences, and broad geographic range, include American eel, Atlantic salmon, brook trout, and pearl dace. Details relating to habitat requirements for Priority Species identified within the Study Area are discussed in Section 6.12.

The Southern Uplands Population of Atlantic salmon has been assessed as endangered by COSEWIC (2010) and is considered imperiled provincially by the ACCDC (ranked S1). This population is not currently protected under SARA or NSESA. Atlantic salmon are divided into unique populations based on genetic distinction and range. For the purposes of this discussion, the EIS is considering only the Southern Uplands (SU) Population, as outlined by DFO in the Recovery Potential Assessment for the Southern Uplands population of Atlantic Salmon (Fisheries and Oceans Canada 2013).

Atlantic salmon was not observed during any fish sampling programs within the FMS Study Area. However, Atlantic salmon were historically abundant within the East River Sheet Harbour river system. With the installation of hydroelectric dams and increased acidification of the river system, the East River Sheet Harbour has been determined to be “largely inaccessible to anadromous fishes since the early 1920s” (O’Neil et al. 1997) and “partially impacted by acidification, and may yet have remnant populations of salmon” (DFO 2000).

During the 1990s, this species was released into Fifteen Mile Stream through a trap and truck system as part of a five-year management plan for anadromous fisheries resources in the East River Sheet Harbour (O'Neil et al. 1997). The species is therefore presumed to have populated several tributaries to this watercourse, including tributaries found within the FMS Study Area. However, despite the considerable amount of resources directed towards managing the Atlantic salmon on the East River Sheet Harbour, adult returns to the river from 2004 -2007 averaged less than five fish and the program was discontinued (NSPI 2009). Watt (1997) described salmon in the East River Sheet Harbour watershed as a remnant population where some may survive in one or two higher pH tributaries. No salmon were reported in the NS Fisheries and Aquaculture surveys completed in 1973, 1993 and 1995 in the local watershed around the FMS Study Area. Research is also suggesting that factors [unknown] other than acidification are reducing salmon production in fresh water throughout the Southern Upland (Gibson et al. 2010). The presence of Atlantic salmon within the FMS Study Area is unlikely, and any Atlantic salmon which may be present in watercourses found within the FMS Study Area would be remnant individuals of an isolated population.

Based on the Nova Scotia Freshwater Fish Species Distribution Records (see Table 6.8-18), and fish studies conducted for the East River Sheet Harbour hydro system other fish species expected within the watershed are white perch, yellow perch, American eel, lake chub, golden shiner, ninespine stickleback, and banded killifish (NSPI 2009; NSDFA 2017). Species-specific habitat descriptions for all species expected or confirmed within the FMS Study Area are provided in Section 6.8.3.9

Table 6.8-18: Nova Scotia Freshwater Fish Species Distribution Records within the East River Sheet Harbour watershed (NSDFA 2017)

County	Name	Easting	Northing	Capture Date	Species Common Name	Capture Method Name
Halifax	Seloam	538,810	5,001,470	08/14/1973	Brook Trout	100 ft gill net
Halifax	Seloam	538,810	5,001,470	08/14/1973	Brown Bullhead	100 ft gill net
Halifax	Seloam	538,810	5,001,470	08/14/1973	White Sucker	100 ft gill net
Halifax	Seloam	538,810	5,001,470	08/14/1973	Lake Chub	unknown
Halifax	Seloam	538,810	5,001,470	08/14/1973	Golden Shiner	100 ft gill net
Halifax	Seloam	538,810	5,001,470	08/14/1973	Nine Spine Stickleback	100 ft gill net
Halifax	Seloam	538,810	5,001,470	08/14/1973	Banded Killifish	100 ft gill net
Halifax	Seloam	538,810	5,001,470	06/21/1995	Brook Trout	100 ft gill net
Halifax	Seloam	538,810	5,001,470	06/21/1995	Brown Bullhead	100 ft gill net
Halifax	Seloam	538,810	5,001,470	06/21/1995	White Sucker	100 ft gill net
Halifax	Seloam	538,810	5,001,470	06/21/1995	Golden Shiner	100 ft gill net
Halifax	Seloam	538,810	5,001,470	06/21/1995	Nine Spine Stickleback	100 ft gill net
Halifax	Seloam	538,810	5,001,470	06/21/1995	Banded Killifish	100 ft gill net
Halifax	Seventeen Mile	535,723	5,003,660	07/06/1973	Brook Trout	100 ft gill net
Halifax	Seventeen Mile	535,723	5,003,660	07/06/1973	Brown Bullhead	100 ft gill net
Halifax	Seventeen Mile	535,723	5,003,660	07/06/1973	White Sucker	100 ft gill net
Halifax	Seventeen Mile	535,723	5,003,660	07/06/1973	Banded Killifish	100 ft gill net
Halifax	Antidam	539,328	4,995,580	06/15/1973	Brook Trout	300 ft gill net
Halifax	Antidam	539,328	4,995,580	06/15/1973	Brown Bullhead	300 ft gill net
Halifax	Antidam	539,328	4,995,580	06/15/1973	White Sucker	300 ft gill net
Halifax	Antidam	539,328	4,995,580	06/15/1973	Lake Chub	300 ft gill net
Halifax	Antidam	539,328	4,995,580	06/15/1973	Nine Spine Stickleback	300 ft gill net

County	Name	Easting	Northing	Capture Date	Species Common Name	Capture Method Name
Guysborough	Lower Rocky	535,862	5,006,700	07/25/1973	Brook Trout	100 ft gill net
Guysborough	Lower Rocky	535,862	5,006,700	07/25/1973	Brown Bullhead	100 ft gill net
Guysborough	Lower Rocky	535,862	5,006,700	07/25/1973	White Sucker	100 ft gill net
Guysborough	Lower Rocky	535,862	5,006,700	08/17/1993	Brook Trout	100 ft gill net
Guysborough	Lower Rocky	535,862	5,006,700	08/17/1993	Brown Bullhead	100 ft gill net
Guysborough	Lower Rocky	535,862	5,006,700	08/17/1993	White Sucker	100 ft gill net

NOTE: *All origin: Natural Occurrence

6.8.3.2.2 *Field Evaluation*

The potential for each watercourse and wetland to support fish habitat and fish was evaluated across the FMS Study Area. Forty-two (42) linear watercourses and their associated open water systems, two waterbodies (Anti-Dam Flowage, East Lake), and 274 wetlands were identified and evaluated within the FMS Study Area. Fish habitat potential was determined at each location during field identification/evaluation and collection of physical characteristics of each watercourse/wetland. The physical characteristics of each homogenous watercourse/watercourse reach described during initial identification and evaluation are provided in Section 6.6. Qualitative fish habitat descriptions for linear (numbered) and open water (lettered) reaches are provided in Table 6.8-19. The detailed quantification of fish habitat by species and life cycle is presented in the effects assessment, Section 6.8.6.1

Table 6.8-19. Fish Habitat Quality Designations for Linear Watercourses within the FMS Study Area

Surface Water System	Watercourse Reach	Discussion
East Lake and tributaries	19, 39, 49, 50, 51	'Nil' reaches are positioned upgradient of East Lake but have no hydrological connection to East Lake or other fish-bearing aquatic features.
	38, 43.1*, 43.2, EB1, EB5	These 1st-2nd order streams are characterized by homogenous habitat throughout, with habitat types restricted to flats or cascades. Bottom substrates are typically dominated or completely composed of one substrate type, and reaches lack in-stream cover in the form of vegetation and woody debris. If potential adult or juvenile habitat is available for brook trout or white sucker, it is extremely limited within the reach. Measured DO and/or pH levels are often limiting.
	KK, LL	Water quality (DO and pH) are limiting within these open water systems immediately above and below East Lake. Substrate is dominated by fines. Woody debris, in-stream vegetation, and other forms of cover are scarce.
	30	This flat tributary to East Lake has suitable depths, in-stream vegetation, and abundant fine substrate to support white sucker rearing and foraging. The lack of substrate complexity and flow does not make this reach suitable for young of year or juvenile brook trout..
	EB2	A complex array of rocky substrates, habitat morphologies, and stable, moderate flows make this reach ideal for rearing juvenile brook trout. A lack of slower pools, fine substrate, and in-stream vegetation limits habitat suitability for white sucker.
	EB3, EB4	These reaches of East Brook provide plenty of suitable young of year, juvenile and adult habitat for both brook trout and white sucker. In-stream cover is provided in the form of deep water, substrate, woody debris, and in-stream vegetation. Overwintering is provided through deep water habitats or suitable flows and cover in the form of larger substrate to prevent freezing.
	EBOA, EBOB	These deep, open water areas within East Brook contain larger substrate mixed with fines. The linear sections of East Brook that flow into these open water areas provide a source of dissolved oxygen that enhances the water quality of these open water features compared to those upstream of East Brook (KK, LL). Woody debris and vegetation provide additional sources of cover.
Seloam Brook and tributaries	3, 41	'Nil' reaches are positioned upgradient of Seloam Brook but have no hydrological connection to Seloam Brook or other fish-bearing aquatic features.
	1.4	This ditched diversion channel along Seloam Brook is result of historic mining activities. It has been assessed as accessible to fish during periods of high flow from the backwatering of Seloam Brook but provides little natural habitat in terms of flow regime, natural substrate, or vegetative cover. This ditched feature is not considered to provide suitable fish habitat.

Surface Water System	Watercourse Reach	Discussion
	2, 5, 6, 7, 8, 9, 10, 12.1*, 12.2*, 12.6, 13, 14*, 15, 21, 23*, 24.1*, 24.3*, 42.4, 45*	These reaches, typically 1st-2nd order, intermittent streams or diversion channels through Seloam Brook are characterized by homogenous habitat throughout. with substrates typically dominated or completely composed of one substrate type, and reaches lack in-stream cover (boulders, undercut banks, vegetation, or woody debris). If potential adult or juvenile habitat is available for brook trout or white sucker, it is extremely limited within the reach. Measured DO and/or pH levels are often limiting.
	A, B, E, L, M, N, O, P, Q, R, S, W, EE*, FF*, GG*, HH	Typically, these open water features are present as a result of historic mining activities and provide little in way of fish habitat complexity. Water quality (DO and pH) are generally limiting within these open water systems, and water is generally shallower than in moderate quality open water features. Substrate is dominated by fines, and cover is limited.
	12.3*, 12.4*, 12.5*, 24.2*, 42.2	These low velocity tributaries to Seloam Brook with in-stream vegetation, and abundant fine substrate support white sucker young of year or juvenile rearing and foraging. The lack of substrate complexity and flows do not make this reach suitable for young of year or juvenile brook trout.
	1.1, 1.3, 1.5, 20.1	Reaches are dominated by larger, rocky substrates. Flows within these systems are stable, with moderate – high velocities. Boulders and undercut banks provide in-stream cover, which makes these reaches suitable for young of year and juvenile brook trout. A lack of slower pools, fine substrate, and in-stream vegetation limits habitat suitability for white sucker.
	1.2, 1.6, 4, 11, 20.2, 22, 25, 42.3, 42.5	These reaches and tributaries of Seloam Brook are typically perennial, 3rd order streams that provide suitable habitat for both brook trout and white sucker. Flows range from low to moderate, with diverse channel morphologies present in the forms of wide, deep-water flats in lower gradient areas and pool-riffle-runs in higher gradient areas. In-stream cover is provided in the form of deep water, larger substrate, woody debris, and in-stream vegetation.
	C, D, F, G, H, I, J, K, T, U, V, X, Y, Z	These open water features associated with Seloam Brook contain areas of deep water and have increased substrate complexity than low quality open water features (typically a mixture of fines and rocky material). Woody debris and vegetation provide additional sources of cover.
Fifteen Mile Stream and tributaries	48	This 'nil' reach is positioned upgradient of Fifteen Mile Stream has no hydrological connection to Fifteen Mile Stream or other fish-bearing aquatic features.
	16, 17, 18, 26, 27, 44*, 47	These 1st order tributaries to Fifteen Mile Stream are all intermittent (i.e. seasonal) streams which flow only during certain times of the year. During low-normal flows, water within the channel is confined to small, residual pools that lack sufficient depth to provide cover. Reaches vary between flat (low gradient, visually stagnant) and high gradient streams characterized by step-pools. Suitable habitat was not observed for brook trout or white sucker.

Surface Water System	Watercourse Reach	Discussion
	40	This reach within Fifteen Mile Stream provides suitable habitat for young of year, juvenile, and adult brook trout and white sucker. Diverse channel morphologies (flats, pools, riffles) provide an array of velocities within the channel. A variety of substrate types were noted to be present, with small boulders providing a form of in-stream cover. Cover is also provided by deep-water pools and in-stream vegetation.
	AA, BB, CC, DD	Among other habitat features, these areas of open water within Fifteen Mile Stream contain suitable spawning substrate (gravels).
Isolated	II, JJ	These 'nil' open water ponds are hydrologically isolated from downgradient fish-bearing systems. Ponds receive overland drainage, and lack a channelized inlet or outlet.

Notes: * Fish habitat/passage available only during periods of high flow. Nil = Not accessible

Sixty-three field-delineated watercourse reaches were categorized into groups of similar qualitative habitat descriptions for brook trout and white sucker, based on the qualitative determination methodology outlined in Section 6.8.2.1.2. These habitat groupings were assigned to reaches based on the presence, absence, and abundance of features within each reach that could support key habitat characteristics for brook trout and white sucker as identified in Table 6.8-2. Generally, watercourse reaches exhibiting greater habitat complexity were determined to provide more suitable fish habitat than watercourse reaches characterized by uniform physical and morphological characteristics.

Eight watercourses reaches (3, 19, 39, 41, 48, 49, 50, and 51) were categorized as 'nil', and therefore provide no fish habitat. For all identified 'nil' reaches, this habitat quality determination was based a complete lack of hydrological connectivity to downstream fish-bearing systems. In layperson terms, these watercourse reaches dissipate into upland habitats, in most cases, upland forested habitat with no seasonal surface water flow path. Hydrological connectivity has been defined in in this document as it relates to fish habitat and the ability for any fish to access the linear watercourse at any time of the year. Hydrological connectivity of surface water features was assessed based the presence of watercourse parameters as defined in NSE guidance (described in Section 6.8.2.1.3), and general hydrology indicators to identify evidence of a surface water connection between the linear watercourse/open water feature in question and a downgradient, known or potential fish-bearing system. 'Nil' reaches have been assessed as isolated from fish based on the following field-verified conditions:

- No evidence of a channel or pathway that would conduct water from the channelized reach in question to a downgradient, fish-bearing system, at any time of the year (i.e., no indication that water has flowed in a path for a length of time and rate sufficient to erode a channel or pathway, no sand, gravel and/or cobbles evident in a continuous pattern over a continuous length with little to no vegetation); and,
- No evidence of other types of surface flow (i.e., overland sheet flow) that could connect the channelized reach in question to a downgradient, fishing-bearing system (i.e., no continuous presence hydrological indicators such as drainage patterns, water marks, sediment deposits, drift deposits, algal mats, surface soil cracks, etc.).

One delineated watercourse reach, WC1.4, was classified as 'nil-low'. This watercourse is in fact a ditched diversion channel that lies just south of Seloam Brook and is present as a result of historic mining activities. Throughout normal to low flow conditions, the channel is predominantly dry; however, during high flow conditions backwater from Seloam Brook has been observed to fill the channel. As such, the channel has been assessed as accessible to fish during periods of high flow, but provides little natural habitat in terms of flow regime, natural substrate, or vegetative cover, and is not considered to provide quality fish habitat.

Thirty-one watercourse reaches (50%) were categorized as low-quality habitat for both brook trout and white sucker (2, 5, 6, 7, 8, 9, 10, 12.1, 12.2, 12.6, 13, 14, 15, 16, 17, 18, 21, 23, 24.1, 24.3, 26, 27, 38, 42.4, 43.1, 43.2, 44, 45, 47, EB1 and EB5). These reaches, typically 1st order seasonal streams, lacked the morphological, substrate, and in-stream cover complexity of moderate quality watercourse reaches. Low DO and pH levels were also common to these reaches. These watercourse reaches lack stream features that would provide suitable young of year, juvenile or adult habitat for either brook trout or white sucker, with habitat provisioning likely restricted to foraging, refuge, and/or passage for these species and other generalist species expected within the FMS Study Area.

Six watercourse reaches (9%) were categorized as low-quality habitat for brook trout and moderate quality habitat for white sucker (12.3, 12.4, 12.5, 24.2, 30, and 42.2). These watercourse reaches are all low-gradient streams characterized by low to visually imperceptible flow. Deep-water, abundant in-stream vegetation, and fine substrates are available to support white sucker, and other generalist species rearing and foraging. However, brook trout rearing habitat was deemed to be absent due to a lack of substrate complexity, channel morphology and flows.

Twelve watercourse reaches (19%) were categorized as providing moderate quality habitat for both brook trout and white sucker. Moderate habitat quality for both species within the FMS Study Area is exclusively associated with delineated reaches of Fifteen Mile

Stream (40), Seloam Brook (1.2, 1.6, 4, 11, 20.2. 22, 25, 42.3, and 42.5), and East Brook (EB3 and EB4). Generally, these habitat quality designations are associated with 2nd-3rd order streams and are described as providing suitable juvenile and adult habitat for both brook trout and white sucker, and other generalist species (i.e. forage fish).

Five watercourse reaches (8%) were categorized as moderate-quality habitat for brook trout and low-quality habitat for white sucker (1.1, 1.3, 1.5, 20.1 and EB2). These reaches within Seloam Brook and East Brook are characterized by moderate gradients, riffle-run habitat types, and moderate-high, stable flow. Substrates are dominated by boulder-sized rock, and in combination with undercut banks provide suitable cover for brook trout rearing. However, the lack of slow and deep pools for velocity refuge, fine substrate, and in-stream vegetation was identified to limit habitat suitability for white sucker and other generalist forage fish.

No high-quality habitat was found within field-delineated watercourses reaches in the FMS Study Area. High quality habitat has been defined as restricted to linear or open water features which would support spawning habitat for either brook trout or white sucker based on suitable substrate, flow rates, channel morphology, water depths, and in-stream habitat features for species as described in the literature (Raleigh 1982; Twomey et al. 1984) and outlined in Section 6.8.2.1.2. The only high-quality habitat designations were given to open water features associated with Fifteen Mile Stream along the western boundary of the FMS Study Area. However, it should be noted there are some generalist species present or expected within the FMS Study Area that may spawn in the reaches identified in Table 6.8-19. The spawning requirements of these species (such as banded killifish, brown bullhead, golden shiner, ninespine stickleback, and lake chub) are either not well documented within the literature, or when they are, are relatively nonspecific. It is therefore impractical to base habitat quality designations on nonspecific spawning provisions – brook trout and white sucker were chosen to support fish habitat quality descriptions because the freshwater habitat requirements for these species are well documented. Habitat requirements and expected freshwater habitat usage for all species known or potentially present within the FMS Study Area are described in Section 6.8.3.2.1.

Field-delineated reaches were then further broken down into linear watercourse, open water, and accessible wetland features using aerial photo interpretation during low flow conditions to further describe types fish habitat available within the FMS Study Area, to evaluate effects to fish and fish habitat, and to advise fish habitat compensation. Fish habitat quality evaluations for linear watercourses are provided in Table 6.8-19, and evaluations for open water features can be found in Table 6.8-20.

Thirty-eight open water features have been mapped using aerial photo interpretation during low flow conditions and categorized into high, moderate, low, or 'nil' habitat quality. Two (5%) open water features (II and JJ) were categorized as 'nil', as they are permanently hydrologically isolated and inaccessible to fish (as defined previously within this Section).

Fourteen open water features (37%) were categorized as moderate quality habitat. Moderate habitat quality within open water features for fish within the Study Area is exclusively found within the series of wetland complexes along Seloam Brook and the lower reaches of East Brook Generally, these open water features are associated with moderate quality linear watercourses and have areas of deep water, a variety of substrates, and an abundance of cover types.

Eighteen open water features (47%) were categorized as low-quality habitat. These open water features typically lacked depths and substrate complexity associated with moderate quality areas, with habitat provisioning likely restricted to foraging, refuge, and/or passage for brook trout, white sucker, and other generalist species. Many of these open water features along Seloam Brook exist as a result of historic mining activities, DO and pH limitations also limit habitat suitability within these features.

Four open water features (11%) were categorized as high-quality habitat. A high quality habitat has designation has been restricted to open water features which would support brook trout or white sucker spawning habitat based on the presence of suitable substrate, as well as the presence of suitable water quality, flow, well vegetated banks, and an abundance of cover (as identified in Section 6.8.2.1.2). The only high-quality habitat designation was given to open water features associated with Fifteen Mile Stream along the western boundary of the FMS Study Area. However, as previously stated, there are some generalist species present or expected within the FMS Study Area that may spawn in some of the open water features identified Table 6.8-20. Potential spawning areas for all species known or potentially present within the FMS Study Area are further described by species in Section 6.8.3.2.1.

There are two waterbodies located completely or partially within the FMS Study Area. East Lake is located in the southeast corner of the Study Area, and Anti-Dam Flowage is located within the southwest corner of the Study Area. Seloam Lake, although located just outside the FMS Study Area to the north, has also been included for evaluation due to its contiguity with the major surface water system within the Study Area (Seloam Brook) and the proposed plan to withdraw start up water and process water during operations from this lake. The physical characteristics of these waterbodies are described in Section 6.6.

Flows in Seloam Lake and Anti-Dam Flowage are regulated by NSPI dams at their natural outflows. There are currently no provisions for upstream fish passage at these dams or additional downstream dams (Marshall Falls, Malay Falls), and as such, Seloam Lake and Anti-Dam Flowage are considered inaccessible to anadromous fish species. East Lake is also considered inaccessible to anadromous fish species as this system discharges into Anti-Dam Flowage at its downstream extent.

Historically documented fish species in Anti-Dam Flowage include brook trout, brown bullhead, white sucker, lake chub, ninespine stickleback, while Seloam Lake has supported brook trout, brown bullhead, white sucker, lake chub, golden shiner, ninespine stickleback, banded killifish (NSDFA 2017). Fish collection surveys conducted in East Lake (see Section 6.8.3.5) resulted in very low catch records within the waterbody (one golden shiner) and its inflow and outflow tributaries (no fish captured), and low pH and DO measurements indicate that water quality is likely a limiting a factor to fish habitat quality.

While mapping and describing habitat along East Brook in December 2019, a waterfall was observed downstream of Grassy Lake (see Figure 6.8-3). This habitat is approximately 60 m in total length, with step-pools bringing flow over an elevation drop of approximately 5 m. Detailed measurements of step pools could not safely be obtained during this evaluation due to high flow rates, but it was determined that during high flow (approximately March-May and November-December), velocity could be a limiting factor for passage of some fish species (i.e., white sucker), and during lower flow, vertical drop heights between step pools could also limit passage of some fish (i.e., white sucker, yellow perch, white perch), based on swimming capabilities described above. Species which have the highest probability of navigating this waterfall include brook trout and American eel.

This system was revisited in July 2020 during low flow conditions. At the time of assessment, the 60 m section was predominantly dry, with no visible or audible evidence of surficial or subterranean flow. Water that remained was confined to small, dispersed pockets between large boulders. It was therefore determined that during low flow conditions, passage is further restricted by a lack of surface water.

Overall, this waterfall could not be described as a complete barrier to fish passage, though it likely limits passage of some fish species (such as white and yellow perch and white sucker) into East Brook, East Lake and its tributaries (i.e., WC43). This could contribute to the low abundance of fish captured during all fish collection surveys completed in this system to date (a single golden shiner in East Lake). The presence of this partial barrier to fish passage further reduces the usage of habitats upstream of this feature. On-going assessments of this system are being completed through 2020 to develop a more thorough understanding of potential limitations to fish passage under multiple flow scenarios.

Table 6.8-20 describes the fish habitat present within each wetland and its associated watercourse in the PA. Wetlands that were determined not to support fish habitat (i.e., no surface water connectivity and/or open water present within the wetland habitat) are not included in this table and are not discussed further in this section. Wetland habitat accessible to fish is displayed on Figures 6.8-1 and 6.8-2.

Table 6.8-20: Fish Habitat Potential within Delineated Wetlands in the FMS Study Area

WL ID	Hydrologic Regime	Associated Watercourse(s)	Potential Fish Habitat	Habitat Overview
1	Ponded Throughflow	WC2 and WC3	Fish habitat within open water, standing water in wetland, and intermittent watercourse draining as outflow from wetland habitat (northern extent of wetland habitat). Permanent open water result of historic mining activities (old pit).	Open water, surface water, watercourse (2) intermittent, surface connection to downstream fish resource during periods of high flow. Shallow contiguous surface water in wetland may provide shelter and food sources for small forage species.
2	Ponded Throughflow	WC1, WC2, WC4, WC5, WC6, WC7, WC8, WC9, WC10, WC11, WC12, WC13, WC14, WC20, WC21, WC22, WC23, WC24, WC25, WC42	Fish habitat within open water, standing water in wetland, and many associated watercourses. Multiple beaver dams and extensive hydrological disturbances from historic mining activities have increased flooded conditions throughout.	Open water, surface water, multiple channelized watercourses with direct connectivity to downstream fish resource. Deeper contiguous surface water may provide rearing, thermal refuge, shelter and food sources for small forage species. Potential habitat for juvenile brook trout along deeper, submerged vegetated wetland edge.
14	Ponded Throughflow	WC20	Fish habitat within open water and standing water in wetland. Beaver dams causing localized flooding.	Open water, surface water, direct connectivity to downstream fish resource. Deeper contiguous surface water may provide rearing, thermal refuge, shelter and food sources for small forage species. Potential habitat for juvenile brook trout along deeper, submerged vegetated wetland edge.
18	Ponded Throughflow	WC12	Fish habitat within standing water, open water in wetland and throughflow watercourse. Beaver activity causing localized flooding.	Open water, surface water, direct connectivity to downstream fish resource. Shallow contiguous surface water in wetland may provide shelter and food sources for small forage species.
20	Throughflow	WC12	Fish habitat within open water, standing water in wetland, and intermittent watercourse with boulder-bed channel draining as outflow from wetland habitat.	Open water, surface water, watercourse (12) intermittent, surface connection to downstream fish resource during periods of high flow. Shallow contiguous surface water in wetland may provide shelter and food sources for small forage species.

WL ID	Hydrologic Regime	Associated Watercourse(s)	Potential Fish Habitat	Habitat Overview
31	Throughflow	WC12	Fish habitat within standing water, open water in wetland and intermittent throughflow watercourse with boulder-bed channel.	Open water, surface water, watercourse (12) intermittent, surface connection to downstream fish resource during periods of high flow. Shallow contiguous surface water in wetland may provide shelter and food sources for small forage species.
35	Throughflow	WC12	Fish habitat within intermittent throughflow watercourse. Large boulder field in northwestern extent of wetland likely flooded during seasonally high flows.	Surface water (seasonal), watercourse (12) intermittent, surface connection to downstream fish resource during periods of high flow. Shallow contiguous surface water in wetland may provide shelter and food sources for small forage species.
53	Headwater – Outflow	WC17	Fish habitat within standing water in wetland and intermittent outflow watercourse.	Surface water, connectivity to downstream fish resource inferred from desktop analysis, no field confirmation. Shallow contiguous surface water in wetland may provide shelter and food sources for small forage species.
64	Ponded Throughflow	WC1, WC42	Fish habitat within open water, standing water in wetland, and throughflow watercourses. Beaver activity causing ponded conditions.	Open water, surface water, channelized watercourses, direct connectivity to downstream fish resource. Shallow contiguous surface water in wetland may provide shelter and food sources for small forage species. Potential habitat for juvenile brook trout along deeper, submerged vegetated wetland edge.
65	Bi-directional non-tidal/ Throughflow	WC43, East Lake	Fish habitat within open water, standing water in wetland, and vegetated wetland habitat along lake edge.	Open water, surface water, channelized watercourses, direct connectivity to downstream fish resource. Deeper contiguous surface water may provide rearing, thermal refuge, shelter and food sources for small forage species. Potential habitat for juvenile brook trout along deeper, submerged vegetated wetland edge.
173	Ponded Throughflow	WC42	Fish habitat within open water and standing water in wetland. Beaver dam causing localized ponding of watercourse.	Open water, surface water, direct connectivity to downstream fish resource. Deeper contiguous surface water may provide rearing, thermal refuge, shelter and food sources for small forage species. Potential habitat for juvenile brook trout along deeper, submerged vegetated wetland edge.

WL ID	Hydrologic Regime	Associated Watercourse(s)	Potential Fish Habitat	Habitat Overview
175	Throughflow	WC24	Fish habitat within standing water in wetland and intermittent boulder-channel throughflow watercourse.	Surface water, watercourse (24) intermittent, surface connection to downstream fish resource during periods of high flow. Shallow contiguous surface water in wetland may provide shelter and food sources for small forage species.
219	Ponded Throughflow	WC20	Fish habitat within open water and standing water in wetland. Beaver dams causing localized ponding of watercourse.	Open water, surface water, direct connectivity to downstream fish resource. Deeper contiguous surface water may provide rearing, thermal refuge, shelter and food sources for small forage species. Potential habitat for juvenile brook trout along deeper, submerged vegetated wetland edge.
240	Ponded Throughflow	WC20, WC21	Fish habitat within open water and standing water in wetland. Beaver dams causing localized ponding of watercourse.	Open water, surface water, direct connectivity to downstream fish resource. Deeper contiguous surface water may provide rearing, thermal refuge, shelter and food sources for small forage species. Potential habitat for juvenile brook trout along deeper, submerged vegetated wetland edge.
279	Bi-directional non-tidal/ Throughflow	East Lake/Outflow	Fish habitat within open water, standing water in wetland, and vegetated wetland habitat along open water edge. Beaver dams causing localized ponding of watercourse at southern extent.	Open water, surface water, direct connectivity to downstream fish resource. Deeper contiguous surface water may provide rearing, thermal refuge, shelter and food sources for small forage species. Potential habitat for juvenile brook trout along deeper, submerged vegetated wetland edge.

Fifteen wetlands have been evaluated to provide and support potential fish habitat. These wetlands are associated with the following surface water systems:

- East Lake: WL65, WL279;
- Seloam Brook (WC1, WC20, and smaller associated reaches/diversions): WL1, WL2, WL14, WL64, WL175, WL219, WL240;
- Watercourse 12: WL18, WL20, WL31, WL35;
- Watercourse 17: WL53; and,
- Watercourse 42: WL64, WL173.

In addition to supporting fish habitat within their associated watercourse and open water features, wetland habitat accessible to fish within the FMS Study Area may generally provide rearing habitat, thermal refuge, shelter, and food sources for smaller forage species (i.e., chubs, shiners). Vegetated wetland edges adjacent to deeper open water features (i.e., low shrub fens flooded by beaver activity) may also provide suitable rearing habitat for brook trout. It should be noted that fish habitat provided by WL2 is heavily influenced by previously excavated watercourses and waterbodies associated with historical mining activities.

6.8.3.3 Assessment of Fish Passage Barriers

6.8.3.3.1 *Desktop Evaluation*

A literature review for species-specific swimming capabilities was conducted for white sucker, white and yellow perch, brook trout, and American eel to aid in the determination of barriers to fish passage. The results of fishing efforts and the relative abundance of fish species within the FMS Study Area are discussed further in Sections 6.8.3.5 and 6.8.3.6.

White sucker were the most abundant species identified during fish collection surveys (n=51, ranging in length between 39 mm and 352 mm). White sucker are not particularly strong swimmers based on physical characteristics and have been shown to actively seek out slower moving waters by Haro, Castro-Santos, Noreika and Odeh (2004). Underwood, Myrick and Compton (2014) determined that white sucker is generally a slow swimmer, lacking the behavioral adaptations to higher flow shown by other sucker species (i.e., station holding, and mouth holding). While they may not show station holding and mouth holding behaviors of other sucker species, Rahel and McLaughlin (2018) found that compared with walleye (which has similar swimming capabilities to white sucker) that when faced with a barrier, white sucker showed a higher attempt rate, resulting in a higher passage rate. Garadunio (2014) found that white sucker are capable of navigating a barrier (i.e., a waterfall) up to 86% of their total length, with smaller individuals showing more success navigating barriers than larger individuals (based somewhat on repeated attempts by smaller fish). Shallow plunge pool depth is a limiting factor for this species, particularly for larger fish.

Perch were not captured during any fish collection surveys completed at FMS. Generally speaking, of the species listed above, yellow perch are weak swimmers. Yellow perch swimming speed is relatively low, and their performance is strongest when water temperatures are in the range of 20-25˚C (Brown, Runciman, Bradford and Pollard, 2009). Meixler et al. (2009) found that neither yellow or white perch could navigate the smallest barrier they faced (0.3m in height).

Brook trout are known to be present within the Antidam Flowage system and the FMS site in general, with 15 fish captured ranging from 49 mm to 262 mm in size. Brook trout are relatively strong swimmers, capable of navigating barriers from 4.7-7.7 times their body length. Kondratieff and Myrick (2006) found that in a controlled environment mimicking waterfall conditions with water temperatures at 11˚C, the highest obstacle jumped by 8.6-34 cm brook trout was 73.5 cm, provided plunge pool depth was at least

40 cm. According to Kondratieff and Myrick (2006) “Shallow pools severely limited jumping ability, brook trout only being able to jump a maximum of 33.5 cm from a 10-cm pool”.

American eel were not captured during fish surveys completed at FMS. American eel, particularly immature yellow eel, are capable of climbing vertical surfaces, provided they are rough and wet (GOMC, 2007). It has been documented that American eel are not restricted to contiguous watercourses as they possess the ability to traverse over land in wet, low lying grass habitats (MacGregor, 2011). Eel can, therefore, navigate across systems which do not even meet the regulatory definition of a watercourse. As such, it is our opinion that this is an inappropriately low threshold to meet when determining waters frequented by fish and identifying the spatial and temporal scale of fish habitat.

6.8.3.3.2 *Field Evaluation*

6.8.3.3.2.1 Watercourse 12

Potential barriers to fish passage were identified in two key locations in the FMS Study Area: WC12, and WC43. Both of these potential barriers are associated with natural boulder fields, which were identified throughout the FMS Study Area in both wetland and upland habitat. As described in Section 6.4, the surficial geology in this region consists of glacial till which is a heterogeneous mixture of unconsolidated clay, sand, gravel and boulders which formed as glaciers moved across the landscape. Boulder fields and boulder bed channels were formed from glacial till deposits, and they are present throughout the FMS Study Area.

Watercourse 12 (WC12) is a first-order headwater stream that originates as drainage from WL27, flowing west. The watercourse was delineated through August of 2017 in low flow conditions. The watercourse is extremely intermittent and only periodically channelized, draining through subterranean sections between lobes of WL27, characterized as a boulder-bed channel. Multiple boulder fields were observed between wetland habitat, including one reach between WL18 and WL20. Boulder-bed channels were mostly devoid of vegetation but were also predominantly lacking surface water. This boulder-bed channel section was identified as a potential barrier to fish passage. It was revisited on April 2nd, 2018, at which point water was observed flowing interstitially. Ice cover on top of the boulders was noted during this visit, as an indication of seasonally higher flows. The boulder-bed channel between WL18 and WL20 was revisited on May 24th, 2018, during high flow. Water was seen and heard flowing through the interstitial spaces of the boulders, though surface flow was not observed. Evidence of surface scouring was documented during this visit (moss scoured from rocks and discoloration noted on rocks). Similar observations were made on June 8th and June 11th, 2018.

Fish collection was completed in WC12 on June 11th, 2018. Below the potential barrier (WC12R1), two eel pots and three minnow traps were deployed, and one electrofishing reach was sampled, yielding one ninespine stickleback and two brook trout. Upstream of the potential barrier (WC12R2), one fyke net, two eel pots, and three minnow traps were deployed, and one electrofishing reach was sampled. This survey yielded one brook trout and ten ninespine stickleback, confirming that the boulder-bed channel section is passable to fish during high flow conditions, or a resident population of fish exists above the barrier.

6.8.3.3.2.2 Watercourse 43

Watercourse 43 (WC43) was initially assessed on November 8th, 2017 on the west side of the main interior logging road that intersects the southeastern portion of the FMS Study Area, and July 10th, 2018 on the east side of the logging road. WC43 is a first-order headwater stream that drains surface water through WL65 east to East Lake. The watercourse originates within the western shrub swamp portion of the wetland complex. Here, the watercourse disperses through the wetland and flows underground in sections, eventually forming a channel which flows east through a main culvert under the logging road (a secondary culvert is present as well). Ponding was observed on the upstream side of the culvert. This is likely the result of a debris blockage identified on the downstream end of the culvert.

East of the logging road, WC43 splits and disperses through treed swamp habitat still in a channelized fashion, eventually draining into fen habitat where the channel was observed to have flooded into WL65. A 30 m section of subsurface flow was documented within the watercourse and has been assessed as a barrier to fish passage during both low and high-flow conditions based on the absence of surficial flow.

During wetland and watercourse delineation surveys completed on July 10th, 2018, the 30 m subterranean section was identified as a section completely lacking flow, or evidence thereof. The entire reach was covered with moss and vegetation species such as *Viola sp.* and *Lycopus uniflorus*, which typically grow near, but not in, flowing water. The majority of boulders within this 30 m subterranean section were covered with *Sphagnum magellanicum* and *Sphagnum girgensohnii;* both of which are common wetland species, and not typically found in flowing water. No signs of moss trim lines or scouring were observed. Water was not observed or heard flowing between boulders during this visit.

This watercourse was reassessed on October 5th, 2018, October 10th, 2018 and September 17th, 2019, all during moderately high to high flow – even the Sept 2019 assessment which was completed following Hurricane Dorian, which resulted in a 73.2 mm rainfall measured at the Halifax Stanfield international Airport (Government of Canada 2019). During all three assessments, the observations made in July 2017 were confirmed, and no contiguous surface water was observed or heard flowing between boulders. Occasional small patches of standing water were observed at the base of boulders, though the depth of each isolated patch was insufficient to expect species to jump from pockets of water, and patches were far enough apart that any attempt to jump from one pocket of water to the next would be unsuccessful (depths were 5-10cm at the most, with gaps between pockets of water ranging from 1-3 m). Furthermore, flowing water was lacking between pockets of water, as such fishes would not likely have any instinctual response or inclination to attempt to move from one pocket to another, and those that may, would likely die as a result due to stranding. Three minnow traps were deployed in WC43 upstream of the barrier on July 11th, 2018. Traps were set for 22 to 24 hours. No fish were captured upstream of the barrier, and none were observed incidentally during dedicated fish collection surveys or other biophysical surveys.

Additional assessments of WC43 were conducted through the fall of 2019 (November 7-8 and 20-21, December 5-6 and 16-17, 2019) and spring of 2020 (April 18-19, 27-28, 2020) during supplementary fishing efforts. During each round of fish collection surveys, a habitat assessment was completed on the subterranean section of WC43. On September 17, 2019, the subterranean section of WC43 was observed to be impassable to fish. The watercourse dissipated through a treed swamp habitat, and for a length of approximately 30m, WC43 had no flowing or standing water above ground for fish to use to navigate upstream. Consistent observations were recorded during the habitat assessments completed in April 2020. Drawing from the literature review presented in Section 6.8.3.3.1, this barrier would not be navigable for strong swimmers such as brook trout during low flow, which require a plunge pool depth of 40 cm to jump approximately 74 cm (Kondratieff and Myrick, 2006). Furthermore, this section would likely provide a complete seasonal barrier for weaker swimmers such as yellow perch, white perch, white sucker and forage fish. Site assessments were completed along with fish trapping efforts in May and June 2020. During all site assessments completed during this timeframe, the water levels and conditions of WC43 were consistent with observations recorded in the summer and fall of 2019.

During surveys completed in the Fall of 2019 and Winter of 2019-2020, water levels were substantially higher within Wetland 65 and generally across the site. Above the subterranean section, Wetland 65 was thoroughly saturated and the watercourse banks were overtopped. With the saturation levels observed through November and December, flow through the previously observed subterranean section was continuous, and determined to be accessible to fish during average high flow. During November and December evaluations, pool depths within this channel ranged from 10-30 cm deep, with an average channel width of 5 cm-1.5 m. Substrate conditions were consistent with observations recorded in September 2019, with both moss-covered and bare boulders. Within the FMS Study Area, bare rocks or boulders have not been considered as a reliable indicator of hydrology, based on deposition of glacial erratics through the Study Area, and presence of bare rocks and boulder fields in both upland, wetland and lotic habitats. As such, the observation of bare rocks through previous assessments of this system was not considered an indicator of hydrology.

A site visit was complete with DFO on November 26th, 2019, at which time DFO personnel observed conditions during average high flow. MEL confirmed during this meeting that during low and normal seasonal flow regimes, this subterranean section limits passage of fish into the upper reaches of WC43.

The quality of the habitat within WC43, East Lake and East Brook is limited by seasonal passage constraints and water quality factors. pH measured in East Lake consistently fell below the optimal range for brook trout (6.5-8, with tolerance to pH ranges from 4.0-9.5) and white sucker (6-10, with tolerance to pH levels as low as 3.8). Table 6.8-12 (Section 6.8.3.1.2) provides field-based pH measurements collected in East Lake (SW12) through 2017-2019. While the data do not indicate that water quality would prevent fish usage, the pH range of 3.44-5.57 (median value of 4.38) does indicate that the habitat within this system is sub-optimal. During all fish collection efforts completed to date throughout the East Lake system, which comprised 4114 hours and 35 minutes of fishing effort, three individual fish have been identified: a golden shiner within East Lake (2018), a ninespine stickleback in reach 2 of WC43 (2020) and a brook trout in East Brook (2020).

6.8.3.4 Touquoy Mine Site

Moose River, which runs along the western extent of the Touquoy Mine Site, was determined to provide habitat for Atlantic salmon and brook trout during surveys conducted in 2005 as part of the Environmental Assessment (CRA 2007a). Atlantic salmon (juveniles) were observed and suitable rearing and potential spawning habitat is available for the species. It was presumed that the Atlantic salmon observed were landlocked due to their proximity to a known landlocked population within Scraggy Lake. American eel, white sucker, and minnow species were also observed in Moose River. Although not observed, surveys determined that there is good adult and juvenile brook trout feeding habitat, fair rearing habitat, and potential spawning habitat available within Moose River (CRA 2007a).

Fish habitat within Scraggy Like was described in the Touquoy Gold Project EARD (CRA 2007a). The fish habitat discussion focused on an un-named tributary to Moose River (identified by MEL as WC4, to the west of the TMF), Moose River, Square Lake and Scraggy Lake. Based on surveys completed, it was determined that the un-named tributary to Moose River provided marginal fish habitat quality, primarily based on low flow rates.

Additional fish community and fish habitat assessments were completed under the EEM to support MDMER regulations under the *Fisheries Act*. These baseline aquatic environment surveys were completed by Stantec Consulting Ltd. in 2017 and 2018. According to the 2017 report, fish surveys completed in Scraggy Lake identified a total of 1,091 individual fish, representing 12 species of fish. These include alewife, American eel, Atlantic salmon, banded killifish, brown bullhead, brook trout, golden shiner, lake chub, lake trout, white perch, white sucker and yellow perch. Fish community surveys were not completed in Scraggy Lake in 2018, but as part of the fish tissue sampling work, bycatch was reported. Incidental capture during fish tissue collection resulted in 143 individual fish, representing seven species within Scraggy Lake (all of which were documented in the 2017 report). Further details about fish habitat and fish communities are available in these reports (Stantec 2018b).

Moose River is a medium sized watercourse with good riparian habitat. According to the Touquoy Gold Project EARD, the portion of Moose River adjacent to the development provided good quality habitat for a variety of fishes including Atlantic salmon and brook trout. These species were observed in the area, along with American eel, white sucker and various forage fish species (CRA 2007a).

6.8.3.5 Electrofishing and Fish Collection Surveys

During assessments completed between July 2017 and July 2018 within the FMS Study Area, a total of 114 individual fish were captured at 11 locations including: Watercourse 20 at the outflow of Seloam Lake, Watercourse 1 within WL2, and WC1 west of WL2. Two locations fished resulted in no fish captured (WC43 and East Lake outflow).

Fish species of known as commercial, recreational or aboriginal interest under the previous version of the *Fisheries Act* identified within the FMS Study Area include brook trout (SOCI) and white sucker. While not identified within the FMS Study Area, yellow perch, white perch and American eel (SOCI) are expected to be present within the watershed, based on the NSPI report. Passage of Atlantic salmon into the FMS Study Area is limited by the presence of downstream dam structures, which have acted as barriers to upstream fish passage since initial dam construction during the 1920's.

Fish collection was completed to support electrofishing and fish habitat surveys across the FMS Study Area. The focus of fish collection efforts was within the Seloam Brook system and one main tributary (WC12), and WC43, a tributary to East Lake. These were selected as the focus of fish collection surveys primarily based on the proposed infrastructure layout. Suitable conditions for electrofishing were limited with the FMS Study Area, where most watercourses had limited wade-ability or accessibility to complete electrofishing surveys. As such, electrofishing surveys were supplemented with the deployment of minnow traps, eel pots and fyke nets to ensure a range of habitat types were surveyed.

Table 6.8-21 outlines a summary of fish species captured within the FMS Study Area.

Table 6.8-22 presents the results of the individual data for fish captured at each sampling site within the FMS Study Area. Fish collection sites are presented on Figure 6.8-2.

Table 6.8-21: Fish Species Captured within FMS Study Area, 2017-2018

Species	**SRank**	**Capture Method**	**Total Catch**		**Average Length (mm) per Species**
			Total #	**% Catch**	
White Sucker *(Catostomus commersoni*)	S5	Shocked, Trapped	51	44.7	160
Lake Chub *(Couesius plumbeus*)	S5	Shocked	27	23.6	83
Brook Trout *(Salvelinus fontinalis*)	S3	Shocked, Trapped	15	13.1	145
Ninespine Stickleback (*Pungitius pungitius*)	S5	Shocked	11	9.6	45
Cyprinid sp.*	-	Shocked	3	2.6	39
Golden Shiner (*Notemigonus crysoleucas*)	S4	Trapped	3	2.6	113
Brown Bullhead (*Ameiurus nebulosus*)	S5	Shocked, Trapped	2	1.7	115
Banded Killifish (*Fundulus diaphanous*)	S5	Shocked	1	0.8	58
Pearl Dace (*Margariscus margarita*)	S3	Shocked	1	0.8	80
Total			114		

Table 6.8-22: Individual Fish Measurements

Site	Survey Method	Common Name	Scientific Name	Fork Length (mm)	Total Length (mm)
WC1R1 (July 28, 2017)	E-Fish	White Sucker	*Catostomus commersoni*	95	102
		Lake Chub	*Couesius plumbeus*	83	87
		Lake Chub	*Couesius plumbeus*	85	92
		Lake Chub	*Couesius plumbeus*	74	79
		Pearl Dace	*Margariscus margarita*	75	80
		Brook Trout	*Salvelinus fontinalis*	150	155
		Brook Trout	*Salvelinus fontinalis*	172	182
		Brook Trout	*Salvelinus fontinalis*	145	148
		Brook Trout	*Salvelinus fontinalis*	142	147
		White Sucker	*Catostomus commersoni*	85	89
		Lake Chub	*Couesius plumbeus*	80	85
		Lake Chub	*Couesius plumbeus*	90	97
		Lake Chub	*Couesius plumbeus*	74	80
		Brook Trout	*Salvelinus fontinalis*	55	60
		Brook Trout	*Salvelinus fontinalis*	143	152
		White Sucker	*Catostomus commersoni*	131	140
		Lake Chub	*Couesius plumbeus*	88	94
		Brook Trout	*Salvelinus fontinalis*	47	49
		Lake Chub	*Couesius plumbeus*	67	74
		Brook Trout	*Salvelinus fontinalis*	63	66
Seloam Brook Pond 1	Eel Pot	---*No Fish*---			
	Fyke Net	Brook Trout	*Salvelinus fontinalis*	156	162
	Minnow Trap 1	---*No Fish*---			

Site	Survey Method	Common Name	Scientific Name	Fork Length (mm)	Total Length (mm)
(June 12-13, 2018)	Minnow Trap 2	White Sucker	*Catostomus commersoni*	116	121
	Minnow Trap 3	*---No Fish---*			
WC1R2 (August 2, 2017)	E-Fish	Lake Chub	*Couesius plumbeus*	79	86
		Lake Chub	*Couesius plumbeus*	90	101
		White Sucker	*Catostomus commersoni*	81	86
		White Sucker	*Catostomus commersoni*	171	184
		Cyprinid sp.	*Cyprinidae sp.*	33	36
		Cyprinid sp.	*Cyprinidae sp.*	37	41
		Lake Chub	*Couesius plumbeus*	38	41
		White Sucker	*Catostomus commersoni*	38	41
		Lake Chub	*Couesius plumbeus*	37	39
		Lake Chub	*Couesius plumbeus*	72	82
		Cyprinid sp.	*Cyprinidae sp.*	37	41
		White Sucker	*Catostomus commersoni*	37	39
		Lake Chub	*Couesius plumbeus*	79	85
		Lake Chub	*Couesius plumbeus*	90	98
		White Sucker	*Catostomus commersoni*	74	78
		Lake Chub	*Couesius plumbeus*	32	34
		White Sucker	*Catostomus commersoni*	34	37
		Lake Chub	*Couesius plumbeus*	128	136
		Lake Chub	*Couesius plumbeus*	76	83
		Lake Chub	*Couesius plumbeus*	35	39
		White Sucker	*Catostomus commersoni*	35	38
	Eel Pot	*---No Fish---*			

Site	Survey Method	Common Name	Scientific Name	Fork Length (mm)	Total Length (mm)
Seloam Brook Pond 2 (June 13-14, 2018)	Fyke Net	White Sucker	*Catostomus commersoni*	331	352
		White Sucker	*Catostomus commersoni*	309	320
		White Sucker	*Catostomus commersoni*	286	295
		White Sucker	*Catostomus commersoni*	280	292
		White Sucker	*Catostomus commersoni*	248	263
		White Sucker	*Catostomus commersoni*	204	214
		White Sucker	*Catostomus commersoni*	250	267
		White Sucker	*Catostomus commersoni*	246	260
		Brook Trout	*Salvelinus fontinalis*	250	266
		White Sucker	*Catostomus commersoni*	217	226
		White Sucker	*Catostomus commersoni*	203	206
		White Sucker	*Catostomus commersoni*	124	129
		White Sucker	*Catostomus commersoni*	115	150
		White Sucker	*Catostomus commersoni*	152	161
		White Sucker	*Catostomus commersoni*	140	148
		White Sucker	*Catostomus commersoni*	169	181
		White Sucker	*Catostomus commersoni*	155	161
		White Sucker	*Catostomus commersoni*	103	106
		White Sucker	*Catostomus commersoni*	134	151
		White Sucker	*Catostomus commersoni*	115	123
		White Sucker	*Catostomus commersoni*	124	130
		White Sucker	*Catostomus commersoni*	125	132
		White Sucker	*Catostomus commersoni*	111	115
		White Sucker	*Catostomus commersoni*	164	174

Site	Survey Method	Common Name	Scientific Name	Fork Length (mm)	Total Length (mm)
		Brown Bullhead	*Ictalurus nebulosus*	N/A	149
		White Sucker	*Catostomus commersoni*	186	195
		White Sucker	*Catostomus commersoni*	161	169
		White Sucker	*Catostomus commersoni*	147	152
		White Sucker	*Catostomus commersoni*	168	175
		White Sucker	*Catostomus commersoni*	158	166
	Minnow Trap 1	*--- No Fish---*			
	Minnow Trap 2	White Sucker	*Catostomus commersoni*	74	80
	Minnow Trap 3	*---No Fish---*			
WC20 (Seloam Lake outflow) (August 3, 2017)	E-Fish	Banded Killifish	*Fundulus diaphanus*	N/A	58
		White Sucker	*Catostomus commersoni*	262	282
		Lake Chub	*Couesius plumbeus*	85	92
		White Sucker	*Catostomus commersoni*	137	144
		Lake Chub	*Couesius plumbeus*	88	95
		Lake Chub	*Couesius plumbeus*	75	81
		Lake Chub	*Couesius plumbeus*	117	125
		Lake Chub	*Couesius plumbeus*	92	97
		Lake Chub	*Couesius plumbeus*	80	86
		White Sucker	*Catostomus commersoni*	226	233
		Lake Chub	*Couesius plumbeus*	U*	U*
		Lake Chub	*Couesius plumbeus*	76	81
		Brown Bullhead	*Ameiurus nebulosus*	N/A	82
WC12R1	E-Fish	Ninespine Stickleback	*Pungitius pungitius*	40	41
	Eel Pot	Brook Trout	*Salvelinus fontinalis*	223	225

Site	Survey Method	Common Name	Scientific Name	Fork Length (mm)	Total Length (mm)
(June 11, 2018)		Brook Trout	*Salvelinus fontinalis*	122	125
	Fyke Net	*---No Fish---*			
	Minnow Trap 1	*---No Fish---*			
	Minnow Trap 2	*---No Fish---*			
	Minnow Trap 3	*---No Fish---*			
WC12R2 (June 11, 2018)	E-Fish	Brook Trout	*Salvelinus fontinalis*	130	134
		Ninespine Stickleback	*Pungitius pungitius*	42	43
		Ninespine Stickleback	*Pungitius pungitius*	39	40
		Ninespine Stickleback	*Pungitius pungitius*	41	42
		Ninespine Stickleback	*Pungitius pungitius*	43	44
		Ninespine Stickleback	*Pungitius pungitius*	55	56
		Ninespine Stickleback	*Pungitius pungitius*	60	61
		Ninespine Stickleback	*Pungitius pungitius*	49	50
		Ninespine Stickleback	*Pungitius pungitius*	42	43
		Ninespine Stickleback	*Pungitius pungitius*	42	43
		Ninespine Stickleback	*Pungitius pungitius*	32	33
	Eel Pot	*---No Fish--*			
	Fyke Net	*---No Fish--*			
	Minnow Trap 1	*---No Fish--*			
	Minnow Trap 2	*---No Fish--*			
	Minnow Trap 3	*---No Fish--*			
WC6 (June 12-13, 2018)	Minnow Trap 1	*---No Fish--*			
	Minnow Trap 2	Brook Trout	*Salvelinus fontinalis*	182	191
	Minnow Trap 3	Brook Trout	*Salvelinus fontinalis*	109	113

Site	Survey Method	Common Name	Scientific Name	Fork Length (mm)	Total Length (mm)
WC7 (June 12-13, 2018)	Eel Pot	White Sucker	*Catostomus commersoni*	168	179
	Fyke Net	White Sucker	*Catostomus commersoni*	116	121
		White Sucker	*Catostomus commersoni*	123	127
		White Sucker	*Catostomus commersoni*	154	161
		White Sucker	*Catostomus commersoni*	124	127
		White Sucker	*Catostomus commersoni*	160	167
		White Sucker	*Catostomus commersoni*	122	128
WC43 (July 11-12, 2018)	Minnow Trap 1	*---No Fish--*			
	Minnow Trap 2	*---No Fish--*			
	Minnow Trap 3	*---No Fish--*			
East Lake (July 11-12, 2018)	Eel Pot	*---No Fish--*			
	Minnow Trap 1	*---No Fish--*			
	Minnow Trap 2	Golden Shiner	*Notemigonus crysoleucas*	109	115
	Minnow Trap 3	*---No Fish—*			
East Brook (East Lake Outflow) (July 11-12, 2018)	Eel Pot	*---No Fish---*			
	Fyke Net	*---No Fish---*			
Anti-Dam Flowage (June 13-14, 2018)	Eel Pot	*---No Fish---*			
	Fyke Net	*---No Fish---*			
	Minnow Trap 1	Golden Shiner	*Notemigonus crysoleucas*	104	111
		Golden Shiner	*Notemigonus crysoleucas*	107	115
	Minnow Trap 2	White Sucker	*Catostomus commersoni*	58	61
	Minnow Trap 3	*---No Fish---*			

Site	Survey Method	Common Name	Scientific Name	Fork Length (mm)	Total Length (mm)
East Brook (28 April 2020)	Fyke Net	Brook Trout	*Salvelinus fontinalis*	255	265
WC43.2 (2 June 2020)	Minnow Trap 16	Ninespine Stickleback	*Pungitis pungitis*	53	53

* Length measurements were not recorded.

Within the FMS Study Area, eight different species of fish were identified through electrofishing and trapping surveys, all of which are known to inhabit the East River Sheet Harbour watershed. White sucker was the most commonly caught species, representing 43.9% of the total catch for all fishing efforts. Lake chub, brook trout, and ninespine stickleback were more frequently represented, while numbers of golden shiner, brown bullhead, banded killifish, and pearl dace were limited. Survey sites within the 3rd order* streams of Seloam Brook (*see note on 3rd order designation for Seloam Brook in Section 6.6.3.1) showed the highest species diversity, with four species captured at both WC20 (just downstream the Seloam Lake dam) and WC1R1. This is supportive of the relatively high (though still low-moderate) habitat quality designations within the watercourses and open water features associated with the dominant Seloam Brook flow system, as opposed to the low quality habitat designations for surveyed, 1st – 2nd order tributaries (WC 6, 7, 12), in which only 1-2 species were caught per survey.

Supplementary fish collection conducted from September 2019 – June 2020 resulted in a total of 7711 hours and 30 minutes of fish collection survey effort within the East Lake, East Brook and the WC43 system. While not captured in Table 6.8-6, DFO also deployed minnow traps and eel pots in WC43 reaches 1 and 2, and East Brook during their site visit on November 26th **(**DFO collected a single brook trout in Seloam Brook within the proposed open pit). No fish were captured in the East Lake/WC43 system during the entirety of the Fall 2019 sampling period by MEL, nor by DFO during their survey effort. During Spring 2020 trapping efforts, a single brook trout was identified in East Brook, and a single ninespine stickleback was identified in WC43 Reach 2 (below the subterranean reach). These catch records support the determination of the low-normal flow barrier on WC43.1, and also the low quality habitat designations for WC43 and EB1. Water quality measurements taken within WC43, East Lake, and East Brook revealed low pH and DO concentrations, which limit fish habitat quality within the system. While the data not indicate that water quality would prevent fish usage, it does indicate that the habitat within this system is sub-optimal.

6.8.3.6 eDNA Survey Results

The results of eDNA samples collected within the proposed TMF location at FMS collected on 25 May 2020 are provided in Table 6.8-23. To improve detection probability and statistical confidence in assay results, each sample is analyzed using 8 technical replicates per sample, on each of the 3 field replicates per site. The results are presented as a fraction of 8; the numerator indicates the number of detections (amplification of fish DNA) observed in the qPCR analysis out of the 8 technical replicates. As each site contains 3 samples, results are provided for 1A, 1B, and 1C (and so on); the interpretation of the overall site result is determined considering the results of all three replicates per site. Interpretation of the sample results is as follows:

- If any replicate yields ≥3/8, the interpretation of that result is positive, or the target species or taxa has been detected.
- If at least one replicate yields a positive qPCR result for 2/8 runs and the other replicates yield a score >0 the site is categorized as suspected. The site is categorized as suspected if result is 2/8 for all 3 replicates, 2/8 for 2 replicates and

1/8 or 0/8 for third. The target species or taxa has not been confirmed to be present, but is suspected – to be determined based on site specific information or further studies.

- If no replicate yields a positive qPCR result >1/8 runs the site is categorized as negative. The site is considered negative if the result is 0/8 or 1/8 (no higher) for all replicates. This site can be interpreted as negative if the site is 2/8 for only one replicate regardless of the other two replicates. If result is 2/8 for one and 1/8 or 0/8 for the other replicates. The target species or taxa has not been detected.

The laboratory results report is provided in Appendix G.12 and sample locations are presented on Figure 6.8-4.

Table 6.8-23: Summary of eDNA sample results.

Site ID	WC Number	Replicate results	Interpretation
1*	East Brook	8/8, 8/8, 8/8	Positive – fish presence detected
2	WC43 Reach 2	0/8, 1/8, 1/8	Negative – fish presence not detected
3	WC43 Reach 1	1/8, 1/8, 0/8	Negative – fish presence not detected
4	WC39	0/8, 1/8, 0/8	Negative – fish presence not detected
5	WC19	0/8, 0/8, 2/8	Negative – fish presence not detected
6*	WC12 at road	8/8, 8/8, 8/8	Positive – fish presence detected
7	WC12 upstream end	0/8, 0/8, 1/8	Negative – fish presence not detected

Note: *Positive control sites. Fish presence was expected at Site 1. Fish presence visually confirmed at site 6.

Results of the eDNA samples indicate positive detection of fish at both positive control sites (East Brook and the downstream portion of WC12). Fish presence was not detected within watercourses identified as 'nil' in terms of access provision for fish (WC19 and WC39). Furthermore, fish presence was not confirmed through eDNA samples within the upstream extent of WC12, or within either sample location in WC43.

6.8.3.7 Characterization of Fish Populations

To increase sampling efficiency and improve information gathering within 1st order streams, methodology for 2018 sampling was switched to open-site electrofishing for which barrier nets were not deployed. Reaches sampled during 2017 were sampled using a closed system because physical parameters of locations sampled limited catchability (angular rock substrate, high flow and presence of tannins in water reducing visibility of shocked fish). While not directly comparable with the open sites, closed sites likely represent an upper limit of abundance in sampled sites. For the purposes of fish presence and relative abundance calculations, data for both closed and open sites have been treated the same.

Single-pass surveys provide a representative index of species diversity (Reid et al. 2009). Single-pass electrofishing can be used to detect spatial and temporal trends in abundance and species richness given standardized effort but may not be representative of absolute population densities (Bertrand et al. 2006). Single pass surveys were completed within watercourses in the FMS Study Area during electrofishing surveys in 2018. This method allows for calculation of catch per unit effort (standardized quantification of species richness and identification of trends). This calculation was also completed for fish collection efforts within the FMS Study Area completed in 2017. CPUE for electrofishing provided in Table 6.8-24

Table 6.8-24: CPUE for Electrofishing Sites in FMS Study Area

Site	Stream Order	Electrofishing Type	Total Number of Fish Captured	Electrofishing Effort (seconds)	CPUE (fish/100 seconds)
WC 1 Reach 1	3	Closed, 3-pass	20	1674	1.19
WC 1 Reach 2	4	Closed, 3-pass	21	1376	1.52
WC 20	3	Closed, 3-pass	13	969	1.34
WC 12 Reach 1	2	Open, 1-pass	1	779	0.13
WC 12 Reach 2	2	Open, 1-pass	11	349	3.15

The total number of fish of each species was used to calculate CPUE for each piece of fishing equipment. CPUE per species was not calculated, due to low abundance of fishes captured during surveys (Table 6.8-25). The numbers form a baseline estimate of catch per unit effort that can be compared between sites and, over time, at each of the watercourses within FMS Study Area.

Table 6.8-25: CPUE for Fish Collection Surveys in FMS Study Area

Site	Stream Order	Equipment	Total Number of Fish Captured	Trap Effort (hour)	CPUE (fish/hour)
WC 12 Reach 1	2	Fyke Net	0	20.12	N/A
		Eel Pot	2	20.35	0.09
		Minnow Trap 1	0	20.25	N/A
		Minnow Trap 2	0	20.27	N/A
		Minnow Trap 3	0	20.32	N/A
WC 12 Reach 2	2	Fyke Net	0	17.87	N/A
		Eel Pot	0	18.15	N/A
		Minnow Trap 1	0	17.92	N/A
		Minnow Trap 2	0	17.92	N/A
		Minnow Trap 3	0	17.93	N/A
WC 6	1	Minnow Trap 1	0	19.47	N/A
		Minnow Trap 2	1	19.43	0.05
		Minnow Trap 3	1	19.53	0.05
WC 7	2	Fyke Net	6	19.37	0.31

Site	Stream Order	Equipment	Total Number of Fish Captured	Trap Effort (hour)	CPUE (fish/hour)
		Eel Pot	1	19.37	0.05
Seloam Brook Pond 1	3	Fyke Net	1	17.53	0.06
		Eel Pot	0	17.52	N/A
		Minnow Trap 1	0	17.58	N/A
		Minnow Trap 2	1	17.58	0.06
		Minnow Trap 3	0	17.65	N/A
Seloam Brook Pond 2	3	Fyke Net	30	23.03	1.30
		Eel Pot	0	22.63	N/A
		Minnow Trap 1	0	22.80	N/A
		Minnow Trap 2	1	22.78	0.04
		Minnow Trap 3	0	22.83	N/A
Anti-Dam Flowage	N/A	Fyke Net	0	20.40	N/A
		Eel Pot	0	20.87	N/A
		Minnow Trap 1	1	20.87	0.05
		Minnow Trap 2	2	20.97	0.10
		Minnow Trap 3	0	20.95	N/A
WC 43	1	Minnow Trap 1	0	23.40	N/A
		Minnow Trap 2	0	23.42	N/A
		Minnow Trap 3	0	23.35	N/A
East Lake Outflow	3	Fyke Net	0	22.45	N/A
		Eel Pot	0	22.50	N/A
East Lake	N/A	Eel Pot	0	22.83	N/A
		Minnow Trap 1	0	22.93	N/A
		Minnow Trap 2	1	22.85	0.04

Site	Stream Order	Equipment	Total Number of Fish Captured	Trap Effort (hour)	CPUE (fish/hour)
		Minnow Trap 3	0	22.87	N/A

Overall, the total number of fish captured within the FMS Study Area is very low (114 individual fish captured within the FMS Study Area in 2017-2018, and 2 individuals captured in 2019-2020), which is reflected in calculated CPUE for electrofishing and trapping efforts. Low CPUE is reflective of low fish abundance, which supports the determination that fish habitat quality within the FMS Study area is predominantly low, and that the presence of hydroelectric dams have limited fish passage within the watershed.

During the fall of 2019 and spring of 2020, intensive fish collection efforts were completed within the proposed TMF location. Sample efforts included a combination of minnow traps, fyke nets and eel pots, as outlined in Table 6.8-6 and Table 6.8-7.

Table 6.8-26: CPUE for Fish Collection in proposed TMF during Fall 2019-Spring 2020

Site	Combined trap effort	Fish Captured	CPUE (fish/hour)
WC 43 Reach 1 (above subterranean barrier)	2798 hrs, 20 mins	0	0
WC 43 Reach 2 (below subterranean barrier)	1036 hrs	1	0.000965
East Lake & East Brook	280 hrs, 15 mins	1	0.003568
WC 19	616 hrs, 5 mins	0	0
WC 39	598 hrs, 40 mins	0	0
WC12 – upstream extent	2382 hrs, 10 mins	0	0

6.8.3.8 Touquoy Baseline Results

Fish survey methods and results for the Touquoy Mine Site are presented in the Touquoy Gold Project EARD and Focus Report (CRA 2007a; CRA 2007b). According to surveys completed by NSDFA in 1975 and 2000, Scraggy Lake supported the following species: white sucker, white perch, brown bullhead, golden shiner, brook trout, American eel, lake chub, banded killifish, alewife (syn. Gaspereau), Atlantic salmon, smallmouth bass, and yellow perch. Baseline work to identify fish species and abundance in the downstream receiving watercourses and waterbodies was presented in the Touquoy Gold Project EARD and Focus Report (CRA 1999a, 1999b). Fish surveys conducted in Scraggy Lake by Stantec in 2017 (Stantec 2018b) indicated presence of alewife, American eel, Atlantic salmon, banded killifish, brown bullhead, brook trout, golden shiner, lake chub, lake trout, white perch, white sucker and yellow perch. It was determined that populations were low in Scraggy Lake due to habitat issues and anecdotal evidence that fishing pressure is high in the lake. Estimates of population or abundance were not presented. Tissue samples were collected to identify baseline metal concentrations in fish captured within Scraggy Lake.

6.8.3.9 Fish Species Descriptions

The potential for each watercourse, open water feature, and wetland to support fish was evaluated across the FMS Study Area. The physical characteristics of each watercourse/watercourse reach described during initial identification and evaluation provided in Section 6.6, along with the indicators of aquatic ecosystem conditions (Section 6.8.3.1), and the results of fishing efforts (Sections 6.8.3.5 and 6.8.3.6), were reviewed to describe how fish may use the aquatic features identified within the FMS Study Area. These descriptions are based on the results of a literature review for species-specific habitat requirements for various life stages. Species-specific habitat descriptions for all species expected or confirmed to frequent aquatic features within the FMS Study Area, along with discussions on how each species may use these features, are provided in Sections 6.8.3.9.1 through 6.8.3.9.10.

6.8.3.9.1 *American Eel*

Suitable habitat for the eel is varied. As a catadromous species, eel spend the majority of their lives in freshwater, moving to the Sargasso Sea to spawn. Once hatched, American Eel larvae drift back to the coast, undergoing several phases of metamorphosis. By the time they reach freshwater, young glass eel have developed pigment and are now referred to as elvers (Scott and Crossman, 1973). In freshwater, elvers develop into yellow eel - growing immature adults and at which point sexual differentiation occurs. As growth proceeds, yellow eel metamorphose into Silver eel, or mature adults that are now physiologically prepared to return to the sea to spawn (COSEWIC 2012a).

Within freshwater environments, American eel are habitat generalists that can tolerate a wide range of water temperatures and pH levels. American eel are frequently found in watercourses that offer structural complexity and shade in the form of coarse woody debris, varied substrate, in-stream vegetation for daytime cover, and an available food source of forage fish, invertebrates, molluscs and vegetation. Scott & Crossman (1973) describe eel as “voracious carnivores” feeding primarily at night on a variety of fishes, insects, mayfly, stonefly and dragonfly larvae, chironomids, snails and worms. Immature eel spend the majority of their time burrowed or hidden (Tomie 2011), with foraging occurring at night. Overwintering habitat requirements are not well understood; however, it is thought that mud bottoms and groundwater seeps play an important role in overwintering burrows (Tomie 2011).

The distribution of American eel in freshwater systems depends highly on the eels’ capacity to migrate upstream. Barriers, such as hydroelectric dams, can severely limit or impede the upstream passage of young eel from the sea. Despite the presence of multiple hydroelectrical dams within the East River Sheet Harbour watershed, eel have been shown to persist in the watershed as of 2007 (NSPI 2009); this is likely due to the eels’ ability to climb vertical surfaces, provided they are rough and wet (GOMC 2007). Still, the low numbers of eel caught during the 2006-2007 NSPI surveys and the fact that no American eel were observed during the 2017-2018 fish surveys within the FMS Study Area demonstrate that upstream migration of eel into the FMS Study Area is limited.

No American eel have been documented in Seloam Lake or its tributaries through historic fishing efforts (NSDAF 2017). One individual American eel was documented by NSPI at both the outlet of Seloam Lake below the dam, and in Fifteen Mile Stream through electrofishing surveys conducted in 2006 (NSPI 2009). No American eel have been documented within East Lake, East Brook, or Anti-Dam Flowage. Though no American eel were captured during 2017-2018 fish surveys, any eel that persist within the FMS Study Area would likely find suitable areas to mature and overwinter within the multiple reaches, open water features, and tributaries of Seloam Brook due the dominant presence of muck substrate, a diverse benthic food source, and cover in the form of large boulders, in-stream vegetation, and coarse woody-debris. However, it has been documented that American eel are not restricted to contiguous watercourses and possess the ability to traverse over land in wet, low lying grass habitats (MacGregor et al. 2011). As such, all hydrologically connected watercourses within the Study Area are believed to be potentially accessible to the American eel, even if habitat provision in those watercourses is low.

6.8.3.9.2 *Banded Killifish*

The banded killifish is a freshwater habitat generalist within the quiet waters of lakes, ponds, and sluggish streams, tolerating a broad temperature, salinity, and dissolved oxygen range (COSEWIC 2014) The species tends to school in shallow water characterized by sand, gravel, or muddy substrate, with submerged aquatic plants (Scott and Crossman 1973). The banded killifish is generally not considered strong swimmer, and high water velocities are thought to limit the species’ movement within a watershed (DFO 2011). Seasonal movement by the species has not been documented, and it is not considered migratory (COSEWIC 2014).

Banded killifish spawning has been seldom documented; however, it is thought that aquatic vegetation is a key component in spawning habitat as an attachment point for externally fertilized eggs (Richardson 1939). This species is a versatile feeder with generalized feeding habits. Smaller killifish will feed on chironomids, ostracods, cladocerands, copepods, amphipods and flying insects, while larger one can prey upon larger invertebrates such as odonates, ephemeropterans, molluscs and ostracods (Scott and Crossman, 1973).

Banded killifish have been historically documented in Seloam Lake (NSDAF 2017). A single banded killifish was captured across all 2017-2018 fish surveys within the FMS Study Area, at a sampling reach located directly downstream of the Seloam Lake spillway. Given the moderate to high water velocities present downstream of the reservoir, it is likely that the individual passed downstream from the lake through the spillway, rather than travelling upstream through Seloam Brook. However, is it plausible that banded killifish may reside within the open, slack-water areas of Seloam Brook, which tend to be characterized by fine substrate, in-stream aquatic vegetation, and accessible riparian wetlands. These open water areas could provide potential spawning habitat; however, travel between these areas is unlikely given the increased velocities within the linear reaches that join these systems. No banded killifish have been documented in the historic records for Anti-Dam Flowage, or in East Brook during the 2006 NSPI electrofishing surveys (NSPI 2006, NSDFA 2017).

6.8.3.9.3 *Brook Trout*

Brook trout are known to inhabit a wide range of cool, freshwater environments, from small headwater streams to large lakes. If river habitat is suitable for brook trout and they do not experience any stressors throughout the year, they tend not to travel large distances. Most brook trout populations existing in larger rivers act this way, not moving until the fall at the onset of spawning. Even then, if the river has adequate habitat diversity, they tend not to travel large distances. Other populations have adapted to various river conditions; they travel very large distances (>120 km) in search of thermal refuge and spawning habitat. Water temperature is a critical factor influencing brook trout distribution and production. Though typically not anadromous, brook trout require free passage along streams to move between areas of use, including spawning grounds, overwintering, summer rearing areas.

In Nova Scotia, mature brook trout migrate to spawn in lakes or streams in the fall of the year. Trout spawning sites are usually near groundwater upwelling or spring seeps and within a lake or stream with gravel substrate (NSDFA 2005). Optimal spawning conditions for brook trout include clear substrate 3-8 mm in size with limited fines (<5%), and velocities of 25-75 cm/s (Raleigh 1982).

Juvenile rearing areas require cold water, stable flow, and an abundance of cover. Optimal temperature for juvenile growth is 10-16℃, while cover in the form of deep water, overhanging and in-stream vegetation, undercut banks, woody debris, and rocky substrate should account for a minimum of 15% of total stream area (Raleigh 1982). In winter, brook trout aggregate in pools beneath silt-free rocky substrate and close to point sources of groundwater discharge (Raleigh 1982; Cunjak and Power 1986). Adult fish use both pools and riffles, with more than 25% in-stream cover being optimal (Raleigh 1982). Brook trout respond negatively to flashy or hydrologically dynamic systems, and require stable flow for all life stages (Raleigh 1982). According to Scott and Crossman (1973), brook trout "will eat any living creature its mouth can accommodate", including prey items encompassing over 80 genera of aquatic insects, terrestrial insects, fishes (including other brook trout and eggs), amphibians, and even small reptiles and mammals. As such, they are generalized feeders which can take advantage of an available prey source.

Brook trout were the third most represented species during 2017-2018 fish surveys within the FMS Study area, accounting for approximately 13% of the total catch with 15 individuals. Brook trout were captured within multiple reaches of Seloam Brook and its tributaries, including WC6 and WC12. The species has also been documented in Seloam Lake and Anti-Dam Flowage (NSPI 2009; NSDFA 2017). A single brook trout was identified in East Brook on April 28th, 2020.

Suitable brook trout summer rearing and overwintering habitat is provided throughout the perennial reaches, open water areas and accessible wetland habitat of Seloam Brook, with in-stream cover available in the form of boulder substrate, deep water, in-stream vegetation, and woody debris. Deeper open water areas (e.g., beaver ponds) within Seloam Brook likely provide important summer refuge within the system, as temperatures in Seloam Brook have been observed to rise above the preferred range for brook trout during July and August (Section 6.8.3.1.2). Brook trout captured in WC12 have limited mobility, as multiple subterranean flow regimes limit passage through this watercourse to periods of high flow. Suitable spawning habitat for brook trout within the Study Area is extremely limited, as. surface water features within the FMS Study Area are largely dominated by boulder substrate that is often embedded in deep muck. Clear gravel substrate, which is optimal for spawning, is restricted to isolated pockets in higher velocity, linear reaches of Seloam Brook. Higher proportions of suitable substrate was identified within Fifteen Mile Stream, which falls along the western boundary of the FMS Study Area. Seloam Lake may provide potential brook trout spawning areas, although no spawning surveys were conducted.

6.8.3.9.4 *Brown Bullhead*

Brown bullheads are bottom dwellers that prefer sluggish and warm water in slow-moving streams, ponds, and lakes with abundant aquatic vegetation. The species is resistant to increased levels of pollution and is tolerant of low oxygen concentrations and temperatures up to 31.6 °C (Scott and Crossman 1973). Brown bullheads can be found in lakes and rivers with a variety of substrates but are typically associated with muddy bottoms. These fish are omnivorous night-feeders and will forage on all types of plant and animal materials that they locate with their barbels. Prey items include molluscs, insects, crustaceans, worms, vegetation and fishes (Scott and Crossman, 1973).

Brown bullhead spawning occurs in late spring and summer when water temperatures reach 21℃ (Scott and Crossman 1973). Adhesive eggs are deposited into shallow nest that is excavated in mud or sand substrate, covered by at least 15 cm of water (Scott and Crossman 1973).

Two individual brown bullheads were captured during the 2017-2018 electrofishing and trapping efforts within the FMS Study area within Seloam Brook. The species has also been documented in Seloam Lake and Anti-Dam Flowage (NSPI 2009; NSDFA 2017). Preferred brown bullhead habitat is prevalent throughout the open, slack-water areas of Seloam Brook, which tend to be characterized by fine substrate, in-stream aquatic vegetation, and accessible riparian wetlands. These open water areas could also support brown bullhead spawning.

6.8.3.9.5 *Golden Shiner*

Golden shiners are habitat generalists, primarily found schooling in well vegetated lakes with extensive shallows (Scott and Crossman 1973). The species can tolerate a wide range of oxygen concentrations and temperatures (Murdy et al. 1997). Spawning takes place from June to August, when temperatures reach 20℃, during which adhesive eggs are scattered over the substratum, attaching to filamentous algae or other aquatic vegetation (Scott and Crossman 1973). Prey items include a variety of invertebrates including flying insects, chironomids, algae, dragonfly nymphs, beetles and water mites.

Golden shiner are currently known to reside in Anti-Dam Flowage and East Lake. Golden shiner was the only species caught in East Lake (one individual) during the 2017-2018 fish surveys, while two individuals were captured in Anti-Dam Flowage. Golden shiner has been historically documented in Seloam Lake (NSDFA 2017). As a habitat generalist and predominant lake species, golden shiner are anticipated to reside within the majority of slack-water areas with aquatic vegetation. Watercourses and waterbodies that offer suitable habitat are Seloam Lake, East Lake, Anti-Dam Flowage, and the flat tributaries, open water bodies, and accessible wetland habitat associated with Seloam Brook.

6.8.3.9.6 *Lake Chub*

The lake chub is a common species of lakes and rivers, preferring cool, clear water and gravel bottomed streams and lake edges (Page and Burr 2011). The species is mostly found in shallow water but may move into deeper areas to escape high temperatures (Scott and Crossman 1973). Lake chub are sight-feeding predators and are known to consume aquatic and terrestrial insects, zooplankton, and small fishes (McPhail and Lindsey 1970).

When inhabiting lakes and larger rivers, schools of lake chub will undergo spawning migrations to shallow areas of tributary streams in the spring, with seasonal movements occasionally being extensive (Scott and Crossman 1973; Stasiak 2006). During spawning, non-adhesive eggs are scattered over gravel or rocky substrate (Scott and Crossman 1973; Stasiak 2006).

Lake chub was the 2nd most common fish species within the FMS Study Area captured during the 2017-2018 fish surveys, accounting for approximately 24% of the total catch with 27 individuals. Lake chub were exclusively caught within linear reaches of Seloam Brook (WC1, WC20), which are characterized by more complex, rocky substrates than its open water and accessible riparian wetland areas. These areas may provide suitable spawning habitat, whereas deeper, open water areas may provide refuge from peak summer temperatures. The species has been historically documented in Seloam Lake and Anti-Dam Flowage (NSDFA 2017)

6.8.3.9.7 *Ninespine Stickleback*

The ninespine stickleback is found in both brackish waters and the shallow areas of freshwater lakes and ponds. In rivers and streams, it is generally found in sluggish pools where there is plenty of aquatic vegetation. The ninespine stickleback primarily feeds on aquatic insects and small crustaceans, but may also feed on fish eggs and small fry of other fish species (Scott and Crossman 1973). Spawning takes place over the summer in fresh water, during which a male stickleback constructs a nest off the bottom substrate by binding plant fragments together (Scott and Crossman 1973). Spawning may occur more than once in a season.

Ninespine stickleback have been historically documented in Seloam Lake and Anti-Dam Flowage (NSDAF 2017). During the 2017-2018 fish surveys, ninespine stickleback were captured exclusively within WC12, whose low gradient supports flat, stagnant reaches, and abundance of in-stream vegetation and fine substrate. Potential spawning habitat is present throughout the watercourse, though upstream and downstream passage through WC12 is limited to periods of high flow. A single ninespine stickleback was identified in the lower reach of WC43 on 2 June 2020.

Potential habitat for ninespine stickleback is also present within the slack, open water areas of Seloam Brook; however, travel between these areas is unlikely given the increased water velocities within the linear reaches that join these systems.

6.8.3.9.8 *Pearl Dace*

The pearl dace is a common cold-water species that tends to congregate in clear headwater streams (Scott and Crossman 1973), preferring water temperatures of 16°C (Stauffer et al. 1984). The species been shown to have a strong habitat preference for sinuous, slow moving, spring-fed streams with heavy cover and a lack of large predatory fishes (Cunningham 2006). Pearl dace spawn in spring, during which eggs are deposited over rock, rubble, or gravel substrates (Cunningham 2006). Pearl dace feed upon a variety of invertebrates including copepods, cladocerans, chironomids and beetles, as well as algae (Scott and Crossman 1973).

A single pearl dace was confirmed during the 2017-2018 fish surveys in Seloam Brook (WC1). Pearl dace were also documented in Seloam Brook (below the Seloam Lake spillway) during electrofishing surveys conducted within the Sheet Harbour Hydro System in 2006 (NSPI 2009). Generally, preferred pearl dace habitat is infrequent and dispersed throughout the Seloam Brook system, as channel conditions have been extensively modified through historic mining activities. This has resulted in predominantly straightened, moderate-high velocity watercourse channels connecting flat, open water features. Slower, sinuous areas with rocky substrate within the FMS Study Area are generally restricted to the braided upper and lower reaches (i.e., WC20, WC1.1, WC1.6) of Seloam Brook. However, as a cold-water species, deeper open water areas may provide refuge from peak summer temperatures. No pearl dace have been documented in Seloam Lake or Anti-Dam Flowage (NSPI 2006, NSDAF 2017).

6.8.3.9.9 *White Sucker*

White sucker, like brown bullhead, are bottom dwellers found in warm, shallow water areas of lakes and quiet streams. They feed on small aquatic plants and animals filtered out of sand or mud (Gilhen 1974). White Sucker have a preferred temperature of 22.4°C (Spotila et al. 1979) and are most abundant in areas with aquatic vegetation and underwater debris that provide cover.

White sucker are active year-round, spawning in May-June when they migrate into small streams and tributaries with water temperatures of 10-18°C (NSSA 2005). Preferred spawning habitat for white sucker is shallow gravel riffles of moderate water velocity. Lake populations sometimes spawn on gravel shoals where there is wave action (NSSA 2005). The adults leave the spawning ground after a week or two and return to the river or lake they originated from (NL Department of Environment and Climate Change, n.d.). Young white sucker feed on a variety of plankton and small invertebrates. Their feeding habit changes when their mouths move to a sub-terminal position, and they start feeding primarily on the benthic invertebrate community. Food items include chironomids, trichoptera, molluscs and cladocerans (Scott and Crossman, 1973).

White sucker was the most common species captured during the 2017-2018 fish surveys, accounting for almost half of the total catch with 51 individuals. Being habitat generalists that can withstand a wide range of water temperatures, white sucker are anticipated to be within the majority of accessible watercourses of the Study Area, particularly open water features of Seloam Brook and associated tributaries and accessible riparian wetlands. Watercourses and waterbodies that offer suitable habitat are Seloam Lake, East Lake, Anti-Dam Flowage, and the tributaries and open water bodies associated with Seloam Brook. Spawning habitat for white sucker within the Study Area is extremely limited due to a lack of suitably-sized substrate and riffle-like habitat, and is likely restricted to Fifteen Mile Stream where these substrates and habitat types are more prevalent. Seloam Lake may provide suitable habitat for white sucker spawning, though this was not confirmed through spawning surveys.

6.8.3.9.10 *White Perch and Yellow Perch*

White perch are found in, lakes, pools, and other quiet-water areas of medium to large rivers (Page and Burr 2011). White perch use both brackish and freshwater, but in Nova Scotia are more commonly seen in freshwater habitats usually over mud substrate (Bigelow and Schroeder 2002). White perch are typically resident species wherever they are found, and seem to be most productive in water temperatures of 24℃ and above (Scott and Crossman 1973). Most yellow perch do not appear to migrate, but some do in patterns which tend to be short and local (Brown et al. 2009). The yellow perch is a schooling, shallow water fish that can adapt to a wide variety of warm or cool habitats. They are found in large lakes, small ponds, or gentle rivers but are most abundant in clear, highly vegetated lakes (1-10 m depth) that have muck, sand, or gravel bottoms (Brown et al., 2009). They prefer summer temperatures of 21-24°C. Both species of perch described herein are generalist carnivores, feeding on a variety of fishes and invertebrates, including crustaceans, oligochaetes, molluscs, and ostracods (Scott and Crossman, 1973).

Both white perch and yellow perch are known throughout the reservoirs and lakes in the secondary watershed which comprises the FMS Study Area (NSPI 2009). However, these species were not observed within the FMS Study Area during fish surveys, nor have they have been historically documented in Seloam Lake or Anti-Dam Flowage (NSPI 2009, NSDAF 2017). Given the multiple barriers to upstream fish passage present along the East River Sheet Harbour Hydro System and these species' preference towards residency, white perch and yellow perch are not expected to access surface water features within the FMS Study Area.

6.8.3.10 Summary of Baseline Conditions

Fish habitat within the FMS Study Area has been substantially degraded by historic mine workings and deposition of tailings. In addition, the presence of multiple hydroelectric dams has limited fish passage within the watershed and accessibility to the FMS Study Area. Fish passage is also limited in certain systems by boulder fields and areas of subterranean flow. Fish habitat quality within the FMS Study Area has been evaluated as predominantly low, which has been supported by the following conclusions.

Overall, the aquatic ecosystem within the FMS Study Area is characterized by acidic conditions as is typical for the watershed in which the FMS Study Area lies. Low pH levels, elevated temperatures and low dissolved oxygen concentrations limit fish habitat quality within select systems. Sediment and water quality are also impacted by the historic deposition of mine tailings and waste rock (see Sections 6.4 and 6.6). Aquatic productivity has been evaluated as low-moderate, which is also typical for the watershed and the region in which the watershed lies.

Relative fish abundance throughout the FMS Study Area is low, as supported through electrofishing and fish collection efforts which resulted in low capture numbers.

Fish habitat across the FMS Study Area has been evaluated on multiple occasions from 2017 to 2020 during high flow and low flow seasons. Where needed, second and third trips to evaluate baseline conditions in systems was completed by the MEL team in order to inform baseline condition conclusions. Fish habitat conclusions were informed by all aspects of the baseline program (i.e., water quality, sediment quality, physical parameters, fish observed).

Fish passage into the upper reach of WC43 is limited during low-normal flows by the presence of a natural barrier to fish passage, as described in Section 6.8.3.3. Through evaluations completed during the fall of 2019, it was determined that the upper reach of WC43 is accessible to fish during seasonal high and extreme flow conditions. While potentially accessible to fish, only three fish have been caught within East Lake system through 5535 hours and 55 minutes of fishing effort within the WC43/East Lake/East Brook system from 2017-2020. Fish habitat quality through this system is limited by low pH and dissolved oxygen levels, and access to these habitats is limited by partial natural barriers at the East Brook waterfall and the subterranean reach along WC43. eDNA samples did not indicate presence of fish within either reach of WC43.

WC12 has been deemed accessible to fish though restricted to periods of high flow, and has been given low quality fish habitat designation, as described in Section 6.8.3.3. Fish presence was confirmed through eDNA sample analysis and through visual observation of fish within the downstream portion of WC12 – however fish presence was not detected within the upstream extent of WC12 through eDNA analysis and extensive fish collection in the spring of 2020 .

Habitat complexity within the FMS Study Area is generally lacking, with the majority of linear and open water features assessed as providing low quality habitat for brook trout and white sucker. Only limited amounts of rearing and overwintering habitat, and even more limited amounts of spawning habitat have been identified within the FMS Study Area for these species. Furthermore, it is important to reiterate that the entire site sits within the East River Sheet Harbour Hydro system, which has experienced fish passage limitations for decades, and therefore does not provide a migratory pathway for anadromous or catadromous species.

6.8.4 Consideration of Engagement and Engagement Results

Key issues raised during public and Mi'kmaq engagement relating to fish and fish habitat include potential indirect effects from wetland alteration or changes to surface water and groundwater quality and quantity on fish and fish habitat. A high value was placed on fish and fish habitat in the receiving waters based on engagement with stakeholders and the Mi'kmaq of Nova Scotia.

The results of the public and Mi'kmaq engagement have been considered in the environmental effects assessment, including the Proponent's commitments on mitigation and monitoring measures and proposed compliance and effects monitoring programs, as well as the Proponent's broader commitment to ongoing public and Mi'kmaq engagement.

6.8.5 Effects Assessment Methodology

6.8.5.1 Boundaries

6.8.5.1.1 *Spatial Boundaries*

The spatial boundaries used for the assessment of effects to fish and fish habitat are defined below:

The PA consists of the two components; the FMS Study Area and the Touquoy Mine Site (Figure 6.6-16). The FMS Study Area is located east of Highway 374, straddling Seloam Lake Road which intersects Highway 374 approximately 30 km north of Sheet Harbour and links with the Project 1.1km from the highway. A small portion of the FMS Study Area resides in the Moser River watershed, which drains to the southeast and eventually to the Atlantic Ocean via the Moser River (Figure 6.6-2). This small portion was included in the FMS Study Area during the iterative process of determining site infrastructure layout. Under current design, no infrastructure is planned in this portion of the Moser River watershed. As such, impacts to the Moser River Watershed were not considered in the effects assessment. The Touquoy Mine Site is located in Moose River Gold Mines, NS.

The LAA consists of portions of downstream aquatic habitats and headwaters where appropriate, depending on Project activities, up to the maximum size of the tertiary watershed (Figure 6.6-16). The LAA boundaries were defined considering the maximum expected extent of direct and indirect impacts to the aquatic environment as well as the location of Project activities across both PA components. The lakes and watercourses that are included as part of the baseline programs and/or predictions of effects are located within the LAA boundary.

The RAA (Figure 6.6-16) encompasses the two secondary watersheds that the PA is located within. These watersheds are the East River Sheet Harbour secondary watershed and the Fish River secondary watershed. The RAA is broader than expected Project impacts and considers other project boundaries as per the cumulative effects assessment methodology.

As the Project has the potential to cause direct and indirect effects to fish and fish habitat outside of the PA, the LAA is the appropriate boundary for evaluation of this VC.

6.8.5.1.2 *Temporal Boundaries*

The temporal boundaries used for the assessment of effects to fish and fish habitat are the construction phase, operational phase, and closure phase, which includes the decommissioning and reclamation stage, and post-closure stage.

6.8.5.1.3 *Technical Boundaries*

No technical boundaries were identified for the effects assessment of fish and fish habitat.

6.8.5.1.4 *Administrative Boundaries*

Fish and fish habitat were evaluated for the Project within the framework offered by the *Fisheries Act* (1985) and supporting policy statements and documents from DFO, including those referenced herein. DFO interpretation of HADD of fish and fish habitat supports the evaluation of this VC for the purpose of this EIS.

6.8.5.2 Thresholds for Determination of Significance

A significant adverse effect from the Project on fish and fish habitat is defined as an effect that results in an unmitigated or uncompensated net loss of fish habitat as defined under the *Fisheries Act*, and its associated no-net loss policy.

For fish and fish habitat, the following logic was applied to assess the magnitude of a predicted change:

- Negligible – No measurable change in fish habitat quantity or quality;
- Low – a measurable change in fish habitat area or quality, but within the range of natural variation, for example a less than 10 percent change in surface flow;
- Moderate – a measurable change in fish habitat area or quality, above the range of natural variation, which partially limits the abilty of fish to use the habitat to carry out one or more life processes, for example to a maximum change of 30 percent of MAD flow; and,
- High – a measurable change in fish habitat area or quality, to an extent which limits the abilty of fish to use the habitat to carry out one or more life processes. For example, above a 30 percent change in MAD flow.

6.8.6 Project Activities and Fish and Fish Habitat Interactions and Effects

During review of Project activities and their expected direct and potential indirect effects to fish and fish habitat, it was understood that authorization under the *Fisheries Act* would be required for development of the pit due to the presence of Seloam Brook overprinting the mining resource. Alternatives for all other site infrastructure were considered, focusing specifically on impacts to fish and fish habitat, with the dual goal of reducing impact to fish and fish habitat, and also to limit the potential for a Schedule 2 requirement under MDMER which would be triggered by deposition of mine waste into waters frequented by fish.

The effects of the Project on fish and fish habitat were determined considering the modelling efforts and effects predictions of the Project on groundwater, surface water and wetlands. This section of the EIS is informed by conclusions presented in these other VC sections and should be read in sequence after Section 6.5, 6.6 and 6.7.

6.8.6.1 FMS Study Area

Table 6.8-27 presents the potential interactions of the Project with fish and fish habitat within the FMS Study Area.

Table 6.8-27: Potential Fish and Fish Habitat Interactions with Project Activities within the FMS Study Area

Project Phase	Duration	Relevant Project Activity
Site Preparation and Construction Phase	1 year	• Clearing, grubbing, and grading; • Drilling and rock blasting; • Topsoil, till and waste rock management • Watercourse and wetland alteration; • Seloam Brook Realignment (realignment channel and diversion berm) construction and dewatering • Mine site road construction, including lighting; • Surface infrastructure installation and construction, including lighting; • Collection ditch and water management pond construction, including lighting; • Local traffic bypass road construction; • Culvert and bridge upgrades and construction; • Environmental monitoring; • General waste management.

Project Phase	Duration	Relevant Project Activity
Operations Phase	7 years	• Drilling and rock blasting; • Open pit dewatering; • Ore management; • Waste rock management; • Tailings management; • Surface water management; • Dust and noise management • Petroleum products management; • Environmental monitoring; • General waste management.
Closure Phase: Reclamation Stage	2-3 years	• Site reclamation activities; • Environmental monitoring; • General waste management.
Closure Phase: Post-Closure Stage	3+ years	• Water treatment and management; • Environmental monitoring.

Development of mine infrastructure will cause direct impacts to habitat used by fish, including linear watercourses, open water features associated with these watercourses (ponded areas), and wetlands. Direct impacts to fish and fish habitat will predominantly occur during the construction phase of the Project through activities such as clearing, grubbing, blasting and development of the mine/associated infrastructure, specifically development of the pit and the Seloam Brook Realignment. Indirect impacts that may affect fish and fish habitat include changes in water quality and quantity associated with direct impacts upstream, the realignment of Seloam Brook, management of historical tailings (positive impact) and site water discharge during operations and closure phases.

Expected and potential direct and indirect fish and fish habitat impacts to surface water features (wetlands, watercourses, and open water features) in the immediate vicinity of the FMS Study Area as a result of the Project construction and development within the FMS Mine Site are described in Table 6.8-28.

Table 6.8-28: Potential Direct and Indirect Impacts to Fish and Fish Habitat within the FMS Mine Site

Impact Type	Direct Impact	Project Phase	Indirect Impact	Project Phase
Destruction of fish habitat	Removal of wetland, watercourse, and open water features within the FMS Mine Site to support mine development including the pit resulting in direct loss of fish habitat	C	N/A	N/A
Fish mortality	Loss of habitat within the FMS Mine Site (removal of wetland, watercourse, open water) to support mine development could result in mortality to fish for various species and life stages	C	N/A	N/A
Changes in composition and characteristics of fish populations	N/A	N/A	Loss of watercourse and/or open water and/or wetland habitat or indirect operational impacts within the mine footprint may result in fish population changes including composition and characteristics of various fish species	C
			Potential for change in fish populations due to changes in water quality or quantity (reduction if water quality was degraded, or increase with management of historical tailings)	O, CL
Vibrations from Blasting	Vibrations from blasting activities within the FMS Mine Site could affect fish behaviour, spawning and migration	C, O	Blasting adjacent to wetlands and watercourses has the potential to alter surface and/or subsurface water flows, especially in fractured rock. This activity has the potential to increase or decrease hydrological flow to adjacent and downstream surface water systems and can hence precipitate drying (dewatering) or wetter conditions in those habitats affecting fish habitat	C, O

Impact Type	Direct Impact	Project Phase	Indirect Impact	Project Phase
Alteration of fish habitat (hydrology): If the hydrological regime of a wetland, watercourse, or open water feature is altered, fish habitat can be negatively affected	Complete dewatering, infilling or flooding of a wetland, watercourse, or open water feature to facilitate Project development resulting in direct loss of fish habitat	C	Wetlands, watercourses, open water features, and associated fish habitat are also at risk of indirect impacts as a result of (management and collection of mine contact water, drainage basin hydrologic adjustments, land elevation changes, blasting etc. causing dewatering). Inadvertent damming of up-gradient wetlands, watercourses, and open water features from construction related infrastructure (i.e. roads with lack of flow through infrastructure) can also affect downstream fish habitat. Changes in surface hydrology can impact downstream water quantity which can affect fish habitat	C, CL
	Alteration of hydrological inputs and outputs into partially altered wetlands, watercourses, or open water has the potential to alter remaining (undeveloped) associated fish habitat	C, CL	Removal of on-site watercourses or outflow and throughflow wetland habitat has the potential to alter the localized hydrology in down-gradient surface water systems and associated fish habitat	C
			Hydrological changes can impact the use of a wetland, watercourse, or open water feature by fish and other aquatic organisms as a habitat resource	C
			Blasting and pumping adjacent to wetlands, watercourses, and open water features has the potential to alter surface and/or subsurface water flows, especially in fractured rock. This activity has the potential to increase or decrease hydrological flow to adjacent and downstream surface water systems and can hence precipitate drying (dewatering) or wetter conditions in those habitats affecting fish habitat	C
			Surface water ditching can reduce inputs into wetlands, watercourses, and open water features, reducing water levels, collecting mine contact water, and potentially affecting fish and fish habitat	C, O, CL
Alteration of fish habitat (and mitigation for lost habitat)	Construction of Seloam Brook Realignment, including the Realignment channel, associated fish habitat, and berm	C	Construction of the Seloam Brook Realignment channel has the potential to alter upstream and downstream hydrology, primarily in the construction phase, extending potentially into operations and closure phases	C, O, CL

Impact Type	Direct Impact	Project Phase	Indirect Impact	Project Phase
Alteration of fish habitat (water quality): If water quality within upland riparian habitat, riparian wetlands, watercourses, or open water features is altered, the capacity for habitat to support fish can be negatively affected	Removal (alteration) of riparian wetlands, upland riparian zones, and watercourses from the landscape leading to a change in water quality in down-gradient aquatic receivers (i.e. streams, additional wetlands and lakes) resulting in an adverse change to fish or fish habitat	C, CL	Alteration of riparian habitat (upland and wetland), watercourses, or open water features increases the risk of down grade sedimentation which could affect fish and fish habitat	C, O, CL
			The effect of increased sedimentation as a result of up-gradient activities (i.e., earth moving, removal of vegetation, soil stockpiling) has the capacity to suffocate existing plant life and increase nutrient levels in downgrade surface water systems. Dust created as a result of construction activities can have a similar impact	C, CL
			Runoff from acid producing rock exposed during construction activities has the potential for negatively altering water quality within down-gradient fish habitat.	C, CL
			Operational discharge of water has potential to negatively affect water quality	O, CL

Note: C= Construction Phase O= Operation Phase CL = Closure Phase

Expected impact extent as a result of Project activities during the temporal lifetime of the mine are described in Table 6.8-28. Direct impacts to watercourses and open water features are expressed through fish habitat quality categorizations – the methodology for these categorizations is described in detail in Section 6.8.2.1.2. Watercourses and open water features categorized as 'nil' are not accessible to fish and have therefore been excluded from determinations of direct impact to fish habitat. In addition, only wetland habitat that has been assessed as accessible to fish are included in direct impact discussions; general wetland habitat impacts from Project activities are discussed in Section 6.7.6.

Mitigation will be implemented to reduce the potential for direct fish mortality where fish were observed through fish rescue efforts. All reasonable efforts will be made to rescue fish, and a fish rescue plan will be developed in consultation with DFO prior to submission of the *Fisheries Act* application. Completion of relevant construction activities within confirmed fish habitat will occur within approved timing windows for construction (June 1st to Sept 30th) to reduce potential for mortality of eggs and juvenile fish. There will be opportunities to further re-design the Project to avoid or minimize the impacts.

According to the Guidelines for the Assessment of Alternatives for Mine Waste Disposal (Government of Canada, 2016) fish habitat compensation is required under section 27(1) of MDMER when a deleterious substance is deposited into waterbodies which are added to Schedule 2 of MDMER. Annex 2 of this guidance document states that:

> *"losses of fish habitat in those portions of the stream into which mine waste would be deposited must be compensated under section 27.1.* ***Losses of fish habitat in those portions of the stream that would be under the footprint of a tailings dam or other containment structure must be compensated under subsection 35(2)*** [of the *Fisheries Act*]" *(bold amended in 2016)*

The Proponent has confirmed that two watercourses with low quality fish habitat are located within the TMF footprint, WC12 and WC43. It has been confirmed that the section of WC12 is not within the portion of the TMF where mine waste would be deposited. The upper reach of WC43 has been determined to be accessible to fish during seasonal high flow and extreme flow events in the fall. The quality of the habitat in the upper reach of WC43 is determined to be low based on seasonal access restrictions, low pH and a partial barrier to fish passage located on East Brook (East Brook waterfall).

A total of four watercourses are proposed for alteration related to deposition of mine waste (Figure 6-8.3). Of these watercourses, two (WC19 and WC39) have been determined to be inaccessible to fish, and have been described as provincially regulated watercourses, rather than fisheries resources (Figure 6.8-5). WC12 and WC43 are proposed for alteration associated with construction of the TMF.

Watercourse 12 is a first-order headwater stream that originates as drainage from WL27, flowing west. Approximately 210 m of the uppermost reach of the watercourse is overlain by the TMF berm and collector ditches. This section of WC12 is extremely intermittent, and only periodically channelized, draining subsurface between lobes of WL27. The watercourse is only contiguous with downstream, fish-bearing reaches during extreme precipitation events (based on observations recorded in August 2017, April 2018 and June 2018, including fish surveys completed in June 2018). Fish collection was completed in WC12 on June 11th, 2018. Below the potential barrier (WC12R1), two eel pots and three minnow traps were deployed, and one electrofishing reach was sampled, yielding one ninespine stickleback and two brook trout. Upstream of the potential barrier (WC12R2), one fyke net, two eel pots, and three minnow traps were deployed, along with sampling of one electrofishing reach. This survey yielded one brook trout and ten ninespine stickleback, confirming that the boulder-bed channel section is passable to fish during high flow conditions. Through the spring of 2020, an additional 2382 hours and 10 minutes of trapping effort was conducted. No fish were captured during the spring surveys; furthermore, environmental DNA samples collected within the upper reach of WC12 did not result in detection of fish.

The section of the watercourse which will be directly impacted by Project infrastructure is classified as low quality for both brook trout and white sucker, providing only potential forage and refuge habitat for both species in the intermittent channelized sections of the watercourse, which is inaccessible to fish at most times of the year. A subterranean flow regime limits passage up into this area of WC12 except during extreme flow events. The only direct impact from construction of the Project infrastructure to WC12 is the construction of the proposed TMF perimeter berm, which overlays approximately 314 m^2 of the uppermost reach of WC12. No portion of the watercourse falls within the current TMF infrastructure - as such, no mine waste will be deposited into WC12.

Watercourse 43 is a first-order headwater stream that drains surface water through WL65 east to East Lake. East of a logging road, WC43 splits and disperses in a channelized fashion through treed swamp habitat, eventually draining into fen habitat where the channel was observed flowing into WL65. A 30 m section of subterranean flow was documented within the watercourse and has been assessed as a barrier to fish passage during both low and normal-flow conditions, as described in detail in Section 6.8.3.3. To date, extensive fish sampling throughout 2018-2020 have not captured fish within the TMF footprint. Additionally, environmental DNA samples collected both upstream and downstream of the barrier on WC43 supports the sampling conclusion that no fish frequent the limited standing water within the TMF boundary upstream of a natural barrier. However, due to uncertainty and data limitations at the time and the need to apply a precautionary approach; a portion of WC-43 within the TMF has been determined as a potential waters frequented by Fish and will plan to commence the process to be listed under Schedule 2 of the MDMER unless it can be clearly demonstrated to not be frequented by fish. Ongoing fish collection efforts are intended to address this uncertainty.

A total of 91 wetlands are proposed for alteration in locations where deposition of mine waste is proposed (WRSA, TMF and stockpiles) (Figure 6-8.5). Of these, 87 are hydrologically isolated. These 87 wetlands are predominantly isolated treed swamps, lacking any surface water within wetland boundaries. Furthermore, these isolated wetlands lack connectivity or access to fish bearing habitats and can be considered ‘Nil’ in terms of fish habitat provision.

Four of the wetlands proposed for alteration due to mine waste deposition have watercourse associations. Wetland 47 is presumed to be accessible to fish at the western end at the outlet (WC16), while impacts associated with the WRSA are limited to the northeastern portion. Wetland 47 does not have standing water during any time of the year or channelized habitat, and fish habitat is only present within the delineated channel within WC16, outside of the WRSA footprint. Similarly, WL1 is accessible to fish in the northwestern end only at the outlet (WC2), and impacts associated with the WRSA are limited to the southeastern portion where standing water is not present during any time of the year. Wetland 65 and WL27 are contiguous with WC43 and WC12, respectively. These wetlands are proposed for partial alteration to allow for construction of the TMF, perimeter berm, collection ditch and collection pond. During high flow events observed in November and December of 2019, WC43 overtops its banks, providing access to portions of Wetland 65 immediately surrounding the watercourse, in the form of shallow flooded wetland habitat. During normal seasonal flow and low flow (observed in September 2019, April, May and June 2020), WC43 is present in a confined channel. In the area of WL27 proposed for alteration, wetland habitat is not accessible to fish during normal seasonal flow, as the watercourse is present in a confined channel.

6.8.6.1.1 *Direct Fish and Fish Habitat Impacts*

The Project will result in direct impacts to fish habitat. Refer to Table 6.8-29 for potential direct fish habitat impacts to surface water features within the FMS Mine Site. The following potential impact extents are included:

- P – Partial expected fish habitat loss
- C – Complete expected fish habitat loss

Table 6.8-29: Summary of Key Diagnostic Features of Fish Habitat within the Project Infrastructure Footprint and TMF

Watercourse	Project Area	Area (m²)	Habitat	Slope (%)	Mean Depth (m)	Dominant Substrate	Emergent Vegetation Coverage	Impact Type
1 (Seloam Brook)	Infrastructure Footprint	3,804	Steady	1.30	0.58	Boulder	0	P
5*		397	Riffle	1.98	0.15	Detritus	0	C
6*		135	Steady	1.31	0.30	Fines	0	C
7*		1,005	Pool	0.45	0.50	Fines	0	C
8*		920	Steady	1.26	0.60	Detritus	0	C
9*		102	Pool	0.39	0.40	-	0	C
10*		56	Pool	0.84	0.40	-	0	C
11*		916	Pool	0.51	0.25	Detritus	0	P
22*		490	Pool	0.62	0.73	Boulder	0	P
42.4 (portion of Trafalgar Brook)		509	Steady	1.00	0.45	Boulder	0	C
Open Water**		19,113	Pool	<1.00	1.00	Detritus	0	P
Wetlands*		51,179	Pool	<1.00	1.00	Detritus	100	P
12*	TMF Dam Footprint	314	Pool	0.83	0.38	Detritus	0	P
43 (tributary to East Brook)	TMF	1,633	Pool	0.50	0.30	Detritus	0	P
Total		**80,573**						

*Tributary to Seloam Brook

**Open water features G, H, I, J, L, M, N, O, P, Q, R, S, T

As outlined in Table 6.8-29, ten linear watercourses, 13 open water features, and one wetland complex comprising fish habitat will be directly impacted by the mine development and have either confirmed fish presence or are accessible to fish, and known to support fish habitat. The total direct impact area is 80,573 m² of fish habitat. All direct impacts to fish and fish habitat are shown on Figure 6.8-5.

Each stream reach potentially affected by the Project has been identified using the existing Project infrastructure layout and the existing aquatic habitat mapping. Each habitat type has been characterized via surveys using standard methodologies to gather important diagnostic measurements such as reach length (m), reach wetted and bankfull width (m), reach slope (%), stream substrate composition (% composition), water depths (m), water velocities (m/s), and riparian habitat (% cover). The data was used to determine the overall habitat area within each reach as well as the habitat suitability, based on measured stream substrate, water depths, and water velocities (habitat parameters) for each fish species identified within the Project footprint.

Based on the anticipated direct and indirect impacts to fish and fish habitat, a Fish Habitat Offset Plan (Appendix J.7) has been developed. The Fish Habitat Offset Plan demonstrates the fish habitat offsetting strategy for the FMS Mine Site and serves as the basis for an application for HADD authorization as required by the *Fisheries Act.* The intent of the Fish Habitat Offset Plan is to provide DFO with the information necessary to determine if measures to offset unavoidable residual HADD (as defined in the *Fisheries Act*) can be achieved. Final HADD determination and offset requirements will be completed with DFO through the *Fisheries Act* authorization process.

As part of the HADD quantification process, habitat suitability values were calculated for applicable life stages for each species; spawning, young-of-year, juvenile, and adult. The final calculation of a Habitat Utilization Index (HUI) for each species life stage is completed by multiplying the final habitat suitability value and the habitat area for each reach. Total HUI values for all reaches are combined for an overall Species life stage HUI value. To be conservative and to ensure that all species and life stages possibly using the habitat are accounted for, the highest Species life stage HUI calculated is used to represent the largest habitat loss and is therefore used to quantify the HADD for the purpose of offset planning and authorization. This procedure has been completed for Section 35 HADD determination and MDMER Schedule 2 separately.

A summary of the likely HADD and Schedule 2 habitat quantification is provided below. Standard mitigations (described further in Section 6.8.7.2) as well as project-specific avoidances and redesigns have minimized the HADD to only those habitats where avoidance and further mitigation is not possible. It is understood that the final HADD determination will be provided by DFO; however, this preliminary quantification is provided to show that the offset concepts described can be designed to meet HADD quantity expectations, including any offset ratios.

Using the identified fish species currently known to use habitat available within the Project footprint, Habitat Suitability Index (HSI) values were generated for each species life stage using DFO data for water velocities, water depth, substrate, and where appropriate, emergent vegetation (Table 6.8-30). Using these suitability indices, the final Habitat Equivalent Units (HEUs) for the lost habitat were generated (Table 6.8-31) with the highest species life stage HEU value used to conservatively represent the overall HEU and therefore the possible HADD.

Extensive field investigations have not identified fish presence within the footprint of the Proposed TMF. However, correspondence with ECCC has indicated that a portion of WC43 may be considered a waterbody frequented by fish, and as such may require listing in schedule 2 of the MDMER, unless additional fish sampling can clearly demonstrate that fish are not present at any time. The habitat within the TMF boundary and that portion of just outside the boundary estimated to be dewatered due to the TMF is a total of 1,954 m^2 as shown in Table 6.8-29. Using the identified fish species currently known to utilize this habitat, Habitat Suitability Values were generated for each species life stage (Table 6.8-32). Using these suitability indices, the final Habitat Equivalent Units (HEUs) for the lost habitat within the TMF were generated (Table 6.8-33) with the highest species life stage HEU value used to conservatively represent the HEU and therefore the possible HADD.

Table 6.8-30: Summary Habitat Suitability Indices for each species life stage within the Project infrastructure footprint area.

Habitat	Brook Trout				White Sucker				Lake Chub				Pearl Dace			
	Spawning	YOY	Juvenile	Adult	Spawning	YOY	Juvenile	Adult	Spawning	YOY	Juvenile	Adult	Spawning	YOY	Juvenile	Adult
Pool	0.13	0.24	0.28	0.32	0.08	0.35	0.01	0.49	0.34	0.34	0.10	0.28	0.03	0.03	0.03	0.03
Rapids	0.13	0.40	0.42	0.41	0.15	0.70	0.00	1.00	0.71	0.71	0.21	0.42	0.20	0.20	0.20	0.20
Riffle	0.15	0.22	0.42	0.27	0.08	0.42	0.04	0.84	0.58	0.65	0.21	0.42	0.02	0.02	0.02	0.02
Steady	0.19	0.31	0.36	0.45	0.10	0.29	0.07	0.36	0.31	0.42	0.17	0.36	0.06	0.06	0.06	0.06
Open Water	0.25	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Wetlands	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 6.8-31: Summary of Habitat Equivalent Units for each species life stage within the Project infrastructure footprint area.

Habitat	Existing Habitat Area	Brook Trout				White Sucker				Lake Chub				Pearl Dace			
		Spawning	YOY	Juvenile	Adult	Spawning	YOY	Juvenile	Adult	Spawning	YOY	Juvenile	Adult	Spawning	YOY	Juvenile	Adult
Pool	2569	341.6	622.7	713.3	830.8	196.1	893.9	16.1	1257.6	861.8	861.8	249.2	713.3	75.8	75.8	75.8	75.8
Rapids	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Riffle	397	59.1	88.5	165.9	105.3	32.0	168.4	17.7	331.8	231.1	260.0	82.9	165.9	9.6	9.6	9.6	9.6
Steady	5368	1036.6	1689.0	1922.3	2397.5	517.3	1578.2	355.8	1922.3	1688.0	2260.7	937.1	1922.3	306.7	298.6	298.6	298.6
Open Water	19113	4730.5	0.0	0.0	4730.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wetlands	51179	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	78626	6167.7	2400.2	2801.4	**8064.1**	745.4	2640.5	389.6	3511.6	2781.0	3382.6	1269.3	2801.4	392.1	383.9	383.9	383.9

Note: Bold indicates the highest HEU value, which formed the basis of the potential HADD.

Table 6.8-32: Summary Habitat Suitability Indices for each species life stage within the TMF footprint area.

Habitat	Brook Trout				White Sucker				Lake Chub				Pearl Dace			
	Spawning	YOY	Juvenile	Adult	Spawning	YOY	Juvenile	Adult	Spawning	YOY	Juvenile	Adult	Spawning	YOY	Juvenile	Adult
Pool	0.13	0.24	0.28	0.32	0.08	0.35	0.01	0.49	0.34	0.34	0.10	0.28	0.03	0.03	0.03	0.03
Rapids	0.13	0.40	0.42	0.41	0.15	0.70	0.00	1.00	0.71	0.71	0.21	0.42	0.20	0.20	0.20	0.20
Riffle	0.15	0.22	0.42	0.27	0.08	0.42	0.04	0.84	0.58	0.65	0.21	0.42	0.02	0.02	0.02	0.02
Steady	0.19	0.31	0.36	0.45	0.10	0.29	0.07	0.36	0.31	0.42	0.17	0.36	0.06	0.06	0.06	0.06
Open Water	0.25	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Wetlands	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 6.8-33: Summary of Habitat Equivalent Units for each species life stage within the TMF footprint area.

Habitat	Existing Habitat Area	Brook Trout				White Sucker				Lake Chub				Pearl Dace			
		Spawning	YOY	Juvenile	Adult	Spawning	YOY	Juvenile	Adult	Spawning	YOY	Juvenile	Adult	Spawning	YOY	Juvenile	Adult
Pool	1954	258.89	471.95	540.57	629.64	148.62	677.51	12.17	953.10	653.16	0.00	188.87	540.57	57.42	0.00	0.00	0.00
Rapids	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Riffle	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Steady	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Open Water	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wetlands	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	1954	258.89	471.95	540.57	629.64	148.62	677.51	12.17	**953.10**	653.16	0.00	188.87	540.57	57.42	0.00	0.00	0.00

Note: Bold indicates the highest HEU value, which formed the basis of the potential HADD.

6.8.6.1.1.1 Direct Impacts- Open Pit and Seloam Brook Realignment

Impacts related to the development of the open pit area, and the Seloam Brook Realignment are expected to be permanent. The open pit infrastructure, including diversion berm, is located centrally within the Seloam Brook system, which is characterized by many smaller, converging linear and open water features, with multiple small ditched channels resulting from historic mine workings (Watercourses WC1, WC6, WC7, WC8, WC9, WC10, WC11, WL2, and associated open water features). A complete loss of fish habitat is expected for Watercourses WC5, WC6, WC7, WC8, WC9, WC10, and WC42.4, and Open Water Features G, H, I, J, L, M, N, O, P, Q, R and S. Partial losses of fish habitat are expected for WC1, WC11, WC22, Open Water Feature T, and fish habitat provided by contiguous habitat in WL2. While these aquatic habitats are inhabited by fish, as described in the baseline conditions section, the quality of the habitat is suboptimal, partially attributed to historic mining activities, and also general watershed condition (low pH and hydro system/barriers to fish movement). The Seloam Brook Realignment and associated fish habitat loss is considered an unavoidable impact of the Project development in order to access the resource.

The development of the proposed open pit within the FMS Mine Site will require dewatering a 1 km long braided section of Seloam Brook below the outlet of Seloam Lake. The Proponent will construct an open pit perimeter berm on the upstream and downstream sides of the open pit to deflect flow north and away from the pit development area. Flow from Seloam Brook, and its tributary WC12, will be diverted to a constructed approximately 800 m long realignment channel with natural floodplain located on the north side of the open pit. This will rejoin Seloam Brook on the western side of the open pit.

A feasibility level design has been completed for the Seloam Brook Realignment, which includes:

- Seloam Brook Diversion Channel Design (Appendix D.4);
- Seloam Brook Realignment Section Model Results Memo (Appendix J.5);
- Seloam Brook Realignment Hydraulic Analysis – Downstream environment (Appendix B.9); and,
- Fish Habitat Offset Plan: Preliminary Concept Update (Appendix J.7).

The Seloam Brook Realignment is required to provide conveyance of flood flows and prevent flooding of the open pit while enabling low flow connectivity around the diversion berm. In the feasibility level engineered design completed by KP, the realignment channel has been designed to provide fish passage during both normal and low flow conditions, and it will incorporate fish habitat enhancement features in the final design, as described in the Fish Habitat Offset Plan (Appendix J.7).

The Seloam Brook Realignment Section Model Memo (Appendix J.5) presents a modelling exercise based on design criteria presented in the KP engineered design to estimate the flow parameters within the conceptual realignment channel. The estimates generated provide greater clarity that the conceptual design can convey the anticipated flows and can be sustainable beyond the life of mining operations. Initial configuration of the Seloam Brook Realignment Channel includes a stream channel as well as a surrounding integrated floodplain. The concept is that the stream channel will be the primary fish habitat and will contain the anticipated principle flows while the floodplain will allow high-flow events such as spring freshets and extreme storm events to pass, similar to a natural wetland/floodplain ecosystem. The channel and floodplain would both be designed to provide substrates, morphology and cover in the high suitability range for the fish species known to exist within the system and to provide ecological function for other species of wildlife that depend on watercourse habitats.

The realignment will allow adequate conditions, particularly water depths for fish habitat and migration under normal flow conditions at Mean Annual Discharge (MAD) as well at 1 in 20-year Mean Annual Dry conditions. The channel is required to remain stable throughout the operational life of the Project and in the long-term following closure.

The realignment channel includes a culvert to allow passage of haul trucks between the pit and the organics pile. The culvert design is based on the requirement to accommodate a 1 in 200-year flood event (Q200) without overtopping the haul road or diversion berm, while also allowing fish passage during both high and low flow scenarios. The culvert will meet all standards for culvert design in Nova Scotia. In addition to the culvert, the realignment channel includes three other components: two inlet structures and an outlet structure. One inlet structure will allow conveyance of flow from Seloam Brook into the channel, while the other will convey flow from WC42 (Trafalgar Creek) into the channel. The outlet structure will exist downstream of the culvert, and will convey all water from the realignment back into WC42. Slightly downstream of the outlet structure, WC42 diverges with one branch (WC42, also referred to herein as the North Channel) flowing west approximately 875 m before converging with Seloam Brook, and another branch (WC4, also referred to herein as the South Channel) flowing southwest approximately 460 m before converging with Seloam Brook.

The preliminary realignment channel design has been modelled under following flow regimes: 1 in 20-year low flow, mean annual discharge (MAD), Q10, and Q200. Details associated with the flow modelling exercise are provided in Appendix D.4. These flow regimes were selected to confirm fish passage during low flow, and to identify appropriate substrate sizing to withstand shear stress and ensure stability of the channel during extreme flows (Q200). The flows originally used by KP to design the stream channel and floodplain have been incorporated into the habitat-based floodplain design by Wood (Appendix J.5). While the original KP channel design was less habitat-focused, the flows estimated from historic hydrologic records and measures remain valid and were used in this revised integrated floodplain design. Flows in excess of 1.0 m^3/s are expected to overtop the realignment channel into the floodplain, mimicking the function of a natural channel condition. The modelled results show that lows as high as the 200-year even would easily be contained within the 40-45m wide conceptual floodplain, and/or within a combination of constructed channel and natural topography.

The preliminary realignment channel design was completed to ensure that the channel would remain stable under high flow regimes while ensuring fish passage under 1 in 20-year low flow. Details are provided in associated technical reports as described above and also in Sections 2 and 6.6 of this EIS.

An impact to the downstream receiving environment from the Seloam Brook Realignment was predicted due to outlet velocities and associated potential for erosion and sedimentation of the North and South Channels (WC42 and WC4, respectively). The realignment design, as revised by Wood, was not modelled in the downstream effects assessment prepared by Golder, however the range of stream velocity estimated through the revised design was compared to those modelled using the KP (2020) design for applicability to the downstream hydraulic assessment. The predicted effects of increased velocity and of increased water levels are discussed in detail in Section 6.8.6.1.2.1.

To mitigate the effects of the predicted increased velocity, water control features were designed downstream of the Seloam Brook Realignment. The details associated with the hydraulic evaluation are outlined in Appendix B.9. Flow restriction structures such as check dams and an outflow weir will be installed within these channels, to reduce the spatial extent of the erosion and sedimentation caused by the velocity of water at the outlet of the realignment channel while maintaining baseline flows to the downstream environment and provision of fish passage.

The construction of the diversion berm and realignment channel will allow for isolation of the proposed open pit area. The direct loss of fish habitat as a result of the Seloam Brook Realignment and construction of the open pit is expected to be 78,626 m^2. This includes accounting for the complete loss of flow in a short section of Seloam Brook located downstream of the western side of the diversion berm, up to the confluence with the South Channel (WC4). This will result in a loss of fish habitat provisions, including access to food sources within that portion of Seloam Brook and its tributaries. While a portion of Seloam Brook and its tributaries will be lost as a food source for fish, the realignment will allow reestablishment of a stream system from Seloam Lake to remaining portions of Seloam Brook, and access to natural habitats and food sources will be provided within this newly established habitat. Furthermore, specific fish habitat enhancement features will be built into the realignment channel and floodplain as described in the Fish Habitat Offset

Plan, upon final design and engineering, which will promote the establishment of a benthic invertebrate population within the channel itself.

The impacted area includes multiple braided channels of Seloam Brook, open water ponded sections of watercourses, small tributaries and wetlands. The majority of the habitat being lost within the FMS Study Area consists of wider, deep pools and areas of floating emergent vegetation, typical of very low-gradient, open water/wetland habitat. While the Habitat Suitability Indices for the fish species life stages that currently reside within the FMS Study Area are low for these habitat types, they do offer habitat complexity and some habitat refuge capacity during low-flow seasonal periods. Therefore, consideration is being given to providing similar habitat in the area of the realignment channel outflow that will mimic these conditions through proper placement of the flow control structures (riffles) and design of expanded low-gradient, open water/wetland habitat.

Direct impacts to fish and fish habitat are expected to allow for construction of the Seloam Brook Realignment (inlet and outlet structures) and associated velocity mitigation (water control structures: check dams and berm). These impact areas will be determined upon completion of engineered design and will be minimal in comparison to broader impacts described within this EIS. The smaller impact areas associated with water control structures will be quantified to support the HADD authorization application.

The existing wetland complex currently experiences water level fluctuations on an annual basis due to management of the NSPI dam infrastructure on Seloam Lake. As a result, these existing wetlands can manage, and have adapted to, fluctuating water conditions. Proper placement of water control structures within WC42 (Trafalgar Creek) downstream of the realignment outflow can cause strategic backwater effects (ponding) on the upstream side. Based on current placement and modelling (Appendix B.9), existing downstream wetlands can be expected to experience flooding to a maximum, steady state depth of approximately 0.4 m, as modelled for mean average discharge rates with the addition of conceptual flow restrictions during operations. While the open water/wetland habitat being lost within the FMS Study Area consists of fine organic substrates and deeper water, habitat at the realignment channel outflow can be constructed that will have more suitable habitat features but still mitigate a portion of open water/wetland habitat being lost within the same watershed/ecological unit.

6.8.6.1.1.2 Direct Impacts – TMF and Berm Infrastructure

Four linear watercourses have been mapped within the TMF infrastructure footprint. Watercourses 19 and 39 are first-order ephemeral provincially regulated watercourses with no hydrological connections to downstream, fish-bearing systems. These watercourses are not defined as fisheries resources (Figure 6.8-5). Extensive fish collection completed in each of these watercourses in the spring of 2020, (1,214 hours and 45 minutes of trapping effort) did not result in any fish captured or observed. Furthermore, eDNA samples collected in WC19 and 39 resulted in non-detection of fish DNA.

Watercourse 19 was assessed on August 11th, 2017, December 6th, 2019, and April 28th, May 25th-29th, June 1st and 2nd, and June 4th and 5th, 2020. It is a first order ephemeral watercourse that develops within WL80 from pockets of standing water. The channel drains water from west to east, dispersing through upland habitat shortly after exiting the wetland. It dissipates into upland habitat which lacked any evidence of an erosion channel, flow pattern, or aquatic insects, fish or vegetation. East of WL80, WC19 dissipates into upland habitat and surface water does not continue to remain as a channel, which was confirmed during both low flow and high flow evaluations. WC19 is not hydrologically connected to any downstream, fish-bearing system, and as such it is not accessible to fish at any time. There is an approximately 450 m span of no hydrological connectivity (following flow accumulation mapping) between WC19 and the closest downgradient, potentially fish-bearing system.

Similarly, WC39 was originally assessed on July 11th, 2018, December 6th, 2019, April 28th, May 25th-29th, June 1st and 2nd, and June 4th and 5th, 2020. WC39 is a first order ephemeral watercourse which forms within the perimeter of WL207. The channel drains from southwest to northeast, transitioning to underground drainage at its downstream extent. At the time of the July 2018 evaluation, the identified channel was mostly dry and had minimal flow. Similar to WC19, WC39 dissipates shortly as it flows out of WL207, which was confirmed during both low and high flow assessments. At the downstream end of WC39, it dissipates into upland habitat with no evidence of a watercourse channel, or even discontinuous pockets of standing water under roots or rocks. Within the adjacent upland habitat, there is no evidence of an erosion channel, flow pattern, or aquatic insects, fish or vegetation. It does not exist downstream as a watercourse, and it is not accessible to fish at any time. There is an approximately 400 m span of no hydrological connectivity (following flow accumulation mapping) between WC39 and the closest downgradient, potentially fish-bearing system.

Watercourse 19 and WC39 will be completely impacted by TMF infrastructure. The habitat quality in these watercourses is considered 'nil' (not accessible to fish) and are therefore excluded from Table 6.8-29.

Watercourse 12 is a first-order headwater stream that originates as drainage from WL27, flowing west to Seloam Brook. Based on habitat observations documented during wetland and watercourse delineation in August 2017, fish collection was conducted upstream and downstream of the boulder channel which exists between WL18 and WL20 (Figure 6.8-2). Fish collection above the potential barrier resulted in the capture of one brook trout and 10 ninespine stickleback, confirming that the barrier is passable to fish, even if only during high flow events, or a resident population of fish exists above the barrier. Fish collection completed in the upstream extent of WC12 in May-June of 2020 (total trap effort of 2382 hour, 10 minutes) did not result in any fish captures. In addition, environmental DNA samples collected in WC12 in May 2020 did not result in detection of fish DNA.

Watercourse 43 is a first-order headwater stream that drains surface water through WL65 east to East Lake. The watercourse originates within the western extent and shrub swamp portion of the wetland complex. A 30 m section of subsurface flow was documented within the watercourse and has been assessed as a barrier to fish passage during both low and normal-flow conditions based on the absence of surficial flow, as described in Section 6.8.3.3. During high flow conditions, contiguous flow was observed through this section and therefore it has been deemed accessible to fish at some points of the year, though the subterranean section generally limits passage of fish into the upper reaches of WC43. Downstream of this section, the watercourse re-channelizes and continues to East Lake.

Approximately 1,565 m^2 of habitat within WC43 will be impacted by the current TMF design. The Proponent is continuing to conduct fish surveys in the WC43/East Lake/East Brook system through 2020 to confirm the use of this system by fish in multiple flow regimes.

Overall, fish habitat potential within the TMF infrastructure footprint is limited to partial reaches of first-order streams. Correspondence with ECCC has indicated that a portion of WC 43 is considered a waterbody frequented by fish, and as such may require listing in schedule 2 of the MDMER, unless additional fish sampling can clearly demonstrate that fish are not present at any time. Direct impacts to fish habitat from the TMF development is considered a low magnitude impact, and will be accounted for in the site-wide Fisheries Act Authorization. The Project Team is continuing to work with ECCC and DFO to confirm whether the Project will require addition to Schedule 2 of the MDMER.

6.8.6.1.1.3 Direct Impacts – Other Infrastructure

Watercourse crossings will be required at several locations, including WC1, WC12, WC15, WC16 and WC42 to allow for road construction and the installation of the Seloam Lake water intake pipe. However, limited impacts are expected once standard construction methods for culvert installation and mitigation strategies are implemented during road widening and re-alignment. Culverts will be installed in accordance with DFO and NSE guidance to reduce potential impacts to fish and fish habitat. Where appropriate, the Proponent will work to install open bottom box culverts or bridges to reduce potential impact on the watercourses and associated fish habitat during road construction.

6.8.6.1.1.4 Direct Impacts - Summary

Mortality to fish is expected to be low, once mitigation measures are implemented, including the Seloam Brook Realignment, downstream controlled flooding of wetland habitat and associated creation and enhancement of fish habitat, and development and implementation of a fish rescue plan for adult fish prior to commencement of construction activities in confirmed fish habitat.

Furthermore, the Proponent commits to adhering to approved timing windows for construction to minimize impact to eggs, larvae, and juvenile fish, wherever practicable. Direct alteration within the FMS Mine Site is restricted to low-moderate quality habitat, having limited potential to support spawning. In addition, aquatic connectivity will be maintained and mitigation offered through the FMS Mine Site with the construction of the Seloam Brook Realignment, associated fish habitat improvements, and downstream enhancement of fish habitat in wetlands. As a result, work associated with development of the mine will not affect migration patterns or local movements of fish species, and there is no expectation of change to the composition of populations of fish from direct loss and alteration of fish habitat, given the limited numbers of fish observed within the FMS Mine Site and its position downstream of Seloam Lake dam, which acts as a barrier to upstream fish passage. Furthermore, the larger waterbodies present within the FMS Mine Site (Seloam Lake, East Lake, Anti-Dam Flowage) will be avoided during Project development, limiting impact to fish populations present in these larger more significant systems.

6.8.6.1.2 *Indirect Fish and Fish Habitat Impacts*

Project activities may have indirect effects on fish and fish habitat through several main pathways:

- Effects related to the Seloam Brook Realignment (upstream and downstream);
- Upgradient hydrological alteration during construction;
- Collection of mine site contact water during operations and closure and associated change in water balance;
- Effects of the Project on water quality, including siltation;
- Water discharge into downstream receiving environments;
- Effects to Riparian Habitats; and,
- Effects of blasting on fish.

Each individual pathway identified above has the potential to indirectly affect fish and fish habitat through changes in both biotic and abiotic environments. For instance, indirect effects could result in changes to physical habitat (i.e., channel morphology), flow regimes and water quality. Each of these changes could indirectly effect fish through resultant changes in primary and secondary productivity and changes in food web dynamics. Potential indirect effects will be described in terms of their effects to both biotic and abiotic environments throughout this section.

Potential for down-gradient, indirect fish and fish habitat impacts could occur throughout the FMS Mine Site as a result of upgradient hydrological alteration. Primarily, the alteration of hydrological conditions through site water management of mine contact water, Seloam Brook Realignment, and associated changes in water balance within local catchments can affect fish.

Maintaining water quality and quantity downstream in the PA and LAA is paramount for limiting broader fish and fish habitat impacts within each affected watershed associated with the Project. The removal of wetlands and watercourses also has the potential to alter surface flows and downgradient hydrology. Water quality could be further affected from an increase in TSS associated with potential siltation and release of substances to downstream receiving surface water systems adjacent to mine infrastructure (LAA).

6.8.6.1.2.1 Effects related to the Seloam Brook Realignment

Effects of the Project on Surface Water quantity are detailed in Section 6.6. During the construction phase, the Seloam Brook Realignment will be completed to support pit development. The realignment of Seloam Brook has the potential to result in indirect impacts to fish and fish habitat through flow path adjustments both upstream and downstream of the realignment, sediment releases, flooding of wetlands, and physical adjustments to fish habitat, as described in the following sub-sections and shown on Figure 6.8-6.

6.8.6.1.2.1.1 Erosion and Sedimentation

As described in the feasibility level design for the Seloam Brook Realignment (Appendix D.4), the realignment channel has been designed to provide fish passage under normal and low flow conditions. The realignment will allow adequate conditions, particularly water depths for fish habitat and migration under normal flow conditions at Mean Annual Discharge (MAD) as well at 1 in 20-year Mean Annual Dry conditions. The Fish Habitat Offset Plan (Appendix J.7) outlines further considerations for the design of the realignment channel, to incorporate a naturalized floodplain and improved fish habitat. The criteria outlined by KP (Appendix D.4) to ensure fish passage through normal and 1 in 20 year low flow, and channel stability will be maintained as design criteria for future iterations of the realignment channel design.

Based on predicted velocities at the outlet of the realignment channel, changes in stream morphology through erosion and sedimentation are expected immediately downstream of the outlet structure and dissipation apron. This is expected to result in alteration of fish habitat. To evaluate the indirect effects to fish and fish habitat as a result of this increase in velocity and associated release of sediment, velocities entering the watercourses downstream of the realignment channel (WC42 and WC4) have been simulated for Baseline and Operation Conditions based on hydraulic modelling developed for the Seloam Brook watershed (Appendix B.9). This evaluation was focused on water velocity, as it is the velocity of the water that drives the energy potential that leads to changes in stream morphology.

The hydraulic model was simulated with the addition of conceptual flow restrictions consisting of two water control structures in the South Channel (WC4) and a water control structure such as an overflow weir at the outlet of the realignment to maintain baseline flows in the North Channel (WC42). In the model, the remaining discharge was directed through the South Channel to confluence with the existing Seloam Brook. These conceptual structures were simulated for both the mean and 95th percentile of discharge rates under Operation Conditions. The goal of these water control structures is to provide the ability to slow the velocity and reduce the spatial extent of erosion and sedimentation caused by increased velocities at the outlet of the realignment channel.

The Baseline Conditions model had velocities simulated through the South Channel on average at 0.2 m/s during the mean discharge rate and a maximum velocity of 0.7 m/s during the 95th percentile of discharge rates. Similarly, the baseline conditions velocities in the North Channel were simulated to be higher than 0.1 m/s, with the average velocity under mean discharge scenario simulated to be 0.2 m/s and the maximum velocity in the percentile of discharge rates was simulated to be 0.8 m/s. Under the Baseline Conditions, simulated velocities in both channels are such that finer particles (grain size diameter less than 0.1 mm) have the potential to be mobilized.

Velocities for both the North and South Channel were simulated under the Operation Conditions. Within this condition, as discussed, it was assumed that a conceptual water control structure would be constructed to maintain the Baseline Conditions discharge ranges into the North Channel. To simulate velocities in the South Channel similar to those simulated in the Baseline Conditions, two conceptual water control structures were simulated. With the addition of conceptual water control structures to the South Channel, the average velocities were simulated to be within the range of the Baseline Conditions.

With the addition of discharge mitigation structures (apron and dissipation pool) and described water control structures further downstream (check berms and/or overflow weirs) to manage water velocity, no significant changes to the velocities or particle mobilization within the downstream two channels are expected during Operations compared to baseline conditions (Appendix B.9). The simulated addition of conceptual water control structures decreased the predicted velocities to within the range of Baseline Conditions. As the Project advances, these conceptual water control structures will need to be optimized for size, placement, and design for appropriate fish passage. With the use of proper mitigation measures to prevent erosion and sedimentation, no changes to downstream geomorphology or sediment deposition are expected.

Based on predicted velocities at the outlet of the Realignment Channel, the reach between the dissipation apron and the downstream water control structures is expected to experience a localized instability. Babakaiff, Hay and Fromouth (1997) state that erosion and sedimentation may be atypically high in magnitude following an initial disturbance (in this case increased velocity), but channel morphology and sediment loading can re-establish and re-naturalize to the new steady state. It is expected that erosion and sedimentation effects in the area between the dissipation apron and water control structures would naturalize overtime, and the effect is expected to be temporary.

The effects to fish and fish habitat due to erosion and sedimentation associated with the Seloam Brook Realignment are expected to change the quality of the habitat for some species and life history stages, rather than result in a complete loss of habitat. Indirect effects to fish and fish habitat due to erosion and sedimentation are anticipated to affect the following areas upstream of the proposed water control structures:

- WC4: 1487 m^2
- WC42: 422 m^2

Total = 1909 m^2 fish habitat indirectly impacted through sediment/erosion.

No indirect impact to downstream systems (WC4 and WC42) are predicted below the water control structures, as described above and in Appendix B.9.

This area has been incorporated into the Fish Habitat Offset Plan. As described above, this impact is expected to be temporary in nature, and is expected to result in a decrease in habitat quality for some species of fish, rather than a complete and permanent destruction of fish habitat. As such, the final offset requirements for this indirectly impacted habitat will be determined through additional consultation with DFO and through detailed design of the Seloam Brook Realignment.

No increase in water velocity or gradient is required to allow water to flow into the Realignment Channel. The Seloam Brook Realignment is not expected to result in any erosion or sedimentation issues upstream of the realignment, provided standard mitigation measures are strictly adhered to during all works in or near water (Appendix D.4).

Provided that flow and fish passage is maintained to both downstream and upstream environments through the construction phase, and all appropriate measures are implemented to prevent erosion and sedimentation and management of historical tailings/waste rock, the realignment channel is not expected to result in a significant adverse effect on fish and fish habitat. As described in the Fish Habitat Offset Plan, the realignment channel has been re-envisioned to incorporate a naturalized floodplain providing suitable fish habitat.

6.8.6.1.2.1.2 Increased Water Levels

The Seloam Brook Realignment and associated water control structures on the North and South Channels are anticipated to result in flooding within fish habitat downstream of the realignment channel. Flooding is predicted to occur downstream of the Realignment Channel dissipation apron and water control structures, within WL2 along WC4, WC42 and Seloam Brook. The predicted flood extend continues west into the eastern extent of WL64, which is approximately 860m west of the dissipation apron at the outlet of the Realignment Channel. Steady state flood extents have been predicted based on mean annual discharge rates modelled for the Seloam Brook Watershed. Downstream of the realignment channel, the flood extent was simulated with depths ranging from 1.8 m within the channel to a maximum of approximately 0.4 m in the floodplain (Appendix B.9). Flood extents are displayed on Figure 6.8-6.

Upstream of the realignment channel, flooding is not predicted to occur under the MAD flow scenario and thus no indirect impacts to fish habitat upstream of the realignment are predicted (Appendix D.4). Under storm events, increases in water levels are expected to mimic natural conditions.

With velocities maintained comparable to baseline conditions (through the methods described in Section 6.8.6.1.2.1.1), a stable increase to water level depths is anticipated to generate net benefits for fish and fish habitat. These benefits may be achieved through the following pathways (Roni, Press, Beechie and Hanson, 2014):

- Improvements to upstream and downstream fish passage;
- The expansion of existing fish habitat and creation of newly accessible habitat;
- An increase in accessible off-channel habitats;
- A decrease in low-flow stranding and predation; and,
- A decrease in peak summer water temperatures.

Increasing water levels in the habitat adjacent to the main stream channel is typically beneficial to fish, as described by Roni et al. (2014), through provision of habitat for juvenile salmonids and increasing overwintering survival. Increased water levels and improved access to flooded wetland habitat can provide refuge, foraging and juvenile rearing habitat for an assemblage of forage fish as well, including banded killifish, brown bullhead, white sucker, golden shiner, and lake chub. Further to these potential net benefits associated with increased water levels listed above, the Proponent may consider addition of physical habitat enhancements in the area where the water level is expected to increase (specifically in the area downstream of the realignment channel and upstream of the water control features). Potential habitat enhancements will be evaluated further in the detailed design process.

6.8.6.1.2.1.3 Changes to Food Web Dynamics

The Project Team considered effects of increased water levels on the benthic invertebrate communities, to identify potential indirect effects from changes in food web dynamics. Some species groups (i.e., chironomids) are less resilient to flood conditions while other groups such as mayflies have behavioral and morphological adaptations to flood conditions (Robinson, Aeschinger and Uehlinger, 2004). This is of particular importance along the Seloam Brook Realignment. The area of direct habitat loss will also be lost as a food source to fishes. Given that the realignment channel is designed to provide fish passage between Seloam Brook, Seloam Lake and WC42, fish will still be able to navigate between these two areas for access to intact natural food sources and this realigned stream will mitigate fish food source losses. Fish habitat enhancements provided within the realignment channel will provide an opportunity for establishment of a healthy benthic invertebrate community. While increased water levels may result in an adjustment of benthic community structure in some areas, it is expected that the benthic community will stabilize and naturalize, provided appropriate flow management and water quality mitigation measures are implemented. Given that the fishes known within the FMS Study Area are generalist feeders, it is expected that any changes in benthic invertebrate community structure will not result in significant effects to food web dynamics. Further detailed design of the Seloam Brook Realignment and downstream water management structures will be completed with the goal of supporting fish habitat upstream, within, and downstream of the realignment, considering both abiotic (physical structures) and biotic factors (food web dynamics) to habitat quality.

Detailed design and regulatory consultation associated with the Seloam Brook Realignment may result in a decrease in predicted flooded area. Fish habitat provided within Seloam Brook and associated wetlands currently experiences water level fluctuations on an annual basis due to management of the NSPI dam infrastructure on Seloam Lake, so it is anticipated that these habitats have a natural tolerance to water level fluctuations.

Changes in water quantity have varying effects on the abundance and diversity of the benthic invertebrate communities. According to Chadwick & Huryn (2007), large-bodied macroinvertebrates (i.e., odonates) are more sensitive to water level reductions than smaller species (i.e., dipterans), as they required more perennial flow to complete their life cycles. Mazzacano & Black (2012) demonstrate that within the benthic community, changing environmental conditions (i.e., changes in flow rates, variations in pH and dissolved oxygen levels) generally results in a change in species composition, rather than a complete failure of the benthos. This was reiterated by Robinson, Aebischer & Uehlinger (2004) who stated that macroinvertebrate communities are generally resilient to hydrologic changes, even in responses to flood conditions. Given that most fishes within the FMS Study Area are generalist feeders with a diverse array of food sources, a shift in the benthic community structure is not anticipated to result in an overall loss of available food source for fishes.

6.8.6.1.2.2 Water Quantity Effects

Effects of the Project to regional catchment areas are expected to commence during construction, and continue through operations and closure as a result of site water management. The details of these effects are presented in Section 6.6 and shown on Figure 6.8-5. The magnitude of the effect to surface water quantity is low in the broader regional watersheds modelled by Golder including SW2, SW4, SW6 and SW14, as all are predicted to have flow reductions of less than 5% across all phases (construction, operations, closure) or, in the case of SW6 during post closure, an increase in flow of 3% is predicted due to release of treated effluent. Changes in flow rates on the order of 3-5% are not anticipated to have an effect on primary or secondary productivity in the affected systems, as this level of fluctuation is within the range of natural variation.

The outflow through the Seloam Brook was simulated to decrease as a result of the Project footprint and the upstream removal from Seloam Lake. Considering the effects of the Seloam Brook Realignment and upstream infrastructure, the resulting effect of the Project on water quantity at SW5 is projected to be low in magnitude, and is not likely to result in significant adverse effects.

As discussed in Section 6.6, initial start-up water and ongoing make-up water is expected to be sourced from Seloam Lake. Water withdrawal from Seloam Lake will be initiated during the construction phase of the Project and will last for approximately three months. Using the Nova Scotia Guide to Surface Water Withdrawal Approvals (NSE 2016), water quantity changes within Seloam Lake during initial water withdrawal were calculated based on lake size (306.9 ha) and the maximum predicted take in volume from the lake (500,000 m^3). This equates to a water level decrease of 11 cm in Seloam Lake.

Water levels within Seloam Lake undergo seasonal fluctuations due to the filling and drawdown of the reservoir. Seloam Lake is drawn down over the winter, early spring, and summer. Some refilling takes place during spring runoff, with most refilling occurring over the fall. As of 2017, the maximum annual water elevation change within Seloam Lake as recorded by NSPI was approximately 6 m (personal communication via email, January 2020, J. Leblanc, NSPI). An 11 cm drop in water levels therefore represents a 1.8% decrease from the baseline maximum annual water elevation fluctuation of the Seloam Reservoir. This small decrease is not expected to intensify effects to water quality or productivity within Seloam Lake from what is already experienced through seasonal reservoir filling and discharging.

Ongoing withdrawal requirements from Seloam Lake during the operations phase is significantly reduced from withdrawal requirements during construction. The predicted annual average withdrawal of 500 m^3/day during operations equates to a 1 cm reduction in water levels per year. This marginal water level reduction is not expected to effect fish or fish habitat quality or quantity within Seloam Lake.

To evaluate potential indirect effects to fish and fish habitat, MEL also considered flow reduction in Local Catchment Areas (LCAs) as defined in Section 6.6. According to Harmal and others (2006) and Di Baldassarre and Montanari (2009), a 10% error in streamflow measurements and discharge calculations is considered reasonable. A change in streamflow of <10% is considered low magnitude as it is within natural variability. Reduction in streamflow between 10% and 25% is considered moderate in magnitude. The upper limit of 25% is based on the potential for fish stranding during low flow conditions. A reduction of surface flow greater than 25% is considered high in magnitude of effect to water quantity. Although the magnitude of effect to flow reduction is considered high, the magnitude of impact to fish and fish habitat associated is considered moderate, as the significance of the impact can be mitigated by obtaining HADD authorization under the *Fisheries Act,* and offsetting for lost habitat. In reality the amount of habitat alteration due to a decrease or increase in flow is considerably less than 100%, and it is anticipated that this value will be adjusted in the HADD application to account for more detailed analysis of area reduction such as the Wetted Perimeter Method which calculates a point where the reduction in flow represents an impairment to the creeks ability to support all habitat functions.

Loss of flow in watercourses is primarily due to the collection of mine contact water which results in size adjustments of local catchments, and this effect is expected to commence in construction, and continue through operations and post-closure. In Section 6.6, the magnitude of effect to WC12 was determined to be low (<10% reduction), while it was predicted to be moderate at WC26 (16% reduction), and high at WC2 and East Brook (29% and 45% reduction, respectively). A high magnitude of impact to water quantity is anticipated to result in a moderate magnitude of impact to fish and fish habitat, given the off-setting provisions. As described above, a reduction in flow may result in a shift in benthic invertebrate community structure and adjustments in primary productivity. Given the dietary flexibility of the fish species within the Study Area, and the adaptability of benthic communities to changes in their environment, it is not expected that the reduction in flow will have an indirect effect on fish through adjustments in food web dynamics.

Construction of the WRSA and subsequent collection of mine contact water is expected to result in a 29% reduction in area within this catchment and expected flow within WC2. Seepage water from the WRSA will be collected in collector ditches and sent to the TMF and released to Anti-Dam Flowage during operations, and sent to the pit and then released to Anti-Dam Flowage during Closure. The total maximum predicted impact area to WC2 is 549 m^2 of fish habitat. WC2 does not provide passage to any upstream watercourses or fish habitat, as it is the headwater of that system. This watercourse is contiguous with WL1, which is partially accessible to fish, and may provide forage and refuge habitat for fish in the northern end of the wetland habitat where open water is present.

Watercourse 12 is a first-order stream that originates as drainage from WL27, flowing west to Seloam Brook. The upper extent of WC12 is intermittent and discontinuous where the TMF infrastructure is proposed. This watercourse flows west through WL27, WL35, WL31, WL20 and WL18. Based on loss of catchment area from construction of the TMF, WC12 is anticipated to result in a reduction of <10% of flow, which is a low magnitude of impact related to water level reduction. This level of flow reduction is not anticipated to result in stranding of fish or loss of access to fish habitat. As such, it is a low magnitude of effect to fish and fish habitat, and is not expected to trigger HADD authorization under the *Fisheries Act.*

Watercourse 18 (within the LCA for WC26) commences within the FMS Study Area at WL 47 and then flows southwest outside of the FMS Study Area towards Fifteen Mile Stream. While it is expected to be accessible to fishes from Fifteen Mile Stream, it does not connect to any upstream resources, as WL47 forms the headwater to this system, and it does not provide fish habitat outside of the WC18 channel (the wetland habitat lacks standing water in isolated pools or channels during all flow regimes). The LCA for WC26 is expected to experience an approximate 16% reduction in flow based on construction of diversion ditches and site water management. This is considered a moderate effect on water quantity (<25% reduction in flow). This level of flow reduction is not anticipated to result in stranding of fish or loss of access to fish habitat. As such, it is a low magnitude of effect to fish and fish habitat, and is not expected to trigger HADD authorization under the *Fisheries Act.*

At East Brook (SW15), which is located at the outlet of East Lake, water quantity is expected to reduce by up to 45%, due to the placement of the TMF, and the resultant permanent catchment changes. This corresponds to a water level decrease on the order of 5 cm in East Lake, which has also been considered to include Open Water KK. East Lake ranges from 1-5 m in depth, so a 5 cm decrease represents a 1-5% reduction in water levels. This is within natural variation (10%) and not likely to exacerbate thermal stress in the summer or have a substantial effect on dissolved oxygen levels or temperature levels within East Lake. Given the relatively low level of water level reduction, and negligible effects to oxygen and temperature levels within East Lake, flow reduction is not expected to result in noteworthy changes to primary or secondary productivity within the lake.

The outlet of East Lake (East Brook/SW15) (Figure 6.8-5), commencing at the downstream end of open water feature LL, is predicted to experience a flow reduction of 45%, which constitutes a high magnitude of impact. Fish surveys conducted in WC43 and at East Brook/SW15 has resulted in identification of three individual fish between 2018 and 2020 (a ninespine stickleback within the downstream portion of WC43 in 2020, a golden shiner within East Lake in 2018, and a brook trout within East Brook in 2020). Despite the relatively poor quality of fish habitat and low abundance of fish within this system, the magnitude of effect to fish and fish habitat is expected to be moderate. Within a 1340 m reach of East Brook/SW15, the effect of flow reduction will be high in magnitude (Section 6.6), with a moderate magnitude of effect to fish and fish habitat, provided HADD authorization is obtained. The total maximum indirect impacts from water quantity reduction in East Brook is 10,331 m^2.

This predicted flow reduction is expected to result in a moderate magnitude of effect to fish and fish habitat, as this area will be incorporated into the application for HADD authorization under the *Fisheries Act.* These areas shown as indirect habitat alteration are accounted for in the HADD quantification very conservatively as 100% of the habitat area being designated as a HADD. In reality the amount of habitat alteration due to a decrease or increase in flow is considerably less than 100%, and it is anticipated that this value will be adjusted during HADD permitting to account for more detailed analysis of area reduction such as the Wetted Perimeter Method which calculates a point where the reduction in flow represents an impairment to the creeks ability to support all habitat functions.

6.8.6.1.2.3 Water Quality Effects

Effects of the Project on water quality are also described in detail in Section 6.6. The effect of the Project on water quality, and resultant potential impacts to fish is expected to commence during the construction phase. The potential effects of water quality on fish during construction are expected to be primarily related to the collection and management of water as infrastructure construction commences, along with erosion and sedimentation, and potential degraded water quality during management of historical tailings. The effect of erosion and sedimentation on fish and fish habitat will be mitigated through the implementation of suitable erosion and sediment control measures and historical tailings will be managed in accordance with the developed Historical Tailings Management Plan (Appendix I.1). A modular effluent treatment plant will be available during construction to manage water quality in constructed ponds if and as needed. As such, the magnitude of impact to fish and fish habitat is expected to be low during the construction phase. An Erosion Prevention and Sediment Control Plan will be developed to support the EMS Framework Document (Appendix L.1).

During operations, surface water modelling does not predict water treatment to be necessary for effluent to meet MDMER discharge requirements, or receiving water quality guidelines for mixed discharge in Anti-Dam Flowage (CCME, NSE Tier I, documented background concentrations or Site Specific Criteria for Arsenic). No water treatment is expected to be required during operations, but will be available and implemented if necessary, based on monitoring results. During the operations phase, the magnitude of effects on water quality based on parameters described in Section 6.6 range from negligible to low, depending on the parameter. As such, there are no anticipated effects to fish and fish habitat based on changes in water quality during operations in Anti-Dam Flowage.

In the Operations scenario, all predicted constituent concentrations based on annual average concentrations in the upper case were consistently below selected water quality benchmarks or baseline, with the exception of iron, which marginally exceeds the respective 75th percentile baseline at SW6 and EMZ-2.

Additional modelling was conducted for all parameters to examine the potential for exceedances on a monthly basis (using upper case source terms). All parameters, when examined on a monthly basis (5th percentile; average and 95th percentile), were less than the receiving environmental quality guidelines (see Appendix B.6). Predicted monthly iron results for the upper case source terms during operations are provided in Figure B-31 of Appendix B.6. The annualized exceedances over baseline for EMZ-2 and SW6, remain fairly consistent when considered on a monthly basis (see Figure B-31 of Appendix B.6). While the predicted levels slightly exceed the 75th percentile of baseline, they remain within the range of baseline and are unlikely to pose a risk to aquatic life (including fish) (Appendix C.2).

The water quality model for WC12 assumed that 15% of the total seepage that exits from the TMF at perimeter locations will bypass the perimeter seepage collection system and enter the adjacent surface water environment (14% to the north toward the WC12 watershed and 1% to the south toward the SW15 watershed). During the operations and post-closure phases, drainage from the topsoil stockpile area will also report to the WC12 watershed. The annual and monthly concentrations at WC12 for the operations and post-closure phase, using both the base case and upper case geochemical source terms, are predicted to be lower than the applicable CCME CWQG, NSEQS, FEQG, and SSWQO for all parameters except aluminum; however, the aluminum concentrations are lower than the SW2 95^{th} percentile baseline concentrations (which are already greater than the CCME CWQGs and NSEQS). Based on the threshold for determination of significance of effects presented in the EIS document, the magnitude of the predicted change in surface water quality at WC12 for the operations and post-closure phases ranges from negligible to low, depending on parameter. As a result, the associated risk to fish is also low, as annual and monthly concentrations are predicted to be below regulatory guidelines or baseline concentrations in WC12.

Only approximately 1% of groundwater seepage is predicted to move southeast towards East Lake and East Brook. Given the predicted quality of groundwater seepage, and the percentage of seepage predicted to move in this direction, the effect of groundwater seepage on water quality in East Brook is expected to be negligible.

During Post Closure, surface water modelling does not predict water treatment to be necessary for effluent to meet MDMER discharge requirements, and although elevated concentrations of zinc, cobalt and cadmium have been predicted above receiving water quality guidelines for mixed discharge in Anti-Dam Flowage (only for upper case source terms and during low flow periods), the analysis by Intrinsik Corp. has concluded that the predicted concentrations of these parameters in Anti-Dam Flowage do not pose an ecological risk (including fish) to the receiving environment. Water treatment, if determined to be required during post closure, will be planned for run off from the PAG portion of the WRSA prior to mixing in the pit. An engineered cover will be built for the PAG stockpile. The NAG stockpile will be covered with topsoil and re-seeded. On-going source term and model refinement will be completed during pre-construction, construction and operational phases to determine post-closure water treatment requirements.

Surface water quality modelling was completed by Golder Associates using the GoldSim hydrology model, whereby geochemical source terms and baseline water quality inputs were integrated with flow rates to calculate mass loading rates. Greater detail on the modelling approach, modeled parameters, methods, assumptions and limitations are discussed in the report on the Surface Water Quality Modelling (Appendix B.6).

The GoldSim water quality models did not predict changes in pH associated with the Project; pH is not a conservative constituent and is influenced by a variety of surface water geochemical reactions (e.g., buffering reactions). The field pH of the receiver measured during the baseline water quality monitoring program ranged from 4.18 to 5.89; the pH ranged from 5.26 to 6.48 (Golder 2019). The potential change in pH in the receiver as a result of effluent discharge depends on 1) the pH of the various Project sources that contribute to the effluent and 2) the effluent flow proportion in the receiver.

The largest contributing Project source flow to the TMF pond is process water at a pH of 8.0, followed by precipitation and catchment runoff at pH of 5.1 and 6.0, respectively. These flows represent approximately 1% or less, on a mean annual basis, of the total flow in the receiver. Minor contributions of Project source flows of neutral pH or pH comparable to the baseline receiver pH are not expected to significantly change the pH in the receiver. In addition, attenuation of water flows by mixing and buffering reactions will occur within the TMF pond prior to effluent release. As such, modeling of pH for the operations phase was not deemed to be warranted.

During post-closure, the largest contributing Project source to flow to the open pit is runoff from the covered tailings beach at a pH of 5.3, followed by catchment runoff and precipitation at a pH of 6.0 and 5.1, respectively, which is similar to the pH range observed in the receiver baseline study. These flows represent approximately 0.9% or less, on a mean annual basis, of the total flow in the receiver. The upper-case source term associated with contact runoff from the PAG pile is acidic (pH 3.5) but represents only 0.03% of the total flow in the receiver. The base-case source term pH is 4.0. Minor contributions of Project source flows are not expected to significantly change the pH in the receiver. In addition, attenuation of water flows by mixing and buffering reactions will occur within the TMF pond prior to effluent release. As such, modelling of pH for the post-closure phase was not deemed to be warranted. Based on this analysis, as the pH is not expected to significantly change in the receiving environment during operations or closure phases, impacts to fish from adjustments in pH in Anti-Dam Flowage are not expected.

The GoldSim water quality models did not predict changes in turbidity associated with the Project, as the transport of TSS is highly influenced by site-specific hydrological conditions, engineered structures, and water management procedures. Engineered control structures, such as the collection ponds, are being incorporated into the site design to allow for settlement of TSS at specific points in the drainage collection system and Best Management Practices will be emplaced to reduce the TSS concentrations to below the applicable effluent discharge limits. Based on this analysis, as TSS concentrations are not expected to significantly increase in the receiving environment, impacts to fish from TSS loading in Anti-Dam Flowage are not expected.

The GoldSim water quality models did not predict changes in dissolved oxygen associated with the Project. During the operations phase, the three largest contributing flows to the TMF pond are process water, precipitation and catchment runoff. During the post-closure phase, the three largest contributing flows to the open pit are runoff from the reclaimed tailings beach, catchment runoff and precipitation. These sources are in contact with the atmosphere and considered to be oxic; while reducing conditions may exist in groundwater and seepage, these source flow contributions to the receiver on a mean annual bases are minor (<0.13%) The predicted nutrient concentrations in the receiver, which account for nutrient loading associated with residual explosives, are presented in Appendix B of the Surface Water Quality Modelling Report (Appendix B.6) and are below the applicable water quality criteria. The camp septic system will be designed with septic tanks and septic fields such that direct sewage effluent is not discharged into the receiver. As such, discharge of effluent is not expected to have a significant effect on dissolved oxygen levels in the receiver, or resulting impact to fish.

The GoldSim water quality models did not predict changes in temperature associated with the Project; temperature is not a conservative constituent and can vary on a very small timestep. Complex hydrodynamic temperature modelling is typically reserved for cases where there is cold water refugia, which is not the case at the Site.

The preliminary design of the TMF pond is for a residence time of one to three months reclaim requirements. The largest contributing Project source flow to the TMF pond is process water, followed by precipitation and catchment runoff. The largest contributing Project source flow to the open pit is runoff from the covered tailings beach, followed by catchment runoff and precipitation. The TMF pond and open pit will be exposed to the atmosphere and the temperature is expected to vary seasonally in a comparable manner to the receiving environment. Given the small effluent flow proportion in the receiver during operations and post-closure (2.9% during each phase), effluent discharge is not expected to have a significant effect on the temperature in the receiver, or a resulting impact to fish.

6.8.6.1.2.4 Effects to Riparian Habitats

Each individual pathway for indirect impacts to fish and fish habitat identified above has the potential to be influenced by alteration to both upland and wetland riparian habitats. Alteration of riparian habitats can affect fish habitat quality through changing physical habitat structure, changing bank stability, and changing the temperature, nutrient regime and food supply within watercourses through removal of vegetative cover. The Project will result in removal of both upland and wetland riparian vegetation, primarily during the construction phase. Removal of riparian habitat and the effects associated with it are expected to be temporary in nature. It is expected that potential effects to fish and fish habitat through alteration of riparian habitat can be managed through best management practices and mitigation measures to protect watercourses during construction and maintain buffers where practicable, and during the operation and especially closure phases of the Project.

6.8.6.1.2.5 Effects of Blasting on Fish

Indirect impacts to fish and indirect impacts to fish behavior, spawning grounds and migration patterns are possible from blasting activities associated with mine development. The detonation of explosives near watercourses within the PA can produce post-detonation shock waves which involves a rise to a high peak pressure and then a subsequent fall to below ambient hydrostatic pressure. This pressure deficit can cause impacts in fish (Wright and Hopky 1998). An overpressure in excess of 100 kPa can result in effects in fish including damage to the swim bladder in finfish, and potential rupture and hemorrhage to the kidney, liver, spleen and sinus venous. It is also possible that fish eggs and larvae can be damaged (Wright and Hopky 1998). The degree of damage is related to the type of explosive, size and pattern of the charges and the distance to the watercourse, depth of water within the watercourse, and species, size and life stage of the fish.

Sublethal effects have also been observed including changes in fish behavior on several occasions as a result of noise produced during blasting (Wright and Hopky 1998). Setback recommendations and other mitigation strategies to minimize impact to fish and fish habitat from blasting activities outlined in Wright and Hopky will be adhered to during the development of the FMS Mine Site.

6.8.6.1.2.6 Summary of Indirect Effects to Fish and Fish Habitat

In summary, indirect impacts to fish and fish habitat related to the Project are predominately moderate in magnitude of effect. A moderate magnitude of effect to fish and fish habitat is predicted in WC2 and East Brook (SW15), due to anticipated flow reduction in the LCAs. The approximate and predicted extent of indirect effects to these systems is 549 m^2 and 10,331 m^2, respectively. Construction of the Seloam Brook Realignment and downstream water control features on WC4 and WC42 are anticipated to result in indirect effects to fish and fish habitat. Erosion and sedimentation are predicted to occur downstream of the realignment channel and upstream of the water control features, resulting in decreased habitat quality throughout 1,909 m^2 of fish habitat. The total combined indirect impact area is 1.28 hectares. In reality the amount of habitat alteration due to changes in flow and erosion are considerably less than 100%, and it is anticipated that this value will be adjusted during HADD permitting. Water quality predictions, and associated ecotoxicity evaluation, during both operations and closure phases conclude low ecological risk (including fish) from the Project effluent in the receiving environment (Anti-Dam Flowage).

6.8.6.1.3 *Summary of Direct and Indirect Effects to Fish and Fish Habitat*

Site specific detailed information (such as habitat quality and quantity, permanent or temporal nature of impacts) will be included in permitting applications in order for DFO to determine the level of risk and potential permitting requirements related to Project impacts. A *Fisheries Act* authorization for alteration of fish habitat, and associated offsetting measures will be required for direct and indirect impact to fish. An Fish Habitat Offset Plan is included in this EIS (Appendix J.7).

6.8.6.2 Touquoy Mine Site

Changes to the Touquoy Mine Site as a result of the Project are anticipated to be minimal. Only minor changes to the existing processing facility at the Touquoy Mine Site will be required, including the addition of concentrate storage and the addition of a second gravity concentrate leach reactor and a gravity electrowinning cell (Table 6.8-34). These changes can be accommodated within the existing facility footprint; as such, no additional direct impacts to fish or fish habitat from the Touquoy Mine Site are anticipated to allow processing of FMS concentrate.

Table 6.8-34: Potential Fish and Fish Habitat Interactions with Project Activities at Touquoy Mine Site

Project Phase	Duration	Relevant Project Activity
Operations Phase	7 years	Tailings management; Environmental monitoring; General waste management.
Closure Phase: Reclamation Stage	2-3 years	Environmental monitoring. Water treatment and management
Closure Phase: Post-closure Stage	3+ years	Environmental monitoring. Water treatment and management

FMS tailings will be deposited into the open pit at Touquoy. Once the tailings have been deposited into the exhausted pit, the open pit will naturally fill which will result in water covering the tailings surface. Pit water will be treated via the existing Touquoy effluent treatment plant and downstream treatment discharge facilities and once the pit is full and water meets MDMER discharge criteria it will be naturally released via a spillway into Moose River (Appendix I.5).

Based on the groundwater flow model results, the Touquoy pit acts as a sink (i.e., gaining groundwater to the Touquoy pit) when the water level in the pit is below 104 m in elevation, and does not result in groundwater or surface water discharge to Moose River. Therefore, there are no water quality effects to Moose River during this period. As the water level in the Touquoy pit rises above 104 m, the groundwater flow gradients will reverse, and seepage from the Touquoy pit will migrate towards Moose River. The seepage is expected to increase to a maximum of 258 m^3/d when the water level in the Touquoy pit increases to an elevation of 108 m. This groundwater seepage is considered in surface water modelling predictions in the Moose River. The flow rate in Moose River in April is 230 times this rate, and therefore represents a dilution ratio of approximately 230. Concentrations of cobalt, copper and nitrite in groundwater were predicted in the model above the CCME FAL or NSE EQS (2013) in the untreated pit water at discharge. The groundwater seepage quality was assumed to be consistent with the source terms pore water quality, at an estimated average concentration of 0.0006 mg/L of arsenic to Moose River. Based on the assimilative capacity model in Moose River these parameters meet CCME FAL/NSE EQS after mixing with Moose River 100 m downstream of the discharge point and thus, do not pose a risk to fish and fish habitat in the receiving environment.

The water quality discharged from the pit to Moose River will be treated to meet MDMER discharge/regulatory closure criteria or site-specific guidelines, if required. Without treatment, arsenic concentrations of 0.363 mg/L are predicted to slightly exceed the MDMER discharge criteria of 0.3 mg/L in Year 14 based on climate normal conditions. Therefore, arsenic concentrations in the discharge to Moose River are predicted to be 0.3 mg/L (post treatment). Once mixed with the background water quality in Moose River, the concentration 100 m downstream of SW-2 is predicted to be 0.024 mg/L for arsenic and 0.184 mg/L for aluminum. Although this arsenic concentration is above the NSE Tier 1 and CCME guidelines of 0.005 mg/L, the background levels at SW-2 also exceed the guidelines at 0.018 mg/L. The aluminum concentration is predicted below the 75^{th} percentile receiver quality in Moose River. Based on the CCME guideline (2001), the arsenic concentration is below the reported lowest toxic levels for fish, algae and aquatic plants. A SSWQO was derived for arsenic, following CCME (2007) protocols, using a species sensitivity distribution (SSD) approach. The SSD approach was comprised of identifying chronic toxicity data for species, analyzing the data using a regression approach and selecting the final chronic effects benchmark. The HC5 (i.e., the concentration that is hazardous to no more than 5% of a species in the community) was selected as the final chronic effects benchmark as per CCME (2007) guidance. The resultant guideline using the protocol is 30 µg/L. The details related to the SSWQO for arsenic and the broader aquatic effects assessment for the Project are provided in the Intrinsik Report provided in Appendix C.2. Conclusions relating to aquatic effects of arsenic in the Moose River are summarized below. Additional detail relating to aquatic effects in the Moose River can be found in Section 6.6.8.4.3 and Appendix C.2.

While predicted receiving environment concentrations of arsenic at the end of the 100 m mixing zone within Moose River (0.024 mg/L) exceeds the CCME FWAL guideline of 0.005 mg/L, this guideline was derived some time ago using a safety factor applied to the Lowest Observed Effect Level [the 14-day EC50 (growth) of 50 µg/L for the algae *Scenedesmus obliquus* (Vocke et al., 1980), with a safety factor of 0.1 (CCME, 1991) as cited in Appendix C.2]. The Vocke et al. (1980) study was the most sensitive freshwater organism to arsenic identified by the CCME, following consideration of data from 21 different species of fish, 14 species of invertebrates and 14 species of plants. Other regulatory guidelines are also available from other jurisdictions, such as the National recommended water quality criterion known as the Criterion Continuous Concentration (CCC) from the US EPA (US EPA, 2018; arsenic criteria developed in 1995 as cited in Appendix C.2). The CCC is," an estimate of the highest concentration of a material in surface water to which an aquatic community can be exposed indefinitely without resulting in an unacceptable effect". The CCC for arsenic are based on the amount of dissolved metal in the water column and is 150 µg/L (0.150 mg/L) and was derived on 1995 (Appendix C.2).

Using the CCME protocol for development of water quality guidelines (CCME, 2007), an SSD approach was used to develop a SSWQO. The value developed is 0.030 mg/L (30µg/L) and concentrations predicted in receiving environment of Moose River are below this value. The predicted receiving environment concentration of 0.024 mg/L is below any of the no observed effect concentration (NOEC) or LOEC data for arsenic provided in Table A-2 of Appendix C.2 for chronic studies. Hence, risks to aquatic life, including fish, are anticipated to be low.

During all Project phases there is a risk of malfunctions and accidents (e.g., spills) to occur throughout the PA in upgrade areas. Spills have the potential to be transported into downgradient surface water systems and negatively impact fish and fish habitat. An evaluation of potential accidents and malfunctions can be found in Section 6.17.

Since the completion of the Touquoy Gold Project EARD and Focus Report, ACCDC status ranks, and listings under the NSESA and SARA have been revised. The species identified in the Touquoy Gold Project EARD and Focus Report were reviewed and confirmed that there are no newly listed species which would experience Project interactions beyond what is expected in terms of interactions to the fish community in general. Furthermore, fish SOCI (even those with revised listings) are expected to experience similar Project interactions as all other fish species. As such, no additional specific mitigation of Project interactions is necessary for priority fish species based on the addition of the Project to the Touquoy Mine Site.

6.8.6.3 Summary of Pre-Mitigation Conclusions

6.8.6.3.1 *FMS Study Area*

The assessment of potential adverse interactions and effects of the Project on this VC takes into account the potential for the Project to result in:

- Direct and indirect mortality to individual fish;
- Permanent and temporary alteration of habitat that directly or indirectly supports the life processes of fish; and,
- Destruction or disruption of fish habitat that directly or indirectly supports the life processes of fish.

Direct impact to fish habitat is proposed to allow for construction of site infrastructure. In total, direct impact is proposed for 8.05 ha of fish habitat, in twelve linear watercourses (1.02 ha), 13 open water features (1.91 ha) and one wetland with habitat accessible to fish (5.12 ha). Indirect effects to fish habitat through reduction in flow and changes to channel morphology through sedimentation and erosion is expected to result in a maximum loss of 1.28 ha of fish habitat. Authorization for HADD under the *Fisheries Act* will be obtained from DFO prior to the completion of any direct alterations to fish habitat, and the Fish Habitat Offset Plan will be implemented. Mortality to fish is expected to be low, once mitigation measures are implemented, including development and implementation of a fish rescue plan for adult fish prior to commencement of construction activities in confirmed fish habitat. With authorization and offsetting measures in place, the effects of the Project on fish and fish habitat is determined to be moderate and adverse, but not significant.

6.8.6.3.2 *Touquoy Mine Site*

No direct impacts are proposed within fish habitat at the Touquoy Mine Site. Indirect effects to water quantity and quality predicted at the Touquoy Mine Site from the addition of the Project involve effluent discharge and groundwater seepage. Effluent discharge quality will continue to be treated to MDMER at the final discharge point. In relation to groundwater seepage from the Touquoy open pit to Moose River, no parameters are predicted to exceed NSE Tier 1 EQS or CCME guidelines (Appendix I.5). No impacts to fish are predicted from the deposition of FMS concentrate tailings into the exhausted Touquoy pit.

None of the potential impacts are expected to require HADD authorization at the Touquoy Mine Site and are therefore considered to have a low magnitude of impact to fish and fish habitat.

6.8.7 Mitigation

Fish habitat components, their function and attributes, and the fish populations that rely on them (e.g., aquatic ecosystems) are dynamic and complex. It can be more difficult, costly and uncertain to restore, enhance, or create, aquatic ecosystems than it is to avoid adverse effects in the first place. For this reason, the DFO emphasizes measures to avoid and mitigate as the preferred steps in the hierarchy of project planning, followed by measures to offset HADD as a means of last resort.

The Policy's hierarchies are listed below along with a summary of how they have been considered with this Project. The three levels include:

- Measures to Avoid;
- Measures to Mitigate; and,
- Measures to Offset

6.8.7.1 Avoidance

Measures to Avoid for the conservation and protection of fish habitat is the first and most important step in the hierarchy of measures and therefore have been the major focus of this Project to date. There have been a number of measures put in place to avoid and minimize the effects on Fish and Fish Habitat.

As part of the early and iterative Project planning and site assessment efforts, multiple site layouts were considered for both Project efficiencies and the avoidance of impacts to fish frequented waters. Although components such as the open pit are fixed due to the location of the resource, other Project infrastructure such as stockpiles, the TMF and road networks have some flexibility in their location, and have been optimized in the proposed site layout. To this end, the Project team reviewed multiple locations and site plans for these features, before selecting the proposed arrangement. In some cases, this effort was dovetailed with requirements associated with the Assessment of Alternatives for Storage of Mine Waste (Appendix J.6). The alternatives assessment involved a review of multiple possible locations for the TMF and considered each under a variety of factors (accounts) such as environmental, socioeconomic, technical and economic considerations.

The selected, or preferred, TMF includes the location and configuration as outlined in Figure 6.8-4. To date extensive fish sampling throughout 2018-2020 have not captured fish within the TMF footprint. Additionally, environmental DNA samples collected both upstream and downstream of the barrier on WC43 supports the sampling conclusion that no fish frequent the limited standing water within the TMF boundary upstream of the observed seasonal barrier. However, due to uncertainty and data limitations at the time and the need to apply a precautionary approach; a portion of WC43 within the TMF has been determined as a potential waters frequented by Fish and will is planned for listing under Schedule 2 of the MDMER unless it can be clearly demonstrated to not be frequented by fish. Ongoing fish collection efforts are intended to address this uncertainty.

All other stockpiles and site water management features (ditches and ponds) including the WRSA have been placed to avoid waters frequented by fish.

6.8.7.2 Mitigation

Measures to mitigate any adverse effects on fish and fish habitat include both standard best practices that are implemented through all phases of the Project (e.g., construction, operation, decommissioning) and site-specific mitigation designs. Measures to mitigate and minimize losses or reduced productivity of fish habitat have been established at several locations within the Project. Site-specific mitigation designs include the Seloam Brook Realignment, habitat erosion/siltation measures, planned water control features downstream of the realignment, and fish relocation activities.

To avoid or mitigate additional loss of waters frequented by fish or harm to fish habitat during Project construction, operations and closure phases, a combination of site-specific mitigation measures as defined in permits, approvals or EA commitments and best management practices will be used. Measures and standards would include but not be limited to construction water management; erosion and sedimentation controls; and adherence to timing windows to protect sensitive life cycle periods.

Sequencing of Project impacts and Project offsets is an important mitigation measure. Where possible the compensation and offset measures will be constructed in advance of major Project impacts, to reduce effects of time lag on impacts compared with offsets. This approach will allow for the initial development and stabilization of the works to be achieved, and significant colonization of the new replacement habitats by adjacent fish communities at the same time that fisheries impacts occur. Any changes to the approximate time periods specified in the final offset plan would require notification and approval by DFO in advance of the revised schedule.

To mitigate and reduce overall loss of function of fish and fish habitat, the actions provided in Table 6.8-36 will be implemented by the Proponent within wetlands and watercourses where direct impacts and potential indirect impacts to fish and fish habitat are expected. Mitigation measures will be confirmed through monitoring requirements, as described at the permitting stage through the IA. Considering the extensive planning, the ongoing engagement with the Mi'kmaq of Nova Scotia and stakeholders, and the use of proven mitigation measures, the Proponent is confident that the Project can be constructed, operated, and rehabilitated and closed, in an environmentally responsible and safe manner that minimizes and mitigates impacts to fish habitat.

6.8.7.2.1 *Seloam Brook Realignment*

A portion of Seloam Brook flows through the open pit location and receives drainage from the surrounding infrastructure area. To maintain creek connectivity, and to prevent flooding of the open pit, this portion of the stream will be realigned. A realignment channel approximately 800 m long will be constructed to convey flows around the north side of the proposed open pit and a proposed realignment berm. The realignment channel and berm will isolate the mine site from the watercourse, maintain fish connectivity around the project footprint, and maintain connectivity between upstream portions of Seloam Brook, Seloam Lake and WC12 to Trafalgar Creek and the lower portion of Seloam Brook (Figure 2.2-1).

Initial Project plans involved a simple diversion channel to provide hydraulic conveyance of flows around the open pit and though the Project site, and to mitigate the fragmentation of habitat upstream and downstream of the project. Based on comments and subsequent discussions between the Project team and stakeholders, the Proponent has decided to design an enhanced and ecologically-focused channel realignment to provide additional mitigation and replacement for the affected fish habitat. The channel realignment design will include an integrated floodplain and natural channel design principles to develop highly suitable fish habitat with biological features to mitigate a large portion of the habitat losses within Seloam Brook and avoid additional HADD. Habitat design will incorporate features to mimic characteristics within the existing habitat that will be lost, but will also include increased species-specific spawning habitat to provide greater productivity potential. The channel will have a better defined flow path to improve fish passage through the reach and mitigate the braided configuration of the existing habitat, caused by past mining activities, and will use the consolidated flow to maximize habitat stability and suitability. The existing engineering assessment conducted during the initial diversion channel concept shows that flows could be conveyed around the Project infrastructure within a confined realignment configuration, however, additional features such as an integrated floodplain area that would take advantage of the natural flow regime would provide increased habitat complexity and suitability.

The realignment will allow adequate conditions, particularly water depths for fish habitat and migration under normal flow conditions at Mean Annual Discharge (MAD) as well as 1 in 20-year Mean Annual Dry conditions. Using flows estimated at key periods within the Seloam Brook hydrologic regime, estimates of flow and habitat conditions within the conceptual floodplain design were completed. The realignment channel configuration was based on the general outline provided in Figure 2.2-1; however, the following parameters and assumptions were also incorporated to the design:

- The main stream channel had to contain at least the flows expected during the MAD at 0.82 m^3/s;
- The main stream channel had to contain water depths capable of fish passage during the 1:20 Annual Dry flow at 0.28 m^3/s;
- The overall channel slope, based on Knight-Pieshold data, was assumed to be 0.5 %;
- The overall main channel roughness, based on Knight-Pieshold data on existing, local streams, was assumed to be 0.06; and,
- The overall floodplain channel roughness, based on Knight-Pieshold data, was assumed to be 0.10.

Based on the above considerations and general main stream / floodplain configuration, the channel and floodplain design was modelled using the Wetted Perimeter Method (WPM; Newbury and Gaboury 1993) and AutoCAD to estimate water levels, water depths, and water velocities within the designed channel (Appendix J.5), and described in more detail in Section 6.6.5.2.5 and Section 6.6.8.1.2.2.

The main stream channel was designed with a bottom width of 1.5 m and side slopes of 1:2. An estimated flow of around 1.0m^3/s will remain within the main channel before overtopping into the floodplain. The width of the stream with this flow is estimated at 2.90 m. The model outputs also indicate that a mean water depth within the main stream will remain near 0.25-0.30 m during the 1:20 Dry Annual flow if the channel is designed similar to existing habitat.

Flows in excess of 1.0 m3/s are shown to overtop the main stream channel into the floodplain. Flows as high as the 200-year event would easily be contained within the existing topography or a constructed floodplain.

Modelling of predicted flows under various scenarios provided above provides greater certainty and confirms the preliminary realignment channel can provide adequate flow capacity and habitat conditions. The preliminary design currently includes two inlet structures to convey water from the Seloam Reservoir and Trafalgar Creek tributaries (WC42) into the Realignment Channel. It will also cross a haul road where an energy dissipation pool will be constructed at the outlet of a culvert. The haul road crossing is designed to pass the 1 in 200 year flood event and the inlets, outlet, and energy dissipation pool will include riprap armor to protect against erosion during high flow events and facilitate fish passage.

The Seloam Brook Realignment Channel will be designed to provide high quality fish habitat and fish passage. Accordingly, the proposed realignment will mimic existing conditions in the surrounding watercourses to the extent practical, while alleviating some existing limitations such as the braided channels to enhance fish passage opportunities. Design considerations related to layout of habitat features and their effects on water resistance and habitat stability will be completed during final design and include habitat features proposed by stakeholders during consultation. Based on preliminary modeling results, the total estimated minimum area of realignment that would be available to fish within the existing engineered preliminary design during MAD conditions is 2,320 m^2 (800 m long x 2.9 m wide wetted width). It is currently assumed that with additional habitat features including wetland / floodplain features, this would conservatively be at least double to 4,640 m^2.

DFO can consider and apply an offset ratio to the final HADD determination to account for uncertainties in the mitigation and oddest concept options and likelihood of success, as well as any delays or gaps in the timing between offset creation and the HADD occurring.

While the construction of the Seloam Brook Realignment is a mitigation to limit project based HADD, the timing is important in achieving this objective. The timing of the realignment, and therefore the fish habitat design features, will occur as one of the initial project construction activities because it will effectively realign the stream flows away from other required Project areas. As a result, no delay or gap in fish habitat mitigation/offset and habitat loss is anticipated. In fact, the fish habitat within the realignment will be constructed and completed prior to the majority of HADD activities.

6.8.7.2.2 *Flow Management*

To avoid potential erosion of existing fish habitat downstream of the Seloam Brook Realignment Channel outflow, flow control structures are being designed to reduce water velocity, and therefore scour energy, as flows enter the downstream north and south channels (WC42 and WC4, respectively) (Appendix B.9). The preliminary design of the channel includes water control structures that will moderate flows and control downstream flow energy while still maintaining connectivity. Check berms or dams will be designed as water control features, allowing both flow management and fish passage. Where possible, additional spawning habitat features will be incorporated into the overall design.

The majority of the habitat being lost within the FMS Mine Site consists of wider, deep pools and areas of floating emergent vegetation, typical of very low-gradient, open water/wetland habitat. While the Habitat Suitability Indices for the fish species life stages that currently reside within the FMS Mine Site are low for these habitat types, they do offer habitat complexity and some habitat refuge capacity during low-flow seasonal periods. Therefore, consideration is being given to providing fish habitat enhancements within the area downstream of the Realignment Channel outflow both upstream and downstream of the proposed water control structures (Figure 6.8-6), that is similar in nature to that provided within the realignment channel and integrated floodplain. Proper placement of water control structures can be completed to mimic natural conditions and expand the low-gradient, open water wetland habitat. While the open water/wetland habitat being lost within the Project area consists of fine organic substrates and deeper water, habitat at the Realignment Channel outflow can be constructed that will have more suitable habitat features but still mitigate a portion of open water/wetland habitat being lost within the same watershed/ecological unit.

The existing wetland complex currently experiences water level fluctuations on an annual basis due to management of the NSPI dam infrastructure on Seloam Lake. As a result, these existing wetlands are able to manage and have adapted to fluctuating water conditions. Proper placement of water control structures within Trafalgar Creek downstream of the Realignment Channel outflow can cause strategic backwater effects (ponding) on the upstream side. Based on current placement and modelling (Appendix B.9), existing downstream wetlands can be expected to experience flooding to a maximum, steady state depth of approximately 0.4 m, as modelled for mean average discharge rates with the addition of conceptual flow restrictions during operations.

Through ongoing design considerations, mitigation features such as proper depth excavations and larger shoreline and bottom substrates could increase suitability of any large, low-lying areas. The location of the water control structures will be finalized with the concept of maintaining downstream stability and maximizing upstream open water/wetland habitat mitigation without incurring additional HADD. Based on modeling results, the total estimated area of additional open water/wetland that could be developed by this measure is approximately 84,449 m^2.

6.8.7.2.3 *Fish Relocation*

Identified locations requiring fish relocation include those sections of Seloam Brook as well as adjoining tributaries within the infrastructure areas. The following outlines the general tasks required to complete the capture and relocation of fish.

6.8.7.2.3.1 Permitting

Upon issuance of an authorization under section 35 of the *Fisheries Act*, general permits required for fish relocation include an experimental license from DFO to handle fish, and a relocation permit to move fish from one waterbody to another (particularly if transfers are required outside the fish's resident watershed). Within the FMS Mine Site, all fish can be relocated to other portions of their resident watershed. Given the numbers of fish captured in baseline habitat characterization, numbers of fish are anticipated to be low.

6.8.7.2.3.2 Tributary Isolation and Relocation

Barrier netting typically used in stream population estimates will be erected at the mouths of each tributary and left in place throughout activities to keep the tributaries isolated. Once isolated, electrofishing will be completed throughout each to capture and remove fish. Fish will be collected in aerated coolers and transported to the release location. Efforts in deeper steadies will include the use of fyke nets, eel pots, and minnow traps (shallow-water traps), as well as angling to capture fish. Fishing gear will be set by experienced personnel using standard techniques outlined in standard work instructions and training. Gear will be checked regularly and reset such that an estimate of depletion can be determined.

6.8.7.3 Offsetting

A summary of likely HADD and Schedule 2 habitat quantification is provided above in Section 6.8.6.1.1.

The Project is proposed to result in the permanent loss of fish habitat and its associated productive capacity, through a portion of Seloam Brook and additional tributaries within the FMS Mine Site. Proven techniques in similar geographic settings for similar fish species provide the greatest likelihood of offsetting lost productive capacity for the long term, are least likely to fail structurally, and require the least amount of maintenance. Low-risk options that are biologically relevant were prioritized during the development of the Fish Habitat Offset Plan (Appendix J.7).

The technical feasibility of the proposed offsetting options was assessed in consideration of the site conditions present, including topography, geomorphology, hydrology, site accessibility, and the type of physical works proposed. To satisfy DFO's guidance, the technical feasibility, biological relevance, and effectiveness of any offsetting works will be determined during long-term monitoring.

The assumption is that a minimum 1:1 gain-to-loss ratio of Habitat Equivalent Units is necessary to satisfy DFO's Fish and Fish Habitat Protection Policy Statement guidance and that this ratio will increase to account for any uncertainties with the offset measures or time lags between habitat losses and offsets. Greater fish habitat offsetting ratios may also be required if the Fish Habitat Offset Plan includes options that utilize techniques with long lag-times before they become fully functional. Equivalency of the proposed offsets is also considered relative to the productivity, importance, and quality of net fish habitat losses identified in the HADD determination.

The Fish Habitat Offset Plan (Appendix J.7) provides a list of preliminary information and strategies to offset remaining HADD after measures to avoid and mitigate have been accounted. Preferred offsetting options will be further refined based on discussions with DFO and relevant stakeholders during the detailed offset planning process. It is also possible that alternative approaches not listed could be integrated into any Final Authorization Application (via an offsetting plan) if required. The offsetting alternatives provided have been developed consistent with DFO's guidance Policy for Applying Measures to Offset Adverse Effects on Fish and Fish Habitat Under the *Fisheries Act* (hereafter this Policy).

6.8.7.3.1 *Residual Offset Requirements (HADD)*

Efforts have been made to minimize residual effects of the Project on fish and fish habitat and to avoid HADD wherever possible. However, portions of Project infrastructure will result in the loss of existing fish habitat that is currently utilized by resident fish species. Table 6.8-35 provides a summary of the quantity of fish habitat to be lost by the project, its calculated Habitat Equivalent Units, mitigation habitat used to reduce overall habitat losses (and its Habitat Equivalent Units), and the overall residual habitat losses.

Table 6.8-35: Summary of Habitat Lost, and Mitigations for FMS Project infrastructure footprint and TMF

Habitat measure	Project Area	Habitat Type	Total Habitat Area (m^2)	HEU (m^2)	Description
Lost	Infrastructure Footprint	Stream	8,334	3,333	Highest Habitat Equivalent Unit for adult Brook Trout.
		Open Water	19,113	4,730	Highest Habitat Equivalent Unit for both spawning and adult Brook Trout.
		Wetland	51,179	0	No Habitat Equivalent Unit value.
	TMF	Stream	1,947	953	Highest Habitat Equivalent Unit for adult White Sucker.
		Open Water	0	-	No open water habitat present.
		Wetland	0	-	No wetland habitat present.
Total			**80,573**	**9,016**	
Mitigation	Realignment	Stream	4,640	4,640	Will be designed as suitable for all species present within the footprint.
	Flood Area	Open Water	84,449	20,901	Will be designed as suitable as possible for all species present with adult Brook Trout as the habitat template.
		Wetland	0	-	No emergent vegetation habitat will be designed or constructed.
Total			**89,089**	**25,541**	
Residual HADD				**-16,525**	Net increase in Habitat Equivalent Units with the development of appropriate mitigations .

Conceptual offset planning has commenced to enable DFO and others to assess the alternatives for feasibility and acceptability. Provided below are several concepts that have been considered feasible at the concept stage and, based on habitat needs of resident species and experience on similar offset designs, have a high degree of successfully being implemented.

Several concepts have been identified for preliminary assessment considering the following criteria. Potential options were evaluated by consideration of multiple criteria including:

- Adherence to DFO's principles and policy for offsetting;
- Location within the Seloam Brook watershed and close to the Project site;
- Self-sustaining;
- Technically feasible and economically viable; and
- Provide similar "in-kind" habitat as an offset.

A ranking scale was developed for candidate fish habitat offset options, and the Seloam Brook Realignment has been selected as the highest ranked option for successful fish habitat offsetting. The ranking scale, presented in the Fish Habitat Offset Plan (Appendix J.7) outlines detailed results of the criteria considered in the ranking exercise. These considerations include:

- alternatives;
- simplicity of the concept and pre-design information needs;
- monitoring simplicity and success certainty;
- operational relevance;
- compatibility with existing land use;
- portion of constructed or restored habitat credited to offset balance;
- percent of total offset amount required;
- construction implementation and required controls;
- construction certainty;
- land tenure certainty;
- relative cost per type of offset measure;
- stakeholder interest; and
- Cumulative score for the offset options listed.

Based on the evaluation of these considerations, work proposed within the Seloam Brook Realignment was selected as the highest ranking option, with a high probability of success. This realignment is provided as a proposed Project mitigation measure, and is identified under Residual HADD offset requirements, as it directly affects the quantity of HADD that will require offsetting. Additional mitigation is also presented in the form of downstream flooded wetland habitat which will be designed for all species present with adult Brook Trout as the habitat template. The proposed losses and gains account for a net increase in HEUs, as described in Table 6.8-35.

To account for any uncertainty, and to provide additional area for fish habitat offsetting, the Proponent has identified an additional habitat creation option, as identified as alternative 2 (creation of onsite open water habitat) in the Fish Habitat Offset Plan. Similar to the creation of open water habitat within Section 6.8.7.2, additional off-channel habitat would be constructed within the Seloam Brook ecological unit. While the exact locations require further investigation of geotechnical, hydrogeological, and terrain constraints, the general description is provided herein.

The Seloam Brook habitat improvements are proposed downstream of the realignment channel and flood area described in Section 6.8.7.2. The proposed concept is to install rock weir riffle enhancements immediately downstream of all mitigation structures and excavate ponds as off-channel habitat adjacent to the exiting channel. The proposed objective is the creation of at least 6,300 HEUs of high-quality pond and stream habitat to offset a portion of the remaining habitat units lost related to existing stream and open water habitat within the Project infrastructure footprint and TMF. The exact locations of the measure will need further adjustment to reflect ongoing flow modelling efforts, but sufficient areas exist adjacent to the Project to provide a high degree of certainty for this alternative.

The rock weir riffle enhancements will require addition of coarse rock and fine gravel to create a riffle-pool type stream along the existing channel reach. Riffle-pool spacing would be determined at the next stage of design once additional site information is collected. The stream reach would be suitable for rearing by several species and potential spawning by brook trout and white sucker. Additional details related to benefits, uncertainty and construction considerations are provided in the Fish Habitat Offset Plan (Appendix J.7). Further investigations would be required to finalize this design, if deemed an appropriate concept through consultation with DFO and the Mi'kmaq of Nova Scotia. The concept is also easily scalable to cover larger or smaller areas, if required.

In addition to mitigation measures associated with the Seloam Brook Realignment Channel and proposed offsetting measures through creation of on-site open water habitat, the evaluation of offsetting options identified options such as complementary measures, and creation of offsite open water habitat. These are outlined in detail in the Fish Habitat Offset Plan (Appendix J.7). Other alternatives may be identified through ongoing consultation.

6.8.7.4 Mitigation Summary

Table 6.8-36: Mitigation for Fish and Fish Habitat

Project Phase	Mitigation Measure
C, O, CL	Develop and Implement Erosion Prevention and Control Plan to support the EMS Framework Document (Appendix L.1)
C, O, CL	Complete pre-construction and periodic site meetings with relevant staff/contractors to educate and confirm policies related to working around fish bearing surface water systems including schedule of construction activities to minimize unauthorized disturbance and limit vegetation clearing
C, O, CL	Maintain pre-construction hydrological flows into and out of down-stream surface water habitats, to the extent practicable, to limit indirect impacts to fish habitat
C, O, CL	Complete offsetting for HADD including for permanent loss of fish habitat through fish habitat restoration activities, subject to DFO approval, based on the *Fisheries Act* current at time of the Project construction

Project Phase	Mitigation Measure
C	Provide signage on fish habitat streams
C	Complete micro-siting of mine infrastructure to avoid or minimize fish habitat impact
C	Complete fish rescue within Seloam Brook Realignment footprint prior to commencement of mine development with DFO approval if required
C	Implement water control features along North and South Channels to limit erosion and sedimentation downstream of the Seloam Brook Realignment
C	Implement construction methods that reduce potential interaction with fish habitat and limit vegetation clearing around watercourses
C	Complete culvert installations and upgrades in accordance with the NSE Watercourse Standard (2015b) or as updated at time of construction. Limit vegetation clearing
C	Minimize the removal of vegetation upgradient of watercourses and stabilize shorelines or banks disturbed by any activity associated with Project activities
C	Minimize the temporal extent of in-stream works as much as practicable
C, O	Develop and Implement Surface Water and Groundwater Management and Contingency Plan to support EMS Framework Document (Appendix L.1)
C, O	Follow DFO-advised *Measures to avoid causing harm to fish and fish habitat including aquatic species at risk* pertaining to blasting (DFO, 2018)
C, O	Select appropriate type of explosive that will minimize nitrogen release to surface water and groundwater
C, O	Use clean, non-ore-bearing, non-watercourse derived and non-toxic materials for erosion control methods
C, O	Incorporate drainage structures, where necessary, to dissipate hydraulic energy and maintain flow velocities sufficiently low to prevent erosion of native soil material
C, O	Limit clearing within confirmed fish habitat outside of approved alteration areas
C, O	Acquire and follow watercourse alteration permits Fisheries Authorizations
C, O	Adhere to applicable timing windows, as directed by DFO, for construction where infilling has been approved in wetlands and watercourses where fish habitat is present
C, O	Ensure fueling areas are a minimum of 30 m from waterbodies
C, O	Use and maintain properly sized screens on any water intakes or outlet pipes to prevent entrainment or impingement of fish
C, O	Ensure that machinery arrives on site in a clean condition and is maintained and free of fluid leaks
C, O	Maintain 30 m riparian wetland and watercourse buffers, where practicable

Note: C= Construction Phase O= Operation Phase CL = Closure Phase

Monitoring of standard mitigations described above are outlined in the Project Environmental Management System (EMS) Framework Document (Appendix L.1) and associated Environmental Protection Plan (EPP) which will be in place prior to construction activities to minimize possible disturbances of fish and fish habitat. To ensure that the measures and standards described are implemented as proposed, the Proponent onsite monitors (or designates) will monitor construction and implementation of this plan. Monitoring will be reported to DFO in an "as constructed" report provided following the works being completed. The "as constructed" monitoring report will document the construction of the offset and works as per the approved plans, and a summary of the mitigation measures and any contingency measures implemented to prevent further impacts to fish habitat. A detailed photographic record will be taken during implementation of the plan using consistent vantage points prior to, during and post construction.

6.8.8 Residual Effects and Significance

The predicted residual environmental effects of Project on fish and fish habitat are assessed to be adverse, but not significant (Table 6.8-37). The overall residual effect of the Project on fish and fish habitat is assessed as not significant after mitigation measures have been implemented.

Table 6.8-37: Residual Environmental Effects for Fish and Fish Habitat

Project VC Interactions	Mitigation and Compensation Measures	Nature of Effect	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect
			Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility		
Construction – FMS Mine Site Direct watercourse, open water, wetland alteration, including the Seloam Brook Realignment	Sediment and erosion control, best management practices, spill preparedness, and watercourse and fish habitat alteration permitting processes. Seloam Brook Realignment downstream water control structures. Implementation of Fish Habitat Offset Plan	A	H VC interaction causes direct loss of fish habitat	LAA Potential adverse effect to fish habitat outside of the PA	A Watercourse alteration will occur outside of sensitive periods for fish, however, other interactions may seasonally affect VC	P VC unlikely to recover to baseline conditions	O Effects occur once during the construction phase	IR VC will not recover to baseline conditions	Habitat loss and disturbance, mitigated through fish habitat offsetting	Not significant
Construction – FMS Mine Site Clearing and grubbing, altered hydrology, and altered surface water quality Sediment loading and resulting change in geomorphology of channels downstream of the Seloam Brook Realignment	Sediment and erosion control, best management practices, spill preparedness, and engagement in the watercourse permitting process Seloam Brook Realignment downstream water control structures Implementation of Fish Habitat Offset Plan	A	M VC interaction causes indirect loss of fish habitat	LAA Potential adverse effect to fish habitat outside of the PA	A Seasonal habitat provisions may affect VC	P VC unlikely to recover to baseline conditions	S Effects occur at irregular intervals	IR VC will not recover to baseline conditions	Disturbance, mitigated in part through fish habitat offsetting	Not significant
Operations – FMS Mine Site Indirect impacts including: altered surface water hydrology in the LCA for WC2 and regional catchment area SW15	Sediment and erosion control, best management practices, and spill preparedness. Implementation of Fish Habitat Offset Plan	A	M Interaction likely to cause indirect impacts to fish habitat	LAA Potential adverse effect to fish habitat outside of the PA	A Seasonal habitat provisions may affect VC	P VC unlikely to recover to baseline conditions	R Effects occur at regular intervals throughout the Project	IR VC will not recover to baseline conditions	Partial habitat loss and disturbance, mitigated in part through fish habitat offsetting	Not significant
Operations – FMS Mine Site Indirect impacts including: altered surface water hydrology in other local or regional catchment areas	Sediment and erosion control, best management practices, and spill preparedness	A	L Change from baseline conditions within natural variation	LAA Potential adverse effect to fish habitat outside of the PA	A Seasonal habitat provisions may affect VC	P VC unlikely to recover to baseline conditions	R Effects occur at regular intervals throughout the Project	IR VC will not recover to baseline conditions	Disturbance	Not significant
Operations and Post Closure – FMS Mine Site Surface water quality	Water treatment (if/as required)	A	N Negligible change to fish and fish habitat	LAA VC interaction will extend beyond PA	A Seasonal aspects will affect VC	P Permanent discharge	R Effects are expected to occur over a regular interval	PR VC will partially recover to baseline conditions	Change in water quality	Not significant
Operations and Post Closure – Touquoy Mine Site	Water treatment (as required)	A	N Negligible change to fish and fish habitat	LAA VC interaction will extend beyond PA	A Seasonal aspects will affect VC	P Permanent discharge	R	PR VC will partially recover to baseline conditions	Change in water quality and quantity	Not significant

Project VC Interactions	Mitigation and Compensation Measures	Nature of Effect	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect
			Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility		
Altered surface water hydrology and surface water quality							Effects are expected to occur over a regular interval			

Legend (refer to Table 5.10-1 for definitions)

Nature of Effect	Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility
A Adverse	N Negligible	PA Project Area	N/A Not Applicable	ST Short-Term	O Once	R Reversible
P Positive	L Low	LAA Local Assessment Area	A Applicable	MT Medium-Term	S Sporadic	IR Irreversible
	M Moderate	RAA Regional Assessment Area		LT Long-Term	R Regular	PR Partially Reversible
	H High			P Permanent	C Continuous	

A significant adverse environmental effect for fish and fish habitat has not been predicted for the Project for the following reasons, with consideration of the ecological and social context of the LAA surrounding the Project:

- During construction, direct impacts to fish and fish habitat will occur. Fish habitat quality within the FMS Study Area is limited by low pH levels, historic mining activity, and by limited fish passage through the watershed based on historic and current operation of the East River Sheet Harbour Hydro System. Given these limitations, fish abundance within the FMS Study Area was relatively low. The direct loss of habitat within the FMS Study Area will require authorization under the *Fisheries Act*. An effect to fish and fish habitat is considered high if it results in a change in fish habitat area or quality which limits the ability of fish to use the habitat to carry out one of more life processes. Mitigation is proposed on site with the Seloam Brook Realignment and associated open water habitat creation downstream of the realignment. Offsetting is anticipated to be required for direct impacts to fish habitat (infrastructure construction) and indirect effects related to flow reduction and the Seloam Brook Realignment;

- During operations, adverse, but not significant effects to fish and fish habitat are predicted through withdrawal of water from Seloam Lake and discharge to Anti Dam flowage. The magnitude of these effects to fish and fish habitat is low based on control of surface water flows and discharge to mimic baseline hydrologic conditions and implementation of sediment and erosion control measures. Construction of the TMF is expected to result in a maximum predicted 45% reduction in flow at the outlet of East Lake, and contact water collection is expected to result in a maximum predicted 29% reduction in flow to WC2. These effects will be commence during the construction phase, and be fully expressed on the landscape during operations. This will result in a moderate magnitude of effect to fish and fish habitat, and will be included for authorization under the *Fisheries Act.* Water quality in the receiving environment (Anti-Dam Flowage) has been predicted to result in a negligible magnitude impact to fish.

- During closure, limited impact to fish and fish habitat is predicted based on control of surface water flows to mimic baseline hydrologic conditions, water quality predictions in the receiving environment (Anti-Dam Flowage), and water treatment, as required, and implementation of sediment and erosion control measures.

- Based on the anticipated direct and indirect impacts to fish and fish habitat, a Fish Habitat Offset Plan has been developed. The Fish Habitat Offset Plan will continue to evolve through consultation with DFO and the Mi'kmaq of Nova Scotia.

6.8.9 Proposed Compliance and Effects Monitoring Program

Surface water monitoring will be completed to verify the accuracy of the predicted environmental effects and the effectiveness of the mitigation measures for fish and fish habitat. A Surface Water Monitoring Plan will be established through the life cycle of the permitting process and will commit to monitoring during baseline/pre-construction to establish baseline conditions, and through the operational phase, reclamation and post closure (as determined to be required). Surface water monitoring will be completed for the Project on selected representative watercourses that have been predicted to have direct or indirect effects on fish and fish habitat from Project development.

Indirect effects related to flow reduction are predicted in WC2 and East Brook (SW15) due to construction of the WRSA and TMF, respectively. These habitat losses will be included in the application for HADD authorization under the *Fisheries Act*, and have been included in the Fish Habitat Offset Plan.

Both direct and indirect effects are expected related to the Seloam Brook Realignment. Monitoring of the extent of indirect effects from erosion and sedimentation at the outlet of the Realignment Channel will be required, along with monitoring the effectiveness of water control features along the North and South Channel and associated predicted flooding.

On-going assessments are currently underway and will continue through 2020 to support understanding of the WC43 system under various flow regimes.

DFO (2015) requires monitoring and reporting on offsetting measures as conditions of the authorization permit. Construction compliance monitoring will be conducted to minimize the environmental effects of construction activities. Effectiveness monitoring will be conducted to ensure the offsetting works are functioning as designed. Detailed monitoring plans will be developed in consultation with DFO to identify the appropriate metrics for assessing the performance of the offsetting works. The monitoring conditions suggested by DFO (2015) include:

- Dated photographs of works undertakings, activities or operations related to mitigation measures and photographs of completed offsetting measures;
- Timelines for monitoring and reporting;
- Monitoring and inspection records;
- Details of any mitigation changes, corrective actions or contingency measures that were followed in the event that mitigation or offsetting measures did not function as described; and,
- The methodology and criteria that will be used to evaluate the success of the offsetting measures.

DFO (2015) requires that monitoring and reporting of offsetting measures are undertaken for a period of time sufficient to allow for:

- Biological or physical changes to be reflected in the data collected;
- Possible adjustments to the monitoring to better estimate changes in fishery productivity; and
- The restored habitat to reach full ecological functionality (that is, supporting fish reproduction, growth, and survival).

The Proponent is normally responsible for the maintenance or repair of the offsetting measures as conditions of the *Fisheries Act* authorization. The requirements for adjustments and contingencies to the offsetting measures will be included in the terms and conditions of the authorization.

Proponents are responsible for implementing offsetting plans and monitoring their effectiveness, as well as for reporting on implementation and the results of monitoring. Monitoring must be designed to confirm that the offsetting measures have been effective in counterbalancing the harmful alteration, disruption or destruction of fish habitat and may identify the need for additional measures should deficiencies be found.

As part of a detailed offset plan, and once the offset measures have been selected, a monitoring program will be developed in consultation with DFO, and included in the final offset plan and Fisheries Authorization. Fish assessment metrics such as catch per unit effort, age, length, and weight will be considered as part of the study design. Physical parameters such as lake levels, lake inflow and outflow, water temperature, lab water quality, and in-situ water quality will be incorporated to the monitoring plan. Criteria (performance measures) for the effectiveness monitoring will be developed through discussions with DFO, the Province, and other interested parties.

The results of compliance and effectiveness monitoring will be compiled annually and submitted to DFO for review. After the third year of effectiveness monitoring, a summary report will be written with recommendations based on the success of the offsetting measures.

Proposed follow-up and monitoring programs have been reviewed with the Mi'kmaq of Nova Scotia during engagement efforts including meetings, sharing of technical documents (Draft EIS, poster boards, Summary of Mi'kmaq Effects and Proposed Mitigation Measures, Plain Language Summary). On-going engagement with the Mi'kmaq will continue through the EA process and associated permitting relating to follow-up programs and monitoring.

6.9 Habitat and Flora

6.9.1 Rationale for Valued Component Selection

Flora species and habitat communities, and the fauna species which rely upon these communities, may be altered, either directly or indirectly, by the proposed Project activities. Field programs were developed to identify ecosystems and landscape-level habitats, and then to identify priority species and SAR which are protected under federal and provincial SAR legislation.

6.9.2 Baseline Survey Methodology

Methodology of habitat and flora surveys within the FMS Study Area are discussed below. Information pertaining to Touquoy Mine Site has been brought forward from the Touquoy Gold Project EARD and Focus Report. Methods and results are summarized in sub-headings within the applicable sections and are carried forward into the effects assessment where deemed appropriate. For further information regarding Touquoy Mine Site, refer to the Touquoy Gold Project EARD (CRA 2007a) and Focus Report (CRA 2007b).

6.9.2.1 FMS Study Area Baseline Program Methodology

6.9.2.1.1 *Desktop Evaluation*

As described in the Guide to Addressing Wildlife Species and Habitat in an EA Registration Document (NSE, 2009b) and the FMS EIS Guidelines (CEAA, 2018), a complete vascular and non-vascular plant inventory is not typically required for an environmental assessment. In accordance with the documents referenced above, the vegetation survey focused on the identification of vegetative communities, with particular attention to identifying priority species. Priority species methodologies, including desktop review, are described in detail in Section 6.12.

For vascular flora surveys, a list of all rare species records found within 100 km of the FMS Study Area was assembled prior to the survey being undertaken (from ACCDC and Environmental Screening Report results) to provide additional information and support the broader Priority Species list regarding the potential presence of Priority Species within the FMS Study Area. An ACCDC report was requested to cover observations within the FMS Study Area. The ACCDC, Priority Species List, and Environmental Screening reports are provided in Appendix G.5, G.6 and G.7. The specific timing of field surveys was determined based on the identification of potential priority species that were documented within the Priority Species List and further informed by the ACCDC and Environmental Screening reports.

Prior to the completion of habitat surveys, a desktop assessment was completed using available GIS Forestry Inventory (NSDNR 2016) and Wetland Inventory (NSE 2017) databases. Habitat survey points were placed throughout the landscape with the goal of assessing all of the major habitat types and landscape features throughout the FMS Study Area. Distances between each habitat survey point varied depending on the complexity of stand types and ranged from 230 – 800 m.

Prior to undertaking the field assessment, a detailed desktop review of known lichen observations and potential habitat for rare lichens within the FMS Study Area was also conducted. The desktop review process involved five components: a review of the Priority Species List, ACCDC and Environmental Screening results; a review of NSL&F predictive habitat mapping for boreal felt lichen (*Erioderma pedicellatum*) (BFL); a review of proposed critical habitat layers for BFL and vole ears (*Erioderma mollissimum*), provided by ECCC-CWS; a review of the results of habitat mapping; and a review of mapped wetland habitat.

To develop the predictive habitat maps for BFL, NSL&F used an algorithm that identifies all forest stands in the provincial forestry database in which balsam fir (*Abies balsamea*) is listed as a primary or secondary species, and that occur within 80 m of a mapped bog or fen. The model further confines the search to only those forest stands located within 30 km of the Atlantic Coast. This database is used to predict areas with a higher potential of locating BFL. This data set was reviewed in advance of field assessment and was uploaded onto the GPS unit prior to conducting the field study. Other habitats identified by the biologist as suitable for rare lichens were surveyed for lichens as well.

While the specific habitat requirements of each of priority lichen species varies, many require mature to over-mature forests; stand age is one of the greatest determinants of the presence of many rare epiphytic lichens (i.e., lichens which grow on other plants) (McMullin, Duinker, Cameron, Richardson, & Brodo 2008). Lichen surveys throughout the FMS Study Area were focused on mature stands, particularly those located within mapped wetlands and predicted BFL habitat, as these habitats have elevated potential for identifying associative priority lichen species.

6.9.2.1.2 *Habitat Survey*

Habitat assessments were completed in the field in July 2017, April 2018 and August 2019 within the FMS Study Area. During the wetland assessments in 2017-2019, sufficient information regarding stand type and vegetative community structure within wetlands were documented, therefore, habitats assessment points were only placed in upland habitats. A total of 39 habitat assessment points were distributed across the FMS Study Area.

The habitat survey methods and results are presented with the acknowledgment of three biases built into the survey methods.

- One bias is towards upland habitat. This bias was purposefully built into the survey methods with the understanding that all wetlands within the FMS Study Area will be delineated and described in detail and their function as habitats within the landscape of the PA would be captured in the wetland program (Section 6.7).
- The second bias is towards forested landscape as opposed to non-forested landscapes. In this context, clear cut lands, or those which have experienced timber harvesting of any sort, are still considered forested because the removal of timber is only a temporary disturbance. Non-forested portions of the landscape, such as roads or extensive gravel areas, often associated with historic mine workings, were not assessed during the habitat survey simply because they lack forest cover to be described and their capability for supporting forest cover in the foreseeable future is low based on the level of disturbance.
- The third bias in this survey is that habitat surveys were completed at discrete points and no effort was made to delineate the extent of that habitat type around those points. As such, the ability to extrapolate habitat survey results across the entire FMS Study Area is limited. These habitat survey points are meant to describe habitat in ‘snapshots’ of specific locations. The results of the habitat survey are meant to describe the diversity of habitat types present throughout the FMS Study Area and the relative abundance thereof, rather than absolute percent cover of each habitat type throughout the FMS Study Area.

During the field assessments two surveyors walked to the established habitat survey points. Locations were adjusted in the field if the point was located in wetland habitat or in a clear cut as per the above reasoning. The distance between habitat survey points was dependent upon the complexity of major habitat types across the landscape.

The Forest Ecosystem Classification for Nova Scotia (FEC) Guide guidebooks were used to describe habitat characteristics within the habitat survey points. The following information was collected at each habitat survey point:

- Vegetation Type was determined using Part 1 of the FEC Guide (Neily, 2017). Each stand was classified by overall forest group code and vegetation type using the keys provided in the guidebook. Forest Groups are general groupings of vegetation types. Within each forest group (e.g., open woodland), there are several specific vegetation types. Vegetation types are recurring and identifiable plant communities which reflect differences in site conditions, natural disturbance regimes and successional stage. For example, TH4 is a tolerant hardwood forest group dominated by sugar maple and white ash vegetation type, while TH6 is a tolerant hardwood forest group dominated by red oak and yellow birch vegetation type.

- Ecosite was determined using Part 3 of the FEC Guide (Neily, 2017). This guide provides keys to identify ecosite using an edatopic grid, which is a two-dimensional diagram used to plot ecosystems and ecosites based on their relative moisture and nutrient regimes. Ecosites are units which represent ecosystems that have developed under a particular nutrient and moisture regimes. A finite range of vegetation types will naturally grow in any given ecosite.
- Natural or anthropogenic disturbance is recorded in each site. Examples of anthropogenic disturbances include timber harvesting or road development. Natural disturbance regimes include fire, pests, wind throw and natural senescence.
- Representative photos were taken of each site.

6.9.2.1.3 *Vascular Plant Surveys*

Vascular plant assessments occurred early and late in the growing season to capture plant species with different phenology. Spring surveys were completed to capture spring ephemerals and early developers on June 14th to 16th, 2017; June 19th to 20th, 2017, and June 4th and 5th, 2018. Late season surveys were completed on September 27th to 30th 2017; October 2nd, 2017; September 17th, 2018, and August 21st, 2019 to capture species developing later in the season. Surveys were completed by Dr. Nick Hill and MEL field ecologists John Gallop and Melanie MacDonald.

Meandering transects were traveled by foot and major habitat types were assessed to create a species list of the general vascular plant species and communities present within the FMS Study Area. Efforts were focused, however, on land features with higher likelihood to have vascular plant Priority Species present such as tolerant hardwood landscapes (where present), seepages, floodplains and wetlands. In addition to targeting the aforementioned habitats, disturbed habitats such as clearings and road ditches were assessed as a variety of Priority Species can be known to thrive in these habitats (e.g., *Equisetum variegatum, Agalinis neoscotica*).

In the event that a species could not be identified in field, specimens were photographed and/or specimens were collected and pressed for identification at a different time. All SAR and/or SOCI species observed were georeferenced, counted, photographed, and their habitat was recorded. The following literature was the primary references used during the field surveys and identification process:

- Roland's Flora of Nova Scotia (Zinck, 1998);
- Nova Scotia Plants (Munro, Newell & Hill, 2014);
- Flora of New Brunswick (Hinds, 2000);
- GoBotany Digital Keys (GoBotany, 2017); and
- Sedges of Maine: A Field Guide to Cyperaceae (Arsenault et al, 2013).

Each species wetland indicator status was recorded. The wetland indicator status indicates a species probability of occurring in wetland habitat. Table 6.9-1 outlines the wetland indicator statuses and their abbreviations.

Table 6.9-1: Wetland indicator status for vascular flora

Wetland Indicator Status	Abbreviation	Probability of occurring in a Wetland
Obligate	OBL	>99%
Facultative Wetland	FACW	66-99%
Facultative	FAC	33-66%
Facultative Upland	FACU	1-33%
Upland	UPL	<1%

6.9.2.1.4 *Lichen Surveys*

All suitable habitats within the FMS Study Area were surveyed on November 12th and 13th, 2017; November 23rd and 24th, 2017; September 17th, 2018, and August 21st, 2019 by local lichen surveyors Chris Pepper and John Gallop. Lichens were also recorded incidentally during the vascular plant and other biophysical surveys conducted throughout 2017-2019. Mature trees that are appropriate for hosting priority lichen species were visually inspected by focusing on tree trunks, branches and twigs. The following information was collected for any priority lichen species identified during field surveys: site location, date, scientific name, count, size, habitat (host tree and general habitat), location (waypoint in UTM NAD83), height of the specimen, direction that the specimen was facing, along with a photograph and any relevant comments.

A general list of common lichens was also recorded with focus on macrolichens (i.e., foliose, fruticose, squamulose), however, crustose and calicioid lichens were also recorded when observed. In the event that a lichen specimen could not be readily identified in the field, photos and/or specimens were collected and identified at a later date. If necessary, collected samples were inspected with microscopy and standard chemical spot tests in accordance with Brodo et al. (2001) to identify to the species level. The following literature was referenced during the surveys and identification process:

- The Macrolichens of New England (Hinds & Hinds, 2007);
- Lichens of North America (Brodo et al., 2001);
- Keys to Lichens of North American – Revised and Expanded (Brodo et al. 2016);
- Microlichens of the Pacific Northwest – Volume 1 – Key to The Genera (McCune 2017a);
- Microlichens of the Pacific Northwest – Volume 2 – Key to the Species (McCune 2017b); and
- Common Lichens of Northeastern North America (McMullin et al. 2014).

6.9.2.2 Touquoy Mine Site Baseline Program Methodology

Vascular flora, lichen and habitat surveys were completed at the Touquoy Mine Site from 2004 to 2006 as part of the EA process. Refer to the Touquoy Mine Site EARD (CRA 2007a) for further methodological details.

6.9.3 Baseline Conditions

6.9.3.1 FMS Study Area Baseline Conditions

6.9.3.1.1 *Desktop Evaluation of Priority Species*

One vascular plant species, Pennsylvania smartweed (*Polygonum pensylvanicum*) was observed approximately 4 km outside of the FMS Study Area in an ACCDC report retrieved June 9th, 2017. No rare lichen species were recorded within or surrounding the FMS Study Area within a 5 km radius. The desktop evaluation confirmed presence of suitable habitat for BFL within and surrounding the FMS Study Area.

The Nova Scotia Department of Communities, Culture and Heritage provided an Environmental Screening Report of flora and fauna for SAR and SOCI documented by their staff within the vicinity of the FMS Study Area (Appendix G.5). The priority flora species (vascular plant species only) recorded are as follows: pubescent sedge (*Carex hirtifolia*), blue cohosh (*Caulophyllum thalictroides*), showy lady's slipper (*Cypripedium reginae*), alder buckthorn (*Rhamnus alnifolia*), foam flower (*Tiarella cordifolia*) and orange-fruit horse gentian (*Triosteum aurantiacum*).

6.9.3.1.2 *Habitat*

The FMS Study Area is located in the Eastern Ecoregion of the Acadian Ecozone and the Eastern Interior Ecodistrict. Ecoregions are subdivisions of the larger ecozones and express macroclimate as a distinctive ecological response to climate through soils and vegetation (Neily et al., 2017). Ecoregions are further subdivided into ecodistricts, which reflect macroelements of the physical and biological attributes of ecosystems which will ultimately influence biodiversity. The Project location is within the Eastern Interior Ecodistrict. The Eastern Interior Ecodistrict is generally characterized by highly visibly bedrock where glacial till is very thin, exposing the ridge topography. Where till is thicker, ridged topography is masked and thick softwood forests occur. There are a few drumlins and hills scattered throughout the ecodistrict and fine textured soils are derived from slates.

Ecosites are units which represent ecosystems that have developed under a variety of conditions and influences, but which have similar moisture and nutrient regimes. An ecosite is associated with a finite range of soil and site conditions and a finite range of vegetation types that grow naturally under those conditions. Ecosites represent general productivity units and provide an ecological setting through which vegetation and soil types can be grouped and compared. In this application, the value in ecosite classification lies in wildlife habitat analysis and biodiversity considerations. For example, ecosite classification can be used to help determine the likelihood of finding particular rare plants that prefer specific moisture or nutrient regimes.

Within the FMS Study Area, habitat survey points confirmed eight different ecosites. The overall landscape within the FMS Study Area is comprised of historic mining, historical and current timber harvesting activities consisting of regenerative vegetation as well as undisturbed mature canopies. Ecosites identified within the FMS Study Area were within the dry to fresh moisture regime, with poor to rich nutrient regimes. These ecosites generally support vegetation types from the spruce-pine (SP) and the mixedwood (MW) forest groups. Generally, SP forest groups are associated with a natural disturbance regime of fire, which leads to stands dominated by spruce understorey vegetation tolerant of acidic, nutrient poor conditions.

MW forest groups are early to late successional mixedwood vegetation. This group can be quite variable and difficult to categorize. Vegetation is found on a range of slope positions and most sites are non-rocky. Soils are mainly derived from glacial till deposits. Thirty-four habitat survey assessment areas were surveyed and abundance of each Ecosite Vegetation Types (VTs) within the FMS Study Area can be found in Table 6.9-2.

Within the FMS Study Area, habitat survey points fell within eight different ecosites. Ecosites identified were within the dry to wet moisture regime with very poor to rich nutrient regimes. These ecosites generally support a broader variety of vegetation types from the spruce-pine, intolerant and tolerant hardwood, mixed wood, open woodland, spruce-hemlock and intolerant hardwood forest groups. Within the FMS Study Area, the dominant ecosite is AC6 which is characterized by well drained soils and poor nutrient regime which supports conifer species which have a tolerance towards acidic soils.

Within the FMS Study Area, 16 VTs were observed during the Habitat Assessments. Collectively, and as a result of the dominance of nutrient poor acidic soils, predominant VTs comprised of conifer species as the dominant canopy layer, often with ericaceous shrubs as the herbaceous layer. The single most dominant VT is MW4 which is dominated by balsam fir – red maple. See Table 6.9-2 for the Habitat Survey Results. Habitat Survey Points are shown on Figure 6.9-1.

Table 6.9-2: Habitat Survey Results within the FMS Study Area

Habitat Survey Point	Ecosite	VT*	Type of disturbance	Habitat Descriptions
HP1	AC6	SP6	Undisturbed	Early to mid-successional vegetation type dominated by black spruce and red maple. Understory consists of balsam fir saplings.
HP2	AC9	MW4	Undisturbed	Early to mid-successional mixedwood vegetation type dominated by balsam fir and red maple. Herbaceous layer sparse and consisting primarily of star flower. Moss layer consisting of Schreber's moss and Bazzania sp.
HP3	AC9	MW4	Undisturbed	Early to mid-successional mixedwood vegetation type dominated by balsam fir and red maple. Herbaceous layer sparse and consisting primarily of star flower. Moss layer consisting of Schreber's moss and Bazzania sp.
HP4	AC6	SP5	Undisturbed	Early to late successional vegetation types dominated by black spruce with balsam fir. Understory consists of white pine, red spruce and rhodora.
HP5	AC6	SP5	Historic mining workings, wind disturbance	Historic mining activity. Early to late successional vegetation types dominated by black spruce with balsam fir. Understory consists of white pine, red spruce and rhodora.
HP6	AC5	MW1	Undisturbed	Late successional mixedwood vegetation types dominated by yellow birch with red spruce and balsam fir. Understory consisting of red maple saplings herbaceous layer consisting of woodferns, and black berries.
HP7	AC11	MW1	Historic mining workings, timber harvesting	Historic mining present. Late successional mixedwood vegetation types dominated by yellow birch with red spruce and balsam fir. Understory consisting of red maple saplings herbaceous layer consisting of woodferns, and black berries.
HP8	AC10	MW4	Undisturbed with portions with evidence of wind disturbance	Early to mid-successional mixedwood vegetation type dominated by balsam fir and red maple. Herbaceous layer sparse and consisting primarily of cinnamon fern. Schreber's moss and Bazzania sp. consisting of bryophyte layer.

Habitat Survey Point	Ecosite	VT*	Type of disturbance	Habitat Descriptions
HP9	AC9	MW4	Undisturbed with portions with historic mining and access roads. Areas with evidence of wind disturbance.	Some anthropogenic disturbances (high winds and historic mining and access road). Early to mid-successional mixedwood vegetation type dominated by balsam fir and red maple. Herbaceous layer sparse and consisting primarily of cinnamon fern. Schreber's moss and Bazzania sp. consisting of bryophyte layer.
HP10	AC7	SP7	Historic mining workings with areas of undisturbed habitat	Historic mining disturbances present. Black spruce dominant overstory with a well-developed shrubby layer consisting of sheep laurel and balsam fir saplings. Herbaceous layer primarily consisting of bunch berry.
HP11	AC7	SP7	Undisturbed	Historic mining disturbances present. Black spruce dominant overstory with a well-developed shrubby layer consisting bracken fern and balsam fir saplings. Herbaceous layer primarily consisting of bunch berry and creeping snowberry.
HP12	AC11	MW5	Undisturbed	Early successional mixedwood vegetation co-dominated by white birch and balsam fir. Understory consisting of Balsam Fir saplings. Herbaceous layer primarily consists of bunch berry.
HP13	AC10	MW4	Undisturbed	Early to mid-successional mixedwood vegetation type dominated by balsam fir and red maple. Understory consisting of balsam fir, white birch and red maple. Herbaceous layer sparse and consisting cinnamon fern, bunch berry and blueberries.
HP14	AC6	SP4	Undisturbed	Mid-successional vegetation type with abundant white pine, balsam fir and red spruce. Understory consisting of balsam fir saplings. Schreber's moss is the dominant bryophyte.
HP15	AC6	SP5	Undisturbed	Early to late successional vegetation type dominated by black spruce. Understory consisting of balsam fir and spruce saplings. Herbaceous layer sparse and consists of sheep laurel as the dominant species. Schreber's moss is the dominant bryophyte.
HP16	AC7	SH9	Undisturbed	Early to mid-successional vegetation type with balsam fir as the dominant species followed by black spruce. Dominant herbaceous layer consists of bracken fern, and bunch berry.
HP17	AC13	TH8	Undisturbed with evidence of wind disturbance	Mid to late successional vegetation type dominated by red maple and yellow birch. Understory consisting of balsam fir and red maple saplings.
HP18	AC10	SH4	Undisturbed	Dominated by high density red spruce and Schreber's moss. Monodominant tree layer with very little/next to no herbaceous layer.

Habitat Survey Point	Ecosite	VT*	Type of disturbance	Habitat Descriptions
HP19	AC10	MW4	Undisturbed	Early to mid-successional mixedwood vegetation type dominated by balsam fir and red maple. Herbaceous layer consisting primarily of bunchberry and gold thread. Moss layer consisting of Schreber's moss and Bazzania sp.
HP20	AC11	MW2	Undisturbed	Mid-successional mixedwood vegetation type dominated by red spruce and red maple. Understory consisting of balsam fir and red maple saplings. Herbaceous layer consists wild-lily-of-the-valley. Schreber's moss and stair-step moss are the dominant bryophytes.
HP21	AC10	MW4	Surrounding by cut block	Early to mid-successional mixedwood vegetation type dominated by balsam fir and red maple. Herbaceous layer sparse and consisting of starflower.
HP22	AC10	SH5	Undisturbed	Mid-successional vegetation type dominated by red spruce and balsam fir. Herbaceous layer dominated by bunchberry, wild-lily-of-the-valley and goldthread. Schreber's moss and stair-step moss are the dominant bryophytes.
HP23	AC13	TH8	Undisturbed with portions with evidence of wind disturbance	Mid to late successional vegetation type dominated by red maple and yellow birch. Understory consisting of balsam fir and red maple saplings.
HP24	AC7	SP6	Undisturbed	Early to mid-successional vegetation type dominated by black spruce and red maple. Understory consists of Balsam Fir saplings.
HP25	AC6	SH5	Undisturbed	Mid-successional vegetation type dominated by red spruce and balsam fir. Herbaceous layer dominated by bunchberry, wild-lily-of-the-valley and goldthread. Schreber's moss and stair-step moss are the dominant bryophytes.
HP26	AC6	IH6	Undisturbed	Early successional vegetation dominated by white birch, red maple with the understory consisting of spruce and fir.
HP27	AC6	SH9	Primarily Undisturbed with evidence of timber harvesting	Early to mid-successional vegetation type with balsam fir as the dominant species followed by black spruce. Dominant herbaceous layer consists of bracken fern, and sheep laurel.
HP28	AC10	SH5	Primarily Undisturbed with evidence of timber harvesting	Mid-successional vegetation type dominated by red spruce and balsam fir. Herbaceous layer dominated by bunchberry, wild-lily-of-the-valley and goldthread. Schreber's moss and stair-step moss are the dominant bryophytes.
HP29	AC6	SP5	Primarily undisturbed with evidence of timber harvesting and wind disturbance	Early to late successional vegetation type dominated by black spruce. Understory consisting of balsam fir and spruce saplings. Herbaceous layer sparse and consists of sheep laurel as the dominant species. Schreber's moss is the dominant bryophyte.

Habitat Survey Point	Ecosite	VT*	Type of disturbance	Habitat Descriptions
HP30	AC5	SP5	Primarily undisturbed with evidence of wind disturbance.	Early to late successional vegetation types dominated by black spruce with balsam Fir. Understory consists of white pine, red spruce and rhodora.
HP31	AC6	SH4	Undisturbed	Dominated by spruce and balsam fir and bracken fern.
HP32	AC6	SP5	Undisturbed	Early to late successional vegetation type dominated by black spruce. Understory consisting of balsam fir and spruce saplings. Herbaceous layer sparse and consists of sheep laurel as the dominant species. Schreber's moss is the dominant bryophyte.
HP33	AC6	SH9	Undisturbed	Early to mid-successional vegetation type with balsam fir as the dominant species with red spruce and red maple intermittently scattered throughout. Dominant herbaceous layer consists of bracken fern, and sheep laurel berry.
HP34	AC4	WC3	Undisturbed	A wet forest occurring on poorly drained acidic soils. This survey area was dominated by tamarack and black spruce.
HP35	AC6	SH8	Undisturbed	Early to mid-successional vegetation type with balsam fir as the dominant species. Dominant herbaceous layer consists of wood fern and Schreber's moss.
HP36	AC6	SH8	Undisturbed	Early to mid-successional vegetation type with balsam fir as the dominant species. Dominant herbaceous layer consists of wood fern and Schreber's moss.
HP37	AC5	SP4a	Undisturbed	Mid-successional vegetation type with black spruce as the dominant species. Dominant herbaceous layer consists of blueberry and bracken fern.
HP38	AC6	SH8	Undisturbed	Early to mid-successional vegetation type with balsam fir as the dominant species. Dominant herbaceous layer consists of wood fern and Schreber's moss.
HP39	AC6	SP6	Undisturbed	Early to mid-successional vegetation type dominated by black spruce and red maple. Understory consists of balsam fir saplings.

The ecosites identified throughout the FMS Study Area are described herein, grouped by predominant nutrient regime with associated VTs.

6.9.3.1.2.1 Very Poor Nutrient Regime

AC4 is the only ecosite observed with a very poor nutrient regime and comprises of 3% (n=1) of all the habitat assessment areas surveyed. This ecosite has a wet moisture regime and supports species with an affinity of poorly drained soils (e.g., black spruce and tamarack). Within the FMS Study Area, the associated VT for this ecosite was WC3, which is within the Wet Conifer group is a VT often dominated by jack pine and black spruce and with an herbaceous layer consisting of rhodora and sphagnum.

6.9.3.1.2.2 Poor Nutrient Regime

Three ecosites within the FMS Study Area consisted of a poor nutrient regime with moisture regimes from fresh to moist. The ecosites observed were AC5 (8%; n=3), AC6 (41%; n=16) and AC7 (10%; n=4) and support the VTs SP4, SP5, SP6, SP7, SH4, SH5, SH9, IH6 and MW1. The most dominant VT group associated with this nutrient regime is the Spruce Pine Forest Group (SP) which consist of conifer dominant vegetative communities. The second most dominant VT associated with this nutrient regime is the Spruce Hemlock Forest Group (SH) which is a mid to late successional softwood VT often consisting of shade tolerant softwood.

6.9.3.1.2.3 Medium Nutrient Regime

Within the FMS Study Area, ecosites AC9 (8%, n=3), AC10 (18%, n=7) and AC11 (8%, n=3) fall within the medium nutrient regime and moisture regimes from dry to moist. Within Nova Scotia more generally, the majority of Acadian climax softwood and mixed wood forests are found on AC10 and AC11 sites. AC9 occurs primarily on well drained steep slopes with shallow glacial till and/or colluvium deposits. This ecosite has dry nutrient medium soils which generally support mixedwood forests of sugar maple, red maple, white birch and beech. Within this ecosite, MW4 was the only VT found associated with this ecosite which is dominated by balsam fir and red maple tree species.

Occurring mainly on well-drained slopes with medium textured glacial till deposits, AC10 has fresh, nutrient-medium soils which generally support late successional forests dominated by red spruce, eastern hemlock, and yellow birch. Earlier successional forests contain balsam fir, white birch, red maple, and trembling aspen. Within the FMS Study Area, a variety of vegetation types and forest groups were found within AC10 ecosites which include the MW, SH, and Tolerant Hardwood (TH) groups.

Occurring mainly on imperfectly drained lower slopes and level areas with medium textured glacial till deposits, AC11 ecosites have moist, nutrient-medium soils which generally support mixed wood climax communities dominated by red spruce, hemlock and yellow birch. Within the FMS Study Area, three of the habitat survey points within ecosite AC11 were identified to be all within the MW group (i.e. MW1, MW2 and MW5).

6.9.3.1.2.4 Rich Nutrient Regime

Ecosite AC13 was observed in one location in the FMS Study Area. This ecosite occurs on well drained slopes with a fresh moisture regime. This ecosite typically supports late successional forests dominated by sugar maple, American beech, yellow birch, white ash, and red maple. Early successional stands may be dominated by aspen or white birch. In each location observed within the FMS Study Area, this ecosite supported a TH vegetation type which was dominated by mature red maple and yellow birch.

6.9.3.1.2.5 Habitat Survey Conclusions

Upland forests in the FMS Study Area have experienced relatively high levels of disturbance from timber harvesting and historical mining activities. Twenty-eight percent of the survey locations had evidence of some level of disturbances, typically from timber harvesting, historic mining activities and natural disturbances (i.e., wind). The FMS Study Area has canopies with various maturity ranging from regenerative to mature. Mature undisturbed habitats are present in the FMS Study Area particularly in large wetland complexes. Canopies typically closer to logging roads and historic mining sites have been disturbed.

The areas affected by natural or anthropogenic disturbance (e.g., wind throw, tree harvesting, and historical mining activities) consisted of the SP, MW, TH and SH vegetation types which were often dominated by regenerating forest stands. The dominant disturbance regime in the FMS Study Area is timber harvesting followed by historical mining activities, which is present in patches throughout upland forests. Generally speaking, uplands within the FMS Study Area contain immature or unevenly aged coniferous stands or mixed wood stands. Several pockets of mature coniferous forests are scattered throughout the PA, but over-mature stands were generally uncommon. Pure deciduous stands (including both tolerant and intolerant hardwood forests) are infrequent within the FMS Study Area.

Within the FMS Study Area, habitat survey points fell within eight different ecosites. Ecosites identified within the FMS Study Area were within the dry to wet moisture regime with very poor to rich nutrient regimes. These ecosites generally support a broader variety of vegetation types from the spruce-pine, intolerant and tolerant hardwood, mixed wood, open woodland, spruce-hemlock and intolerant hardwood forest groups. Within the FMS Study Area, the dominant ecosite is AC6 which is characterized by well drained soils and poor nutrient regime which supports conifer species which have a tolerance towards acidic soils. Within the FMS Study Area, 16 VTs were observed during the Habitat Assessments. Collectively, and as a result of the dominance of nutrient poor acidic soils, predominant VTs comprised of conifer species as the dominant canopy layer, often with ericaceous shrubs as the herbaceous layer. The single most dominant VT is MW4 which is dominated by balsam fir and red maple.

6.9.3.1.3 *Vascular Flora*

A total of 277 species of vascular plants were identified (Table 6.9-3). The diversity of species is moderate to high, especially considering the low fertility of soils within the FMS Study Area. This is attributed to the range of habitat types encountered, from natural aquatic systems, a variety of wetland types, and both intact and disturbed upland habitats. The vegetation species observed within the FMS Study Area are largely native, however, within disturbed areas, exotic species were more prevalent. Within these disturbed areas, coltsfoot (*Tussilago farfara*), considered to be a moderate invasive species, is present. The observations of coltsfoot were restricted to clearings and linear disturbances, and no observations of this species being disruptive or invasive to native, undisturbed plant communities were recorded.

To determine the presence of invasive species within the FMS Study Area, the Clean Annapolis River Project Checklist of Invasive Species was used (CARP 2007). The species and communities of vascular plants encountered were typical given the eco-regional context, nutrient regimes, moisture regimes, and disturbance regimes. Of the 277 species identified, three are considered priority species: southern twayblade (*Neottia bifolia* syn. *Listera australis*); silvery flowered sedge (*Carex argyrantha*), and Wiegand’s sedge (*Carex wiegandii*). These species are discussed further in Section 6.12. Priority species locations are shown on Figure 6.9-2.

Table 6.9-3: Vascular Flora Species Identified within the FMS Study Area

Scientific Name	Common Name	S Rank	Indicator Status	Scientific Name	Common Name	S Rank	Indicator Status	Scientific Name	Common Name	S Rank	Indicator Status	Scientific Name	Common Name	S Rank	Indicator Status
Carex argyrantha	**Silvery Flowered Sedge**	**S3S4**	*upl*	*Cypripedium acaule*	Pink Lady's-Slipper	S5	*fac*	*Kalmia angustifolia*	Sheep-Laurel	S5	*fac*	*Rhynchospora fusca*	Brown Beakrush	S4	obl
Carex wiegandii	**Wiegand's Sedge**	**S3**	*obl*	*Danthonia compressa*	Flattened Oatgrass	S5	*facu*	*Kalmia polifolia*	Pale Bog Laurel	S5	*obl*	*Ribes glandulosum*	Skunk Currant	S5	fac
Neottia bifolia	**Southern Twayblade**	**S3**	*obl*	*Danthonia spicata*	Poverty Oatgrass	S5	*facu*	*Larix laricina*	Tamarack	S5	*fac*	*Rosa nitida*	Shining Rose	S4S5	obl
Abies balsamea	Balsam Fir	S5	*fac*	*Dennstaedtia punctilobula*	Eastern Hay-Scented Fern	S5	*fac*	*Rhododendron groenlandicum*	Common Labrador Tea	S5	*facw*	*Rosa palustris*	Swamp Rose	S4	obl
Acer rubrum	Red Maple	S5	*fac*	*Dicanthelium acuminatum*	Woolly Panic Grass	SNA	*fac*	*Leersia oryzoides*	Rice Cutgrass	S5	*obl*	*Rosa virginiana*	Virginia Rose	S5	fac
Achillea millefolium	Common Yarrow	SNA	*facu*	*Diervilla lonicera*	Northern Bush Honeysuckle	S5	*facu*	*Linnaea borealis*	Twinflower	S5	*fac*	*Rubus flagellaris*	Northern Dewberry	SU	fac
Agrostis gigantea	Redtop	SNA	*fac*	*Digitaria ischaemum*	Smooth Crabgrass	SNA	*facu*	*Neottiacordata*	Heart-leaved Twayblade	S4	*facw*	*Rubus hispidus*	Bristly Dewberry	S5	facw
Agrostis hyemale	Rough Bent Grass	S5	*fac*	*Doellingeria umbellata*	Hairy Flat-top White Aster	S5	*fac*	*Littorella uniflora*	American Shoreweed	S4?	*obl*	*Rubus idaeus*	Red Raspberry	S5	fac
Agrostis stolonifera	Creeping Bent Grass	S5	*facw*	*Drosera intermedia*	Spoonleaved Sundew	S5	*obl*	*Lobelia inflata*	Inflated Lobelia	S5	*facu*	*Rubus x. recurvicaulis*	Arching Dewberry	SNR	-
Alnus incana	Speckled Alder	S5	*facw*	*Drosera rotundifolia*	Round-leaved Sundew	S5	*facw*	*Lonicera villosa*	Mountain Fly Honeysuckle	S4S5	*facw*	*Rubus pubescens*	Dwarf Red Raspberry	S5	fac
Amelanchier laevis	Smooth Serviceberry	S5	*fac*	*Dryopteris campyloptera*	Mountain Wood Fern	S5	*fac*	*Lotus corniculatus*	Garden Bird's Foot Trefoil	SNA	*facu*	*Rumex acetosella*	Sheep Sorrel	SNA	upl
Anaphalis margaritacea	Pearly Everlasting	S5	*upl*	*Dryopteris cristata*	Crested Wood Fern	S5	*fac*	*Lycopodiella inundata*	Northern Bog Clubmoss	S5	*facw*	*Rumex crispus*	Curled Dock	SNA	fac
Andromeda polifolia	Bog Rosemary	S5	*obl*	*Dryopteris intermedia*	Evergreen Wood Fern	S5	*fac*	*Lycopodium annotinum var alpestre*	Stiff Clubmoss var 1	S5	*fac*	*Salix bebbiana*	Bebbs Willow	S5	fac
Aralia hispida	Bristly Sarsaparilla	S5	*upl*	*Dulichium arundinaceum*	Three Way Sedge	S5	*obl*	*Lycopodium annotinum var annotinum*	Stiff Clubmoss var 2	S5	*fac*	*Salix discolor*	Pussy Willow	S5	fac
Aralia nudicaulis	Wild Sasparilla	S5	*fac*	*Eleocharis acicularis*	Needle Spikerush	S5	*obl*	*Dendrolycopodium obscurum*	Flat-branched Tree Clubmoss	S4S5	*facu*	*Salix lucida*	Shining Willow	S5	facw
Aralia racemosa	American Spikenard	S4	*fac*	*Eleocharis robbinsii*	Robbin's Spikerush	S4	*obl*	*Lycopus uniflorus*	Northern Water Horehound	S5	*facw*	*Salix pyrifolia*	Balsam Willow	S5	facw
Arethusa bulbosa	Swamp-Pink (Dragon's Mouth)	S4	*obl*	*Eleocharis tenuis*	Slender Spikerush	S5	*facw*	*Lysimachia terrestris*	Swamp Yellow Loosestrife	S5	*facw*	*Sambucus racemosa*	Red Elderberry	S5	facu

Scientific Name	Common Name	S Rank	Indicator Status	Scientific Name	Common Name	S Rank	Indicator Status	Scientific Name	Common Name	S Rank	Indicator Status	Scientific Name	Common Name	S Rank	Indicator Status
Athyrium felix-femina	Common Lady Fern	S5	*fac*	*Elymus repens*	Quack Grass	SNA	*fac*	*Maianthemum trifolium*	Three-leaved False Solomons Seal	S5	*obl*	*Sarracenia purpurea*	Northern Pitcher Plant	S5	obl
Bartonia paniculata	Branched Bartonia	S4S5	*obl*	*Epigaea repens*	Trailing Arbutus	S5	*facu*	*Maianthemum canadense*	Wild Lily-of-The-Valley	S5	fac	*Scheuchzeria palustris*	Marsh Scheuchzeria	S5	obl
Betula alleghaniensis	Yellow Birch	S5	*fac*	*Epilobium ciliatum*	Northern Willowherb	S5	*fac*	*Medeola virginiana*	Cucumber Root	S5	facu	*Schoenoplectus subterminalis*	Water Bulrush	S5	obl
Betula papyrifera	Paper Birch	S5	*facu*	*Epilobium leptophyllum*	Bog Willowherb	S5	*facw*	*Menyanthes trifoliata*	Bog Buckbean	S5	facu	*Scirpus atrocinctus*	Black-girdled Bulrush	S5	facw
Brachyelytrum erectum	Bearded Shorthusk	SNA	*fac*	*Epilobium palustre*	Marsh Willowherb	S5	*obl*	*Mitchella repens*	Partridgeberry	S5	fac	*Scirpus microcarpus*	Small-fruited Bulrush	S5	obl
Brasenia schreberi	Water-shield	S5	*obl*	*Equisetum arvense*	Field Horsetail	S5	*fac*	*Hypopitys monotropa*	Pinesap	S4	obl	*Scirpus cyperinus*	Common WoollyBulrush	S5	facw
Bromus ciliatus	Fringed Brome	S5	*fac*	*Equisetum fluviatile*	Water Horsetail	S5	*obl*	*Monotropa uniflora*	Convulsion-Root	S5	fac	*Scutellaria galericulata*	Marsh Skullcap	S5	obl
Calamagrostis canadensis	Bluejoint Reed Grass	S5	*facw*	*Equisetum sylvaticum*	Woodland Horsetail	S5	*fac*	*Muhlenbergia uniflora*	Bog Muhly	S5	fac	*Sium suave*	Water Parsnip	S5	facw
Calamagrostis pickeringii	Pickering's Reed Grass	S4S5	*obl*	*Erechtites hieracifolia*	EasternBurnweed	S5	*fac*	*Myrica gale*	Sweet Gale	S5	upl	*Solidago canadensis*	Canada Goldenrod	S4S5	facw
Calla palustris	Wild Calla	S4	*obl*	*Eriocaulon aquaticum*	White Buttons	S5	*obl*	*Morella pensylvanica*	Northern Bayberry	S5	upl	*Solidago gigantea*	GiantGoldenrod	S5	obl
Calopogon tuberosus	Tuberous Grass Pink	S4	*facw*	*Eriophorum angustifolium*	Narrow-leaved Cottongrass	S5	*obl*	*Myriophyllum tenellum*	Slender Water Milfoil	S5	facu	*Solidago puberula*	Downy Goldenrod	S5	upl
Carex atlantica spp. atlantica	Atlantic Sedge var1	S4	*facw*	*Eriophorum tenellum*	Rough Cottongrass	S4S5	*obl*	*Ilexs mucronata*	Mountain Holly	S5	*fac*	*Solidago uliginosa*	Bog Goldenrod	S5	upl
Carex atlantica spp. atlantica	Atlantic Sedge var2	S4	*facw*	*Eriophorum vaginatum*	Tussock Cottongrass	S5	*obl*	*Nuphar variegata*	Variegated Pond-lily	S5	*obl*	*Solidago rugosa*	Rough-Leaf Goldenrod	S5	fac
Carex brunnescens	Brownish Sedge	S5	*fac*	*Eriophorum virginicum*	Tawny Cottongrass	S5	*obl*	*Nymphaea odorata*	Fragrant Water-lily	S5	*obl*	*Sorbus americana*	American Mountain Ash	S5	fac
Carex bullata	Button Sedge	S4	*obl*	*Eupatorium maculatum*	Spotted Joe Pye Weed	S5	*facw*	*Oclemena acuminata*	Whorled Wood Aster	S5	facu	*Sparganium americanum*	American Burreed	S5	obl
Carex canescens	Silvery Sedge	S5	*obl*	*Eupatorium perfoliatum*	Common Boneset	S5	*facw*	*Oclemena nemoralis*	Bog Aster	S5	obl	*Sparganium angustifolium*	Narrow-leaved Burreed	S5	obl
Carex communis	Fibrous-root Sedge	S5	*facu*	*Eurybia radula*	Low Rough Aster	S5	obl	*Onoclea sensibilis*	Sensitive Fern	S5	facw	*Sparganium emersum*	Green-fruited Burreed	S5	obl

Scientific Name	Common Name	S Rank	Indicator Status	Scientific Name	Common Name	S Rank	Indicator Status	Scientific Name	Common Name	S Rank	Indicator Status	Scientific Name	Common Name	S Rank	Indicator Status
Carex crawfordii	Crawford's Sedge	S5	*fac*	*Euthamia graminifolia*	Grass-leaved Goldenrod	S5	obl	*Orthilia secunda*	One-sided Wintergreen	S5	facu	*Spiraea alba*	White Meadowsweet	S5	fac
Carex crinita	Fringed Sedge	S5	*obl*	*Festuca filiformis*	Hair Fescue	SNA	fac	*Osmundastrum cinnamomea*	Cinnamon Fern	S5	facu	*Spiraea tomentosa*	Steeplebush	S5	fac
Carex debilis	White-edge Sedge	S5	fac	*Fragaria virginiana*	Virginia Strawberry	S5	fac	*Osmunda claytoniana*	Interrupted Fern	S5	fac	*Spiranthes cernua*	Nodding Ladies Tresses	S5	facw
Carex deflexa	Northern Sedge	S4	fac	*Fraxinus americana*	White Ash	S5	fac	*Osmunda regalis*	Royal Fern	S5	obl	*Symphyotrichum lateriflorum*	Calico Aster	S5	fac
Carex echinata	Star Sedge	S5	facu	*Galium palustre*	Common Marsh Bedstraw	S5	fac	*Oxalis stricta*	European Wood Sorrel	S5	obl	*Symphyotrichum novi-belgii*	New York Aster	S5	fac
Carex exilis	Coastal Sedge	S4	facu	*Galium tinctorium*	Dyer's Bedstraw	S5	upl	*Oxalis montana*	Common Wood Sorrel	S5	facu	*Symphyotrichum puniceum*	Purple-stemmed Aster	S5	facw
Carex folliculata	Northern Long Sedge	S5	facu	*Galium triflorum*	Three-flowered Bedstraw	S5	upl	*Packera schweinitziana*	Schweinitz's Groundsel	S4	facu	*Taxus canadensis*	Canada Yew	S4S5	fac
Carex gynandra	Nodding Sedge	S5	obl	*Gaultheria hispidula*	Creeping Snowberry	S5	fac	*Petasites frigidus*	Northern Sweet Coltsfoot	S4	upl	*Thalictrum pubescens*	Meadow Rue	S5	facw
Carex intumescens	Bladder Sedge	S5	upl	*Gaultheria procumbens*	Teaberry	S5	fac	*Phegopteris connectilis*	Northern Beech Fern	S5	upl	*Thelypteris palustris*	Eastern Marsh Fern	S5	obl
Carex lasiocarpa	Slender Sedge	S5	upl	*Gaylussacia baccata*	Black Huckleberry	S5	facu	*Aronia x prunifolia*	Purple Chokeberry	S5	fac	*Thelypteris simulata*	Bog Fern	S4	obl
Carex leptalea	Bristly Stalk Sedge	S5	facw	*Glyceria borealis*	Northern Manna Grass	S5	facw	*Aronia melanocarpa*	Black Chokeberry	S5	fac	*Thelypteris noveboracensis*	New York Fern	S5	fac
Carex lurida	Sallow Sedge	S5	obl	*Glyceria obtusa*	Atlantic Manna Grass	S4	facw	*Aronia pyrifolia*	Red Chokeberry	S4	upl	*Toxicodendron radicans*	Poison Ivy	S5	fac
Carex magellanica	Boreal Bog Sedge	S5	facu	*Glyceria striata*	Fowl Manna Grass	S5	upl	*Picea mariana*	Black Spruce	S5	upl	*Hypericumvirginicum*	Virginia St. John's-wort	S5	obl
Carex michauxiana	Michaud's Sedge	S4	obl	*Glyceria canadensis*	Canada MannaGrass	S5	upl	*Picea rubens*	Red Spruce	S5	upl	*Trichophorum cespitosum*	Tufted clubrush	S5	obl
Carex novae-angeliae	New England Sedge	S5	obl	*Glyceria grandis*	Common Tall Manna Grass	S4S5	fac	*Pinus strobus*	White Pine	S5	facw	*Lysimachia borealis*	Northern Starflower	S5	fac
Carex oligosperma	Few-seeded Sedge	S5	obl	*Gnaphalium uliginosum*	Marsh Cudweed	SNA	fac	*Plantago major*	Common Plantain	SNA	fac	*Trifolium repens*	White Clover	SNA	facu
Carex pallescens	Pale Sedge	S5	facu	*Gymnocarpium dryopteris*	Oak Fern	S5	fac	*Platanthera clavellata*	Club Spur Orchid	S5	facw	*Trillium undulatum*	Painted Trillium	S5	fac
Carex pauciflora	Few-Flowered Sedge	S4S5	obl	*Pilosella officinarum*	Mouse-ear hawkweed	SNA	facu	*Poa pratensis*	Kentucky Blue Grass	S5	upl	*Typha latifolia*	Broad-leaved Cattail	S5	obl

Scientific Name	Common Name	S Rank	Indicator Status	Scientific Name	Common Name	S Rank	Indicator Status	Scientific Name	Common Name	S Rank	Indicator Status	Scientific Name	Common Name	S Rank	Indicator Status
Carex stipata	Awl-fruited Sedge	S5	upl	*Hypericum canadense*	Canada St. John's-wort	S5	upl	*Pogonia ophioglossoides*	Rose Pogonia	S4	fac	*Urtica dioica var dioica*	Stinging Nettle	SNA	facu
Carex stricta	Tussock Sedge	S5	obl	*Hypericum ellipticum*	Pale St John's-Wort	S5	obl	*Polypodium virginianum*	Rock Polypody	S5	fac	*Utricularia cornuta*	Horned Bladderwort	S5	obl
Carex trisperma	Three-seeded Sedge	S5	obl	*Hypericum perforatum*	Common St. John's-wort	SNA	fac	*Pontederia cordata*	Pickerelweed	S5	obl	*Utricularia geminiscapa*	Twin-stemmed Bladderwort	S4	obl
Carex billingsii	Billings' Sedge	S4	obl	*Ilex verticillata*	Common Winterberry	S5	facu	*Populus tremuloides*	Trembling aspen	S5	facu	*Utricularia vulgaris ssp. macrorhiza*	Greater Bladderwort	S5	obl
Carex umbellata	Hidden Sedge	S4	obl	*Impatiens capensis*	Spotted Jewelweed	S5	upl	*Potamogeton confervoides*	Alga Pondweed	S5	facw	*Utricularia purpurea*	Eastern Purple Bladderwort	S5	obl
Carex utriculata	Northern Beaked Sedge	S5	obl	*Iris versicolor*	Harlequin Blue Flag	S5	upl	*Potamogeton epihydrus*	Ribbon-leaved Pondweed	S5	facw	*Vaccinium macrocarpon*	Large Cranberry	S5	facw
Carex vesicaria	Inflated Sedge	S4	upl	*Isoetes echinospora*	Spiney-Spored Quillwort	S5	upl	*Potamogeton natans*	Floating-leaved Pondweed	S5	facu-	*Vaccinium oxycoccos*	Small Cranberry	S5	obl
Chamaedaphne calyculata	Leatherleaf	S5	obl	*Juncus articulatus*	Jointed Rush	S5	fac	*Potamogeton oakesianus*	Oakes' Pondweed	S4S5	facu	*Vaccinium angustifolium*	Late Lowbush Blueberry	S5	fac
Chamaenerion angustifolium	Fireweed	S5	obl	*Juncus balticus*	Baltic Rush	S5	fac	*Potentilla simplex*	Old Field Cinquefoil	S5	fac	*Vaccinium myrtilloides*	Velvet-leaved Blueberry	S5	fac
Chelone glabra	White Turtlehead	S5	obl	*Juncus brevicaudatus*	Narrow-Panicled Rush	S5	facw	*Nabalus trifoliolatus*	Three-leaved Rattlesnakeroot	S5	facu	*Vaccinium vitis-idaea*	Mountain Cranberry	S5	fac
Circaea alpina	Small Enchanter's Nightshade	S5	obl	*Juncus canadensis*	Canada Rush	S5	fac	*Prunella vulgaris*	Common Self-heal	S5	facu	*Viburnum nudum*	Northern Wild Raisin	S5	fac
Cladium mariscoides	Smooth Twigrush	S5	obl	*Juncus effusus*	Soft Rush	S5	fac	*Prunus pensylvanica*	Pin Cherry	S5	facu	*Viola cucullata*	Marsh Blue Violet	S5	fac
Clematis virginiana	Virginia Clematis	S5	obl	*Juncus filiformis*	Thread Rush	S5	facw	*Pteridium aquilinum*	Bracken Fern	S5	upl	*Viola lanceolata*	Lance-leaved Violet	S5	obl
Clintonia borealis	Yellow Bluebead Lily	S5	obl	*Juncus militaris*	Bayonet Rush	S5	facu	*Radiola linoides*	Tiny Allseed	SNA	obl	*Viola sororia*	Woolly Blue Violet	S5	fac
Coptis trifolia	Goldthread	S5	obl	*Juncus pelocarpus*	Brown-Fruited Rush	S5	fac	*Ranunculus flammula*	Lesser Spearwort	S5	obl	*Viola macloskeyi*	Small White Violet	S5	facw
Corema conradii	Broom Crowberry	S4	fac	*Juncus tenuis*	Slender Rush	S5	facw	*Ranunculus recurvatus*	Hooked Buttercup	S4	obl	*Xyris difformis*	Bog Yellow-eyed-grass	S4	obl
Cornus canadensis	Bunchberry	S5	obl	*Juniperus communis*	Common Juniper	S5	facw	*Rhododendron canadense*	Rhodora	S5	obl				

The geology of the FMS Study Area combined with the near-boreal climate determines a narrow range of plant associations governed largely by the infertility of soils (low nutrients) derived from the Meguma Group (greywacke and slate) and granite, and summer temperatures that approximate the summer isotherm limit of the boreal forest (i.e., 18˚C). The infertile soil, low summer temperature and moderate precipitation (122-137 cm/annum) result in wetlands that accumulate peat from sphagnum growth and forests that have a well-developed bryophyte layer which leads to low nutrient availability and an accumulation of organic matter. Many of the resulting wetlands are fens and bogs with stunted tree flora of black spruce, tamarack and red maple and a shrub layer consisting of ericaceous shrubs reflecting the low nutrient status and acidity of the soil. The upland forest is also typically boreal with the hallmark black spruce and fir trees in a mat of Schreber's moss, feather moss and *Bazzania trilobata*. Despite the general low productivity of the forest and its largely boreal tree signature (e.g., black spruce, balsam fir and tamarack), white pine and red spruce do occur in the more drained and richer (drumlin) sites and large individuals of these and of black spruce are scattered over the site.

Overall, the FMS Study Area is primarily comprised of disturbed areas from clear cutting and historical mining activities consisting of disturbance-thriving species (e.g., *Scirpus cyperinus, Euthamia graminifolia,* etc.). However, a series of high integrity peatland ecosystems exist consisting of high flora biodiversity. Within these peatlands, a variety of peatland specialists of the Atlantic Coastal Plain Flora (ACPF) group occur (e.g., *Thelypteris simulata, Calopogon tuberosus, Carex atlantica, Neottia bifolia*). Although the ACPF species observed within the FMS Study Area (with the exception of *N. bifolia*) are not priority species in NS, they are a unique group of unrelated species which, in Canada, are only found in Nova Scotia (MTRI, 2011). These landscapes also had a boreal element consisting of *Arethusa bulbosa, Calla palustris, Carex pauciflora, Carex vesicaria, Carex michauxiana, Scheuzeria palustris, Lycopodium annotinum var alpestre, Menyanthes trifoliata, Petasites frigidus*.

6.9.3.1.4 *Lichens*

During the field surveys, 59 lichen species were observed. Nine species were determined to be priority species including one Species at Risk: blue felt lichen (*Pectenia plumbea* syn. *Degelia plumbea*) and eight SOCI: eastern candlewax lichen (*Ahtiana aurescens*), appressed jellyskin lichen (*Scytinium subtile* syn. *Leptogium subtile*), blistered tarpaper lichen (*Collema nigrescens*), corrugated shingles lichen (*Fuscopannaria cf. ahlneri*), a shingle lichen (*Fuscopannaria cf. sorediata*), crumpled bat's wing lichen (*Collema leptaleum*), ghost antler lichen (*Pseudevernia cladonia*) and fringe lichen (*Heterodermia neglecta*). Additional information regarding the priority lichen species observed is provided in Section 6.12. Priority species locations, along with BFL predictive mapping are provided on Figure 6.9-2.

The FMS Study Area, as mentioned in previous sections, is an area that consists of historic mining and timber harvesting, with components of relatively undisturbed forest. The FMS Study area consists of an array of forest types which comprise regenerative and young forests, cutblocks, fragmented canopies and mature intact hardwood, softwood and mixedwood forested wetlands, uplands and riparian areas. In general, the highest potential for priority lichen species were habitats associated with mature forested wetlands and upland habitats in close proximity to open water and watercourses.

Areas which consisted of young regenerative forests did not provide suitable habitat as stand age is often one of the greatest determinants of lichen diversity (McMullin, Duinker, Cameron, Richardson, & Brodo 2008). In the event that mature canopies with the appropriate tree species were present, these habitats were often fragmented resulting in altered sun exposure and moisture regimes which often have a drying effect on forested edges and canopies/wetlands in close proximity (Rheault et al. 2003). Many lichens which are dependent on humid environments (including BFL) are often greatly negatively impacted by the presence of fragmented habitats (Rheault et al. 2003).

The lichen community observed within the FMS Study Area consisted of primarily epiphytic species associated with mature conifer and hardwood stands, as well as terricolous and saxicolous lichens usually observed along trails, clearings and open woodlands. Sphagnum dominant swamps with mature red maples and balsam fir provided suitable habitat for priority species such as *Pectenia* *plumbea* syn. *Degelia plumbea* and *Fuscopannaria cf. ahlneri* as well as other species with an affinity towards mature hardwood and softwood stands.

Mature conifer swamps were present which primarily consisted of an intermixing of spruce and balsam fir surrounded by disturbances (i.e., historical mining and forestry) and lacked BFL indicator species (i.e., *Coccocarpia palmicola* and *Lobaria spp*. on Balsam Fir). See Section 6.12.3.2 for details regarding BFL surveys and potential habitat. Table 6.9-4 provides a list of lichen species observed within the FMS Study Area.

Table 6.9-4: Lichen Species Observed within the FMS Study Area

Scientific name	Common name	COSEWIC, SARA, NSESA	S-Rank
*Pectenia plumbea (syn. Degelia plumbea)**	Blue Felt Lichen	COSEWIC & SARA Special Concern, NSESA Vulnerable	S3
Ahtiana aurescens	Eastern Candlewax Lichen	-	S2S3
Heterodermia neglecta	Fringe Lichen	-	S3S4
*Scytinium sutbile (syn. Leptogium subtile)**	Appressed Jellyskin Lichen	-	S3
Collema nigrescens	Blistered Tarpaper Lichen	-	S3
Fuscopannaria cf. *ahlneri*	Corrugated Shingles Lichen	-	S3
Fuscopannaria cf. sorediata	A shingle lichen	-	S3
Collema leptaleum	Crumpled Bat's Wing Lichen	-	S2S3
Pseudevernia cladonia	Ghost Antler Lichen	-	S2S3
Buellia erubescens	Common Button Lichen	-	-**
Arctioparmelia centrifuga	Ripple Ring Lichen	-	S5
Bacidia Schweinitzii	Surprise Lichen	-	-**
Bryoria trichodes	Inelegant Horsehair Lichen	-	S5
Calicium glaucellum	White-collar Stubble Lichen	-	-**
Chaenotheca balsamconensis	A stubble Lichen	-	-**
Chaenotheca brunneola	A stubble Lichen	-	-**
Cladonia maxima	Giant Cladonia Lichen	-	S5
Cladonia ochrochlora	Smooth-footed Powderhorn Lichen	-	S5
Collema subflaccidum	Tree Tarpaper Lichen	-	S5
Diabaeis baeomoyces	Pink Earth Lichen	-	S5

Scientific name	Common name	COSEWIC, SARA, NSESA	S-Rank
Cladina stellaris	Star-tipped Reindeer Lichen	-	S5
Cladina rangiferina	Gray Reindeer lichen	-	S5
Cladonia cristatella	British Soldiers	-	S5
Cladonia gracilis ssp. turbinata	Bronzed Lichen	-	S5
Umbilicaria mammulata	Smooth Rocktripe Lichen	-	S5
Umbilicaria muehlenbergii	Plated Rocktripe Lichen	-	S5
Pseudocyphellaria holarctica	Yellow Specklebelly Lichen	-	S5
*Icmadophila ericetorum***	Peppermint Drop Lichen	-	-
Imshaugia aleurites	Salted Starburst Lichen	-	S4
Imshaugia placorodia	Eyed Starburst Lichen	-	S4S5
Lasallia papulosa	Brown-bellied Toadskin Lichen	-	S5
Lepraria sp.	A Dust Lichen		
Leptogium cyanescens	Blue Jellyskin	-	S5
Lobaria pulmonaria	Lungwort Lichen	-	S5
Lobaria scrobiculata	Textured Lungwort	-	S5
Lobaria quercizans	Smooth Lungwort	-	S5
Lopadium disciforme	Urn-disk Lichen	-	-**
Loxospora ochrophaea	Eastern ragged-rim lichen	-	-**
Mycoblastus sanguinarioides	A lichen	-	-**
Melanelixia subaurifera	Abrading Camouflage Lichen	-	S5
Nephroma helveticum	Fringed Kidney Lichen	-	S4S5
Ochrolechia androgyna	Powdery Saucer Lichen	-	-**
Ochrolechia pseudopallescens	A lichen species	-	-**
Pannaria conoplea	Mealy-rimmed Single Lichen	-	S4
Pannaria rubiginosa	Brown-eyed Shingle Lichen	-	S4
Parmelia squarrosa	Bottlebrush Shield Lichen	-	S5

Scientific name	Common name	COSEWIC, SARA, NSESA	S-Rank
Parmeliella triptophylla	Black-bordered Shingles Lichen	-	S5
Parmotrema crinitum	Salted Ruffle Lichen	-	S5
Platismatia tuckermanii	Crumpled Rag Lichen	-	S5
Phaeophyscia rubropulchra	Orange-cored Shadow Lichen	-	S5
Pyxine sorediata	Mustard Lichen	-	S5
Platismatia glauca	Varied Rag Lichen	-	S5
Protopannaria pezizoides	Brown-gray Moss-shingle Lichen	-	S5
Punctelia rudecta	Rough Speckleback Lichen	-	S5
Tuckermannopsis americana	Fringed Wrinkle Lichen	-	S5
Usnea sp.	Beard Lichen	-	
Usnea longissima	Methuselah's Beard Lichen	-	S4
Usnea strigosa	Bushy Beardlichen	-	S5
Vulpicida pinastri	Powdered Sunshine Lichen	-	S5

Note: *Species name is in accordance to the newly accepted lichen nomenclature found in the "A Cumulative Checklist for the Lichen-forming, Lichenicolous and Allied Fungi of the Contiental United States and Canada, Version 21" (Esslinger, 2016). **Due to the incomplete nature of the ACCDC species list regarding lichens, particularly in the crustose group, species and ranking is not listed.

While the specific habitat requirements of each priority lichen species vary slightly, they primarily require mature to over-mature forests. Stand age is one of the greatest determinants of lichen diversity for epiphytic lichens (McMullin, Duinker, Cameron, Richardson & Brodo 2008). Within the FMS Study Area, small to moderate scale disturbance is abundant in the form of timber harvesting and historic mining; however, where mature, intact natural stands support several rare species of lichen. According to lichen specialists Chris Pepper and John Gallop, the majority of the landscapes within the FMS Study Area lacked the over mature red maple and balsam fir required to support many of the rare lichen species. However, there were regions of old, intact swamps which supported some SAR/SOCI lichen species such as blue felt lichen.

6.9.3.2 Touquoy Baseline Conditions

6.9.3.2.1 *Habitat*

In the Touquoy Gold Project EARD, habitat was documented to contain coniferous forest, deciduous forest, mixed forest, cutover forest, wetlands, rural residential areas, and areas to be cleared (CRA 2007a). Site clearing commenced in the spring of 2016, and the Touquoy Gold Project operations officially commenced in October 2017. A total of approximately 250 hectares have been developed to support the Touquoy Gold Project infrastructure. No additional physical disturbance is expected to allow for processing and deposition of FMS concentrate and tailings, respectively, at the Touquoy Mine Site.

6.9.3.2.2 *Vascular Flora*

Prior to the construction of site infrastructure, coniferous forest was the most common forest habitat type within the Touquoy Mine Site. These forests were dominated by red spruce, balsam fir, bunchberry and goldthread. No vascular plant SOCI were observed during vascular plant surveys conducted in August 2004, May and June 2005, and September 2006 as part of the EA process (CRA 2007b). One black ash was discovered within the Touquoy Mine Site incidentally during wetland surveys in September 2015.

6.9.3.2.3 *Lichens*

Lichen surveys conducted in the Touquoy Mine Site in 2004 and 2005 as part of the EA process found the presence of blue felt lichen (*Pectenia plumbea* syn. *Degelia plumbea*). An additional lichen survey in 2007 found 20 additional species (CRA 2007a). Eight of the 21 species identified in 2007 are priority species.

6.9.4 Consideration of Engagement and Engagement Results

Key issues raised during public and Mi'kmaq engagement relating to habitat and flora include potential effect on biodiversity and permanent loss of habitat associated within the Project. Potential effects on traditional uses of land and resources by the Mi'kmaq were noted, including potential loss of medicinal food and plants.

The results of the public and Mi'kmaq engagement have been considered in the environmental effects assessment including the Proponent's commitments on mitigation and monitoring measures and proposed compliance and effects monitoring programs, as well as the Proponent's broader commitment to ongoing public and Mi'kmaq engagement.

6.9.5 Effects Assessment Methodology

6.9.5.1 Boundaries

6.9.5.1.1 *Spatial Boundaries*

The PA consists of two project components; FMS Study Area and the Touquoy Mine Site (Figure 6.9-3). The FMS Study Area is located directly east of Highway 374 near Trafalgar, NS, and the Touquoy Mine Site is located at the Moose River Gold Mines. For the purposes of this VC, the PA has been limited to the FMS Study Area portion, as there are no Project interactions with Habitat and Flora at the Touquoy Mine Site.

The LAA includes a 2 km buffer on the FMS Study Area (Figure 6.9-3). This area encompasses the maximum expected extent of the Project direct and indirect impacts to habitat and flora.

The RAA encompasses a portion of Ecodistrict 440 constrained in the east by the boundary of the Liscomb Game Sanctuary, and west by the western edge of Lake Alma (Figure 6.9-3). The RAA was extended north of the FMS Study Area to incorporate the entirety of the Liscomb Game Sanctuary and as such encompasses this portion of Ecodistrict 450. These Ecodistrict portions span an area broader than the expected Project impacts to habitat and flora and considers other Project boundaries as per cumulative effects methodology.

Assessment of habitat and flora will be completed in consideration of the LAA as the primary spatial boundary. All spatial boundaries will help to identify the direct or indirect impacts to flora and habitat and the effects of the Project on distribution and abundance of these species.

6.9.5.1.2 *Temporal Boundaries*

The temporal boundaries used for the assessment of effects to flora are the construction phase, operational phase, and active reclamation stage of the closure phase.

6.9.5.1.3 *Technical Boundaries*

No technical boundaries were identified for the effects assessment of habitat and flora.

6.9.5.1.4 *Administrative Boundaries*

There are no administration boundaries (specific legislation) that guided the evaluation of flora and habitat for this EIS.

6.9.5.2 Interior and Old Forest Desktop Analysis

A desktop GIS analysis was conducted to identify potential interior and Old Forest habitat in relation to Project infrastructure. The NSDNR Old Forest Policy 2012 (NSDNR 2012a) definition of interior forest and Old Forest were used to determine these habitat types.

Interior forest is defined as an area within a forest sheltered from edge effects. These forests provide suitable habitat for interior bird species, wildlife, and epiphytic lichens that are sensitive to fragmented habitats. The Old Forest Policy uses an edge effect distance of 200 meters from disturbance to define interior forest condition. Any patch that is suitably outside of this edge effect and over 15 ha is considered as capable of supporting interior forest. In reality, interior forest is dependent on the condition being measured and the nature of the edge interface (NSDNR 2012a).

To simulate current conditions, the NSTBD Roads and Railroads layer and polygons from the NS Forest Inventory layer classified as: clearcut, urban, agriculture, gravel pit, misc. (non-forest), Christmas trees, and gravel pit were buffered by 200 m to represent existing anthropogenic disturbance and associated edge effect. Patches of potential interior forest within the LAA were then identified as any polygon outside this existing disturbance and edge effect, excluding open water/lakes, and greater than 15 ha. Based on visual review using aerial imagery, this method yields a relatively representative prediction of potential interior forest availability, though it overestimates in areas where new clearcuts have not been updated in the forestry inventory layer.

Old Forest is defined as a stand or collection of stands containing old growth and/or mature climax conditions (NSDNR 2012a). Mature climax is a forest stand of trees aged 80 to 125 years old and old growth forest is a stand with trees 125 years or older, with at least half of the basal area composed of climax species, and the total crown closure is a minimum of 30%. Stands of Old Forest were identified using the NS Old Forest Layer. This dataset identifies crown land forest stands that meet the Old Forest criteria under the Old Forest Policy. (Open Data Nova Scotia 2016).

To determine potential Project impact on interior forest and Old Forest, Project infrastructure was buffered by 200 m to represent the extent of edge effect influence from its operational footprint. This area was referred to as the maximum Project edge effect.

6.9.5.3 Thresholds for Determination of Significance

A significant adverse effect from the Project on flora and habitat is defined as an effect that is likely to cause a permanent, unmitigated, alteration to habitat that supports flora species distribution. An adverse effect that does not cause a permanent alteration of habitat is considered to be not significant. Significance criteria related to impacts to flora SAR and SOCI are presented in Section 6.12.

The following logic was applied to assess the magnitude of a predicted change in flora and habitat:

- Negligible – no measurable change in flora communities or habitat;

- Low – the Project results in loss of habitat, within natural variation (considering ongoing anthropogenic disturbance regimes), and the loss of habitat is mitigated in the long term through reclamation planning and other mitigation measures as determined to be necessary based on flora species and communities present;
- Moderate – the Project results in loss of habitat, above natural variation (considering ongoing anthropogenic disturbance regimes), and the loss of habitat is mitigated in the long term through reclamation planning and other mitigation measures as determined to be necessary based on flora species and communities present; and,
- High – the Project results in loss of habitat, above natural variation (considering ongoing anthropogenic disturbance regimes), and the loss of habitat is not mitigated in the long term through reclamation planning and other mitigation measures as determined to be necessary based on flora species and communities present.

The timing of residual effects for flora and habitats considers when the residual environmental effect is expected to occur, considering seasonal aspects. The duration of residual effects considers the time frame over which the effects are likely to last, ranging from short-term to permanent. For the purpose of the effects assessment related to habitat and flora, long term reflects the commencement of reclamation activities. The frequency of residual effects considers the rate of recurrence of the effects, ranging from once to continuous. The reversibility of residual effects considers the time required for habitat to recover to naturalized conditions, or whether the changes to habitat, if identified, are permanent.

6.9.6 Project Activities and Habitat and Flora Interactions and Effects

Within the FMS Study Area, there are expected flora and habitat interactions to occur during the different stages of the FMS Mine Site. Potential flora and habitat interactions within the Project activities in the FMS Study Area are summarized in Table 6.9-5.

Table 6.9-5: Potential Flora and habitat Interactions with Project Activities in the FMS Study Area

Project Phase	Duration	Relevant Project Activity
Site Preparation and Construction Phase	1 year	• Clearing, grubbing, and grading • Topsoil, till and waste rock management • Watercourse and wetland alteration • Seloam Brook Realignment construction and dewatering • Mine Site road construction, including lighting • Surface infrastructure installation and construction, including lighting • Collection ditch and water management pond construction, including lighting • Local traffic bypass road construction • Culvert and bridge upgrades and construction • General waste management

Project Phase	Duration	Relevant Project Activity
Operations Phase	7 years	• Open pit dewatering • Tailings management • Dust and noise management • Petroleum products management • Environmental monitoring • General waste management
Closure Phase: Reclamation Stage	2-3 years	• Site reclamation activities • Environmental monitoring • General waste management

The development of the FMS Mine Site will cause direct impacts to habitat and flora, including upland forested and wetland habitats, resulting in direct loss and fragmented habitat. These disturbances are expected to occur primarily during the construction phase of the Project.

6.9.6.1 Old Forest and Interior Forest Desktop Analysis

There are no Old Forest polygons in the Old Forest Layer present within the Habitat and Flora LAA.

The LAA is covered with a network of roads, historical mining and forestry activities, and forestry trails creating a largely disturbed forest landscape. Figure 6.9-4 shows the extent of the simulated existing disturbance and edge effect largely covering the majority of the LAA. A total of 2372 ha of predicted interior forest has been identified within the LAA. Project infrastructure, as signified as the maximum Project edge effect in Section 6.9.5.2, will affect 275 ha of interior forest habitat, which accounts for 12% of predicted interior forest in the LAA.

The two largest patches of potential interior forest are located in the east and southeastern portion of the LAA around Moser Lake and in the Toad Fish Wilderness Area. These patches contain contiguous forested habitat and could provide a means of wildlife movement, migration, breeding bird habitat and flora and fauna habitat. Maximum Project edge effect is predicted to impact predicted interior forest near the Seloam Brook Realignment, the eastern local traffic bypass road and TMF, and southern area of the plant and ancillary building footprint. Much of the area of predicted impact near the bypass road and TMF look to be cut over on aerial imagery and could be an overestimate in the analysis due to the lack of recent cutting in the GIS data layer. It is expected that the results of this fragmentation on flora and habitat to be minimal.

The interface between two or more habitats (i.e., forest and cleared area) affects different taxa differently (NSDNR 2012b). As a result, analysis of the effects of interior forest loss on different species has been completed for fauna, avifauna and associated SAR/SOCI (refer to Sections 6.10, 6.11 and 6.12).

6.9.6.2 Direct and Indirect Project Impacts to Habitat and Flora

Development of the FMS Mine Site will result in direct impacts to vascular and non-vascular individuals and to flora communities at the full or partial forest stand level. The effects of the Project on flora encompass vascular and non-vascular flora in wetland, and upland habitats. As such, many of the effects described in Section 6.7 specific to wetland habitat will directly relate to effects on flora.

Details relating to effects on priority flora species are provided in Section 6.12. The majority of direct mortality to flora will occur during site preparation and construction.

The Project activities have the ability to indirectly affect flora in the construction, operational, and active reclamation stage of the closure phases of the Project. The vast majority of Project interactions with flora will occur during construction, specifically during clearing, grubbing, and grading. Indirect impacts could include altered hydrology as a result of activity (including dewatering) in close proximity to wetland habitat; erosion and sedimentation from Project activities; dust accumulation on vegetation smothering and stressing plants; accidental spills involving deposition of a deleterious substance, including fuel oil, lubricants, or engine oil, and impoundment of up-gradient wetlands if inadvertent dams are built as part of the mine development (e.g., roads can act as dams if not constructed properly to maintain water flow).

Movement of equipment during site preparation, operation, and maintenance can result in deposition of dust on vegetation within close proximity of roads when conditions are dry. This affects flora through the deposition of dust on leaves, which temporarily reduces evapotranspiration and photosynthesis. Over time this may reduce overall growth rates. Dust is predicted to meet criteria at the proposed property boundaries for the FMS Mine Site. This will be achieved through twice daily application of water on site roads within the FMS Mine Site property boundaries during dusty times, with the exception of the main road from the plant to the pit, and the plant to Highway 374, which will both require 75% mitigation through the expected use of chemical dust suppressants.

Indirect impacts to native plant communities include the potential for introduction of invasive species. Seeds and roots of invasive species can be transferred from construction equipment, transportation vehicles, or workers (footwear and clothing) into adjacent habitat during construction and operational activities. Introduction of invasive species can occur when equipment or people enter vascular plant communities, or indirectly via runoff or dust from the roads. Invasive species, such as purple loosestrife (*Lythrum salicaria*), can severely degrade habitat quality and outcompete many native species, particularly along roadsides.

Direct and indirect impacts of the Project on habitat and flora are summarized in Table 6.9-6.

Table 6.9-6: Direct and Indirect Impacts on Habitat and Flora

<table>
<tr><th>Impact Type</th><th>Direct Impact</th><th>Project Phase</th><th>Indirect Impact</th><th>Project Phase</th></tr>
<tr><td rowspan="3">Vegetative and habitat integrity</td><td>Direct loss of individual vegetation (vascular and non-vascular) and the habitats which support them. In some cases, whole forest stands (upland and wetland) will be removed.</td><td>C</td><td>Hydrologically connected upstream wetlands may also be at risk of indirect impacts as a result of downstream alteration activities (e.g., water outflow changes, land elevation changes, blasting, etc. causing dewatering). Inadvertent damming of up-gradient wetlands from construction related infrastructure (e.g., roads with lack of flow through infrastructure).</td><td>C, O, CL</td></tr>
<tr><td rowspan="2">Extensive ground works, including activities such as blasting in and adjacent to wetlands has the potential to destabilize land surfaces and the root zone of vegetative areas, including wetland buffers.</td><td rowspan="2">C, CL</td><td>Introduction of invasive species can occur indirectly into wetlands when equipment or people move around the PA or via runoff or dust from the roads. Invasive species, such as purple loosestrife (Lythrum salicaria), can severely degrade wetland habitat and function.</td><td>C, O, CL</td></tr>
<tr><td>Dust accumulation on vegetation can smother and stress plants and provide minerals and nutrients into the wetland habitat.</td><td>C, O, CL</td></tr>
</table>

Note: C = Construction Phase; O= Operation Phase; CL= Closure Phase

6.9.7 Mitigation

To mitigate and reduce overall loss of function of habitat used by flora, the actions provided in Table 6.9-7 will be implemented by the Proponent where direct impacts and potential indirect impacts to flora and habitat are expected. Mitigation measures will be confirmed through monitoring requirements, as described at the permitting stage through the IA. The following actions will be implemented where direct loss of habitat is expected to support the development of the FMS Study Area:

- 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);
- Topsoil will be salvaged and stored for use in site restoration where practicable. Upland and wetland soils will be stockpiled separately;
- Where natural, intact habitat cannot be avoided, minimization of total Project footprint will be considered during detailed planning;
- Erosion and sediment control planning will be completed to ensure site runoff is not directed towards unaltered habitat where practicable to ensure existing drainage patterns are maintained;
- The effect of dust accumulation on adjacent undisturbed vegetation can be mitigated by monitoring dust conditions and when normal precipitation levels are not enough to suppress fugitive dust, water trucks and chemical dust suppressants will be used to suppress dust. This reduces potential impact on flora and improves safety and visibility for other vehicular traffic as well;
- Winter road maintenance will include conventional snow clearing and deposition of sand for traction control where necessary;
- Site haul trucks will be equipped with spill kits and instructed on their use and spill prevention and appropriate site personnel will be trained in spill isolation, containment, and recovery;
- A wetland alteration application will be submitted during Project planning and design to request an authorization to alter wetland habitat. Loss of function will be addressed in this wetland alteration application; and,
- Compensation for permanent loss of wetland habitat will be completed through wetland restoration activities to support no net loss of wetland function, subject to NSE approval.

Project activities will result in direct mortality of vascular and non-vascular flora within the FMS Study Area in both upland and wetland habitat. Compensation, mitigation, and monitoring programs for vegetation related to wetland habitat are described in Section 6.7. The long-term reclamation and remediation will involve re-vegetation of the FMS Study Area at the end of the life of the mine. Revegetation will involve establishment of native vegetation communities. Stockpiled soils will be used in reclamation efforts. This soil will contain a seedbank of native species to increase the establishment of native communities.

Table 6.9-7: Mitigation for Habitat and Flora

Project Phase	Mitigation Measure
C, O	Develop and Implement Erosion Prevention and Sediment Control Plan to support the EMS Framework Document (Appendix L.1)
C, O	Maintain existing vegetation cover whenever practicable and minimize overall areas of disturbance
C, O	Avoid frequent or unnecessary travel over erosion prone areas through communication with personnel and project planning
C, O	Conduct vegetation management by cutting (e.g., no use of herbicides)
C, O	Implement construction methods that reduce the potential to drain or flood surrounding wetlands
C, O	Employ measures to reduce the spread of invasive species (such as cleaning and inspecting vehicles) to maintain the quality of remaining habitat
CL	Hydroseed areas that have erosion potential to return the area to pre-disturbance and stable conditions in a timely fashion upon final reclamation
CL	Implement reclamation program within the FMS Study Area to re-establish native vegetation communities

Note: C= Construction Phase O= Operation Phase CL= Closure Phase

6.9.8 Residual Effects and Significance

The predicted residual environmental effects of Project development and production on habitat and flora are assessed to be adverse, but not significant (Table 6.9-8). The overall residual effect of the Project on habitat and flora is assessed as not significant after mitigation measures have been implemented.

Table 6.9-8: Residual Environmental Effects for Habitat and Flora

Project - VC Interactions	Mitigation and Compensation Measures	Nature of Effect	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect
			Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility		
Construction of FMS Mine Site Clearing and grubbing	Limit habitat disturbance and minimize Project footprint during detailed design, sediment and erosion control, re-establish habitat and associated vegetation communities during reclamation	A	M VC interaction causes direct loss of habitat and flora	PA VC interaction is confined to the PA	N/A VC is not expected to be affected by timing	LT Effects occur beyond 7 years when reclamation activities commence	O VC interaction will occur once	PR Reclamation cannot guarantee a return to baseline conditions	Habitat Loss	Not Significant
Operations and Reclamation Stage of Closure – FMS Mine Site Heavy machinery operation, vehicle activity	Monitor dust conditions on roads in periods with low rain. Sediment and erosion control. Dust mitigation Practice spill preparedness	A	L Small changes relative to baseline conditions in remaining habitat	PA VC interaction is confined to the PA	N/A VC is not expected to be affected by timing	MT VC interaction will occur between 1 year and 7 years	R VC interaction will occur regularly	R VC will recover to baseline conditions before or after the Project activities have been completed	Disturbance	Not Significant
Reclamation Stage of Closure– FMS Mine Site Re-vegetation using stockpiled materials	N/A	P	L Negligible change from baseline conditions	PA VC interaction is confined to the PA	N/A VC is not expected to be affected by timing	LT Effects occur beyond 7 years	O Effects occur once during the reclamation stage	PR Reclamation cannot guarantee a return to baseline conditions	Habitat restoration	Not significant

Legend (refer to Table 5.10-1 for definitions)

Nature of Effect	Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility
A Adverse	N Negligible	PA Project Area	N/A Not Applicable	ST Short-Term	O Once	R Reversible
P Positive	L Low	LAA Local Assessment Area	A Applicable	MT Medium-Term	S Sporadic	IR Irreversible
	M Moderate	RAA Regional Assessment Area		LT Long-Term	R Regular	PR Partially Reversible
	H High			P Permanent	C Continuous	

A significant adverse environmental effect for habitat and flora has not been predicted for the Project for the following reasons, with consideration of the ecological and social context of the LAA surrounding the Project:

- During construction, direct impacts to habitat and flora will occur. However, these impacts are limited to the construction phase.
- During operations, indirect impacts to habitat and flora will be reduced through erosion and sediment control measures and dust mitigation.
- During closure, reclamation will allow for site restoration of a native assemblage of plant communities.

6.9.9 Proposed Compliance and Effects Monitoring Program

Habitat and flora monitoring programs will include the following, as well as additional monitoring as determined through discussions with regulatory agencies:

- In partially altered wetlands and selected additional representative wetlands, baseline monitoring measurements and observations will be completed prior to wetland alteration activities taking place so that comparisons with post alteration conditions can be ascertained. Proposed wetland monitoring is described in Section 6.7.

Proposed follow-up and monitoring programs have been reviewed with the Mi'kmaq of Nova Scotia during engagement efforts including meetings, sharing of technical documents (Draft EIS, poster boards, Summary of Mi'kmaq Effects and Proposed Mitigation Measures, Plain Language Summary). On-going engagement with the Mi'kmaq will continue through the EA process and associated permitting relating to follow-up programs and monitoring.

6.10 Terrestrial Fauna

6.10.1 Rationale for Valued Component Selection

Terrestrial fauna, and the habitat upon which they rely, may be altered either directly or indirectly by proposed Project activities. While this valued component includes understanding the potential effects of the Project on all fauna, the specific survey methods are mainly driven by identification of SAR and SOCI.

6.10.2 Baseline Program Methodology

6.10.2.1 FMS Study Area Baseline Program Methodology

Data collection on various fauna species occurred through a combination of targeted field surveys and incidental observations. Targeted surveys were completed for bats, mainland moose, and wood turtles. Incidental observations were recorded for all other fauna species including other mammals, reptiles and amphibians, and invertebrates (including freshwater molluscs, lepidopterans, and odonates). The goal of both targeted surveys and incidental observations was to understand which species are present within the FMS Study Area and how they are using the FMS Study Area to allow for a discussion of Project interactions, potential effects, and mitigation measures.

Incidental observations of mammals and various signs of mammals across the FMS Study Area were documented and photographed during all field surveys. Signs included features such as dens and nests, scat, tracks, and forage evidence. Mammal observations were collected throughout the field seasons in 2017-2019. Incidental observations for priority invertebrates occurred during all field programs, particularly wetland and watercourse delineation, and fish habitat surveys. Other than surveys associated with the mainland moose and potential bat hibernacula (e.g., AMOs) described in the following sections, no targeted mammal surveys were undertaken. Given that mainland moose have large home ranges, moose surveys were completed within and outside of the FMS Study Area to provide additional regional survey effort. The mainland moose surveys conducted outside of the FMS Study Area can be used as reference sites post-construction. Terrestrial fauna methods for mainland moose and wood turtle surveys are outlined in Section 6.12.2.2.

An initial habitat assessment was completed throughout the FMS Study Area in June 2017. The desktop evaluation confirmed that the FMS Study Area is located within a mainland moose concentration area, within the Liscomb Game Sanctuary, and identified the presence of AMOs which could provide bat hibernacula habitat (see Figure 2.1-3 for AMO locations). The desktop evaluation confirmed that the FMS Study Area does not contain wood turtle critical habitat or known bat hibernacula.

This initial assessment combined with a desktop analysis generation of the priority species list and review of the Environmental Screening and ACCDC (Appendix G.5 and G.7), determined that additional specialized surveys (i.e., in addition to those mentioned above) for priority fauna species would not be required within the FMS Study Area. Information on mammal species potentially present within the FMS Study Area was derived from a number of sources, such as NSL&F's Significant Species and Habitats Database GIS mapping, the priority species list, the ACCDC and Environmental Screening reports, Tracking and the Art of Seeing (Rezendes 1999), and personal knowledge of the MEL ecologists. Figure 6.10-1 identifies field methods for Terrestrial Fauna.

6.10.2.2 Touquoy Baseline Program Methodology

Field surveys for terrestrial fauna were conducted concurrently with vegetation, birds and wetland surveys from 2004-2006 (CRA 2007a). Refer to the Touquoy Gold Project EARD for detailed methodology. A mainland moose monitoring program has been implemented at the Touquoy Mine Site, along with a Wildlife Management and Monitoring Plan (WMMP) for the Touquoy Gold Project. The mainland moose program includes post-construction surveys for mainland moose, and both plans require any observations of wildlife species (particularly priority species and those which pose a safety concern) to be reported to the site Environmental Technician.

6.10.3 Baseline Conditions

6.10.3.1 FMS Study Area Baseline Conditions

6.10.3.1.1 *Mammals*

Incidental observations of mammal species were documented during all field surveys during 2017-2019 across the FMS Study Area. Specific focus was given to priority species identified as having appropriate habitat within the FMS Study Area. Table 6.10-1 lists those species that were confirmed within the FMS Study Area either visually or by sign (scat, footprints, etc.).

Table 6.10-1: Confirmed mammalian species during 2017, 2018 & 2019 field surveys

Common Name	Scientific Name	Sign Observed	COSEWIC, SARA, NSESA	S Rank
Mainland Moose	*Alces alces americana*	tracks, scat	NSESA Endangered	S1
American Black Bear	*Ursus americanus*	observed, tracks, scat, digs	-	S5
American Red Squirrel	*Tamiasciursus hudsonicus*	observed, tracks, middens	-	S5

Common Name	Scientific Name	Sign Observed	COSEWIC, SARA, NSESA	S Rank
Beaver	*Castor canadensis*	observed, tracks, dams, lodges, felled trees	-	S5
Bobcat	*Lynx rufus*	observed	-	S5
Coyote	*Canis latrans*	tracks, scat	-	S5
North American Porcupine	*Erethizon dorsatum*	observed, tracks, browse	-	S5
North American River Otter	*Lontra canadensis*	tracks	-	S5
Red Fox	*Vulpes vulpes*	tracks		S5
Short-tailed Weasel	*Mustela erminea*	tracks	-	S5
Snowshoe Hare	*Lepus americanus*	observed, tracks, scat	-	S5
Vole sp.	*Microtus sp.*	tracks/subnivium burrow	-	-
White-tailed Deer	*Odocoileus virginianus*	tracks, scat, browse	-	S5

Note: The ACCDC works with provincial and federal experts to develop rarity ranks (i.e. S-Ranks) for species in Nvova Scotia, as well as othe rother maritime provinces. See http://www.accdc.com/en/rank-definitions.html for more information. An S-rank of S5 means that the species is Secure – Common, widespread, and abundant in the province.

6.10.3.1.1.1 Mainland Moose

Mainland moose have been recorded within 12.7 km of the FMS Study Area (ACCDC). According to NSL&F regional biologist Jolene Laverty, 19 observations of moose have been recorded in the vicinity of the Liscomb Game Sanctuary since 2014. Observations curated by NSL&F include visual observations of cows, bulls and calves, as well as tracks, vocalizations and pellets, several of which were recorded within 2018 (pers. comm., Jolene Laverty, February 2019). Tracking surveys were completed by MEL for the purpose of determining the presence of moose within and surrounding the FMS Study Area as per methodology described in Section 6.12.

Twenty-eight observations of mainland moose were documented within, and adjacent to the FMS Study Area through baseline environmental work completed in 2017, 2018 and 2019 (24 pellet piles and 4 track observations). Of the 28 observations, four were located outside of the current FMS Study Area (Figure 6.10-1). Data recorded outside of the FMS Study Area are included in this report along with observations recorded within the FMS Study Area because they are relevant on a regional scale and can act as post-construction control sites. These observations were recorded during targeted winter track surveys and spring Pellet Group Inventory (PGI) surveys (N = 3), however most were incidental observations recorded during botany, wetland, fish and bird surveys. No other mainland moose signs were observed during either targeted or incidental surveys within the FMS Study Area. These findings will be discussed further in Section 6.12.

6.10.3.1.1.2 Bats

According to the ACCDC reports, no known bat hibernacula are present within the FMS Study Area. The closest known bat hibernaculum is located in Glenelg Lake in an AMO, approximately 35 km north east of the FMS Study Area (Moseley 2007; EC 2015a).

Provincial government records of AMOs were reviewed within the boundary of the FMS Study Area, as AMOs could potentially provide bat hibernacula. Seventy-seven AMOs were assessed. Seventy-two AMOs were identified within the FMS Study Area and five were identified within 5 km from the FMS Study Area boundary. A desktop review coupled with field visits in spring 2017 confirmed these AMOs within the FMS Study Area and surrounding areas do not provide suitable bat hibernacula habitat. The AMOs identified within and outside the FMS Study Area were evaluated for their potential to provide bat hibernacula on August 2nd and 3rd, 2017 and July 4th, 2018. Of the 77 AMOs assessed, all were either in-filled, contained a concrete cap blocking access, or were flooded. The locations of AMOs are shown on Figure 2.1-3.

6.10.3.1.2 *Herpetofauna*

Herpetofaunal species were inventoried within the FMS Study Area through both targeted searches of appropriate habitats and through incidental observations. Specialized survey methods used to identify wood turtles and their habitat are described in Section 6.12.

Species that have been observed, either directly or indirectly (through vocalizations, egg masses, cast snake skins, etc.) within the FMS Study Area during the various field programs completed throughout the site, (primarily wetland and watercourse assessments) are provided in Table 6.10-2.

Table 6.10-2. Herpetofauna species observed during 2017-2018 field surveys

Common Name	Scientific Name	S Rank
Common Garter Snake	*Thamnophis sirtalis*	S5
Eastern American Toad	*Anaxyrus americanus americanus*	S5
Smooth Greensnake	*Opheodrys vernalis*	S4
Green Frog	*Lithobates clamitans*	S5
Northern Leopard Frog	*Lithobates pipiens*	S5
Spring Peeper	*Pseudacris crucifer crucifer*	S5
Wood Frog	*Lithobates sylvaticus*	S5

Though not observed, it is likely that other common herpetile species use habitat within the FMS Study Area, at least periodically. These species include mink frog (*Rana septentrionalis*), pickerel frog (*Rana palustris*), yellow-spotted salamander (*Ambystoma maculatum*), northern red-bellied snake (*Storeria occipitomaculata occipitomaculata*), and northern ring-necked snake (*Diadophis punctatus edwardsii*).

The snapping turtle (*Chelydra serpentina*, SARA Special Concern, NSESA Vulnerable, S3) was not observed within the FMS Study Area. Although no observations of snapping turtle were recorded, suitable habitat was observed, and ACCDC has documented their presence within 17 km of the FMS Study Area.

6.10.3.1.3 *Invertebrates*

A review of the Maritime Butterfly Atlas (square 20NQ39) and records provided by Odonata Central was completed. No observations were recorded within or adjacent to the FMS Study Area by Odonata Central. The results of the desktop evaluation indicated that the Maritime Breeding Bird Atlas (MBBA) recorded 49 observations of 19 species within Square 20NQ39. Three field evaluations were completed between mid-July and mid-August 2017. Dr. Ken McKenna completed a non-standardized area search within the FMS Study Area to complete surveys in accordance with the Maritime Butterfly Atlas methods. The goal of field evaluations for butterflies was to identify usage of the FMS Study Area by monarch butterflies (*Danius plexippus*, NSE and SARA Special Concern, S2B). Incidental observations for this species and its host breeding species (milkweed, *Asclepias syriaca)* were recorded through all field studies. Site visits were planned to identify the highest diversity of species, recognizing that flights for each species can be quite variable. Observations of odonates and lepidopterans included live adults or larvae, or cast skins observed incidentally during all biophysical surveys, and during focused lepidopteran surveys completed in 2017. Signs of molluscs included live or dead individuals, or shells. The results of the field and desktop evaluations for butterflies are included in Table 6.10-3.

Table 6.10-3. Desktop and Field Results of Butterfly Surveys completed within the FMS Study Area.

Family	Common Name	Scientific Name	SRank	Square 20NQ39	Field
Skippers	Arctic Skipper	*Carterocephalus calaemon*	S5	1	
	European Skipper	*Thymelicus lineola*	SNA - Exotic	2	
	Long Dash Skipper	*Polites mystic*	S5	4	
	Peck's Skipper	*Polites peckius*	S5	6	1
	Tawny-edged Skipper	*Polites Themistocles*	S5	3	
	Hobomok Skipper	*Poanes hobomok*	S5	1	1
	Dun Skipper	*Euphyes vestris*	S5	4	6
Pierids	Mustard White	*Pieris oleracea*	S4	1	
	Cabbage White	*Pieris rapae*	SNA – Exotic	3	1
	Orange Sulphur	*Colias eurytheme*	S5B	2	
	Clouded Sulphur	*Colias philodice*	S5	2	
Lycaenids	Eastern Tailed-blue	*Cupido comyntas*	S3?	1	
	Northern Spring Azure	*Celastrina lucia*	S5	1	
Nymphalids	Atlantis Fritillary	*Speyeria atlantis*	S5	5	1
	Great Spangled Fritillary	*Speyeria cybele*	S5	6	5
	Silver-bordered Fritillary	*Boloria selene*	S5	1	
	Northern Crescent	*Phyciodes cocyta*	S5	4	1
	Common Ringlet	*Coenonympha tullia*	S5	1	
	Common Wood-nymph	*Cercyonis pegala*	S5	1	

Family	Common Name	Scientific Name	SRank	Square 20NQ39	Field
	Northern Pearly-eye	*Lethe anthedon*	S4		1
	Painted Lady	*Vanessa cardui*	S4B		1

Overall, diversity and abundance of butterfly species observed was relatively low. According to Dr. McKenna, the site lacked the abundance of flowering plants and old field habitat required to support a diversity of butterfly species. No suitable host plant communities for monarch butterflies were observed during biophysical surveys completed within the FMS Study Area from 2017-2019. No incidental observations of freshwater molluscs were recorded during aquatic surveys. Results of benthic invertebrate surveys are presented in Section 6.8.3.1.8.

During the biophysical surveys within the FMS Study Area, seven additional invertebrates were observed, none of which were priority species as presented in Table 6.10-4.

Table 6.10-4: Incidental Invertebrate Observations at FMS Study Area

Family	Common Name	Scientific Name	SRank
Acronictinae	Fingered Dagger Moth	*Acronicta dactlylina*	SU
Calopterygidae	Ebony Jewelwing	*Calopteryx maculata*	S5
Coenagrionidae	A damselfly	*Enallagma sp.*	N/A
Gomphidae	Lancet clubtail	*Gomphus exilis*	S5
Libelluidae	Meadowhawk sp.	*Sympetrum sp.*	N/A
	Cherry-faced Meadowlark	*Sympetrum* cf. *internum*	S5
Tipulidae	A Crane fly	*Tipula sp.*	N/A

6.10.3.1.4 *Summary of Fauna and Habitat within the FMS Study Area*

The variety of both upland and wetland habitats identified throughout the FMS Study Area support a range of terrestrial fauna. The FMS Study Area is located in a relatively remote, undeveloped landscape. Timber harvesting and associated forestry roads form the dominant land use pattern and disturbance regime within the FMS Study Area and the surrounding landscape. This land use within and surrounding the FMS Study Area has created edge habitats and openings in the canopy coverage to provide foraging opportunities for species such as white-tailed deer, black bears, and coyote. Evidence of these species, along with snowshoe hare and porcupine, were abundant in disturbed habitats throughout the FMS Study Area. Beavers and evidence thereof have been observed in Seloam Lake and occasionally along Seloam Brook. All of the mammal species identified within the FMS Study Area are presumed to use parts of the site for foraging, breeding, denning, and raising young, at least periodically.

Herpetofauna species were observed throughout the FMS Study Area, generally in association with an aquatic ecosystems, such as wetlands, waterbodies, and watercourses. Open-water wetlands (such as those present along Seloam Brook) and wetlands experiencing hydrological alterations (via existing roads, blocked culverts, old mining activities) provide breeding and foraging habitat for many of Nova Scotia's herpetofauna species within the FMS Study Area.

Incidental sightings of fauna were recorded during all field programs throughout the FMS Study Area during all seasons. Aside from mainland moose tracks and pellets, no priority terrestrial fauna species or signs thereof were observed. Given the mobility of fauna species, the absence of observation does not confirm absence of the species within the FMS Study Area. The size of a species and a species' behavior can result in a bias against detection. For instance, very small species, such as the maritime shrew (*Sorex maritimensis,* S3) and the rock vole (*Microtus chrotorrhinus,* S2) were not observed within the FMS Study Area. As another example, the fisher (*Pekania pennant,* S3) is a largely nocturnal hunter, with large home ranges and elusive behavior. They prefer dense, mature to over-mature coniferous stands with large hollow snags for den sites. Their preferred habitat and prey items (porcupine, rabbits, squirrels and other small mammals) are present within the FMS Study Area. The lack of observed evidence of fisher does not confirm absence of the species. Furthermore, weather conditions can affect the detectability of species. Rain or snow can wash away or cover animal tracks and scat, while temperature affects the activity levels of herpetofauna and, therefore, their detectability. When there is a thermal advantage to staying under water or immersed in wetland vegetation, herpetofauna can be more difficult to detect, compared with warmer days when they can be found basking in the sun.

6.10.3.2 Touquoy Mine Site Baseline Conditions

Since the completion of the Touquoy Gold Project EARD and Focus Report, ACCDC status ranks and listings under the NSESA and SARA have been revised. Species identified in the Touquoy Gold Project EARD and Focus Report were reviewed for revised rankings with ACCDC, NSESA and SARA listings and are discussed in Section 6.12.

6.10.3.2.1 *Mammals*

6.10.3.2.1.1 Mainland Moose

Mainland moose tracks were observed within the Touquoy Mine Site in a bog during field surveys to support the Touquoy Gold Project EARD in 2006. Moose are known to the Tangier Grand Lake Wilderness Area, and evidence of moose is reported every year by NSL&F in the Moose River Gold Mines area during deer pellet surveys (CRA, 2007a).

A Post-Construction Moose Monitoring Program for mainland moose has been underway in lands surrounding the Touquoy Mine Site during winter and spring in 2017 and 2018. Surveys are ongoing throughout 2020 and include a combination of winter tracking surveys and spring pellet group inventory surveys. Surveys are completed on foot along transects surrounding the Touquoy Mine Site throughout a diversity of habitat types. During surveys, moose observations are recorded including a description of moose sign observed, a GPS location and a microhabitat assessment. Three sightings of moose were encountered during 2017, and two sightings of moose were encountered during 2018 surveys. Annual reports have been provided to NSL&F as per the Touquoy Gold Mine IA conditions.

6.10.3.2.1.2 Bats

According to CRA (2007a), NSL&F has extensively surveyed more than 100 AMOs mapped in close proximity to the Touquoy Mine Site (within 500 m of the Moose River Gold Mines Provincial Park). The Touquoy Gold Project EARD determined that these openings are either blocked or filled with water, therefore, suitable habitat for bat hibernacula is not present.

6.10.3.2.2 *Herpetofauna*

No wood turtle or suitable habitat were observed within the Touquoy Mine Site during wood turtle habitat surveys conducted in 2004 (CRA 2007a). No snapping turtles were recorded within the Touquoy Mine Site during the EARD process, however, on June 26th, 2016 a snapping turtle was observed within the LAA, north of the Touquoy Mine Site, on Moose River Road. From June 19th to mid-July, 2017 two snapping turtles were observed by MEL staff. One was found along Moose River Road, at the location identified above. The second snapping turtle was observed on Higgins Mines Road, west of the PA but within the LAA.

A WMMP was implemented upon commencement of operations of the Touquoy Mine Site. Under this Plan, wildlife sightings, particularly turtles, were reported to the site Environmental Technicians. Between June 19th and 27th, 2017, nine observations of Snapping Turtles were recorded by Touquoy Gold Project staff and contractors at various locations throughout the Touquoy Mine Site, typically in close proximity to the Moose River.

6.10.4 Consideration of Engagement and Engagement Results

Key issues raised during public and Mi'kmaq engagement relating to terrestrial fauna include potential effects on fauna from permanent loss of habitat associated with the footprint of the FMS Mine Site. Potential effects on traditional uses of land and resources by the Mi'kmaq were noted, including hunting and trapping of small game and deer.

The results of the public and Mi'kmaq engagement have been considered in the environmental effects assessment, including the Proponent's commitments on mitigation and monitoring measures and proposed compliance and effects monitoring programs, as well as the Proponent's broader commitment to ongoing public and Mi'kmaq engagement.

6.10.5 Effects Assessment Methodology

6.10.5.1 Boundaries

6.10.5.1.1 *Spatial Boundaries*

The spatial boundaries used for the assessment of effects to terrestrial fauna are the PA, LAA and RAA.

The PA consists of the Touquoy Mine Site, and the FMS Study Area (Figure 6.10-2).

The LAA consists of a 500 m buffer on the Touquoy Mine Site and a 2 km buffer on the FMS Study Area (Figure 6.10-2). The LAA boundaries were defined considering the maximum expected extent of direct and indirect impacts to terrestrial fauna.

The RAA encompasses a portion of Ecodistrict 440 constrained in the east by the boundary of the Liscomb Game Sanctuary, and west by the northern end of Lake Charlotte (Figure 6.10-2). The RAA was extended north of the FMS Study Area to incorporate the entirety of the Liscomb Game Sanctuary and as such encompasses this portion of Ecodistrict 450. These Ecodistrict portions span an area broader than the expected Project impacts to fauna and considers other project boundaries as per cumulative effects methodology.

Assessment of Terrestrial Fauna will be completed in consideration of the RAA as the primary spatial boundary. All spatial boundaries will help to identify the direct or indirect impacts to terrestrial fauna and the effects of the Project on distribution and abundance of these species.

6.10.5.1.2 *Temporal Boundaries*

The temporal boundaries used for the assessment of effects to terrestrial fauna are the Construction, Operations, and Closure phases.

6.10.5.1.3 *Technical Boundaries*

No technical boundaries were identified for the effects assessment of terrestrial fauna.

6.10.5.1.4 *Administrative Boundaries*

Administrative boundaries for management of terrestrial fauna includes the *Nova Scotia Wildlife Act* and regulations, specifically the *Sanctuary and Wildlife Management Area Regulations*. This Act and its regulations protect wild species diversity and abundance, particularly within the Liscomb Game Sanctuary which overlies the FMS Study Area. Furthermore, the *Canada Wildlife Act*, *Species at Risk Act* and *Nova Scotia Endangered Species Act* provide protection to terrestrial fauna.

6.10.5.2 Threshold for Determination of Significance

A significant adverse effect from the Project on terrestrial fauna is defined as an effect that is likely to cause a permanent, unmitigated, alteration to habitat that supports fauna species distribution.-An adverse effect that does not cause a permanent alteration of habitat is considered to be not significant. Significance criteria related to impacts to SAR and SOCI are presented in Section 6.12.

The following logic was applied to assess the magnitude of a predicted change in terrestrial fauna:

- Negligible – no measurable change in fauna communities or habitat;
- Low – the Project results in loss of habitat for terrestrial fauna, within natural variation (considering ongoing anthropogenic disturbance regimes), and the loss of habitat is mitigated in the long term through reclamation planning and other mitigation measures as determined to be necessary based on fauna species present;
- Moderate – the Project results in loss of habitat for terrestrial fauna, above natural variation (considering ongoing anthropogenic disturbance regimes), and the loss of habitat is mitigated in the long term through reclamation planning and other mitigation measures as determined to be necessary based on fauna species present; and,
- High – the Project results in loss of habitat for terrestrial fauna, above natural variation (considering ongoing anthropogenic disturbance regimes), and the loss of habitat is not mitigated in the long term through reclamation planning and other mitigation measures as determined to be necessary based on fauna species present.

The timing of residual effects for terrestrial fauna considers when the residual environmental effect is expected to occur, considering seasonal aspects. The duration of residual effects considers the time frame over which the effects are likely to last, ranging from short-term to permanent. For the purpose of the effects assessment related to terrestrial fauna, long term reflects the commencement of reclamation activities. The frequency of residual effects considers the rate of recurrence of the effects, ranging from once to continuous. The reversibility of residual effects considers the time required for habitat to recover to naturalized conditions, or whether the changes to habitat, if identified, are permanent.

6.10.6 Project Activities and Terrestrial Fauna Interactions and Effects

The assessment of potential adverse interactions and effects of the Project on this VC takes into account the potential for the Project to result in changes to:

- Permanent and temporary habitat alteration and fragmentation;
- Disturbance and/or displacement;
- Potential for direct and indirect mortality to individuals; and,
- Sensory disturbance.

6.10.6.1 FMS Study Area

The Table 6.10-5 below presents the potential interactions of the Project with terrestrial fauna within the FMS Study Area.

Table 6.10-5. Potential Terrestrial Fauna Interactions with Project Activities at FMS Study Area

Project Phase	Duration	Relevant Project Activity
Site Preparation and Construction Phase	1 year	• Clearing, grubbing, and grading; • Drilling and rock blasting; • Topsoil, till and waste rock management; • Watercourse and wetland alteration; • Seloam Brook Realignment construction and dewatering; • Mine site road construction, including lighting; • Surface infrastructure installation and construction, including lighting; • Collection ditch and water management pond construction, including lighting; • Local traffic bypass road construction; • Environmental monitoring; • General waste management.
Operations Phase	7 years	• Drilling and rock blasting to access and extract ore; • Ore management • Waste rock management; • Tailings management; • Surface water management; • Dust and noise management • Environmental monitoring; • General waste management,
Closure Phase: Reclamation Stage	2-3 years	• Site reclamation activities; • Environmental monitoring; • General waste management.

Development of the mine infrastructure at the FMS Study Area will cause direct impacts to habitat used by terrestrial fauna, including upland forested habitat and wetlands. This will occur mostly within the construction phase of the Project.

The current condition of the FMS Study Area includes a mosaic of intact habitat and disturbed or fragmented habitat, based on current and historic timber harvesting, and historic mining activity. The level of disturbance within the FMS Study Area disproportionately affects uplands over wetlands. Large, natural, undisturbed wetland and upland habitats do exist within the FMS Study Area, particularly to the northwest of the proposed pit and diversion berms, and in the area surrounding the proposed TMF (though the proposed TMF location itself is intersected with several forestry roads and trails). Timber harvesting is concentrated in the southern half of the FMS Study Area, where the WRSA is proposed, along with the access road, till stockpile and truck shop. Historic mining activities dominate the disturbance regime in and around the proposed pit, and a network of forestry roads and trails are present throughout the FMS Study Area.

The FMS Mine Site will have a total disturbed area of approximately 400 ha, consisting of the pit; WRSA; TMF; LGO stockpile; till stockpile; topsoil stockpiles; organic material stockpile; operational facilities; Seloam Brook Realignment; water management ponds and structures; potential borrow pit areas; access road; local road bypasses; powerline and mine site roads. LGO, till, topsoil, and organic material stockpiles will comprise approximately 51 ha during operations but are not anticipated to remain at the completion of the Project. This total disturbed area represents approximately 32% of the FMS Study Area, and 7% of the established LAA.

6.10.6.2 Habitat Fragmentation

Connectivity can be defined as the basic ecological requirement to be able to move freely within areas that provide critical functions for a species, and habitat fragmentation is the disturbance of this movement. Connectivity is critical for maintaining biodiversity and healthy species populations and interior forests are often an important feature that supports this movement (NSDNR, 2015b).

Road construction and other development can decrease habitat quality through direct habitat loss, degradation, and fragmentation (Underhill and Angold, 2000). For some species (e.g., porcupine), the construction can be beneficial by providing new foraging opportunities, while species that rely on interior forest conditions (e.g., fisher) are likely to avoid areas with new construction in favor of more undisturbed habitats. Local level changes in abundance and distribution of species may occur as the result of Project activities, but it is not anticipated than any of these changes will result in changes in overall fauna populations. While some direct loss of habitat will occur, the FMS Study Area is located in an undeveloped, natural landscape with a diversity of habitats. Habitat present within the FMS Study Area is not unique or rare in the local, regional or provincial context.

The methodology described in Section 6.9.5.2 was used to simulate current conditions for interior forest at the RAA level as a proxy for habitat availability and fragmentation, and wildlife movement. Road density has been identified as an excellent indicator of ecological integrity and potential predictor of habitat suitability for large mammals, like moose, as roads are closely correlated with human development (Snaith, Beazley, MacKinnon and Duinker 2002).

Mainland moose are particularly susceptible to habitat fragmentation as it constrains their movement and habitat use, while increasing other pressures like predator and human interference (Snaith, Beazley, MacKinnon and Duinker 2002). Snaith et al. (2002) found that road density had a significant negative correlation with the probability of mainland moose observations in Nova Scotia, and potentially more indicative of habitat selection than habitat composition alone. Interior forest patches as simulated in the analysis are inherently good proxy for good areas of cover and protection as they are isolated from edge effects.

Thermal protection of mature forest areas near forage producing areas and open water areas support mainland moose requirements without extensive travel, which allows for year round habitat (Snaith, Beazley, MacKinnon and Duinker 2002). The predicted interior forest simulation was completed at a course enough scale (i.e., - large anthropogenic disturbance vs. small scale forestry patch dynamics) that it encompasses a mix of forest age structures and wetland habitat and has not restricted access to open water.

The RAA is generally remote, with a moderate network of roads and forestry activity, though large tracts of forest landscape undisturbed by roads still exist in this region (NSDNR, 2015b). Figure 6.10-3 shows the extent of the simulated existing disturbance and edge effect and remaining predicted interior forest patches for the RAA. A total of 56,573 ha of predicted interior forest has been identified within the RAA. The maximum Project edge effect as discussed in Section 6.9.5.2, will affect 275 ha of interior forest habitat, which accounts for 0.49% of predicted interior forest in the RAA.

Project activities are expected to result in increased habitat fragmentation and a decrease in habitat quality for those species which rely especially on interior forest conditions. This decrease in habitat quality for species relying on interior forest condition is based on increased activity and sensory disturbance, along with increased physical fragmentation. Increase in physical fragmentation is expected to be low, based on the current high level of disturbed habitat and the limited Project edge effect impact to predicted interior forest patches. Moose tend to stick close to areas of protection and do not move more than 80 m to 200 m from cover avoiding large open areas (Eastman 1974, Hamilton et al. 1980, Tomm and Beck 1981, Peek et al. 1987, Jackson et al. 1991, Thompson et al. 1995 as cited in Snaith, Beazley, MacKinnon and Duinker 2002). Undisturbed, unfragmented habitat is present in the RAA, and the larger tracts are maintained around the FMS Mine Site, particularly on the south and eastern side. The FMS infrastructure footprint is situated primarily on an area of high existing disturbance and will only have fringe effects on the interior forest availability. There will be some limited isolation of habitat that is currently contiguous limiting some movement to this area particularly in the area between Seloam Lake and the TMF. However, broadly speaking, accessible routes to provide movement through and across the larger region at the LAA and RAA level still exist for wildlife and are un-impacted by the development of the Project.

The Ecological Landscape Analysis undertake by NSL&F in 2015 and updated in 2019 identifies valley corridors travelling north-south between the Sheet Harbour area and the New Glasgow area, generally following the Highway 374 and passing around and through the FMS Study Area. These linear corridors are typically dictated by physical features such as river valleys, and in this case follows the East River Sheet Harbour system (NSL&F 2019a). The Project has the potential to impact this corridor in particular between Fifteen Mile Stream and Seloam Lake, along Seloam Brook. This impact is predicted to be low as the predictive interior forest patches show good connectivity north and south of the FMS Mine Site and the Seloam Brook Realignment is planned to improve the habitat provided by this currently degraded and disrupted system.

6.10.6.3 Direct Mortality

Direct mortality of fauna species could result from Project activities, particularly due to the increase in traffic during construction and operation of the facility. Increased traffic poses a risk to wildlife along site haul roads.

According to Fahrig and Rutwinski (2009), road construction can have relatively high negative impacts on amphibians and reptiles, and large mammals, compared with small mammals and birds. Road infrastructure and traffic within the mine site can have a negative impact on those species which are attracted to roads but lack the speed or reaction time to avoid traffic (e.g., turtles attracted to gravel roadsides for nesting). Small mammals and birds, on the other hand, are able to avoid collisions with vehicles in general. Amphibians in particular can benefit from culvert installation where wetlands and watercourses intersect roads, as an alternative to crossing the roads, because this group can experience high mortality (Bouchard et al., 2009).

The risk of collisions within the FMS Study Area is expected to low, as the speed limit will be limited to 40 km/hr, giving both drivers and wildlife more reaction time to avoid collisions. While no obvious wildlife corridors were observed within the PA, it is anticipated that some wild species (e.g., herpetofauna) will use watercourses and wetland complexes as travel corridors, thereby increasing the risk of collisions with wildlife along these systems where they intersect with interior mining roads.

The risk of collisions with wildlife will vary depending on the season and the species. For instance, during winters with deep snow conditions, white-tailed deer are more likely to use roads and trails, putting them at an elevated risk of collisions. During spring and summer, porcupine and skunk forage on roadside vegetation at dawn and dusk, increasing the risk of collisions with those species, and turtles are drawn to the roadside to nest in the gravelly shoulders in June. As such, the risk of wildlife collisions is present at any time of year.

6.10.6.4 Sensory Disturbance

Sensory disturbance to terrestrial fauna would result from rock blasting, clearing and grubbing, infrastructure construction, lighting and operations, haul truck internal mine traffic, ore processing, tailings deposition and management, and overall increased traffic during operations. This will likely result in a localized wildlife avoidance of the FMS Study Area, particularly in close proximity to the site infrastructure/disturbed footprint. Overall, Project activities will likely cause a localized change in usage of the FMS Study Area by wildlife, with some species tending to avoid the area, while others may be attracted to the increased activity, including opportunistic species such as coyotes, raccoons, skunks, or black bears. Sensory disturbance related to Project activity will occur within the FMS Study Area, and within the Touquoy Mine Site, as the addition of material from the FMS mine will, in part, extend the life of the Touquoy Mine Site by seven years.

The overall (24 hr) L_{90} for the FMS Study Area is 25.9 dBA during assessments in 2019 and has been used in the noise model as the representative background noise level. The Environment Code of Practice for Metal Mines (EC 2012c) has established parameters for ambient noise levels for wildlife. These parameters indicate that ambient noise observed above 55 dBA during the day and 45 dBA at night can affect wildlife in a number of ways. Noise can simply act as a sensory disturbance resulting in avoidance. Noise can affect communication between individuals, including mating calls and alarm calls. Maier et al. (1998) and Flydal et al (2001) observed that sounds at 46 dBA and 60 dBA elicited responses in caribou and reindeer, respectively. While Drolet et al. (2016) report no changes to density of white-tailed deer when a simulated drilling noise was played at 55-65 dBC, a literature review conducted by Shannon et al. (2016) found that an increase in stress and decrease in reproductive success in terrestrial mammals has the potential to occur at noise levels ranging from 52 to 68 dBA. Levels from these studies are higher than those cited by Environment Canada (2012c). According to the results of the Noise Impact Assessment (Appendix J.1), noise measured at 45 dBA is predicted to travel not farther than 1.5 km from the FMS Mine Site property boundary only during operations (predicted worst case Project phase). Terrestrial fauna within this maximum approximate range of noise distribution surrounding the FMS Study Area have the potential to result in localized avoidance due to noise.

If blasting is required near fish-bearing watercourses or waterbodies, guidelines identified by Wright and Hopky (1998) will be provided to site personal and contractors and adhered to as part of the EPP.

Light propagation from the Project has been determined to extend between 0 and 2km from the FMS Mine Site Property Boundary. While research is limited and often species specific, in general, the plausible effects of artificial lighting on mammals (especially nocturnal mammals) may include disruption of foraging behavior, increased risk of predation, disruption of biological clocks, increased deaths in road collisions, and disruption of dispersal movements and corridor use. Some of these effects have also been observed, apart from artificial light, in correlation to moon cycles (Rich & Longcore, 2006). Within the FMS Study Area, light impacts on fauna will be reduced by installing lights facing downward and wherever practicable using motion-sensing lights.

6.10.6.5 Touquoy Mine Site

Table 6.10-6 presents the potential interactions of the Project with terrestrial fauna within the Touquoy Mine Site.

Table 6.10-6: Potential Terrestrial Fauna Interactions with Project Activities at the Touquoy Mine Site

Project Phase	Duration	Relevant Project Activity
Operations Phase	7 years	• Tailings management • Environmental monitoring; • General waste management.
Closure Phase: Reclamation Stage	2-3 years	• Environmental monitoring

The Project will have no new effects on terrestrial fauna at the Touquoy Mine Site.

It is expected there will be on-going lighting and noise and deposition of tailings from the FMS concentrate in the exhausted Touquoy pit. A bird deterrent program has been implemented at the Touquoy Project TMF to reduce avian interactions with the TMF and prevent them from using it as nesting habitat. This deterrent program involves a combination of auditory and visual deterrents. Two Bird Gard Super Pro Amps from Margo Supplies Ltd. are deployed at the Touquoy TMF. These auditory deterrent devices are equipped with an EPROM Chip which randomly broadcasts calls of 8 species of birds, either predatory birds or distress calls of non-predatory species. While this deterrent system is primarily focused on deterring birds from landing in the TMF, it can be effective for some terrestrial species as well. Currently, the Waterfowl Combination Chip is being used at the Touquoy TMF, and the Marine Combination Chip is available if personnel notice habituation of birds. The installation of reflective tape adds a visual component to this deterrent system. A deterrent system should also be considered post closure at the Touquoy Mine Site when the pit fills as tailing deposition will be present. This will deter wildlife from using the pit during and after filling which may have deleterious effects resulting from long-term exposure.

Sensory disturbance caused by noise and light will occur within the Touquoy Mine Site as a result of the extension of processing at the Touquoy Mine Site associated with the Project. The addition of FMS concentrate for processing at the Touquoy facility will extend the life of the Touquoy Mine Site by seven years and incorporate the deposition of FMS concentrate tailings into the Touquoy exhausted pit thus extending the temporal indirect sensory disturbance to wildlife. Increased traffic poses a risk to wildlife within the FMS Study Area and in the Touquoy Mine Site.

Since the completion of the EARD and focus report for the Touquoy Gold Project, ACCDC status ranks, and listings under the NSESA and SARA have been revised. The species identified in the EARD were reviewed and it was confirmed that there are multiple fauna species that have been added to the list since the submission of the EARD including but not limited to: little brown myotis (*Myotis lucifugus*); northern myotis (*Myotis septentrionalis*); and, tri-colored bat (*Perimyotis subflavus*). Also, multiple species of bees, the transverse lady beetle, and the monarch butterfly have been included on the NSESA. These species are not expected to experience Project interactions beyond what is expected in terms of interactions to the fauna community in general and discussed herein, relating to an extension of sensory disturbance at the Touquoy Mine Site.

6.10.6.6 Summary of Pre-mitigation Effects

The Project is expected to have several main pathways in terms of Project interactions with terrestrial fauna pre-mitigation. Project interactions found in Table 6.10-7 can be summarized by:

- Direct habitat loss and habitat fragmentation;
- Direct and indirect mortality through vehicular collisions; and,

- Sensory disturbance through increases in noise, light and vibration above background, particularly during site-preparation and operation phases of the Project, which could result in changes in wildlife patterns.

Table 6.10-7: Impacts of the Project on Fauna

Impact Type	Direct Impact	Project Phase	Indirect Impact	Project Phase
Habitat Integrity	Loss of vegetative cover decreases wildlife habitat availability and also has the potential to reduce natural surface water drainage.	C	Habitat fragmentation may alter habitat suitability for those species which rely on interior forest conditions.	C, O, CL
Direct Mortality	Increased traffic and general activity within the PA may result in direct mortality to wild species through vehicular collisions and construction, or through access to the pits prior to completion of pit filling.	C, O, CL	N/A	
Sensory Disturbance	Extensive ground works, including activities such as blasting will increase noise levels. Increase in vehicular traffic will add to sensory disturbance through increased noise. This has the potential to reduce habitat for fauna.	C, O, CL	Sensory disturbance (both lights and sounds) may result in further avoidance of the PA by some species.	C, O
	Project infrastructure will have lights which are operational at all times, which can alter habitat quality and sleep/wake cycles within the immediate vicinity of the PA. This may decrease efficiency of nocturnal hunters.	C, O	Some opportunistic wild species may be attracted to the site as a result of increased access and available food sources (natural prey or anthropogenic food sources), potentially increasing interactions between site personnel and wildlife.	C, O

Note: C= Construction Phase O= Operation Phase CL= Closure Phase

6.10.7 Mitigation

In order to mitigate and reduce overall loss of function of habitat used by terrestrial fauna, and reduce direct impacts on fauna, the following actions as described in Table 6.10-8 will be implemented where direct loss of habitat is expected to support development of the Project:

- 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);
- Where natural, intact habitat cannot be avoided, minimization of total Project footprint will be considered during planning;
- Site infrastructure will be fenced in, where practical and appropriate, to reduce interactions between Project infrastructure and wildlife;
- A speed limit of 40 km/hr within the FMS Mine Site and Touquoy Mine Site will be implemented to reduce likelihood of collisions with fauna;

- An un-vegetated buffer along roadsides will be maintained, where practicable, to improve visibility along roadsides and reduce the potential for collisions with wildlife;
- Clearing and construction will be limited within wetlands that could support snapping turtles during winter hibernation period;
- Site-specific measures to protect wildlife will be addressed in the WMMP which will be developed to support the EMS Framework Document (Appendix L.1);
- A wildlife deterrent system will be implemented at the FMS TMF, and continued at the Touquoy Mine SIte and should be implemented to the open pits from both sites during post-closure, as is required;
- Waste must be managed to reduce attractants to opportunistic wildlife species;
- Proper handling of hazardous wastes will reduce exposure to contaminants as a result of unplanned incidents;
- Erosion and sediment control planning will be completed to ensure site runoff is not directed towards unaltered habitat;
- For those species reliant on wetland habitat, a wetland alteration application will be submitted during Project planning and designed to request an authorization to alter wetland habitat. Loss of function and habitat will be addressed in this wetland alteration application, along with associated proposed compensation; and,
- Mainland moose monitoring program is to be implemented to determine moose activity surrounding the active FMS Mine Site.

Where direct impacts to habitat are not expected, the FMS Mine Site development and continued operations at the Touquoy Mine Site may be potentially affected by indirect impacts from construction, operation, and closure of the Project. The following actions will be implemented to reduce the potential for indirect impacts to adjacent undisturbed habitat:

- In order to protect adjacent habitats from accidental spills, ensure that spill control and contingency planning is in effect, and its procedures fully communicated to staff;
- Ensure all development related activity (construction areas, access roads, etc.) are located within areas where appropriate surveys have been completed and approvals/written authorizations are in place as required; and,
- Machinery and personnel will be instructed not to enter the habitats outside of approved Project footprint.

Table 6.10-8: Mitigation for Terrestrial Fauna

Project Phase	Mitigation Measure
C, O, CL	Provide wildlife awareness training to site personnel to reduce interactions between site personnel and wildlife
C	Reduce habitat fragmentation by minimizing new road construction wherever practicable
C	Complete detailed design of mine infrastructure to avoid major faunal habitat
C	Properly install culverts to improve or maintain habitat and connectivity for fauna
C, O	Maintain existing vegetation cover whenever practicable and minimize overall areas of disturbance

Project Phase	Mitigation Measure
C, O, CL	Develop and implement an Erosion Prevention and Sediment Control Plan in accordance with the EMS Framework Document (Appendix L.1)
C, O, CL	Implement Emergency Response and Spill Contingency Plans to protect fauna and their habitat from accidental spills
C, O	Store hazardous and non-hazardous waste in designated locations, in appropriate containers to reduce potential for spills, and to prevent attracting wildlife (e.g., food waste in bear proof containers)
C, O, CL	Vehicles will yield to wildlife on roads
C, O, CL	Implement speed limits within the FMS and Touquoy Mine Sites of 40 km/hr to reduce potential collisions with fauna
C, O, CL	Install signage where specific wildlife concerns have been identified
C, O	Install fencing, where practicable, to prevent wildlife from accessing areas with increased risk of injuries to wildlife
C, O	Monitor in and around site infrastructure for wildlife and if present work to relocate in accordance with the Wildlife Monitoring and Management Plan
C, O	Develop and implement Wildlife Monitoring and Management Plan in accordance with the EMS Framework Document (Appendix L.1)
C, O	Follow the *Pit and Quarry Guidelines* to reduce impact of noise and vibration on wildlife
C, O	Limit use of lights to the amount necessary to ensure safe operation within the FMS Study Area, with the recognition that excessive lighting can be disruptive to wildlife
C, O	Restrict blasting to a specific and regular daytime schedule during weekdays to allow time for wildlife to recover from potential noise disturbance
C, O	Implement bird and wildlife deterrent program at the FMS TMF and Touquoy during post closure
CL	Implement reclamation plans to restore natural habitat and food source re-establishment to support fauna

Note: C= Construction Phase O= Operation Phase CL= Closure Phase

6.10.8 Residual Effects and Significance

The predicted residual environmental effects of Project development and production on terrestrial fauna are assessed to be adverse, but not significant (Table 6.10-9). The overall residual effect of the Project on terrestrial fauna is assessed as not significant after mitigation measures have been implemented.

Table 6.10-9: Terrestrial Fauna Residual Effects

Project VC Interactions	Mitigation and Compensation Measures	Nature of Effect	Significance Criteria for Residual Environmental Effects						Residual Effect	Significance
			Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility		
Construction – FMS Mine Site Habitat loss and fragmentation from clearing and grubbing, sensory disturbance related to noise, light, dust deposition and vehicle collisions	Limit habitat disturbance and minimize Project footprint during detailed design, implement speed limits, install fences where necessary, and minimize lighting	A	M VC interaction causes direct loss of habitat for fauna	LAA Potential adverse effect to fauna outside of the PA	A VC interaction may affect seasonal aspects of fauna	MT Effects can occur beyond 12 months and up to 7 years	O Effects occur once during the construction phase	PR Mitigation cannot guarantee a return to baseline conditions	Loss of habitat	Not significant
Construction – FMS Mine Site Disturbance (noise, light, and wildlife vehicle collisions) from construction activities	Limit habitat disturbance and minimize Project footprint during detailed design, implement speed limits, install fences where necessary, and minimize lighting	A	L Minor change from baseline conditions	LAA Potential adverse effect to fauna outside of the PA	A VC interaction may affect seasonal aspects of fauna	ST Effects are limited to occur from as little as 1 day to 12 months	R Effects occur at regular intervals during the construction phase	R VC will recover to baseline conditions	Disturbance	Not significant
Operations and Closure – FMS Mine Site and Touquoy Mine Site Disturbance (light and wildlife vehicle collisions) from haul trucks and heavy machinery	Implement speed limits, install fences where necessary, and minimize lighting	A	L Minor change from baseline conditions	LAA Potential adverse effect to fauna outside of the PA	A VC interaction may affect seasonal aspects of fauna	MT Effects can occur beyond 12 months and up to 7 years	R Effects occur at regular intervals	R VC will recover to baseline conditions	Disturbance	Not significant
Reclamation –FMS Mine Site Re-establishment of habitat for fauna	N/A	P	L Minor change from baseline conditions	LAA Potential effect on fauna outside of the PA	A VC interaction may affect seasonal aspects of fauna	LT Effects can occur beyond 7 years	O Effects occur once during the reclamation phase	PR VC will recover to baseline condition	Habitat restoration	Not significant

Legend (refer to Table 5.10-1 for definitions)

Nature of Effect	Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility
A Adverse	N Negligible	PA Project Area	N/A Not Applicable	ST Short-Term	O Once	R Reversible
P Positive	L Low	LAA Local Assessment Area	A Applicable	MT Medium-Term	S Sporadic	IR Irreversible
	M Moderate	RAA Regional Assessment Area		LT Long-Term	R Regular	PR Partially Reversible
	H High			P Permanent	C Continuous	

A significant adverse environmental effect for fauna has not been predicted for the Project for the following reasons, with consideration of the ecological and social context of the LAA surrounding the Project:

During Construction:

- Direct impacts to fauna habitat are expected, however, impacts will be minimized through on-going Project design and micro-sighting of infrastructure footprints wherever practicable.
- The baseline habitat of the FMS Mine Site is a network of existing fragmentation due to historical and present forestry activities.
- Construction work will be considerate of the breeding patterns for fauna, wherever practicable.
- Construction noise and light will be limited to a 12-month window.

During Operations:

- Noise will be elevated above baseline during this period and may cause disturbance of fauna in close proximity to the Mine Sites.

During Closure:

- Noise will be elevated above baseline during reclamation activities (2-3 years) involving mobile equipment and then drop to baseline for the post-closure period.
- Appropriate mitigation such as wildlife deterrents will be implemented to deter wildlife species from entering the TMF and open pits during post closure.

6.10.9 Proposed Compliance and Effects Monitoring Program

Monitoring of terrestrial fauna will be completed to verify the accuracy of the predicted environmental effects and the effectiveness of the mitigation measures specific to terrestrial fauna. Mitigations are outlined in Table 6.10-9. A WMMP will be developed in accordance with the EMS Framework Document (Appendix L.1), outlining wildlife mitigation and specific protocols for monitoring mainland moose during baseline/pre-construction to establish baseline conditions, and through the operational phase, reclamation and post closure (as determined to be required). Monitoring associated with the WMMP will be completed for the Project on selected transects within suitable mainland moose habitat within the FMS Study Area and in regional reference locations for which baseline data has already been collected. Mainland moose survey methods will be consistent with methods presented in the EIS, described in detail in Section 6.12.

Proposed follow-up and monitoring programs have been reviewed with the Mi'kmaq of Nova Scotia during engagement efforts including meetings, sharing of technical documents (Draft EIS, poster boards, Summary of Mi'kmaq Effects and Proposed Mitigation Measures, Plain Language Summary). On-going engagement with the Mi'kmaq will continue through the EA process and associated permitting relating to follow-up programs and monitoring.

6.11 Avifauna

6.11.1 Rationale for Valued Component Selection

Bird habitat may be altered or lost as a result of direct or indirect disturbances from the Project. Migratory birds and SAR are protected under federal legislation by the *Migratory Birds Convention Act* (MBCA) and SARA. The *Nova Scotia Wildlife Act* protects all birds within the province by stating that, except with a permit issued by the minister, *no person shall destroy, take, possess, buy or sell any egg of a bird or turtle or disturb the nest of a bird or turtle; or use a snare, net or trap to take any bird* (Section 51).

6.11.2 Baseline Program Methodology

Methodology of avian baseline monitoring programs within the FMS Study Area are discussed below. Information pertaining to Touquoy Mine Site has been brought forward from the EARD and Focus Report. Methods and results are referred to in sub-headings within the applicable sections; however, the data is not being re-evaluated. For further information regarding Touquoy Mine Site refer to the Touquoy Gold Project EARD (CRA 2007a) and Focus Report (CRA 2007b).

6.11.2.1 FMS Study Area Desktop Review Methodology

A background review of potential avian species that could occur within the FMS Study Area was completed prior to the start of the baseline monitoring programs. Table 6.11-1 presents the data sources that were used. Results and sources for the priority species assessment will be discussed in Section 6.12. Analysis in Section 6.12 includes priority avifauna observations from additional locations outside of the point counts included in the Avifauna section. As a result, avifauna results in Section 6.12 vary from results in this present section, based on incidental observations of SAR or SOCI during all other baseline field programs. Results of the desktop review and aerial photograph interpretation were used to develop the entire suite of avian baseline survey protocols.

Table 6.11-1: Data Sources for the Background Review

Task	Source(s)	Product
Breeding Bird Identification	Second Maritime Breeding Bird Atlas (MBBA; 2006-2010)	Identification of bird species observed within 10 km square grids that encompass the FMS Study Area. Atlas Square 20NQ38.
Priority Species Assessment*	Atlantic Canada Conservation Data Centre (ACCDC) Committee on the Status of Endangered Wildlife in Canada (COSEWIC) Species At Risk Act (SARA) Nova Scotia Endangered Species Act (NS ESA) Environmental Screening Report Habitat mapping for the site	A priority list for SAR and SOCI with suitable habitat inside the FMS Study Area and a list of species identified near the FMS Study Area by ACCDC (Appendix G.7) and the Environmental Screening (Appendix G.5).
Important Bird Areas	Important Bird Areas of Canada	Description of nearest Important Bird Area to the FMS Study Area.

Note: *Priority species and the associated desktop analyses is discussed in Section 6.12.

6.11.2.2 FMS Study Area Baseline Program Methodology

Following completion of the desktop evaluation for avifauna, a suite of seasonal survey protocols was developed. The locations of individual point count locations were determined based on representative habitat types, access, and FMS Study Area boundaries at the time of the surveys. As previously discussed, Project infrastructure layout has been an iterative process, resulting in changes to the FMS Study Area boundary throughout collection of baseline data. The survey locations selected and carried forward to the EIS provide coverage of the current FMS Study Area, plus several reference locations outside of the FMS Study Area. Specific surveys for nocturnal owl and common nighthawk require greater separation distances between point counts to reduce the risk of double counting (1.6 km and 800 m, respectively, compared with a minimum separation distance of 250 m for regular point counts in forested habitat). As such, owl survey locations and common nighthawk survey locations extend further from the FMS Study Area boundary. Survey locations for all avian baseline programs are provided in Figures 6.11-1 to 6.11-4. Avian baseline monitoring programs were completed by MEL and included the surveys outlined in Table 6.11-2.

Table 6.11-2: Avian baseline monitoring program locations and details

Survey Type	FMS Study Area
Breeding Bird Survey 2017	June 9, 2017 – July 6, 2017 • Seventy (70) point count stations • Two (2) visits – early and late
Common Nighthawk 2017	June 11, 2017 – July 8, 2017 • Thirteen (13) call playback stations • Two (2) visits
Fall Migration 2017	September 3, 2017 – October 28, 2017 • Forty-one (41) point count stations • Three (3) visits
Winter Wildlife Survey (including birds) 2018	January 20, 2018 – March 27, 2018 • Incidental observations • Seven (7) visits
Spring Nocturnal Owl 2018	April 23, 2018 – April 27, 2018 • Six (6) call playback stations • Three (2) visits
Spring Migration 2018	April 16, 2018 – May 23, 2018 • Forty-three (43) point count stations • Three (3) visits
Breeding Bird Survey 2018	June 8, 2018 – July 11, 2018 • Thirty-eight (38) point count stations • Two (2) visits – early and late

Survey Type	FMS Study Area
Fall Migration 2018	September 16, 2018 – October 17, 2018 • Ten (10) point count stations • Three (3) visits

Detailed descriptions of the survey methodologies for each of these baseline monitoring programs are provided in the following sections.

6.11.2.2.1 *Breeding Bird Survey*

Breeding Bird surveys were completed by MEL biologists using methods adapted from the Canadian Wildlife Service (CWS) in the Recommended Protocols for Monitoring Impacts of Wind Turbines on Birds (2007). While this protocol is specific to wind power projects, it provides detailed standards on survey design, including standardized data collection and proper spacing of point counts relative to each other. As such, it was used as a guideline for determining all seasonal bird survey protocols. Survey protocols were further advised by the guide for “Atlassing for Species at Risk in the Maritime Provinces” (MBBA 2008), and the “Guide for Atlassers” (MBBA 2006).

Surveys for breeding birds commenced on June 9th, 2017 at 70 point-count locations distributed throughout a past iteration of the FMS Study Area. Following revision of the FMS Study Area, additional breeding bird surveys were conducted in the summer of 2018 at 38 new point count locations. For the purposes of this section and analysis of effects of the Project on birds, 84 point counts are located throughout the current FMS Study Area with several occurring just outside this boundary for reference sites (n=24) for a total of 108 point counts. Thirty of these point counts are located within the FMS infrastructure (Figure 6.11-1).

Two rounds of surveys for breeding birds were conducted by MEL biologists from June 9-15 (early) and June 25-July 3 (late), 2017, and from June 8th – 27th (early) and July 1st – 11th (late), 2018. The methodologies for these surveys are described herein. During breeding bird surveys, the surveyor recorded any notes on bird behaviour observed, especially as they related to breeding behaviour such as distraction display, carrying food, and carrying nesting material. Behaviours were characterized based on the MBBA breeding status codes, which are available on their website (https://www.mba-aom.ca/).

All point count surveys began at, or within, half an hour of sunrise and were completed within four-and-a-half hours or by 10:00 a.m., whichever came first. Weather conditions (e.g., precipitation and visibility) were monitored and confirmed to be within the parameters required by monitoring programs such as ECCC’s Breeding Bird Survey (2017b).

Ten-minute point count surveys were conducted twice during the breeding season; once early, and once later to confirm whether breeding evidence increased for any species at any given point count location. Bird observations were recorded at four distance categories, within a 50 m radius, 50 to 100 m radius, outside the 100 m radius, and flyovers. For each point count, a record was made of the start time and a hand-held GPS unit was used to geo-reference its location. General observations, including the temperature, visibility, wind speed, date, start and end time, and location (UTM NAD83) were also recorded. Bearings (in degrees) were taken for SOCI and SAR observed during dedicated survey periods and incidentally. Breeding evidence as described in the MBBA was recorded where observed.

6.11.2.2.2 *Common Nighthawk*

The common nighthawk prefers to nest in gravelly substrates and is best detected while foraging for insects shortly after sunset. This species breeds in a range of open habitats including sandy areas, open forests, grasslands, wetlands, gravelly or rocky areas, and some cultivated landscapes such as roads, gravel rooftops, blueberry fields or croplands (New Hampshire Fish and Wildlife

Department 2015; Campbell et al. 2006; and COSEWIC 2007). Suitable habitat is available for this species within the FMS Study Area, typically around widened roadsides and recent clear-cuts.

Dedicated surveys for the common nighthawk were conducted from the middle of June to the end of July 2017 at dusk (30 minutes before sunset to an hour after sunset), as described in the Common Nighthawk Survey Protocol (Saskatchewan Ministry of Environment 2015). Stations were spaced at least 800 m apart within suitable habitat, and a point count survey with call playback was used to detect the presence of common nighthawk within the FMS Study Area. A three-minute passive point count was conducted at each station, followed by a call playback that includes 30-seconds of the conspecific common nighthawk call followed by 30-seconds of silence (or passive surveying), repeated for three-minutes (i.e., three times). The total time spent at each survey point was a minimum of six-minutes. Thirteen call playback stations were surveyed twice, within and surrounding the FMS Study Area. Point count locations and common nighthawk survey points are presented on Figure 6.11-2.

6.11.2.2.3 *Fall Migration*

Fall migration surveys were completed by MEL biologists using methods adapted from the CWS in the Recommended Protocols for Monitoring Impacts of Wind Turbines on Birds (2007). While this protocol is specific to wind power projects, it provides detailed standards on survey design, including standardized data collection and appropriate spacing of point counts relative to each other. As such, it was used as a guideline for determining all seasonal bird survey protocols. Survey protocols were further advised by the guide for "Atlassing for Species at Risk in the Maritime Provinces" (MBBA 2008), and the "Guide for Atlassers" (MBBA 2006).

Fall migration surveys commenced on September 3rd, 2017 at 41 point count locations. Point count numbers 14 and 28-35 are not shown on Figure 6.11-3, as they were located in a previous version of the FMS Study Area boundary. Point count stations were established through all representative habitat types within a past iteration of the FMS Study Area. Ten additional point count locations were established and surveyed during fall 2018 to incorporate changes to the FMS Study Area. A total of 45 point counts are located throughout the current FMS Study Area and will be used for evaluation of Project effects on birds with several occurring just outside this boundary for reference sites (n=8) for a total of 51 point counts. Eighteen of these point counts are located directly within the FMS infrastructure (Figure 6.11-3).

Surveys began at, or within, half an hour of sunrise and were completed within four-and-a-half hours or by 10:00 a.m., whichever came first. Weather conditions (e.g., precipitation and visibility) were monitored and confirmed to be within appropriate parameters for observations. Ten-minute point counts were conducted during peak migration. Bird observations were recorded at four distance categories, within a 50 m radius, 50 to 100 m radius, outside the 100 m radius, and flyovers. For each point count, a record was made of the start time and a hand-held GPS unit was used to geo-reference its location. General observations, including the temperature, visibility, wind speed, date, start and end time, and location (UTM NAD83) were also recorded. Species recorded outside of the 100 m radius, between point counts, outside of the 10-minute survey window, and flyovers were recorded as incidentals. Bearings (in degrees) were taken for SOCI and SAR observed during dedicated survey periods and incidentally.

6.11.2.2.4 *Winter Wildlife Survey (including Birds)*

No dedicated surveys for winter birds took place within the FMS Study Area; however, incidental observations of birds were recorded during winter wildlife (primarily moose) surveys. As much as practicable, winter wildlife surveys were planned on days with suitable weather conditions for detecting birds as described above (see Figure 6.11-2).

6.11.2.2.5 *Spring Nocturnal Owl*

The objectives of the nocturnal owl survey were to gather information on the presence and distribution of owl species within the FMS Study Area, determine the location of active nests, and record incidental observations of other SAR and SOCI.

The methods for monitoring nocturnal owls followed the *Guideline for Nocturnal Owl Monitoring in North America* (Takats et al. 2001). Takats et al. recommends that surveys take place once per year when vocal activity of most owl species is greatest (2001). According to Greg Campbell (Senior Project Biologist with the Atlantic Chapter of Bird Studies Canada), in Nova Scotia, data collected through the *Nova Scotia Nocturnal Owl Survey* program shows peaks in Barred (*Strix varia*) and Great Horned (*Bubo virginiatus*) owls in early April, while Northern Saw-whet owls (*Aegolius acadicus*) peak in late April to mid-May. While other owl species have been observed during these studies, their numbers are too low to determine peak calling periods (G. Campbell, pers. comm. 9 April 2015). The nocturnal owl surveys for this Project took place on April 23rd and 27th, 2018.

Wind can limit the ability of owls to hear a call broadcast and/or the ability of the observer to hear an owl calling. It is recommended that a survey be suspended if wind speed is Beaufort 4 or higher (i.e., >20 km/hr). If conditions were not suitable for surveying, then the survey was deferred or moved to a more suitable location. Owls have been observed to be less vocal when temperatures are significantly lower than average for the season, thus surveys were also delayed in this circumstance. Surveys were stopped in the case of heavy precipitation; light drizzle and flurries are not likely to reduce calling rates or detectability (Takats et al. 2001).

Prior to starting the survey, the broadcaster being used (ONN 2-watt mini cube portable PA system) was tested to ensure that the owl calls being broadcasted from it were audible and recognizable at a distance of 400 m (Takats et al. 2001). Ensuring that the broadcast could be heard beyond 400 m minimizes bias at the next survey station due to owls hearing the recording from the previous station (Takats et al. 2001). The aforementioned test was carried out under weather and noise conditions similar to those that were likely to be encountered during the survey.

The broadcast used by the Bird Studies Canada Nova Scotia Nocturnal Owl Survey program was used for the survey. It consists of a 9.5-minute broadcast, which includes alternating owl calls with silent listening periods (BSC Atlantic Region 2007). Only the calls of two owl species, the Boreal (*Aegolius funereus*) and Barred Owls, are used in the BSC Nova Scotia Nocturnal Owl Survey program broadcast because they are particularly rare and sensitive, respectively. To date, the Boreal Owl has only been reported as breeding in Nova Scotia four times (Lauff 2009). The Barred Owl is targeted because it has been used as an indicator of ecosystem health due to its dependence on cavities in large trees for nesting (Allen 1987).

Playback stations were spaced at least 1.6 km apart in order to reduce the chances of detecting the same owl at multiple stations (Takats et al. 2001). Some of the louder owls, such as the Barred Owl, can be heard at distances of two kilometers or more. However, most of the smaller owls cannot be heard as far or as clearly (Takats et al. 2001). Surveys were conducted between half an hour after sunset and midnight (Takats et al. 2001). There are five species of nocturnal owls that could potentially breed at the PA: the great horned, barred, long-eared (*Strix varia*), boreal, and northern saw-whet owls. Nocturnal owl point count locations are presented on Figure 6.11-2.

6.11.2.2.6 *Spring Migration*

Spring migration surveys were completed by MEL Biologists using methods adapted from the CWS in the Recommended Protocols for Monitoring Impacts of Wind Turbines on Birds (2007). Survey protocols were further advised by the guide for “Atlassing for Species at Risk in the Maritime Provinces” (MBBA 2008), and the “Guide for Atlassers” (MBBA 2006).

Surveys during spring migration commenced on April 16th, 2018 at 43 locations distributed throughout the FMS Study Area with several occurring just outside this boundary for reference sites (n=3). Point count stations were established through all representative habitat types within the FMS Study Area. Nineteen point counts are located within the FMS infrastructure. Point count numbers 28, 29, 31-34 are not shown on Figure 6.11-4, as they were located in a previous version of the FMS Study Area boundary and have not been used in the effects analysis for the Project.

The surveys were conducted following the same methodology as the fall migration survey. Point count stations are presented in Figure 6.11-4.

6.11.2.3 Touquoy Baseline Program Methodology

As part of the EARD process, bird habitat usage within the Touquoy Mine Site was characterized. The following surveys were carried out: fall migration monitoring, winter wildlife (including birds), spring diurnal migrating raptor, spring nocturnal owl, spring migration monitoring, breeding bird, and common nighthawk. Refer to the Touquoy Mine Site EARD (CRA 2007a) for further methodological details.

6.11.3 Baseline Conditions

6.11.3.1 Desktop Review

The FMS Study Area encompasses MBBA squares 20NR30 and 20NQ38 (Appendix G.8). Within this square there are 11 possible breeders, 19 probable breeders, and 56 confirmed breeders for a total of 86 individuals displaying breeding behaviour.

The MBBA data summaries for squares 20NQ38 can be found in Appendix G.8, along with bird species codes and breeding evidence codes.

The nearest (IBA) is the Eastern Shore Islands, located approximately 30 km south of the FMS Study Area (Figure 2.1-4). The Eastern Shore Islands are situated along the southeast coast of central Nova Scotia, between 60 and 120 km east of Halifax. The site includes inshore islands roughly located between Clam Harbour and Ecum Secum. Within this rock-strewn stretch of sea are many low islands, islets, and reefs located between 2 and 15 km offshore. The vegetation on these islands varies from mostly wooded to treeless. The Eastern Shore Islands IBA supports large congregations of common eiders (*Somateria mollissima*), representing more than 2.5% of the subspecies population, as well as a wintering population of harlequin ducks (*Histrionicus histrionicus*). Other waterfowl frequent the site during spring migration, including thousands of scoters, and Leach's storm-petrels (*Oceanodroma leucorhoa*) also breed on some of the islands (Bird Studies Canada 2019). Habitat present within the FMS Study Area is not consistent with habitat present on the Eastern Shore Islands. Furthermore, the FMS Study Area is located a sufficient distance from the nearest IBA and is not located within a significant migratory flyway for species that rely on the Eastern Shore Islands.

6.11.3.2 FMS Study Area Baseline Conditions

6.11.3.2.1 *Breeding Season*

The 2017 breeding bird survey consisted of seventy (70) point count stations that were surveyed twice each. A total of 2247 individuals representing 69 species were recorded during breeding season in the FMS Study Area. An additional 37 individuals were observed incidentally, of these only four species were not observed during dedicated surveys: American woodcock (*Scolopax minor*), northern goshawk (*Accipiter gentilis*), Tennessee warbler (*Oreothlypis peregrina*), and Wilson's snipe (*Gallinago delicata*). These species were not included in abundance summaries. Nineteen (19) priority species were observed during this breeding season survey, which are discussed in more detail in Section 6.12. Of these species four are SAR: Canada warbler (*Cardellina canadensis*; SARA Threatened; COSEWIC Threatened; NSESA Endangered, S3B), common nighthawk (*Chordeiles minor*; SARA Threatened; COSEWIC Special Concern; NSESA Threatened, S2B), evening grosbeak (*Coccothraustes vespertinus*; SARA Special Concern, COSEWIC Special Concern; NSESA Vulnerable, S3S4B, S3N), and olive-sided flycatcher (*Contopus cooperi*; SARA Threatened, COSEWIC Special Concern; NSESA Threatened, S2B).

The most abundant species observed was the magnolia warbler (*Setophaga magnolia;* n=155), followed by the common yellowthroat (*Geothylpis trichas;* n=150), and the palm warbler (*Setophaga palmarum;* n=136). Passerines represented the most abundant and diverse group of birds observed, accounting for 95% of all individuals, followed by non-passerine land birds (3% of individuals).

The 2018 breeding bird survey consisted of thirty-eight (38) point count stations that were surveyed twice each. A total of 1243 individuals representing 61 species were recorded during breeding season in the FMS Study Area. Six incidentals were observed, of which the following two species were not observed during dedicated surveys: common nighthawk and spruce grouse (*Falcipennis canadensis*). Seventeen (17) priority species were observed during this breeding season survey, which are discussed in more detail in Section 6.12. Four of these were SAR: Canada warbler, common nighthawk, evening grosbeak, and olive-sided flycatcher.

The most abundant species observed in 2018 was the common yellowthroat (n=88), followed by the magnolia warbler (n=84), and the white-throated sparrow (*Zonotrichia albicollis*; n=84). Passerines represented the most abundant and diverse group of birds observed, accounting for 95% of all individuals, followed by non-passerine landbirds (4% of individuals).

Table 6.11-3 outlines the observed breeding behaviour during the 2017 and 2018 survey seasons. Overall, 11 species displayed confirmed breeding evidence in 2017, and one in 2018. Probable breeding evidence was displayed in 39 species in 2017 and 32 species in 2018. Possible breeding evidence was displayed in 14 species in 2017 and 28 species in 2018.

Table 6.11-3: Breeding Bird Evidence per Species

Scientific Name	Common Name	2017 Breeding Evidence	2018 Breeding Evidence
Actitis macularius	**Spotted Sandpiper**	**Probable**	**Possible**
Archilochus colubris	Ruby-throated Hummingbird	Probable	n/a
Bombycilla cedrorum	Cedar Waxwing	Probable	Possible
Bonasa umbellus	Ruffed Grouse	Confirmed	Possible
Cardellina canadensis	**Canada Warbler**	**Confirmed**	**Probable**
Carduelis tristis	American Goldfinch	Possible	Possible
Catharus guttatus	Hermit Thrush	Confirmed	Probable
Catharus ustulatus	**Swainson's Thrush**	**Probable**	**Probable**
Certhia americana	Brown Creeper	Probable	Possible
Chordeiles minor	**Common Nighthawk**	**Probable**	**Possible**
Coccothraustes vespertinus	**Evening Grosbeak**	**Possible**	**Possible**
Colaptes auratus	Northern Flicker	Probable	Possible
Contopus cooperi	**Olive-sided Flycatcher**	**Probable**	**Probable**
Corvus brachyrhynchos	American Crow	Probable	Possible
Corvus corax	Common Raven	Confirmed	Possible
Cyanocitta cristata	Blue Jay	Possible	Possible
Dendroica castanea	**Bay-breasted Warbler**	**Probable**	**Probable**

Scientific Name	Common Name	2017 Breeding Evidence	2018 Breeding Evidence
Dendroica coronata	Yellow-rumped Warbler	Probable	Confirmed
Dendroica fusca	Blackburnian Warbler	Probable	Possible
Dendroica magnolia	Magnolia Warbler	Confirmed	Probable
Dendroica palmarum	Palm Warbler	Confirmed	Probable
Dendroica virens	Black-throated Green Warbler	Probable	Probable
Dryocopus pileatus	Pileated Woodpecker	Possible	Possible
Empidonax alnorum	Alder Flycatcher	Probable	Probable
Empidonax flaviventris	**Yellow-bellied Flycatcher**	**Probable**	**Probable**
Empidonax minimus	Least Flycatcher	Probable	Probable
Falcipennis canadensis	Spruce Grouse	Confirmed	Possible
Falco sparverius	**American Kestrel**	**Observed**	**Possible**
Gavia immer	Common Loon	Probable	Probable
Geothlypis trichas	Common Yellowthroat	Confirmed	Probable
Haemorhous purpureus	**Purple Finch**	**Possible**	**Possible**
Junco hyemalis	Dark-eyed Junco	Confirmed	Probable
Lophodytes cucullatus	Hooded Merganser	Possible	n/a
Loxia curvirostra	**Red Crossbill**	**Probable**	**Possible**
Loxia leucoptera	White-winged Crossbill	Possible	Possible
Megaceryle alcyon	Belted Kingfisher	Probable	Possible
Melospiza georgiana	Swamp Sparrow	Probable	Probable
Melospiza lincolnii	Lincoln's Sparrow	Probable	Probable
Melospiza melodia	Song Sparrow	Possible	Probable
Mergus merganser	Common Merganser	Possible	Possible
Mergus serrator	**Red-breasted Merganser**	**Probable**	**n/a**
Mniotilta varia	Black-and-white Warbler	Probable	Probable

Scientific Name	Common Name	2017 Breeding Evidence	2018 Breeding Evidence
Oporornis philadelphia	Mourning Warbler	n/a	Possible
Pandion haliaetus	Osprey	Possible	n/a
Parula americana	Northern Parula	Probable	Possible
Perisoreus canadensis	**Gray Jay**	**Confirmed**	**Probable**
Picoides arcticus	**Black-backed Woodpecker**	**Probable**	**Probable**
Picoides pubescens	Downy Woodpecker	n/a	Possible
Picoides villosus	Hairy Woodpecker	Probable	Probable
Poecile atricapilla	Black-capped Chickadee	Probable	Possible
Poecile hudsonica	**Boreal Chickadee**	**Possible**	**Possible**
Quiscalus quiscula	Common Grackle	Possible	n/a
Regulus calendula	**Ruby-crowned Kinglet**	**Confirmed**	**Probable**
Regulus satrapa	Golden-crowned Kinglet	Probable	Probable
Seiurus aurocapilla	Ovenbird	Possible	Possible
Seiurus noveboracensis	Northern Waterthrush	Probable	Possible
Setophaga ruticilla	American Redstart	Probable	Probable
Spinus pinus	**Pine Siskin**	**Possible**	**Possible**
Sitta canadensis	**Red-breasted Nuthatch**	**Probable**	**Probable**
Tachycineta bicolor	Tree Swallow	Probable	Probable
Tringa melanoleuca	**Greater Yellowlegs**	**Probable**	**n/a**
Troglodytes troglodytes	Winter Wren	Probable	Probable
Turdus migratorius	American Robin	Probable	Probable
Vermivora ruficapilla	Nashville Warbler	Probable	Probable
Vireo olivaceus	Red-eyed Vireo	Probable	Probable
Vireo solitarius	Blue-headed Vireo	Probable	Probable
Zonotrichia albicollis	White-throated Sparrow	Probable	Probable

Note: *Priority species are shown in **bold**

6.11.3.2.2 *Common Nighthawk*

Common nighthawks were observed 43 times during dedicated surveys completed in 2017. Evidence of breeding behaviour (i.e., a nasal peent call and booming courtship dives) was displayed in 36 of these individuals. Common nighthawks were observed in habitats with expansive gravelly areas adjacent to clear cuts and disturbed areas. Suitable habitat is present within the FMS Study Area for this species, furthermore their presence during the breeding season and observed breeding behaviours confirms that breeding is likely to occur within the FMS Study Area.

6.11.3.2.3 *Fall Migration*

During the 2017 fall migration, 1102 individuals representing 55 species were observed. During the 2018 fall migration, 223 individuals representing 40 species were observed at the 10 additional surveyed point count locations. In 2017, 57 incidental observations were made representing 12 species, only one of which was not observed during the dedicated survey period (rusty blackbird, *Euphagus carolinus*). In 2018, 20 individuals representing 12 species were observed incidentally, all of which were species seen during the dedicated survey period except for American black duck x mallard (hybrid; *Anas rubripes* x *Anas platyrhynchos*), common yellowthroat, and winter wren (*Troglodytes hiemalis*). In total, nine priority species were observed during fall migration surveys in 2017 and six were observed in 2018. The only SAR among these species is the rusty blackbird (SARA Special Concern; COSEWIC Special Concern; NSESA Endangered; S2B), which was observed incidentally in Fall 2017.

The most commonly observed species in 2017 were golden-crowned kinglets (*Regulus satrapa;* n=135), followed by red-breasted nuthatch (*Sitta canadensis*; n=113), and yellow-rumped warbler (*Setophaga coronata*; n=87). In 2018 the most commonly observed species were black-capped chickadee (*Poecile atricapillus;* n=24), yellow-rumped warbler (n=21), and American robin (*Turdus migratorius;* n=20). During both seasons, most observations documented groups of one or two, although group size ranged up to ten. On three occasions in 2017 groups of ten individual dark-eyed juncos (*Junco hyemalis*), black-capped chickadees, and spruce grouse were observed, and in 2018 a group of 16 American robin were observed. There were no observations of obvious migrants noted based on abundance, passage height or direction. The most abundant group observed on site during the fall migration period was passerines (songbirds) that accounted for 89% of individuals and 68% of species in 2017 and 87% of individuals and 73% of species in 2018.

6.11.3.2.4 *Winter Birds*

Eleven confirmed species and two unidentified species (i.e., a grouse and woodpecker) were observed incidentally during winter wildlife surveys within the FMS Study Area: American goldfinch (*Spnius tristis*), black-capped chickadee, boreal chickadee (*Poecile hudsonicus*), golden-crowned kinglet, gray jay (*Perisoreus canadensis*), hairy woodpecker (*Picoides villosus*), northern flicker (*Colaptes auratus*), purple finch (*Haemorhous purpureus*), red-breasted nuthatch, ruffed grouse (*Bonasa umbellus*), and spruce grouse. Four priority overwintering bird species were observed: boreal chickadee (S3), gray jay (S3), purple finch (S3S4N), and red-breasted nuthatch (S3). While abundance was not recorded during these surveys, the red-breasted nuthatch was observed the most frequently (17 observations between January 20th, 2018 and March 27th, 2018). The second-most observed species was the boreal chickadee, which was observed on four occasions between January 21st, 2018 and February 28th, 2018. Gray jay and purple finch were each observed once on January 20 and March 27, 2018, respectively.

6.11.3.2.5 *Spring Nocturnal Owl*

Five owls were observed within the FMS Study Area during the dedicated nocturnal owl surveys in spring, 2018. One great horned owl (*Bubo virginianus*) and four northern saw-whet owls (*Aegolius acadicus*) were observed on April 27th, 2018.

6.11.3.2.6 *Spring Migration*

During the 2018 spring migration, 1553 individuals representing 66 species were observed. Incidental observations resulted in the sighting of 25 individuals, of these two species were not observed during dedicated surveys: the American black duck (*Anas rubripes*) and the common merganser (*Mergus merganser*). In total, eight priority species were observed during spring migration surveys. One of these, the rusty blackbird, is a SAR.

The most commonly observed species were yellow-rumped warblers (n=128), followed by palm warbler (n=122), and ruby-crowned kinglet (*Regulus calendula,* n=87). During this season, most observations documented groups of one or two, although group size ranged up to five individuals. There were no observations of obvious migrants noted based on abundance. The most abundant group observed on site during spring migration surveys was passerines, that accounted for 89% of individuals and 72% of species.

6.11.3.2.7 *Summary of Field Surveys*

Baseline assessments for birds were completed from June 2017 through October 2018 by MEL biologists. A total of 5,090 minutes (84.8 hours) of surveys were completed over the five seasonal surveys (breeding bird 2017, fall 2017, spring 2018, breeding bird 2018, and fall 2018). All surveys resulted in the observation of 6,644 individuals, representing 89 species within the FMS Study Area. Within each seasonal survey, observations determined to be 'incidental' were not included in this tabulation. These included individuals observed outside of the 10-minute survey window and those observed outside of a designated point count location.

Table 6.11-4 below identifies the total number of individuals and species observed in each survey, the number of incidental observations, and the species name that were only observed incidentally.

Table 6.11-4: Summary of bird observations for each survey

Survey	Number of Individuals	Number of Species	Number of Incidental Individuals	Species Observed only Incidentally
Breeding Bird Survey 2017	2247	69	37	American Woodcock, Northern Goshawk, Tennessee Warbler, Wilson's Snipe
Common Nighthawk 2017	43	4	3	Canada Warbler, Greater Yellowlegs, Ruby-crowned Kinglet
Fall Migration 2017	1102	55	57	Rusty Blackbird
Winter Wildlife Survey (including Birds) 2018	77	11	0	n/a
Spring Nocturnal Owl 2018	7	4	0	n/a
Spring Migration 2018	1553	66	25	American Black Duck, Common Merganser
Breeding Bird Survey 2018	1243	61	7	Common Nighthawk, Spruce Grouse
Fall Migration 2018	223	40	20	American Black Duck x Mallard (hybrid), Common Yellowthroat, Winter Wren

Across all survey seasons, a total of 22 priority species were observed either during dedicated survey periods or incidentally. Breeding bird status qualifiers are used to determine whether a species is a priority species, based on the time of year in which the species was observed. For instance, a bird with an SRank of S2S3B, S5N is considered a priority species if observed during the breeding season. If observed outside of breeding season, this species would not be considered a priority species. The following priority species were observed:

- Canada Warbler (*Cardellina canadensis;* SARA Threatened; COSEWIC Threatened; NSESA Endangered; S3B);
- Common Nighthawk (*Chordeiles minor;* SARA Threatened; COSEWIC Special Concern; NSESA Threatened; S2B);
- Eastern-wood Pewee (*Contopus virens*; SARA & COSEWIC Special Concern; NSESA Vulnerable; S3S4B);
- Evening Grosbeak (*Coccothraustes vespertinus;* SARA & COSEWIC Special Concern; NSESA Vulnerable; S3S4B, S3N);
- Olive-sided Flycatcher (*Contopus cooperi*; SARA Threatened; COSEWIC Special Concern; NSESA Threatened; S2B);
- Rusty Blackbird (*Euphagus carolinus;* SARA Special Concern; COSEWIC Special Concern; NSESA Endangered; S2B);
- American Kestrel (*Falco sparverius;* S3B);
- Bay Breasted Warbler (*Dendroica castanea;* S3S4B);
- Black-backed Woodpecker (*Picoides arcticus;* S3S4);
- Boreal Chickadee (*Poecile hudsonica;* S3);
- Gray Jay (*Perisoreus canadensis;* S3);
- Greater Yellowlegs (*Tringa melanoleuca;* S3B,S3S4M);
- Northern Goshawk (*Accipiter gentilis;* S3S4);
- Pine Siskin (*Spinus pinus;* S2S3);
- Purple Finch (*Haemorhous purpureus;* S4S5B, S3S4N);
- Red Crossbill (*Loxia curvirostra;* S3S4);
- Red-breasted Nuthatch (*Sitta canadensis;* S3);
- Ruby-crowned Kinglet (*Regulus calendula;* S3S4B);
- Semipalmated Plover (*Charadrius semipalmatus;* S1B,S3S4M);
- Spotted Sandpiper (*Actitis macularius;* S3S4B);
- Swainson's Thrush (*Catharus ustulatus;* S3S4B); and,
- Yellow-bellied Flycatcher (*Empidonax flaviventris;* S3S4B).

These species are shown on Figures 6.11-5 and 6.11-6 and discussed in detail in the Section 6.12.

Avian species were identified based on functional bird groups to understand how each group of birds is using the FMS Study Area, and to help identify trends in the data. These functional groups include:

- **Waterfowl**: Ducks, geese, or other large aquatic birds, especially when regarded as game;
- **Shorebirds**: Waders, from the Order Charadriiformes;
- **Other waterbirds**: Includes seabirds (i.e., marine birds), grebes (Order Podicipediformes), loons (Order Gaviiformes), Ciconiiformes (i.e., storks, herons, egrets, ibises, spoonbills, etc.), pelicans (Order Pelicaniformes), flamingos (Order Phoenicopteriformes), Gruiformes (i.e., cranes and rails), kingfishers, gulls and dippers (the only family of passerines considered waterbirds);
- **Diurnal Raptors**: Birds within the families Accipitridae (i.e., hawks, eagles, buzzards, harriers, kites and old-world vultures), Pandidonidae (i.e., Osprey), Sagittariidae (i.e., Secretary bird), Falconidae (i.e., falcons, caracaras, and forest falcons), Cathartidae (i.e., new world vultures), and one species from the Order Strigiformes (i.e., Hawk Owl);
- **Nocturnal Raptors**: Birds of the Order Strigiformes (i.e., owls; with exception of the Hawk Owl, which is a diurnal species of owl);
- **Passerines**: Any bird of the Order Passeriformes, which includes more than half of all bird species. This is with exception of the dippers, which are a passerine considered a waterbird; and,
- **Other Landbirds**: Birds within the Orders Galliformes (i.e., quail, pheasant, and grouse), Columbiformes (i.e., pigeons and doves), Cuculiformes (i.e., cuckoos), Caprimulgiformes (i.e., nighthawks and whip-poor-wills), Apodiformes (i.e., swifts and hummingbirds), and Piciformes (i.e., woodpeckers, flickers and sapsuckers).

Table 6.11-5 presents all species observed during seasonal surveys (excluding incidental observations), including seasonal and total abundance.

Table 6.11-5: Seasonal and total abundances of avian species identified during the baseline assessments for dedicated fall, spring, and breeding bird surveys

Scientific Name	Common Name	Group	Breeding 2017	Fall 2017	Spring 2018	Breeding 2018	Fall 2018	Total
Actitis macularius ~€	Spotted Sandpiper	2	11	0	0	1	0	12
Agelaius phoeniceus	Red-winged Blackbird	6	0	0	1	0	0	1
Anas rubripes €	American Black Duck	1	0	0	0	0	3	3
Anthus rubescens €	American Pipit	6	0	0	0	0	0	0
Archilochus colubris €	Ruby-throated Hummingbird	6	2	0	0	0	0	2
Aythya collaris €	Ring-necked Duck	1	0	0	2	0	0	2
Bombycilla cedrorum €	Cedar Waxwing	6	20	11	0	4	1	36
Bonasa umbellus	Ruffed Grouse	7	4	1	13	2	1	21
Branta canadensis €	Canada Goose	1	0	4	7	0	0	11
Buteo jamaicensis	Red-tailed Hawk	4	0	1	1	0	0	2
Calidris pusilla ~€	Semipalmated Plover	2	0	1	0	0	0	1
Cardellina canadensis ±~€	Canada Warbler	6	28	0	0	10	0	38
Carduelis tristis €	American Goldfinch	6	5	4	14	2	2	27
Catharus guttatus €	Hermit Thrush	6	66	14	57	73	4	214
Catharus ustulatus ~€	Swainson's Thrush	6	130	1	7	68	0	206
Certhia americana €	Brown Creeper	6	8	9	11	2	1	31
Chordeiles minor ±~€	Common Nighthawk	6	18	0	0	0	0	18

Scientific Name	**Common Name**	**Group**	**Breeding 2017**	**Fall 2017**	**Spring 2018**	**Breeding 2018**	**Fall 2018**	**Total**
Coccothraustes vespertinus ±~€	Evening Grosbeak	6	4	0	0	2	0	6
Colaptes auratus €	Northern Flicker	7	22	10	32	13	2	79
Contopus cooperi ±~€	Olive-sided Flycatcher	6	37	0	0	15	0	52
Corvus brachyrhynchos	American Crow	6	5	5	6	7	3	26
Corvus corax	Common Raven	6	7	18	19	2	8	54
Cyanocitta cristata	Blue Jay	6	2	11	4	1	3	21
Dendroica coronate €	Yellow-rumped Warbler	6	97	87	128	44	21	377
Dendroica fusca €	Blackburnian Warbler	6	31	0	3	3	0	37
Dendroica magnolia €	Magnolia Warbler	6	155	7	60	84	1	307
Dendroica palmarum €	Palm Warbler	6	136	69	122	67	9	403
Dendroica striata €	Blackpoll Warbler	6	0	6	2	0	8	16
Dendroica tigrine €	Cape May Warbler	6	0	0	1	0	0	1
Dendroica virens €	Black-throated Green Warbler	6	103	2	51	63	1	220
Dryocopus pileatus €	Pileated Woodpecker	7	9	4	12	10	1	36
Empidonax alnorum €	Alder Flycatcher	6	38	0	0	26	0	64
Empidonax flaviventris ~€	Yellow-bellied Flycatcher	6	100	0	0	40	0	140
Empidonax minimus €	Least Flycatcher	6	12	1	15	15	0	43
Euphagus carolinus ±~	Rusty Blackbird	6	0	0	2	0	0	2

Scientific Name	Common Name	Group	Breeding 2017	Fall 2017	Spring 2018	Breeding 2018	Fall 2018	Total
Falcipennis canadensis	Spruce Grouse	7	6	11	14	0	1	32
Falco columbarius	Merlin	4	0	0	1	0	0	1
Falco sparverius ~	American Kestrel	4	1	5	2	2	0	10
Gavia immer €	Common Loon	3	7	9	10	3	3	32
Geothlypis philadephia €	Mourning Warbler	6	0	0	0	4	0	4
Geothlypis trichas €	Common Yellowthroat	6	150	16	32	88	0	286
Haemorhous purpureus ~€	Purple Finch	6	5	43	65	14	5	132
Junco hyemalis €	Dark-eyed Junco	6	66	61	86	32	11	256
Lophodytes cucullatus €	Hooded Merganser	2	1	3	3	0	0	7
Loxia curvirostra ~€	Red Crossbill	6	53	43	12	26	5	139
Loxia leucoptera €	White-winged Crossbill	6	2	44	0	1	0	47
Megaceryle alcyon	Belted Kingfisher	3	4	2	9	1	0	16
Melospiza georgiana €	Swamp Sparrow	6	23	8	27	5	0	63
Melospiza lincolnii €	Lincoln's Sparrow	6	24	0	11	17	0	52
Melospiza melodia €	Song Sparrow	6	3	2	9	2	0	16
Mergus merganser €	Common Merganser	2	7	0	0	1	0	8
Mergus serrator €	Red-breasted Merganser	2	4	0	0	0	0	4
Mniotilta varia €	Black-and-white Warbler	6	78	7	55	57	1	198

Scientific Name	Common Name	Group	Breeding 2017	Fall 2017	Spring 2018	Breeding 2018	Fall 2018	Total
Oreothlypis peregrina €	Tennessee Warbler	6	0	1	0	0	0	1
Pandion haliaetus	Osprey	4	1	0	0	0	0	1
Parula americana €	Northern Parula	6	14	1	7	2	1	25
Perisoreus canadensis ~	Gray Jay	6	11	36	5	17	10	79
Picoides arcticus ~€	Black-backed Woodpecker	7	8	3	11	3	1	26
Picoides pubescens €	Downy Woodpecker	7	0	4	1	1	2	8
Picoides villosus €	Hairy Woodpecker	7	20	19	19	14	2	74
Pinicola enucleator €	Pine Grosbeak	6	0	0	0	0	1	1
Poecile atricapilla €	Black-capped Chickadee	6	32	86	46	16	24	204
Poecile hudsonica ~€	Boreal Chickadee	6	9	17	13	6	7	52
Quiscalus quiscula	Common Grackle	6	2	2	14	0	0	18
Regulus calendula ~€	Ruby-crowned Kinglet	6	77	11	87	33	3	211
Regulus satrapa €	Golden-crowned Kinglet	6	56	135	80	37	16	324
Seiurus aurocapilla €	Ovenbird	6	2	0	1	1	0	4
Seiurus noveboracensis €	Northern Waterthrush	6	31	0	19	3	0	53
Setophaga castanea ~€	Bay-breasted Warbler	6	20	2	3	16	0	41
Setophaga ruticilla €	American Redstart	6	62	5	11	41	0	119
Sitta canadensis ~€	Red-breasted Nuthatch	6	28	113	65	23	15	244

Scientific Name	Common Name	Group	Breeding 2017	Fall 2017	Spring 2018	Breeding 2018	Fall 2018	Total
Spinus pinus ~€	Pine Siskin	6	2	40	4	5	5	56
Spizella passerine €	Chipping Sparrow	6	0	0	1	0	0	1
Tachycineta bicolor €	Tree Swallow	6	20	0	26	14	0	60
Tringa melanoleuca ~€	Greater Yellowlegs	2	14	2	8	0	0	24
Tringa solitaria €	Solitary Sandpiper	2	0	2	0	0	2	4
Troglodytes hiemalis €	Winter Wren	6	37	1	17	9	0	64
Turdus migratorius €	American Robin	6	11	35	25	7	20	98
Unknown Blackbird sp	Unknown Blackbird sp	6	0	0	6	1	0	7
Unknown Sandpiper sp €	Unknown Sandpiper sp	2	0	1	0	0	0	1
Unknown Warbler sp. €	Unknown Warbler sp.	6	0	29	0	0	11	40
Unknown Woodpecker sp €	Unknown Woodpecker sp	7	3	0	15	5	0	23
Vermivora ruficapilla €	Nashville Warbler	6	51	0	22	32	0	105
Vireo olivaceus €	Red-eyed Vireo	6	29	2	1	15	0	47
Vireo solitarius €	Blue-headed Vireo	6	109	9	57	51	8	234
Zenaida macroura €	Mourning Dove	7	0	0	1	0	0	1
Zonotrichia albicollis €	White-throated Sparrow	6	114	26	82	84	0	306
TOTAL	**83 species****		**2247**	**1102**	**1553**	**1243**	**223**	**6368**

*Note – SAR(±), SOCI (~), and migratory birds (€) are noted in the above table ** Unknown species (i.e. Unknown warbler, unknown woodpecker) are not included in the total species count.

Of the 89 species observed during the five seasonal surveys (breeding bird 2017, fall 2017, spring 2018, breeding bird 2018, and fall 2018) within the FMS Study Area, 69 (83% of species; 94% of individuals) are protected under the *Migratory Bird Convention Act* (1994). Birds observed that are not protected under the *Act* were from the Accipitridae (e.g., harriers and hawks), Alcedinidae (e.g., kingfisher), Corvidae (e.g., jays, crows and ravens), Phasianidae (e.g., grouse and pheasants), and Strigidae (e.g., owls) families.

Overall, avian diversity and abundance observed was moderate to high based on observer experience in the geographic area. The common species assemblage of forest birds was observed, along with a cohort of species more typically found in intact or interior forests. Passerines were the dominant species group across all seasons within the FMS Study Area; this was the expected outcome given the habitat (dominated by forest cover, both deciduous and coniferous of varied maturity levels). The order Passeriformes includes more than half of all bird species and is one of the most diverse, so their relative abundance within the FMS Study Area is to be expected.

Other species groups identified within the FMS Study Area, were observed in lesser numbers. Non-passerine land birds were the second most abundant species group observed within the FMS Study Area. This group consisted mainly of woodpecker and grouse species, for which habitat is present throughout the FMS Study Area. No large congregation of waterfowl or shorebird species were observed roosting or staging within the FMS Study Area. Several species within this group were observed during the breeding season in conjunction with breeding behaviour: common loon (probable), common merganser (possible), greater yellowlegs (probable), hooded merganser (possible), red-breasted merganser (probable), and spotted sandpiper (probable). Raptors, both nocturnal and diurnal, were observed in low numbers; the most abundantly observed species within this group was the American kestrel, which was observed 10 times. Overall, no abundance patterns were observed in non-passerine species.

6.11.3.3 Touquoy Mine Site Baseline Conditions

The 2005 breeding bird surveys of the Touquoy Mine Site found 398 birds representing 52 species over 11 point count stations. The most abundant species were the magnolia warbler (7.5% of the total) and the common grackle (*Quiscalus quiscula*, 7.3%) (CRA 2007). Ten of the 52 species observed were considered priority species at the time of the assessment. They are as follows: pine grosbeak (*Pinicola enucleator*), willow flycatcher (*Empidonax traillii*), yellow-bellied flycatcher, barn swallow (*Hirundo rustica*), boreal chickadee, ruby-crowned kinglet, rusty blackbird, bay-breasted warbler (*Setophaga castanea*), swainson's thrush (*Catharus ustulatus)*, and pine siskin (*Spinus pinus)*.

Since the completion of the Touquoy Gold Project EARD and Focus Report, ACCDC status ranks and listings under the NSESA and SARA have been revised. Species identified in the Touquoy Gold Project EARD and Focus Report were reviewed for revised rankings with ACCDC, NSESA and SARA listings. Avian listings have been updated since the EARD. However, there are no newly listed species which would experience Project interactions beyond what is expected in terms of interactions to the avian community in general (i.e. sensory disturbance). Furthermore, avian SOCI (even those with revised listings) are expected to experience similar Project interactions as all other avian species. As such, no specific mitigation of Project interactions is necessary for priority avifauna species based on the addition of the Project to the Touquoy Mine Site.

6.11.4 Consideration of Engagement and Engagement Results

Key issues raised during public and Mi'kmaq engagement relating to birds include potential for direct mortality associated with the operations and indirect effects on other VCs, such as dust, noise and light, as well as potential effects on birds associated with permanent loss of habitat from construction of the Project. Potential effects on traditional uses of land and resources by the Mi'kmaq were noted.

The results of the public and Mi'kmaq engagement have been considered in the environmental effects assessment, including the Proponent's commitments on mitigation and monitoring measures and proposed compliance and effects monitoring programs, as well as the Proponent's broader commitment to ongoing public and Mi'kmaq engagement.

6.11.5 Effects Assessment Methodology

6.11.5.1 Boundaries

6.11.5.1.1 *Spatial Boundaries*

The spatial boundaries used for the assessment of effects to birds are the PA, LAA, and RAA. The PA (Figure 6.10-2) consists of the FMS Study Area and the Touquoy Mine Site.

The LAA consists of a 2 km buffer around the FMS Study Area, and a 500 m buffer surrounding the Touquoy Mine Site component of the PA (Figure 6.10-2). The LAA boundaries were defined considering the maximum expected extent of direct and indirect impacts to birds.

The RAA encompasses a portion of Ecodistrict 440 constrained in the east by the boundary of the Liscomb Game Sanctuary, and west by the northern end of Lake Charlotte (Figure 6.10-2). The RAA was extended north of the FMS Study Area to incorporate the entirety of the Liscomb Game Sanctuary and as such encompasses this portion of Ecodistrict 450. These Ecodistrict portions span an area broader than the expected Project impacts to fauna and considers other Project boundaries as per cumulative effects methodology.

Assessment of Avifauna will be completed in consideration of the LAA as the primary spatial boundary. All spatial boundaries will help to identify the direct or indirect impacts to avifauna and the effects of the Project on distribution and abundance of these species.

6.11.5.1.2 *Temporal Boundaries*

The temporal boundaries used for the assessment of effects to birds are the construction phase, operational phase, and closure phases.

6.11.5.1.3 *Technical Boundaries*

No technical boundaries were identified for the effects assessment of birds.

6.11.5.1.4 *Administrative Boundaries*

Administrative boundaries for evaluation and management of birds include the *Nova Scotia Wildlife Act*, which protects all birds within the province and the *MBCA,* which offers protection for migratory birds. Further protection is offered to SAR through the provincial *Nova Scotia Endangered Species Act* and the federal *Species at Risk Act*.

6.11.5.2 Thresholds for Determination of Significance

A significant adverse effect from the Project on avifauna is defined as an effect that is likely to cause a permanent, unmitigated, alteration to habitat that supports avian species distribution. An adverse effect that does not cause a permanent alteration in distribution of any bird species is considered to be not significant. Significance criteria related to impacts to SAR and SOCI are presented in Section 6.12.

The following logic was applied to assess the magnitude of a predicted change in Avifauna:

- Negligible – no measurable change in avifauna communities or habitat;

- Low – the Project results in loss of habitat for avifauna, within natural variation (considering ongoing anthropogenic disturbance regimes), and the loss of habitat is mitigated in the long term through reclamation planning and other mitigation measures as determined to be necessary based on avian species present;
- Moderate – the Project results in loss of habitat for avifauna, above natural variation (considering ongoing anthropogenic disturbance regimes), and the loss of habitat is mitigated in the long term through reclamation planning and other mitigation measures as determined to be necessary based on avian species present; and,
- High – the Project results in loss of habitat for avifauna, above natural variation (considering ongoing anthropogenic disturbance regimes), and the loss of habitat is not mitigated in the long term through reclamation planning and other mitigation measures as determined to be necessary based on avian species present.

The timing of residual effects for avifauna considers when the residual environmental effect is expected to occur, considering seasonal aspects and sensitive time periods for avifauna. The duration of residual effects considers the time frame over which the effects are likely to last, ranging from short-term to permanent. For the purpose of the effects assessment related to avifauna, long term reflects the commencement of reclamation activities. The frequency of residual effects considers the rate of recurrence of the effects, ranging from once to continuous. The reversibility of residual effects considers the time required for habitat to recover to baseline conditions, or whether the changes to habitat, if identified, are permanent.

6.11.6 Project Activities and Avifauna Interactions and Effects

The assessment of potential adverse interactions and effects of the Project on this VC takes into account the potential for the Project to result in changes to:

- Permanent and temporary habitat alteration and fragmentation;
- Disturbance and/or displacement;
- Potential for direct and indirect mortality to individuals; and,
- Sensory disturbance.

6.11.6.1 FMS Study Area

Table 6.11-6 presents the potential interactions of the Project with birds and bird habitat within the FMS Study Area.

Table 6.11-6: Potential Avifauna Interactions with Project Activities within the FMS Study Area

Project Phase	Duration	Relevant Project Activity
Site Preparation and Construction Phase	1 year	• Clearing, grubbing, and grading; • Drilling and rock blasting; • Topsoil, till and waste rock management; • Watercourse and wetland alteration; • Seloam Brook Realignment construction and dewatering; • Mine Site road construction, including lighting; • Surface infrastructure installation and construction, including lighting;

Project Phase	Duration	Relevant Project Activity
		• Collection ditch and water management pond construction, including lighting; • Local traffic bypass construction; • Environmental monitoring, and • General waste management.
Operations Phase	7 years	• Drilling and rock blasting to access and extract ore; • Open pit dewatering; • Ore management; • Waste rock management; • Tailings management; • Surface water management; • Dust and noise management; • Site maintenance and repairs, including lighting; • Environmental monitoring, and • General waste management.
Closure Phase: Reclamation Stage	2-3 years	• Infrastructure demolition; • Water treatment and management; • Site reclamation activities; • Environmental monitoring, and • General waste management.

6.11.6.1.1 *Habitat Fragmentation*

Development of the mine infrastructure will cause direct impacts to habitat used by avifauna, including upland forested habitat and wetlands. While some direct loss of habitat will occur, the FMS Study Area is located in an undeveloped, natural landscape with a diversity of habitats. Habitat present within the FMS Study Area is not unique or rare in the local, regional or provincial context. Habitat loss will occur within the construction phase of the Project. Habitat within the FMS Study Area and surrounding landscape currently exhibits fragmented conditions based on historic mine operations, existing road and trail networks, and current and historic timber harvesting activity within and adjacent to the FMS Study Area. Project activities are likely to result in increased habitat fragmentation and a decrease in habitat quality for those species that rely on interior forest conditions, where intact interior forest remains. Interior forests are defined as an area within a forest that is sheltered from edge effects; interior and mature forest mapping is discussed in Section 6.9 (Flora).

There are no Old Forest polygons in the Old Forest Layer present within the Avifauna LAA.

The LAA (specific to the FMS Mine Site) is covered with a network of roads, historical mining and forestry activities, and forestry trails creating a largely disturbed forest landscape. Figure 6.9-4 shows the extent of the simulated existing disturbance and edge effect largely covering the majority of the LAA. A total of 2372 ha of predicted interior forest has been identified within the LAA. Project infrastructure, as signified as the maximum Project edge effect in Section 6.9.5.2, will affect 275 ha of interior forest habitat, which accounts for 12% of predicted interior forest in the LAA.

The two largest patches of potential interior forest are located in the east and southeastern portion of the LAA around Moser Lake and in the Toad Fish Wilderness Area. These patches contain contiguous forested habitat and could provide a means of wildlife movement, migration, breeding bird habitat and flora and fauna habitat. Maximum Project edge effect is predicted to impact predicted interior forest near the Seloam Brook Realignment, the eastern local traffic bypass road and TMF, and southern area of the plant and ancillary building footprint. Much of the area of predicted impact near the bypass road and TMF look to be cut over on aerial imagery and could be an overestimate in the analysis due to the lack of recent cutting in the GIS data layer. It is expected that the results of this specific fragmentation of interior forest on avifauna to be minimal.

This decrease in habitat quality for species relying on interior forest condition is based on increased activity and sensory disturbance, along with increased physical fragmentation. Project activities are expected to result in increased general habitat fragmentation and a decrease in habitat quality for those species which rely especially on interior forest conditions.

Common migratory bird species that require Old Forest or interior forest habitats include: blackburnian warbler, black-throated blue warbler, black-throated green warbler, black and white warbler, Canada warbler, cape may warbler, hairy woodpecker, hermit thrush, magnolia warbler, northern goshawk, ovenbird, pileated woodpecker, Swainson's thrush, wood thrush, veery and white-throated sparrow (C. Pepper, pers. comm. 8 March 2019; Ontario Ministry of Natural Resources 2000). Additionally, bird species identified within the priority species list (Appendix G.6) that prefer mature or interior forest are outlined in Table 6.11-7.

Table 6.11-7: Species Identified within Priority Species List Associated with Interior Forest Habitat

Scientific Name	Common Name	SARA, COSEWIC, NSESA	SRank	Habitat Requirements
Accipiter gentilis	Northern Goshawk	COSEWIC NAR	S3S4	Nest in mature mixed hardwood forests
Cardellina canadensis	Canada Warbler	SARA & COSEWIC Threatened, NSESA Endangered	S3B	Dense understory vegetation of mature to mid-aged mixed forest
Catharus ustulatus	Swainson's Thrush		S3S4B	Closed canopy forests, breeding habitat includes deciduous and coniferous forests
Coccothraustes vespertinus	Evening Grosbeak	SARA & COSEWIC Special Concern, NSESA Vulnerable	S3S4B, S3N	Breed in mature and second-growth coniferous forests
Contopus virens	Eastern wood-Pewee	SARA & COSEWIC Special Concern, NSESA Vulnerable	S3S4B	Interior forests
Dendroica tigrine	Cape May Warbler		S2B	Northern coniferous forest, mature spruce
Empidonax flaviventris	Yellow-bellied Flycatcher		S3S4B	Conifer forests and peatlands. It nests in typically cool, moist conifer or mixed forests, bogs, swamps, and muskegs
Euphagus carolinus	Rusty Blackbird	SARA & COSEWIC Special Concern, NSESA Endangered	S2B	Wet coniferous and mixed wood forests

Scientific Name	Common Name	SARA, COSEWIC, NSESA	SRank	Habitat Requirements
Loxia curvirostra	Red Crossbill		S3S4	Mature coniferous forests
Perisoreus canadensis	Gray Jay		S3	Coniferous forest
Picoides arcticus	Black-backed Woodpecker		S3S4	Coniferous forest
Pinicola enucleator	Pine Grosbeak		S2S3B, S5N	Open coniferous forests.
Poecile hudsonica	Boreal Chickadee		S3	Coniferous forest
Regulus calendula	Ruby-crowned Kinglet		S3S4B	Coniferous and deciduous forests
Sitta canadensis	Red-breasted Nuthatch		S3	Deciduous and coniferous forests
Spinus pinus	Pine Siskin		S2S3	Open coniferous forests, mixed forest and deciduous forests

6.11.6.1.2 *Sensory Disturbance*

Sensory disturbance to avifauna would result from rock blasting, clearing and grubbing, infrastructure construction, ore and waste rock transportation, ore processing, and tailings management within the FMS Study Area, and overall increased traffic along roads within the PA during operations. These project components will likely result in the localized avifauna avoidance of the PA. Overall, project activities will likely cause a change in usage of the PA by avifauna, with some species tending to avoid the area, while others may be attracted to the increased activity.

Changes to ambient noise levels and the presence of periodic vibrations from blasting have the potential to adversely affect fauna and birds by influencing migration and behavioral patterns. Noise and vibration are provincially regulated via the Workplace Health and Safety Regulations and the Pit and Quarry Guidelines, which protect the health of site workers and the general public at PA boundaries, respectively.

Existing noise (measured in 2017) around the FMS Study Area had an average value of 29.5 dBA ±. The predicted noise levels from the Project will be elevated above background within the PA and into the LAA. (Appendix J.1).

The Environment Code of Practice for Metal Mines (EC 2012c) has established parameters for ambient noise levels for wildlife. These parameters indicate that ambient noise observed above 55 dBA during the day and 45 dBA at night can affect wildlife. The predicted noise levels presented in the Noise Impact Study (Appendix J.1) exceed the levels outlined by ECCC (2012c). Additionally, a literature review conducted by Shannon et al. (2016) found that birds have the potential to exhibit changes in song characteristics, reproduction, abundance, stress levels, and species richness at levels greater than 45 dBA on average. Specially, studies showed biological responses commenced at 40-45 dBA, with a decline in species diversity (i.e., avoidance by sensitive species) and reproductive success at 43-58 dBA. Changes in song frequency and length were observed at 45 dBA. Francis et al (2009) notes noise pollution can lead to changes in avian communities and altered species interactions. However, a study of the impact of logging truck traffic on bird reports no observed effects on nesting at noise levels of 53 dbA (Grubb et al. 1998).). It was also found that noise tolerant species had increased nest success through decreasing nest predation (Francis et al, 2009).

Impacts can also differ between acute and chronic noise sources. Chronic exposure may degrade auditory cues, feedback and vocal development over time, important for predator/prey detection, communication and orientation (Shannon et al, 2016; Bickley and Patricelli, 2010; Marler et al, 1973). A direct physiological impact causing a temporary decrease in auditory sensitivity can occur at acute noise levels above 93 dBA, while permanent damage to avian auditory systems is not recorded until 125-140 dBA (Bickley and Patricelli, 2010). Routine Project operations are not predicated to reach these noise levels.

According to the results of the Noise Impact Study, noise generated from Project activities diminishes to 45 dBA (the most conservative guideline) at a maximum of 1.5 km beyond of the FMS Mine Site property boundaries. Avifauna within close proximity of the FMS Mine Site have the potential to be affected by noise. However, it should be noted that noise effects are rarely isolated from other disturbances and impacts likely coincide with habitat suitability changes that accompany increased noise levels (Shannon et al, 2016).

Light propagation from the Project has been determined to extend between 0 and 2km from the FMS Study Area. Within the FMS Study Area, light impacts on avifauna will be reduced by installing lights facing downward and wherever practicable using motion-sensing lights.

Light can impact avifauna by potentially causing disorientation or by causing attraction or avoidance. Birds may be attracted to or disoriented by open pit lighting at night, particularly during migration periods, leading to mortality (Jones and Francis 2003). In turn, these behavioral changes can affect the success of foraging, reproduction, and communication of wildlife (Longcore and Rich 2004) and can disrupt habitat connectivity (Bliss-Ketchum et al. 2016). Artificial lighting at night has been shown to influence the seasonal start of bird vocalizations, which could affect individual fitness and reproductive success (Da Silva et al. 2014).

6.11.6.1.3 *Direct Mortality*

Direct mortality of avifauna species could result from Project activities, particularly due to the increase in traffic during construction and operation of the facility. Increased traffic poses a risk to avifauna within the FMS Study Area. Indirect mortality could result from long term exposure to low levels of contaminants or spills from incidents and accidents.

Migratory birds may be indirectly impacted as a result of the surface water quality in the pit lakes and the TMF constructed to support the Project, and Touquoy Mine Site open pit, which will store tailings from the Project. These water features may appear to be resting places for migratory birds, however, mitigation measures such as bird deterrents are currently in place at Touquoy Mine Site, and will be applied to reduce the potential environmental impacts of the Project on migratory birds at the FMS Study Area as per existing approvals.

6.11.6.2 Touquoy Mine Site

Table 6.11-8 below presents the potential interactions of the Project with birds and bird habitat within the Touquoy Mine Site.

Table 6.11-8. Impacts of the Project on Avifauna at the Touquoy Mine Site

Project Phase	Duration	Relevant Project Activity
Operation and Maintenance	7 years	• Lighting of facilities and mine site roads; • Tailings management; • Environmental monitoring; and • General waste management.
Closure Phase: Reclamation Stage	2-3 years	• Environmental monitoring.

The Project will have no new effects on birds at the Touquoy Mine Site. There will be no changes to interior forest at the Touquoy Mine Site as there is no new footprint disturbance associated with the Project. Sensory disturbance caused by noise and light will occur within the Touquoy Mine Site, however, this is already occurring at this location. However, the addition of FMS concentrate for processing at the Touquoy facility will extend the life of the Touquoy Mine Site by several years thus extending the sensory disturbance period. Increased traffic poses a risk to avifauna within the FMS Study Area and in the Touquoy Mine Site. The addition of FMS concentrate tailings to the Touquoy exhausted pit will extend the temporal disturbance to birds, particularly related to habitat suitability of the Touquoy exhausted pit. The current bird deterrent program will be continued at the Touquoy TMF and extended to the Touquoy Pit if necessary.

6.11.6.3 Summary of Pre-mitigation Effects

The Project is expected to have several main pathways in terms of Project interactions with avifauna (Table 6.11-9). Project interactions (direct and indirect) can be summarized by:

- Direct habitat loss and fragmentation;
- Direct and indirect mortality through vehicular collisions;
- Decreased habitat quality including potential long-term exposure to low concentrations of contaminants in the FMS Mine Site and Touquoy TMF and the open pit; and
- Sensory disturbance through increases in noise, light and vibration above background, particularly during construction and operation phases.

Table 6.11-9: Impacts of the Project on Avifauna

Impact Type	Direct Impact	Project Phase	Indirect Impact	Project Phase
Vegetative and Habitat Integrity	Loss of vegetative cover through clearing and grubbing decreases bird habitat availability and Project development also has the potential to reduce natural surface water drainage, altering wet areas.	C	Habitat fragmentation may alter habitat suitability for those species that rely on interior forest conditions.	C, O, CL

Impact Type	Direct Impact	Project Phase	Indirect Impact	Project Phase
Sensory Disturbance	Extensive ground works, including activities such as blasting, will increase noise levels. An increase in vehicular traffic will also increase noise levels, and thus sensory disturbance. This has the potential to reduce habitat for avifauna.	C, O, CL	Sensory disturbance (from both sound and light) may result in further avoidance of the PA by some species including birds.	C, O
	Birds may be attracted to or disoriented by open pit lighting at night, particularly during migration periods, leading to mortality.	C, O	Artificial lighting at night has been shown to influence the seasonal start of bird vocalizations, which could affect individual fitness.	C, O
Direct Mortality	Increased traffic and general activity within the PA may result in direct mortality to wild species, including avifauna, through vehicular and construction collisions.	C, O, CL	Potential long-term exposure to low levels of contaminants in tailings facilities.	O

Note: C= Construction Phase O= Operation Phase CL= Closure Phase

Baseline assessments were completed during multiple seasons to capture an accurate snapshot of avian use of the FMS Study Area. These surveys resulted in the observation of 6,644 individuals, representing 89 species. Of these species 22 are considered priority species. Of the total number of species, 69 (83% of species; 92% of individuals) are protected under the *Migratory Bird Convention Act* (1994). Based on observer experience in this geographic region, avian diversity and abundance is considered moderate to high.

Considering the moderate to high levels of bird species and abundance found within the FMS Study Area, the greatest pre-mitigation effect is a change in habitat, which may take the form of the loss of vegetative cover and/or habitat fragmentation. A total of 2372 ha of predicted interior forest has been identified within the LAA. Project infrastructure, as signified as the maximum Project edge effect in Section 6.9.5.2, will affect 275 ha of interior forest habitat, which accounts for 12% of predicted interior forest in the LAA.

Maximum Project edge effect is predicted to impact predicted interior forest near the Seloam Brook Realignment, the eastern local traffic bypass road and TMF, and southern area of the plant and ancillary building footprint. Much of the area of predicted impact near the bypass road and TMF look to be cut over on aerial imagery and could be an overestimate in the analysis due to the lack of recent cutting in the GIS data layer. It is expected that the results of this fragmentation on avifauna to be minimal.

According to the results of the Noise Impact Study (Appendix J.1), noise generated from Project activities diminishes to 45 dBA (the most conservative guideline) at a maximum of 1.5 km beyond of the FMS Mine Site property boundaries. Avifauna within close proximity of the FMS Mine Site have the potential to be affected by noise. Light propagation from the Project has been determined to extend between 0 and 2km from the FMS Study Area. Within the FMS Study Area, light impacts on avifauna will be reduced by installing lights facing downward and wherever practicable using motion-sensing lights.

6.11.7 Mitigation

The potential effects to migratory birds associated with the Project phases are outlined in Table 6.11-10.

The mitigation measures provided are also applicable to the Touquoy Mine Site for the processing of FMS concentrate. Mitigation measures will be applied to reduce the potential environmental impacts of the Project on migratory birds at the PA as per existing operational approvals. Audio (Bird Gard Super Pro Amp: S4657) and visual deterrents (reflector tape) are currently being used at Touquoy Mine Site to dissuade birds from landing in the TMF. Each of the two audio deterrents employed has an effective range of 12 ha and is equipped with customizable calls from birds of prey. Due to the success of these deterrents, their use will continue at the FMS Study Area, as required.

There is low impact to mature and interior forest within the FMS Study Area or adjacent lands. There are no old forest patches within the PA. Those located within the LAA are not expected to be indirectly impacted by the Project. In instances where interior forest cannot be avoided the following mitigation measures are proposed to identify and reduce indirect impacts to migratory birds that rely on this habitat throughout the PA:

- Grubbing and clearing activities will be avoided during nesting season if practicable; and,
- Where practicable, adjustments will be made to infrastructure locations during detailed design phase to limit impact to intact forest.

Table 6.11-10. Mitigation for Avifauna

Project Phase	Mitigation Measure
C, O	Avoid construction on native vegetation during the regional breeding season for migratory birds where practicable (beginning of April to end of August for migratory birds; EC 2015b). Where this is not practicable, a Bird Nest Mitigation Plan will be developed
C, O	If a raptor nest is found within the forested areas to be cleared, a buffer zone appropriate to the species (as determined in consultation with NSL&F) would be placed around the nest
C, O	Limit the amount of exposed soil during nesting season
C, O	Discourage ground-nesting or burrow-nesting species (such as common nighthawk and bank swallows), by limiting large piles or patches of bare soil during the breeding season, wherever practicable
C, O	Communicate regulations related to nesting birds to all site personnel, particularly focused on those priority bird species which may be attracted to Project activities. If nesting behaviour is observed, site personal are to report this activity to the Proponent so appropriate mitigation measures can be implemented as necessary
C, O	Should any ground- or burrow-nesting species initiate breeding activities on stockpiles or exposed areas, the Proponent will work with ECCC and NSE to develop buffer zones that incorporate adaptive management
C, O	Maintain speed limits on mine roads (max. 40 km/hr. within the FMS Study Area) to minimize collisions with birds
C, O	Implement dust suppression mitigation (refer to Air Mitigation)
C, O	Install downward-facing lights on site infrastructure and site roads. Wherever practicable, install motion-sensing lights to ensure lights are not turned on when they are not necessary
C, O	Conduct mobile refueling at least 30 m from any identified breeding locations
C, O	Monitor known nests around stockpiles and exposed areas from a distance with a spotting scope or binoculars to verify the effectiveness of an identified buffer until the nests are inactive

Project Phase	Mitigation Measure
C, O	Conduct routine inspections of the open pit area to remove any trapped or injured birds. If identified, determine a plan for removal in consultation with an avian expert
C, O	Notify ECCC within 24 hours in the event of the mortality or injury of ten or more migratory birds in a single event or in the event of the mortality or injury of a migratory bird SAR
O	Implement bird deterrent program at the FMS TMF if required, and continue current bird deterrent program at Touquoy (expanding to the exhausted pit if necessary)

Note: C= Construction Phase O= Operation Phase CL= Closure Phase

6.11.8 Residual Effects and Significance

The predicted residual environmental effects of the Project on birds and bird habitat are assessed to be adverse, but not significant (Table 6.11-11). The overall residual effect of the Project on birds and bird habitat is assessed as not significant after mitigation measures have been implemented.

Table 6.11-11. Residual Environmental Effects for Avifauna

Project VC Interactions	Mitigation and Compensation Measures	Nature of Effect	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect
			Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility		
Construction – FMS Mine Site Loss of habitat from clearing and grubbing	Limit habitat disturbance and minimize Project footprint during detailed design, implement speed limits, install fences where necessary, and minimize lighting. Re-establish habitats which support avifauna during reclamation	A	M VC interaction causes direct loss of habitat for birds	LAA Potential adverse effect to birds outside of FMS Study Area	A Although clearing and grubbing will occur outside of the sensitive period for birds, other activities will not	MT Effects can occur beyond 12 months and up to 7 years	O VC interaction will occur once within the construction phase	PR Mitigation cannot guarantee a return to baseline conditions	Disturbance and = habitat loss	Not significant
Construction – FMS Mine Site Disturbance (noise, light and wildlife vehicle collisions) from construction activities	Implement speed limits and minimize lighting	A	L Minor change from baseline conditions	LAA Potential adverse effect to birds outside of the PA	A VC interaction may affect seasonal aspects of birds.	ST Effects may extend up to 12 months	R VC interaction will occur at regular intervals	R VC will recover to baseline conditions	Disturbance	Not significant
Operations and Closure – FMS Study Area Disturbance (noise, light and wildlife vehicle collisions) from haul trucks and heavy machinery	Implement speed limits minimize and lighting	A	L Minor change from baseline conditions	LAA Potential adverse effect to birds outside of the PA	A VC interaction may affect seasonal aspects of birds.	MT Effects may extend beyond 12 months, and up to 7 years	R VC interaction will occur at regular intervals	R VC will recover to baseline conditions	Disturbance	Not significant
Operations – FMS Mine Site and Touquoy Mine Site Tailings deposition	Best management practices Bird Deterrent Program implementation	A	L VC interaction causes change in habitat for birds	PA VC interaction is confined to the PA.	A VC interaction may occur during sensitive period for birds	LT Effects may extend beyond 7 years	R VC interaction will occur at regular intervals	PR Mitigation cannot guarantee a return to baseline conditions	Creation of potential open water habitat; decreased water quality	Not Significant
Reclamation Stage of Closure– FMS Mine Site Re-establishment of habitat for avifauna	N/A	P	L Minor change from baseline conditions	LAA Potential adverse effect birds outside of the PA	A VC interaction may affect seasonal aspects of birds.	LT Effects can occur beyond 7 years when reclamation activities commence	O Effects occur once during the reclamation phase	PR Reclamation cannot guarantee a return to baseline condition	Habitat restoration	Not significant

Legend (refer to Table 5.10-1 for definitions)

Nature of Effect	Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility
A Adverse	N Negligible	PA Project Area	N/A Not Applicable	ST Short-Term	O Once	R Reversible
P Positive	L Low	LAA Local Assessment Area	A Applicable	MT Medium-Term	S Sporadic	IR Irreversible
	M Moderate	RAA Regional Assessment Area		LT Long-Term	R Regular	PR Partially Reversible
	H High			P Permanent	C Continuous	

A significant adverse environmental effect for birds has not been predicted for the Project for the following reasons, with consideration of the ecological and social context of the LAA surrounding the Project:

During Construction:

- Direct impacts to bird habitat are expected, however, impacts will be minimized through on-going Project design and micro-sighting of infrastructure footprints wherever practicable. Habitat will be re-established to support avifauna during reclamation, where practicable.
- The baseline habitat within the LAA consists of a network of existing fragmentation due to historical and present forestry and mining activities. The LAA is rural and undeveloped.
- Micro-siting has reduced the impact to interior forest patches within the FMS Study Area.
- Construction work will be considerate of the breeding bird season wherever practicable.
- Construction noise and light will be limited to a 12-month window.

During Operations:

- Noise will be elevated above baseline during this period and light levels will be elevated above baseline. Both may cause a displacement of birds in close proximity to the FMS Study Area. Available similar habitat is present across the broader LAA given the remote nature of the area surrounding the PA.

During Closure:

- Noise and light will be elevated above baseline, but below the predicted operational noise levels, during reclamation activities (2-3 years) involving mobile equipment. Noise and light will then drop to baseline for the post-closure period.

6.11.9 Proposed Compliance and Effects Monitoring Program

The *Migratory Birds Convention Act, 1994*, protects breeding birds in Canada and will be complied with by all site workers. Clearing or grubbing that could potentially impact breeding birds will be conducted outside the breeding season, where practicable. If avoidance of clearing during nesting is not possible, a nest survey will be completed, in consultation with CWS, prior to clearing activities. If a nest or evidence of breeding bird activity is identified, the Proponent will be notified immediately, so steps can be taken to identify the species and determine appropriate mitigation or avoidance if required. In this situation, the Proponent will also consult with appropriate regulatory agencies to determine an appropriate spatial and temporal buffer, based on site and seasonal specific parameters at the time of the observation.

As wetlands provide habitat to several priority bird species, wetland monitoring will be completed to ensure the integrity of wetland conditions is maintained.

Proposed follow-up and monitoring programs have been reviewed with the Mi’kmaq of Nova Scotia during engagement efforts including meetings, sharing of technical documents (Draft EIS, poster boards, Summary of Mi’kmaq Effects and Proposed Mitigation Measures, Plain Language Summary). On-going engagement with the Mi’kmaq will continue through the EA process and associated permitting relating to follow-up programs and monitoring.

6.12 Species of Conservation Interest and Species at Risk

6.12.1 Rationale for Valued Component Selection

SAR are protected under federal or provincial endangered species legislation. These pieces of legislation outline protection of these species and their habitats in the form of species-specific recovery strategies and action plans, where available. The level of protection offered to a listed species varies depending on its designation. SOCI represent species whose populations are either currently or potentially threatened by natural or anthropogenic factors. These species are listed as S1-S3 or any combination thereof by the ACCDC and are not designated by federal or provincial endangered species legislation. Natural systems and ecological processes often depend on healthy, diverse ecosystems. As such, understanding the distribution and diversity of rare species present within a PA is key to proper risk assessment, Project planning, and mitigation of risks posed to rare species.

6.12.2 Baseline Program Methodology

6.12.2.1 Desktop Priority Species List Methodology

Assessment of wildlife, vegetation, and habitat was completed based on the requirements outlined in the NSE Guide to Addressing Wildlife Species and Habitat in an EA Registration Document (NSE 2009b). The priority species list was used throughout the biophysical assessments to inform the field programs as it identified a broad list of priority species which have the potential to be present within the FMS Study Area. The desktop priority list was based on general species habitat requirements and the broad geographic area in which individual species are known to occur.

Development of a priority list of species for each taxonomic group was completed based on a compilation of listed species from the following sources:

- Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and the Federal Species-at Risk Act (SARA 2002). All species listed as Endangered, Threatened, or of Special Concern;
- Nova Scotia Endangered Species Act (NSESA 1999). All species listed as Endangered, Threatened, or Vulnerable; and,
- Conservation Rank: All species designated as S1, S2 or S3 or any combination thereof (i.e. S3S4 is considered a Priority Species) as defined by the ACCDC.

Collectively, this group of species is known as priority species. This umbrella grouping includes species of conservation interest (SOCI) that are not listed species under provincial or federal legislation (such as COSEWIC species and ACCDC S1, S2 and S3 species or any combination thereof), and Species at Risk (SAR) which are listed on SARA or NSESA.

The priority species list is referenced across the various biophysical assessments and is provided in Appendix G.6. See Table 6.12-1 for S-Rank definitions (ACCDC 2017).

Table 6.12-1: Provincial Status Ranks Definitions

S-rank	Definition
SX	**Presumed Extirpated** - Species or community is believed to be extirpated from the province. Not located despite intensive searches of historical sites and other appropriate habitat, and virtually no likelihood that it will be rediscovered.

S-rank	Definition
S1	**Critically Imperiled** - Critically imperiled in the province because of extreme rarity (often 5 or fewer occurrences) or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation from the state/province.
S2	**Imperiled** - Imperiled in the province because of rarity due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation from the nation or state/province.
S3	**Vulnerable** - Vulnerable in the province due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors making it vulnerable to extirpation.
S4	**Apparently Secure** - Uncommon but not rare; some cause for long-term concern due to declines or other factors.
S5	**Secure** - Common, widespread, and abundant in the province.
SNR	**Unranked** - Nation or state/province conservation status not yet assessed.
SU	**Unrankable** - Currently unrankable due to lack of information or due to substantially conflicting information about status or trends.
SNA	**Not Applicable** - A conservation status rank is not applicable because the species is not a suitable target for conservation activities.
S#S#	**Range Rank** - A numeric range rank (e.g., S2S3) is used to indicate any range of uncertainty about the status of the species or community. Ranges cannot skip more than one rank (e.g., SU is used rather than S1S4).
Not Provided	Species is not known to occur in the province.
Breeding Status Qualifiers	
Qualifier	**Definition**
B	Breeding - Conservation status refers to the breeding population of the species in the province.
N	Nonbreeding - Conservation status refers to the non-breeding population of the species in the province.
M	Migrant - Migrant species occurring regularly on migration at particular staging areas or concentration spots where the species might warrant conservation attention. Conservation status refers to the aggregating transient population of the species in the province.

As outlined above, the compilation of a priority species list is habitat driven, rather than observation driven (based on information provided in reports from ACCDC or the MBBA, for example). This is based on the recognition that observation-based datasets are not comprehensive lists of species identified in any given area. . A habitat-driven list forms a comprehensive list of all possible priority species that may be present on the landscape, based on habitat expectations for each species and presence of that habitat within the PA. As such, the information provided by observation-driven sources are supplementary to the priority species list, rather than forming the basis of the priority species list.

A list of all SAR and SOCI as defined above was compiled with habitat preferences and geographic distribution (if known) included. To complete the Project-specific priority species list, the province-wide list was narrowed based on:

- Broad geographic area (for this Project, the broad geographic area considered is central mainland Nova Scotia);
- Habitat preferences; and,
- Presence of preferred habitat within the PA based on habitat survey results.

A single desktop priority species list is developed for all seasons for the Project using this methodology. The seasonality of mobile species is not used to screen species into, or out of, the desktop priority species list. The final priority list of species used for field assessments is attached in Appendix G.6

Once the priority species list was completed, a series of additional data sources were reviewed. Sightings of priority species recorded within 5 km and 100 km by ACCDC were reviewed (reports included in Appendix G.7). One report was prepared for the FMS Study Area on June 9th 2017, and another was prepared for the Touqouy Mine Site on September 10th 2015.

When the ACCDC prepares a rare species report, they provide the user with georeferenced shapefile points of rare species records within 5 km of the center of the study area. However, NSL&F has classified several species as 'location sensitive', meaning that ACCDC is not permitted to provide specific location data for these species in their reports. Concern about exploitation of location-sensitive species precludes inclusion of coordinates in the rare species reports. Location sensitive species in Nova Scotia include black ash (*Fraxinus nigra*), blandings turtle (*Emydoidea blandingii*), wood turtle (*Glyptemys insculpta*), peregrine falcon anatum/tundrius populations (*Falco peregrinus, pop.1*), and any bat hibernaculum. If any of these species are present within 5 km of the center of the study area, the ACCDC report will simply identify that they are present, but will not provide specific location data. No location sensitive species were documented within 5 km of the PA in the ACCDC reports.

The Nova Scotia Department of Communities, Culture and Heritage provided a Environmental Screening Report of flora and fauna SAR and SOCI documented by their staff within the vicinity of the PA, and the NSL&F Significant Species and Habitats Database (SSHD) was reviewed. The Environmental Screening Report for the FMS Study Area is provided in Appendix G.5. Two additional datasets were reviewed for priority invertebrates. These include the Maritime Butterfly Atlas and Odonata Central, which provide records of butterfly and odonate observations, respectively.

The compilation of the priority species list and the review of all other available desktop resources for priority species observations is completed primarily to advise field methodology, and to inform field staff to the species they are likely to encounter during field surveys. The desktop review for priority species provided the study team with information that directly guided the methods and the timing of all field programs. All field staff reviewed the desktop evaluation for priority species prior to commencing field work. This allowed field staff to review field identification guides and ensured that they were familiar with priority species identification and their status ranks.

6.12.2.2 Field Program Methodologies

Specific field program methodologies for each taxonomic group are outlined in previous sections of this EIS (Fish and Fish Habitat, Flora and Habitat, Terrestrial Fauna, and Birds). These sections describe the detailed and specific field program methods (if any) to identify SAR and SOCI within the FMS Study Area. Specific field program methods are shown on associated figures within their respective sections.

Methods and results from SAR/SOCI surveys within the FMS Study Area are discussed below. Information pertaining to Touquoy Mine Site has been brought forward from the EARD and Focus Report. Methods and results are referred to in subheadings within the applicable sections; however, the data is not being reevaluated. For further information regarding Touquoy Mine Site refer to the EARD (CRA 2007a) and Focus Report (CRA 2007b).

6.12.2.2.1 *Priority Fish Survey Methodology*

No targeted methods were employed specifically for priority fish species. The diversity of fish survey methods employed (habitat assessments, eel pots, fyke nets, minnow traps and electrofishing) were used with the goal of capturing the broadest diversity of fish species present within the FMS Study Area. Section 6.8.2 outlines detailed fish survey methods used in the FMS Study Area.

6.12.2.2.2 *Priority Vascular Flora Survey Methodology*

No specific targeted surveys for priority vascular plant species were completed although all surveys for vascular plants were focused towards habitats where rare plants were more likely to be present across the FMS Study Area.. Botanical surveys were completed in all habitats throughout the FMS Study Area to compile a comprehensive list of vascular flora species present within the FMS Study Area. Botanists conducting vascular plant surveys thoroughly reviewed the results of the desktop evaluation for vascular flora priority species. This allows the botanical surveys to focus on habitats with elevated potential for any priority vascular flora species.

Vascular plant assessments occurred early and late in the growing season to capture plant species with different phenology. Spring surveys were completed to capture spring ephemerals and early developers on June 14th -16th, 19th -20th, 2017 and on June 4th - 5th, 2018. Late season surveys were completed on September 27th – 30th, October 2nd, 2017, September 17th, 2018, and August 21st, 2019 to capture species developing later in the season. Surveys were completed by Dr. Nick Hill, Mr. John Gallop, and Ms. Melanie MacDonald. Vascular flora survey methods are outlined in Section 6.9.2.

The following information was collected for any priority vegetation species identified during field surveys: site location, date, scientific name, count, size, habitat, location (UTM NAD83 CSRS), along with a photograph and any relevant comments. Any specimens that could not be identified in the field were photographed in order to aid in identification.

6.12.2.2.3 *Priority Lichen Survey Methodology*

Prior to completing the field assessment for priority lichens, a detailed desktop review of known lichen observations and potential habitat for rare lichens within and surrounding the FMS Study Area was conducted. The desktop review involved a review of the following four components:

- the priority species list;
- predictive habitat mapping for boreal felt lichen (provided by NSL&F), a review of the extant populations of boreal felt lichen, vole ears (*Erioderma mollissimum*) and lichen database (provided by MTRI);
- existing and proposed Critical Habitat mapping for vole ears and boreal felt lichen provided by ECCC-CWS; and,
- results of wetland and habitat mapping.

To develop the predictive habitat maps for boreal felt lichen, NSL&F used an algorithm which identifies all forest stands in the provincial forestry database in which balsam fir is listed as a primary or secondary species and which occur within 80 m of a mapped bog or fen. The model further confines the search to only those forest stands located within 30 km of the Atlantic Coast. This was used to predict areas with a higher potential of locating boreal felt lichen. This data set was reviewed in advance of field assessment and was uploaded onto the assessors' GPS units during field assessments. MEL biologists reviewed the survey requirements outlines in the Special Management Practices for at-risk lichens (NSL&F, 2018) prior to completing lichen surveys. Other habitats identified by the MEL biologists as suitable for rare lichens were surveyed as well.

While the specific habitat requirements of each priority lichen species vary slightly, they all require mature to over-mature forests. Stand age is one of the greatest determinants of lichen diversity (McMullin, Duinker, Cameron, Richardson & Brodo, 2008). Lichen surveys throughout the FMS Study Area were focused on undisturbed stands, particularly those located near mapped wetlands, as these habitats have elevated potential for identifying priority lichen species.

All suitable habitats within the FMS Study Area were surveyed on November 12th-13th, November 23rd-24th, 2017, September 17th 2018 and August 21st 2019 for priority lichen species. Lichens were also recorded incidentally during the vascular plant and additional biophysical surveys conducted in 2018-2019. Mature trees that are appropriate for hosting priority lichen species were visually inspected by a qualified lichenologist. The visual inspections focused on tree trunks but included branches and twigs where it was determined to be safe and appropriate. The following information was collected for any priority lichen species identified during field surveys: site location, date, scientific name, count, size, habitat (host tree and general habitat), location (waypoint in UTM NAD83), height of the specimen, direction that the specimen was facing, along with a photograph and any relevant comments. In the event that a lichen specimen could not be readily identified in the field, photos and/or specimens were collected and identified at a later date. If necessary, collected samples were inspected with microscopy and standard chemical spot tests in accordance with Brodo et al. (2001) to identify to the species level. For further information regarding literature used in the identification process, see Section 6.9.

6.12.2.2.4 *Priority Terrestrial Fauna Survey Methodology*

6.12.2.2.4.1 Mainland Moose Survey Methodology

The Endangered Mainland Moose Special Management Practices Report (NSDNR 2012b) and the Status Report of the Eastern Moose (Parker 2003) were consulted to determine the level of concern associated with mainland moose.

Tracking surveys were completed to determine if Mainland Moose are present within the FMS Study Area and surrounding landscape. Moose transects were also completed outside of the FMS Study Area to serve as reference sites. Forty transects, approximately 1 km in length, were established through representative habitat types. An observer capable of identifying moose and white-tailed deer tracks, browse and scat competed the surveys. These were completed in winter conditions on January 20th – January 22nd 2018, March 26th – March 27th 2018 and April 11th – 12th 2018. One Pellet Group Inventory (PGI) survey was completed along these same transects on February 27th – 28th 2018 due to limited snow cover. Winter track surveys were completed following a 10 cm snowfall, within 3-7 days with no additional precipitation. Locations of moose and deer tracks, browse and scat were recorded using a handheld GPS unit. Incidental observations of other wildlife species, tracks, and scat were also recorded.

If a moose sign was encountered during dedicated surveys or incidentally during other field programs, MEL completed a moose sign microhabitat assessment form. This form is used to collect data relating to the survey type, weather and tracking conditions, type of sign observed, forest type, approximate stand age, and location of the sign in relation to nearest watercourse, wetland and road. Photographs of the moose sign were also taken.

6.12.2.2.4.2 Bat Survey Methodology

A desktop evaluation of potential bat habitat was conducted to determine level of concern associated with the Project and to determine whether field assessments were necessary. The desktop evaluation commenced with a review of known bat occurrences and bat hibernacula as noted in the ACCDC report, and the SSHD. The Recovery Strategy for Little Brown Myotis (*Myotis lucifugus)*, Northern Myotis (*Myotis septentrionalis)* and Tri-colored Bat (*Perimyotis subflavus)* in Canada (EC 2015a) was reviewed to identify the Projects' proximity to known hibernacula as well.

According to Holroyd and Craig (2016), to assess effects to hibernating bats, blasting should ensure sound concussion of less than 150 decibels or maintain a setback of 2 km from occupied significant roost sites. The provincial government records for AMOSs were reviewed (Hennick and Poole, 2016) within a 5 km radius of the site, as these AMOs potentially provide bat hibernacula if they have not been capped or flooded. All AMOs within 5 km of the FMS Study Area were assessed through desktop and field evaluation. Desktop evaluation of AMOs included reviewing data related to mine shaft type, access, original depth, degree of hazard and escape potential.

MEL assessed each location to determine whether the AMO had been infilled or naturally flooded. Any AMOs which were neither infilled nor flooded would require further investigation, and potentially deployment of an AnaBAT Roost Logger. The field evaluation of all AMOs occurred on August 2nd, 2017 and July 4th, 2018 to identify potential bat hibernacula. During all other surveys completed within the FMS Study Area, MEL biologists were trained to evaluate landscapes for potential hibernacula habitat, including natural caves or anthropogenic habitats such as mine openings, excavations or abandoned wells.

Most species of bats native to NS roost amongst tree foliage or within tree cavities throughout the summer. Old growth trees in mixed wood/deciduous forests are typically preferred as they offer the tree sizes required for suitable roosting habitat; the exception being the little brown bat which prefers to roost in buildings, although tree cavities are sometimes used. Maternity roosts typically mimic summer roosting habitats and pups are moved by the mother between roost sites throughout the season. Again, the exception is the Little Brown Bat that typically selects buildings for maternity roosts and will generally stay at the selected site until the pup is weaned (Naughton, 2012).

Foraging occurs over various habitats with species specializing between clearings, forest edge and tree canopy areas. Foraging also occurs at various height intervals between the native bat species ranging from ground level to above the tree canopy. However, most bat species native to Nova Scotia forage near or over open water (Naughton, 2012). MEL biologists recorded evidence of any bat usage within the FMS Study Area during all biophysical surveys, primarily during avifauna surveys which are typically conducted at dawn or dusk, when many bats are more active.

6.12.2.2.4.3 Priority Herpetofauna Survey Methodology

Wood turtles and snapping turtles are SAR which have been identified as having the potential to be present within the FMS Study Area based on habitat preference and known distribution. The wood turtle prefers clear rivers, streams or creeks with moderate current and sandy or gravelly substrate (ECCC 2016b). The snapping turtle occurs in almost any freshwater habitat, though it is most often found in slow-moving water with a soft mud or sand bottom and abundant vegetation (ECCC 2016c).

Three wood turtle surveys were conducted on May 18th, May 24th and on May 30th 2018 on watercourses 1 and 21 (Figure 6.10-1). No other suitable wood turtle habitat was identified within the FMS Study Area that would warrant a detailed survey for wood turtles. The MEL biologists continued to look for signs of turtle usage during all other site surveys, particularly suitable nesting habitat along watercourses throughout the FMS Study Area.

Wood turtle survey methods were completed in accordance with the Wood Turtle (*Glyptemys insculpta*) Standardized Water-based Survey Protocol (Ikanawtiket Environmental Inc. 2018). Wood turtles are typically associated with some form of vegetative structure, therefore the MEL biologists searched for turtles at the base of woody shrubs, under or near deadfall, and amongst grasses or leaf litter. The ground and undergrowth were searched from the waters' edge inland to 20 m along one side of the watercourse at a time. Wood turtles are active in temperatures over 9˚C, but best results are found when temperatures range from 15-20˚C. Observations drop off significantly when temperatures exceed 25˚C. Ambient temperature appears to be as good an indicator of the probability of detection as sunlight, so surveys can occur on cloudy days. As long as air temperature is warmer than water temperature, there is a thermal advantage to basking on land (ECCC 2016b).

Opportunistic observations for snapping turtles and suitable habitat were documented through all field programs, particularly wetland and watercourse evaluations. Biologists conducting field assessments searched for snapping turtles in aquatic ecosystems with slow moving water, mucky substrate, and dense vegetation. During June, particular attention was paid to identifying snapping turtles, wood turtles, or signs thereof (i.e., test scrapes or depredated nests) along exposed gravel including roadside shoulders, when turtles move to these habitats to nest.

The FMS Study Area was also surveyed for herpetofauna during other field programs, particularly wetland and watercourse assessments, with special attention paid towards identifying any signs of turtle usage. Signs such as animal sightings, vocalizations, amphibian egg masses, cast snake skins, turtle nest scrapes, or depredated nests were recorded during any field programs by biologists capable of recognizing these signs.

6.12.2.2.4.4 Priority Invertebrate Survey Methodology

A desktop review for rare invertebrates was completed. This included reviewing species records in the vicinity of the FMS Study Area provided by Odonata Central, the Maritime Butterfly Atlas, and the ACCDC reports for Odonates, Lepidopterans and all other invertebrates, respectively. Incidental observations for priority invertebrates occurred during all field programs, particularly wetland and watercourse delineation, and fish habitat surveys by the team of MEL biologists. Incidental observations of odonates and lepidopterans include live adults or larvae or cast skins. Signs of freshwater molluscs include live or dead individuals and shells.

6.12.2.2.5 *Priority Avifauna Survey Methodology*

The second atlas of the MBBA was reviewed to determine possible, probable, and confirmed records of breeding avian SAR and SOCI in proximity to the FMS Study Area. The FMS Study Area falls within a single 10 km^2 MBBA survey square (20NQ38). The results of MBBA desktop review are presented in Section 6.11.3 and provided in Appendix L.1.

Targeted surveys for the common nighthawk were completed throughout the FMS Study Area. Suitable habitat is available for this species within the FMS Study Area, therefore, dedicated surveys for the common nighthawk were conducted on June 11th, June 12th, June 27th and July 8th 2017 at dusk (30 minutes before sunset to an hour after sunset), as described in the Common Nighthawk Survey Protocol (Saskatchewan Ministry of Environment, 2015). Stations were spaced at least 800 m apart and a point count survey with call playback was used to detect the presence of common nighthawk within the FMS Study Area. A three-minute passive point count was conducted at each station, followed by a call playback which includes 30-seconds of the conspecific common nighthawk call followed by 30-seconds of silence (or passive surveying), repeated for three-minutes (i.e., three times). The total time spent at each survey point was a minimum of six-minutes. Thirteen call playback stations were surveyed within the FMS Study Area.

No other targeted surveys for priority bird species were conducted, as all other species are anticipated to be detectable during standard methods for bird surveys.

During data analysis, breeding status qualifiers are used to identify which avian species are considered SOCI, based on the season in which they were observed. Breeding status qualifiers are defined by the Maritime Breeding Bird Atlas, and assigned to each species by the ACCDC. SAR are considered priority species, regardless of the seasonality of their observation. For instance, a bird with an S-Rank of S2S3B,S5N (such as the pine grosbeak) would not be considered a priority species if observed overwintering (the N qualifier represents a non-migratory, or overwintering population). Conversely, a species ranked S5B, S3N (such as the American robin) would not be considered a priority species if observed during migration or breeding season, and would only be considered a priority species of observed overwintering. Some species do not have a compound rank assigned with varying seasonal considerations, such as the turkey vulture (ranked S2S3B). This species has no alternate ranking status for migratory or overwintering populations, therefore this species, by default, would be considered a priority species regardless of its' observation date.

6.12.3 Baseline Conditions

6.12.3.1 Priority Fish Species and Habitat

6.12.3.1.1 *FMS Study Area Baseline Conditions*

The desktop evaluation for priority fish species revealed that Atlantic salmon (Nova Scotia Southern Uplands population) and brook trout were recorded within 5km of the FMS Study Area by the ACCDC. No location sensitive species of fish have been identified within 5 km of FMS Study Area according to the ACCDC report. The following priority fish species are identified as having an elevated potential to be located within the FMS Study Area, based on habitat preferences, and broad geographic area (See Table 6.12-2).

Table 6.12-2. Priority fish species with elevated potential to occur in the FMS Study Area.

Latin Name	Common Name	SARA, COSEWIC, NSESA	S-Rank
Anguilla rostrata	American eel	COSEWIC: Threatened	S2
Salmo salar	Atlantic salmon – Southern Uplands Population	COSEWIC: Endangered	S1
Salvelinus fontinalis	brook trout		S3
Culaea inconstans	brook stickleback		S3
Margariscus margarita	pearl dace		S3

As described in Section 6.8.2, all fish survey methods were designed to identify the diversity of species within the diversity of habitats present within the FMS Study Area, including any priority species. Field survey locations for various fish programs are shown on Figure 6.8-2. No species-specific targeted surveys were completed for priority fish species. Within the FMS Study Area, two priority species, brook trout and pearl dace, were identified during electrofishing and fish collection. Although they were not observed, the American eel has been previously documented by NSPI and has suitable habitat within the FMS Study Area, and therefore may be present. No fish SAR have been documented during fish surveys completed within the FMS Study Area.

Atlantic salmon was not observed during any fish sampling programs within the FMS Study Area. However, Atlantic salmon were historically abundant within the East River Sheet Harbour river system, which is potentially why their documented range according to the ACCDC extends into the FMS Study Area. ACCDC was not able to verify the source or date of the Atlantic salmon range data. With the installation of hydroelectric dams and increased acidification of the river system, the East River Sheet Harbour has been determined to be “largely inaccessible to anadromous fishes since the early 1920s” (O’Neil et al. 1997) and “partially impacted by acidification, and may yet have remnant populations of salmon” (DFO 2000). During the 1990s, this species was released into Fifteen Mile Stream through a trap and truck system as part of a five-year management plan for anadromous fisheries resources in the East River (O'Neil et al. 1997). The species is therefore presumed to have populated several tributaries to this watercourse, including tributaries found within the FMS Study Area.

Despite the considerable amount of resources directed towards managing the Atlantic salmon on the East River Sheet Harbour, adult returns to the river in the from 2004 -2007 averaged less than 5 fish (NSPI, 2009). Watt (1997) described salmon in the East River as a remnant population where some may survive in one or two higher pH tributaries. No salmon were reported in the NS Fisheries and Aquaculture surveys completed in 1973, 1993 and 1995 in the local watershed area around the FMS Study Area. Research is also suggesting that factors [unknown] other than acidification are reducing salmon production in fresh water throughout the Southern Upland (Gibson et al. 2010). The presence of Atlantic salmon within the FMS Study Area is therefore unlikely, and any Atlantic salmon which may be present in watercourses found within the FMS Study Area would be remnant individuals of an isolated population.

Specific information regarding the two priority fish species found within the FMS Study Area is presented below:

6.12.3.1.1.1 Brook Trout

Brook trout (S3) are known to inhabit a wide range of cool, freshwater environments, from small headwater streams to large lakes. If river habitat is suitable for brook trout and they do not experience any stressors throughout the year, they tend not to travel large distances. Most brook trout populations existing in larger rivers act this way, not moving until the fall at the onset of spawning. Even then, if the river has adequate habitat diversity, they tend not to travel large distances. Other populations have adapted to various river conditions; they travel very large distances (>120 km) in search of thermal refuge and spawning habitat. Water temperature is a critical factor influencing brook trout distribution and production. Though typically not anadromous, brook trout require free passage along streams to move between areas of use, including spawning grounds, overwintering, summer rearing areas.

In Nova Scotia, mature brook trout migrate to spawn in lakes or streams in the fall of the year. Trout spawning sites are usually near groundwater upwelling or spring seeps and within a lake or stream with gravel substrate (NSDFA 2005). Optimal spawning conditions for brook trout include clear substrate 3-8 mm in size with limited fines (<5%), and velocities of 25-75 cm/s (Raleigh 1982).

Juvenile rearing areas require cold water, stable flow, and an abundance of cover. Optimal temperature for juvenile growth is 10-16°C, while cover in the form of deep water, overhanging and in-stream vegetation, undercut banks, woody debris, and rocky substrate should account for a minimum of 15% of total stream area (Raleigh 1982). In winter, brook trout aggregate in pools beneath silt-free rocky substrate and close to point sources of groundwater discharge (Raleigh 1982; Cunjak and Power 1986). Adult fish use both pools and riffles, with more than 25% in-stream cover being optimal (Raleigh 1982). Brook trout respond negatively to flashy or hydrologically dynamic systems, and require stable flow for all life stages (Raleigh 1982). According to Scott and Crossman (1973), brook trout "will eat any living creature its mouth can accommodate", including prey items encompassing over 80 genera of aquatic insects, terrestrial insects, fishes (including other brook trout and eggs), amphibians, and even small reptiles and mammals. As such, they are generalized feeders which can take advantage of an available prey source.

Within the FMS Study Area, fifteen individual brook trout were observed within Watercourses 1, 6, 12, 20 and 24 with suitable habitat types which support rearing, overwintering, foraging, refuge and passage. All of these watercourses where brook trout were observed are contiguous with WL2 and fish habitat (i.e., open water) is present within the wetland.

6.12.3.1.1.2 Pearl Dace

The pearl dace (S3) is a common cold-water species that tends to congregate in clear headwater streams (Scott and Crossman 1973), preferring water temperatures of 16°C (Stauffer et al. 1984). The species been shown to have a strong habitat preference for sinuous, slow moving, spring-fed streams with heavy cover and a lack of large predatory fishes (Cunningham 2006). Pearl dace spawn in spring, during which eggs are deposited over rock, rubble, or gravel substrates (Cunningham 2006). Pearl dace feed upon a variety of invertebrates including copepods, cladocerans, chironomids and beetles, as well as algae (Scott and Crossman 1973). Within the FMS Study Area one pearl dace was observed in Watercourse 1. Within portions of this watercourse, ponding of water exists within WL2 which provides fish habitat.

6.12.3.1.1.3 Priority Fish Summary: FMS Study Area

Although American eel were not observed within the FMS Study Area, the species has been previously documented and suitable habitat is present, therefore, there is potential for eel to be present within the FMS Study Area. Migration of American eel and Atlantic salmon into the FMS Study Area is limited due to the presence of multiple downstream hydroelectric dam structures which have acted as barriers to upstream fish passage since initial dam construction during the 1920's.

No fish SAR were observed within the FMS Study Area. Two priority species of fish were identified during field surveys (brook trout, S3, and pearl dace, S3). Quality spawning habitat for Brook Trout was limited within the FMS Study Area, as described in Section 6.8. No other fish SAR or SOCI were observed and aside from potential for American eel, no other priority species are expected based on habitat, species distribution, and survey effort completed within the FMS Study Area.

6.12.3.1.2 *Touquoy Mine Site Baseline Conditions*

Moose River, within the Touquoy Mine Site, provides habitat for Atlantic salmon and brook trout. Good juvenile and rearing habitat and potential spawning habitat is available for Atlantic salmon. Several juvenile Atlantic salmon were observed in 2006, however, these species were believed to be from the landlocked population known to Scraggy Lake. Good adult and juvenile brook trout feeding habitat, fair rearing habitat, and potential spawning habitat is available within Moose River (CRA 2007a).

The Nova Scotia Department of Agriculture and Fisheries conducted a fisheries resource study in Scraggy Lake in July of 1975. Fish captured included; brook trout and American eel. Atlantic salmon smolts were recorded during creel census in 1979. Fingerling landlocked Atlantic salmon and brook trout were stocked in Scraggy Lake between 1998-2000 and 1994-1996, respectively (CRA 2007a).

To support permitting within the Touquoy Mine Site, MEL completed fish surveys within the historic Mini-Pit, which has since been excavated to support development of the main pit. On July 5th, 2016, fish habitat surveys were conducted using a Go-Pro attached to extendable rods with a scuba diving light to capture footage at depths of 1.5 m and 10 m. Transects were completed around the perimeter of the mini-pit above the rocky littoral shelf. The mini-pit contained un-natural banks which abruptly dropped at a 90-degree angle with the sparse vegetation and suitable nesting substrate. The littoral zone comprised mainly of blasted boulders and cobble. During these surveys, brook trout were incidentally observed.

Fish surveys were completed on June 19th and June 20th, 2017 to determine the species present in the Mini Pit. Gill nets, eel pots, minnow traps, rod and reel fishing were place within various portions of the mini pit. During the surveys the species observed were: white sucker (S5), creek chub (S5), dace sp. (S5) and brook trout (S3).

6.12.3.2 Priority Vascular Flora and Lichen Species

6.12.3.2.1 *FMS Study Area Priority Vascular Flora Baseline Conditions*

The desktop evaluation for priority species of vascular flora revealed that one SOCI, the Pennsylvania smartweed (*Persicaria pensylvanicum*, S3) has been observed within 3km of the FMS Study Area (ACCDC report).

Table 6.12-3 provides a list of vascular plant priority species which have elevated potential to be located within the FMS Study Area based on habitat preferences and known distribution. Species which have been documented within the vicinity of the FMS Study Area by the Environmental Screening Report are highlighted in bold text and species observed within 5 km by ACCDC are underlined.

Table 6.12-3. Vascular flora species with elevated potential to occur within the FMS Study Area

Latin Name	Common Name	SARA, COSEWIC, NSESA	S-Rank
Agalinis paupercula	Small-flowered Agalinis		S1
Allium tricoccum var. *burdickii*	Narrow-Leaved Wild Leek		S1?

Latin Name	Common Name	SARA, COSEWIC, NSESA	S-Rank
Allium schoenoprasum	Wild Chives		S2
Allium schoenoprasum var. sibiricum	Wild Chives		S2
Allium tricoccum	Wild Leek		S1
Antennaria rosea and ssp. arida	Rosy Pussytoes		S1
Bartonia virginica	Yellow Bartonia		S3
Betula borealis	Northern Birch		S2
Betula pumila var. pumila	Bog Birch		S3
Betula pumila var. renifolia	Bog Birch		S1?
Botrychium lanceolatum var. angustisegmentum	Narrow Triangle Moonwort		S2S3
Bromus latiglumis	Broad-Glumed Brome		S1
Cardamine pratensis var. angustifolia	Cuckoo Flower		S1
Carex alopecoidea	Foxtail Sedge		S1
Carex argyrantha	Silvery Flowered Sedge		S3S4
Carex granularis	Limestone Meadow Sedge		S1
Carex grisea	Inflated Narrow-leaved Sedge		S1
Carex haydenii	Hayden's Sedge		S1
Carex hirtifolia	**Pubescent Sedge**		**S2S3**
Carex lapponica	Lapland Sedge		S1?
Carex peckii	White-Tinged Sedge		S2?
Carex plantaginea	Plantain-Leaved Sedge		S1
Carex tribuloides var. tribuloides	Blunt Broom Sedge		S3
Carex wiegandii	Wiegand's Sedge		S3
Caulophyllum thalictroides	**Blue Cohosh**		**S2**
Cypripedium reginae	**Showy Lady's-Slipper**		**S2**

Latin Name	Common Name	SARA, COSEWIC, NSESA	S-Rank
Eleocharis erythropoda	Red-stemmed Spikerush		S1
Eleocharis ovata	Ovate Spikerush		S2?
Endotropis alnifolia	**Alder-leaved Buckthorn**		**S3**
Epilobium strictum	Downy Willowherb		S3
Equisetum hyemale	Common Scouring-rush		S3S4
Equisetum hyemale var. affine	Common Scouring-rush		S3S4
Equisetum palustre	Marsh Horsetail		S1
Equisetum variegatum	Variegated Horsetail		S3
Equisetum variegatum var. variegatum	Variegated Scouring-rush		S3
Eriophorum gracile	Slender Cottongrass		S2S3
Eriophorum gracile var. gracile	Slender Cottongrass		S2S3
Fraxinus nigra	Black Ash	NSESA Threatened	S1S2
Galium aparine	Common Bedstraw		S2S3
Galium obtusum ssp. obtusum	Blunt-leaved Bedstraw		S2S3
Geocaulon lividum	Northern Comandra		S3
Goodyera pubescens	Downy Rattlesnake-Plantain		S2
Halenia deflexa ssp. brentoniana	Spurred Gentian		S1?
Hordeum brachyantherum	Meadow Barley		S1
Hordeum brachyantherum ssp. brachyantherum	Meadow Barley		S1
Humulus lupulus var. lupuloides	Common Hop		S1?
Hypericum majus	Large St John's-wort		S2
Isoetes acadiensis	Acadian Quillwort		S3
Juncus subcaudatus	Woods-Rush		S3
Juncus subcaudatus var. planisepalus	Woods-Rush		S3

Latin Name	Common Name	SARA, COSEWIC, NSESA	S-Rank
Lachnanthes caroliniana	Redroot	COSEWIC Special Concern, NSESA Vulnerable	S2
Lilium canadense ssp. canadense	Canada Lily		S2
Liparis loeselii	Loesel's Twayblade		S3S4
Lycopodium sabinifolium	Ground-Fir		S3?
Lysimachia quadrifolia	Whorled Yellow Loosestrife		S1
Neottia bifolia syn. Listera australis	Southern Twayblade		S3
Ophioglossum pusillum	Northern Adder's-tongue		S2S3
Panicum dichotomiflorum var. puritanorum	Spreading Panic grass		S1?
Panicum tuckermanii	Tuckerman's Panic grass		S3S4
Persicaria careyi	Carey's Smartweed		S1
Persicaria pensylvanicum	Pennsylvania Smartweed		S3
Pinguicula vulgaris	Common Butterwort		S1
Platanthera flava var. herbiola	Pale Green Orchid		S2
Platanthera hookeri	Hooker's Orchid		S3
Potamogeton obtusifolius	Blunt-leaved Pondweed		S3
Potamogeton pulcher	Spotted Pondweed	NSESA - Vulnerable	S2S3
Potamogeton zosteriformis	Flat-stemmed Pondweed		S3
Rudbeckia laciniata	Cut-Leaved Coneflower		S1S2
Salix pedicellaris	Bog Willow		S2
Salix serissima	Autumn Willow		S1
Schizaea pusilla	Little Curlygrass Fern		S3S4
Silene antirrhina	Sleepy Catchfly		S1
Solidago latissimifolia	Elliott's Goldenrod		S3S4
Spiraea septentrionalis	Northern Meadowsweet		S1?

Latin Name	Common Name	SARA, COSEWIC, NSESA	S-Rank
Stellaira crassifolia and var. crassifolia	Fleshy Stitchwort		S1
Torreyochloa pallida var. pallida	Pale False Manna Grass		S1
Triosteum aurantiacum	Orange-fruit Tinker's Weed		S2S3
Vaccinium uliginosum	Alpine Bilberry		S3
Vallisneria americana	Wild Celery		S2
Verbena hastata var. hastata	Blue Vervain		S3
Viola nephrophylla	Northern Bog Violet		S2
Viola sagittata	Arrow-Leaved Violet		S3S4
Viola sagittata var. ovata	Arrow-Leaved Violet		S3S4
Zizia aurea	Golden Alexanders		S1

Note: *Speices in bold have been documented within the vicinity of the FMS Study Area by the Environmental Screening Report (Appendix G.5). Those underlined have been documented within 5km of the FMS Study Area by the ACCDC (G.7).

A total of 277 species of vascular flora have been identified in field assessments within the FMS Study Area. No SAR vascular plant species were observed. Three plants that were observed are priority species (SOCI), based on provincial status ranks (S3 and S3S4). These SOCI identified within the FMS Study Area are outlined in Table 6.12-4 and locations shown on Figures 6.9-2 and 6.12-1.

Table 6.12-4. Vascular flora SOCI observed within the FMS Study Area

Scientific name	Common name	COSEWIC, SARA, NSESA	S-Rank	Location within FMS Study Area
Carex agyrantha	Silvery flowered sedge	-	S3S4	Observed in one location south of WL 211 in upland habitat on a side of a road. One clump was observed.
Carex wiegandii	Wiegand's sedge	-	S3	Observed in one location in WL 27.
Neottia bifolia syn. Listera australis	Southern twayblade	-	S3	Nine locations observed with a total of 33 individuals within WLs 1, 18, 40, 64, 180 and 221 which consist of peatlands such as fens, bogs and swamps.

6.12.3.2.1.1 Silvery Flowered Sedge

The Silvery Flowered Sedge (*Carex argyrantha*) was identified in one location within the FMS Study Area. This species is a member of the Cyperoideae section of the genus *Carex*. This section is a large section characterized by its flat and 'winged' perigynia. This species grows in loose tufts with a silvery-green drooping inflorescence and often found growing in dry, sandy or acidic soils in wooded areas as well as fields and road edges. In Nova Scotia, silvery flowered sedge is considered to be apparently secure/vulnerable by the ACCDC (S3S4). One clump of the silvery flowered sedge was found south of Wetland 211 in upland habitat on a side of a road.

6.12.3.2.1.2 Wiegand's Sedge

Wiegand's sedge (*Carex wiegandii)* was identified in one location within the FMS Study Area. This species is a member of the Stellulatae section of the genus *Carex*. This species grows in a tuft formation in acidic peatlands, black spruce and larch bogs, and conifer and alder thickets. Wiegand's sedge was observed in a large bog (WL27) with peat accumulations of exceeding 40 cm. In Nova Scotia, Wiegand's sedge is considered vulnerable by ACCDC (S3). Wiegand's sedge grows in clumps or clusters of many individual plants. One observation of C*. wiegandii* was observed and the population consisted of 1 clump, approximately $1m^2$ in size.

6.12.3.2.1.3 Southern Twayblade

Southern twayblade (*Neottia bifolia syn. Listera australis*) is a small inconspicuous member of the orchid family (Orchidaceae), characterized by its reddish snake-tongue-like labellum, opposite ovate-oblong basal leaves and scape lacking cauline leaves. This species belongs to the unique Atlantic Coastal Plain Flora (ACPF) community with an affinity for peatlands such as bogs, fens and swamps which usually contain variable microtopography and microhabitats. Often this species is found on the toe of hummocks. Nine observations, with a total of 33 individuals were observed within WLs 1, 18, 40, 64,180 and 221 in predominantly fens and bogs. Its distribution is scattered throughout NS and is considered vulnerable by the ACCDC (S3).

6.12.3.2.1.4 Priority Vascular Flora Summary: FMS Study Area

No vascular flora SAR were identified and three vascular plant SOCI were identified within the FMS Study Area (*Carex wiegandii, Carex argyrantha,* and *Neottia bifolia)*. Three additional SAR species were identified as having elevated potential to be located within the FMS Study Area based on habitat preference and known distribution. These species, listed in Table 6.12-3, are redroot (*Lachnanthes caroliniana*, SARA & COSEWIC special concern, NSESA vulnerable), spotted pondweed (*Potamogeton pulcher*, NSESA vulnerable), and black ash (*Fraxinus nigra*, NSESA threatened). The preferred habitats for each of these species were focused on during all vegetation, habitat, and wetland delineation surveys. None of these species were identified within the FMS Study Area. All priority vascular plant species identified in the FMS Study Area are shown on Figure 6.9-2.

Within the FMS Study Area, direct loss to known populations of southern twayblade and Wiegand's sedge are expected due to infrastructure placements. The only observed population of Wiegand's sedge within the FMS Study Area is expected to be lost as a result of the development of the TMF and associated infrastructures. Southern twayblade populations are also expected to be lost due to infrastructure however, other populations exist away from proposed infrastructure and are not expected to be affected by the Project.

6.12.3.2.2 *Touquoy Mine Site Baseline Conditions*

No SOCI plants were observed during vascular plant surveys conducted in August 2004, May and June 2005, and September 2006 as part of the EARD process (CRA 2007a).

One black ash (*Fraxinus nigra*) was discovered within the Touquoy Mine Site incidentally during wetland surveys in September 2015. The permitted loss of the black ash as part of Touquoy Mine Site development occurred in the Spring of 2016, after the Mi'kmaq of Nova Scotia were consulted.

6.12.3.2.3 *FMS Study Area Priority Lichen Baseline Conditions*

The desktop evaluation for priority species of lichens revealed that no rare lichens have been documented within 5km of the FMS Study Area by the ACCDC. NSL&F has not determined any lichen species to be 'location sensitive'. A desktop review of various lichen databases provided by MTRI and NSL&F have revealed priority lichen species and their habitats have been recorded and predicted to be within and/or surrounding the FMS Study Area. ECCC-CWS provided MEL with proposed Critical Habitat Layers for boreal felt lichen and vole ears. These data indicate that the nearest proposed critical habitats for these species are 5 km and 15 km to the southeast, respectively. Furthermore, the 'At Risk Lichens – Special Management Practices' (NSL&F, 2018) has been reviewed. This SMP outlines the importance for maintaining microclimates surrounding rare lichens, to promote long term survival of rare lichens. This SMP is applicable to all lichens located on Crown lands, however other activities, such as those subject to an EA process may use this SMP for guidance.

The lichen, vole ears and boreal felt lichen database provided by MTRI (2019a,b) shows an extant boreal felt lichen population just under 4 km north east of the FMS Study Area. Other boreal felt lichen habitat indicator species such as salted shell lichen (*Coccocarpia palmicola*) were observed approximately 3 km south west of the FMS Study Area. Additionally, blue felt lichen (SAR) was observed approximately 120 m east of the FMS Study Area and eastern candlewax lichen (SOCI) has also been known to occur within the FMS Study Area.

According to the predictive boreal felt lichen habitat layer provided by NSDNR (2010) twenty-six predictive boreal felt lichen habitat polygons are present within the FMS Study Area. Based on habitats types present within the FMS Study Area and surrounding land and a desktop review of species known in the area, a priority list (Table 6.12-5) of lichen species with an elevated potential to occur within the FMS Study Area was created. No lichen species were documented in the Environmental Screening Report (Appendix G.5).

Table 6.12-5.Priority lichen species with elevated potential to occur within the FMS Study Area

Scientific Name	Common Name	COSEWIC, SARA, NSESA	S-Rank
Anzia colpodes	Black-foam Lichen	SARA, COSEWIC & NSESA Threatened	S3
Erioderma mollissimum	Graceful Felt Lichen (Vole Ears Lichen)	SARA, COSEWIC & NSESA Endangered	S1S2
Erioderma pedicellatum (Atlantic pop.)	Boreal Felt Lichen - Atlantic pop.	SARA, COSEWIC & NSESA Endangered	S1
Pannaria lurida	Veined Shingle Lichen (Wrinkled Shingle Lichen)	SARA, COSEWIC & NSESA Threatened	S1S2
Pectenia plumbea (syn. Degelia plumbea)	Blue Felt Lichen	SARA & COSEWIC Special Concern, NSESA Vulnerable	S3
Sclerophora peronella (Nova Scotia pop.)	Frosted Glass-whiskers Lichen - Nova Scotia pop.	SARA & COSEWIC Special Concern	S1?
Ahtiana aurescens	Eastern Candlewax Lichen		S2S3
Cladina stygia	Black-footed Reindeer Lichen		S3?
Collema leptaleum	Crumpled Bat's Wing Lichen		S2S3

Scientific Name	Common Name	COSEWIC, SARA, NSESA	S-Rank
Fuscopannaria ahlneri	Corrugated Shingle Lichens		S3
Fuscopannaria leucosticta	Rimmed Shingles Lichen		S2S3
Fuscopannaria praetermissa	Moss Shingles Lichen		S1
Fuscopannaria sorediata	A shingle Lichen		S3
Heterodermia squamulosa	Scaly Fringe Lichen		S3
Hypotrachyna catawbiense	Powder-tipped Antler Lichen		S2S3
Leptogium corticola	Blistered Jellyskin Lichen		S3
Leptogium lichenoides	Tattered Jellyskin Lichen		S3
Massalongia carnosa	Rockmoss Rosette Lichen		S1S2
Nephroma bellum	Naked Kidney Lichen		S3
Parmeliopsis ambigua	Green Starburst Lichen		S2S3
Peltigera collina	Tree Pelt Lichen		S2?
Physconia detersa	Bottlebrush Frost Lichen		S3S4
Pseudevernia cladonia	Ghost Antler Lichen		S2S3
Pseudevernia consocians	Common Antler Lichen		S1?
Psoroma hypnorum	Green moss-shingle Lichen		S1
Sticta fuliginosa	Peppered Moon Lichen		S3
Sticta limbata	Powdered Moon Lichen		S1S2

Nine priority lichen species (one SAR and 8 SOCI) were observed during the field surveys within the FMS Study Area are shown in Table 6.12-6, and Figure 6.9-2.

Table 6.12-6. SAR and SOCI Lichen Species Observed within the Lichen FMS Study Area

Scientific Name	Common Name	COSEWIC, SARA, NSESA	S-Rank	Location within the FMS Study Area
Pectenia plumbea (syn. *Degelia plumbea)*	Blue Felt Lichen*	SARA/COSEWIC Special Concern; NSESA Vulnerable	S3	Eleven locations with approximately 48 thalli found within Wetlands 27, 65, 159, 240 and upland habitat near Wetlands 137, 145, 149, 155 and 265.

Scientific Name	Common Name	COSEWIC, SARA, NSESA	S-Rank	Location within the FMS Study Area
Ahtiana aurescens	Eastern Candlewax Lichen	-	S2S3	Twelve locations with approximately 12 individuals are found within or in close proximity to Wetlands 20, 27, 31,120, 129, 232 and upland habitat.
Collema leptaleum	Crumpled Bat's Wing Lichen	-	S2S3	One location with 1 individual observed adjacent to Watercourse 24.
Collema nigrescens	Blistered Tarpaper Lichen	-	S3	One location with 20 individuals observed adjacent to Watercourse 24. One location with 2 individuals in Wetland 65.
Fuscopannaria cf. *ahlneri*	Corrugated Shingles Lichen	-	S3	Two locations with 4 individuals observed in Wetland 159 and adjacent to Watercourse 1.
Fuscopannaria cf. sorediata	A shingle lichen	-	S3	One location with over 20 individuals in Wetland 65.
Heterodermia neglecta	Fringe Lichen	-	S3S4	One location with one individual observed in Wetland 65.
Pseudevernia cladonia	Ghost Antler Lichen	-	S2S3	One location and one individual observed north of Wetland 31.
Scytinium sutbile (syn. Leptogium subtile)	Appressed Jellyskin Lichen	-	S3	Three locations with three individuals observed in upland habitat and in close proximity of Watercourse 1.

Note: *Listed under Table 2 (Rare and sensitive lichens) under the At-Risk Lichens SMP (NSL&F, 2018)

6.12.3.2.3.1 Boreal Felt Lichen Predictive Habitat Polygons Ground Truthing

During the lichen field assessments, it was determined that the FMS Study Area consists of historical mining workings and timber harvesting often with fragmented habitats which were not supportive of boreal felt lichen. The boreal felt lichen polygons which were visited during the surveys were often within cut blocks that have been harvested recently and/or with a canopy cover that often lacked the appropriate stand types (continuous stands of balsam fir) and landforms (treed swamps and/or in close proximity to lakes and rivers).

Boreal felt lichen has a very specific lichen community it is often associated with. Boreal felt lichen habitat indicator species such as salted shell lichen and the lungwort lichens (*Lobaria spp*.) growing on fir were not observed. The amount of fragmented habitat (as a result of timber harvesting, access roads and historic mine workings) results in altered sun exposure and moisture regimes which often have a drying effect on forested edges and canopies/wetlands in close proximity. The effects of fragmented habitats are often unfavorable for the site-specific boreal felt lichen (Rheault et al. 2003). No boreal felt lichen was observed within the FMS Study Area.

6.12.3.2.3.2 Blue Felt Lichen

Blue felt lichen is a foliose cyanolichen (a lichen with a cyanobacteria as a photobiont) which typically grows on mature red maple on the edge of swamps, lakes and rivers. This species can also be found growing upland and on other hardwood species such as white ash, yellow birch and sugar maple (COSEWIC 2010). Blue felt lichen is fairly common in Nova Scotia, however, in North America the range is restricted to the north east and only found in Nova Scotia, Newfoundland and Labrador and New Brunswick (COSEWIC 2010). Blue felt lichen is listed as Vulnerable (S3) by the ACCDC and special concern and vulnerable under SARA and NSESA, respectively. Blue felt lichen is listed under table 2: rare and sensitive lichens within the SMP for at risk lichens (NSL&F, 2018). Species listed under Table 2 are managed for minimal disturbance within a 100m buffer of the lichen. This includes limitations for timber harvesting, mineral exploration and construction of new roads.

Within the FMS Study Area 48 thalli within 11 different locations were observed. Blue felt lichen were all observed on mature red maple and generally associated on wetland edges of swamps and wetland complexes (80% of the observations). In Wetland 240, two locations were observed within the treed swamp portion of a fen/swamp complex. One observation was demented within WL159, and one observation was documented in the eastern lobe of WL65.. Additional observations were made within WL27 and adjacent to WLs 137, 145, 149 and adjacent to the western lobe of WL65. Two observations were observed within upland forested landscapes and residual tree patches adjacent and surrounded by cut blocks.

6.12.3.2.3.3 Eastern Candlewax Lichen

The eastern candlewax lichen is a foliose lichen with a bright yellow-green thallus with conspicuous marginal pycnidia (Brodo et al. 2001). This species is typically found on the bark or wood on low-lying conifer branches typically on the edge of wetlands of fens and bogs, however, they are also commonly found in upland conifer dominant stands with a heath dominated shrub layer. The eastern candlewax lichen is listed as imperiled/vulnerable (S2S3) by the ACCDC.

Within the FMS Study Area, 12 locations with 12 individuals were observed in both wetland and upland habitat. Observations were located on the edge and/or within WLs 20, 27, 31, 129, 232 and 279 which are fens and/or fen/bog/swamp complexes. One observation was made in upland habitat dominated by conifers south east to WL161 and directly adjacent to a cutblock.

6.12.3.2.3.4 Fringe Lichen

The fringe lichen is a small light gray-green lichen with conspicuous long black rhizines (root like structures) which is often associated with mature hardwood trees such as red maple and yellow birch and can also be found on balsam fir. This species is frequently associated with wetlands and watercourses however it also frequents upland habitat. This species is listed as apparently secure/vulnerable (S3S4) in NS by the ACCDC. Within the FMS Study Area, one thallus was observed on a mature red maple on the edge of a large swamp/fen complex (WL65).

6.12.3.2.3.5 Appressed Jellyskin Lichen

The appressed jellyskin lichen is a small inconspicuous cyanolichen often associated with mature hardwood trees in close proximity to streams and wetlands (Hinds & Hinds 2007). This species is often found on the base of trees close to the forest floor or on the upper surface of bracket fungi. The ACCDC has this species listed as vulnerable (S3) in Nova Scotia. There were three locations of three thalli within the FMS Study Area found on the base of a red maple adjacent to WC1, and within upland forest habitat found growing on a moss-covered bracket fungus on the base of a mature red maple.

6.12.3.2.3.6 Crumpled Bat's Wing Lichen

The crumpled bat's wing lichen is a foliose cyanolichen belonging to the 'jelly' lichen group, which is characterized by lichens lacking a stratified thallus and appears jelly-like when wet (Brodo et al. 2010). This species is often cushion-forming (pulvinate) and found on tree species such as red maple and trembling aspen in both upland and wetland habitats. The crumpled bat's wing lichen is listed as imperiled/vulnerable (S2S3) in Nova Scotia by the ACCDC. One individual was observed on a mature red maple adjacent to Watercourse 24 within the FMS Study Area.

6.12.3.2.3.7 Blistered Tarpaper Lichen

The blistered tarpaper lichen is another cyanolichen belonging to the “jelly” lichen group and is typically associated with mature red maple in treed swamps, however, it can be found growing on hardwoods on the edge of disturbances (i.e., cutblocks). This species can be distinguished from other epiphytic collemas in NS by the presence of conspicuous pustules (warts), abundant apothecia (sexual reproductive structures of lichens) and needle-like spores (Hinds & Hinds 2007). The ACCDC lists this species as vulnerable (S3) in Nova Scotia. Twenty thalli were observed on a mature red maple adjacent to WC24 within the FMS Study Area. Two thalli were observed on a mature red maple within WL65.

6.12.3.2.3.8 Corrugated Shingles Lichen

The corrugated shingles lichen is a cyanolichen often associated with mature and old growth forests within or in close proximity to swamps, rivers and lakes (Hinds & Hinds 2007). Typically, this species is brown, scabrous (rough textured), has marginal soredia and forms rosettes on mature hardwood and softwood tree species (Hinds & Hinds 2007). The species is ranked as vulnerable (S3) and a species of conservation concern in Nova Scotia.

Differentiating the sorediate *Fuscopannaria* species in Nova Scotia is poorly resolved and somewhat problematic among the lichen community (S. Clayden, personal communication, November 6^{th}, 2018). The specimens collected in Nova Scotia share characteristics of both *F. ahlneri* and *F. sorediata*, and in some instances it is not possible to identify the species. Morphology-based identification features for this group of *Fuscopannaria* species are not apparent and/or not well known in Nova Scotia. Further molecular studies are needed to understand precisely which species are present in Nova Scotia and whether some specimens collected may even represent an undescribed species. For the purposes of the EIS, specimens were identified to the species level using the best available literature. Given the high level of ambiguity regarding the identity of sorediate *Fuscopannaria* species in Nova Scotia, the abbreviation “cf” has been assigned. This designation indicates that a specimen is difficult to confidently identify to the species level but that it is more-likely-than-not the specified taxon.

Within the FMS Study Area 4 thalli were observed. Three thalli were observed on a mature red maple in upland habitat adjacent to WC1. An additional location of one thallus was observed on a mature red maple in a treed swamp in WL159.

6.12.3.2.3.9 A Shingle Lichen - Fuscopannaria cf. sorediata

Fuscopannaria cf. sorediata is a cyanolichen, similarly to *F. ahlneri*, it is associated with mature to old growth forests within or close proximity to swamps, rivers and lakes (Hinds & Hinds 2007). Typically, this species has labriform soredia (soredia forming from beneath the lobe tips), is squamulose and often the thallus will take up large areas on a tree trunk of hardwood species (Hinds & Hinds 2007). Due to the challenges of confidently identifying to the species level and as described in the *F. ahlneri* section, the abbreviation “cf” has been assigned.

6.12.3.2.3.10 Ghost Antler Lichen

The ghost antler lichen is a sub-fruticose sterile grey lichen with a clear upper and lower surface. The lower surface which often consists of black blotches and its delicate branching are usually distinctive features which help distinguish this species from the other morphologically similar species (Brodo et al. 2001). This species is often found on conifer branches (often low lying) in humid environments. The ghost antler lichen is listed as imperiled/vulnerable (S2S3) in Nova Scotia by the ACCDC. One individual was observed within the FMS Study area in a forested conifer upland habitat on a low-lying branch just north of WL31.

6.12.3.2.3.11 Lichen SAR and SOCI Summary: FMS Study Area

The FMS Study Area, as mentioned in previous sections, is an area that consists of historic mining and timber harvesting. The FMS Study area consists of an array of forest types which comprise of regenerative and young forests, cutblocks, fragmented canopies and mature intact hardwood, softwood and mixedwood forested wetlands, uplands and riparian areas. In general, the highest potential for priority lichen species were habitats associated with mature forested wetlands and upland habitats in close proximity to open water and watercourses.

Areas which consisted of young regenerative forests did not provide suitable habitat, as stand age is often one of the greatest determinants of lichen diversity (McMullin, Duinker, Cameron, Richardson, & Brodo 2008). In the event that mature canopies with the appropriate tree species were present, often these habitats were fragmented resulting in altered sun exposure and moisture regimes which often have a drying effect on forested edges and canopies/wetlands in close proximity (Rheault et al. 2003). Many lichens, such as boreal felt lichen, which are dependent on humid environments, are often greatly impacted by the presence of fragmented habitats (Rheault et al. 2003).

In total, nine priority lichen species were observed during lichen surveys (1 SAR and 8 SOCI). Although boreal felt lichen predictive habitat polygons were present within the FMS Study Area, due to the amount of fragmentation, lack of indicator species and lack of continuous mature balsam fir swamps, boreal felt lichen habitat suitability was determined to be poor, and none were observed within the FMS Study Area.

Direct loss to populations of blue felt lichen, eastern candlewax lichen and fringe lichen are expected due to the placement of the infrastructure. The locations of all the priority lichen species documented within the FMS Study Area are provided in Figure 6.9-2.

6.12.3.2.4 *Touquoy Mine Site Baseline Conditions*

Lichen surveys conducted in the Touquoy Mine Site in 2004 and 2005 as part of the Touquoy Gold Project EARD found the presence of blue felt lichen. An additional lichen survey in 2007 found seven additional SOCI including; salted shell lichen (*Coccocarpia palmicola*), corrugated shingles lichen (*Fuscopannaria ahlneri*), powdered fringe lichen (*Heterodermia speciosa*), blistered jellyskin lichen (*Leptogium corticola*), blue-gray moss shingle lichen (*Moelleropsis nebulosa*), naked kidney lichen (*Nephroma bellum*), and peppered moon lichen (*Sticta fuliginosa*) (CRA 2007a). These lichens were observed in the northern, southern and south eastern portions of the Project Area. Both locations of blue felt lichen have not been directly impacted by infrastructure however, direct impacts to corrugated shingles lichen and blue-gray moss shingle lichen have occurred.

6.12.3.3 Priority Terrestrial Fauna Species

6.12.3.3.1 *FMS Study Area Priority Terrestrial Mammal Species Baseline Conditions*

The desktop evaluation for priority species of terrestrial fauna revealed that no priority terrestrial mammal species were observed within 5 km of the FMS Study Area. However, within 100 km of the FMS Study Area, the little brown myotis (*Myotis lucifugus*) and northern long-eared myotis (*Myotis septentionalis*) were observed. Both of these species are listed as critically imperiled by the ACCDC and endangered by COSEWIC, SARA and NSESA.

NSL&F has determined that bat hibernacula sites are location sensitive. No bat hibernaculum were documented within 5 km of the FMS Study Area by the ACCDC. The Recovery Strategy for Little Brown Myotis, Northern Myotis, and Tri-colored Bat in Canada (2015) confirmed that no known critical habitat (hibernacula) is located in the vicinity of the FMS Study Area.

Table 6.12-7 below provides a list mammal priority species which have elevated potential to be located within the FMS Study Area, based on habitat preferences and known distribution. No mammal species were documented in the Environmental Screening Report (Appendix G.5).

Table 6.12-7: Terrestrial mammal species with an elevated potential to be within the FMS Study Area

Scientific Name	Common Name	COSEWIC, SARA, NSESA	S-Rank
Alces americana	Mainland Moose	NSESA Endangered	S1
Myotis lucifugus	Little Brown Myotis	COSEWIC, SARA & NSESA Endangered	S1
Myotis septentrionalis	Northern Long-eared Myotis	COSEWIC, SARA & NSESA Endangered	S1
Perimyotis subflavus	Tri-colored Bat (syn. Eastern Pipistrelle)	COSEWIC, SARA & NSESA Endangered	S1
Pekania pennanti	Fisher	-	S3
Microtus chrotorrhinus	Rock Vole	-	S2
Lasionycteris noctivagans	Silver-haired Bat	-	SUB, S1M
Lasiurus borealis	Eastern Red Bat	-	S1S2B, S1M
Lasiurus cinereus	Hoary Bat	-	S1S2B, S1M
Sorex maritimensis	Maritime Shrew	-	S3

6.12.3.3.1.1 Mainland Moose

The mainland moose (*Alces alces americana*) is listed as endangered under NSESA and considered S1, or critically imperiled, by the ACCDC. The moose is the largest member of the deer family (Cervidae), which prefers boreal forest and mixed wood habitats with an abundant food source of young twigs and stems from deciduous trees and shrubs. As a large mammal, they are prone to thermal stress in the summer, often seeking refuge in coniferous forests with full canopy cover. As adept swimmers, they often forage for submerged aquatic vegetation during the summer as well, which provide minerals critical for antler growth. During winter, their long legs and large bodies allow them to move through deep snow, relatively unhindered by cold weather, which may be restrictive to smaller Cervids such as white-tailed deer.

While moose habitat preferences can change as the abundance of available habitat changes (Osko, Hiltz, Hudson, & Wasel 2004), and habitat selection shows a high degree of variability among individuals (McLaren, Taylor, & Luke 2009), moose generally require large areas with diverse habitat types (Snaith & Beazley 2004). Moose habitat preferences are correlated with forage and cover requirements, as well as breeding behaviours (Peek, Urich, & Mackie 1976). Early successional deciduous vegetation is the main source of moose forage, food types often associated with open or disturbed areas (Snaith, Beazley, MacKinnon, & Duinker 2002; Snaith & Beazley 2004; Parker 2003). The presence of such early successional trees and shrubs is particularly important during the winter months (Parker 2003). Regenerating vegetation provides good moose browse for 5-40 years following disturbances, such as fire, disease, timber harvest, and wind-throw (Snaith, Beazley, MacKinnon, & Duinker 2002; Snaith & Beazley 2004). Fire appears to be the most important disturbance in terms of providing quality moose habitat (Parker 2003 and references therein).

In Nova Scotia, the most important food species are red, sugar, and mountain maple, as well as yellow and white birch (Snaith & Beazley 2004). In the summer months, particularly in June, aquatic vegetation can be an important component of the diet of moose (Peek, Urich, & Mackie 1976; Fraser, Arthur, Morton, & Thompson 1980), but the fact that moose have persisted in areas containing infrequent or unsuitable wetlands suggests that these areas are not essential foraging grounds for moose in Nova Scotia (Snaith & Beazley 2004). This is supported by the findings of Telfer (1967a) who observed no feeding of moose on aquatic vegetation in the

Cobequid region. Water bodies such as streams, ponds, and lake shorelines can be important for relief from heat stress in the summer months (Parker 2003) because moose are not well adapted for temperatures above 14-20°C (Snaith & Beazley 2004). Moose have also been shown to preferentially select dense, mature forests with a closed canopy in the summer months because the canopy provides shade and heat relief.

When female moose give birth to their calves in the spring of the year, they often select islands or peninsulas because of the protection from predators they afford, or areas of high elevation because of visibility in availability of escape routes (Wilton & Garner 1991). In mountainous regions of British Columbia, however, only 52% of 31 GPS-collared female moose climbed to higher elevations to calve, while the other 48% changed little in elevation. These researchers found that those females that remained at lower elevations preferentially selected areas with increased forage, decreased slope, and in closer proximity to water. Langley & Pletscher (1994) characterized calving areas in Montana and British Columbia as having dense hiding cover and open patches with bare ground. It was found that all cows returned to the same summer range each spring, and Bogomolova and Kurochkin (2002) determined that cows returned to the same area of the forest every year before giving birth.

Although not considered critical habitat, mature, conifer forests are extremely important for moose in Nova Scotia during the late winter months (Telfer 1967a; Peek, Urich, & Mackie 1976; Parker 2003) because they provide protection from extreme weather and the canopy prevents snow from accumulating to depths hindering moose movement (Snaith & Beazley 2004). Travelling in areas where they sink into the snow can cause moose to expend a significant amount of energy (Lundmark and Ball 2008) at a time when adequate forage may be scarce. Ideal winter habitat also includes regenerating mixed woods that provide both hardwood and softwood browse (Parker 2003). In the winter months, moose in northern Nova Scotia concentrate in small areas known as “yards” and move very little (winter range of 2.6 km^2), particularly when the yard is contains good browse as in the Cobequid region (Telfer 1967a,b).

In Quebec, the vast majority of these winter yards were less than 0.5km^2 in area (Guertin, Doucet, & Weary 1984). Prescott (1968) determined that the use of winter yards by moose in northeastern Nova Scotia was influenced most heavily by having a variety of vegetation types and that food availability was more important than cover in determining the attractiveness of winter habitat to moose (summarized from Parker 2003). Moose yards in Quebec were characterized by gentle slopes with southern exposure, with pure or mixed stands of black spruce and adjacent patches of white birch, young balsam fir, and alder (Guertin, Doucet, & Weary 1984). Other important winter food items include willow, which accounted for 35% of the winter diet of moose in northern British Columbia (Goulet 1985).

A similarly restricted winter range of moose was determined from studies in Minnesota (Ballenberghe and Peek 1971; Phillips, Berg, & Siniff 1973). Phillips, Berg, & Siniff (1973) that found that the late winter ranges of all tracked moose were distinct in habitat from the areas used at other time of year and that the summer-fall and early winter ranges were much larger. Furthermore, they determined that most moose returned to the same wintering area each year and that they used similar travel routes each year between seasonal habitats. Seasonal movements between winter and summer ranges were reported in moose in Alberta, with individual movement of up to 20 km observed (Hauge & Keith 1981). Even greater migrations between winter and non-winter ranges of up to 75 km were observed in British Columbia, with non-winter ranges being twice as large as winter ranges (Demarchi 2003).

If the habitat in an area is diverse and provides the necessary interspersion of open areas for foraging and dense, mature forests for cover and relief from snow, seasonal ranges need not be widely separated (Snaith & Beazley 2004). For example, only 22% and 38% of adult moose in Michigan migrated between distinct summer and winter ranges in 1999 and 2000, respectively. In Alaska, 43% of bulls and cows had distinct winter and summer ranges and distance between ranges were up to 17 km (Bangs, Bailey, & Portner 1984). In southwestern NS, however, the mean home range of moose was found to be large (55.2 km^2) because the rocky, barren conditions mean the moose must range farther to obtain resources (see Snaith & Beazley 2004). When moving between seasonal ranges, moose use well established routes and travel corridors (Neumann 2009). In terms of activity within seasons, daily movement rates of moose are higher in the summer than in the winter (McLaren, Taylor, & Luke 2009).

Two sub-species of moose are present within Nova Scotia. The Cape Breton population (*Alces andersoni)* is an introduced species from Alberta and their population is abundant and stable. According to NSDNR (2007), the mainland moose (*Alces americana*) population has been reduced to approximately 1200 individuals, restricted to small, isolated sub-populations. The Recovery Plan for Moose in Mainland Nova Scotia (NSDNR 2007) identifies several limiting factors to moose abundance and distribution. These include disease and parasites, poaching, access to habitat, development, forest practices, acid rain, and climate change. Of highest concern are threats related to disease and parasites, poaching, access to moose habitat, and development.

The primary parasite threatening survival of mainland moose is a parasitic worm (*Parelaphostrongylus tenuis*), known as brainworm. Approximately 65% of white-tailed deer in NS are carriers of this parasite; however, it is not lethal to deer. According to NSDNR (2007, p.14), "Where moose and deer range overlap, brainworm is a significant mortality factor". Because the abundance of white-tailed deer can have an influence on the health of mainland moose, signs of white-tailed deer are documented during mainland moose surveys.

The threats of poaching and access to moose habitat are correlated, as increased access to moose habitat can ultimately increase the level of poaching. These threats can result in lowered viability of individual populations of moose by direct mortality and reduction in range. Similarly, land development of various types can result in increased access to moose habitat, fragmentation of habitat, and direct loss of habitat, while (potentially) further isolating sub-populations from one another.

According to the Recovery Plan for Mainland Moose in Nova Scotia (NSDNR 2007, p. 30), core habitat means "specific areas of habitat essential for the long-term survivability and recovery of endangered or threatened species and that are designated as core habitat" under the NSESA. Mainland moose use a wide variety of habitat types, over relatively large home ranges. The specific spatial and temporal use of the landscape and habitat is not well known in Nova Scotia. As such, 'core habitat' has not been defined or designated under the Endangered Species Act. The FMS Study Area lies within a significant Mainland Moose Concentration Area, as identified in Endangered Mainland Moose Special Management Practices (NSDNR 2012b).

Within the FMS Study Area, suitable habitat for moose at varying times of the year are present. Historical mining and timber harvesting have resulted in clearings, and subsequently, regenerative wood perennials which provide suitable foraging for moose in the winter months. Open waterbodies are also present which support aquatic vegetation which are often common foraging grounds for Mainland Moose in the summer months. In portions of the FMS Study Area, mature conifer stands also exist, which provide refuge for Mainland Moose during high snow fall events.

The forest industry is required to protect viable moose shelter patches when harvesting on Crown land. Through direct consultation with NSL&F to confirm current locations of these shelter patches, there are nine moose shelter patches that have been identified to the Proponent within the FMS Study Area. The Proponent has endeavored to avoid these patches during mine development planning; however, site infrastructure will impact three of these shelter patches. Where impacts are proposed, there are limitations relating to moving infrastructure for a variety of reasons including fish habitat considerations and other constraints.

Twenty-eight observations of mainland moose were documented within, and adjacent to the FMS Study Area through baseline environmental work completed in 2017, 2018, and 2019. Of the 28 observations, four were located outside of the current FMS Study Area. See Figure 6.10-1 and Table 6.12-8 for details. Data recorded outside of the FMS Study Area are included along with observations recorded within the FMS Study Area, because they are relevant on a regional scale, and can act as post-construction control sites. These included observations recorded during targeted winter track surveys and spring PGI surveys (n=3), though most were incidental observations recorded during botany, wetland delineation, fish and bird surveys. No other mainland moose signs were observed during either targeted or incidental surveys within the FMS Study Area.

Mainland moose sign, both scat and tracks, were observed in a range of habitats such as within wetlands (bogs, fens and swamps), cut blocks and access roads. Although mainland moose sign observations were spread throughout the FMS Study Area, there were several moose observations (n=6) within and/or directly adjacent to WL125. This wetland is located within the proposed footprint of the WRSA.

According to Rezendes (1999) and Murie (1982), moose scat varies quite considerably through the year based on available food sources. Scat, also referred to as pellets, can be spherical, somewhat cubical or oblong when well formed (particularly during the winter), or a formless soft mass in the summer when succulent plants form a larger part of the diet. Moose pellets are typically 1”-1.75” and can be readily distinguished on the upper end of that range, however smaller scat can overlap in size between both white-tail deer and even porcupine. Identification of scat can also be challenging based on condition of the scat, and deterioration in form and size over time. Scat which was observed that falls within the range of several species dropping characteristics were marked as moose scat (n=6) to be conservatively inclusive, as identified in Table 6.12-8.

Moose tracks, on the other hand, are quite distinctive and with the exception of calves do not overlap in size or shape with white-tail deer, which is the only other cervid in the province. The hoof (minus the dewclaw, which is only visible in some tracking conditions) of an adult white-tail deer is typically 2.5” in length, compared with the hoof size range of 5-8” for an adult moose. When the dewclaw track is visible in a set of adult moose tracks, the size can exceed 10” in length. The hooves of a moose calf are more difficult to differentiate from white-tail deer based on size alone as they are both typically 2.5”. However at that size range, a moose calf would typically be accompanied by an adult, and the stride length may be longer than a similar sized deer as well (Rezendes, 1999; Murie, 1982). As such, the observation of moose tracks (n=4) is more conclusive evidence than scat observations. The number of scat observations observed should be considered along with the moose tracks as evidence of moose presence, but not an estimate of abundance of any kind, especially given the limitations on scat identification.

Table 6.12-8: Mainland Moose Observations within the FMS Study Area and Adjacent Lands

Date	**Distance to nearest:**			**Observation Type**	**Habitat/Comments**
	Road	**Watercourse**	**Wetland (and WL#)**		
19-Jun-17	439 m	85 m	60 m; Swamp*	Scat	Regenerating mixed forest following timber harvest. Upland
21-Sep-17	On road	297 m	45 m; Wetland 141, Bog	Tracks	Tracks following road
19-Oct-17	519 m	403 m	Within Wetland 121, Fen	Scat	Edge of tall shrub fen
08-Nov-17**	166 m	241 m	119 m; Wetland 194, Swamp	Scat	Road. Upland
12-Nov-17	537 m	383 m	50 m, Wetland 39, Swamp	Scat	Regenerating mixed forest following timber harvest. Upland
27-Feb-18**	**338 m**	**191 m***	**88 m; Marsh***	**Scat**	**Regenerating mixed forest following timber harvest. Upland**
27-Feb-18**	**269 m**	**211 m**	**182 m; Swamp***	**Scat**	**Regenerating mixed forest following timber harvest. Upland**
03-Apr-18	132 m	291 m	32 m; Wetland 43, Swamp	Track	Regenerating coniferous forest (Black Spruce, Larch). Upland
12-Apr-18	**On road**	**1,050 m***	**144 m; Swamp***	**Scat**	**Logging Road in mixed forest. Upland**

Date	Distance to nearest:			Observation Type	Habitat/Comments
	Road	Watercourse	Wetland (and WL#)		
05-Jun-18	432 m	90 m	59 m; Wetland 180, Bog	Scat	Regenerating coniferous forest. Upland
05-Jun-18	150 m	505 m	Within Wetland 125, Swamp	Scat	Mature coniferous bog. Wetland
05-Jun-18	134 m	354 m	Within Wetland 125, Swamp	Scat	Mature coniferous forest. Upland
05-Jun-18	126 m	450 m	Within Wetland 125, Swamp	Scat	Mature coniferous bog. Wetland
05-Jun-18	132 m	454 m	Within Wetland 125, Swamp	Scat	Mature coniferous bog. Wetland
05-Jun-18	141 m	458 m	Within Wetland 125, Swamp	Scat	Mature coniferous bog. Wetland
05-Jun-18	445 m	223 m	140 m; Wetland 130, Swamp	Scat	Regenerating coniferous forest following timber harvest. Upland
05-Jun-18	418 m	241 m	94 m; Wetland 130, Swamp	Scat	Regenerating coniferous forest following timber harvest. Upland
05-Jun-18	150 m	453 m	Within Wetland 125, Swamp	Scat	Mature coniferous bog. Wetland
08-Jun-18	113 m	235 m	37 m; Wetland 43, Swamp	Tracks	Located within immature mixed forest. Upland
14-Jun-18	213 m	720 m	71 m; Wetland 258, Swamp	Tracks	Mature mixed forest along Antidam Flowage. Upland
22-Jun-18**	135 m	255 m	Within Wetland 266; Swamp	Scat	Regenerating mixed forest. Alder swamp
03-Jul-18**	356 m	581 m	17 m; Wetland 275, Swamp	Scat	Located within immature mixed forest near shrub swamp. Upland
03-Aug-18	112 m	303 m	36 m, Wetland 43, Swamp	Scat	Located within immature mixed forest. Upland
25-Sep-18	165 m	482 m	15 m, Wetland 125, Swamp	Scat	Located within dry shrub open area near bog wetland. Upland
6-Aug-19**	389 m	467 m	Within Wetland 324, Swamp	Scat	Located within swamp, in historically clear-cut area. Immature forest
17-Aug-19	822 m	492 m	Within Wetland 252, Complex	Scat	Located within immature mixed forest swamp
17-Aug-19	922 m	614 m	Within Wetland 331, Swamp	Scat	Located within mixedwood swamp. Immature tree and tall shrubs
21-Aug-19	605 m	147 m	Within Wetland 337, Swamp	Scat	Located within swamp, in historically clear-cut area. Immature forest

Notes: * Moose observation was outside the wetland and watercourse assessment area, therefore, wetlands and watercourse distances are to the closest NSE mapped wetland and watercourse polygon. **Moose pellets a naturally quite variable. These pellet piles overlapped in size or shape with other species, but were included in this table to be conservatively inclusve.

Bold indicates observations recorded during dedicated moose surveys. All other observations are considered incidental and were recorded during wetland, watercourse, fish, or bird surveys.

6.12.3.3.1.2 Bats

According to the ACCDC report, no known bat hibernacula are present within the FMS Study Area. The closest known bat hibernacula is located in Glenelg Lake in an abandoned mine opening, approximately 35 km north east of the FMS Study Area (Moseley 2007, EC 2015a).

Provincial government records of AMOs were reviewed within the boundary of the FMS Study Area, as AMOs could potentially provide bat hibernacula. Seventy-seven AMOs were assessed. Seventy-two AMOs were identified within the FMS Study Area and five were identified within 5 km from the FMS Study Area boundary. A desktop review coupled with field visits in spring 2017 confirmed these AMOs within the FMS Study Area and surrounding areas do not provide suitable bat hibernacula habitat. The AMOs identified within and outside the FMS Study Area were evaluated for their potential to provide bat hibernacula on August 1st, 2017 and July 4th, 2018. Of the 77 AMOs assessed all were either in-filled, contained a concrete cap blocking access, or were flooded. The locations of AMOs are shown on Figure 2.1-3.

Suitable foraging habitat for bats exists within the FMS Study Area. The availability of roosting sites and maternal roosting sites is relatively low, given the site generally lacks standing large coarse woody debris suitable for roosting. Bats are generally difficult to detect but could be detectable during all avian surveys completed within the FMS Study Area. MEL biologists did not record any incidental observations of roots, maternity roosts or foraging bats during any biophysical surveys.

6.12.3.3.1.3 Terrestrial Mammal Fauna SAR and SOCI Summary

Through all targeted surveys and incidental observations, evidence of a single mammalian priority species was observed. Twenty-eight observations of mainland moose were documented within, and adjacent to the FMS Study Area through baseline environmental work completed in 2017, 2018 and 2019.

Seventy-seven AMOs were assessed to determine suitability for bat hibernacula. Of the AMOs assessed, all were either blocked with a concrete cap or flooded. No bat hibernacula or bats were observed during the assessments and according to the ACCDC report, no bat hibernacula is present within 5 km of the FMS Study Area.

6.12.3.3.2 *Touquoy Mine Site Priority Terrestrial Mammal Baseline Conditions*

Mainland moose tracks were observed within the Touquoy Mine Site in a bog during field surveys to support the Touquoy Gold Project EARD in 2006. Moose are known to the Tangier Grand Lake Wilderness Area, and evidence of moose is reported every year by NSL&F in the Moose River Gold Mines area during deer pellet surveys (CRA, 2007a).

In addition to the information above, a Post-Construction Moose Monitoring Program for mainland moose has been underway in lands surrounding the Touquoy Gold Project during winter and spring in 2017, 2018 and 2019. Surveys are completed on foot along transects surrounding the Touquoy Gold Project throughout a diversity of habitat types. During surveys, moose observations are recorded including a description of moose sign observed, a GPS location and a microhabitat assessment. To date, three sightings of moose were encountered during 2017, and two sightings of moose were encountered during 2018 surveys. Annual reports have been provided to NSL&F as per the Touquoy Gold Project IA conditions.

No suitable bat hibernating areas were found within the Touquoy Mine Site during environmental screening to support the Touquoy Gold Project EARD (CRA, 2007a).

6.12.3.3.3 *FMS Study Area Priority Herpetofauna Baseline Conditions*

A desktop evaluation for amphibian and reptile priority species revealed that no priority herpetile species have been documented within 5 km of the FMS Study Area by the ACCDC. The following herpetofauna priority species have an elevated potential for being located within the FMS Study Area based on broad geographic range and habitat preferences (Table 6.12-9). No amphibians or reptiles were documented within the vicinity of the FMS Study Area in the Environmental Screening Report (Appendix G.5).

Table 6.12-9 Herpetofauna priority species with an elevated potential for being identified within the FMS Study Area

Scientific Name	Common Name	COSEWIC, SARA, NSESA	S-Rank
Chelydra serpentina	Snapping turtle	SARA & COSEWIC Special Concern, NSESA Vulnerable	S3
Glyptemys insculpta	Wood turtle	SARA, COSEWIC, NSESA Threatened	S2
Hemidactylium scutatum	Four-toed salamander		S3

Targeted surveys for wood turtles within the FMS Study Area did not reveal any sightings, however, potential habitat for nesting and overwintering were observed within Seloam Brook. No opportunistic observations of wood turtles were documented during any wetland or watercourse surveys throughout the entirety of the FMS Study Area.

No snapping turtles were observed opportunistically during any surveys, including those with considerable field effort in suitable habitat such as wetland and watercourse evaluations. However, areas within Seloam Brook and its' tributaries provide the appropriate water depths (greater than 1 m) and substrate for nesting and over wintering habitat.

6.12.3.3.4 *Touquoy Mine Site Baseline Conditions: Herpetofauna*

No wood turtle or suitable habitat were observed within the Touquoy Mine Site during wood turtle habitat surveys conducted in 2004 (CRA 2007a). No snapping turtles were recorded within the Touquoy Mine Site during the Touquoy Gold Project EARD process, however, on June 26th, 2016 a snapping turtle was observed within the LAA, north of the Touquoy Mine Site, on Moose River Road. From June 19th to mid-July 2017 two snapping turtles were frequently observed. One was found along Moose River Road, at the location identified above. The second snapping turtle was observed on Higgins Mines Road west of the PA but within the LAA.

A WMMP was implemented upon commencement of operations of the Touquoy Mine Site. Under this Plan, wildlife sightings, particularly turtles, were reported to the site Environmental Technicians. Between June 19th, 2017 and June 27th, 2018, nine observations of snapping turtles were recorded by the Proponent staff members and contractors at various locations throughout the Touquoy Mine Site, typically in close proximity to the Moose River.

6.12.3.3.5 *FMS Study Area Priority Invertebrate Baseline Conditions*

The desktop evaluation for priority species of invertebrate fauna revealed that none were identified within 5 km of the FMS Study Area by ACCDC reports. NSL&F has not identified any invertebrate species as 'location sensitive' species and no invertebrate species were listed as being documented within the vicinity of the FMS Study Area by the Environmental Screening Report (G.5). The Maritime Butterfly Atlas was reviewed (Square 20NQ39) for observations of priority Lepidopterans. The desktop reviewed indicated that no priority lepidopterans were observed within this square.

Table 6.12-10 below provides a list of invertebrate fauna priority species which have elevated potential to be located within the FMS Study Area, based on habitat preferences and known distribution.

Table 6.12-10: Invertebrate priority species with an elevated potential for being identified within the FMS Study Area

Scientific Name	Common Name	COSEWIC, SARA, NSESA	S-Rank
Danaus plexippus	Monarch	COSEWIC/NSESA Endangered, SARA Special Concern	S2B
Gomphus ventricosus	Skillet Clubtail	COSEWIC/SARA Endangered	S1
Alasmidonta undulata	Triangle Floater		S2S3
Amblyscirtes hegon	Pepper and Salt Skipper		S2S3
Boyeria grafiana	Ocellated Darner		S3
Epitheca princeps	Prince Baskettail		S2
Erora laeta	Early Hairstreak		S1
Gomphus descriptus	Harpoon Clubtail		S2S3
Gomphaeschna furcillata	Harlequin Darner		S3
Lanthus parvulus	Northern Pygmy Clubtail		S3S4
Ophiogomphus mainensis	Maine Snaketail		S2S3
Ophiogomphus rupinsulensis	Rusty Snaketail		S1S2
Polygonia gracilis	Hoary Comma		SU
Polygonia interrogationis	Question Mark		S3B
Polygonia satyrus	Satyr Comma		S1?
Satyrium liparops and var. strigosum	Striped Hairstreak		S2S3
Somatochlora albicincta	Ringed Emerald		S2S3
Somatochlora brevicincta	Quebec Emerald		S1
Somatochlora septentrionalis	Muskeg Emerald		S2
Somatochlora williamsoni	Williamson's Emerald		S2
Stylurus scudderi	Zebra Clubtail		S1S2
Thorybes pylades	Northern Cloudywing		S2S3
Williamsonia fletcheri	Ebony Boghaunter		S2

Surveys for benthic invertebrates were completed as part of the fish habitat assessment, following the methodologies described in Section 6.8.2. No priority invertebrate species were identified through sampling for benthic invertebrates (as described in Section 6.8.3). Field staff searched for signs of priority aquatic invertebrates, such as freshwater mussels during all wetland and watercourse related programs. None were observed. No observations of odonates were recorded within the vicinity of the FMS Study Area by Odonata Central. No other targeted surveys were completed for invertebrates and no opportunistic observations of priority invertebrate species were recorded. No other priority invertebrate species were identified during the desktop review or field surveys.

6.12.3.3.6 *Touquoy Mine Site Priority Invertebrate Baseline Conditions*

Aquatic benthic invertebrates were surveyed during the aquatic surveys. No priority invertebrate (terrestrial and aquatic) species were observed within the Touquoy Mine Site during environmental screening to support the Touquoy EARD (CRA, 2007a).

6.12.3.4 Priority Avifauna Species

6.12.3.4.1 *FMS Study Area Priority Avifauna Baseline Conditions*

A desktop review for priority species revealed that 48 priority bird species were identified as having the potential to occur within the FMS Study Area based on habitat availability and geographic distribution. Nineteen species have been documented within 5 km of the FMS Study Area by ACCDC. These species are underlined in Table 6.12-11.

NSL&F has classified one species, the peregrine falcon, as 'location sensitive', meaning that their exact locations cannot be provided to proponents in ACCDC reports. Instead, ACCDC indicates whether a location sensitive species is documented within 5 km of the PA. The peregrine falcon (*anatum/tundrius* pop.) is considered a location sensitive species; however, it has not been documented within 5 km of the PA in either of the ACCDC reports.

The Environmental Screening Report indicated that no nesting records or probable nesting records for priority species within the vicinity of the FMS Study Area (Appendix G.5).

Table 6.12-11: Priority bird species with elevated potential to be within the FMS Study Area

Scientific Name	Common Name	COSEWIC, SARA, NSESA	S-Rank
Accipiter gentilis	Northern Goshawk		S3S4
Actitis macularius	Spotted Sandpiper		S3S4B
Asio flammeus	Short-eared Owl	COSEWIC/SARA Special Concern	S1S2B
Asio otus	Long-eared Owl		S2S3
Botaurus lentiginosus	American Bittern		S3S4B
Cardellina canadensis	Canada Warbler	COSEWIC/SARA Threatened, NSESA Endangered	S3B
Cardellina pusilla	Wilson's Warbler		S3B
Catharus fuscescens	Veery		S3S4B
Catharus ustulatus	Swainson's Thrush		S3S4B

Scientific Name	Common Name	COSEWIC, SARA, NSESA	S-Rank
Chaetura pelagica	Chimney Swift	COSEWIC/SARA Threatened, NSESA Endangered	S2B, S1M
Charadrius vociferus	Killdeer		S3B
Chordeiles minor	Common Nighthawk	COSEWIC/SARA Threatened, COSEWIC Special Concern, NSESA Threatened	S2B
Coccothraustes vespertinus	Evening Grosbeak	COSEWIC/SARA Special Concern, NSESA Vulnerable	S3S4B, S3N
Coccyzus erythropthalmus	Black-billed Cuckoo		S3B
Contopus cooperi	Olive-sided Flycatcher	COSEWIC/SARA Threatened, COSEWIC Special Concern, NSESA Threatened	S2B
Contopus virens	Eastern Wood-Pewee	COSEWIC/SARA Special Concern, NSESA Vulnerable	S3S4B
Dumetella carolinensis	Gray Catbird		S3B
Empidonax flaviventris	Yellow-bellied Flycatcher		S3S4B
Empidonax traillii	Willow Flycatcher		S2B
Euphagus carolinus	Rusty Blackbird	COSEWIC/SARA Special Concern, NSESA Endangered	S2B
Gallinago delicata	Wilson's Snipe		S3B
Haemorhous purpureus	Purple Finch		S4S5B, S3S4N
Hirundo rustica	Barn Swallow	COSEWIC/SARA Threatened, NSESA Endangered	S2S3B
Hylocichla mustelina	Wood Thrush	COSEWIC/SARA Threatened, NSESA Endangered	SUB
Icterus galbula	Baltimore Oriole		S2S3B
Loxia curvirostra	Red Crossbill		S3S4
Mimus polyglottos	Northern Mockingbird		S1B
Oreothlypis peregrina	Tennessee Warbler		S3S4B
Perisoreus canadensis	Canada Jay		S3

Scientific Name	Common Name	COSEWIC, SARA, NSESA	S-Rank
Pheucticus ludovicianus	Rose-breasted Grosbeak		S2S3B
Picoides arcticus	Black-backed Woodpecker		S3S4
Pinicola enucleator	Pine Grosbeak		S2S3B, S5N
Poecile hudsonica	Boreal Chickadee		S3
Regulus calendula	Ruby-crowned Kinglet		S3S4B
Riparia riparia	Bank Swallow	COSEWIC/SARA Threatened, NSESA Endangered	S2S3B
Setophaga pinus	Pine Warbler		S1B
Setophaga castanea	Bay-breasted Warbler		S3S4B
Setophaga striata	Blackpoll Warbler		S3S4B
Setophaga tigrina	Cape May Warbler		S2B
Sialia sialis	Eastern Bluebird		S3B
Sitta canadensis	Red-breasted Nuthatch		S3
Spinus pinus	Pine Siskin		S2S3
Tringa flavipes	Lesser Yellowlegs		S3M
Tringa melanoleuca	Greater Yellowlegs		S3B, S3S4M
Turdus migratorius	American Robin		S5B, S3N
Tyrannus tyrannus	Eastern Kingbird		S3B
Vireo gilvus	Warbling Vireo		S1B
Vireo philadelphicus	Philadelphia Vireo		S2?B

Across all survey seasons, a total of 22 priority species were observed either during dedicated survey periods or incidentally. Breeding bird status qualifiers are used to determine whether a species is a priority species, based on the time of year in which the species was observed. For instance, a bird with an SRank of S2S3B,S5N is considered a priority species if observed during the breeding season. Outside of breeding season, this species would not be considered a priority species. A list of the priority avifauna species observed during the field surveys is provided below, along with Table 6.12-12 which presents locations of all priority avifauna species observed.

- Canada warbler (*Cardellina canadensis;* SARA Threatened; COSEWIC Threatened; NSESA Endangered; S3B)

- common nighthawk (*Chordeiles minor;* SARA Threatened; COSEWIC Special Concern; NSESA Threatened; S2B)
- eastern wood-pewee (*Contopus virens*; COSEWIC Special Concern; SARA Special Concern; NSESA: Vulnerable; S3S4B)
- evening grosbeak (*Coccothraustes vespertinus;* SARA Special Concern; COSEWIC Special Concern; NSESA Special Concern; S3S4B, S3N)
- olive-sided flycatcher (*Contopus cooperi*; SARA Threatened; COSEWIC Special Concern; NSESA Threatened; S2B)
- rusty blackbird (*Euphagus carolinus;* SARA Special Concern; COSEWIC Special Concern; NSESA Endangered; S2B)
- American kestrel (*Falco sparverius;* S3B)
- bay-breasted warbler (*Setophaga castanea;* S3S4B)
- black-backed woodpecker (*Picoides arcticus;* S3S4)
- boreal chickadee (*Poecile hudsonica;* S3)
- gray jay (*Perisoreus canadensis;* S3)
- greater yellowlegs (*Tringa melanoleuca;* S3B,S3S4M)
- northern goshawk (*Accipiter gentilis;* S3S4)
- pine siskin (*Spinus pinus;* S2S3)
- purple finch (*Carpodacus purpureus;* S4S5B, S3S4N)
- red crossbill (*Loxia curvirostra;* S3S4)
- red-breasted nuthatch (*Sitta canadensis;* S3)
- ruby-crowned kinglet (*Regulus calendula;* S3S4B)
- semipalmated plover (*Charadrius semipalmatus;* S1B,S3S4M)
- spotted sandpiper (*Actitis macularius;* S3S4B)
- swainson’s thrush (*Catharus ustulatus;* S3S4B)
- yellow-bellied flycatcher (*Empidonax flaviventris;* S3S4B)

Table 6.12-12 Priority avifauna species observed within the FMS Study Area

Common Name	SARA	COSEWIC	NSESA	S-Rank	Season Observed	Spring Migration 2018		Breeding 2017		Breeding 2018		Fall Migration 2017		Fall Migration 2018		Breeding 2019		Winter Wildlife		Total Individuals Observed*
						#	Location	#	Location	#	Location	#	Location	#	Location	#	Location			
Canada Warbler	Threatened	Threatened	Endangered	S3B	B	-	-	52	1,2, 3, 4, 5, 6, 19, 24, 26, 33, 34, 37, 38, 40, 41, 42, 55, 56, 63, 70, inc	20	04, 21, 22, 30, 37, inc	-	-		-	-	-	-	-	72
Common Nighthawk	Threatened	Special Concern	Endangered	S2B	B	-	-	85	CONI survey locations: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13 FMS-2017 BBS: 16, 33, 37, 42, 46, 57, 58, 60, 67, inc	5	20, inc	-	-	-	-	1	Inc	-	-	91
Evening Grosbeak	Special Concern	Special Concern	Special Concern	S3S4B, S3N	B	-	-	5	29, 46, 49	1	inc	-	-	-	-	-	-	-	-	6
Eastern Wood-Pewee	Special Concern	Special Concern	Vulnerable	S3S4B	FM	-	-	-	-	-	-	1	Inc	-	-	-	-	-	-	1
Olive-sided Flycatcher	Threatened	Special Concern	Threatened	S2B	B	-	-	46	1, 2, 3, 4,5, 6, 7, 8, 9, 13, 14, 19, 22, 24, 27, 29, 31, 33,34,38, 39, 48, 49, 50, 65, 67, Inc	20	6, 9, 10, 11, 12, 13, 18, 19, 20, Inc	-	-	-	-	-	-	-	-	66
Rusty Blackbird	Special Concern	Special Concern	Endangered	S2B	B	4	5, Inc	-	-	-	-	1	36	-	-	-	-	-	-	5
Bay-breasted Warbler	-	-	-	S3S4B	SM, B, FM	NPS	NPS	42	20, 30, 31, 34, 42, 55, 62, 64, 68, 69, 70, inc	27	2, 4, 14, 15, 16, 21, 22, 27, 33, inc	NPS	NPS		-	-	-	-	-	69
Black-backed Woodpecker	-	-	-	S3S4	SM, B, FM	14	13, 14, 40, 41, 42, 49, 50	11	4, 6, 7, 12, 13, 14, 47, inc	4	17, 24, 28	4	18. 19, 43	1	6	-	-	-	-	34

Common Name	SARA	COSEWIC	NSESA	S-Rank	Season Observed	Spring Migration 2018		Breeding 2017		Breeding 2018		Fall Migration 2017		Fall Migration 2018		Breeding 2019		Winter Wildlife		Total Individuals Observed*
						#	Location	#	Location	#	Location	#	Location	#	Location	#	Location			
Boreal Chickadee	-	-	-	S3	SM, B, FM, W	20	8, 9, 10, 21, 22, 23, 36, 39, 43, inc	15	11, 33, 38, 42, 43, 44, 45, 49, 57, inc	9	2, 3, 11, 22, 24, 27, 34	25	6, 8, 9, 11, 17, 32, 38, 43, 48, 49, 52, 56, 66, inc	10	1, 2, 4, 6, 10	4	Inc	10	T: 4, 13, 23, 26, 28	94
American Kestrel	-	-	-	S3B	SM, B, FM	NPS	NPS	3	8, inc	-	-	NPS	NPS	-	-	-	-	-	-	3
Gray Jay	-	-	-	S3	SM, B, FM, W	5	-	16	12, 19,25, 3, 65, 66, inc	20	6, 9, 14, 17, 18, 23, 28, 34, 36	46	1, 3, 4, 5, 13,17, 18, 20, 26, 36, 37, 41, 42, 43, 44, 45,47, 48, 49, 50, Inc	12	1, 2, 6, 8, 9, Inc	2	Inc	2	T: 23	103
Greater Yellowlegs	-	-	-	S3B, S3S4M	SM, B, FM	8	2, 9, 10, 20, 27, 37, 39, inc	18	33, 42, 46, 47, 51, 58, 63, 65, 66, 67, 68	4	Inc	2	Inc	-	-	-	-	-	-	32
Pine Siskin	-	-	-	S2S3	SM, B, FM	4	21, 22, 35	2	10, 29	5	6, 24, 25, 26, 30	39	3, 6, 7, 12, 13, 18, 23, 24, 39, 40, 45, 46, 47, 49, 50,	6	1, 7, inc	-	-	-	-	56
Purple Finch	-	-	-	S4S5B, S3S4N	SM, B, FM, W	NPS	NPS	NPS	NPS	NPS	NPS	NPS	1, 3, 4, 5, 6, 7, 8, 12, 13, 16, 17, 18, 20, 22, 23, 24, 37, 39, 42,44, 45, 48,	6	1, 3, 5, 6, 7	-	-	4	T6, T23, T16 T31	10
Red Crossbill	-	-	-	S3S4	SM, B, FM	14	12, 24, 25, 27, 37	56	1, 2, 4, 14, 22, 24, 33, 34, 42,43, 46, 47, 50, 62, 66, 69, 70	25	2, 6, 8, 18, 20, 25, 38, Inc	51	4, 5, 17, 18, 19, 37, 38 39, 42, 44, 45,46, 47,48, 50, Inc	5	9, 10	1	Inc	-	-	152
Red-breasted Nuthatch	-	-	-	S3	SM, B, FM, W	68	1, 2, 3, 4, 5, 6, 7,8, 9, 11,14, 16,17, 18, 19, 20, 21, 23, 24, 35, 37, 38, 39, 41, 44, 45, 46, 49, 50,	28	4, 6, 15, 17, 18, 20, 22, 26, 28, 29, 30, 37, 51, 59, 62, 66, 68, 70,	34	2, 4, 5, 8, 14, 17, 18, 19, 20, 21, 25, 26, 27, 28, 32, 38, Inc	113	1, 3, 4, 5, 6, 7, 10, 11, 15, 16, 18, 19, 20, 22, 23, 24, 25, 27, 38, 39, 40, 41,42, 43,44, 47, 49, 50	17	2, 3, 4, 5, 6, 7, 8, 10,	1	Inc	44	T: 2, 3, 4, 6, 11, 12, 18, 23, 24, 27, 28,	305

Common Name	SARA	COSEWIC	NSESA	S-Rank	Season Observed	Spring Migration 2018		Breeding 2017		Breeding 2018		Fall Migration 2017		Fall Migration 2018		Breeding 2019		Winter Wildlife		Total Individuals Observed*
						#	Location	#	Location	#	Location	#	Location	#	Location	#	Location			
Ruby-crowned Kinglet	-	-	-	S3S4B	SM, B, FM	NPS	NPS	79	3, 5, 7, 12, 16, 17, 18, 19, 20, 22, 23, 24, 25, 26, 27, 28, 29, 32, 34, 35, 37, 38, 39, 40, 41, 42, 43, 44, 51, 52, 54, 56, 60,61, 64, 65, 67, 68, Inc	41	1, 4, 5, 6, 7, 8, 10, 17, 22, 26, 28, 30, 31, 32, 34,37, 38, Inc	NPS	NPS	NPS	NPS	-	-	-	-	120
Semipalmated Plover	-	-	-	S1B, S3S4M	FM	-	-	-	-	-	-	1	25	-	-	-	-	-	-	1
Spotted Sandpiper	-	-	-	S3S4B	B	-	-	11	36, 65, 66, 67, 68	1	26	-	-	-	-	-	-	-	-	12
Swainson's Thrush	-	-	-	S3S4B	SM, B, FM		-	130	-	68	1, 2, 3, 4,5, 6, 7, 8, 9, 10, 11, 13, 15, 16, 17, 18, 21, 22, 23, 26, 28, 29, 30, 34, 35, 36, 37, 38,	NPS	NPS	-	-	-	-	-	-	198
Yellow-bellied Flycatcher	-	-	-	S3S4B	B	-	-	100	1, 2, 3, 4, 5, 6, 7, 8, 9, 12, 13, 14, 15, 16, 17, 18, 19, 20,23,25,27, 28, 29, 31, 33,34, 35, 36, 39, 40, 41, 42, 44, 47, 48, 50, 51,54,55, 56, 57, 60, 64, 67, 68, 69,	41	2, 3, 4, 5, 8,11, 12, 14, 16,17,18, 19, 22,23, 25, 27, 28, 29,30, 32, 33, 34, 35, 36, 37, 38, Inc	-	-	-	-	1	Inc	-	-	142
Northern Goshawk	-	-	-	S3S4	B	-	-	2	37, inc	-	-	-	-	-	-	-	-	-	-	-

Notes: * Observation numbers includes incidentals; SM=Spring Migration, B=Breeding, FM=Fall Migration, W=Winter, T=Transect. NPS indicates that the species was observed but based on the breeding status, it is not a priority species during that season. Inc., indicated that the species was observed incidentally, i.e. outside a designated avifauna point count location.

All priority species observed in the FMS Study Area (SAR and SOCI) have been described in sub-sections for other taxa in this section (fish, flora, and terrestrial fauna). Given the abundance of priority bird species observed, SOCI are only described in tabular form above, which identifies abundance, location and seasonality of observations and general habitat types found. The six bird SAR observed in the FMS Study Area are described in further detail below.

6.12.3.4.1.1 Common Nighthawk

The common nighthawk is a medium-sized crepuscular bird with large eyes, a small bill, and a large mouth on its large flattened head. They have long slender pointed wings (falcon-like) and a long slightly notched tail. The territorial call of common nighthawk is the nasal ‘peent’ and their territorial display consists of a ‘boom’ sound which is a mechanical noise caused by the sudden downward flexing of their wings as they dive (Brigham, Ng, Poulin and Girndal 2011). Preferred breeding habitats include areas devoid of vegetation, such as sand dunes, beaches, logged areas, burned-over areas, forest clearings, quarries and pastures. Common nighthawk populations have been on the decline; however, the reasons for the decline have not been determined. Large-scale pesticide use, which has reduced the numbers of insect prey, is a likely factor for the decline in common nighthawk populations (COSEWIC 2007a). Habitat loss and alteration, including fire suppression and intensive agriculture, may also have contributed to these declines (COSEWIC 2007a). The common nighthawk is federally listed as threatened by SARA and special concern by COSEWIC, provincially listed as threatened by NSESA, and the breeding population in Nova Scotia is ranked as imperiled (i.e., S-rank S2B) by ACCDC.

During the dedicated common nighthawk surveys, 43 observations, comprising of 36 of the individuals were exhibiting territorial displays (calling and booming) in 2017. In addition, incidental observations of 49 individuals were also observed, with some in pairs and calling (total of 85 individuals in the breeding season of 2017). Based on these findings, it is assumed that common nighthawk breeding is taking place within the FMS Study Area. The majority of the observations of common nighthawk were within or in close proximity to cut blocks and/or clearings.

Incidentally, common nighthawk were observed flying over or in close proximity to wetlands. Based on the habitat suitability and often adjacent to cut blocks and/or clearings it is assume common nighthawk are using adjacent upland habitat for breeding, with the exception of WL2 which has small upland gravel (likely historical waste rock) inclusions which may be suitable nesting habitat for common nighthawk. The majority of the common nighthawk observations were made within upland habitats, and often in close proximity to clearings and cut blocks when breeding behavior was observed. During the additional biophysical surveys which occurred, incidental observations of common nighthawk were observed, some of which, were observed within wetlands. Wetlands where common nighthawk were observed, were frequently in close proximity to cut blocks, clearings and roadside which could provide suitable breeding habitat. With the exception of potential breeding in WL2, it is not expected common nighthawk would be breeding in the wetlands where observations were made.

Wetland 2, which may support common nighthawk breeding habitat, is a large wetland complex with disturbed portions consisting of historical mine workings both within the wetland (as small upland inclusions) and immediately adjacent to it. These disturbed areas consist of cleared areas with gravel and cobble substrates which could provide breeding habitat for common nighthawk. Common nighthawks are aerial insectivores and the open water portions within this wetland could also provide suitable foraging habitat. No common nighthawk were observed within this wetland during the biophysical surveys in 2017-2018, however, during common nighthawk surveys in 2017, two individuals were observed calling from Point Count 3 which is immediately adjacent to WL2. The common nighthawk were heard approximately 200 – 300 m SE and NE from the Point Count location. A common nighthawk was also observed incidentally in the breeding season of 2019.

Although suitable habitat is expected to be lost due to the proposed mine infrastructure, the surrounding areas which have been cleared due to historic mining and timber harvesting, provide suitable habitat for breeding common nighthawk.

6.12.3.4.1.2 Canada Warbler

The Canada warbler is a small brightly colored songbird; the males have blue-gray upperparts and tail with a contrasting yellow throat and breast. The Canada warbler has a wide range of suitable habitats, including deciduous, coniferous, and mixed forests and wetlands, with a well-developed shrub layer. Their preferred habitat is moist mixed forests (COSEWIC 2008). They also use regenerating stands after natural and human-caused disturbances (COSEWIC 2008).

The factors for population decline of the Canada warbler are unknown. One likely reason is habitat degradation and loss of wintering ranges. Habitat loss includes agricultural activities and road development and conversion of swamp forests (COSEWIC 2008). The Canada warbler is federally listed as threatened under COSEWIC and SARA, provincially listed as endangered under NSESA, and the breeding population in Nova Scotia is ranked as vulnerable (i.e., S-rank S3B) by ACCDC.

The Canada warbler's preferred habitat, mixedwood swamps, was observed within the FMS Study Area. Seventy-two Canada warblers were observed during the 2017 and 2018 bird and other biophysical surveys. Within FMS Study Area, confirmed (i.e., breeding pair, building nest) behavior and breeding behavior (i.e., agitated behavior and anxiety calls of an adult) was observed in the 2017 and 2018 surveys. Canada warblers were observed primarily in shrub swamps, edges of fens and bogs and treed swamps. For details on specific wetlands that Canada warbler was observed in, see Section 6.7.3.

6.12.3.4.1.3 Evening Grosbeak

Evening grosbeaks are a member of the true finch family (Fringillidae), are a short stocky, vibrant coloured and equipped with a large yellowish-green bill (COSEWIC 2016). This species breeds in Mexico, Canada and the United States. In the winter months, their range can vary widely depending on the food source available and is often found in backyards feeding off feeders. Breeding habitat is typically in open, mature mixedwood upland forests often dominated by balsam fir and white spruce and where their main food source, the spruce budworm (*Choristoneura* spp.) is present (COSEWIC 2016).

Since the 1970's, a significant long-term decline in the Evening Grosbeak population as occurred. According to some reports, a decline of nearly 40% has occurred since the 1970's (COSEWIC 2016). Leading factors which may be contributing to the decline of this species include: fluctuations in spruce budworm populations, mortalities by window strike and road collisions, ingestion of sodium chloride from road sides and the effects of climate change. The evening grosbeak is listed as special concern by SARA, COSEWIC and NSESA and vulnerable/apparently secure (S3S4B) in the breeding season and vulnerable (S3N) in the winter months.

Within the FMS Study Area six individuals were observed and were primarily found in upland habitats (e.g., forested uplands and edges of cut blocks). However, an observation was made in WL59 (swamp). It is not expected this species will be breeding in this wetland as they primarily breed in upland forests.

6.12.3.4.1.4 Eastern Wood-pewee

The eastern wood-pewee is a small insectivore belonging to the "tyrant flycatchers" (*Tyrannidae*) family. Visually, this species can often be confused by other fly catchers and male and females are not sexually dimorphic. Despite this species looking very similar to its cousin species, it can often be distinguished by its "pee-ah-wee" song (COSEWIC 2012). The breeding range of this species covers the majority of south-central and eastern North America and in the winter months, this species is found primarily in South America.

This species, like many other avifauna insectivores have been experiencing a decline in populations despite being resilient to many habitat changes (COSEWIC 2012). According to the data, declines in the eastern wood-pewee have been occurring over the past 40 years in both Canada and the United States (COSEWIC 2012). Over the past ten years, there has been an observed population decline by 25% (COSEWIC 2012).

In Canada, the eastern wood-pewee is often associated with forested edge habitats often surrounding cut blocks, wetlands, lakes and rivers or in close proximity to these features. The eastern wood-pewee is listed as special concern by COSEWIC and SARA, vulnerable by NSESA and vulnerable/apparently secure (S3S4B) by the ACCDC.

Within the FMS Study Area, one male individual was incidentally observed during the wetland and watercourse evaluations in Wetland 35. Suitable breeding habitat is present within the FMS Study Area.

6.12.3.4.1.5 Olive-sided Flycatcher

The olive-sided flycatcher is a small insectivore belonging to the “tyrant flycatchers” (*Tyrannidae*) family, with plumage with deep brownish olive grey above and whitish breast and throat (COSEWIC 2007). Although members of this family can be strikingly similar, the distinctive three-note song reminiscent of the phrase “quick, three-beers” is often diagnostic (COSEWIC, 2007). The olive-sided flycatcher is a widespread migratory species, with 53% of its breeding range being encompassed in forested areas in Canada.

The Canadian population of this species has been experiencing a substantial long-term decline however, it is uncertain of what is the main cause of this decline is, it is likely a result of multiple factors. It is thought that loss of overwintering habitat in South America is likely the greatest threat facing aerial insectivores. Other factors such as climate change and overall changes in abundance and quality of insect prey may also be a factor. The olive-sided flycatcher is often associated with forested edge habitats often surrounding cut blocks, wetlands, lakes and rivers or in close proximity to these features. The olive-sided flycatcher is as special concern by COSEWIC, threatened by SARA and NSEA and imperiled (S2) by the ACCDC.

Within the FMS Study Area, 66 individuals were observed. Due to historic mining activities and timber harvesting, edge habitats were frequent within the FMS Study Area and provided suitable breeding habitat.

6.12.3.4.1.6 Rusty Blackbird

The rusty blackbird is a medium sized blackbird with pale yellow eyes and a slightly curved bill. During the breeding season the male is black with a greenish gloss and slight purple gloss to its head and neck (COSEWIC, 2017). The female is less showy and often is a brownish black. This species has a wide distribution across northern regions of Canada and breeds in all province and territories in Canada. Breeding habitat for rusty blackbirds are often coniferous-dominated forests adjacent to wetlands such as peat bogs, sedge meadows, marshes, swamps and beaver ponds (COSEWIC 2017).

Historically the rusty blackbird has experienced steep population declines throughout the 20th century. Factors which could be some of the leading factors towards the decline of the rusty blackbird include destruction of over wintering habitats, the use of pesticides, mercury contamination and degradation of wetland habitats due to climate change (COSEWIC 2017). The rusty blackbird is a species of special concern by COSEWIC and SARA, endangered by NSEA and imperiled (S2B) by the ACCDC.

Within the FMS Study Area, five individuals were observed at the dedicated bird surveys as well as incidentally during the 2017 and 2018 biophysical surveys. Within the FMS Study Area, wetland habitats which are ponded, as well as edge habitats adjacent to wetland habitats, are present. Rusty blackbirds were observed calling within these habitat types however, they were only observed in the spring and fall surveys. None were observed during the breeding bird surveys and it is likely these individuals were using habitat within the FMS Study Area to forage and/or stage as they were migrating locally within the province.

6.12.3.4.1.7 Avifauna SAR and SOCI Summary

Across all survey seasons, a total of 22 priority species were observed either during dedicated survey periods or incidentally within the FMS Study Area. The presence of wetlands, forested uplands, watercourses, clearings and fragmented habitats (resulting in edge habitats) provided suitable habitat for many of the priority bird species in NS.

During all breeding bird surveys, evidence of breeding behavior was recorded for all species, with particular attention towards SAR and SOCI. Breeding evidence was recorded in accordance with guidance provided by Bird Studies Canada (2016), which defines behavior in terms of possible, probable, and confirmed breeders. Any species observed during breeding season singing in suitable habitat is identified as a possible breeder. Signs of probable breeding observed are agitation and established territories. Evidence of confirmed breeders observed includes distraction displays, feeding young or carrying food, nests with young, or recently fledged young. The highest evidence of breeding status recorded for all priority bird species observed during breeding season is presented in Table 6.12-13. Two SAR are identified as possible breeders (evening grosbeak and common nighthawk), and two as probable (Canada warbler and olive-sided flycatcher) were documented. Seven SOCI are identified as possible breeders, while nine show evidence of probable breeding. None of the incidental observations recorded in the breeding season in 2019 were confirmed or probable breeders. All are considered possible breeders, being observed during the breeding season, in or near suitable breeding habitat.

Table 6.12-13: Highest breeding evidence for avian SAR and SOCI within the FMS Study Area

Scientific Name	Common Name	2017 Breeding Evidence	2018 Breeding Evidence
Accipter gentilis	Northern Goshawk	Possible	N/A
Actitis macularius	Spotted Sandpiper	Probable	Possible
Cardellina canadensis	Canada Warbler	Confirmed	Probable
Carpodacus purpureus	Purple Finch	Possible	Possible
Catharus ustulatus	Swainson's Thrush	Probable	Probable
Chordeiles minor	Common Nighthawk	Probable	Possible
Coccothraustes vespertinus	Evening Grosbeak	Possible	Possible
Contopus cooperi	Olive-sided Flycatcher	Probable	Probable
Dendroica castanea	Bay-breasted Warbler	Probable	Probable
Empidonax flaviventris	Yellow-bellied Flycatcher	Probable	Probable
Falco sparverius	American Kestrel	Observed	Possible
Loxia curvirostra	Red Crossbill	Probable	Possible

Scientific Name	Common Name	2017 Breeding Evidence	2018 Breeding Evidence
Perisoreus canadensis	Gray Jay	Confirmed	Probable
Picoides arcticus	Black-backed Woodpecker	Probable	Probable
Poecile hudsonica	Boreal Chickadee	Possible	Possible
Regulus calendula	Ruby-crowned Kinglet	Confirmed	Probable
Sitta canadensis	Red-breasted Nuthatch	Probable	Probable
Spinus pinus	Pine Siskin	Possible	Possible

6.12.3.4.2 *Touquoy Mine Site Priority Avifauna Baseline Conditions*

The 2005 breeding bird surveys of the Touquoy Mine Site found ten priority species. They included; pine grosbeak (*Pinicola enucleator*), willow flycatcher (*Empidonax traillii*), yellow-bellied flycatcher, barn swallow, boreal chickadee, ruby-crowned kinglet, rusty blackbird, bay-breasted warbler, swainson’s thrush, and pine siskin.

6.12.4 Consideration of Engagement and Engagement Results

Key issues raised during public and Mi’kmaq engagement relating to SAR and SOCI include potential direct effects on rare flora and fauna associated with construction of the Project and potential indirect effects associated with sensory disturbance and changes to other VCs, such as wetlands, surface water and groundwater. Potential effects on traditional uses of land and resources by the Mi’kmaq were noted, including SAR/SOCI species of significance to the Mi’kmaq such as moose and American eel.

The results of the public and Mi’kmaq engagement have been considered in the environmental effects assessment, including the Proponent’s commitments on mitigation and monitoring measures and proposed compliance and effects monitoring programs, as well as the Proponent’s broader commitment to ongoing public and Mi’kmaq engagement.

6.12.5 Effects Assessment Methodology

6.12.5.1 Boundaries

6.12.5.1.1 *Spatial Boundaries*

The spatial boundaries used for the assessment of effects for all SAR and SOCI are the PA, LAA and RAA. The PA consists of the FMS Study Area and the Touquoy Mine Site.

The LAA and RAA and the extent of these areas and boundaries are specific to each taxa group and are defined below:

6.12.5.1.1.1 Fish

The LAA consists of portions of downstream aquatic habitats and headwaters where appropriate, depending on project activities, up to the maximum size of the tertiary watershed(s) (Figure 6.6-16). The LAA boundaries were defined considering the maximum expected extent of direct and indirect impacts to the aquatic environment as well as the location of project activities across all three project components.

The RAA encompasses the two secondary watersheds that the PA is located within. These watersheds are the East River Sheet Harbour secondary watershed and the Fish River secondary watershed (Figure 6.6-16). The RAA is broader than expected project impacts and considers other project boundaries as per the cumulative effects methodology.

6.12.5.1.1.2 Vascular Flora and Lichens

The LAA (Figure 6.9-3) includes a 2 km buffer on the FMS Study Area. This area encompasses the maximum expected extent of the Project direct and indirect impacts to habitat and flora.

The RAA encompasses a portion of Ecodistrict 440 constrained in the east by the boundary of the Liscomb Game Sanctuary, and west by the western edge of Lake Alma (Figure 6.9-3). The RAA was extended north of the FMS Study Area to incorporate the entirety of the Liscomb Game Sanctuary and as such encompasses this portion of Ecodistrict 450. These spatial boundaries will help to identify the direct or indirect impacts to flora species and critical habitats, and the effects of the Project on distribution and abundance of these species.

As the Project has the potential to cause direct and indirect effects to SAR/SOCI outside of the PA, the LAA is the appropriate boundary for evaluation of this VC.

6.12.5.1.1.3 Terrestrial Fauna and Avifauna

The LAA (Figure 6.10-2) includes a 500 m buffer on the Touquoy Mine Site, and a 2 km buffer on the FMS Study Area. This area encompasses the maximum expected extent of the Project direct and indirect impacts to terrestrial fauna and avifauna.

The RAA encompasses a portion of Ecodistrict 440 constrained in the east by the boundary of the Liscomb Game Sanctuary, and west by the northern end of Lake Charlotte (Figure 6.10-2). The RAA was extended north of the FMS Study Area to incorporate the entirety of the Liscomb Game Sanctuary and as such encompasses this portion of Ecodistrict 450. These Ecodistrict portions span an area broader than the expected Project impacts to fauna and considers other Project boundaries as per cumulative effects methodology. These spatial boundaries will help to identify the direct or indirect impacts to terrestrial fauna and avifauna species and critical habitats, and the effects of the Project on distribution and abundance of these species.

As the Project has the potential to cause direct and indirect effects to SAR/SOCI outside of the PA, the RAA is the appropriate boundary for the evaluation of fauna, and the LAA is the appropriate boundary for evaluation of avifauna.

6.12.5.1.2 *Temporal Boundaries*

The temporal boundaries used for the assessment of effects to SAR and SOCI are the construction phase, operational phase, and closure phases.

6.12.5.1.3 *Technical Boundaries*

No technical boundaries were identified for the effects assessment of SAR and SOCI.

6.12.5.1.4 *Administrative Boundaries*

The primary administrative boundaries for SAR and SOCI are outlined in the federal SARA and provincial NSESA. Terrestrial fauna is provided protection under the provincial *Wildlife Act* and the federal *Canada Wildlife Act*. Fish species are further regulated under the federal *Fisheries Act*, while migratory bird species are regulated under the *Migratory birds Convention Act*.

6.12.5.2 Thresholds for Determination of Significance

A significant adverse effect from the Project on SAR and SOCI is defined as an effect that is likely to cause a permanent, unmitigated, alteration to habitat that supports a species' distribution, or alteration of critical habitat. An adverse effect that does not cause a permanent alteration to habitat of SAR or SOCI species is not considered to be significant. Sedentary species such as vascular and non-vascular flora do not have the opportunity to move to avoid direct or indirect impact. For these species, the loss of an individual or individuals of a SAR species that is important in the context of the province, or that species' overall abundance or distribution, may be considered significant, if appropriate mitigation measures are not implemented. Mortality of a single SAR could, under some circumstances, be considered a significant effect. The loss of an individual SAR due to an accident or malfunction (i.e., wildlife collision) is not incorporated into the magnitude threshold or overall significance of Project Activities.

The following logic was applied to assess the magnitude of a predicted change in SAR and SOCI:

- Negligible – no measurable change in SAR and SOCI habitat;
- Low – the Project results in loss of habitat, within or above natural variation (considering ongoing anthropogenic disturbance regimes), and the loss of habitat is mitigated in the long term through reclamation planning and other mitigation measures as determined to be necessary based on SAR species present;
- Moderate – the Project results in loss of habitat, above natural variation (considering ongoing anthropogenic disturbance regimes) and the loss of habitat is mitigated through long term reclamation planning, and other mitigation measures as determined to be necessary based on SAR species present, and direct impact to SOCI, or SAR with authorization granted under SARA and/or NSESA; and,
- High – the Project results in loss of habitat, above natural variation (considering ongoing anthropogenic disturbance regimes), or defined critical habitat, and that habitat loss is not mitigated through long term-compensation planning, other mitigation measures as determined to be necessary based on SAR species present, and direct impact to SAR without authorization granted under SARA and/or NSESA.

The timing of residual effects for SAR and SOCI considers when the residual environmental effect is expected to occur, considering seasonal aspects. The duration of residual effects considers the time frame over which the effects are likely to last, ranging from short-term to permanent. Long term reflects the commencement of reclamation activities, relating to habitat, flora, fauna and avifauna. The frequency of residual effects considers the rate of recurrence of the effects, ranging from once to continuous. The reversibility of residual effects considers the time required for habitat to recover to naturalized conditions, or whether the changes to habitat, if identified, are permanent.

6.12.6 Project Activities and SAR/SOCI Interactions and Effects

Priority species identified within the PA represent a diversity of taxa, habitat preferences, and, therefore, represent a diversity of potential and confirmed Project interactions, effects, mitigation, and monitoring. As such, Project effects, mitigation, and monitoring are discussed in terms of each taxa, rather than individual species, with a focus on SAR, recognizing that mitigation measures for SAR will generally provide appropriate mitigation for identified SOCI in the same taxonomic group. Where this is not the case, it will be stated. Project interactions, mitigation, and monitoring for each broad taxonomic group are outlined in previous sections as well, and these mitigation measures are appropriate and should be applied for all SAR and SOCI within the same taxonomic group. Potential interactions between the Project activities and SAR and SOCI are outlined in Table 6.12-14 and Table 6.12-15.

Table 6.12-14: Potential Interactions between Project Activities and SAR and SOCI at FMS Study Area

Project Phase	Duration	Relevant Project Activity
Site Preparation and Construction Phase	1 year	• Clearing, grubbing, and grading; • Drilling and rock blasting; • Topsoil, till and waste rock management; • Watercourse and wetland alteration; • Seloam Brook Realignment construction and dewatering; • Mine site road construction, including lighting; • Surface infrastructure installation and construction, including lighting; • Collection ditch and water management pond construction, including lighting; • Local traffic bypass road construction; • Environmental monitoring; • General waste management.
Operations Phase	7 years	• Drilling and rock blasting to access and extract ore; • Open pit dewatering • Ore management • Waste rock management; • Tailings management; • Surface water management; • Dust and noise management; • Petroleum products management; • Environmental monitoring; • General waste management,
Closure Phase: Reclamation Stage	2-3 years	• Site reclamation; • Environmental monitoring; • General waste management.

Table 6.12-15: Potential Interactions between Project Activities and SAR and SOCI at the Touquoy Mine Site

Project Phase	Duration	Relevant Project Activity
Operations Phase	7 years	• Tailings management • Environmental monitoring; • General waste management.
Closure Phase: Reclamation Stage	2-3 years	• Environmental monitoring

6.12.6.1 Priority Fish Species

Two priority fish species have been identified or are expected to reside within watercourses within the FMS Study Area (brook trout and pearl dace). Fish habitat is described in Section 6.8.3 using brook trout and white sucker as reference species. Mitigation (Seloam Brook Realignment and downstream enhancement of fish habitat), monitoring and proposed offsetting for fish and fish habitat (Section 6.8) will address direct and indirect effects to pearl dace and brook trout.

Within the FMS Study Area, qualitative assessments of twelve watercourse reaches categorized these reaches as moderate fish quality habitat for brook trout and white sucker. Five watercourse reaches were categorized as moderate-quality habitat for brook trout and low-quality for white sucker, six watercourse reaches were categorized as low-quality habitat for brook trout and moderate-quality for white sucker, and thirty-one watercourse reaches were categorized as low-quality habitat for both species, as described in Section 6.8. Ten watercourses comprising fish habitat within the FMS Study Area are expected to experience direct impact, with three having moderate quality habitat for either species, and seven having low quality habitat for both brook trout and white sucker.

Expected and potential direct and indirect fish and fish habitat impacts to surface water features (wetlands and watercourses) in the immediate vicinity of the FMS Study Area as a result of the FMS Mine Site construction is described in Section 6.8.6. These direct and indirect effects of Project activities are expected to be similar in nature between priority fish species and all other fish species. Broader potential indirect impacts to down-gradient water quality and quantity within the LAA are described in Section 6.6.6 and effects are evaluated within that section. Maintaining water quality and quantity downstream in the LAA is paramount for limiting broader fish and fish habitat impacts within each affected watershed associated with the Project, particularly those known to support priority fish species.

Development of the mine will cause direct impacts to fish and fish habitat mostly within the construction phase of the Project during clearing, grubbing, blasting, and development of the mine and its associated infrastructure. On-going impacts to fish and fish habitat are possible during operations of the mine from on-going dewatering efforts within the open pit and potential siltation and release of substances to receiving surface water systems adjacent to the mine infrastructure.

The Touquoy Mine Site is currently operational. There are no direct or indirect effects to priority fish or fish habitat anticipated to be caused by the processing of ore and the management of the tailings facilities for the Project beyond that discussed in Section 6.8. Broader potential indirect impacts to down-gradient water quality and quantity within Moose River are described in Section 6.6. Since the completion of the Touquoy Gold Project EARD and Focus Report, ACCDC status ranks, and listings under the NSESA and SARA have been revised. The species identified in the EARD were reviewed and it was confirmed that there are no newly listed species which would experience Project interactions beyond what is expected in terms of interactions to the fish community in general. Furthermore, fish SOCI (even those with revised listings) are expected to experience similar Project interactions as all other fish species. As such, no additional specific mitigation of Project interactions is necessary for priority fish species for the Project at the Touquoy Mine Site.

6.12.6.2 Priority Vascular Flora and Lichens

Development of the Project will result in direct impacts to vascular and non-vascular individuals and to habitat and flora communities. The effects of the Project on flora encompass vascular and non-vascular priority flora species in wetland, and upland habitats. As such, many of the effects described in Section 6.7 specific to wetland habitat and Section 6.9 (Habitat and Flora) will directly relate to effects on priority flora species. The majority of direct mortality to flora will occur during site preparation.

Within the FMS Study Area, four locations with a total of 11 thalli of blue felt lichen are expected to be directly impacted by the construction of the TMF (3) and WRSA (1). Three additional observations are within the proposed Plant and Ancillary Building Footprint. Individuals within the proposed Plant and Ancillary Building area may be avoidable at the detailed design stage of the Project. If direct avoidance is possible within the Plant and Ancillary Buildings, these three occurrences may experience indirect impact due to changes in vegetative cover surrounding the individuals. Rheault and colleagues (2003) describe the effect of habitat fragmentation on the quality of epiphytic lichen habitats; stating that fragmented habitats have altered sub exposure and moisture regimes, leading to a drying effect on forested edges and canopies. Many lichens which depend on humid environments, such as the epiphytic blue felt lichen, are often greatly impacted by presence of fragmented habitats. Where maintenance of the 100 m SMP buffer surrounding blue felt lichen is not practicable, the Proponent will consider inclusion of affected individuals in a Blue Felt Lichen Translocation Plan to be prepared in consultation with NSL&F.

Lichen translocation will be considered for the blue felt lichen, based on guidance provided by Smith (2014). According to Smith, successful translocation occurs when individuals are transferred from a donor site to a receptor site to establish a self-maintaining colony. Lichen translocation can be successful, provided the translocation plan considers the morphology of the species, the habitat and substrate, reproductive strategy of the species, the nature of the receptor site, threats to establishment, and seasonality and climate change. Translocation success is greater in stands where the target species is present, so unimpacted colonies of blue felt lichen can be used as receptor sites (Smith, 2014). Translocation has been completed with some success for boreal felt lichen in Newfoundland. The methods outlined in Nalcor (2016) can be adapted to translocation of blue felt lichen within the FMS Study Area. A Blue Felt Lichen Translocation Plan will be developed in consultation with NSL&F.

One thallus of the eastern candlewax lichen and fringe lichen were observed within the TMF berm and TMF, respectively, and are expected to be directly impacted. An additional observation of the eastern candlewax lichen was observed within the Plant and Ancillary Building Footprint and will also be directly impacted by mine development.

One thallus of the corrugated shingles lichen is located within the proposed Plant and Ancillary Building Footprint and will be directly impacted by mine development.

Two observations of the appressed jellyskin lichen are located 11 and 15 m east of the proposed road bypass located in the northwest section of the FMS Study Area. Due to the proximity of the appressed jellyskin to the bypass road, it is possible they may be directly or indirectly impacted during construction activities (e.g., temporary work areas, clearings etc.). Potential indirect impacts to lichens surrounding Project infrastructure will be reduced through best management strategies, mitigation measures and micro-siting to avoid direct impact wherever practicable.

One observation of the silvery flowered sedge is located 30 m south of the proposed road bypass in the north west of the FMS Study Area, 10 m north of the proposed organics stockpile. This observation has the potential to be directly or indirectly impacted during construction activities (e.g., temporary work areas, clearings etc.). Expected direct loss of three individuals of the southern twayblade is expected to occur by the construction of the TMF and Plant Facilities. Weigand's sedge (one clump, approximately 1 m^2 in size) was observed in WL27 and is expected to be directly impacted by TMF infrastructure. Potential indirect impacts to vascular flora surrounding Project infrastructure will be reduced through best management strategies, mitigation measures and micro-siting to avoid direct impact wherever practicable.

The Touquoy Mine Site is currently in operation. There are no direct or indirect effects to vascular flora and priority lichen species anticipated to be caused by the processing of FMS concentrate and the management of tailings from the FMS Mine Site. Effects to flora and habitat related to the Project are described in Section 6.9.

6.12.6.3 Priority Terrestrial Fauna

Mainland moose is the only terrestrial fauna priority species observed during field surveys within the FMS Study Area. Mainland moose are found in habitat mosaics of uneven age stands with abundant twigs and foliage for foraging. These uneven-aged mosaic forests that moose prefer can be formed from natural disturbance such as fire or wind throw, or anthropogenic disturbance such as timber harvesting. During the summer months, they are reliant upon aquatic systems (lakes, rivers, and wetlands) for submergent and emergent vegetation, and cover from thermal stress (NSDNR, 2007). Mainland moose are not particularly affected by habitat fragmentation based on habitat preference; however, increased access into a site (construction of new roads) may increase direct interaction with the species, including potential accidents. As such, low-level habitat fragmentation can indirectly affect mainland moose.

Development of the FMS Mine Site will cause direct impacts to habitat used by mainland moose. The WRSA is expected to directly impact WL125 where six observations of moose sign were documented. The number of moose sign observed within this wetland is likely reflective of the dense understory consisting of shrubs which provides suitable foraging habitat in the winter months, yet it is unclear whether this was a single individual or multiple. Upland habitat where moose signs have been observed are also expected to be directly impacted by the TMF and WRSA.

The methodology described in Section 6.9.5.2 was used to simulate current conditions for interior forest at the RAA level as a proxy for habitat availability and fragmentation, and wildlife movement. Road density has been identified as an excellent indicator of ecological integrity and potential predictor of habitat suitability for large mammals, like moose, as roads are closely correlated with human development (Snaith, Beazley, MacKinnon and Duinker 2002).

Mainland moose are particularly susceptible to habitat fragmentation as it constrains their movement and habitat use, while increasing other pressures like predator and human interference (Snaith, Beazley, MacKinnon and Duinker 2002). Snaith et al. (2002) found that road density had a significant negative correlation with the probability of mainland moose observations in Nova Scotia, and potentially more indicative of habitat selection than habitat composition alone. Interior forest patches as simulated in the analysis are inherently good proxy for good areas of cover and protection as they are isolated from edge effects.

Thermal protection of mature forest areas near forage producing areas and open water areas support mainland moose requirements without extensive travel, which allows for year round habitat (Snaith, Beazley, MacKinnon and Duinker 2002). The predicted interior forest simulation was completed at a course enough scale (i.e., - large anthropogenic disturbance vs. small scale forestry patch dynamics) that it encompasses a mix of forest age structures and wetland habitat and has not restricted access to open water.

The RAA is generally remote, with a moderate network of roads and forestry activity, though large tracts of forest landscape undisturbed by roads still exist in this region (NSDNR 2015b). Figure 6.10-3 shows the extent of the simulated existing disturbance and edge effect and remaining predicted interior forest patches for the RAA. A total of 56,573 ha of predicted interior forest has been identified within the RAA. The maximum Project edge effect as discussed in Section 6.9.5.2, will affect 275 ha of interior forest habitat, which accounts for 0.47% of predicted interior forest in the RAA.

Project activities are expected to result in increased habitat fragmentation and a decrease in habitat quality for those species which rely especially on interior forest conditions. This decrease in habitat quality for species relying on interior forest condition is based on increased activity and sensory disturbance, along with increased physical fragmentation. Increase in physical fragmentation is expected to be low, based on the current high level of disturbed habitat and the limited Project edge effect impact to predicted interior forest patches. Moose tend to stick close to areas of protection and do not move more than 80 to 200 m from cover avoiding large open areas (Eastman 1974, Hamilton et al. 1980, Tomm and Beck 1981, Peek et al. 1987, Jackson et al. 1991, Thompson et al. 1995 as cited in Snaith, Beazley, MacKinnon and Duinker 2002). Undisturbed, unfragmented habitat is present in the RAA, and the larger tracts are maintained around the FMS Mine Site, particularly on the south and eastern side. The FMS infrastructure footprint is situated primarily on an area of high existing disturbance and will only have fringe effects on the interior forest availability. There will be some limited isolation of habitat that is currently contiguous limiting some movement to this area particularly in the area between Seloam Lake and the TMF. However, broadly speaking, accessible routes to provide movement through and across the larger region at the LAA and RAA level still exist for wildlife, including moose, and are un-impacted by the development of the Project.

The Ecological Landscape Analysis undertake by NSL&F in 2015 and updated in 2019 identifies valley corridors travelling north-south between the Sheet Harbour area and the New Glasgow area, generally following the Highway 374 and passing around and through the FMS Study Area. These linear corridors are typically dictated by physical features such as river valleys, and in this case follows the East River Sheet Harbour system (NSL&F ELA 2015). The Project has the potential to impact this corridor in particular between Fifteen Mile Stream and Seloam Lake, along Seloam Brook. This impact is predicted to be low as the predictive interior forest patches show good connectivity north and south of the FMS Mine Site and the Seloam Brook Realignment is planned to improve the habitat provided by this currently degraded and disrupted system.

Based on the wetland cumulative effects modelling (Section 6.7.5.2), a maximum of 23% of wetlands suitable for mainland moose is expected to be directly lost within the FMS Study Area due to the development of the FMS Mine Site, which equates to 2.5% of suitable mainland moose wetland habitat within the LAA.

Sensory disturbance to mainland moose would result from rock blasting, clearing and grubbing, infrastructure construction, ore processing, tailings management, and overall increased traffic during operations. This will likely result in the localized wildlife avoidance of the FMS Study Area, particularly in close proximity to the site infrastructure. Overall, Project activities will likely cause a localized change in usage of the FMS Study Area by moose. Undisturbed forest patches and corridors between those patches remain within the LAA, to maintain movement of wildlife across the broader landscape. Sensory disturbance related to Project activity will occur within the FMS Study Area, and within the Touquoy Mine Site, as the additional processing of ore from the FMS mine will extend the life of the Touquoy Mine Site by seven years.

Direct mortality of fauna species such as moose could result from Project activities, particularly due to the increase in traffic during construction and operation of the facility. Increased traffic poses a risk to wildlife within the FMS Mine Site and the Touquoy Mine Site. Indirect mortality could result from exposure to contaminants or spills from unplanned incidents.

The Touquoy Mine Site is currently operational, and it is expected that ongoing sensory disturbances may occur in close proximity to the mine site as a result of the Project. Effects to terrestrial fauna species related to the Project are described in Section 6.10.

Since the completion of the EARD and focus report for the Touquoy Gold Project, ACCDC status ranks, and listings under the NSESA and SARA have been revised. The EARD was reviewed and it was confirmed that there are multiple fauna species that have been added to the list since the submission of the EARD including but not limited to: little brown myotis (*Myotis lucifugus*); northern myotis (*Myotis septentrionalis*); and, tri-colored bat (*Perimyotis subflavus*) and several other species. These species are not expected to experience Project interactions beyond what is expected in terms of interactions to the fauna community in general and discussed in Section 6.10, relating to an extension of the Touquoy Mine Site from the Project, and associated potential sensory disturbance in close proximity to the mine.

6.12.6.4 Priority Avifauna

The assessment of potential adverse interactions and effects of the Project on avifauna takes into account the potential for the Project to result in changes to:

- Permanent and temporary habitat alteration and fragmentation;
- Disturbance and/or displacement;
- Potential for direct and indirect mortality to individuals; and,
- Attraction and disorientation resulting from sensory disturbance.

With appropriate mitigation and monitoring, no direct mortality of priority bird species is anticipated, with the exception of the low potential for a bird strike with a haul truck or by other vehicles within the PA. Avifauna usage of the Project during construction and operation will largely be driven by changes and loss of habitat, resulting in expected localized avoidance of the PA by some species and occupation of nearby suitable habitat. Noise and light generated during all Project phases also has the potential to affect birds and cause avoidance behaviour. Refer to Section 6.11 for a discussion of the impact of predicted noise and light levels around the PA on avifauna.

Some priority species may avoid the PA in favor of undisturbed habitat in the surrounding landscape. Other priority species are anticipated to be attracted to the mine infrastructure and newly created habitat. The common nighthawk, for instance, is a crepuscular insectivore which nests on exposed gravel and disturbed areas. Lighting of buildings at dawn and dusk can create a foraging opportunity where insects are attracted to the lights. As such, Project activities may increase habitat suitability for the common nighthawk.

Twenty-two (six of which are SAR) priority avifauna species were observed within the FMS Study Area and proposed Project infrastructure and a direct loss of their habitat is expected. The six SAR avifauna species are common nighthawk, Canada warbler, rusty blackbird, olive-sided flycatcher, evening grosbeak, and eastern wood-peewee.

A total of 2372 ha of predicted interior forest has been identified within the LAA. Project infrastructure, as signified as the maximum Project edge effect in Section 6.9.5.2, will affect 275 ha of interior forest habitat, which accounts for 12% of predicted interior forest in the LAA. The two largest patches of potential interior forest are located in the east and southeastern portion of the LAA around Moser Lake and in the Toad Fish Wilderness Area. These patches contain contiguous forested habitat and could provide a means of wildlife movement, migration, breeding bird habitat and flora and fauna habitat. Maximum Project edge effect is predicted to impact predicted interior forest near the Seloam Brook Realignment, the eastern local traffic bypass road and TMF, and southern area of the plant and ancillary building footprint. Much of the area of predicted impact near the bypass road and TMF look to be cut over on aerial imagery and could be an overestimate in the analysis due to the lack of recent cutting in the GIS data layer. It is expected that the results of this fragmentation on avifauna to be minimal.

Based on the wetland cumulative effects modelling (Section 6.7.5.2) Canada warbler habitat is expected to have a maximum loss of 37%, olive-sided flycatcher 29% and rusty blackbird 23% within the FMS Study Area. However, in comparison to the LAA it was estimated that up to 5.5% of suitable wetland habitat for olive-sided flycatcher is expected to be lost, and 0.3% of suitable wetland habitat for rusty blackbird (loss of wetland habitat for Canada warbler was not evaluated at the LAA level). Refer to the wetland cumulative effects modelling (Section 6.7) which determined the extent of predicted habitat loss for three SAR species, Canada warbler, olive-sided flycatcher, and rusty blackbird within the FMS Study Area.

In addition to the focus on habitat loss for the aforementioned SAR, habitat loss of greater yellowlegs was also reviewed. Nova Scotia is the only maritime province in Canada in which greater yellowlegs is found breeding (Erksine 1992) and for that reason, focus on this species is brought forward. Twenty-four observations of greater yellowlegs occurred with and surrounding wetland habitat during breeding (2017), fall (2017) and spring (2018) surveys. Within the FMS Study Area multiple observations of greater yellowlegs occurred within suitable breeding habitat (it was identified as a probable breeder in 2017). Two of these observations were located within proposed infrastructure. One observation was within the open pit which cannot be micro-sited as the location is dependent on the location of the ore and the other observation is within the TMF. Although direct breeding habitat loss for the greater yellowlegs is expected to occur based on proposed infrastructure, suitable breeding habitat is located in adjacent wetland habitats.

The Touquoy Mine Site is currently operational, and it is expected ongoing sensory disturbance for avian priority species will occur as a result of the Project. Effects to avifaunal species related to the Project are described in Section 6.11.6.

Since the completion of the EARD and focus report, ACCDC status ranks and listings under the NSESA and SARA have been revised. The species identified in the EARD were reviewed against updated NSESA and SARA listings. There are no newly listed species which would experience Project interactions beyond what is expected in terms of interactions to the avian community in general (i.e., sensory disturbance). Furthermore, avian SOCI (even those with revised impacts) are expected to experience similar Project interactions as all other avian species. As such, no additional specific mitigation of Project interactions is necessary for priority avifauna species resulting from Project at the Touquoy Mine Site.

6.12.7 Mitigation

The potential effects related to species and that are associated with the different phases of the Project are outlined in the relevant VC sections for each taxonomic group of species. Specific mitigation measures related to priority species are outlined in the following sections. For all taxa, the Proponent will engage with the NSL&F biodiversity team to identify SAR permit requirements under the NSESA to mitigate impacts to species at risk and their habitats.

6.12.7.1 Priority Fish Species

Standard mitigation for fish and fish habitat is expected to appropriately mitigate effects on priority fish species. Watercourse alteration permitting and a *Fisheries Act* authorization for the proposed Seloam Brook Realignment and other direct impacts to fish for the Project will also be required, at which time detailed fish habitat quantification and potential effects on priority fish species will be addressed. The following mitigation efforts are considered in addition to those general fish and fish habitat mitigation measures outlined in Section 6.8.7.

- Site specific terms and conditions for alteration of watercourses which support priority fish species will be communicated to all site personnel and strictly adhered to; fish rescue will be completed, wherever practicable, within the FMS Study Area prior to mine construction; and
- The location of all watercourses that will be avoided by the Project that are known to support priority species will be communicated to site personnel along with recommended mitigation measures.

6.12.7.2 Priority Vascular Flora and Lichens

No vascular flora SAR has been observed within the FMS Study Area. Three priority species of vascular flora were identified across the FMS Study Area. One SAR lichen and eight SOCI lichens were identified within the FMS Study Area. Standard mitigation measures outlined previously in Section 6.9.7 will provide appropriate guidance and these mitigation measures outlined below will be also be considered specifically for priority vascular flora and lichen species:

- Avoid SAR/SOCI wherever practicable, particularly during micro-siting, upgrades and new construction. Clearly identifying locations of SAR/SOCI where they will be avoided, and instruct personnel of their whereabouts;
- Adhere to the 100 m buffer zone for blue felt lichen (as described in the SMP, NSL&F 2018) wherever practicable. Where maintenance of a 100 m buffer zone on a blue felt lichen occurrence is not practicable the Proponent will consider monitoring or translocation of individual thalli into suitable habitat;
- Assess the possibility of avoiding blue felt lichen individuals within the proposed Plant and Ancillary Building footprint;
- A map of all priority vascular and non-vascular flora will be provided to site personnel during site orientation, and the locations of all priority flora species that will be avoided during Project construction will be clearly flagged in the field;
- The Proponent will transplant priority flora species, where deemed, reasonable and appropriate in consultation with regulators and the Mi'kmaq of Nova Scotia, that are located within the direct footprint of the Project infrastructure to nearby areas where suitable habitat is present. Where avoidance or transplanting is not practicable, vascular flora SOCI from areas proposed for direct impact will be collected for herbarium records or for preservation of seeds in a seed bank through Acadia University; and,
- Wherever avoidance of priority lichen species is not practicable, the Proponent will consult with a lichen specialist to determine the likelihood of successful translocation of SAR lichens (blue felt lichen) to adjacent areas with suitable habitat. Where avoidance and translocation are not practicable or appropriate, specimens will be collected for submission to Frances Anderson or equivalent contact at time of construction (Lichen Specialist, Research Associate, and Nova Scotia Museum). Following consultation with NSL&F and the lichen recovery team, details associated with lichen translocation will be outlined in a Blue Felt Lichen Translocation Plan.

6.12.7.3 Priority Terrestrial Fauna Species

Mainland moose was the only priority terrestrial fauna species observed within the FMS Study Area. Standard mitigation measures outlined previously in Section 6.10.7 will provide appropriate guidance and these mitigation measures outlined below will be also be considered specifically for priority fauna (moose):

- Implement the WMMP as presented in the EMS Framework Document (Appendix L.1), which outlines specific measure to monitor impacts of the Project on moose, including activities such as repeated winter track surveys and pellet group inventories, and collaboration with the Mi'kmaq of Nova Scotia to study Mainland Moose in a broader context; and,
- Wildlife observation reporting to appropriate site personnel during construction, operation and decommissioning of Project.

6.12.7.4 Priority Avifauna

The potential effects related to birds and the different phases of the FMS Mine Site are outlined in Section 6.11.7. Most direct and indirect impacts on birds, including SAR, are accounted for in general mitigation/monitoring for all birds, since many have legislated protection under the *Migratory Birds Convention Act* (primarily through avoiding clearing/grubbing during nesting season if practicable, and conducting detailed pre-construction nest searches if clearing or grubbing must occur during nesting season). These pre-construction nest searches are particularly important in wetlands which provide suitable breeding habitat for the olive-sided flycatcher, Canada warbler and rusty blackbird.

Standard mitigation presented in Section 6.11 is recommended for priority avifauna species along with the following recommendations:

- Clearing and construction can increase habitat quality for common nighthawk (CONI), increasing potential interactions with this species. To limit attraction of CONI to the Project, the amount of exposed soil during nesting season should be limited, and cover or revegetate soil wherever practicable.

6.12.7.5 Summary of SAR Mitigation

Table 6.12-16 below provides a summary of proposed SAR mitigation measures for the Project.

Table 6.12-16: Mitigation for SAR

Species Name and Rank	Observations	Direct Impact Proposed Infrastructure	Potential Adverse Effects	Monitoring Plan, Action Plan, or Recovery Strategy	Mitigation	Effectiveness of Mitigation
Blue Felt Lichen SARA – SC COSEWIC – SC NSESA- V	Within the FMS Study Area eleven locations with approximately 48 thalli found within Wetlands 27, 65, 159, 240 and upland habitat near Wetlands 137, 145, 149, 155, and 265 7 locations were observed within proposed infrastructure	Seven locations with a total of 11 thalli are expected to be directly impacted by the construction of the TMF and WRSA Three additional observations are within the proposed Plant and Ancillary Building Footprint, which may be able to be avoided during detailed Project design, but may be directly impacted by Project infrastructure	Sensitive to changing environmental conditions, particularly air quality in close proximity Accidental cutting of host tree during construction of mine infrastructure Edge effects – e.g.: increased light, wind, temp; decrease in moisture due to nearby disturbance	An At-Risk-Lichens Special Management Practices (SMP) was released by NSL&F on May 23rd, 2018 No federal or provincial rmanagement plan for this species to date	Complete further detailed design, as is practicable, of FMS Mine Site infrastructure to avoid priority lichen species Reduce disturbance through buffering of habitat - maintain 100m buffer, wherever practicable Implement air quality monitoring and dust suppression plans Flag host trees Provide map of all priority vascular and non-vascular flora to site personnel during site orientation Wherever avoidance of priority lichen species is not practicable, the Proponent will consult with a lichen specialist to determine the likelihood of successful transplantation of SAR lichens to adjacent areas with suitable habitat. Where avoidance and transplantation are not feasible, specimens will be collected for submission to Frances Anderson or equivalent contact at time of construction (Lichen Specialist, Research Associate, and Nova Scotia Museum) Develop a Blue Felt Lichen Translocation Plan	Avoidance or implementation of buffers where practicable Observed populations are of similar extent or exhibit similar abundance/distribution over the FMS Study Area to baseline data (considering loss from external environmental factors) Include mitigation effectiveness in development of Blue Felt Lichen Translocation Plan
Mainland Moose SARA – Not Listed COSEWIC – Not Listed NSESA - E	FMS Study Area is within a Mainland Moose Concentration Area 28 observations were made incidentally and during the winter wildlife surveys. See Section 6.10 for habitat details. 13 observations are located within proposed infrastructure	Direct loss of wetlands and upland habitat suitable for Mainland Moose	Increased access into a site (construction of new roads) may increase poaching levels Lowered viability of individual populations of moose by direct mortality and reduction in range Habitat alteration, fragmentation, or loss	Recovery Plan for Mainland Moose in Nova Scotia (NSDNR, 2007)	Implement WMMP - including activities such as repeated winter track surveys and pellet group inventories, and collaboration with the Mi'kmaq of Nova Scotia to study Mainland Moose in a broader context Implement wildlife observation reporting to appropriate site personnel during construction, operation, and decommissioning of Project Vehicles will yield to wildlife on roads Vehicles will adhere to safe speed limits, particularly around blind corners. An un-vegetated buffer along roadsides will be maintained, where practicable, to improve visibility along roadsides and reduce the potential for collisions with wildlife Install fencing, where practicable, to prevent wildlife from accessing areas with increased risk of injuries to wild species - appropriate dimensions to address and eliminate accidental falls of species of varying size including deer and moose into the open pit	No increase in mortalities due to mine related activities. If a mortality occurs, the Proponent will consult with regulatory agencies to determine the necessary action to be taken If monitoring of Mainland Moose to verify the efficacy of mitigation strategies show signs of disturbance due to mine related activities, the Proponent will consult with regulatory agencies to develop an adaptive management plan or other appropriate mitigation as deemed necessary by regulators Inclusion in development of Environmental Effects Monitoring (EEM) Plan to monitor effectiveness

Species Name and Rank	Observations	Direct Impact Proposed Infrastructure	Potential Adverse Effects	Monitoring Plan, Action Plan, or Recovery Strategy	Mitigation	Effectiveness of Mitigation
Common Nighthawk SARA - Th COSEWIC - Th NSESA - Th	During the dedicated Common Nighthawk surveys, 43 observations, comprising of 36 of the individuals were exhibiting territorial displays (calling and booming) in 2017 55 incidental observations were documented in 2017, 2018 and 2019 A total of 91 individuals were observed through standard surveys and incidental observations. 17 individuals were observed within proposed infrastructure	Loss of breeding habitat within the FMS Study Area	Collisions with anthropogenic structures and vehicles Habitat alteration, fragmentation, or loss Unintentional destruction of nests, eggs, nestlings or adults Breeding disruption or functional habitat loss due to sensory disturbance (noise or light)	Recovery Strategy 2016	Avoid clearing/grubbing activities during nesting season If construction is required during the active nesting season, an avian specialist will monitor for nesting activity. If evidence of nesting is observed, the Proponent will consult with appropriate regulatory agencies to determine an appropriate spatial and temporal buffer, based on site and seasonal specific parameters at the time of the observation To limit attraction of CONI to the Project, the amount of exposed soil during nesting season should be limited, and cover or revegetate soil wherever practicable. Limit light use to direct and focused light when needed for worker safety Implement noise management including use of mufflers on equipment and regular maintenance All site workers shall comply with regulations outlined in the Migratory Bird Convention Act, which prohibits the disturbance of migratory birds, their nests and eggs. If any nest is identified, the Proponent Environmental Technician must be notified immediately, so steps can be taken to identify the species and determine appropriate mitigation or avoidance if required. Species identified of particular risk and several species of birds known to nest around active construction sites will be included in the Wildlife Sighting Report Card similar to those required at the Touquoy Mine Site	If monitoring to verify the efficacy of mitigation strategies and any executed setbacks show signs of disturbance despite the setback, consultation with Environment and Climate Change Canada's Canadian Wildlife Service and other appropriate regulatory authorities will take place to develop a proposed adaptive management plan Monitor known nests around stockpiles and exposed areas from a distance with a spotting scope or binoculars to verify the effectiveness of the buffer until the nests are inactive Notify Environment and Climate Change Canada within 24 hours in the event of the mortality or injury of ten or more migratory birds in a single event or in the event of the mortality or injury of a migratory bird SAR
Canada Warbler SARA - Th COSEWIC - Th NSESA - E	Preferred Canada Warbler habitat (mixedwood swamps) were observed within the FMS Study Area Seventy-two Canada warblers were observed during the 2017 and 2018 bird surveys 19 individuals were observed within proposed infrastructure	Loss of breeding habitat within the FMS Study Area	Collisions with anthropogenic structures and vehicles Habitat alteration, fragmentation, or loss Unintentional destruction of nests, eggs, nestlings or adults Breeding disruption or functional habitat loss due to sensory disturbance (noise or light)	Recovery Strategy 2016	Avoid clearing/grubbing activities during nesting season If construction is required during the active nesting season, an avian specialist will monitor for nesting activity. If evidence of nesting is observed, the Proponent will consult with appropriate regulatory agencies to determine an appropriate spatial and temporal buffer, based on site and seasonal specific parameters at the time of the observation Limit light use to direct and focused light when needed for worker safety Implement air quality monitoring and dust suppression plans Implement noise management including use of mufflers on equipment and regular maintenance All site workers shall comply with regulations outlined in the Migratory Bird Convention Act, which prohibits the disturbance of migratory birds, their nests and eggs. If any nest is identified, the Proponent Environmental Technician must be notified immediately, so steps can be taken to identify the species and determine appropriate mitigation or avoidance if required. Species identified of particular risk and several species of birds known to nest around active construction sites will be included in the Wildlife Sighting Report Card similar to those required at the Touquoy Mine Site	If monitoring to verify the efficacy of mitigation strategies and any executed setbacks show signs of disturbance despite the setback, consultation with Environment and Climate Change Canada's Canadian Wildlife Service and other appropriate regulatory authorities will take place to develop a proposed adaptive management plan Notify Environment and Climate Change Canada within 24 hours in the event of the mortality or injury of ten or more migratory birds in a single event or in the event of the mortality or injury of a migratory bird SAR

Species Name and Rank	Observations	Direct Impact Proposed Infrastructure	Potential Adverse Effects	Monitoring Plan, Action Plan, or Recovery Strategy	Mitigation	Effectiveness of Mitigation
Rusty Blackbird SARA - SC COSEWIC - SC NSESA - E	Five observations of Rusty Blackbird were documented in upland and wetland habitats All individuals (observed at three locations) were observed in proposed infrastructure (open pit and TMF)	Breeding habitat, including forested wetlands, swamps, and peat bogs are present within the FMS Study Area	Collisions with anthropogenic structures and vehicles Habitat alteration, fragmentation, or loss - particularly wetland loss Unintentional destruction of nests, eggs, nestlings, or adults Breeding disruption or functional habitat loss due to sensory disturbance (noise or light)	Management Plan 2015	Avoid clearing/grubbing activities during nesting season If construction is required during the active nesting season, an avian specialist will monitor for nesting activity. If evidence of nesting is observed, the Proponent will consult with appropriate regulatory agencies to determine an appropriate spatial and temporal buffer, based on site and seasonal specific parameters at the time of the observation Limit light use to direct and focused light when needed for worker safety Implement air quality monitoring and dust suppression plans Implement noise management including use of mufflers on equipment and regular maintenance All site workers shall comply with regulations outlined in the Migratory Bird Convention Act, which prohibits the disturbance of migratory birds, their nests and eggs. If any nest is identified, the Proponent Environmental Technician must be notified immediately, so steps can be taken to identify the species and determine appropriate mitigation or avoidance if required. Species identified of particular risk and several species of birds known to nest around active construction sites will be included in the Wildlife Sighting Report Card similar to those required at the Touquoy Mine Site	If monitoring to verify the efficacy of mitigation strategies and any executed setbacks show signs of disturbance despite the setback, consultation with Environment and Climate Change Canada's Canadian Wildlife Service and other appropriate regulatory authorities will take place to develop a proposed adaptive management plan Notify Environment and Climate Change Canada within 24 hours in the event of the mortality or injury of ten or more migratory birds in a single event or in the event of the mortality or injury of a migratory bird SAR
Evening Grosbeak SARA - SC COSEWIC -SC NSESA - SC	6 individuals observed in upland and wetland habitat within the FMS Study Area Two individuals observed within infrastructure (south western borrow pit, contractor laydown)	Loss of breeding habitat within the FMS Study Area	Collisions with anthropogenic structures and vehicles Habitat alteration, fragmentation, or loss Unintentional destruction of nests, eggs, nestlings or adults Breeding disruption or functional habitat loss due to sensory disturbance (noise or light)	No current monitoring plan, action plan or recovery strategy for this species in this area	Avoid clearing/grubbing activities during nesting season If construction is required during the active nesting season, an avian specialist will monitor for nesting activity. If evidence of nesting is observed, the Proponent will consult with appropriate regulatory agencies to determine an appropriate spatial and temporal buffer, based on site and seasonal specific parameters at the time of the observation Limit light use to direct and focused light when needed for worker safety Implement noise management including use of mufflers on equipment and regular maintenance Implement air quality monitoring and dust suppression plans All site workers shall comply with regulations outlined in the Migratory Bird Convention Act, which prohibits the disturbance of migratory birds, their nests and eggs. If any nest is identified, the Proponent Environmental Technician must be notified immediately, so steps can be taken to identify the species and determine appropriate mitigation or avoidance if required. Species identified of particular risk and several species of birds known to nest around active construction sites will be included in the Wildlife Sighting Report Card similar to those required at the Touquoy Mine Site	Avoid clearing/grubbing activities during nesting season If construction is required during the active nesting season, an avian specialist will monitor for nesting activity. If evidence of nesting is observed, the Proponent will consult with appropriate regulatory agencies to determine an appropriate spatial and temporal buffer, based on site and seasonal specific parameters at the time of the observation Limit light use to direct and focused light when needed for worker safety Implement noise management including use of mufflers on equipment and regular maintenance Implement air quality monitoring and dust suppression plans Notify Environment and Climate Change Canada within 24 hours in the event of the mortality or injury of ten or more migratory birds in a single event or in the event of the mortality or injury of a migratory bird SAR

Species Name and Rank	Observations	Direct Impact Proposed Infrastructure	Potential Adverse Effects	Monitoring Plan, Action Plan, or Recovery Strategy	Mitigation	Effectiveness of Mitigation
Olive-sided Flycatcher SARA - Th COSEWIC - Th NSESA - Th	Within the FMS Study Area 66 individuals were observed Five individuals were observed within infrastructure (TMF, access road and the south western borrow pit)	Loss of breeding habitat within the FMS Study Area	Collisions with anthropogenic structures and vehicles Habitat alteration, fragmentation, or loss Unintentional destruction of nests, eggs, nestlings or adults Breeding disruption or functional habitat loss due to sensory disturbance (noise or light)	Recovery Strategy 2016	Avoid clearing/grubbing activities during nesting season If construction is required during the active nesting season, an avian specialist will monitor for nesting activity. If evidence of nesting is observed, the Proponent will consult with appropriate regulatory agencies to determine an appropriate spatial and temporal buffer, based on site and seasonal specific parameters at the time of the observation Limit light use to direct and focused light when needed for worker safety Implement noise management including use of mufflers on equipment and regular maintenance Implement air quality monitoring and dust suppression plans All site workers shall comply with regulations outlined in the Migratory Bird Convention Act, which prohibits the disturbance of migratory birds, their nests and eggs. If any nest is identified, the Proponent Environmental Technician must be notified immediately, so steps can be taken to identify the species and determine appropriate mitigation or avoidance if required. Species identified of particular risk and several species of birds known to nest around active construction sites will be included in the Wildlife Sighting Report Card similar to those required at the Touquoy Mine Site	If monitoring to verify the efficacy of mitigation strategies and any executed setbacks show signs of disturbance despite the setback, consultation with Environment and Climate Change Canada's Canadian Wildlife Service and other appropriate regulatory authorities will take place to develop a proposed adaptive management plan Notify Environment and Climate Change Canada within 24 hours in the event of the mortality or injury of ten or more migratory birds in a single event or in the event of the mortality or injury of a migratory bird SAR
Eastern Wood-pewee SARA - SC COSEWIC - SC NSESA - V	One observation within Wetland 35, outside of proposed infrastructure.	Loss of possible breeding habitat within the FMS Study Area – mature and intermediate mixed wood forest with open understory	Collisions with anthropogenic structures and vehicles Habitat alteration, fragmentation, or loss Unintentional destruction of nests, eggs, nestlings, or adults Breeding disruption or functional habitat loss due to sensory disturbance (noise or light) Impacts from dust along mine site roads	No current monitoring plan, action plan or recovery strategy for this species in this area	Avoid clearing/grubbing activities during nesting season If construction is required during the active nesting season, an avian specialist will monitor for nesting activity. If evidence of nesting is observed, the Proponent will consult with appropriate regulatory agencies to determine an appropriate spatial and temporal buffer, based on site and seasonal specific parameters at the time of the observation Limit light use to direct and focused light when needed for worker safety Implement noise management including use of mufflers on equipment and regular maintenance Implement air quality monitoring and dust suppression plans All site workers shall comply with regulations outlined in the Migratory Bird Convention Act, which prohibits the disturbance of migratory birds, their nests and eggs. If any nest is identified, the Proponent Environmental Technician must be notified immediately, so steps can be taken to identify the species and determine appropriate mitigation or avoidance if required. Species identified of particular risk and several species of birds known to nest around active construction sites will be included in the Wildlife Sighting Report Card similar to those required at the Touquoy Mine Site	If monitoring to verify the efficacy of mitigation strategies and any executed setbacks show signs of disturbance despite the setback, consultation with Environment and Climate Change Canada's Canadian Wildlife Service and other appropriate regulatory authorities will take place to develop a proposed adaptive management plan Notify Environment and Climate Change Canada within 24 hours in the event of the mortality or injury of ten or more migratory birds in a single event or in the event of the mortality or injury of a migratory bird SAR

6.12.8 Residual Effects and Significance

Based on avoidance, mitigation and monitoring proposed for all priority species listed above, the following residual effects are anticipated. Project VC interactions of a priority taxa (e.g., priority fish species) that have the same residual environmental effects characteristic rankings of their related non-priority specific VC (e.g., fish and fish habitat) are not carried forward in the tables below.

The ecological and social context of each priority species taxa was included throughout the evaluation as was completed for all VCs. In general, the ecological and social context specific to priority species are more significant than non-listed species in each taxa. Ecological (species abundance, habitat, food source etc.) and social factors (recreational, commercial and Indigenous) for priority species are typically more specific and sensitive than for non-priority species. For example, rusty blackbirds have very specific ecological requirements for foraging and nesting and brook trout is of great social importance recreationally as one of Nova Scotia's most important sports fish and is also an important fish for the Mi'kmaq of Nova Scotia. SAR/SOCI species are also less abundant than common species (mainland moose vs. snowshoe hare).

6.12.8.1 Priority Fish Species

There are no differences between the residual environmental effects for non-priority priority fish species compared to priority fish species found within the FMS Study Area. Refer to Table 6.8-37 for residual environmental effects on fish.

6.12.8.2 Priority Vascular Flora and Lichens

There are no differences between the residual environmental effects for non-priority specific flora and lichens compared to priority flora and lichens. Refer to Table 6.9-8 for residual environmental effects of habitat and flora.

6.12.8.3 Priority Terrestrial Fauna Species

Four VC interactions presented in Table 6.12-17 have been carried forward for priority terrestrial fauna species.

The RAA is generally remote, with a moderate network of roads and forestry activity, though large tracts of forest landscape undisturbed by roads still exist in this region (NSDNR, 2015b). A total of 56,573 ha of predicted interior forest has been identified within the RAA. The maximum Project edge effect as discussed in Section 6.9.5.2, will affect 275 ha of interior forest habitat, which accounts for 0.49% of predicted interior forest in the RAA.

Project activities are expected to result in increased habitat fragmentation and a decrease in habitat quality for those species, including the moose, which rely especially on interior forest conditions. This decrease in habitat quality for species relying on interior forest condition is based on increased activity and sensory disturbance, along with increased physical fragmentation. Increase in physical fragmentation is expected to be low, based on the current high level of disturbed habitat and the limited Project edge effect impact to predicted interior forest patches. Undisturbed, unfragmented habitat is present in the RAA, and the larger tracts are maintained around the FMS Mine Site, particularly on the south and eastern side. The FMS infrastructure footprint is situated primarily on an area of high existing disturbance and will only have fringe effects on the interior forest availability. There will be some limited isolation of habitat that is currently contiguous limiting some movement to this area particularly in the area between Seloam Lake and the TMF. However, broadly speaking, accessible routes to provide movement through and across the larger region at the LAA and RAA level still exist for wildlife and are un-impacted by the development of the Project.

Vehicle and haul truck activity will occur on mine site roads throughout the PA during the construction, operation, and closure phases. Vehicle and haul truck activity can cause impacts to priority fauna from wildlife vehicle collisions, dust, noise, and accidents (e.g., spills). Wildlife vehicle collisions can directly affect priority fauna and noise can indirectly affect priority fauna by encouraging avoidance behaviour.

Blasting and drilling of in-situ rock is expected to occur at the FMS Mine Site during the operational phase of the Project. Blasting could negatively affect priority fauna from the noise associated with the activity. Although blasting is restricted to the PA the sound disturbance to terrestrial fauna has the potential to extend into the LAA. For example, a noise disturbance can cause avoidance behaviour in all terrestrial fauna but the impact to the energy balance of a mainland moose may have more severe consequences compared to a non-priority fauna species because stress on an already endangered (NSESA) population may impede its biological success in turn having a greater impact on the species.

6.12.8.4 Priority Avifauna Species

Four VC interactions presented in Table 6.12-17 have been carried forward for priority avifauna species. Clearing and grubbing will result in habitat loss for avifauna. Mitigation measures such as bird awareness and best management practices will be used. Best management practices include the avoidance of clearing and grubbing during the breeding season for migratory birds where practical (beginning of April to end of August for migratory birds; EC 2015b). Disturbances (wildlife vehicle collisions, light etc.) have the potential to pose a greater impact on priority bird species in comparison to non-priority specific bird species. This can be attributed to the rarity of priority bird species.

Table 6.12-17: Residual Environmental Effects for Terrestrial Fauna and Avifauna SAR

Project VC Interactions	Mitigation and Compensation Measures	Nature of Effect	Significance Criteria for Residual Environmental Effects						Residual Effect	Significance
			Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility		
Construction – FMS Mine Site Habitat loss and fragmentation from clearing and grubbing	Limit habitat disturbance and minimize Project footprint during detailed design, implement speed limits, install fences where necessary, and minimize lighting	A	M VC interaction causes direct loss of habitat for fauna and avifauna	LAA Potential adverse effect to fauna and avifauna outside of the PA	A VC interaction may affect seasonal aspects of fauna and avifauna	MT Effects can occur between 1 year and 7 years	O Effects occur once during the construction phase	PR Mitigation cannot guarantee a return to baseline conditions	Habitat Loss	Not significant
Construction – FMS Mine Site Operations – FMS Mine Site and Touquoy Mine Site Reclamation Stage of Closure – FMS Mine Site Disturbance (noise, light, and wildlife vehicle collisions) from Project activities	Limit habitat disturbance and minimize Project footprint during detailed design, implement speed limits, install fences where necessary, and minimize lighting	A	L VC interaction causes direct loss of habitat for fauna and avifauna	LAA Potential adverse effect to fauna and avifauna outside of the PA	A VC interaction may affect seasonal aspects of fauna and avifauna	LT Effects are expected to occur beyond 7 years	R Effects occur at regular intervals during the construction phase	R VC will recover to baseline conditions	Disturbance	Not significant
Operations – FMS Mine Site and Touquoy Mine Site Tailings management, deposition of tailings and controlled release of effluent	Implement bird and wildlife deterrent systems at FMS Mine Site TMF and Touquoy exhausted pit	A	L VC interaction results in on-going sensory disturbance from operations at Touquoy Mine Site	LAA Potential adverse effect to fauna outside of the PA	A VC interaction may affect seasonal aspects of fauna and avifauna	LT Effects can occur beyond 7 years	R Effects occur at regular intervals during the operational phase	R VC will recover to baseline conditions	Creation of potential open water habitat; decreased water quality	Not significant
Reclamation Stage of Closure–FMS Mine Site FMS Mine Site, Re-establishment of habitat for SAR/SOCI	N/A	P	L Minor change from baseline conditions	LAA Potential effect on fauna outside of the PA	A VC interaction may affect seasonal aspects of fauna and avifauna	LT Effects can occur beyond 7 years	O Effects occur once during the reclamation phase	PR Reclamation cannot guarantee a return to baseline conditions	Habitat restoration	Not significant

Legend (refer to Table 5.10-1 for definitions)

Nature of Effect	Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility
A Adverse	N Negligible	PA Project Area	N/A Not Applicable	ST Short-Term	O Once	R Reversible
P Positive	L Low	LAA Local Assessment Area	A Applicable	MT Medium-Term	S Sporadic	IR Irreversible
	M Moderate	RAA Regional Assessment Area		LT Long-Term	R Regular	PR Partially Reversible
	H High			P Permanent	C Continuous	

6.12.9 Proposed Compliance and Effects Monitoring Program

The monitoring of priority fish species will be captured under general fish and fish monitoring. Similarly, the monitoring of vascular plants encompassed within the Wetland Monitoring Plan which will be developed during permitting, may include priority vascular plants. As part of the WMMP, which is provided within the EMS Framework Document (Appendix L.1), a mainland moose monitoring protocol has been developed. Monitoring associated with this protocol will be completed for the Project on selected transects within suitable mainland moose habitat. Additionally, the WMMP outlines protocols to minimize interactions between wildlife (e.g., snapping turtles) and Project activities.

If construction is required during the active nesting season, an avian specialist will monitor for nesting activity.

Permitting may be required for Species At Risk and any monitoring requirements will be determined during permitting

Proposed follow-up and monitoring programs have been reviewed with the Mi'kmaq of Nova Scotia during engagement efforts including meetings, sharing of technical documents (Draft EIS, poster boards, Summary of Mi'kmaq Effects and Proposed Mitigation Measures, Plain Language Summary). On-going engagement with the Mi'kmaq will continue through the EA process and associated permitting relating to follow-up programs and monitoring.

6.13 Mi'kmaq of Nova Scotia

6.13.1 Rationale for Valued Component Selection

Assessment of the potential for the Project to interact with and affect the Mi'kmaq of Nova Scotia is included in consideration of its socio-economic, socio-cultural, and/or traditional importance; in recognition of potential or established Aboriginal and Treaty rights; and due to the nature of potential Project-VC interactions. Additionally, subparagraph 5(1)(c) of *CEAA 2012* and the FMS EIS Guidelines (CEAA, 2018) require assessment of potential effects to Indigenous Peoples including consideration of:

- Health and socio-economic conditions;
- Physical and cultural heritage, including any structure, site or thing that is of historical, archaeological, paleontological or architectural significance; and
- Current use of lands and resources for traditional purposes.

As per Nova Scotia's Environmental Assessment Regulations, proponents are required to identify concerns of the Mi'kmaq of Nova Scotia regarding potential adverse effects and clarify the steps taken or proposed to be taken by the Proponent to address concerns.

The Mi'kmaq in the provinces of Nova Scotia, New Brunswick, PEI, and the Gaspé Peninsula in Quebec are founded on land historically occupied by the ancestors of the Mi'kmaq. The earliest evidence of the Mi'kmaq of Nova Scotia in the Maritimes Region indicates that the ancestors of the Mi'kmaq have existed on the land for more than 11,000 years (NSOAA 2017). The Mi'kmaq generally lived in semi-permanent and permanent settlements at resource-rich locations (Appendix H.1). The lives of the Mi'kmaq of Nova Scotia, in what are today referred to as the Maritime Provinces, considered the seasonal cycles of the local vegetation, animals, and fish, living a traditional life as fishers, hunters, and gatherers throughout their territory (Appendix H.1). In the summer months, summer villages along the Eastern Shore provided fish, shellfish, fowl, and eggs, while during the colder months, the Mi'kmaq did most of their game hunting, moving inland from their summer camps (Hoffman 1955 in Appendix H.1).

The Mi'kmaq of Nova Scotia have established Aboriginal and Treaty rights, including the right to fish for a "moderate livelihood" which flows from the Peace and Friendship Treaties, and Aboriginal rights to hunt, fish and gather for food, social and ceremonial (FSC) purposes – more broadly referred to as "traditional" purposes. The FMS EIS Guidelines (CEAA, 2018) require the Proponent to identify potential adverse impacts of the Project on potential or established Aboriginal or Treaty rights, and related interests.

The Crown has a duty to consult with the Mi'kmaq of Nova Scotia, which is achieved in accordance with the Mi'kmaq-Canada-Nova Scotia Consultation TOR. As per Supreme Court of Canada instruction and subsequent guidance from governments, such as the Updated Guidelines for Federal Officials to Fulfill the Duty to Consult (Government of Canada, 2011) and the Proponents' Guide: Engagement with the Mi'kmaq of Nova Scotia (Province of Nova Scotia, 2012), the Crown may delegate procedural aspects of consultation to proponents. However, the duty to consult, and ultimate decision-making authority remains with the Crown. The results of the Proponent's Mi'kmaq of Nova Scotia engagement program and EIS development is expected to be considered by the federal and provincial governments in the EA decision-making process.

For the purposes of consultation, 11 of the 13 Mi'kmaq communities are represented in consultation by the Kwilmu'k Maw-klusuaqn Negotiation Office (KMKNO), which reports to the Assembly of Nova Scotia Mi'kmaq Chiefs (ANSMC). Millbrook and Sipekne'katik First Nations represent their own communities in consultation through their elected Chiefs and Councils.

In summary, the historical presence of the Mi'kmaq in Nova Scotia, their proven Aboriginal and treaty rights and title claim, the duty of the Crown to consult with the Mi'kmaq of Nova Scotia when contemplating decisions that could potentially adversely affect their rights, the potential for the Project to have an impact on Indigenous rights and interests, and the requirements of the *Canadian Environmental Assessment Act*, 2012 all form the rationale for the selection of the Mi'kmaq of Nova Scotia as a VC. The Mi'kmaq of Nova Scotia continue to rely on their traditional lands for cultural and economic survival. Broadly speaking, the Project has the potential to impact the Mi'kmaq's ability to access lands during the temporal life of the Project; and, to potentially alter the presence or availability of animals or plants that the Mi'kmaq rely on. Details relating to the specific nature of the potential impacts of the Project on the Mi'kmaq of Nova Scotia are described herein.

6.13.1.1 Baseline Program Methodology

6.13.1.2 FMS Study Area Baseline Program Methodology

Four main components were used to define the baseline information for the Mi'kmaq of Nova Scotia:

- Information obtained during on-going engagement with the Mi'kmaq of Nova Scotia;
- Completion of a Mi'kmaq Ecological Knowledge Study (MEKS) for the FMS Study Area (2018);
- Publicly-available Indigenous knowledge related to the Mi'kmaq of Nova Scotia; and,
- Completion of archaeological screening and reconnaissance.

The on-going engagement activities and issues raised during the engagement are described in Section 4 of this EIS. The archaeological screening is described in Section 6.14 of this EIS, with findings relevant to the Mi'kmaq noted in this section. Issues raised during the Mi'kmaq engagement activities were considered in Project design and the overall development of this EIS, as described in Section 4.

Mi'kma'ki All Points Services (MAPS) was retained in 2018 by MEL on behalf of the Proponent to complete a MEKS for the proposed Project. This MEKS is attached as Appendix H.1.

The purpose of the MEKS is to foster the integration of Mi'kmaw traditional ecological knowledge into the environmental assessment process and development decisions. It also aims to identify and report any ecological concerns regarding the Project's impact on Mi'kmaw use of land, resources and special places within the Project Study Area.

The MEKS includes:

- a study of historic and current Mi'kmaq land and resource use;
- an evaluation of the potential impacts of the Project on Mi'kmaq use and occupation and constitutionally-protected rights;
- an evaluation of the significance of the potential impacts of the Project on Mi'kmaq use and occupation; and,
- recommendations to proponents and regulators that may include recommendations for mitigation measures, further study, or consultation with the Mi'kmaq of Nova Scotia.

MAPS has indicated in their report that the MEKS methodological approach includes the adherence to the Mi'kmaq Ecological Knowledge Study Protocol (2nd edition) as ratified by the Assembly of Nova Scotia Mi'kmaw Chiefs (ANSMC 2007). Accordingly, this research initiative and its methodological approach were communicated to the Mi'kmaw Ethics Watch Committee in 2017 whose mandate is to ensure research activities with the Nova Scotia Mi'kmaw community comply with the Mi'kmaq Research Ethics Protocol of 1999.

The MEKS baseline information includes both historic and available current Mi'kmaq land and resource use. As defined in the MEKS, the MEKS Study Area for current use is the FMS Study Area with a 5-km radius, while the historic use may also include a wider surrounding area. Figure 6.13-1 shows the Mi'kmaq LAA which is the equivalent to the MEKS Study Area. Relevant details from the MEKS relating to historical and available current Mi'kmaq land and resource use are included in this section and support the analysis of potential Project impacts to the Mi'kmaq of Nova Scotia. As the conclusions and recommendations as they are portrayed in the study are broad in nature, the Proponent sought further refinement and detail of traditional and current Mi'kmaq land and resource use from MAPS and other potential researchers, but none were available to undertake the work. It is the intention of the Proponent to continue to seek a more specific level of detail as the environmental assessment and Project progresses.

6.13.1.3 Touquoy Baseline Program Methodology

Four main components were used to define the baseline information for the Mi'kmaq of Nova Scotia:

- Information obtained during ongoing engagement with the Mi'kmaq of Nova Scotia since 2005;
- Completion of a Mi'kmaq Ecological Knowledge Study (MEKS) for the Touquoy Golf Project (CRA 2007a);
- Publicly-available Indigenous knowledge related to the Mi'kmaq of Nova Scotia; and,
- Completion of archaeological screening and reconnaissance at the Touquoy Mine Site.

The MEKS was completed for the Touquoy Gold Project in December 2005 [prior to the development of the Mi'kmaq of Nova Scotia's MEKS Protocol (ANSMC 2007)]. Mi'kmaq involvement and the results of the MEKS for TouquoyGold Project were documented in the EARD for this project that can be found on the NSE Environmental Assessment website. (http://novascotia.ca/nse/ea/MooseRiver.asp)

6.13.2 Baseline Conditions

6.13.2.1 Regional Baseline Conditions and General Information Relating to Mi'kmaq Communities

There are 13 Mi'kmaq communities in Nova Scotia, with two First Nation (Mi'kmaq) reserves in the vicinity of the Project: Beaver Lake IR 17 (49.4 ha) is located approximately 24 km southwest from the FMS Study Area, and Sheet Harbour IR 36 (32.7 ha) is located 25 km south of the Project. Both these reserves belong to the Millbrook First Nation which is located in Truro, Nova Scotia, 64 km northwest of the FMS Study Area. The 2017 Census reports 21 and 25 Mi'kmaw residents at Beaver Lake and Sheet Harbour, respectively (Statistics Canada 2017, 2017a).

The Pictou Landing First Nation (PLFN), located north of the town of New Glasgow, is located 59km north of the Project. The Sipekne'katik First Nation, located in Indian Brook, Nova Scotia, is located approximately 75 km west of the Project and Paqtnkek First Nation, located in Afton, Nova Scotia, is located 79 km northeast of the Project.

Mi'kmaq rights are communal rights and therefore shared amongst all members of the Mi'kmaq Nation in Nova Scotia. Community profiles of the 13 Mi'kmaw First Nations in Nova Scotia have been included in Table 6.13-1 (Stantec 2018c).

The locations of First Nations reserve lands in Nova Scotia are also depicted below on Figure 6.13-2.

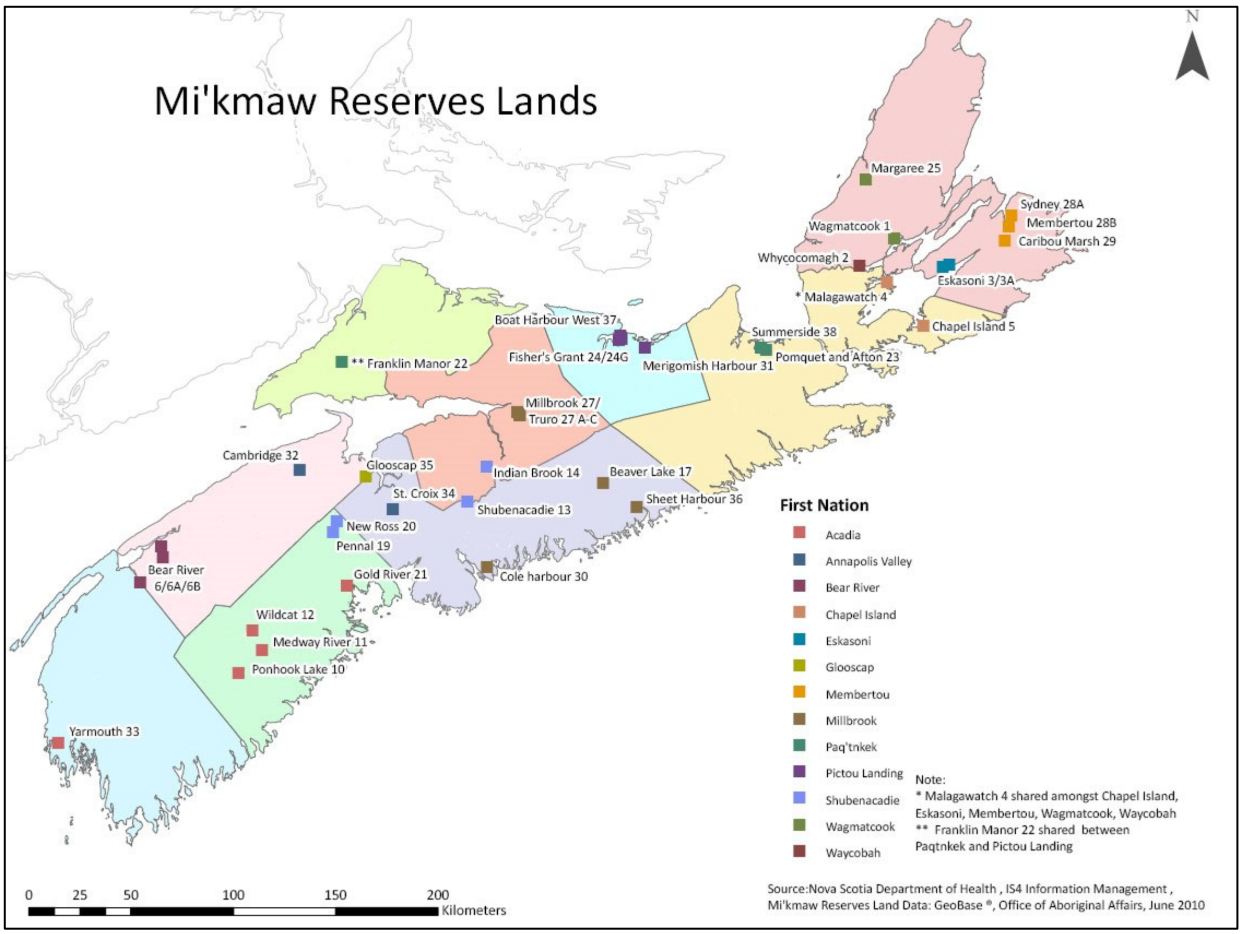

Figure 6.13-2: First nations Reserve Lands in Nova Scotia

Table 6.13-1: Community profiles of the 13 Mi'kmaw First Nations in Nova Scotia (Stantec 2018c; CBU 2020)

Mi'kmaw First Nation	Description
Acadia First Nation	
Location	Acadia First Nation in southwestern Nova Scotia is comprised of five reserves, in five counties from Yarmouth to Halifax.
Reserves	Gold River IR 21; Medway River IR 11; Ponhook Lake IR 10; Wildcat IR 12; Yarmouth IR 33
General Overview	Acadia First Nation encompasses five reserves: Yarmouth 33 (3.2 km east of Yarmouth with an area of 27.7 ha), Ponhook Lake 10 (115.2 km southwest of Halifax with an area of 101.8 ha), Medway River 11 (l108.8 km southwest of Halifax with an area of 4.7 ha), Wildcat 12 (11 km southwest of Halifax with an area of 465.4 ha) and Gold River 21 (60.8 km west of Halifax with an area of 270.2 ha) (INAC undated, as citied in Stantec 2018c). Acadia First Nation also has separate land holdings in Gardner's Mill and Hammonds Plains. Acadia First Nation is represented by the ANSMC. According to 2017 census data, the registered population was 1,524 (approx. 230 on and 1,289 off reserve). As of February 2020, the total population was 1664: • Registered Males on Own Reserve – 112 • Registered Females on Own Reserve – 127 • Registered Males on Other Reserves – 2 • Registered Females on Other Reserves – 0 • Registered Males on No Band Crown Land – 1 • Registered Females on No Band Crown Land – 2 • Registered Males Living Off-Reserve – 697 • Registered Females Living Off-Reserve – 723 (CBU, 2020) No data was available related to age of population.
Health and Socio-economic Conditions	The availability of infrastructure within each community varies, however Acadia First Nation has experienced infrastructure growth over the past decade, including the development of housing and roads (Acadia First Nation undated, as citied in Stantec 2018c). An after-school program exists within Yarmouth for children ages 5-12 attending elementary school. Health centers are in Yarmouth and Gold River. The Yarmouth Health Centre includes a dentist, Victorian Order of Nurses (VON), clinic nursing, foot care clinics and wellness and health promotion clinics (Acadia First Nation undated, as citied in Stantec 2018c). The Gold River Health Centre provides a VON, clinic nursing, wellness and health-promotion clinics, afterschool program and parent and tot groups (Acadia First Nation undated, as citied in Stantec 2018c). In Wildcat, a VON is available once a month (Acadia First Nation undated, as citied in Stantec 2018c). Recent economic developments for the Nation include administrative buildings, gaming facilities, and offices in Halifax and Milton to serve the off-reserve population.
Physical and Cultural Heritage (including archaeological, paleontological, historical or architectural sites)	The Acadia First Nation were once based in what is today's Queen's County with artifacts found along the Mersey River (KMKNO undated, as citied in Stantec 2018c). Proposed PA does not overlap with any known physical and cultural heritage sites related specifically to Acadia First Nation.
Historical and Current Use of Lands and Waters	All Mi'kmaq in Nova Scotia would have a right to trap, hunt and harvest fish, animals and plants in the PA, as part of their Aboriginal and Treaty rights to hunt, fish, and gather. In particular, Mi'kmaq community members likely use the area within and surrounding the PA to hunt deer, bear, porcupine and foul; trap rabbits, fox and other small fur-bearing animals; fish for trout and other freshwater species; gather berries and plants for food and medicinal purposes; harvest plants, birchbark and fallen wood for handicrafts and cultural items. Mi'kmaq families also enjoy camps in the area for recreational purposes. All Nova Scotia Mi'kmaq communities hold FSC and commercial communal fishing licenses to harvest a variety of marine and freshwater species in tidal and non-tidal waters of Nova Scotia. Specific details and information relating to how subpopulations within a Mi'kmaq community (women, youth, elders, families) engage in traditional practices, other than the general information provided above, has been requested (as described in Section 4) of Mi'kmaq communities and organizations. To date, this information has not been shared with the Proponent, but the Proponent understands additional information may be available during the EIS review process from Mi'kmaq communities, and will continue to work with communities to integrate that information into project planning. Furthermore, details relating to the quality of traditional practices within and surrounding the Project have not been shared specifically with the Proponent; however, due to the rural location of the Project, with the exception of forestry activities, it is expected that traditional practices in the general area of the Project are considered of moderate to high quality, with limited additional impact from outside sources (humans, industry, other) beyond known forestry activities.
Asserted or Established Aboriginal and / or Treaty Rights	The Mi'kmaq of Nova Scotia have established Aboriginal and Treaty rights. This includes traditional rights to hunt, gather and fish, as well as treaty-protected rights to hunt and gather, and to fish for a "moderate livelihood". Those activities are related to sustenance, cultural and socio-economic practice.
Annapolis Valley First Nation	

Mi'kmaw First Nation	Description
Location	Annapolis Valley First Nation is comprised of two reserves within Kings County in southwestern Nova Scotia.
General Overview	Annapolis Valley First Nation encompasses two reserve lands: Annapolis Valley (Cambridge) (88 km northwest of Halifax with an area of 59 ha) and St. Croix 34 (46.6 km northwest of Halifax with an area of 126.2 ha) (INAC undated, as citied in Stantec 2018c). Annapolis Valley First Nation is represented by the ANSMC. According to 2017 census data, the registered population was 290 (approx. 117 on and 173 off reserve). As of February 2020, the population was 302: • Registered Males on Own Reserve – 68 • Registered Females on Own Reserve – 55 • Registered Males Living Off-Reserve – 73 • Registered Females Living Off-Reserve – 106 (CBU, 2020) No data was available related to age of population.
Health and Socio-economic Conditions	Established in 1998, the Three Wishes Learning Centre provides a nursery school program, after school program, and culture programs (Annapolis Valley First Nation undated). The Annapolis Valley First Nation Health Centre has a registered community health nurse, access to prevention and weight control programs, foot care clinics, prenatal programs, massage therapy, physical activity programs, drug and alcohol abuse prevention, suicide prevention, injury / illness prevention and health and wellness promotion (Annapolis Valley First Nation undated). A dental hygienist is available twice a month at the health center. Annapolis Valley First Nation's economic initiatives include Annapolis Valley First Nation Gaming, Annapolis Valley First Nation Smoke Shop, and Annapolis Valley First Nation Gas Bar (Annapolis Valley First Nation undated, as citied in Stantec 2018c).
Physical and Cultural Heritage (including archaeological, paleontological, historical or architectural sites)	There is a long history of Mi'kmaq presence in Annapolis Royal and the surrounding areas; archeologists have identified several settlement patterns (Statoil 2017, as citied in Stantec 2018c). The Mi'kmaq lived in Annapolis Valley when the Europeans arrived in the area, with lifestyles heavily influenced by the land and ecosystems and a strong tradition of innovation connected to the homelands. Proposed PA does not overlap with any known physical and cultural heritage sites related specifically to Annapolis First Nation.
Historical and Current Use of Lands and Waters	All Mi'kmaq in Nova Scotia would have a right to trap, hunt and harvest fish, animals and plants in the PA, as part of their Aboriginal and Treaty rights to hunt, fish, and gather. In particular, Mi'kmaq community members use the area within and surrounding the PA to hunt deer, bear, porcupine and foul; trap rabbits, fox and other small fur-bearing animals; fish for trout and other freshwater species; gather berries and plants for food and medicinal purposes; harvest plants, birchbark and fallen wood for handicrafts and cultural items. Mi'kmaq families also enjoy camps in the area for recreational purposes. All Nova Scotia Mi'kmaq communities hold FSC and commercial communal fishing licenses to harvest a variety of marine and freshwater species in tidal and non-tidal waters of Nova Scotia. Specific details and information relating to how subpopulations within a Mi'kmaq community (women, youth, elders, families) engage in traditional practices, other than the general information provided above, has been requested (as described in Section 4) of Mi'kmaq communities and organizations. To date, this information has not been shared with the Proponent, but the Proponent understands additional information may be available during the EIS review process from Mi'kmaq communities, and will continue to work with communities to integrate that information into project planning. Furthermore, details relating to the quality of traditional practices within and surrounding the Project have not been shared specifically with the Proponent; however, due to the rural location of the Project, with the exception of forestry activities, it is expected that traditional practices in the general area of the Project are considered of moderate to high quality, with limited additional impact from outside sources (humans, industry, other) beyond known forestry activities.
Asserted or Established Aboriginal and / or Treaty Rights	The Mi'kmaq of Nova Scotia have established Aboriginal and Treaty rights. This includes traditional rights to hunt, gather and fish, as well as treaty-protected rights to hunt and gather, and to fish for a "moderate livelihood". Those activities are related to sustenance, cultural and socio-economic practice.
Bear River First Nation	
Location	Bear River First Nation is comprised of three reserves, within the Annapolis Valley between the towns of Annapolis Royal and Digby (KMKNO undated).

Mi'kmaw First Nation	Description
General Overview	Bear River First Nation encompasses three reserve lands: Bear River 6 (17.7 km southeast of Digby with an area of 633.8 ha), Bear River 6A (9.6 km southeast of Annapolis Valley with an area of 31.2 ha), and Bear River 6B (6.4 km southeast of Annapolis Valley with an area of 24.3 ha) (INAC undated). Bear River First Nation is represented by the ANSMC. According to 2017 census data, the registered population was 338 (approx. 110 on and 228 off reserve). As of February 2020, the population was 357: • Registered Males on Own Reserve – 50 • Registered Females on Own Reserve – 63 • Registered Males on Other Reserves – 0 • Registered Females on Other Reserves – 1 • Registered Males Living Off-Reserve – 119 • registered Females Living Off-Reserve – 124 (CBU, 2020) No data was available related to age of population.
Health and Socio-economic Conditions	The majority of community members live on the Bear River 6, also known as L'sitkuk Mainland (Mainland Mi'kmaq Development Inc. 2016, as citied in Stantec 2018c). In Bear River, a learning center provides space for educational activities. There is a health center in Bear River, offering healing services and workshops (Bear River First Nation 2016, as citied in Stantec 2018c). A doctor visits the health center monthly (Bear River First Nation 2016, as citied in Stantec 2018c). Recently, an RCMP satellite office opened in the community. Bear River First Nation enterprises include a Treaty Gas bar, L'sitkuk Gas Bar Limited, and a seasonal Heritage and Cultural Centre.
Physical and Cultural Heritage (including archaeological, paleontological, historical or architectural sites)	There is a long history of Bear River Mi'kmaq presence in Digby and Annapolis Counties (Mainland Mi'kmaq Development Inc. 2016, as citied in Stantec 2018c). As early as 1612, the Mi'kmaq have been recorded as harvesting resources in the Annapolis River and French Bay (Bay of Fundy) (Mainland Mi'kmaq Development Inc. 2016, as citied in Stantec 2018c). Traditionally, during the fall and winter, families would travel to hunt big game such as moose, deer, caribou and bear, and smaller game such as beaver, bird species, and rabbit. In the spring, families typically settled along the coast and in the summer, they harvested shellfish such as clam, mussels, and scallops as well as several fish species including cod, salmon, trout, eel, herring, and bass (Mainland Mi'kmaq Development Inc. 2016, as citied in Stantec 2018c). Seals, walrus, porpoises and berries and plants were also harvested. Bear River First Nation was traditionally, and continues to be, well known for their artwork, specializing in embroidering porcupine quills on birchbark, leatherwork, and basketry (Mainland Mi'kmaq Development Inc. 2016, as citied in Stantec 2018c). Proposed PA does not overlap with any known physical and cultural heritage sites related specifically to Bear River First Nation.
Historical and Current Use of Lands and Waters	All Mi'kmaq in Nova Scotia would have a right to trap, hunt and harvest fish, animals and plants in the PA, as part of their Aboriginal and Treaty rights to hunt, fish, and gather. In particular Mi'kmaq community members use the area within and surrounding the PA to hunt deer, bear, porcupine and foul; trap rabbits, fox and other small fur-bearing animals; fish for trout and other freshwater species; gather berries and plants for food and medicinal purposes; harvest plants, birchbark and fallen wood for handicrafts and cultural items. Mi'kmaq families also enjoy camps in the area for recreational purposes. All Nova Scotia Mi'kmaq communities hold FSC and commercial communal fishing licenses to harvest a variety of marine and freshwater species in tidal and non-tidal waters of Nova Scotia. Specific details and information relating to how subpopulations within a Mi'kmaq community (women, youth, elders, families) engage in traditional practices, other than the general information provided above, has been requested (as described in Section 4) of Mi'kmaq communities and organizations. To date, this information has not been shared with the Proponent, but the Proponent understands additional information may be available during the EIS review process from Mi'kmaq communities, and will continue to work with communities to integrate that information into project planning. Furthermore, details relating to the quality of traditional practices within and surrounding the Project have not been shared specifically with the Proponent; however, due to the rural location of the Project, with the exception of forestry activities, it is expected that traditional practices in the general area of the Project are considered of moderate to high quality, with limited additional impact from outside sources (humans, industry, other) beyond known forestry activities.
Asserted or Established Aboriginal and / or Treaty Rights	The Mi'kmaq of Nova Scotia have established Aboriginal and Treaty rights. This includes traditional rights to hunt, gather and fish, as well as treaty-protected rights to hunt and gather, and to fish for a "moderate livelihood". Those activities are related to sustenance, cultural and socio-economic practice.
Eskasoni First Nation	
Location	Eskasoni First Nation is comprised of three reserves, along the shore of the Bras d'Or Lakes.

Mi'kmaw First Nation	Description
General Overview	Eskasoni First Nation encompasses three reserves: Eskasoni 3 (40 km southwest of Sydney with an area of 3,504.6 ha), Eskasoni 3A (40 km southwest of Sydney with an area of 28.5 ha), and Malagawatch 4 (62 km southwest of Sydney with an area of 661.3 ha) (INAC undated, as citied in Stantec 2018c). Eskasoni First Nation is the largest Indigenous community in Atlantic Canada (KMKNO undated, as citied in Stantec 2018c). According to 2017 census data, the registered population was 4,443 (approx. 3,780 on and 631 off reserve). As of February 2020, the population was 4642: • Registered Males on Own Reserve – 1953 • Registered Females on Own Reserve – 1998 • Registered Males on Other Reserves – 16 • Registered Females on Other Reserves – 18 • Registered Males on Other Band Crown Land – 1 • Registered Females on Other Band Crown Land – 0 • Registered Males Living Off-Reserve – 303 • Registered Females Living Off-Reserve – 353 (CBU, 2020) No data was available related to age of population.
Health and Socio-economic Conditions	Eskasoni First Nation has community-owned infrastructure such as a community-operated school, accommodating students from kindergarten to grade 12, a supermarket, a community rink and a cultural center. The Eskasoni Community Health Centre provides a wide range of primary care services as well as several health programs and services such as blood collection, community health nursing, maternal child health, medical transportation, and diabetic services (Eskasoni Community Health Centre 2004, as citied in Stantec 2018c). The Eskasoni Pharmacy is in the Health Centre. The pharmacy provides information to the community on drug use, Native Alcohol and Drug Addiction Counseling Association, and Mi'kmaq Family and Children's Services. The Health Centre is staffed with a nurse, medical transcriptionist, and several physicians (Eskasoni Community Health Centre 2004, as citied in Stantec 2018c). Community Health Representatives are also on-site and act as a liaison between health care providers and community members, assisting with translation and administration of health care services and programs (Eskasoni Community Health Centre 2004, as citied in Stantec 2018c). Within the community there is also a fire department, with four career firefighters and 20 volunteer firefighters (Eskasoni First Nation undated, as citied in Stantec 2018c). As described in more detail below, Eskasoni First Nation hold several commercial communal licenses for a variety of fish and marine species. The community operates Crane Cove Seafoods. Crane Cove Seafoods owns 13 vessels ranging from 30 – 65 feet and employs over 100 community members, with an additional 35 community members employed at the associated processing plant (Eskasoni First Nation undated, as citied in Stantec 2018c). Fish harvesting takes place throughout Nova Scotia from Ingonish to Yarmouth.
Physical and Cultural Heritage (including archaeological, paleontological, historical or architectural sites)	Chartered in 1832, Eskasoni First Nation became an official reserve in 1834. From 1845 to 1851, much of Cape Breton suffered from famine (MGS 2012, as citied in Stantec 2018c). During this time, the Mi'kmaq transitioned into a more stationary lifestyle and found opportunities to provide labour, typically traveling to Sydney to work and sell wares (MGS 2012, as citied in Stantec 2018c). The population of Eskasoni grew in the 1940s as the Department of Indian Affairs implemented a new policy to centralize Indigenous peoples (Eskasoni First Nation undated, as citied in Stantec 2018c). In the 1950s, Eskasoni First Nation began controlling their own affairs and a Band Council was established in 1958 (Eskasoni First Nation undated, as citied in Stantec 2018c). Proposed PA does not overlap with any known physical and cultural heritage sites related specifically to Eskasoni First Nation.
Historical and Current Use of Lands and Waters	All Mi'kmaq in Nova Scotia would have a right to trap, hunt and harvest fish, animals and plants in the PA, as part of their Aboriginal and Treaty rights to hunt, fish, and gather. In particular, Mi'kmaq community members use the area within and surrounding the PA to hunt deer, bear, porcupine and foul; trap rabbits, fox and other small fur-bearing animals; fish for trout and other freshwater species; gather berries and plants for food and medicinal purposes; harvest plants, birchbark and fallen wood for handicrafts and cultural items. Mi'kmaq families also enjoy camps in the area for recreational purposes. All Nova Scotia Mi'kmaq communities hold FSC and commercial communal fishing licenses to harvest a variety of marine and freshwater species in tidal and non-tidal waters of Nova Scotia. Specific details and information relating to how subpopulations within a Mi'kmaq community (women, youth, elders, families) engage in traditional practices, other than the general information provided above, has been requested (as described in Section 4) of Mi'kmaq communities and organizations. To date, this information has not been shared with the Proponent, but the Proponent understands additional information may be available during the EIS review process from Mi'kmaq communities, and will continue to work with communities to integrate that information into project planning. Furthermore, details relating to the quality of traditional practices within and surrounding the Project have not been shared specifically with the Proponent; however, due to the rural location of the Project, with the exception of forestry activities, it is expected that traditional practices in the general area of the Project are considered of moderate to high quality, with limited additional impact from outside sources (humans, industry, other) beyond known forestry activities.
Asserted or Established Aboriginal and / or Treaty Rights	The Mi'kmaq of Nova Scotia have established Aboriginal and Treaty rights. This includes traditional rights to hunt, gather and fish, as well as treaty-protected rights to hunt and gather, and to fish for a "moderate livelihood". Those activities are related to sustenance, cultural and socio-economic practice.
Glooscap First Nation	
Location	Glooscap First Nation is comprised of one reserve (Glooscap 35), northwest of Halifax.

Mi'kmaw First Nation	Description
General Overview	Glooscap 35 is 68.8 km northwest of Halifax with an area of 171.1 ha (INAC undated). Glooscap First Nation is represented by the ANSMC. According to 2017 census data, the registered population was 375 (approx. 94 on and 280 off reserve). As of February 2020, the population was 393: • Registered Males on Own Reserve – 32 • Registered Females on Own Reserve – 65 • Registered Females on Other Reserves – 1 • Registered Males Living Off-Reserve – 143 • Registered Females Living Off-Reserve – 152 (CBU, 2020) No data was available related to age of population.
Health and Socio-economic Conditions	Glooscap First Nation does not have any schools within the community; however, the Nation has an appointed education director who oversees primary and secondary education for on-reserve members (Glooscap First Nation 2018, as citied in Stantec 2018c). There is a Health Centre in the community, offering health and healing services that focus on six components: education, health promotion, culture and language, nutrition, social support, and parent / family involvement (Glooscap First Nation 2018, as citied in Stantec 2018c). Established in 2014, Glooscap Ventures was created as the economic department for the community and is owned and operated by Glooscap First Nation. Glooscap Ventures manages on-reserve businesses including the variety store / gas bar, gaming facility, and commercial fisheries. Currently, Glooscap Ventures is developing a 27-acre parcel of land, Glooscap Landing, along Highway 101 for retail purposes (Glooscap First Nation 2018, as citied in Stantec 2018c). Other initiatives include the expansion of the commercial fisheries and pursuing opportunities in renewable energy (Glooscap First Nation 2018, as citied in Stantec 2018c).
Physical and Cultural Heritage (including archaeological, paleontological, historical or architectural sites)	Established in 1984, Glooscap First Nation became the thirteenth Mi'kmaq band in NS (KMKNO undated). Originally, Glooscap First Nation was created following the separation of two communities, Annapolis Valley and Glooscap, that were 30 km apart (KMKNO undated, as citied in Stantec 2018c). Glooscap First Nation was originally known as Horton but was renamed in 2001 (KMKNO undated, as citied in Stantec 2018c). Proposed PA does not overlap with any known physical and cultural heritage sites related specifically to Glooscap First Nation.
Historical and Current Use of Lands and Waters	All Mi'kmaq in Nova Scotia would have a right to trap, hunt and harvest fish, animals and plants in the PA, as part of their Aboriginal and Treaty rights to hunt, fish, and gather. In particular, Mi'kmaq community members use the area within and surrounding the PA to hunt deer, bear, porcupine and foul; trap rabbits, fox and other small fur-bearing animals; fish for trout and other freshwater species; gather berries and plants for food and medicinal purposes; harvest plants, birchbark and fallen wood for handicrafts and cultural items. Mi'kmaq families also enjoy camps in the area for recreational purposes. All Nova Scotia Mi'kmaq communities hold FSC and commercial communal fishing licenses to harvest a variety of marine and freshwater species in tidal and non-tidal waters of Nova Scotia. Specific details and information relating to how subpopulations within a Mi'kmaq community (women, youth, elders, families) engage in traditional practices, other than the general information provided above, has been requested (as described in Section 4) of Mi'kmaq communities and organizations. To date, this information has not been shared with the Proponent, but the Proponent understands additional information may be available during the EIS review process from Mi'kmaq communities, and will continue to work with communities to integrate that information into project planning. Furthermore, details relating to the quality of traditional practices within and surrounding the Project have not been shared specifically with the Proponent; however, due to the rural location of the Project, with the exception of forestry activities, it is expected that traditional practices in the general area of the Project are considered of moderate to high quality, with limited additional impact from outside sources (humans, industry, other) beyond known forestry activities.
Asserted or Established Aboriginal and / or Treaty Rights	The Mi'kmaq of Nova Scotia have established Aboriginal and Treaty rights. This includes traditional rights to hunt, gather and fish, as well as treaty-protected rights to hunt and gather, and to fish for a "moderate livelihood". Those activities are related to sustenance, cultural and socio-economic practice.
Membertou First Nation	
Location	Membertou First Nation is comprised of four reserves, in northeastern and southwestern Sydney.

Mi'kmaw First Nation	**Description**
General Overview	Membertou First Nation encompasses four reserves: Membertou 28B (1.6 km south of Sydney with an area of 100.1 ha), Sydney 28A (1.6 km northeast of Sydney with an area of 5.1 ha), Caribou Marsh 29 (8 km southwest of Sydney with an area of 219 ha) and Malagawatch 4 (62 km southwest of Sydney with an area of 661.3 ha) (INAC undated, as citied in Stantec 2018c). Membertou First Nation is represented by the ANSMC. According to 2017 census data, the registered population was 1,500 (approx. 904 on and 552 off reserve). As of February 2020, the population was 1573: • Registered Males on Own Reserve – 482 • Registered Females on Own Reserve – 454 • Registered Males on Other Reserves – 19 • Registered Females on Other Reserves – 25 • Registered Males on No Band Crown Land – 1 • Registered Females on No Band Crown Land – 2 • Registered Males Living Off-Reserve – 299 • Registered Females Living Off-Reserve – 291 (CBU, 2020) No data was available related to age of population.
Health and Socio-economic Conditions	Membertou First Nation has one school, Maupeltuewey Kina'matno'kuom, accommodating students from kindergarten to grade 6 (Membertou First Nation undated). A local Cape Breton Regional Police detachment is in Membertou. The Membertou Wellness Centre delivers programs to the community that address prominent health issues such as smoking cessation, crisis prevention / intervention, addictions services, and home and community care (Membertou First Nation undated, as citied in Stantec 2018c). The Membertou Wellness Centre also provides a family practice medical clinic with a doctor available Monday through Friday (Membertou First Nation undated, as citied in Stantec 2018c). Membertou First Nation has made considerable investments in infrastructure and providing services to community members over the last decade such as a gas station, church, community center, band office and boxing gym. Membertou First Nation also recently built the Membertou Sports and Wellness Centre, with two ice surfaces, an indoor walking track, a YMCA gym and multi-purpose meeting and event rooms (Membertou Sports and Wellness Centre undated, as citied in Stantec 2018c). Within Membertou, there is a business park including the Membertou Trade and Convention Centre, Membertou Heritage Park and Petroglyphs Gift Shop, a hotel, Kiju's Restaurant, Membertou Entertainment Centre, and private businesses. In 2002, Membertou First Nation became the first Indigenous government in the world to be ISO-certified (CANDO 2018, as citied in Stantec 2018c). The Nation owns and operates a seafood company, First Fishermen Seafoods. The company has six fleet vessels and harvests a variety of groundfish, shellfish, tuna, and swordfish (Membertou First Nation undated, as citied in Stantec 2018c).
Physical and Cultural Heritage (including archaeological, paleontological, historical or architectural sites)	Once known as Kings Road, Membertou was situated along the banks of Sydney Harbour. In 1926, Membertou was officially moved to its present location (Membertou First Nation undated). As an urban Indigenous community, few members relied solely on traditional hunting, fishing, and gathering to earn their living; instead, both men and women worked in various industries (Membertou First Nation undated, as citied in Stantec 2018c). Proposed PA does not overlap with any known physical and cultural heritage sites related specifically to Membertou First Nation.
Historical and Current Use of Lands and Waters	All Mi'kmaq in Nova Scotia would have a right to trap, hunt and harvest fish, animals and plants in the PA, as part of their Aboriginal and Treaty rights to hunt, fish, and gather. In particular, Mi'kmaq community members use the area within and surrounding the PA to hunt deer, bear, porcupine and foul; trap rabbits, fox and other small fur-bearing animals; fish for trout and other freshwater species; gather berries and plants for food and medicinal purposes; harvest plants, birchbark and fallen wood for handicrafts and cultural items. Mi'kmaq families also enjoy camps in the area for recreational purposes. All Nova Scotia Mi'kmaq communities hold FSC and commercial communal fishing licenses to harvest a variety of marine and freshwater species in tidal and non-tidal waters of Nova Scotia. Specific details and information relating to how subpopulations within a Mi'kmaq community (women, youth, elders, families) engage in traditional practices, other than the general information provided above, has been requested (as described in Section 4) of Mi'kmaq communities and organizations. To date, this information has not been shared with the Proponent, but the Proponent understands additional information may be available during the EIS review process from Mi'kmaq communities, and will continue to work with communities to integrate that information into project planning. Furthermore, details relating to the quality of traditional practices within and surrounding the Project have not been shared specifically with the Proponent; however, due to the rural location of the Project, with the exception of forestry activities, it is expected that traditional practices in the general area of the Project are considered of moderate to high quality, with limited additional impact from outside sources (humans, industry, other) beyond known forestry activities.
Asserted or Established Aboriginal and / or Treaty Rights	The Mi'kmaq of Nova Scotia have established Aboriginal and Treaty rights. This includes traditional rights to hunt, gather and fish, as well as treaty-protected rights to hunt and gather, and to fish for a "moderate livelihood". Those activities are related to sustenance, cultural and socio-economic practice.
Paq'tnkek Mi'kmaw Nation	
Location	Paq'tnkek Mi'kmaw Nation is comprised of three reserves, southeast of Amherst and east of Antigonish.

Mi'kmaw First Nation	Description
General Overview	Paq'tnkek Mi'kmaw Nation encompasses three reserves: Franklin Manor 22 (32 km southeast of Amherst with an area of 212.5 ha), Paq'tnkek-Niktuek 23 (24 km east of Antigonish with an area of 218.1 ha), and Welnek 38 (18 km east of Antigonish with an area of 43.4 ha) (INAC undated, as citied in Stantec 2018c). Paq'tnkek is represented by the ANSMC. According to 2017 census data, the registered population was 573 (approx. 404 on and 141 off reserve). As of February 2020, the population was 599: • Registered Males on Own Reserve – 197 • Registered Females on Own Reserve – 229 • Registered Males on Other Reserves – 10 • Registered Females on Other Reserves – 20 • Registered Males Living Off-Reserve – 62 • Registered Females Living Off-Reserve – 81 (CBU, 2020) No data was available related to age of population.
Health and Socio-economic Conditions	Since 1980, the Paq'tnkek Pre-School has been in operation in Afton, NS. The nearest RCMP detachment is in Antigonish. The Paq'tnkek Health Centre provides a variety of programs and services to community members, including community health promotion, education, and prevention programming (Paq'tnkek Mi'kmaw Nation 2018, as citied in Stantec 2018c). Paq'tnkek Mi'kmaw Nation has an Economic Development Department which manages all development projects within the community, including recent infrastructure development projects related to highway development and commercial opportunities. The First Nation also operates the Paq'tnkek Entertainment Centre, Gas Bar, and Smoke Shop (Paq'tnkek Mi'kmaw Nation 2018, as citied in Stantec 2018c). The First Nation owns and operates the Paq'tnkek Fisheries Enterprise, employing 20 community members. The enterprise has a fleet of five communal vessels and harvests lobster, snow crab, and herring (Paq'tnkek Mi'kmaw Nation 2018, as citied in Stantec 2018c).
Physical and Cultural Heritage (including archaeological, paleontological, historical or architectural sites)	Established in 1820, Paq'tnkek, meaning "by the bay", has been a traditional stopping point for Mi'kmaq travelling to and from Unama'ki, and a central meeting point for Chiefs across the province. Cultural and traditional practices such as spearing eel and salmon and snaring rabbits are still practiced within the community (Paq'tnkek Mi'kmaw Nation 2018, as citied in Stantec 2018c). Proposed PA does not overlap with any known physical and cultural heritage sites related specifically to Paq'tnkek First Nation.
Historical and Current Use of Lands and Waters	All Mi'kmaq in Nova Scotia would have a right to trap, hunt and harvest fish, animals and plants in the PA, as part of their Aboriginal and Treaty rights to hunt, fish, and gather. In particular, Mi'kmaq community members use the area within and surrounding the PA to hunt deer, bear, porcupine and foul; trap rabbits, fox and other small fur-bearing animals; fish for trout and other freshwater species; gather berries and plants for food and medicinal purposes; harvest plants, birchbark and fallen wood for handicrafts and cultural items. Mi'kmaq families also enjoy camps in the area for recreational purposes. All Nova Scotia Mi'kmaq communities hold FSC and commercial communal fishing licenses to harvest a variety of marine and freshwater species in tidal and non-tidal waters of Nova Scotia. Specific details and information relating to how subpopulations within a Mi'kmaq community (women, youth, elders, families) engage in traditional practices, other than the general information provided above, has been requested (as described in Section 4) of Mi'kmaq communities and organizations. To date, this information has not been shared with the Proponent, but the Proponent understands additional information may be available during the EIS review process from Mi'kmaq communities, and will continue to work with communities to integrate that information into project planning. Furthermore, details relating to the quality of traditional practices within and surrounding the Project have not been shared specifically with the Proponent; however, due to the rural location of the Project, with the exception of forestry activities, it is expected that traditional practices in the general area of the Project are considered of moderate to high quality, with limited additional impact from outside sources (humans, industry, other) beyond known forestry activities.
Asserted or Established Aboriginal and / or Treaty Rights	The Mi'kmaq of Nova Scotia have established Aboriginal and Treaty rights. This includes traditional rights to hunt, gather and fish, as well as treaty-protected rights to hunt and gather, and to fish for a "moderate livelihood". Those activities are related to sustenance, cultural and socio-economic practice.
Pictou Landing First Nation	
Location	Pictou Landing First Nation is comprised of five reserves on the south shore of the Northumberland Strait in Pictou County.

Mi'kmaw First Nation	Description
General Overview	Pictou Landing First Nation encompasses five reserves: Franklin Manor 22 (32 km southeast of Amherst with an area of 212.5 ha), Fisher's Grant (10 km north of New Glasgow with an area of 142.7 ha), Boat Harbour West 37 (8 km north of New Glasgow with an area of 98.2 ha), Fisher's Grant 24G (3.2 km southeast of Pictou Landing with an area of 60.0 ha) and Merigomish Harbour 31 (12.8 km east of New Glasgow with an area of 14.2 ha) (INAC undated). Pictou Landing First Nation is represented by the ANSMC. According to 2017 census data, the registered population was 663 (approx. 483 on and 157 off reserve). As of February 2020, the population was 672: • Registered Males on Own Reserve – 241 • Registered Females on Own Reserve – 250 • Registered Males on Other Reserves – 10 • Registered Females on Other Reserves – 12 • Registered Males Living Off-Reserve – 83 • Registered Females Living Off-Reserve – 76 (CBU, 2020) No data was available related to age of population.
Health and Socio-economic Conditions	Pictou Landing First Nation School accommodates students from primary to grade 6. There are no police detachments or fire halls within the community. The Nation has a church, gas bar, and health center (KMKNO undated, as citied in Stantec 2018c). As described in more detail below Pictou Landing First Nation holds several commercial communal licenses for a variety of fish and marine species. The Pictou Landing First Nation fishery is the Nation's main industry, with a fleet of 12 vessels and employing approximately 100 people (full and part time) a year (KMKNO undated, as citied in Stantec 2018c).
Physical and Cultural Heritage (including archaeological, paleontological, historical or architectural sites)	Pictou Landing First Nation have lived on a seasonal basis in and around a small tidal estuary connected by a narrow channel to the Northumberland Strait (Statoil 2017, as citied in Stantec 2018c). The area provided an abundance of resources such as fish, eel, crustaceans, and shellfish as well as hunting and trapping near shore (Statoil 2017, as citied in Stantec 2018c). Proposed PA does not overlap with any known physical and cultural heritage sites related specifically to Pictou Landing First Nation.
Historical and Current Use of Lands and Waters	All Mi'kmaq in Nova Scotia would have a right to trap, hunt and harvest fish, animals and plants in the PA, as part of their Aboriginal and Treaty rights to hunt, fish, and gather. In particular, Mi'kmaq community members use the area within and surrounding the PA to hunt deer, bear, porcupine and foul; trap rabbits, fox and other small fur-bearing animals; fish for trout and other freshwater species; gather berries and plants for food and medicinal purposes; harvest plants, birchbark and fallen wood for handicrafts and cultural items. Mi'kmaq families also enjoy camps in the area for recreational purposes. All Nova Scotia Mi'kmaq communities hold FSC and commercial communal fishing licenses to harvest a variety of marine and freshwater species in tidal and non-tidal waters of Nova Scotia. Specific details and information relating to how subpopulations within a Mi'kmaq community (women, youth, elders, families) engage in traditional practices, other than the general information provided above, has been requested (as described in Section 4) of Mi'kmaq communities and organizations. To date, this information has not been shared with the Proponent, but the Proponent understands additional information may be available during the EIS review process from Mi'kmaq communities, and will continue to work with communities to integrate that information into project planning. Furthermore, details relating to the quality of traditional practices within and surrounding the Project have not been shared specifically with the Proponent; however, due to the rural location of the Project, with the exception of forestry activities, it is expected that traditional practices in the general area of the Project are considered of moderate to high quality, with limited additional impact from outside sources (humans, industry, other) beyond known forestry activities.
Asserted or Established Aboriginal and / or Treaty Rights	The Mi'kmaq of Nova Scotia have established Aboriginal and Treaty rights. This includes traditional rights to hunt, gather and fish, as well as treaty-protected rights to hunt and gather, and to fish for a "moderate livelihood". Those activities are related to sustenance, cultural and socio-economic practice.
Potlotek First Nation	
Location	Potlotek First Nation is comprised of two reserves, southwest of Sydney.

Mi'kmaw First Nation	Description
General Overview	Potlotek First Nation encompasses two reserves: Chapel Island 5 (69 km southwest of Sydney with an area of 595.5 ha) and Malagawatch 4 (62 km southwest of Sydney with an area of 661.3 ha (INAC undated, as citied in Stantec 2018c). Potlotek First Nation is represented by the ANSMC. According to 2017 census data, the registered population was 727 (approx. 552 on and 140 off reserve). As of February 2020, the population was 773: • Registered Males on Own Reserve – 297 • Registered Females on Own Reserve – 290 • Registered Males on Other Reserves – 19 • Registered Females on Other Reserves – 19 • Registered Males Living Off-Reserve – 66 • Registered Females Living Off-Reserve – 82 (CBU, 2020) No data was available related to age of population.
Health and Socio-economic Conditions	Within the community, there is a day care and elementary school, the Mi'kmawey School. Established in 1998, it accommodates students from primary to grade 6 (Potlotek First Nation 2016, as citied in Stantec 2018c). An RCMP building and fire hall exist within the community. The Potlotek Volunteer Fire Department has 14 active members (KMKNO undated, as citied in Stantec 2018c). A Health Centre is in the community, providing a variety of services and programs such as addiction services, maternal care, home care, advanced and diabetic foot care, healing programs and wellness programs (Potlotek First Nation 2016, as citied in Stantec 2018c). A doctor visits the Health Centre on a weekly basis (Potlotek First Nation 2016, as citied in Stantec 2018c). Additional infrastructure within the community includes the Chapel Island Community Hall / Kateri Chapel and a Youth Centre. Recently, economic developments such as the construction of a store-gas bar which includes Robins Donuts, a Rite Stop, Esso and video lottery terminals have provided employment opportunities for community members (KMKNO undated). The fisheries industry plays a dominant role in the First Nation's economy, particularly in oyster cultivation. Formed in 1995, the Apaqtukewaq Fisheries Co-op includes four members and employs seven people during peak season (May to September) (Potlotek First Nation 2016, as citied in Stantec 2018c). An oyster plant operates within the community and the Co-op operates two fishing vessels used for harvesting of lobster and snow crab (Potlotek First Nation 2016, as citied in Stantec 2018c).
Physical and Cultural Heritage (including archaeological, paleontological, historical or architectural sites)	Established in 1834, Potlotek First Nation, also known as Chapel Island, is the home of the Saint Anne's Mission where each year Mi'kmaw people gather to celebrate the Feast of Saint Anne (Potlotek First Nation 2016, as citied in Stantec 2018c). Chapel Island is considered a sacred ground to the Mi'kmaq (Potlotek First Nation 2016, as citied in Stantec 2018c). Proposed PA does not overlap with any known physical and cultural heritage sites related specifically to Potletek First Nation.
Historical and Current Use of Lands and Waters	All Mi'kmaq in Nova Scotia would have a right to trap, hunt and harvest fish, animals and plants in the PA, as part of their Aboriginal and Treaty rights to hunt, fish, and gather. In particular, Mi'kmaq community members use the area within and surrounding the PA to hunt deer, bear, porcupine and foul; trap rabbits, fox and other small fur-bearing animals; fish for trout and other freshwater species; gather berries and plants for food and medicinal purposes; harvest plants, birchbark and fallen wood for handicrafts and cultural items. Mi'kmaq families also enjoy camps in the area for recreational purposes. All Nova Scotia Mi'kmaq communities hold FSC and commercial communal fishing licenses to harvest a variety of marine and freshwater species in tidal and non-tidal waters of Nova Scotia. Specific details and information relating to how subpopulations within a Mi'kmaq community (women, youth, elders, families) engage in traditional practices, other than the general information provided above, has been requested (as described in Section 4) of Mi'kmaq communities and organizations. To date, this information has not been shared with the Proponent, but the Proponent understands additional information may be available during the EIS review process from Mi'kmaq communities, and will continue to work with communities to integrate that information into project planning. Furthermore, details relating to the quality of traditional practices within and surrounding the Project have not been shared specifically with the Proponent; however, due to the rural location of the Project, with the exception of forestry activities, it is expected that traditional practices in the general area of the Project are considered of moderate to high quality, with limited additional impact from outside sources (humans, industry, other) beyond known forestry activities.
Asserted or Established Aboriginal and / or Treaty Rights	The Mi'kmaq of Nova Scotia have established Aboriginal and Treaty rights. This includes traditional rights to hunt, gather and fish, as well as treaty-protected rights to hunt and gather, and to fish for a "moderate livelihood". Those activities are related to sustenance, cultural and socio-economic practice.
Wagmatcook First Nation	
Location	Wagmatcook First Nation is comprised of three reserves, within the Bras d'Or Lakes region of Cape Breton.

Mi'kmaw First Nation	Description
General Overview	Wagmatcook encompasses three reserves: Malagawatch 4 (62 km southwest of Sydney with an area of 661.3 ha), Margaree 25 (68.8 km northwest of Sydney with an area of 0.8 ha), and Wagmatcook 1 (51 km west of Sydney with an area of 385.0 ha) (INAC undated). Wagmatcook First Nation is represented by the ANSMC. According to 2017 census data, the registered population was 852 (approx. 626 on and 184 off reserve). As of February 2020, the population was 900: • Registered Males on Own Reserve – 334 • Registered Females on Own Reserve – 328 • Registered Males on Other Reserves – 19 • Registered Females on Other Reserves – 25 • Registered Males Living Off-Reserve – 83 • Registered Females Living Off-Reserve – 111 (CBU, 2020) No data was available related to age of population.
Health and Socio-economic Conditions	In 1986, Wagmatcook First Nation initiated the first Indigenous secondary school in the Atlantic Region and established the first Nova Scotia Mi'kmaq Day Care Centre (Statoil 2017, as citied in Stantec 2018c). A new elementary-secondary education school, Wamgatcookewey School, is the first kindergarten to grade 12 Mi'kmaq First Nation school in Nova Scotia (Wagmatcook First Nation 2016, as citied in Stantec 2018c). There is no police detachment within the community, but there is a fire hall. The cultural center, the Wagmatcook Enterprise and Cultural Centre, provides a variety of services to community members including an Alternate School for Youth, cultural demonstration projects, and a Fitness Centre (Wagmatcook First Nation 2016, as citied in Stantec 2018c). The cultural center also houses the TD Canada Trust Agency bank, a Canada Post office, and the Clean Wave Restaurant (Wagmatcook First Nation 2016, as citied in Stantec 2018c). The band also operates a gas bar, grocery store, wharf, and warehouse. The Wagmatcook commercial fishery has been in operation since 1990 and is communally owned by registered members of Wagmatcook First Nation (Wagmatcook First Nation 2016). The Wagmatcook Commercial Fishery employs 35 fishers and one shore-based manager (Wagmatcook First Nation 2016). It utilizes a total of eleven fishing vessels and primarily harvests groundfish, palegics, shellfish and is a producer / wholesaler of shell ice products (Wagmatcook First Nation 2016). The fishery has six Cape Islander-style lobster vessels, one groundfish vessel, two storage facilities and an ice processing facility (Wagmatcook First Nation 2016, as citied in Stantec 2018c). The fishery generates the highest projected returns to the community (Wagmatcook First Nation 2016, as citied in Stantec 2018c).
Physical and Cultural Heritage (including archaeological, paleontological, historical or architectural sites)	Proposed PA does not overlap with any known physical and cultural heritage sites related specifically to Wagmatcook First Nation.
Historical and Current Use of Lands and Waters	All Mi'kmaq in Nova Scotia would have a right to trap, hunt and harvest fish, animals and plants in the PA, as part of their Aboriginal and Treaty rights to hunt, fish, and gather. In particular, Mi'kmaq community members use the area within and surrounding the PA to hunt deer, bear, porcupine and foul; trap rabbits, fox and other small fur-bearing animals; fish for trout and other freshwater species; gather berries and plants for food and medicinal purposes; harvest plants, birchbark and fallen wood for handicrafts and cultural items. Mi'kmaq families also enjoy camps in the area for recreational purposes. All Nova Scotia Mi'kmaq communities hold FSC and commercial communal fishing licenses to harvest a variety of marine and freshwater species in tidal and non-tidal waters of Nova Scotia. Specific details and information relating to how subpopulations within a Mi'kmaq community (women, youth, elders, families) engage in traditional practices, other than the general information provided above, has been requested (as described in Section 4) of Mi'kmaq communities and organizations. To date, this information has not been shared with the Proponent, but the Proponent understands additional information may be available during the EIS review process from Mi'kmaq communities, and will continue to work with communities to integrate that information into project planning. Furthermore, details relating to the quality of traditional practices within and surrounding the Project have not been shared specifically with the Proponent; however, due to the rural location of the Project, with the exception of forestry activities, it is expected that traditional practices in the general area of the Project are considered of moderate to high quality, with limited additional impact from outside sources (humans, industry, other) beyond known forestry activities.
Asserted or Established Aboriginal and / or Treaty Rights	The Mi'kmaq of Nova Scotia have established Aboriginal and Treaty rights. This includes traditional rights to hunt, gather and fish, as well as treaty-protected rights to hunt and gather, and to fish for a "moderate livelihood". Those activities are related to sustenance, cultural and socio-economic practice.
We'koqma'q First Nation	
Location	We'ko'kmaq (Waycobah) First Nation is comprised of two reserves within the village of Whycocomagh in Cape Breton.

Mi'kmaw First Nation	**Description**
General Overview	Waycobah First Nation encompasses two reserves: Malagawatch 4 (62 km southwest of Sydney with an area of 661.3 ha) and Whycocomagh 2 (70 km west of Sydney with an area of 908 ha) (INAC undated, as citied in Stantec 2018c). Waycobah First Nation is represented by the ANSMC. According to 2017 census data, the registered population was 999 (approx. 883 on and 81 off reserve). As of February 2020, the population was 1031: • Registered Males on Own Reserve – 454 • Registered Females on Own Reserve – 458 • Registered Males on Other Reserves – 15 • Registered Females on Other Reserves – 18 • Registered Males on Own Band Crown Land – 1 • Registered Females on Own Band Crown Land – 1 • Registered Males Living Off-Reserve – 36 • Registered Females Living Off-Reserve – 48 (CBU, 2020) No data was available related to age of population.
Health and Socio-economic Conditions	In 2008, a new elementary-secondary school was opened within the community (Waycobah First Nation undated). A daycare facility also exists within the community as well as a RCMP station and volunteer fire department. In 2010, the Theresa Cremo Memorial Health Centre was opened, offering a variety of programs and services such as a full time Nurse Practitioner, full time clinical therapist, prenatal classes, lab collection, Reiki treatments, an Alcohol and Drug counselor, midwifery clinics, well women and men clinics, a dietician, teen health clinic and a variety of activities for members of the community of all ages (Waycobah First Nation undated). A doctor is available at the Health Centre twice a week. The Nation also owns and operates a convenience store and gas bar and a gaming center (Waycobah First Nation undated, as citied in Stantec 2018c). The First Nation has two lobster licenses, shrimp trap and trawl licenses, groundfish quotas and an active elver fishery (Waycobah First Nation undated). The Waycobah Fisheries employs approximately 35 community members (Waycobah First Nation undated, as citied in Stantec 2018c). In 2011, a trout fish farm was re-established within the community. Although owned by Cold Water Fisheries, employees are largely Waycobah community members (Waycobah First Nation undated, as citied in Stantec 2018c).
Physical and Cultural Heritage (including archaeological, paleontological, historical or architectural sites)	Established in the early 1800s, Waycobah First Nation was originally known as We'ko'kmaq. In the 1940s, the community experienced a decline in population because of the federal government's centralization policy, where many individuals were relocated to the community of Eskasoni (Waycobah First Nation undated, as citied in Stantec 2018c). Proposed PA does not overlap with any known physical and cultural heritage sites related specifically to We'ko'kmaq First Nation.
Historical and Current Use of Lands and Waters	All Mi'kmaq in Nova Scotia would have a right to trap, hunt and harvest fish, animals and plants in the PA, as part of their Aboriginal and Treaty rights to hunt, fish, and gather. In particular, Mi'kmaq community members use the area within and surrounding the PA to hunt deer, bear, porcupine and foul; trap rabbits, fox and other small fur-bearing animals; fish for trout and other freshwater species; gather berries and plants for food and medicinal purposes; harvest plants, birchbark and fallen wood for handicrafts and cultural items. Mi'kmaq families also enjoy camps in the area for recreational purposes. All Nova Scotia Mi'kmaq communities hold FSC and commercial communal fishing licenses to harvest a variety of marine and freshwater species in tidal and non-tidal waters of Nova Scotia. Specific details and information relating to how subpopulations within a Mi'kmaq community (women, youth, elders, families) engage in traditional practices, other than the general information provided above, has been requested (as described in Section 4) of Mi'kmaq communities and organizations. To date, this information has not been shared with the Proponent, but the Proponent understands additional information may be available during the EIS review process from Mi'kmaq communities, and will continue to work with communities to integrate that information into project planning. Furthermore, details relating to the quality of traditional practices within and surrounding the Project have not been shared specifically with the Proponent; however, due to the rural location of the Project, with the exception of forestry activities, it is expected that traditional practices in the general area of the Project are considered of moderate to high quality, with limited additional impact from outside sources (humans, industry, other) beyond known forestry activities.
Asserted or Established Aboriginal and / or Treaty Rights	The Mi'kmaq of Nova Scotia have established Aboriginal and Treaty rights. This includes traditional rights to hunt, gather and fish, as well as treaty-protected rights to hunt and gather, and to fish for a "moderate livelihood". Those activities are related to sustenance, cultural and socio-economic practice.
Millbrook First Nation	
Location	Millbrook First Nation is comprised of seven reserves, near the communities of Truro and Halifax. It is the Mi'kmaq First Nation that is located in closest geographic proximity to the proposed Project.

Mi'kmaw First Nation	Description
General Overview	Millbrook First Nation encompasses seven reserves. Four reserve lands: Truro 27A, Truro 27B, Truro 27C and Millbrook 27, are near the town of Truro with a total area of 344.9 ha (INAC undated, as citied in Stantec 2018c). The remaining three are: Beaver Lake 17 (78.4 km southeast of Halifax with an area of 49.4 ha), Sheet Harbour 36 (91.2 km northeast of Halifax with an area of 32.7 ha), and Cole Harbour 30 (9.6 km east of Halifax with an area of 18.6 ha (INAC undated). The Beaver Lake and Sheet Harbour reserves are the two Millbrook communities in closest geographic proximity to the proposed Project. Millbrook First Nation is currently not represented in consultation by the ANSMC. According to 2017 census data, the registered population was 1,831 (approx. 872 on and 916 off reserve). As of February 2020, the population was 1995: • Registered Males on Own Reserve – 452 • Registered Females on Own Reserve – 460 • Registered Males on Other Reserves – 22 • Registered Females on Other Reserves – 15 • Registered Females on Own Crown Land – 1 • Registered Males on Other Band Crown Land – 1 • Registered Females on Other Band Crown Land – 1 • Registered Males on No Band Crown Land – 1 • Registered Males Living Off-Reserve – 507 • Registered Females Living Off-Reserve – 535 (CBU, 2020) No data was available related to age of population.
Health and Socio-economic Conditions	Infrastructure and services available in the community of Millbrook are the Millbrook Band Office, Millbrook Community Hall, Millbrook Ballfield, Millbrook Gym, Millbrook Early Education Centre, Millbrook Senior's Centre, and Sacred Heart Mission Church (Millbrook First Nation 2018, as citied in Stantec 2018c). The Millbrook Health Centre is also in the community, providing a variety of programs and services such as home and community care and assisted living programs, youth support, addiction services, wellness programs and community support and family enrichment programs. Millbrook First Nation owns, develops, and manages the retail park, Millbrook Power Centre, in Truro, NS. This park encompasses 68 acres of commercial land on the most traveled stretch of highway in Nova Scotia, outside of Halifax (Millbrook First Nation 2018, as citied in Stantec 2018c). Since opening in 2001, the Millbrook Power Centre has approximately a dozen tenants including a multiplex theatre, several restaurants, two hotels, a recreational vehicle retailer, a service station, an aquaculture facility, a furniture store, and the Glooscap Heritage Centre (Millbrook First Nation 2018, as citied in Stantec 2018c). There have also been recent developments in the Cole Harbour community, including apartment buildings, General Dynamics Building, and a gaming center. Millbrook Fisheries is an important part of the local economy, controlling eight vessels and employing over 40 staff members throughout the year. In recent years, Millbrook First Nation has opened several cannabis dispensaries in the community of Millbrook.
Physical and Cultural Heritage (including archaeological, paleontological, historical or architectural sites)	From the late 1700s to the early 1800s, the Mi'kmaq near Truro were settled along the banks of the Salmon River. The Mi'kmaq then relocated to their current community at Millbrook (Millbrook First Nation 2018, as citied in Stantec 2018c). Both the MEKS and the Archaeological studies completed for the Touquoy Gold Project and the Fifteen Mile Stream Gold Project were considered in this EIS, and archaeological studies appended to this EIS. The proposed PA does not overlap with any known physical and cultural heritage sites related specifically to Millbrook First Nation.
Historical and Current Use of Lands and Waters	All Mi'kmaq in Nova Scotia would have a right to trap, hunt and harvest fish, animals and plants in the PA, as part of their Aboriginal and Treaty rights to hunt, fish, and gather. In particular, Mi'kmaq community members use the area within and surrounding the PA to hunt deer, bear, porcupine and foul; trap rabbits, fox and other small fur-bearing animals; fish for trout and other freshwater species; gather berries and plants for food and medicinal purposes; harvest plants, birchbark and fallen wood for handicrafts and cultural items. Mi'kmaq families also enjoy camps in the area for recreational purposes. All Nova Scotia Mi'kmaq communities hold FSC and commercial communal fishing licenses to harvest a variety of marine and freshwater species in tidal and non-tidal waters of Nova Scotia. Specific details and information relating to how subpopulations within a Mi'kmaq community (women, youth, elders, families) engage in traditional practices, other than the general information provided above, has been requested (as described in Section 4) of Mi'kmaq communities and organizations. To date, this information has not been shared with the Proponent, but the Proponent understands additional information may be available during the EIS review process from Mi'kmaq communities, and will continue to work with communities to integrate that information into project planning. Furthermore, details relating to the quality of traditional practices within and surrounding the Project have not been shared specifically with the Proponent; however, due to the rural location of the Project, with the exception of forestry activities, it is expected that traditional practices in the general area of the Project are considered of moderate to high quality, with limited additional impact from outside sources (humans, industry, other) beyond known forestry activities.
Asserted or Established Aboriginal and / or Treaty Rights	The Mi'kmaq of Nova Scotia have established Aboriginal and Treaty rights. This includes traditional rights to hunt, gather and fish, as well as treaty-protected rights to hunt and gather, and to fish for a "moderate livelihood". Those activities are related to sustenance, cultural and socio-economic practice
Sipekne'katik First Nation	
Location	Sipekne'katik First Nation (also known as Indian Brook or Shubenacadie) is comprised of five reserves in Hants County, near the town of Shubenacadie. It is the second most proximate Mi'kmaw community to the proposed Project.

Mi'kmaw First Nation	Description
General Overview	Sipekne'katik First Nation encompasses five reserves: Indian Brook 14 (29 km southwest of Truro with an area of 1,234.2 ha), Wallace Hills 14A (with an area of 54.8 ha), Shubenacadie 13 (32 km north of Halifax with an area of 412.0 ha), Pennal 19 (67.2 km northwest of Halifax with an area of 43.5 ha) and New Ross 20 (64 km northwest of Halifax with an area of 408.3 ha) (INAC undated, as citied in Stantec 2018c).The Indian Brook and Shubenacadie reserves would be the two most proximate Sipekne'katik communities to the proposed Project. Sipekne'katik First Nation is currently not represented by the ANSMC. According to 2017 census data, the registered population was 2,645 (approx. 1,268 on and 1,298 off reserve). As of February 2020, the population was 2771: • Registered Males on Own Reserve – 617 • Registered Females on Own Reserve – 699 • Registered Males on Other Reserves – 34 • Registered Females on Other Reserves – 31 • Registered Males on Other Band Crown Land – 2 • Registered Females on Other Band Crown Land – 1 • Registered Males on No Band Crown Land – 8 • Registered Females on No Band Crown Land – 7 • Registered Males Living Off-Reserve – 655 • Registered Females Living Off-Reserve – 717 (CBU, 2020) No data was available related to age of population.
Health and Socio-economic Conditions	In 2008, the L'nu Sipuk Kina'muokum (LSK) school opened in the community, accommodating students from primary to grade 12. The school specializes in Mi'kmaq studies and Mi'kmaq language courses (Sipekne'katik First Nation 2016, as citied in Stantec 2018c). Little Eagles Daycare Centre provides care to children ages 1-4 years old (Sipekne'katik First Nation 2016, as citied in Stantec 2018c). The community also has the Sipekne'katik Multipurpose Centre, used for community meetings, events, and social gatherings. Local businesses within the community include a community gas-bar, tobacco shop, gaming room and convenience store. The Sipekne'katik First Nation Fisheries Department is an economic enterprise, managing 33 fishing licenses for various species including lobster, crab, and groundfish (BP 2017, as citied in Stantec 2018c).
Physical and Cultural Heritage (including archaeological, paleontological, historical or architectural sites)	Established in 1820, Sipekne'katik was originally named "Indian Brook". The area was traditionally used as a sacred site to prepare for ceremonies and hunting and fishing trips (Sipekn'katik First Nation undated). In 1752, one of the most significant Peace and Friendship Treaties was signed at Shubenacadie District (Sipekn'katik First Nation 2016, as citied in Stantec 2018c). This treaty dealt with lands, hunting, fishing, trapping, gathering, and trading. In 2002, a memorial was erected in honor of Chief Jean Baptiste Cope and the Treaty of 1752 (Sipekn'katik First Nation 2016, as citied in Stantec 2018c). Proposed PA does not overlap with any known physical and cultural heritage sites related specifically to Sipekne'katik First Nation.
Historical and Current Use of Lands and Waters	All Mi'kmaq in Nova Scotia would have a right to trap, hunt and harvest fish, animals and plants in the PA, as part of their Aboriginal and Treaty rights to hunt, fish, and gather. In particular, Mi'kmaq community members use the area within and surrounding the PA to hunt deer, bear, porcupine and foul; trap rabbits, fox and other small fur-bearing animals; fish for trout and other freshwater species; gather berries and plants for food and medicinal purposes; harvest plants, birchbark and fallen wood for handicrafts and cultural items. Mi'kmaq families also enjoy camps in the area for recreational purposes. All Nova Scotia Mi'kmaq communities hold FSC and commercial communal fishing licenses to harvest a variety of marine and freshwater species in tidal and non-tidal waters of Nova Scotia. Specific details and information relating to how subpopulations within a Mi'kmaq community (women, youth, elders, families) engage in traditional practices, other than the general information provided above, has been requested (as described in Section 4) of Mi'kmaq communities and organizations. To date, this information has not been shared with the Proponent, but the Proponent understands additional information may be available during the EIS review process from Mi'kmaq communities, and will continue to work with communities to integrate that information into project planning. Furthermore, details relating to the quality of traditional practices within and surrounding the Project have not been shared specifically with the Proponent; however, due to the rural location of the Project, with the exception of forestry activities, it is expected that traditional practices in the general area of the Project are considered of moderate to high quality, with limited additional impact from outside sources (humans, industry, other) beyond known forestry activities.
Asserted or Established Aboriginal and / or Treaty Rights	The Mi'kmaq of Nova Scotia have established Aboriginal and Treaty rights. This includes traditional rights to hunt, gather and fish, as well as treaty-protected rights to hunt and gather, and to fish for a "moderate livelihood". Those activities are related to sustenance, cultural and socio-economic practice.

6.13.2.2 FMS Study Area Baseline Conditions

This section describes the historical and current traditional Mi'kmaq use of the FMS Study Area, as described through regional research, direct engagement, circulation of a questionnaire to Mi'kmaq communities and the KMKNO, and the conclusions from the MEKS (Appendix H.1).

6.13.2.2.1 *Historic Mi'kmaq Land and Resource Use*

As described by MAPS in the MEKS for the Project, Mi'kma'ki, the district of Eskikewa'kik, and the FMS Study Area have been occupied by Mi'kmaq and their ancestors since the deglaciation some 12,000 years ago. The so far earliest physical traces of the presence of Mi'kmaq and their ancestors are archaeological finds unearthed at Debert, NS dating from 11,500 BP, a period labelled as Paleo-Indian by archaeologists or Sa'giwe'k L'nuk by Mi'kmaq (Appendix H.1).

In general, Mi'kmaw land use and occupancy involved semi-permanent and permanent settlement at resource-rich locations. Based on the overlapping seasonal fluctuations in the local availability and abundance of terrestrial and aquatic resources, Mi'kmaw groups exploited singular or multiple resources in a succession of habitats throughout their territory.

At the time of early European contact, 500 years ago to present day, Mi'kmaw occupied the shores of virtually all waterbodies, both marine and freshwater. River systems and connected lakes were particularly important features in traditional Mi'kmaw land use as they offered a multitude of food resources as well as access to inland terrestrial habitats and their resources (The Confederacy of Mainland Mi'kmaq. 2007).

Villages were usually situated at a navigable body of water. Preferred summer locations were coastal sites at the mouths of rivers with significant spawning runs of salmon, eel, gaspereau and other fish species as well as waterfowl. Such sites provided ready access to a variety of freshwater and marine resources, plus a waterway into the interior (Appendix H.1).

East Sheet Harbour River and what are today the Marshall and Anti-Dam Flowages represented such waterways, as well as Moser and Liscomb Rivers.

Among the most important coastal resources were migratory fish species such as salmon, eel, gaspereau, striped bass, smelts and sturgeon, marine species such as mackerel, skates, cod, marine mammals such as seals and porpoise, ducks and geese, various sea- and shore birds, clams, quahogs, limpids and other shellfish and whelks, lobster and crab.

At the time of early contact, reports of large summer villages along the Eastern Shore with easy access to the interior included Nipmanegatik at Beaver Bank in Halifax Bay, Esgegeogagig at Indian Point in Ship Harbour (at the time the residence of the District Chief), Goimotijig ("little harbour") at Spry Harbour, Megateoig ("big eels") at Liscomb Harbour, Gamsog ("rock on the other side") at Canso, Notogeteoalneg at the mouth of the Salmon River emptying into Chedabucto Bay, and Oalamgoaganeg ("lobster ground") at Port Mulgrave.

Similarly, summer villages were located along the opposite coast, the Northumberland Strait, for example Piktuk ("from great fire") at Pictou Harbour, at Merigomish (Maligomitjk or "Many Coves"), Antigonish (Naligitgonietjg or "broken branches"), Pomquet (Pogomgeg or "dry sand") and Tracadie harbours (Tlagatig or "encampment").

Two of the main regional coast-to-coast travel routes connected Country Harbour with Antigonish Harbour via the South River, and Sherbrooke with Pictou and via the East River St. Mary's and the East River Pictou (Ogoasgog or "drawing up canoes").

During fall and winter, terrestrial and other wildlife resources of the interior generally drew Mi'kmaw families into the region, including the FMS Study Area, whenever their abundance favoured inland food resources.

Mainland moose as well as the woodland caribou herds roaming the open inland areas, and in particular the barrens, black bear, beaver and other furbearers, the ubiquitous snowshoe hare and grouse, waterfowl, as well as fish species such as eel, salmon and gaspereau would have been able to support relatively large groups during the winter months. The district's name "Eskikewa'kik" or "Skindresser's Country" highlights the region's richness in terrestrial and semi-aquatic mammals (Appendix H.1).

In both inland and coastal areas, a large variety of plant species were utilized for food, medicines, housing, crafts and tool production, as well as stones and minerals for tools and implements.

Besides providing a rich wildlife habitat, Nova Scotia's original Acadian forests offered an astounding palette of plant resources. The various varieties of maple, birch, spruce, fir, pine, beech, ash, yew as well as tamarack and hemlock were used in housing (wigwam frame and covering) and tool making (tool handles, baskets, traps), for nutritional (syrup, beverage, nuts) and medicinal (tea, poultice) purposes. A large variety of edible berries, fruits (crabapple, service berry), roots (sweetflag, dandelion), tubers (groundnuts, cattails), shoots (fiddleheads), bulbs (wild leek) and leaves (lambsquarters) provided high-quality food resources some of which could be preserved by drying (Appendix H.1).

In addition to their nutritional qualities, many of those plants possess medicinal properties which were known and utilized by the Mi'kmaq. A large number of plant species were also used primarily for medicinal purposes (e.g. alder, wild sarsaparilla, gold thread, jewelweed, labrador tea, sheep laurel).

Although Nova Scotia has, since the 18th century, increasingly been settled by predominantly European immigrants, no portion of Mi'kma'ki has ever been formally and legally ceded. Quite to the contrary, several treaties between the sovereign Indigenous nations and the British Crown were signed between 1725 and 1779 and affirmed Mi'kmaw rights to their territory and its resources, and pledging peaceful coexistence and Mi'kmaw loyalty to the British Crown (Appendix H.1). This covenant chain of treaties includes the 1752 and 1760/01 treaties that were affirmed by the Supreme Court of Canada as legal and binding.

During the 1800s and1900s, European settlement expanded and increasingly appropriated the most accessible, and for their economic interests, most productive areas - the safe harbours, resource-rich estuaries and near-shore fishing grounds all around the Nova Scotia coast as well as the few fertile agricultural regions. In order to minimize Mi'kmaw interference in the settler economy, the Nova Scotia government began in 1812 to relocate Mi'kmaw families onto a number of small reserves set up in areas deemed less productive.

To the Mi'kmaw population, the less disturbed inland areas and their resources gained in relative importance as a result, and the focus of much of their traditional harvesting activities was pushed into the Province's more remote regions. The Liscomb region in particular was a favoured hunting, fishing and trapping area for Mi'kmaw, well-known for its wildlife resources (Appendix H.1).

Seloam Lake is named after well-known Mi'kmaw hunter Mattio Selome. He and his family were one of the Mi'kmaq groups active in the FMS Study Region during the late 1800s. He used to camp most frequently at Seloam and Ladle Lakes. Mattio Selome buried his wife on an island in Seloam Lake. Typhus Lake is another one of the locations whose name relates to the presence of Mi'kmaw families in the area. Situated about 15 km east of Seloam Lake, it received its name when several Mi'kmaw died of typhoid fever at their camp and were buried at this location in the mid-1800s (Appendix H.1).

Among today's non-indigenous residents, older individuals remember Mi'kmaw families criss-crossing the region, maintaining hunting camps or cabins throughout. It wasn't until the 1940s when they reported observing a noticeable drop in the presence and extended stays of Mi'kmaw family groups in the region. This appears to have been the result of the Federal Government's Centralization policy, an attempt to further concentrate the Mi'kmaw population onto only two large reserves, Shubenacadie Indian Reserve on the Nova Scotia mainland and Eskasoni Indian Reserve on Cape Breton Island.

The policy ultimately failed' and was abandoned in 1949, and the majority of Mi'kmaq today live in 13 communities spread out over the province. Most of the families that were active in the FMS Study Area eventually relocated to the Indian Brook (Shubenacadie), Millbrook and Paqtnkek reserves.

The decline in the visibility of Mi'kmaw families or groups in the inland in terms of seasonal camps by no means implies that the importance of their traditional lands and resources began to decline, nor harvesting activities were being abandoned.

The general pattern of Mi'kmaw land and resource uses in the area gradually changed during this period from extended seasonal inland stays, often by complete families, to briefer, frequent hunting/fishing excursions. This trend was facilitated, possibly even stimulated, by increasing accessibility through a growing network of country roads and the use of motorized vehicles.

Mi'kmaw families were thus able to re-connect with their traditional harvesting areas, as far as they had not in the meantime become subject to competing uses by the dominant society such as municipal, agricultural or industrial development, or parks and protected areas. Despite progressive developments and forced centralization, the Mi'kmaw never voluntarily or willfully abandoned any part of their traditional territory (Appendix H.1).

6.13.2.2.2 *Known Mi'kmaq Archaeological Sites near the FMS Study Area*

The vast majority of archaeological discoveries in Nova Scotia have been incidental rather than the result of targeted archaeological surveys. More often than not they have been made in the context of some sort of development – agricultural development or residential, industrial or infrastructural construction. The FMS Study Area has to date not had significant development activities. The archaeological record for most of Eskikewa'kik is very sparse and consists mostly of sporadic surface finds.

It is obvious therefore, and important to note, that the relative lack of archaeological evidence in the FMS Study Area cannot be construed as proof of a lack of pre-contact Mi'kmaw occupancy. The archaeological potential of the FMS Study Area and surrounding region, however, is judged as being high. The area has a long history of Mi'kmaw occupancy, harvesting/gathering and guiding (Appendix H.1).

Two known archaeological sites attest to pre-contact Mi'kmaw occupancy of this part of the interior of mainland Nova Scotia, one located just north of the FMS Study Area on an island in Seloam Lake (burial site). Just outside the FMS Study Area on Liscomb River, 11 km further to the east, is another archaeological site.

An additional cluster of sites are located at the north end of Marshall Flowage, about 8-9 km south of the FMS Study Area. Some of those sites contain both pre- and post-contact components.

The Proponent has shared the archaeological reports directly with KMKNO, Sipekne'katik and Millbrook First Nations (October 2019 and then supporting documentation in May 2020) and has requested a meeting with the KMKNO archaeology team (May and June 2020) to review these conclusions and confirm if any additional known Mi'kmaq archaeological sites are present in close proximity to the Project. At the time of the EIS submission, this meeting has not occurred.

6.13.2.2.3 *Current Mi'kmaq Land and Resource Use*

Drawing from information provided through the MEKS completed in 2018, direct information gathered from engagement activities between the Proponent and the KMKNO, Millbrook First Nation and Sipekne'katik First Nation, and the Project team's knowledge of the PA, the following summary of current Mi'kmaq land and resource use has been prepared as a basis from which to understand and evaluate Project interactions and potential effects of the Project on the Mi'kmaq of Nova Scotia.

The following key aspects were considered and requested from the Mi'kmaw communities during collection of baseline data (either through direct engagement or the completion of the MEKS or through a shared questionnaire in Dec 2019/Jan 2020):

- General information about Mi'kmaq of Nova Scotia populations;
- General description of baseline conditions within the FMS Study Area and surrounding landscape to support an understanding of the current experience of the traditional practice for the Mi'kmaq of Nova Scotia;
- Sites or areas that are used by the Mi'kmaq of Nova Scotia either for permanent residences or on a seasonal/temporary basis and the number of people that use each site/area identified;
- Drinking water sources (permanent, seasonal, periodic, or occasional);
- Consumption of country foods (also known as traditional foods) including food that is trapped, fished, hunted, harvested, or grown for subsistence or medicinal purposes, outside of the commercial food chain;
- Which country foods are consumed by which groups, how frequently, and where these country foods are harvested;
- How are different subpopulations of the Mi'kmaq communities are using the land;
- How often is the right practiced or exercised and timing/seasonality of the practice; the context in which the right is practiced;
- Commercial activities (e.g., fishing, trapping, hunting, forestry, outfitting) and the frequency, duration and timing of these activities including maps and data sets; and,
- Recreational uses and the frequency, duration and timing of these activities.

Baseline information that was shared and available for the Project is described in this section. It is important to note that several limitations relating to baseline information are present and thus, evaluation of Project interactions and potential effects to the Mi'kmaq of Nova Scotia within this section of the Project EIS are provided in a general format, with limitations on specific analysis:

- **Drinking Water Sources:** No surface drinking water sources were identified through the MEKS, direct engagement activities with the communities, or the questionnaire shared in Dec 2019/Jan 2020. As a result, no analysis of specific surface water drinking water sources is included in this section. However, a discussion of impact of drinking water at EMZ-2 (discharge location from the Project within Anti Dam Flowage) is included as it is considered the reasonable worst case predicted water quality conditions stemming from the Project.
- **Residences (Permanent or Seasonal):** No specific detail relating to location of seasonal or temporary camps/cottages/residences were provided to the Proponent. The MEKS identified a cabin, but no general or specific location was provided. Thus, no analysis of specific Mi'kmaq residential receptors has been included in this Project EIS. It is expected that a number of Mi'kmaw residents maintain or regularly use cabins or cottages in the region. However, no Mi'kmaw owned or utilized cottages or cabin have so far been recorded in or directly surrounding the FMS Study Area with the exception of the cabin noted in the MEKS. No further information was provided in the MEKS, from direct engagement with the Mi'kmaq communities and the KMKNO, or the questionnaire shared in Dec 2019/Jan 2020 relating to specific locations of seasonal residences/cottages/camps. The Proponent team requested additional information via email from the KMKNO relating to the general location of this cabin(s) identified within the MEKS on March 12, 2020. To date, no specific detail has been provided, although the Proponent anticipates the KMKNO will provide analysis and recommendations with their EIS review. However, conclusions relating to Project impacts at the FMS Mine Site property boundaries have been provided for each VC in Table 6.13-5 and these conclusions can support analysis of particular camps/cottages that may be present surrounding and in close proximity to the FMS Mine Site.

- **Consumption of Country Foods:** Details relating to locations, frequency, duration and timing of harvesting for specific fish, wildlife species, plants or other natural resources were not shared at this time with the Proponent. Traditional land use activities are an integral part of the domestic economy of many households and make an important contribution to their food security. Of the sample of Mi'kmaw individuals interviewed for the MEKS, 84% identified the traditional sector of their domestic economy, the harvesting of wildlife and plant resources, as an indispensable component of their families' food security (Appendix H.1).

  Mi'kmaq individuals or families from all surrounding communities were, and are, involved in harvesting and other land use activities in the region including the FMS Study Area. However, specific details regarding the frequency, duration and timing of the harvesting or wildlife and plant resources, or which groups practice the activities (women, elders, youth, families) were not shared with the Proponent. Thus, detailed analysis of specific current traditional use in relation to Project development and potential impacts/effects is limited. However, analysis was completed (Appendix C.1) related to the evaluation of potential human exposures and risks related to emissions from the Project (Dust Deposition; Recreational Water Usage; Country Foods) and this analysis has been based on assumptions of traditional use**.**

- **Ceremonial/Spiritual Activities and Sites:** General information about a sacred site was provided in the MEKS, but details relating to its specific location was not shared with the Proponent due to privacy concerns. If a general location was provided, analysis could be completed at this location to evaluate change in noise, light, and viewshed analysis from the Project. The Proponent team requested additional information via email from the KMKNO relating to the general location of this sacred site identified within the MEKS on March 12, 2020. To date, no specific detail has been provided, although the Proponent anticipates the KMKNO will provide analysis and recommendations with their EIS review.

Additional information relating to strengthening the Proponent understanding of current Mi'kmaq land use was requested from the Mi'kmaq of Nova Scotia as documented in detail in Section 4.0 and summarized herein.

Requests for more detailed information were made of the KMKNO, Millbrook First Nation, Sipekne'katik First Nation in April and May 2019 related to camp/cabin locations, potable water supply locations (even occasional water usage), swimming and fishing locations, recreational uses, and frequency, duration and timing of traditional practices in and around the proposed FMS Mine Site. A detailed questionnaire was then provided in December 2019/January 2020 with a request for feedback by February 15th, 2020, and a Mi'kmaq Impact Statement was shared in July 2020 with the KMKNO, Millbrook, and Sipekne'katik, with a request for feedback by August 14th, 2020.

The Proponent team also requested additional information from the KMKNO archaeological team in an email dated March 12th, 2020 relating to specific information regarding locations of burial sites, sacred sites, and cabins, beyond what was documented in the MEKS (Appendix H.1). Finally, a prepared Plain Language Summary (PLS) of the Project was shared with PLFN and Paq'tnkek.

As described herein, this information has been requested of all Mi'kmaq communities and organizations over the course of the last eighteen months to two years. No specific information has been provided relating to the Proponent requests. The feedback that has been received from the Mi'kmaq indicates that specificity of traditional use data may be difficult to obtain during the EA process, and if documented, may not be shared with the Proponent due to privacy considerations. However, if data is obtained and if it is in a format that can be shared, it is most likely to become available through the formal EIS review period, once the EIS is publicly available through IAAC. The Proponent will continue to work with the Mi'kmaq of Nova Scotia to identify any outstanding information related to the Project.

6.13.2.2.3.1 Baseline Current Mi'kmaq Land Use

The FMS Study Area is located in a very remote area of Nova Scotia. The current conditions, through baseline monitoring, have been documented as quiet and dark. There are limited development pressures around the Project and the FMS Study Area is generally undisturbed; however, commercial forestry operations are present and active within the PA and surrounding the area and the central portion of the FMS Study Area has been disturbed as a result of historical mining activities. The forestry and previous mining activities have supported a series of roads and access trails within the FMS Study Area.

Highway 374 is a paved highway that connects the PA directly to the community of Sheet Harbour. Few residences are present within 10 km of the PA. NSPI infrastructure is present across the East River Sheet Harbour watershed including necessary access roads to their infrastructure within the FMS Study Area and surrounding area.

Generally, the FMS Study Area and immediately surrounding area is remote, quiet, dark, and undisturbed, with the exception of forestry activities and NSPI operations within the watershed. As a result, it is expected that the use of the land for traditional practices by the Mi'kmaq of Nova Scotia is, and has historically been, completed with limited disturbance or interruption, with the exception of forestry and NSPI activity which would periodically, when forest harvesting is active, result in a temporary restriction of access, increase of human presence and activity in the area, along with an increase in baseline noise and light.

The regional road network surrounding and within the FMS Study Area facilitates quick year-round access for harvesting excursions of one or several days by Mi'kmaw from the surrounding First Nation communities on the Eastern and Northumberland shores, the Shubenacadie River and Cape Breton, whether they reside on-reserve or not. Motorized transportation such as pick-up trucks, all-terrain vehicles snowmobiles, and engine-powered boats puts the FMS Study Area's resources within relatively easy reach from any of these communities.

The resulting patterns of current use described in the MEKS and through direct engagement with the Mi'kmaq communities concludes the FMS Study Area and surrounding area are being used for traditional purposes by the Mi'kmaq of Nova Scotia. Engagement and the conclusions of the MEKS illustrate that both the FMS Study Area as well as the broader PA itself are being utilized by the Mi'kmaw First Nation, and that these lands and resources are integral parts of its traditional economic sector.

The pattern of reported activities shows three major spatial clusters within, or overlapping, the defined FMS Study Area:

- One of those areas of concentration of recorded traditional land use is located between Lower Rocky Lake, Seloam Lake and Antidam Flowage, at the centre of which lies the proposed FMS Study Area.
- An area west of the FMS Study Area near Como Lake traverses the second cluster of reported land use activities.
- The third cluster is found east of the FMS Study Area just south of Hunting Lake.

As mentioned above, details relating to locations, frequency, duration and timing of harvesting for specific fish, wildlife species, plants or other natural resources were not shared with the Proponent. Specific locations for recreational uses, especially swimming, have not been provided to date. Further details relating to the context within which Mi'kmaq rights are being practiced including how subgroups (youth, elders, families, women) are using the land have not been shared. Appendix H.1 shows the level of detail provided through the MEKS format, and available through direct engagement with Mi'kmaq communities.

Table 6.13-2 lists the sample of contemporary land and resource use activities reported to occur within the FMS Study Area and surrounding area. It should be kept in mind that these are merely a reported selection of ongoing activities by a sample of the Mi'kmaw land users active in the region.

Table 6.13-2: Reported Contemporary Mi'kmaw Land and Resource Uses within the Study Region (Appendix H.1)

Land and Resource Use Category	Reported Resources and Activities
Hunting and Trapping	Whitetail deer (*Odocoileus virgianus*), Eastern moose (*Alces alces americana*) [sighting], Snowshoe hare (*Lepus americanus*), Porcupine (*Erethizon dorsatum*), Groundhog (*Marmota monax*), Black bear (*Ursus americanus*), Red fox (*Vulpes vulpes*), Bobcat (*Felis rufus*), Lynx (*Felis lynx*), Coyote (*Canis latrans*), Beaver (*Castor canadensis*), Muskrat (*Ondatra zibethica*), Otter (*Lutra canadensis*), Fisher (*Martes pennanti*), Mink (*Mustela vison*), Raccoon (*Procyon lotor*), Ruffed grouse (*Bonasa umbellus*), Ducks (*Anas rubripes & al.*), Canada goose (*Branta canadensis*), Barred owl (*Strix varia*)
Fishing	Speckled trout (*Salvelinus fontialis*), Atlantic salmon (*Salmo salar*), American eel (*Anguilla rostrata*), White sucker (*Catostomus commersoni*), Yellow perch (*Perca flavenscens*), Gaspereau (*Alosa pseudoharengus*), Smallmouth bass (*Micropterus dolomieui*), Freshwater mussels (*Margaritifera margaritifera & al.*)

Land and Resource Use Category	Reported Resources and Activities
Food, Medicinal and Decoration Plants Collection	Blueberries (*Vaccinium angustifolium*), Cranberries (*Vaccinium macrocarpon*), Fiddleheads (*Matteuccia struthiopteris*), Chokecherries (*Prunus virgiana*), Goldenrod (*Solidago canadensis*), Gold thread (*Coptis trifolia*), Sphagnum moss (*Sphagnum spp*), Labrador tea (*Ledum groenlandicum*), Hazelnuts (*Corylus cornuta*), Mushrooms (*Cantharellus, Agaricus campestris & al.*), Mayflower (*Epigaea repens*), Lion's paw (*Prenanthes trifoliolata*), Bloodroot (*Sanguinaria canadensis*), Golden seal (*Hydrastis canadensis*), Flag root (*Acorus calamus*)
Wood and Wood Products Harvesting	White ash (*Fraxinus americana*), Black ash (*Fraxinus nigra*), Balsam fir (*Abies balsamea*), Hemlock (*Tsuga canadensis*), Juniper (*Juniperus communis*), White cedar (*Thuja occidentalis*), Birch bark (*Betula papyfera*), Red oak (*Quercus rubra*)
Ceremonial/Spiritual Activities and Sites	Sacred Site
Burial and Birth Places	Burial
Habitation and Camp Sites	Cabin, travel route

Table 6.13-3 displays the results of the surveys, with the number of species broken down into the categories of food/beverage and medicinal plants as well as plant species used for arts and crafts applications. None of the plant species identified in the surveys are threatened or limited to local distribution. As the harvesting and use of traditional medicines embodies a spiritual component beyond the practical medicinal applications, many Mi'kmaq are reluctant to publicize the respective species names, specific harvesting locations and medicinal uses. Plant uses are therefore given here in a generalized format only.

Table 6.13-3: Number of Identified Plant Species of Special Significance to the Mi'kmaw During FMS Plant Surveys (Appendix H.1)

Plant Type	Fall (2017)	Spring (2018)
Food/Beverage	14	6
Medicinal	47	28
Arts/Crafts	11	11

While all above-mentioned wildlife and plant species are of economic significance to Mi'kmaw harvesters, moose, salmon, eel, black ash, and various medicinal plants are of special cultural and/or spiritual importance as well. The threatened status of the mainland moose population further heightens the importance of the fact that its presence in the FMS Study Area has been confirmed during the data collection for this EIS.

The evidence presented above shows Mi'kmaw occupancy and land/resource use in the FMS Study Area and wider region of Eskikewa'kik – a changing, and more limited but uninterrupted use from pre-contact times to today.

Summary: Both those aspects, the economic and cultural motivations for traditional land and resource uses, feed into a third impetus: the need to express, affirm and exercise their Aboriginal rights to live their cultural heritage within Mi'kma'ki, and their Treaty rights to continue harvesting the resources of their traditional territory.

There are limitations associated with the data collected and shared. Specific details and locations are not provided in the MEKS relating to specific foods consumed, or harvesting locations, nor was the Proponent able to collect details on locations of commercial and traditional fishing, hunting, or trapping locations within or near the Project. No information has been shared either through the procured MEKS, a questionnaire shared in Dec 2019/Jan 2020, or direct, ongoing engagement with the communities regarding seasonal or temporary sites used by the Mi'kmaq or surface water drinking water locations. No information relating to frequency, duration and timing of traditional practices was shared. As a result, analysis of Project effects on the Mi'kmaq of Nova Scotia is limited; however, a more general analysis of Project impacts is completed which allows for appropriate conclusions relating to residual impact and significance of effects. On-going engagement and dialogue during the EIS review process will continue to refine the specific conclusions and proposed mitigation and management commitments relating to the impact of this Project on the Mi'kmaq of Nova Scotia throughout the life of the environmental assessment process.

6.13.2.3 Touquoy Mine Site Baseline Conditions

The continued processing of FMS concentrate at the Touquoy Mine Site will not result in any additional impact to the Mi'kmaq of Nova Scotia, other than those effects already addressed and evaluated in the Touquoy EARD (CRA 2007a). Therefore, the effects assessment portion of this section will address only the Project in the context of the FMS Study Area. The cumulative effect of the Touquoy Gold Project and the Project is considered in Section 8.

6.13.3 Consideration of Engagement and Engagement Results

Key issues raised during public and Mi'kmaq engagement with the Mi'kmaq of Nova Scotia include concerns related to adverse effects from Project activities during construction and operation, including potential habitat loss and effects on individual flora and fauna used in traditional hunting, fishing and trapping activities and medicinal food and plants. The Proponent acknowledges there will be a loss of access to the FMS Mine Site for up to eleven years (1 year construction, 7 years operations, 2-3 years active reclamation stage). The Proponent has reviewed the surrounding landscape and available Crown land, and has concluded there is similar and abundant habitat surrounding the Project that may help mitigate impact to traditional use practices by the Mi'kmaq in this local area. Furthermore, the Proponent has planned for bypass roads that will allow local traffic to continue to access Seloam Lake and the areas east of the FMS Mine Site. The Proponent will continue to engage in discussions with the Mi'kmaq regarding appropriate avoidance, access, mitigation options, and compensation as required.

Specific questions were noted on potential effects of accidents and malfunctions on current use of traditional lands and associated contingency planning for an unplanned release and the potential effects of climate change on the Project. These items are discussed further in Section 6.17 and Section 7.0. The Proponent has developed an emergency response protocol with the Mi'kmaq to ensure their interests are protected in the unlikely case of an accident or malfunction, and to ensure appropriate communication if an emergency were to occur. Specific questions have also been raised relating to potential sensory disturbance from noise and light and their potential effect on traditional practices on the land surrounding the FMS Mine Site.

From a socio-economic perspective, interest has been expressed by the Mi'kmaq of Nova Scotia to work toward benefit agreement(s). These discussions and negotiations are ongoing and are privileged and confidential discussions between the Proponent and the Mi'kmaq of Nova Scotia. While not required by the Crown or legislation, such agreements are considered a best practice. The Proponent will continue to work with the organizations representing Mi'kmaq communities in order to provide appropriate opportunities for economic benefits including training, contracting and employment.

The results of Mi'kmaq engagement have been considered and incorporated in the environmental effects assessment and are reflected in the Proponent's commitments to involve the Mi'kmaq in the development and implementation of mitigation and monitoring measures and proposed compliance and effects monitoring programs. The specific engagement record describing the results of engagement efforts and how these comments have been incorporated into the EIS is provided in Section 4.0 and Appendix K.2.

6.13.4 Effects Assessment Methodology

6.13.4.1 Boundaries

6.13.4.1.1 *Spatial Boundaries*

The spatial boundaries for the assessment of effects to the Mi'kmaq of Nova Scotia are defined below.

Project Area (PA): The PA is the most basic and immediate area of the Project and consists of the FMS Mine Site and the Touquoy Mine Site, as described in Section 2. For the purpose of this assessment, only the FMS Study Area portion of the PA is considered for effects assessment.

Local Assessment Area (LAA): The LAA encompasses a 5 km radius from the PA (FMS Study Area portion only). The LAA includes the maximum extent of physical disturbance from the Project and interactions with expected Mi'kmaq current use of lands and resources, and physical and cultural heritage (Figure 6-13-1). The LAA is the maximum area within which Project-related effects can be predicted or measured with a reasonable degree of accuracy and confidence.

Regional Assessment Area (RAA): The RAA for the assessment of the Mi'kmaq of Nova Scotia is defined as the territorial boundaries of the *Eskikewa'kik* (meaning 'skin dressers territory'; Figure 6.13-1). The extent to which cumulative effects on the Mi'kmaq of Nova Scotia may occur depends on physical and biological conditions, the particular VC being considered, and the type and location of other past, present, or reasonably foreseeable future projects or activities that have been or will be carried out, as defined within the RAA.

Effects from the Project on the Mi'kmaq of Nova Scotia may potentially occur within and immediately adjacent to the PA (FMS Study Area portion only), therefore, the LAA has been selected as the appropriate boundary for the evaluation of this VC.

6.13.4.1.2 *Temporal Boundaries*

The temporal boundary for the assessment of effects to the Mi'kmaq of Nova Scotia extends through the Project, including construction (1 year), Operation (7 years) and Closure (reclamation and post closure stages) (2-3+ years) phases.

6.13.4.1.3 *Technical Boundaries*

The assessment of potential Project-related effects is limited by the availability of information, which has been obtained primarily through a balance of ongoing engagement, the MEKS conducted for the Project and related projects, and Mi'kmaq groups' reviews and submissions to IAAC regarding the FMS EIS Guidelines and draft EIS. The Proponent feels there has been a good balance between first-hand knowledge shared through engagement and the studies completed to date, and secondary sources, although the limited amount of published information regarding historical and current use does present a technical limitation as to the comprehensiveness and verification of the information provided. The Proponent has assumed Mi'kmaq use of the area to be moderate, given information provided by Mi'kmaq community members, the history of the area, and the presence of two small local Mi'kmaq communities within 25 km of the FMS Study Area, connected to the broader Mi'kmaw Nation. However, specifics of this moderate use are not fully understood, and thus, analysis can only be completed broadly, with the information provided.

6.13.4.1.4 *Administrative Boundaries*

Provincially, the Nova Scotia Environmental Assessment Regulations include a requirement to identify concerns of the Mi'kmaq of Nova Scotia about potential adverse effects and steps taken or proposed to be taken by the Proponent to address concerns, as well as the steps taken to identify these concerns.

Federally, subparagraph 5(1)(c) of *CEAA 2012* requires the assessment of effects of changes to the environment on Aboriginal peoples, including: health and socio-economic conditions; physical and cultural heritage, including any structure, site or thing that is of historical, archaeological, paleontological or architectural significance; and current use of lands and resources for traditional purposes.

The governments of Nova Scotia and Canada, and the Mi'kmaq follow a TOR that lays out a process for Crown consultation with the Mi'kmaq. Procedural aspects of the Crown's duty to consult are delegated to the Proponent.

6.13.4.2 Thresholds for Determination of Significance

A significant adverse residual effect on the Mi'kmaq of Nova Scotia is defined as a Project-related environmental effect that results in one or more of the following outcomes:

- Long-term (greater than 20 years) or permanent loss of the availability of, or access to, land and resources currently relied on for traditional use practices; or if long-term or permanent loss is expected, no allowance for agreed-upon compensation with the affected Mi'kmaq community(s). A twenty year temporal scale was chosen to represent a generational loss of access to an area.
- Human health risk assessments are inherently conservative, and hence, development of a threshold of significance for human health is complicated, since risk estimates tend to be biased high, based on the degree of conservatism included in any given risk assessment. The threshold for a significant residual effect has been defined as a potential adverse effect to health, identified through the conclusions presented in the HHRA.

- An unmitigated loss of a physical or cultural structure, site or thing that is of historical, archaeological, paleontological or architectural significance to the Mi'kmaq.

Short-term (less than 20 years) loss of availability of land and resources caused by displacement due to Project activities are not considered to be significant.

The significance of potential effects on potential or established Aboriginal or treaty rights is a matter of consideration by the Crown and Mi'kmaq representatives (Assembly of Nova Scotia Chiefs and the Governments of Canada and Nova Scotia).

For the Mi'kmaq of Nova Scotia, the following logic was applied to assess the magnitude of a predicted change (one or more of these aspects):

- Negligible
  - no loss of a structure, site or thing that is of historical, archaeological, paleontological or architectural significance to the Mi'kmaq of Nova Scotia as a result of Project development;
  - no observable change in the availability and baseline condition of lands and resources for traditional purposes; and
  - no change in baseline socio-economic condition of the affected Mi'kmaq communities from Project activities.
- Low
  - loss of a structure, site or thing that is of historical, archaeological, paleontological or architectural significance to the Mi'kmaq of Nova Scotia as a result of Project development, but only after a comprehensive evaluation by Mi'kmaq archaeological teams determines the loss is considered appropriate and mitigation measures are employed;
  - an observable change availability and baseline condition of the lands and resources for traditional purposes for a short temporal window (<20 years) and with commitment to appropriate and negotiated accommodation and compensation with the affected Mi'kmaq community(s);
  - elevated risk of non-carcinogenic or carcinogenic health risk that do not exceed Risk Quotients and where Incremental Lifetime Cancer Risks (ILCR) related to the Project were not predicted to exceed the benchmark cancer risk level of 1 in 100,000; and
  - a positive potential change in baseline socio-economic condition of the affected Mi'kmaq communities from Project activities.
- Moderate
  - loss of a structure, site or thing that is of historical, archaeological, paleontological or architectural significance to the Mi'kmaq of Nova Scotia as a result of Project development, with mitigation measures;
  - an observable change in the availability and baseline condition of the lands and resources for traditional purposes for a short temporal window (<20 years) with no consideration of appropriate and negotiated accommodation and compensation with the affected Mi'kmaq community(s); and

- elevated risk of non-carcinogenic or carcinogenic health risk that do not exceed Risk Quotients and where Incremental Lifetime Cancer Risks (ILCR) related to the Project were not predicted to exceed the benchmark cancer risk level of 1 in 100,000.

- High
  - loss of a structure, site or thing that is of historical, archaeological, paleontological or architectural significance to the Mi'kmaq of Nova Scotia as a result of Project development, without mitigation measures;
  - an observable change in the availability and baseline condition of the lands and resources for traditional purposes for a long term temporal window (>20 years);
  - elevated risk of non-carcinogenic or carcinogenic health risk that exceed Risk Quotients and/or where Incremental Lifetime Cancer Risks (ILCR) related to the Project were predicted to exceed the benchmark cancer risk level of 1 in 100,000; and
  - a negative potential change in baseline socio-economic condition of the affected Mi'kmaq communities from Project activities.

6.13.5 Project Activities and Mi'kmaq of Nova Scotia Interactions and Effects

Per subparagraph 5(1)(c) of *CEAA 2012*, the assessment of potential effects on Indigenous Peoples includes consideration of changes in health and socio-economic conditions; physical and cultural heritage, including any structure, site or thing that is historical, archaeological, paleontological or architectural significance; and current use of lands and resources for traditional purposes.

Potential interactions between Project activities and the Mi'kmaq of Nova Scotia are outlined in Table 6.13-4 below.

Table 6.13-4: Potential Mi'kmaq of Nova Scotia Interactions with Project Activities at FMS Mine Site

Project Phase	Duration	Relevant Project Activity
Site Preparations and Construction Phase	1 year	• Clearing, grubbing and grading • Drilling and rock blasting • Topsoil, till and waste rock management • Watercourse and wetland alteration • Seloam Brook Realignment construction and dewatering • Mine site road construction, including lighting • Surface infrastructure installation and construction, including lighting; • Collection ditch and water management pond construction, including lighting; • Local traffic bypass road construction • Culvert and bridge upgrades and construction

Project Phase	Duration	Relevant Project Activity
Operations Phase	7 years	• Drilling and rock blasting • Open pit dewatering • Ore management • Waste rock management • Tailings management • Surface water management • Dust and noise management • Petroleum products management;
Closure Phase: Reclamation stage	2-3 years	• Infrastructure decommissioning and demolition • Water treatment and management • Site reclamation
Closure Phase: Post-closure Stage	3 years +	• Water treatment and management

The temporal scale of effects to the Mi'kmaq of Nova Scotia will begin with initiation of site preparation activities, as the land and resources within the proposed site property boundaries at the FMS Mine Site will no longer be available for use, and continue throughout all Project phases until completion of the active site reclamation stage of the Closure Phase. During the post-closure stage of the Closure Phase, the pit at the FMS Mine Site will be re-filling with water, and water treatment as required and monitoring is predicted to continue, but no other site activities would affect the site area usage for the Mi'kmaq, as active reclamation activities will be completed.

Many of the potential Project effects to the Mi'kmaq of Nova Scotia health and socio-economic conditions, and current use of lands and resources for traditional purposes, are via effects to VCs assessed as part of this EIS (including potential adverse effects to noise, air, light, geology/soil/sediment, surface water, groundwater, wetlands, fish and fish habitat, habitat and flora, birds, fauna, and SAR/SOCI). A summary of each of these relevant VC predicted residual effects (post mitigation) is provided below in Table 6.13-5, and these effects are evaluated for potential interaction with the Mi'kmaq of Nova Scotia.

Where appropriate, individual VCs were included in a human health risk assessment (HHRA) completed by Intrinsik Corp. in 2019 to evaluate potential risk to human health from the Project. This report assesses the potential for emissions from the mine, released via Project activities, to change the chemistry of air, water and soils in the area, and whether the predicted changes have the potential to result in metals accumulation in, or on, vegetation, or other selected country foods that may be consumed by humans. In addition, this report also provides an assessment of other exposure pathways, such as recreational swimming (Anti-Dam Flowage), and inhalation and incidental ingestion of metals on dusts in air and soil. The focus of this assessment is on the FMS Mine Site, in areas outside of the proposed property boundary which could be accessed by the general public, including the Mi'kmaq, during various activities. The Moose River was not evaluated due to demonstrated low water levels and limited opportunity for swimming in this receiving environment. Figure 6.13-3 documents exposure pathways considered in the HHRA. The complete HHRA is included in Appendix C.1.

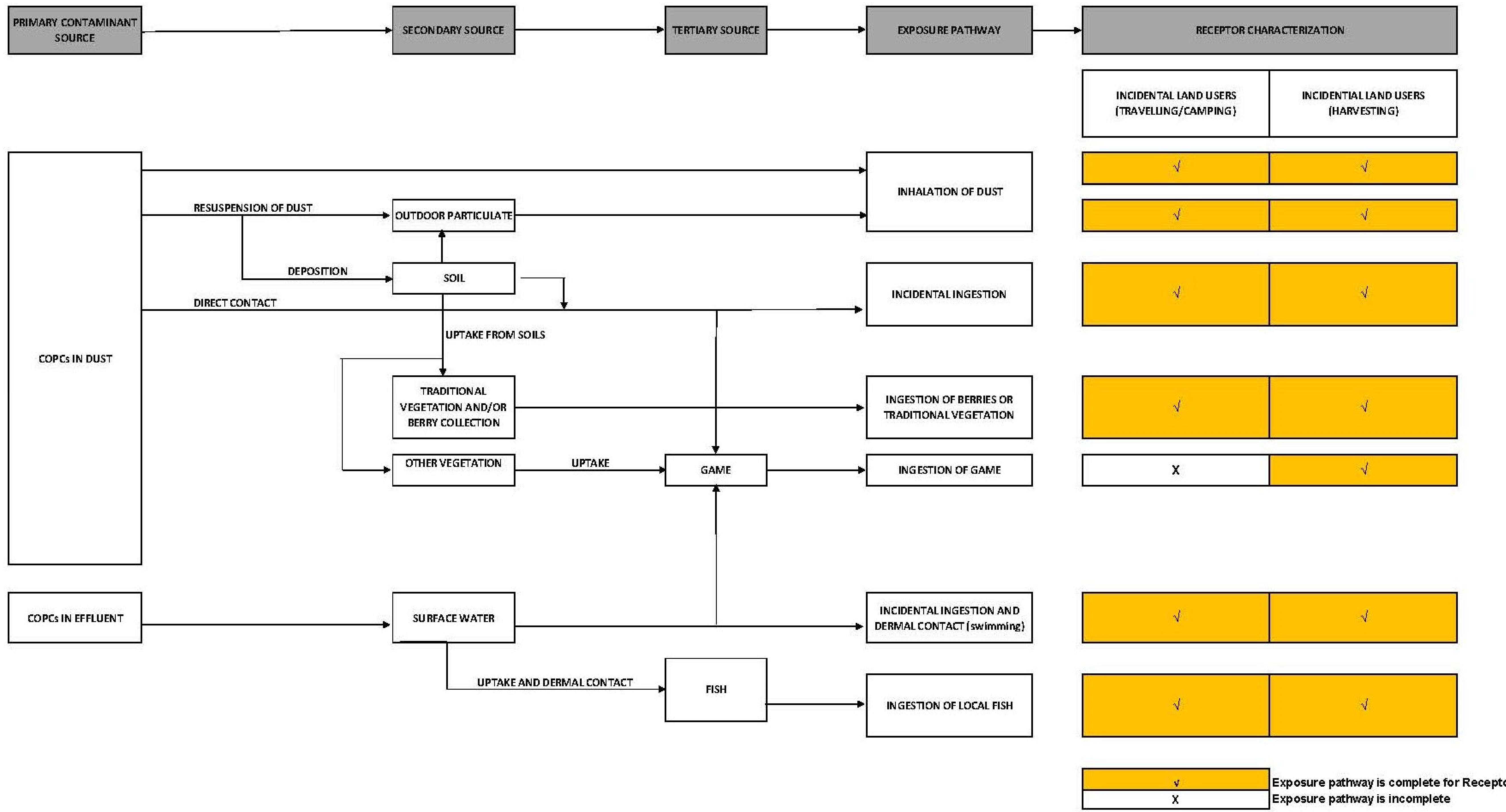

Figure 6.13-3: Human Health Conceptual Site Model (Intrinsik 2019)

Table 6.13-5: Project Interactions and Summaries for each VC and Potential Effect to Mi'kmaq of Nova Scotia

Valued Component	Summary of Residual Effect	Potential Interaction with, and Effect to the Mi'kmaq of Nova Scotia (health and socio-economic conditions, current use, physical and cultural heritage)	Consideration in HHRA
Noise	Project noise is predicted to be in compliance with the Pit and Quarry Guideline nighttime guideline of 55 dBA at the proposed property boundaries for the FMS Mine Site. Predicted blasting noise will meet the Nova Scotia Pit and Quarry Guidelines (NSDEL 1999) criteria of 128 dBA at approximately 100 metres from the blast location. Project noise is predicted to reach measured background levels (approximately 26 dBA) at 4 to 5 km from the proposed property boundaries.	Noise levels are predicted to meet the Pit and Quarry Guidelines at the proposed property boundary and thus, there is limited noise exposure to the Mi'kmaq of Nova Scotia outside of the Mine property boundaries. Elevated noise above background concentrations near the FMS Mine Site may affect wildlife patterns and as a result, affect traditional hunting practices by the Mi'kmaq of Nova Scotia within 1 to 1.5km (north and south) of the FMS Mine Site, based on the most conservative guideline (nighttime value of 45 dBA) identified for potential broad wildlife effects (Environmental Code of Practice for Metals Mines EC 2012c). Elevated noise is not expected to affect plant gathering or fishing activities or other recreational/commercial uses of the area directly surrounding the Project.	No
Air	Concentrations of all parameters are predicted to be in compliance with appropriate regulatory criteria at the proposed FMS Mine Site property boundary, with consideration of mitigation equivalent to twice daily dust suppression (via water) during dusty times and possible use of chemical dust suppressants to mitigate up to 75% of predicted dust on the main onsite haul road from pit to plant and from plant to Highway 374.	Elevated particulate levels above background concentrations outside of the FMS Mine Site property boundaries could be present on vegetation and berries and as a result, affect traditional gathering and food consumption practices and human health by the Mi'kmaq of Nova Scotia.	Yes
Light	Direct line of sight is possible up to 2 km from the FMS Mine Site property boundary where topography favors light propagation (generally north of the FMS Mine Site).	Increased light levels above background levels near the FMS Mine Site could affect wildlife patterns and as a result, affect traditional hunting practices by the Mi'kmaq of Nova Scotia. Increased light are not expected to affect plant gathering or fishing activities or other recreational/commercial uses of the area directly surrounding the Project. There is no pathway for effect to human health from light.	No

Valued Component	Summary of Residual Effect	Potential Interaction with, and Effect to the Mi'kmaq of Nova Scotia (health and socio-economic conditions, current use, physical and cultural heritage)	Consideration in HHRA
Geology, Soils and Sediment	62 static tests and 5 humidity cell tests and various other tests have been conducted on the mine rock materials – these tests remain on-going and will support on-going predictive modelling work. Based on a number of conservative assumptions, the results indicate that there is very low potential for acidic conditions to occur during operations. During closure phase, there is potential for acidic conditions to occur (50% of PAG is predicted to be acidic within 10 years), however, through mitigation (e.g. water treatment if required; impermeable cover) these conditions can be mitigated. Historical tailings present at FMS Mine Site will be fully delineated, tested and managed on site before new mining activities commence. Options for disposal on-site or off-site are being considered in conjunction with regulatory consultation.	Acidic conditions in predicted surface water quality from the Project could affect fishing practices in Anti-Dam Flowage (receiving environment for mine discharge). This potential pathway for exposure is considered in the Surface Water VC. Release of sediment and contaminants associated with historical tailings could also affect downstream water quality in surface water systems (Seloam Brook, Fifteen Mile Stream and Anti-Dam Flowage). The Proponent is committed to necessary water treatment to ensure surface water discharge meets compliance with appropriate criteria and/or background conditions in the receiving environment. Currently, water quality predictions from modelling efforts conclude that water treatment will not be required (during operations) and that if required, limited water treatment will be complete on discharge from the PAG WRSA during post-closure. Erosion and sediment control measures and water management will be employed during construction and management of historical tailings to ensure release of sediment or surface water with elevated concentrations of mercury or arsenic into the downstream receiving environment does not occur. The Stantec Phase I/II work to identify historical tailings only identified tailings within the FMS Mine Site proposed property boundaries – human exposure to those soils/sediments will be limited because they are either going to be removed and managed/disposed of, to enable mining to occur, or left in their current stable condition. Furthermore, there will be no access for general public in the active mining area. * Human exposure to soils outside the proposed property boundaries, which could be potentially influenced by atmospheric deposition from mining activities is included in the HHRA (dust deposition onto soils).	No*

Valued Component	Summary of Residual Effect	Potential Interaction with, and Effect to the Mi'kmaq of Nova Scotia (health and socio-economic conditions, current use, physical and cultural heritage)	Consideration in HHRA
Groundwater	Maximum radius of influence (groundwater drawdown) is predicted at 830 m from the pit during operations, and less that this during closure, when the pit is re-filling with water. The nearest potable well is 8.7 km south of the FMS Study Area (dug well confirmed by property owner). Groundwater seepage has been predicted through modelling efforts and these seepage rates have been included in operational and closure surface water modelling efforts to understand potential effect of groundwater seepage on surrounding surface water features.	During the closure phase, seepage will move at a speed of less than 6 m^3/day from the TMF towards East lake catchment, and 75 m^3/day towards the north and WC12. Seepage will move at a predicted 175 m^3/day from the WRSA to the flooded open pit. This slow rate of movement permits monitoring to confirm seepage from the TMF and allow for adaptive management if required. Groundwater seepage was considered as part of the surface water quality modelling efforts. Due to the distance of Mi'kmaq communities and residences, and proposed surface water treatment, if required, during Closure Phase of the Project, predicted groundwater changes and groundwater seepage are not expected to affect the traditional practices or residences of the Mi'kmaq of Nova Scotia.	No

Valued Component	Summary of Residual Effect	Potential Interaction with, and Effect to the Mi'kmaq of Nova Scotia (health and socio-economic conditions, current use, physical and cultural heritage)	Consideration in HHRA
Surface Water	All mine contact water during operations will be directed to the TMF. During closure, all mine contact water will be directed to the pit, to facilitate pit filling. Discharge water will meet MDMER at the end of pipe during all phases of the Project. There is a 100 m modelled mixing zone from the water discharge point within Anti-Dam Flowage. During Closure, a cover system is planned on the PAG portion of the WRSA to improve water quality and reduce the need for potential water treatment. No chemical water treatment is anticipated to be required during operations but will be available. Water treatment, if required, will be completed during the closure phase; however, current predictions do not conclude treatment will be required. There will be a modular effluent treatment plant present on site during the construction phase and this system can be adapted and utilized throughout the life of mine, as required based on site effluent quality.	Due to the distance of Mi'kmaq communities and residences, and proposed surface water treatment, if required, during operations and during Closure Phase of the Project, surface water quality and quantity predictions are not expected to affect the traditional practices or residences of the Mi'kmaq of Nova Scotia outside of the FMS Mine Site property boundary during operations and the active reclamation stage of closure, or within the FMS Mine Site during the post-closure stage of closure. No known locations where Mi'kmaq residents draw directly from lakes or rivers for potable purposes (permanent or seasonal/temporary) have been identified, through direct engagement with Mi'kmaq communities or through the MEKS, in close proximity to the FMS Study Area. In the absence of such locations being identified to the Proponent, no evaluation of surface potable water sources was considered in the HHRA. However, evaluation of the predicted concentrations at EMZ-2 (Anti Dam Flowage) have been compared to Canadian Drinking Water Guidelines within the HHRA. This location is considered the worst-case scenario and these predictions demonstrate there is no concern associated with occasional consumption of surface water surrounding the FMS Mine Site. The potential for adverse health effects from recreational water use (i.e. swimming) in Anti-Dam Flowage have been considered in the HHRA. Swimming in the Moose River has been excluded from HHRA consideration due to low water levels in this river.	Yes

Valued Component	Summary of Residual Effect	Potential Interaction with, and Effect to the Mi'kmaq of Nova Scotia (health and socio-economic conditions, current use, physical and cultural heritage)	Consideration in HHRA
Wetlands	Of the 274 wetlands identified within the FMS Study Area, 138 (50%) will be avoided by Project design. A total of 136 wetlands are proposed for alteration, 23 of which will require only partial alteration. Indirect wetland impacts are expected from flooding due to the Seloam Brook Realignment, and potential impacts are considered within the groundwater radius of influence (drawdown), and as a result of changes in surface water catchments. There are opportunities for these flooded areas downstream of the realignment to enhance wetland function. Wetland compensation will be required to off-set the loss of wetland habitat from the Project. A preliminary Wetland Compensation Plan is attached as Appendix G.4.	Loss of wetland habitat is limited to the area directly surrounding the pit and associated infrastructure development for the proposed mine. The Seloam Brook Realignment project provides an opportunity for potential wetland enhancement within and downstream of the realignment channel, and management of historical tailings will improve wetland quality in the local area and improve water quality, and overall watershed health. Wetland restoration opportunities will be identified in consultation with the Mi'kmaq of Nova Scotia with the goal to identify projects that would benefit the Mi'kmaq and local watersheds where wetland restoration would benefit traditional Mi'kmaq practices.	No
Fish and Fish Habitat	Spawning habitat for species known or expected is limited in the FMS Study Area. Physical barriers, pH, dissolved oxygen levels and temperatures were limiting factors to fish habitat quality. Atlantic Salmon access to the FMS Study Area has been limited by installation of hydroelectric dams and increased acidification since the 1920's. Development of the FMS Pit and associated mine infrastructure will require the realignment of Seloam Brook and several smaller tributaries and side channels. A Seloam Brook Realignment construction plan will be developed, and a Fish Habitat Offset Plan (Appendix J.7) has been developed to facilitate this realignment and compensate for loss of fish habitat required for Project development. Site infrastructure has been micro-sited for fish habitat avoidance wherever practicable. A Fisheries Authorization will be required for the Project, and a Fish Habitat Offset Plan for fish habitat offsetting is included in the EIS	The Seloam Brook Realignment plans for fish habitat creation and enhancement within the realignment channel and through a natural floodplain/riparian wetland habitat, improving fish habitat within the FMS Study Area. The development of the pit will also manage the containment/disposal of historical tailings and the realignment will provide fish habitat that is not affected by contamination or historical mine adjustments (straightening, ditching). Areas where Mi'kmaq fishing activities are known or expected to take place (Anti-Dam Flowage, Seloam Lake and other surrounding waterbodies) will not be affected by Project development. Access will be maintained to Seloam Lake through a constructed bypass access road for Mi'kmaq and local people who want to continue to fish in this lake and access areas to the east of the Project. Evaluation of the potential exposure pathway of uptake of metals from surface water into fish and subsequent consumption by humans was considered in the HHRA.	Yes

Valued Component	Summary of Residual Effect	Potential Interaction with, and Effect to the Mi'kmaq of Nova Scotia (health and socio-economic conditions, current use, physical and cultural heritage)	Consideration in HHRA
Flora and Habitat	Soils are nutrient poor, acidic, and the landscape is dominated by mixedwood and conifer forest stands often with a shrub layer. Historical mining, disturbances from timber harvesting and hydroelectric power generating infrastructure (dams) have historically affected the habitat and flora communities with the FMS Study Area. Two hundred seventy-seven species of vascular plants were observed. No SAR vascular plant species were observed within the FMS Study Area, although three SOCI were observed. Fifty-nine species of lichens were observed within the FMS Study Area. One of these is a SAR, and eight are SOCI.	15 occurrences of lichen and/or vascular plant SAR and SOCI will be directly impacted by the Project. The loss of these individual plants and lichens is not expected to have a significant impact on the Mi'kmaq of Nova Scotia and their traditional practices. New habitat loss to support Project development is minimized by active historical timber harvesting activities in this area and historical mining activities. Reclamation will involve seeding the disturbed areas with an approved mix of native seeds. This Reclamation Plan will be developed in consultation with Mi'kmaq of Nova Scotia.	No
Fauna	The FMS Study Area was evaluated for bat hibernacula potential through both desktop and field evaluations. No evidence of bat usage or suitable hibernacula habitat were observed. A common assemblage of fauna was observed within the FMS Study Area. While not observed, it is possible that snapping turtle (SAR) uses portions of the FMS Study Area, at least periodically. The Project will result in a loss of habitat for Fauna, increased habitat fragmentation, and potential sensory disturbance to wildlife in close proximity to the FMS Mine Site property boundaries.	Project activities are likely to result in localized avoidance of the FMS Study Area and directly surrounding areas by some species. This potential avoidance would be due to changes in ambient noise levels and light levels in close proximity to the FMS Mine Site property boundaries, direct habitat loss, potential indirect habitat loss, and increased fragmentation. This potential change in wildlife patterns may affect the traditional practices of the Mi'kmaq of Nova Scotia in close proximity to the FMS Mine Site (within 1-1.5 km of the property boundaries). This disturbance is limited spatially, and temporary in nature, with construction, operation and active reclamation of the Project resulting in up to eleven years of potential local disruption to wildlife patterns. Evaluation of the potential exposure pathway of uptake of metals from soil or vegetation, uptake of metals in game species, and subsequent consumption by humans was considered in the HHRA.	Yes

Valued Component	Summary of Residual Effect	Potential Interaction with, and Effect to the Mi'kmaq of Nova Scotia (health and socio-economic conditions, current use, physical and cultural heritage)	Consideration in HHRA
Avifauna	Abundance and diversity of avian species observed was moderate to high based on observer experience in the geographic area. The common species assemblage of forest birds was observed, along with a cohort of species more typically found in intact or interior forest (such as Cape May warbler, northern goshawk, and blackburnian warblers). Six SAR and 16 SOCI bird species were observed in the FMS Study Area. The Project will result in a loss of habitat for avifauna, increased habitat fragmentation, and potential sensory disturbance to birds in close proximity to the FMS Mine Site property boundaries.	Project activities are likely to result in localized avoidance of the FMS Study Area and directly surrounding areas by some bird species. This potential avoidance would be due to changes in ambient noise levels, light levels, direct and indirect habitat loss and increased fragmentation. This potential change in bird usage patterns may affect the traditional practices of the Mi'kmaq of Nova Scotia in close proximity to the FMS Mine Site. This disturbance is temporary in nature, with construction, operation and active reclamation of the Mine resulting in up to eleven years of potential local disruption to bird usage patterns.	No
Species at Risk	Multiple mainland moose (*Alces americanus*, ACCDC: S1; NSESA: E) observations were recorded across the FMS Study Area. Six SAR and 16 SOCI bird species were recorded. Three vascular plant SOCI species were recorded. One SAR and eight SOCI lichen species were recorded. Two SOCI fish species were observed. Direct habitat loss is expected as a result of the Project. SOCI vascular plant loss include southern twayblade and Wiegand's sedge, and SOCI and SAR lichen loss include blue felt lichen, fringe lichen, eastern candlewax lichen and corrugated shingles lichen.	Mobile species (birds, fish, moose) are expected to occupy adjacent suitable habitat for the 11 years that the Project is being developed, operated and completion of active reclamation. The FMS Mine Site is located in a very rural area, with limited development pressures in close proximity to the FMS Mine Site. This potential change in wildlife patterns, including SAR, may affect the traditional practices of the Mi'kmaq of Nova Scotia in close proximity to the FMS Mine Site.	No

Valued Component	Summary of Residual Effect	Potential Interaction with, and Effect to the Mi'kmaq of Nova Scotia (health and socio-economic conditions, current use, physical and cultural heritage)	Consideration in HHRA
Physical and Cultural Heritage	Seven archaeological sites were identified with the FMS Study Area. All sites are associated with historical mining activities and all sites will be impacted by pit and associated infrastructure development. The western by-pass road will be micro-sited through Site 7 to avoid the majority of the cultural features it contains except for an unavoidable section of an historic road. Two areas of archaeological potential were identified; both were identified to be potential areas used by Mi'kmaw based on their proximity to a water source and terrain suitable for settlement/encampment. Area 1 is on the shoreline of Anti-Dam Flowage and has been classified by CRM Group as having low archeological potential and as such infrastructure in this area (water lines and associated infrastructure) does not have any significant impacts predicted to occur. Area 2 is on the shores of Seloam Lake and is considered an area of elevated potential for Mi'kmaq archaeological resources. This area will be avoided by Project development.	Identified archaeological sites that will be affected by the Project are not Mi'kmaq resources. Identified areas of Mi'kmaq elevated potential within the FMS Study Area for archaeological resources will be avoided. Identified and known Mi'kmaq archaeological features (burial site on Seloam Lake and others) are outside of the proposed development footprint of the Project and thus will not be affected by Project development. In the event that archaeological deposits or human remains are encountered during construction activities associated with the Fifteen Mile Stream Development, all work in the associated area(s) should be halted and immediate contact made with the Nova Scotia Special Places Program and with the KMKNO Archaeological Division. No additional discussion is provided relating to potential interactions with physical and cultural heritage, based on these technical conclusions presented herein.	No

Stemming from the technical conclusions presented in Table 6.13-5, a discussion of potential Project interactions with Mi'kmaq traditional use of the land, and Project Interactions with Mi'kmaq Health and Socioeconomic Conditions is provided in the following sections, followed by proposed mitigation measures to minimize impact to the Mi'kmaq of Nova Scotia. Throughout these subsections, feedback received from the Mi'kmaq communities relating to Project interactions, mitigation and accommodation conclusions are presented, where feedback has been provided. The Proponent is committed to on-going dialogue with the Mi'kmaq of Nova Scotia throughout the environmental assessment, and the entire life cycle of the Project, and continuing to support adjustments in proposed mitigation measures, and monitoring plans relating to Project impacts based on on-going feedback and input received from communities.

6.13.5.1 Project Interactions with Mi'kmaq Traditional Use/Rights

Plant species of significance to the Mi'kmaq were identified within the FMS Study Area and surrounding LAA. Based on the knowledge of the Project team and the understanding of the regional landscape, these same species that have been documented within the FMS Study Area also exist within the immediate adjacent surrounding area. These plant communities are expected to remain accessible to the Mi'kmaq, especially with access routes adjusted to allow for traffic to bypass the FMS Mine Site, and given the large tracts of available crown land surrounding the Project. The Proponent does acknowledge that there will be destruction of some specimens, therefore altering the habitat and area available to the Mi'kmaq for their use. However, it is the conclusion of the Proponent that the permanent loss of some individual plants does not pose a significant threat to Mi'kmaq use of the species as a whole, given their abundance and availability within close proximity, and the limited development pressures surrounding the FMS Study Area.

There will be a reduction in area available for hunting, trapping, gathering, fishing, spiritual ceremonies and other Mi'kmaq traditional activities within the FMS Mine Site. Due to the proximity of the mine to traditional harvesting areas as demonstrated through the MEKS, there will be a loss of access, including a potential exclusion zone in close proximity to the FMS Mine Site for the use of firearms. This will reduce the overall area of access for current Mi'kmaq traditional use within and potentially near the Project for a period of eleven years. Within the proposed property boundary of the FMS Mine Site, approximately 765 ha is crown land, with limited open water/lakes/recreational swimming or known fishing areas.

Within close proximity to the proposed property boundaries of the FMS Mine Site, there is the potential for sensory disturbance to wildlife and birds from noise and light above background conditions resulting in potential changes to wildlife patterns and by extension, hunting practices for the Mi'kmaq of Nova Scotia. There are limited Project effects expected to hunting, gathering and trapping activities beyond the potential adjustment of wildlife patterns (1-2km) as a result of elevated noise and light in close proximity to the FMS Mine Site.

Identified archaeological sites that will be affected by the Project are not Mi'kmaq resources. Identified areas of Mi'kmaq elevated potential within the FMS Study Area for archaeological resources will be avoided. Identified Mi'kmaq archaeological features (burial site on Seloam Lake and others) are outside of the proposed FMS Mine Site property boundaries and thus will not be affected by Project development. Discussions and review of the Project by the KMKNO archaeological division have occurred (see Section 4.0 and Appendix K.2 for details on engagement and dialogue efforts with the KMKNO teams). To date, no additional archaeological sites have been identified within the FMS Mine Site.

Nortek Resource Solutions Inc. (Nortek) has completed a viewshed analysis of the Project to support a visual representative of where the Project will be visible from surrounding vantage points (Appendix G.13).

The Zone of Visual Influence (ZVI) provides a spatial overview of where the proposed Project stockpiles will be visible. The FMS Study Area is predominantly forested and therefore the existing forest stand data was included in the analysis. The analysis consisted of preparing a Digital Surface Model (DSM) which included the proposed stockpiles. Once the model was prepared, a visibility analysis was completed to determine all areas on the DSM in which the stockpiles are visible. This analysis focused on stockpile locations as they are the highest infrastructure proposed at the FMS Mine Site.

The ZVI was generated for the region within a 10 km radius of the FMS Study Area. The Nova Scotia Provincial Digital Terrain Model (DTM) at 20 m resolution was used as a base layer for the analysis. The proposed stockpiles were rasterized and added to the base DTM so that they were included in the model. A visibility analysis was run using the upper rims of the stockpiles as targets and receptor heights of 1.7 m. The resulting raster was clipped with forest stand polygons that have an average height of 2 m or less which excluded areas were the forest is higher than eye height. The final results show where the proposed stockpiles will be visible assuming summer, leaf on forest conditions.

The Visual Zone of Influence (ZVI) (Appendix G.13) identifies where stockpiles (highest elevation features on the FMS Mine Site) are visible from the surrounding landscape. The NAG pile, which will be present during operations and closure, is 160m asl. The LGO pile, which will be present only during operations, is 170m asl. These are the two highest infrastructure features associated with the Project. On the ZVI, these areas where stockpile(s) are predicted to be visible are shown in green. This ZVI was prepared in order to provide a general overview of where the Project will be visible from, and also to demonstrate a visual representation of what the visual influence will look like from specific locations. As shown in Appendix G.13, the Project stockpile(s) will be visible from the north of the FMS Mine Site, the west of the FMS Mine Site (especially just west of Highway 374) and to the south of the FMS Mine Site along Anti Dam Flowage. Commercial and recreational activities (boating, fishing, swimming) on Anti Dam Flowage and Seloam Lake will observe an adjusted viewplane with visible stockpile(s).

To support Project development, there will be two local bypass roads constructed to allow continued public access to Seloam Lake and the lands to the east of the FMS Mine Site. Based on a review of the ZVI, the Project stockpiles will be visible from the northern bypass road (the bypass road from the west of the Project to Seloam Lake). The stockpiles are not predicted to be visible from the eastern bypass road, which will extend east and south from Seloam Lake to re-connected to existing trails east of the FMS Mine Site. The TMF (lower elevation) will be visible from this bypass road as the road is proposed to be constructed in close proximity to the TMF.

Through a review of the ZVI results, several photos were then taken from various vantage points to attempt to demonstrate specific locations where visual influence of the Project would be greatest. Visual Simulations 1-4 in Appendix G.13 show these four vantage points and what will be visual during operations and closure phases of the Project.

Visual Simulation 1 illustrates the view from the south side of Anti Dam Flowage from Highway 374 looking northwest towards the Project. The NAG stockpile will be visible during operations and closure phases, as shown on Visual Simulation 1. Visual Simulation 2 illustrates the view from Seloam Lake Road West (just south of Seloam Lake) where the ZVI predicted a visual change from the Project. The NAG stockpile will be marginally visible during operations and closure phases, as shown on Visual Simulation 2. Visual Simulation 3 illustrates the view from north of Trafalgar Creek where the ZVI also predicted a visual change from the Project. The PAG and NAG stockpiles will be visible from this vantage point during the operation and closure phases, as shown on Visual Simulation 3. Finally, Visual Simulation 4 illustrates the view from west of Highway 374 along Abrahams Lake Road. From this location, the PAG and NAG stockpiles will be visible during both the operations and closure phases. The LGO stockpile will be visible during the operation phase but will be removed once operations are completed. These four vantage points were selected to be representative of expected maximum change in viewscape, while also working to choose locations where the Project team anticipated human activities to be taking place (near access trails, lakes and other access points).

Once the construction phase, operation phase, and active reclamation stage of the closure phase are complete (eleven years), access will be re-established within the FMS Mine Site for the Mi'kmaq of Nova Scotia. At this time, the site infrastructure will be dismantled and removed, the waste rock piles and TMF will be covered and seeded/reclaimed, and water management systems will be adjusted towards the exhausted pit to facilitate pit filling. With the exception of the pit area, where filling will be on-going and water monitoring will be occurring, it is the opinion of the Proponent that traditional practices within the FMS Mine Site can resume. The landscape will be altered, with more limited forested cover for an extended period of time. This will likely affect the specific nature of traditional practices that will resume within the FMS Mine Site. The majority of identified historical tailings will have been managed and removed from waterways, and water quality and fish habitat will be improved within the realignment of Seloam Brook. This is a positive impact of this Project on future traditional practices with the FMS Study Area.

If generalized locations of seasonal camps, cabins or sacred sites were provided, that have been referenced in the MEKS, the Proponent could provide specific detail on noise, light, and dust levels at these generalized locations and provide additional specific conclusions relating to Project impact. The Project team could also review the viewscape at these specific locations to support Mi'kmaq understanding and perspective on Project visual impacts. The Proponent will continue to work with the Mi'kmaq of Nova Scotia to provide specificity in analysis, where possible, to support comprehensive conclusions of Project impacts and to support mitigation and accommodation opportunities.

Given this discussion of Project interactions and the current available baseline data, the predicted impacts of the Project to the Mi'kmaq traditional use of the land are summarized below. These impacts are predicted to be low magnitude, as defined in Section 6.13.5.2 and in consideration of mitigation and accommodation. A low magnitude change is defined (in part) by an observable change in the availability and baseline condition of the lands and resources for traditional purposes for a short temporal window (<20 years) and with commitment to appropriate and negotiated accommodation and compensation with the affected Mi'kmaq community(s). The Proponent is committed to appropriate and negotiated accommodation and compensation, as described in Section 6.13.7.

- It is the conclusion of the Proponent that the permanent loss of some plant species does not pose a significant threat to Mi'kmaq use of the species as a whole, given their abundance and availability within close proximity, and the limited development pressures surrounding the FMS Study Area;
- The FMS Mine Site will be restricted for access. This area includes 765 ha of crown land, with limited open water/lakes/recreational swimming or known fishing areas;
- Access to Seloam Lake and Anti Dam Flowage will be maintained. Local bypass roads will be constructed to maintain access to Seloam Lake and local trails east of the FMS Mine Site;
- Change in noise and light levels will meet compliance with guidelines at the FMS Mine Site property boundary. Elevated noise and light levels above background conditions are expected, but only in close proximity to the FMS Mine Site (1-2 km);
- Within close proximity to the proposed property boundaries of the FMS Mine Site (1-2km), there is the potential for sensory disturbance to wildlife and birds from noise and light above background conditions resulting in potential changes to wildlife patterns and by extension, hunting practices;
- Access limitations are for a temporal scale of eleven years (construction, operations and the active reclamation stage of the closure phase);
- It is the opinion of the Proponent that traditional practices within the FMS Mine Site can resume during the post-closure stage of the closure phase. The landscape will be altered, with more limited forested cover for an extended period of time. This will likely affect the specific nature of traditional practices that will resume within the FMS Mine Site.
- There will be a change in surrounding viewscape of the Project. Project stockpiles will be visible from several local vantage points around the FMS Mine Site including Seloam Lake and Anti Dam Flowage;
- No known physical and cultural sites of Mi'kmaq importance will be affected by Project development. Monitoring will be completed during all phases of the Project for additional potential archaeological deposits or human remains; and,

- There are limited development pressures in the area, and the closest Mi'kmaq community is 24km from the FMS Mine Site.

These conclusions relating to Project impacts and the magnitude of these impacts have been shared with the Mi'kmaq of Nova Scotia through face to face meetings and discussions that included the preparation and delivery of a draft Mi'kmaq Impact Statement and a Plain Language Summary (Appendix K.2). These documents were shared with all interested Mi'kmaq communities, and the KMKNO and feedback was requested by August 14, 2020. At the time of submission of this EIS, no formal feedback was received from any Mi'kmaq community or organization. Mi'kmaq groups acknowledged that feedback will be received once the EIS is formally accepted by IAAC, the document is publicly available, and the Mi'kmaq of Nova Scotia have the chance to review the entire document.

6.13.5.2 Project Interactions and Mi'kmaq Health and Socioeconomic Condition

It is important to note that potential health impacts on Mi'kmaq communities are linked to the interconnected nature of the ability to access traditional territory to continue cultural practices, such as hunting, gathering and fishing – not only for their consumptive human health value, but also for mental and human health associated with cultural survival and continuity. While issues impacting Indigenous health are complex, the Mi'kmaq of Nova Scotia would view a loss of access to territory and the ability to exercise Aboriginal and Treaty rights in that area to extend to potential impacts to human health outcomes.

The Health Canada document "Useful Information for Environment Assessments" (HC 2015) was reviewed to determine the appropriate baseline information that should be included relevant to human health and First Nations. Table 6.13-6 presents the relevant information related to effects on human health of the Mi'kmaq of Nova Scotia based on the review of the Health Canada document.

Table 6.13-6: Baseline Information Relevant to Human Health and the Mi'kmaq of Nova Scotia

Elements to Consider	Anticipated Effect
Location of First Nations in relation to the Project	The nearest First Nation (Mi'kmaq) reserves are the Beaver Lake IR 17, located 24 km from the Project, and the Sheet Harbour IR, also located approximately 25 km from the Project. The EIS has concluded that there are likely occasional use and modern day camps used by the Mi'kmaq in closer proximity to the proposed Project, based on conclusions relating to traditional practices in close proximity to the Project. The locations of these camps are unknown, and as a result, have not been evaluated as specific receptors in any VCs.
Size of the Population Potentially Affected	21 people are living at Beaver Lake and 15 people are living at Sheet Harbour IR. However, extended familial and broader community relationships exist at the other Millbrook locations and also with other Mi'kmaq communities including, but not limited to, Pictou Landing First Nation, Sipekne'katik First Nation and Paqtnkek First Nation, and would indicate a larger potentially-affected population.
Presence of Drinking Water Intakes	The nearest domestic well is 8.7 km south from the Project, at a residence along Hwy 374. No other seasonal/temporary or permanent water usage has been documented in closer proximity to the Project through research completed for this EIS. As a result, no surface water withdrawal locations have been evaluated, although as mentioned in Table 6.13-5, an analysis of surface water concentrations at EMZ-2 (discharge location and presumed reasonable worst case surface water location from Project) has been completed against the Canadian Drinking Water Quality Guidelines.

Elements to Consider	Anticipated Effect
Timing/Duration of Project	The Project will take place in stages – first construction, followed by operations, closure and reclamation. It is anticipated that the period from construction through active reclamation is eleven years. The mine will limit access to specific areas for hunting, fishing and harvesting purposes for that period. After this period, during the post-closure stage of Closure, monitoring and water treatment(as required) in the pit will be on-going, but access to the areas surrounding the pit will be re-established for the Mi'kmaq.
Recreational Use of Surface Water	The Project, as planned with constructed bypass roads, does not restrict access to areas of documented use. Swimming is expected in Seloam Lake and potentially within Anti-Dam Flowage during high flows (Spring and Fall). During the summer months, Anti-Dam Flowage is run-of-river, based on operational conditions for the hydro system. The HHRA evaluated risk to recreational swimming and also accidental ingestion of surface water during swimming.
Country Food Harvesting	Based on the information compiled through the MEKS, historical information and secondary sources, and findings during site visits, it is concluded that there is a moderate level of Mi'kmaq use of the Project site and surrounding areas for subsistence harvesting of food and medical plants, fish and furbearing animals. It is known that areas to the north of the site have traditionally been used for these and ceremonial (burial) activities. Historical information indicates that the Mi'kmaq would have conducted these activities in the FMS Study Area and surrounding areas.
Location of Traditional Resource Use	

As with the analysis of Project impacts to traditional use, specificity relating to Mi'kmaq land use and baseline health and socio-economic condition is not fully understood, and as a result, some analyses relating to health and socio-economic conditions have been completed utilizing a series of assumptions. During the course of the EIS review, should additional information become available relating to baseline health and socio-economic conditions of the Mi'kmaq of Nova Scotia beyond what is presented in this document, analyses can and will be reviewed and updated. The Proponent has attempted to collect information through multiple methods, as described in Section 4 and Appendix K.2. Information that would support analyses includes:

- Locations of Mi'kmaq commercial forestry and logging operations within and surrounding the FMS Study Area;
- Use of the FMS Study Area for Mi'kmaq commercial outfitting;
- Details relating to the Mi'kmaq non-commercial/trade economy within and surrounding the FMS Study Area;
- Specificity of country food consumption within and surrounding the FMS Study Area (duration, timing, seasonality);
- Seasonal camp and potable surface water locations within and surrounding the FMS Study Area;
- Fishing locations within and surrounding the FMS Study Area;
- Details relating to Mi'kmaq recreational uses within and surrounding the FMS Study Area;
- Community members opinion on how the Project could positively or negatively impact the economic condition of the community (income, population, housing, jobs, cost of living and food security);
- An understanding of what community members would do if there was a loss of access to traditional areas within the FMS Study Area. Would they shift to other areas? Stop using traditional resources? Purchase goods elsewhere to replace traditional goods? Others?; and,

- An understanding of whether loss of access to land or resources would have a direct impact on community member's income. If so, how and to what extent?

The Proponent will continue to work with the Mi'kmaq of Nova Scotia to provide specificity in analysis, where possible, to support comprehensive conclusions of Project impacts and to support mitigation and accommodation opportunities.

6.13.5.3 Human Health Risk Assessment Summary of Methods and Results

The HHRA completed by Intrinsik Corp. evaluated the following VCs to support the analysis of Project impact to the MI'kmaq of Nova Scotia: Air, Surface Water, Fish and Fish Habitat, and Fauna. Table 6.13-5 outlines the technical conclusions for each VC and the justification for inclusion in the HRRA. Activities in the area could include traditional hunting and plant gathering, fishing, swimming, hiking, use of ATVs, and camping. The HHRA identified possible exposure pathways such as:

- inhalation of air containing dusts;
- incidental soil and dust ingestion;
- ingestion of berries and/or traditional vegetation, game meats and fish; and
- incidental consumption and dermal contact to surface waters through recreational activities (swimming).

All of these exposure pathways were included in the assessment for the Project. The HHRA followed a standard screening level risk assessment approach using methods outlined by Health Canada (2012; 2016a; 2016b; 2018 as cited in Appendix C.1). The steps of a HHRA involve conducting a Problem Formulation, which involves identifying the ways by which people could be exposed to chemicals released from mining activities (which are known as exposure pathways), the identification of Chemicals of Potential Concern (known as COPCs), and identifying the characteristics of people who could be exposed (known as receptors), based on the types of activities that could occur in the area of the mine. This stage was followed by an Exposure Assessment (to estimate the potential rate of exposure to COPCs) and Toxicity Assessment (which estimates exposure rates which are considered to be without risk of adverse health effects, or of negligible risk) and a Risk Characterization step. Activities in the area could include traditional hunting and plant gathering, fishing, hiking, use of ATVs, and camping. The HHRA identified possible exposure pathways such as inhalation of air containing dusts; incidental soil and dust ingestion; ingestion of berries and/or traditional vegetation, game meats and fish; incidental consumption and dermal contact to surface waters through recreational activities (swimming), which were all included in the assessment.

Chemicals of Potential Concern (COPC) were identified through examination of the geochemistry of dusts which could be released by the mine, as well as through predicted future surface water concentrations in the watercourse which will receive direct effluent discharge (Anti Dam Flowage). Screening of these sources resulted in several metals/metalloids meriting further assessment in the HHRA (aluminum; arsenic; barium; chromium; cobalt; copper; lead; manganese; molybdenum; nickel; strontium; vanadium and zinc).

Dust deposition from FMS Mine Site activities was predicted by Wood (Appendix J.2), based on proposed operations and activities at the FMS Mine Site, using standard methods. Predicted deposition rates were provided for the maximum point of impingement (MPOI) at the FMS Mine Site property boundary, as well as a location approximately 1 km from the property boundary. These predictions were used to estimate potential future soil, vegetation and game meat concentrations in the FMS Study Area, using standard risk assessment equations provided by Health Canada and US EPA (e.g., US EPA OSW, 2005; US EPA, 1993 as cited in Appendix C.1). Metal concentrations on fine and coarse particulate matter were also estimated based on predicted concentrations of PM2.5 and PM10, provided by Wood (2019) at the MPOI. These predicted concentrations were used to assess potential inhalation exposures in areas outside the property boundary, for either short term or chronic time frames. Effluent release into the nearby receiving environment (Anti Dam Flowage) and possible future receiving environment concentrations were predicted by Golder (Appendix B.6). These data were used to evaluate potential exposures related to recreational swimming, and fish consumption.

Potential exposures to releases of the COPCs from the proposed Project for people who could spend time in areas near the FMS Mine Site were estimated using standardized equations by Health Canada (2012) and US EPA (2003; 2004) (as cited in Appendix C.1). Consumption rates for various foods which could be harvested from the area near the proposed mine, such as leafy vegetation, berries, fish and game meats (deer), were identified from the First Nations Food, Nutrition and Environment Study (FNFNES) for the Atlantic region (Chan et al, 2017 as cited in Appendix C.1). Soil ingestion, dust inhalation exposure rates were identified from Health Canada (2012). Exposure rates from swimming and incidental water ingestion were identified from both Health Canada (2012) (as cited in Appendix C.1) and US EPA (2003; 2004). Chronic Toxicity Reference Values (TRVs), which are exposure levels of COPCs for a life-time below which adverse effects are not anticipated, or which are associated with negligible risk levels, were identified from Health Canada (2010), World Health Organization (2010), US EPA (1996; 1993) (as cited in Appendix C.1) and other notable regulatory agencies. Potential risks were characterized by comparing the predicted exposure levels from all exposure pathways to the TRV, to predict a Risk Quotient (RQ) for non-carcinogens. RQs less than 0.2 for the Project scenario, or less than 1.0 for the Baseline + Project scenario, are considered to indicate that the intake of the COPC through the consumption of traditional foods and other Project-related pathways does not exceed the TRV and no adverse health effects are expected. For carcinogenic chemicals, an Incremental Lifetime Cancer Risk (ILCR) for all life stages is calculated. A benchmark cancer risk level of 1 in 100,000 (i.e., 1×10-5) is used to assess risk, and cancer risks are deemed negligible when the estimated ILCR is less than the benchmark value of 1 in 100,000 (i.e., ILCR ≤ 1.0).

Based on the assessment conducted, non-carcinogenic risks from soil and dust exposures, the consumption of country foods harvested from the vicinity of the FMS Mine Site, and recreational water use (i.e., swimming), as well as soil ingestion, are considered to be negligible, and hence, are not anticipated to result in adverse health effects. For arsenic, predicted ILCRs were below the benchmark ILCR of 1 in 100,000 in all scenarios and assessment cases. Therefore, the potential for adverse health effects from arsenic exposure are considered negligible.

Based on the assessment conducted, it is considered unlikely that ore dust deposition from the Project at the rates considered in this assessment would result in levels of metals in country foods, soils and dust that would be harmful to human health. Adverse health effects from soil and dust exposure, the consumption of country foods harvested from the vicinity of the FMS Mine Site, and recreational water use (i.e. swimming) are not anticipated.

6.13.5.4 Socio-Economic and Mental and Social Well-Being

The Project is planned for an eleven-year timeframe within the proposed FMS Mine Site property boundaries. As described above, the HHRA has determined that there is a low risk of direct human health effects from this Project within and surrounding the FMS Mine Site. The Proponent understands that this Project may result in an impact to the socio-economic, mental and social well-being of the Mi'kmaq of Nova Scotia.

The Project may impact the economic condition of the Mi'kmaq communities. This impact could be felt in either a positive or negative way. Some of these potential changes, related to the economic condition of Mi'kmaq individuals, families and at the community level, include changes in income, population, housing conditions, employment, cost of living and food security.

With loss of access to the FMS Mine Site, the Proponent acknowledges that patterns of traditional use (hunting; trapping; medicinal, food or cultural-use plants; and recreational use of water) may change. This may result in a shift to other areas to practice traditional use, or a reduction or stoppage of the use of traditional resources in the local area, and potentially the need to purchase goods to replace these traditional resources. These shifts could increase the cost of living for Mi'kmaq families who rely on traditional resources. There are also possible positive effects on the economic condition for the Mi'kmaq with provision of potential new job opportunities and improved socio-economic conditions through increased income. However, it is also possible that the Project may cause worker shortages in other businesses if people are recruited away from their current jobs in the community, and it is also possible that loss of access to the land and resources may have a direct effect on an individual's income.

The Proponent anticipates that the Project will have limited effect on Mi'kmaq use of navigable waters. Inside the property boundary of the proposed FMS Mine Site, there is limited open water, with the exception of Seloam Brook. Access to this brook will be limited during Project development and operations as it is situated within the FMS Mine Site property boundary. However, there is limited expectation that this brook is currently used by the Mi'kmaq for travel, given the size of the brook, elevated location in the watershed, the low water levels through this system, and given the NSPI control of this system and fluctuating water levels. As a result, the effect on navigable waters from Project development is predicted to be low.

As previously discussed in this section, there is a Project impact on traditional practices of the Mi'kmaq due to a loss of access, which potentially includes Mi'kmaq forestry and logging operations, commercial outfitters and traditional practices in the context of moderate livelihood. Forestry activities have been documented historically and are currently active on the crown land portion of the FMS Mine Site (Northern Timber has a harvesting lease on this area of Crown land). The specific details of Mi'kmaq commercial forestry and logging activities are not fully understood. The MEKS does describe the harvesting of wood and wood products as a general aspect of Mi'kmaq traditional practice. As a result, lack of access to this area of Crown land (765 ha) could impact Mi'kmaw ability to harvest wood and wood products and may affect what Mi'kmaq commercial forestry and logging activities are present within this area. The same is true for commercial outfitters; limited information has been provided relating to specific use of the FMS Mine Site, but the MEKS does report trapping and hunting efforts within and surrounding the FMS Mine Site, which may be part of broader commercial outfitting programs.

The Proponent team acknowledges that the Mi'kmaq of Nova Scotia may use the FMS Mine Site and surrounding area for recreational purposes and for non-commercial/trade economy purposes. These activities will be limited during Project construction, operation and active reclamation to areas surrounding the FMS Mine Site, which will have an effect on the Mi'kmaq individuals and communities who carry out these activities. Some Mi'kmaq individuals may currently use the FMS Mine Site specifically to gather food for sustenance for themselves and/or their family members and thus, for these people, the loss of access into the FMS Mine Site for the eleven year period may affect their food security and require an adjustment to either hunt and gather in other areas near their traditional area within the mine footprint, or purchase food instead.

The Project will provide employment opportunities for individuals from the Mi'kmaq communities, including the youth. There may be an increase in public and community services in the area once the Project is developed, resulting from increased population and economic activity in the local area around the FMS Mine Site. This may also raise the cost of living in close proximity to the mine. However, few residences are present within 10 km of the FMS Mine Site, so this potential effect is expected to be minimal. There is no expected impact on housing conditions for the Mi'kmaq of Nova Scotia from this proposed mine, given the specific location of the mine, and the distance to nearby Mi'kmaq communities (24km to closest community). The mine will provide added employment and economic opportunities to the area, and the Mi'kmaq are anticipated to benefit from this increased economic activity.

The development of the mine will change the baseline conditions in the local area. There will be an increase in background noise, dust, and light in close proximity to the mine. This may affect the spiritual and cultural experience and sense of well-being for the Mi'kmaq of Nova Scotia on the nearby landscape to the FMS Mine Site.

Once the construction phase, operation phase, and active reclamation stage of the closure phase are complete (eleven years), access will be re-established within the FMS Mine Site for the Mi'kmaq of Nova Scotia. With the exception of the pit area, where filling will be on-going and water monitoring will be occurring, it is the opinion of the Proponent that commercial and traditional practices within the FMS Mine Site can resume. The landscape will be altered, with more limited forested cover for an extended period of time. This will likely affect the specific nature of traditional practices that can resume within the FMS Mine Site.

All of these potential changes as a result of the proposed mine development are expected to have an impact on the economic condition of the Mi'kmaq of Nova Scotia. Although there may be specific individual examples of negative economic impact as a result of changed traditional practices (for example), generally, the overall conclusion of the Proponent is that this Project will have a net positive impact on the Mi'kmaq of Nova Scotia through an increase in job opportunities and economic prosperity in the local region around the Project. The development of the Project is also expected to have an impact on the, mental and social well-being of the Mi'kmaq of Nova Scotia. Similarly to economic condition changes, the Proponent anticipates that although the Project may have a negative localized impact on Mi'kmaq individuals partaking in traditional practices within close proximity to the mine, overall, the impact on the Mi'kmaq of Nova Scotia as it relates to mental and social wellbeing will be low, given the very remote location of the mine, the distance to Mi'kmaq communities, the available crown land surrounding the property that can continue to be used by the Mi'kmaq, and the short temporal scale of the Project (11 years).

In order to understand these Project interactions and potential effects to the Mi'kmaq of Nova Scotia more thoroughly and with broader input from the Mi'kmaq of Nova Scotia, a questionnaire was distributed to all Mi'kmaq communities. This questionnaire was distributed, in part, to gain specific perspective from community members on the effect of the development of this Project on the socio-economic and mental and social well-being of their individuals and families, as well as at the community level. This questionnaire was distributed to KMKNO, Pictou Landing First Nation, Paqtnkek First Nation, Sipekne'katik First Nation and the Millbrook First Nation in December 2019 or January 2020 (for details please refer to section 4.0). Input from communities was requested by February 15, 2020. At the time of the EIS submission, no feedback or input was received from any of these parties; however, this dialogue is expected to be strengthened and on-going throughout the life of the environmental assessment process to support proposed mitigation measures and accommodations with the Mi'kmaq of Nova Scotia.

A Plain Language Summary (PLS) of the Project EIS has been prepared by the Proponent (Appendix K.2). A draft Mi'kmaq Impact Statement document has also been prepared by the Proponent (Appendix K.2). Both documents have been shared with the Mi'kmaq communities (KMKNO, PLFN, Paqtnkek, Sipekne'katik and Millbrook) in July 2020, with a request for feedback by August 14, 2020. The Proponent also requested direct engagement to support further understanding of Mi'kmaq perspective on Project effects and proposed mitigation measures directly to the Assembly of First Nations (through Chief Terry and Chief Peters) and the KMKNO on May 13, 2020 (via email). At the time of this submission, no specific feedback or input was received from any of these parties; however, this dialogue, as described above, is expected to be strengthened and on-going throughout the life of the environmental assessment process, and the Project in general.

6.13.6 Mitigation

Mitigation measures and monitoring associated with related VCs are key to avoiding effects on the Mi'kmaq of Nova Scotia, as detailed in each VC section. The Project has been planned to minimize footprint disturbance and impacts to the Mi'kmaq of Nova Scotia. While there are limited expected indirect effects on the Mi'kmaq of Nova Scotia based on the assessment of effects for related VCs, this evaluation is based on the implementation of the proposed mitigation and associated monitoring as a result of direct effects as outlined in the VC sections. These mitigation measures are not repeated in detail in this section but generally including dust mitigation and monitoring, treatment of discharge water if/as needed prior to discharge into Anti-Dam Flowage during both the operations and closure phases of the Project, surface and ground water monitoring program, implementation of erosion and sediment control measures throughout the life of the Project, completion of the Seloam Brook Realignment, management and disposal of historical tailings when they are required to be disturbed, fisheries offsetting, wetland compensation, and wetland, lichen and moose monitoring programs.

There are also direct proposed mitigation measures to reduce impact on traditional practices, Mi'kmaq archaeological features (if identified) and the mental and social well-being of the Mi'kmaq of Nova Scotia. These mitigations are described in detail below and in Table 6.13-7.

Bypass routes have been designed to allow for travel routes to by-pass the FMS Mine Site and allow access to Seloam Lake and areas east of the Project. These bypass roads are necessary as the current access road (Northern Timber and NSPI controlled) will be within the proposed FMS Mine Site property boundaries and not accessible to the public. The two proposed bypass roads are shown on Figure 2.1-7. The northern bypass road loops to the north of the FMS Mine Site and leads to Seloam Lake, allowing continued access to the lake for fishing and recreational purposes. The eastern bypass road continues southeast from Seloam Lake to join with existing trails to the east of the FMS Mine Site. Mine infrastructure including stockpiles and the TMF will be visible from these bypass roads, as shown in Appendix G.13.

Figure 6.13-4 shows the FMS Mine Site and land ownership (Crown vs. private land) within and surrounding the site. Tracts of Crown land are available of equivalent area surrounding the FMS Mine Site (to the east, northeast, west and southwest). Based on a review of these areas by the Proponent study team, the Proponent has concluded that the general habitat quality, access, and percentage of wetland, watercourse and lakes within these areas is similar to that found within the FMS Mine Site. Access is available into these areas of Crown land through existing roads (Highway 374) and a myriad of existing trails (ATV and local forestry roads). The Proponent concludes that these areas surrounding the FMS Mine Site may be suitable alternative areas for the Mi'kmaq of Nova Scotia to continue traditional practices during the 11 year life of the mine.

In the event that archaeological deposits or human remains are encountered during construction activities associated with the Fifteen Mile Stream Development, all work in the associated area(s) will be halted and immediate contact made with the Nova Scotia Special Places Program and with the KMKNO Archaeological Division.

Feedback from the Mi'kmaq of Nova Scotia has been requested relating to these specific proposed mitigation measures. These requests have been made during face to face meetings, through direct engagement efforts (emails and phone calls), and recently, through the sharing of the draft Mi'kmaq Impact Statement (Appendix K.2). Feedback was requested by August 14th, 2020. To date, no specific feedback on the suitability of these proposed mitigation measures has been received.

The Proponent's mitigation measures as described in Table 6.13-7 have been developed through ongoing discussions with the Mi'kmaq of Nova Scotia. Environmental monitoring and follow-up monitoring, as described in Section 6.13-9 will be conducted with Mi'kmaq participation, including in planning and executing wetland compensation, wildlife monitoring, and fisheries productivity offsetting projects.

Follow-up programs will be developed in engagement with the Mi'kmaq of Nova Scotia to verify the nature and extent of the effects on current use of lands and resources for traditional purposes, to determine the effectiveness of mitigation measures, and to ensure ongoing and adaptive management of any unanticipated outcomes. A pilot Emergency Response Mi'kmaq Communications Plan has been developed and implemented with Indigenous groups to ensure the Mi'kmaq of Nova Scotia are kept informed and are able to provide feedback on key issues related to the Project; and, to implement an emergency response protocol, in the unlikely event of an incident.

Table 6.13-7: Mitigation for Potential Effects on the Mi'kmaq of Nova Scotia

Project Phase	Mitigation Measures
EIS Review	Support Mi'kmaq third party review of the Proponent's EIS, including mitigation and monitoring programs.
EIS Review	Continuing to work with the Mi'kmaq to delineate the specificity of Mi'kmaq traditional use, and meet with the Mi'kmaq to receive feedback on EIS conclusions and impacts.
Pre-construction	Provide Mi'kmaq land users the opportunity to walk the FMS Study Area with Proponent representatives to identify and document sensitive sites prior to construction
Pre-construction	Provide a tour of the FMS Mine Site and information on Project operations to interested Mi'kmaq peoples.

Project Phase	Mitigation Measures
Pre-construction	Develop a Mi'kmaq Communication Plan with the Mi'kmaq of Nova Scotia that outlines an ongoing two-way communication process throughout the lifecycle of the Project.
Pre-construction	As part of the existing communications process, the Proponent will build upon and strengthen a Complaints Management and Action Program for Mi'kmaq input in advance of Project commencement, as an opportunity for having grievances heard and addressed, and development of an emergency communication protocol.
Pre-construction	Possible establishment of an environmental protection committee to review proposed and develop additional environmental mitigation protocols, oversee monitoring procedures and review/evaluate results. This committee should have representation from Proponent environmental experts, as well as Mi'kmaw representatives from Unama'ki Institute of Natural Resources, the Mi'kmaq Conservation Group, and NSE.
Construction	Designed bypass roads allow for travel routes to by-pass the FMS Mine Site and allow access to Seloam Lake and areas east of the Project.
Construction	In the event that Mi'kmaw archaeological features are encountered during construction or operation of the Project, all work in the area will be halted and immediate notification made to the Special Places Coordinator, Nova Scotia Museum, the KMKNO and the communities of Sipekne'katik and Millbrook. As part of the EMS, the Proponent will ensure mitigation measures are undertaken to prevent irreversible damage to Mi'kmaq archaeological resources and known burial site(s), including ensuring all Project activities are within the defined Project property boundaries only.
On-going	The Proponent would like to ensure there are various opportunities for Mi'kmaq participation in the Project, including opportunities to participate in environmental monitoring and implementation of Mi'kmaq projects such as fish habitat offsetting, wetland compensation, and others. The Proponent will continue to engage with the Mi'kmaq on various Project benefits.
On-going	Engage in open dialogue with affected communities relating to issues of limited Mi'kmaq access to the FMS Mine Site for the eleven year project window and discuss mitigation options including suitable alternative crown land access in close proximity to the FMS Mine Site.
On-going	Continue to engage with the Mi'kmaq of Nova Scotia to determine how they would like to participate and integrate traditional knowledge into the Reclamation and Closure Plan for the Project. The Proponent will also provide the opportunity for the Mi'kmaq to provide input on species used in revegetation, reclamation techniques, and the opportunity for Mi'kmaq members to join the reclamation team to execute this Project phase.
On-going	Commitment to developing and conducting a Mi'kmaq Cultural Awareness Program for staff and contractors. Scope to be determined based on further discussions.

6.13.7 Residual Effects and Significance

The predicted residual environmental effects of the Project on the Mi'kmaq of Nova Scotia are assessed to be adverse, but not significant following implementation of applicable mitigation measures (Table 6.13-8). Potential residual effects to the Mi'kmaq of Nova Scotia's physical health from Project-related changes to the environment (e.g., changes to country foods, water, and soils) are anticipated to be not significant. Potential pathways of effects on human health associated with consumption of or contact with country foods, water and soils will be minimized by implementing mitigation measures such as dust control, water management infrastructure and processes and water treatment (if required). Mitigation measures to reduce atmospheric emissions will be implemented to minimize potential related effects on human health, and the residual risk to human health from inhalation of Project-related dust and airborne contaminants is considered low.

Mitigation measures and conclusions relating to impacts to traditional practices and socio-economic and mental well-being will continue to be evaluated directly with the Mi'kmaq communities throughout the environmental assessment process, and throughout the lifecycle of the Project. Access to Seloam Lake and lands east of the Project via bypass roads, as well as the availability and suitability of nearby crown land as partial mitigation for loss of access during the eleven years that the mine will be limiting access to the FMS Mine Site area will also be discussed with the Mi'kmaq. Feedback on all summary of impacts and proposed mitigation measures has been requested and this dialogue will continue.

Table 6.13-8: Residual Effects of the Project on Mi'kmaq of Nova Scotia

Project - VC Interactions	Mitigation and Compensation Measures	Nature of Effect	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect
			Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility		
Construction - FMS Mine Site Direct effect on archaeological resources and burial site	Ensure no Project activities occur outside of PA, education and procedures in place as part of the EPP to halt work and notify the Mi'kmaq if archaeological deposits are encountered	A	N No interactions with known archaeological Mi'kmaq resources and burial sites are expected. Identified resources will be avoided	PA VC confined to the mine site	N/A This project interaction is not expected to be affected by timing	ST VC interaction will occur during construction phase	O VC interaction will occur once	IR VC remains at the end of the activity	None	Not Significant
Construction - FMS Mine Site Direct habitat loss, including wetlands, and loss of plants of significance to the Mi'kmaq	Minimize footprint as per Project design, implementation of mitigation and monitoring as per other VCs to minimize indirect effects, engagement and involvement of the Mi'kmaq throughout Project (including monitoring and compensation)	A	L Mitigation strategies and best management practices reduce the magnitude of impact	PA VC confined to the mine site	A timing is applicable and clearing and grubbing will be completed outside of the growing season wherever practicable	ST VC interaction will occur during construction phase	O VC interaction will occur once	PR VC remains at the end of the activity	Loss of plant specimens, habitat loss. Reclamation will restore some native plant species but not expected to return to baseline	Not Significant
Construction and Operations - FMS Mine Site Direct and indirect impacts to fish and fish habitat	Minimize footprint as per Project Design, erosion and sediment control to minimize impact, and water quality treatment, if required. Fisheries Act Authorization and Fish Habitat Offset Plan	A	L Mitigation strategies and best management practices reduce the magnitude of impact	PA/LAA Direct effect within PA, indirect effect within LAA	A Seasonality (spawning) windows applicable	MT VC interaction will occur during construction, operations and active reclamation	O/S Effects will be once from direct impacts, effects will be sporadic from indirect impacts	IR VC interactions are permanent	Habitat loss, change in water quality/quantity. Positive change in water quality due to historical tailings management	Not Significant
Construction and Operations - FMS Mine Site Indirect impacts to fauna- loss of habitat; noise and fragmentation	Minimize footprint as per Project Design, utilize existing roads wherever practicable, provision of bypass roads to maintain access	A	L Mitigation and best management strategies reduce magnitude of impact	PA/LAA Direct effect within PA, indirect effect within LAA	A Seasonality (breeding windows) applicable	MT VC interaction will occur during construction, operations and active reclamation	R effects will be regular from indirect impacts	PR Traffic will reduce on roads once operations cease	Habitat loss, potential changes in species movement patterns	Not Significant
Construction and Operations - FMS Mine Site Predicted noise and air potential interaction with traditional practices surrounding the Project	Utilize berms and other mitigation where required to reduce noise levels to minimize indirect impact to Mi'kmaq; share noise study results and involve Mi'kmaq in data collection Twice daily watering of mine site when dusty and use of chemical dust suppressants on main road to plant from pit, and plant to Highway 374 as required	A	L noise and dust levels predicted to be elevated above background but in compliance at the property boundaries	LAA Noise will potentially affect wildlife patterns in close proximity to the Mine (LAA)	N/A This project interaction is not expected to be affected by timing	MT VC interaction will occur during construction, operations and active reclamation (2-3 yrs) phases of the Project	R VC interaction will occur at regular intervals throughout the Project	R VC interaction will recover to baseline after Project activities are completed	Sensory Disturbance	Not Significant
Construction and Operations - FMS Mine Site Predicted Light levels and potential interaction with traditional practices surrounding the Project	Maintenance of forested canopy wherever practicable within the Project property boundaries. Limit unnecessary lighting at FMS Mine Site; utilization of potential green energy options	A	L Light levels are predicted to meet guidelines at residences. Elevated light levels above background will be present up to 2 km from the Mine	LAA light from the FMS Mine Site is predicted to extend into the LAA	A Timing is applicable as visual effect is adjusted based on foliage on trees	MT VC interaction will occur during construction, operations and active reclamation (2-3 yrs) phases of the Project	R VC interaction will occur at regular intervals throughout the Project	R VC interaction will recover to baseline after Project activities are completed	Sensory Disturbance	Not Significant

Project - VC Interactions	Mitigation and Compensation Measures	Nature of Effect	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect
			Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility		
Construction, Operations and Closure, FMS Mine Site Potential impact to human health from the Project	Implement mitigation and monitoring measures identified for each VC for the life of the Project as required	A	L Adverse health effects from dust exposure, the consumption of country foods harvested from the vicinity of the Mine Site, and recreational water use are not anticipated.	LAA This project interactions resulting in potential health effects extend into the LAA	N/A This project interaction is not expected to be affected by timing	MT VC interaction will occur during construction, operations and active reclamation (2-3 yrs) phases of the Project	R VC interaction will occur at regular intervals throughout the Project	R VC interaction will recover to baseline after Project activities are completed	Human Health	Not Significant
Construction, Operations and Closure, FMS Mine Site Potential impact to the economic, social and mental well being of the Mi'kmaq of Nova Scotia from the Project	Continue discussions with the Mi'kmaq to determine appropriate mitigation and compensation requirements, where appropriate. Potentially suitable alternative large tracts of Crown land are available surrounding the FMS Mine Site Mi'kmaq participation in monitoring programs and development of Reclamation and Closure Plan for the Project	A and P	L	LAA	A	MT VC interaction will occur during construction, operations and active reclamation (2-3 yrs) phases of the Project	C	PR	Change in economic, social and mental well being of the Mi'kmaq of Nova Scotia	Not Significant
Construction, Operations and Closure - FMS Mine Site Restriction and loss of access for traditional practice during construction, operations and active reclamation of the Mine	Continue discussions with the Mi'kmaq to determine appropriate mitigation and compensation requirements, where appropriate. Potentially suitable alternative large tracts of crown land are available surrounding the FMS Mine Site	A	L Mitigation strategies and best management practices reduce the magnitude of impact	LAA Access restriction is confined to PA; hunting effects may be felt within LAA due to sensory disturbance and/or firearm restrictions	N/A This project interaction is not expected to be affected by timing	MT VC interaction will occur during construction, operations and active reclamation (2-3 yrs) phases of the Project	R VC interaction will occur regularly	R VC returns to baseline conditions at the end of the activity	Loss of Access	Not Significant
Construction, Operations and Closure - FMS Mine Site Development of Project	Continue confidential discussions with the Mi'kmaq of Nova Scotia (parallel to the federal environmental assessment) to identify employment, community and economic benefits	P	L Considerable and tangible opportunities for Mi'kmaq communities	RAA Opportunities can be considered across the RAA	N/A This project interaction is not expected to be affected by timing	MT to LT Opportunities will extend past operational period into reclamation and post closure.	C There are continuous opportunities throughout all project phases.	R VC returns to baseline conditions at the end of the activity	Benefits to the Mi'kmaq of Nova Scotia	Not Significant

Legend (refer to Table 5.10-1 for definitions)- definitions provided below (where different) supercede those provided in Section 5

Nature of Effect	Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility
A Adverse	N Negligible	PA Project Area	N/A Not Applicable	ST Short-Term	O Once	R Reversible
P Positive	L Low	LAA Local Assessment Area	A Applicable	MT Medium-Term (2-20 years)	S Sporadic	IR Irreversible
	M Moderate	RAA Regional Assessment Area		LT Long-Term (> 20 years)	R Regular	PR Partially Reversible
	H High			P Permanent	C Continuous	

A significant adverse environmental effect for the Mi'kmaq of Nova Scotia has not been predicted for the Project for the following reasons, with consideration of the ecological and social context of the LAA surrounding the Project:

During Construction:

- Direct impacts to terrestrial habitat, flora and fish habitat will be minimized through on-going Project design and micro-sighting of infrastructure footprints where practicable.
- Construction work and methods will be considerate of fish spawning timing windows and the breeding bird season.
- Construction noise and light will be limited and temporary in nature with an approximate 12 month duration.
- The Seloam Brook Realignment offers an opportunity to improve fish habitat given baseline condition of Seloam Brook due to historical mining practices (ditching/straightening of waterways) and presence of historical tailings and waste rock.
- Changes to access for the Mi'kmaq of Nova Scotia to the FMS Mine Site will be evaluated through on-going dialogue between individual Mi'kmaq communities and the Proponent as part of broader impact benefits and compensation discussions. Bypass access routes have been planned to allow access to Seloam Lake and areas east of the FMS Mine Site. There are limited development pressures in the area surrounding the FMS Mine Site and available expected alternative suitable areas for the continuation of traditional practices (large tracts of Crown land).

During Operations:

- Noise and air concentrations will be elevated above regulatory criteria only within the proposed property boundaries, and elevated above background near the Mine during this period. The likelihood of mobile receptors being regularly in close proximity to noise generation sites is low. Noise is predicted at levels consistent with the most conservative overnight wildlife guidance within 1-1.5 km of the property boundaries.
- It is considered unlikely that ore dust deposition from the FMS Mine Site at the rates considered in this assessment would result in levels of metals in country foods, soils and dust that would be harmful to human health, based on the risk assessment conducted. Adverse health effects from soil and dust exposure, the consumption of country foods harvested from the vicinity of the FMS Mine Site, and recreational water use (i.e., swimming) are not anticipated.
- Changes to access for the Mi'kmaq of Nova Scotia will be evaluated through on-going dialogue between individual Mi'kmaq communities and the Proponent as part of broader impact benefits and compensation discussions. There are limited development pressures in the area surrounding the FMS Mine Site and available expected alternative suitable areas for the continuation of traditional practices (large tracts of Crown land).

During Closure:

- Noise will be elevated above baseline during reclamation activities (2-3 years) involving mobile equipment and then drop to baseline for the post-closure period. During post-closure, water treatment, if required, and associated monitoring will be on-going, and the pit will be filling with water. However, Mi'kmaq access to the site can be restored during this stage of the Closure Phase.
- Changes to access for the Mi'kmaq of Nova Scotia will be evaluated through on-going dialogue between individual Mi'kmaq communities and the Proponent as part of broader impact benefits and compensation discussions. There are limited development pressures in the area surrounding the FMS Mine Site and available expected alternative suitable areas for the continuation of traditional practices (large tracts of Crown land).

6.13.8 Proposed Compliance and Effects Monitoring Program

The Proponent commits to Mi'kmaq participation in community-based monitoring programs and development of the Reclamation and Closure Plan. As the Project moves forward, discussions will continue with the Mi'kmaq of Nova Scotia regarding participation in the development, implementation and evaluation of proposed compliance and effects monitoring programs. These could include monitoring programs such as:

- Wetland Monitoring;
- Wildlife Monitoring, including Moose; and
- Other monitoring programs such for air, surface water, groundwater, and noise.

In addition, the Proponent will hold periodic meetings with the Mi'kmaq of Nova Scotia, including Millbrook and Sipekne'katik First Nations, to review overall environmental compliance and effects monitoring programs associated with other VCs, and provide data and results of monitoring programs. On-going dialogue will continue with the Mi'kmaq of Nova Scotia regarding participation in, and implementation of, monitoring programs for the Project.

The effects monitoring program will verify the effectiveness of mitigation measures associated with minimizing any potential effects to human health from consumption of or contact with country foods, water and soils, and results will be shared with local Indigenous groups.

6.14 Physical and Cultural Heritage

6.14.1 Rationale for Valued Component Selection

Physical and cultural heritage are provincially regulated through the *Special Places Act*, which supports the preservation, regulation, and study of archeological, historical, and paleontological sites and artifacts deemed to be important parts of Nova Scotia's natural or cultural heritage. The areas of historical importance for post-contact land use and recreational value are important considerations for the Project development.

6.14.2 Baseline Program Methodology

6.14.2.1 FMS Study Area Baseline Program Methodology

In 2008, Cultural Resource Management Group (CRM Group), undertook an archeological screening and reconnaissance program at the FMS Study Area of behalf of Acadian Mining. At that time, a surface mine was in early stage planning with the exact configuration of the mine complex unknown.

In 2018, CRM Group was retained on behalf of the Proponent to conduct archeological screening and reconnaissance at the FMS Study Area using the 2018 site development plan. Building upon the research and reconnaissance undertaken on the property in 2008, CRM Group revisited several of the sites previously noted, as well as identified other features of archeological potential (Stanley crusher and areas of elevated archeological potential). As part of the 2018 archeological assessment, an archeological screening was completed prior to site reconnaissance. CRM Group reviewed documents available through the Nova Scotia archives, the Nova Scotia Land Information Centre, the Department of Natural Resources, the Nova Scotia Registry of Deeds, and the Nova Scotia Museum. The screening included a review of previous archeological reports, land grants records, legal survey, historical maps, local and regional histories, topography maps, aerial photos and satellite, LiDAR and bathymetric data. Additionally, CRM Group contacted the KMKNO's Archeological Research Division and Millbrook and Sipekne'katik First Nations for information on potential traditional or historic Mi'kmaw use of the area. In 2019, CRM Group completed additional screening and site reconnaissance to support the EIS in the western and eastern portions of the FMS Study Area (transmission line and the eastern by-pass road).

The 2008, 2018, and 2019 archeological screening and reconnaissance for the FMS Study Area consisted of visual inspection of the ground surface and did not involve sub surface testing. The archeological reports are included in Appendix A.1 to A.3

6.14.2.2 Touquoy Baseline Program Methodology

The Touquoy Mine Site was previously subjected to archeological reconnaissance in November 2006. No additional disturbances are anticipated at the Touquoy Mine Site as a result of the Project and therefore no additional work was completed to support the preparation of the EIS.

The archeological reports are included in Appendix A.1 to A.3

6.14.3 Baseline Conditions

6.14.3.1 Regional Baseline Conditions

The 2008, 2018 and 2019 archeological screenings completed at the FMS Study Area identified that the surrounding lands were historically part of the greater Mi'kmaw territory known as Eskikewa'kik, meaning 'skin dressers territory'. The surrounding area contains many lakes and watercourses that would serve as important transportation corridors and resource base for the Mi'kmaw and their ancestors prior to the arrival of European settlers.

Euro-Canadian settlement in the area began in the early nineteenth century at what would become the community of Trafalgar. Development began with the establishment of a sawmill, post office and hotel, followed by increased development in the mid-to late nineteenth century as mining activities increased in the current FMS Study Area.

The FMS Study Area comprises the eastern two thirds of the historic Fifteen Mile Stream Gold District and can be characterized as unpopulated, gently undulating and forested with low swampy areas.

6.14.3.2 FMS Study Area Baseline Conditions

The Maritime Archeological Resource Inventory does not identify any registered archeological sites within the FMS Study Area. However, the lack of archeological data may represent a lack of archeological investigation and not an absence of archeological sites. The FMS Study Area was historically developed for industrial use and associated settlement during the mid-1800s.

Archeological screening conducted in 2018 identified that, based on the environmental setting and the Mi'kmaq of Nova Scotia land use, as well as the long history of industrial use and settlement, the FMS Study Area exhibits an elevated potential for encountering historic Pre-contact and historic Mi'kmaw archeological resources and elevated potential for encountering historic Euro-Canadian archeological resources.

Based on the field reconnaissance completed as part of the 2008, 2018 and 2019 archeological assessments, seven Euro-Canadian historic sites (Sites 1-7) and three small areas (Areas 1, 2 and 3) of archeological potential for encountering Mi'kmaw archeological resources were identified. Details on Sites 1-7 and Areas 1, 2 and 3 are provided in Table 6.14-1 and all are presented in Figure 6.14-1 with the exception of Area 3.

Table 6.14-1: Details of Archeological Resources Identified during 2008, 2018, and 2019 Field Reconnaissance at the FMS Study Area

Site ID	Site Description
Site 1	A moss-covered log sill foundation observed during field reconnaissance was identified as being the remnants of a nineteenth century school house based on historical mapping.
Site 2	A moss-covered log sill foundation and a small assortment of early twentieth century artifacts were observed during field reconnaissance but were unable to be identified through the review of available historical documentation.
Site 3	A moss-covered log sill foundation and a small assortment of early twentieth century artifacts were observed during field reconnaissance but were unable to be identified through the review of available historical documentation.
Site 4	A partially infilled cellar hole and a small assortment of early twentieth century artifacts were observed during field reconnaissance but were unable to be identified through the review of available historical documentation.
Site 5	Building demolition rubble and partially infilled cellar hole observed during field reconnaissance were identified as the remnants of the New Egerton Gold Mining Company office based on historic mapping.
Site 6	An artificially levelled and cleared area observed during field reconnaissance was identified as the New Egerton Gold Mining Company store based on historical mapping.
Site 7	Multiple components encompassing an historic road, standing masonry, wooden crib work with iron components and a wooden channel observed during field reconnaissance were identified as the remnants of the Stanley Crusher based on historic documentation and mapping.

Site ID	Site Description
Area 1	A flat, dry plateau bordering Anti-Dam Flowage. Area 1 was classified as having low potential for Mi'kmaw archeological resources upon review of satellite imagery and bathymetric data for the Anti-Dam Flowage.
Area 2	An area of relatively high and level terrain in close proximity to Seloam Lake. Area 2 was classified as having elevated potential for Mi'kmaw archeological resources.
Area 3	A small flat dry area in close proximity to Glassy Lake. Area 3 was classified as having elevated potential for Mi'kmaw archeological resources. Area 3 was determined after the assessment completed by CRM Group to not be within the current FMS Study Area and therefore is not further referenced in this assessment.

CRM Group recommended that Sites 1-7 be subject to intensified historical review, detailed documentation and shovel testing if any of them fell within areas of future development. CRM Group also recommended that if Area 2 is impacted by the Project, it should be subject to a shovel testing program. Given the low archeological potential classification of Area 1 CRM Group did not recommend additional measures be taken if impacted by the Project.

6.14.3.3 Touquoy Mine Site Baseline Conditions

The Touquoy Mine Site was previously subjected to archeological reconnaissance in November 2006. An archeological screening was conducted by CRM group to evaluate the archeological potential within the Touquoy Gold Project development limits. The results of the study indicated that there is a low archeological potential ascribed to the area. No additional disturbances are anticipated at the Touquoy Mine Site as a result of the Project and thus, no additional evaluation is presented in this section relating to the Touquoy Mine Site.

6.14.4 Consideration of Engagement and Engagement Results

Issues raised during public and Mi'kmaq engagement relating to physical and cultural heritage include potential disturbance of pre and post-European contact archeological resources.

The results of the public and Mi'kmaw engagement have been considered in the environmental effects assessment, including the Proponent's commitments on mitigation and monitoring measures and proposed compliance and effects monitoring programs, as well as the Proponent's broader commitment to ongoing public and Mi'kmaq engagement.

6.14.5 Effects Assessment Methodology

6.14.5.1 Boundaries

6.14.5.1.1 *Spatial Boundaries*

The spatial boundaries used in the assessment of physical and cultural heritage is the PA. The PA encompasses two primary components from Trafalgar to Moose River Gold Mines, Halifax County, NS. The primary component is the FMS Study Area which will be located east of Highway 374 near Seloam Lake, and the second component is the Moose River Gold Mines, where the Touquoy Mine Site [processing and exhausted pit (to be used to dispose FMS concentrate tailings)] is located. For the purposes of this section, only the FMS Mine Site portion of the PA is evaluated for effects assessment.

The LAA for physical and cultural heritage is determined to be a 1.5 km buffer surrounding the FMS Study Area.

The RAA for physical and cultural heritage is determined to be a 5 km buffer surrounding the FMS Study Area.

As the loss or destruction of heritage or archeological resources could occur only within the disturbed footprint of the Project, the PA (FMS Mine Site portion only) is the most appropriate spatial boundary for this assessment. No additional physical disturbance is required at the Touquoy Mine Site for the Project and thus, as mentioned, the Touquoy Mine Site is not carried forward for effects assessment for this VC. The spatial boundaries for physical and cultural heritage are provided in Figure 6.14-2.

6.14.5.1.2 *Temporal Boundaries*

The temporal boundaries used for the assessment of effects to physical and cultural heritage are limited to the construction phase of the Project. Construction is estimated to take approximately one year.

6.14.5.1.3 *Technical Boundaries*

No technical boundaries were identified for the effects assessment of physical and cultural heritage.

6.14.5.1.4 *Administrative Boundaries*

Physical and cultural heritage are provincially regulated through the *Special Places Act*. In order to conduct any archeological work, a Heritage Research Permit must be issued by the Minister of the Department of Communities, Culture, and Heritage.

6.14.5.2 Thresholds for Determination of Significance

A significant adverse effect is an uncontrolled (without appropriate study, analysis and mitigation measures in conjunction with the Province and Mi'kmaq archaeologists as required) disturbance to, or destruction of, any unassessed historical or cultural resource of importance in context of the *Special Places Act*. The assessment of historical or cultural features is considered complete when the feature has undergone intensified historical research involving archeological shovel testing, where required, surveyed plans, photography and videography.

For physical and cultural heritage, the following logic was applied to assess the magnitude of a predicted change in baseline documented conditions at the FMS Mine Site:

- Negligible – no direct or indirect impacts are expected to identify archaeological features .
- Low – impacts are expected to historical mining feature(s) only, with consideration of all mitigation and in consultation with appropriate regulatory and Mi'kmaq agencies. No direct or indirect impacts to Mi'kmaq archaeological features are expected.
- Moderate – direct impacts to Mi'kmaq and/or other archaeological features are expected, with consideration of all mitigation and in consultation with appropriate regulatory and Mi'kmaq agencies.
- High – direct impacts to Mi'kmaq and other archaeological features are expected, without consideration of all mitigation and without consultation with appropriate regulatory and Mi'kmaq agencies.

6.14.6 Project Activities and Physical and Cultural Heritage Interactions and Effects

Potential interactions between Project activities and physical and cultural heritage resources are outlined in Table 6.14-2 below.

Table 6.14-2: Potential Interactions with Project Activities and Physical and Cultural Heritage in the FMS Study Area

Project Phase	Duration	Relevant Project Activity
Site Preparation and Construction Phase	1 year	• Clearing, grubbing, and grading • Drilling and rock blasting • Topsoil, till and waste rock management • Watercourse and wetland alteration • Seloam Brook Realignment construction and dewatering • Mine site road construction, including lighting • Surface infrastructure installation and construction, including lighting • Collection and settling pond construction, including lighting • Local traffic by-pass road construction • Culvert and bridge upgrades and construction

6.14.6.1 FMS Study Area

A review of identified archeological feature locations and the current configuration of the Project infrastructure was completed with the following results:

- Sites 5 and 6 are centrally located within the proposed FMS pit and will be lost during the construction phase to support pit development and access to the mineral resource;
- The western by-pass road will be micro-sited through Site 7 to avoid the majority of the cultural features it contains except for an unavoidable section of an historic road;
- Sites 1-4 are located directly adjacent to the proposed pit and within or adjacent to defined historical tailings and/or waste rock, as well as within the footprint of proposed road infrastructure to support the pit development. These features will be lost during the construction phase to support pit development and access to the mineral resource;
- Area 1 has been classified by CRM Group as having low archeological potential and as such infrastructure in this area does not have any significant impacts predicted to occur; and
- No interaction of Project activities is anticipated at Area 2.

There is no potential for the disturbance of known cultural or physical heritage resources during the operational and reclamation phases of the Project based on studies to date.

There are no known federal decisions that could affect physical and cultural heritage in the PA, or that could affect structures, sites, or items of historical, archeological, paleontological, or architectural significance of non-Indigenous Peoples.

6.14.7 Mitigation

The areas included in the 2008, 2018, and 2019 archeological assessments were cleared of any requirement for further archeological investigation. Based on the 2008, 2018 and 2019 archeological assessments, the following mitigation activities were recommended by CRM Group and are in the process of being accepted by NSCCH.

- It is recommended that any further changes in the layout of the mine and associated facilities are evaluated as to the potential impacts to archeological resources.
- It is recommended that areas of potential archeological significance (Sites 1-7) be avoided if practicable, in the design and development of the Project.
- It is recommended that areas of proposed impact (Sites 1-6 and a portion of Site 7) undergo intensified historical research, archeological shovel testing, where required, and detailed documentation in advance of disturbance.
- It is recommended that if the area of elevated archeological potential (Area 2) is to be impacted by future development, a program of archeological shovel testing should be conducted in advance of disturbance.
- It is recommended that if archeological deposits or human remains are encountered during construction activities associated with the Project, all work in the immediate vicinity should be halted and the Special Places Program contacted.

Mitigation measures for the FMS Study Area are described in Table 6.14-3 and will be implemented by the Proponent.

Table 6.14-3: Mitigation for Physical and Cultural Heritage

Project Phase	Mitigation Measures
C	Any further changes in the layout of the mine and associated facilities will be evaluated as to the potential impacts to archeological resources.
C	Areas of potential archeological significance (Area 2) will be avoided, in the design and development of the Project.
C	Intensified historical research, archeological shovel testing, where required, and detailed documentation will be conducted in advance of disturbance at Sites 1-6 and the historical road associated with Site 7.
C	If the area of elevated archeological potential (Area 2) is to be impacted by future development, a program of archeological shovel testing will be conducted in advance of disturbance to allow for micro-siting of infrastructure.
C	If archeological deposits or human remains are encountered during construction activities associated with the Project, all work in the immediate vicinity will be halted and the Special Places Program will be contacted.
O, CL	N/A

Note: C = Construction Phase, O = Operation Phase, CL = Closure Phase.

6.14.8 Residual Effects and Significance

The predicted residual environmental effects of the Project development and production on physical or cultural heritage resources are assessed to be adverse, but not significant. The overall residual effect of the Project on physical or cultural heritage resources is assessed as not significant after mitigation measures have been implemented and are surmised in Table 6.14-4.

Table 6.14-4: Residual Environmental Effects for Physical and Cultural Heritage.

Project VC Interactions	Mitigation and Compensation Measures	Nature of Effect	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect
			Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility		
Construction – FMS Mine Site (identification and/or damage to physical and cultural heritage resources – Sites 1-6 and the historic road associated with Site 7)	Evaluate changes to layout for potential impacts to archeological resources Complete intensified historical research, shovel pit testing, where required, and detailed documentation at archeological features prior to disturbance cause by Project activities, in conjunction with Mi'kmaq agencies as required Contact the Special Places Program, Nova Scotia Communities, Culture & Heritage Department if human remains or archeological deposits are identified	A	L Sites 1-6 will be lost due to project activities Impacts to Site 7 will be minimized through micro-siting but a portion of a historic road is unavoidable	PA Potential to encounter archeological deposits confined to the PA	N/A	P Effects are permanent	O Effects will occur once within the life of the Project	IR VC will not return to baseline conditions	Loss of resource	Not significant

Legend (refer to Table 5.10-1 for definitions)

Nature of Effect	Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility
A - Adverse	N – Negligible	PA – Project Area	N/A - Not Applicable	ST – Short Term	O – Once	R – Reversible
P - Positive	L – Low	LAA – Local Assessment Area	A - Applicable	MT – Medium Term	S – Sporadic	IR – Irreversible
	M – Moderate	RAA – Regional Assessment Area		LT – Long Term	R – Regular	PR – Partially Reversible
	H - High			P - Permanent	C- Continuous	

A significant adverse environmental effect for physical and cultural heritage has not been predicted for the Project for the following reasons, with consideration of the ecological and social context within the PA of the Project:

- During Construction: The following four conclusions have been made:
  - No impacts to Area 2 are anticipated based on the proposed development of the Project;
  - Area 1 will be disturbed by Project activities, but has been classified as area of low archeological potential upon review of topographic and bathymetric data surrounding Anti Dam Flowage;
  - Although the loss of Sites 1- 6 is anticipated, appropriate mitigation and evaluation will be completed prior to construction at these locations, and these features are historical mining features only; and
  - Although disturbance to Site 7 will occur, it is limited to a single feature (the historical road) and appropriate mitigation and evaluation will be completed prior to construction.
- During Operations and Closure: No impacts are expected.

6.14.9 Proposed Compliance and Effects Monitoring Program

As noted above, there is no requirement for a compliance or effects monitoring program related to physical and cultural heritage

Proposed follow-up and monitoring programs have been reviewed with the Mi'kmaq of Nova Scotia during engagement efforts including meetings, sharing of technical documents (Draft EIS, poster boards, Summary of Mi'kmaq Effects and Proposed Mitigation Measures, Plain Language Summary). On-going engagement with the Mi'kmaq will continue through the EA process and associated permitting relating to follow-up programs and monitoring.

6.15 Socio-economic Conditions

6.15.1 Rationale for Valued Component Selection

Socio-economic factors can be defined as relating to or concerned with the interaction of social and economic factors, with the FMS EIS Guidelines specifically referencing that the analysis should "recognize interrelationships, system functions and vulnerabilities" (CEAA, 2018).

The Project will generate employment and economic activity during all Project phases and has the potential to attract new residents to the broader area. During construction and operation there will be significant labour force needs to support the Project's activities. Additionally, with the number of jobs projected at the FMS Mine Site, there will be increased traffic to and from the mine site from both the staff and visitors, and from trucks that will transport materials to the Touquoy Mine Site. Indirect employment will be generated by the Project by external contractors and suppliers.

Tax revenues and royalties will be generated by the Project that will benefit all levels of government: federal, provincial and municipal. Increased economic activity by suppliers and external contractors will contribute to government coffers but also impact the local business economy.

The increased economic activity has the potential to impact adjacent communities by attracting new residents, creating demand for housing, traffic, creating opportunities for social conflict, increased usage of public infrastructure such as health facilities, recreation facilities and other social services.

6.15.2 Baseline Program Methodology

The analysis for this section uses data from a KPMG report titled "Economic Impact Assessment of the Fifteen Mile Stream Mining Project" from March 2019 (Appendix E.1). This report uses financial data provided to KPMG to present static economic impacts that "measure the cascading effects that are produced by an injection of cash in a given territory." The KPMG report uses Statistics Canada Input-Output (I-O) model.

The analysis also is influenced by the work of Mancini and Serenella (2018) in their article "Social impact assessment in the mining sector: Review and Comparison of indictor frameworks" which conducts a literature review and identifies a list of typical social impacts in the mining sector, both positive and negative.

Additional data sources for this information came from a variety of online sources, published reports, primary data collection and observations that were then synthesized and summarized. Using professional judgement and experience, determinations were made regarding the characterization of residual effects.

6.15.3 Baseline Conditions

6.15.3.1 Regional Baseline Conditions

6.15.3.1.1 *Nova Scotia Outlook*

As the <u>*Now or Never Report: An Urgent Call to Action*</u> stated, Nova Scotia is today in the early stages of what may be a prolonged period of accelerating population loss and economic decline" (OneNovaScotia 2014). Nova Scotia's economy is typified by slow growth, averaging 1.8% between 1981 and 2016. It historically has been highly dependent on government spending, as a proportion of the GDP.

Since the Now or Never Report, the Province of Nova Scotia has put emphasis on several goals to create change. These include promoting interprovincial migration, increasing labour force participation and encouraging business start ups. Since mid-2014 Nova Scotia has seen a decrease in outmigration and between 2016 and 2017, saw a net grain of 314 people from other provinces (OneNovaScotia 2014). The Now or Never Report recommended a goal of creating a net gain of 1,000 working age people per year.

Nova Scotia has a somewhat lower than average of high-growth firms and has set a goal of having 465 business start ups a year. Since 2014, this goal has not been met. Another indicator of economic health is labour force participation. In 2017 Nova Scotia's is lower than the national average and has fallen since 2012, likely due to the aging population (OneNovaScotia 2019).

6.15.3.1.2 *The local context and population*

The Project is in a largely unpopulated area within rural Halifax Regional Municipality. The closest population centre to the FMS Mine Site is Sheet Harbour. For the purposes of this study, the rural eastern portion of Halifax Municipality will serve as a boundary (see Section 6.15.5.1 where spatial boundaries are discussed) this is used for other administrative purposes by the local municipal unit and agencies. The Eastern Rural area is a sub-area within the Census Metropolitan Area (CMA) and is composed of a number of census track areas. The Great Halifax Partnership collated and analyzed this data in "Halifax Community Profile: Eastern Rural."

The population of Eastern Rural HRM is 18,189 people as of the 2016 Census, which is a reduction of 1.7% in population since the 2011 Census (Table 6.15-1). This is consistent with recent historical trends (Greater Halifax Partnership, 2017).

Table 6.15-1: Population Trends Eastern HRM

Spending Category	Nova Scotia	Halifax CMA	Eastern Rural
Population, 2016	923,598	403,390	19,189
Population, 2011	921,727	390,328	19,528
Growth, 2011 to 2016	0.2%	3.3%	-1.7%
Annualized Growth, 2011 to 2016	0.0%	0.7%	-0.3

Compared to a population increase of 3.3% for HRM and 0.2% for Nova Scotia as a whole, the Eastern Shore is experiencing population decline. In general, the Eastern Shore has lower percentages of its population in the youth and working age categories and high percentage in the senior categories (Halifax Partnership 2018).

The labour force in the Eastern Rural declined between 2011 to 2016 and labour force participation fell from 62.1% to 60.7%. This is substantially below the 67% labour force participation rate for Halifax CMA. The trades and transport occupation, along with sales and services group, are the two largest occupation groups (Halifax Partnership 2018).

6.15.3.1.3 *Community Infrastructure*

The FMS Project is located 31 km from Sheet Harbour. Sheet Harbour is a community of about 800 people but the Sheet Harbour Chamber of Commerce states that the catchment for the area is approximately 5000 people (Sheet Harbour Commerce 2019 a).The Port of Sheet Harbour, upgraded in 1988, is the second largest port facility in the HRM and includes an Industrial Park as well as a 500-foot Common User Dock. The 129-acre Industrial Park is marketed as a location for manufacturing, processing and transportation facilities and has additional development potential (Sheet Harbour Commerce 2019b).

Sheet Harbour is a local commercial centre that provides many amenities for the surrounding areas, including:

- Eastern Shore Memorial Hospital;
- Sheet Harbour Branch of the Halifax Public Library System;
- Duncan MacMillan High School, which is currently being replaced by a new P-12 School. The school population is approximately 249 students (Halifax Regional Centre for Education 2020);
- Royal Canadian Legion Branch 58;
- Halifax Recreation Facilities;
- Habourview Lodge Continuing Care Centre;
- LEA Place Women's Resource Centre;
- Living Water Baptist Church;
- MUSGO Rider Cooperative Ltd – Rural Transportation Association;
- Sheet Harbour & Area Chamber of Commerce;
- Sheet Harbour & Area Ground Search and Rescue;
- Sheet Harbour Marina;
- Sheet Harbour Radio;
- Sheet Harbour Wildlife Association; and
- Gerald Hardy Memorial Society -Food Bank.

The local school for Sheet Harbour is Duncan MacMillan High School, which is being replaced with a new P-12 school, slated for opening in January 2020. This will be a new modern school, designed to the standards of the Halifax Regional Centre for Education (HRCE). General population growth caused by the Project has the potential to increase the school age population, which has been in decline in the Eastern Shore area, resulting in closing of schools in the general area.

The closest hospital for the FMS Mine Site is the Eastern Shore Memorial Hospital (ESMH), which has a 24-hour emergency department, a variety of clinics and services, and hospital beds. The emergency department at the ESMH experiences frequent closures due to staff shortages. As of March 1, 2019, the Nova Scotia Health Authority estimates that 5.0% of the population in the Central Zone (HRM, Eastern Shore and West Hants areas) is without a family doctor (Nova Scotia Health Authority 2019)

6.15.3.1.4 *Local Economy*

As of December 2017, Statistics Canada reported 613 businesses located in the Eastern Rural area of HRM. Most have fewer than five employees and 88% have less than 20. There are nine with over 100 employees, with three in transportation and warehousing, two in mining, quarry and oil and gas extraction, one in manufacturing, one in wholesale trade, retail trade and accommodation and food services. The Touquoy Mine would be one of the nine businesses with over 100 employees. Sheet Harbour also is the home to of a variety of commercial amenities such as overnight accommodations, Nova Scotia Liquor Commission (NSLC), drugstore, grocery store, gas stations, hardware store, banks and credit unions.

Coastal areas along the Eastern Shore are being promoted as an eco-tourism destination due to its topography, coastal access and views and its natural beauty. The Wild Islands Tourism Advancement Partnership (WITAP) mission is, "to position and advance Musquodoboit Harbour to Sherbrooke as a dynamic new in-demand destination offering the best designed touring, outdoor and nature infrastructure and experiences in Nova Scotia" (WITAP 2019). The Eastern Shore is an Area of Interest as a Marine Protected Area by Fisheries and Oceans Canada. This focus of having tourism as an economic development driver is reinforced in the Eastern HRM Strategic Plan prepared in 2014.

The Eastern Shore has lower total household incomes then both the Nova Scotia average and the broader HRM region. Approximately one-sixth of all income received is from government transfers, versus one-tenth for Halifax. This is again likely due to the number of seniors who received payments such as Old Age Security or the Guaranteed Income Supplement (Halifax Partnership 2018).

6.15.3.1.5 *Traffic*

The Nova Scotia Department of Transportation and Infrastructure Renewal most recent traffic counts for the area surrounding the FMS Mine Site shows the following (NS Department of Transportation and Infrastructure Renewal 2017):

- Along Trunk 7 east of Route 224 the Average Daily Traffic count in 2017 was 2887 vehicles. The Annual Average Daily Traffic count is 2440 vehicles. The difference between the two numbers is likely the result of increased seasonal traffic. The traffic counts for 2017 are generally consistent with traffic counts in the same location from previous years, dating back to 2009.
- On Hwy 374 approximately 2 km north of Trunk 7, the traffic counts prepared by NSTIR in 2017 show an Average Daily Traffic count of 392 vehicles and an Annual Average Daily Traffic of 350 vehicles. The traffic counts for 2017 are consistent with previous years counts prepared by NSTIR dating back to 2009.

The closest community to the Project is Malay Falls, located approximately 23 km south of the Project. This is very small collection of homes. Although there is no census data to confirm population, this community has less than 20 homes according to Google Maps.

6.15.3.1.6 *Housing*

Within the 10 km of the FMS Mine site there are three seasonal dwellings (Figure 2.1-2). The two closest structures are 4.9 km and 8.7 km from the PA and, based on a review of satellite imagery, are seasonal dwellings or camps. Civic 8411 is located 8.7 km away and has been confirmed by the owner that it is a seasonal dwelling with a dug well and is off grid (Bruce Crowell, personal communication, April 2018).

Housing more generally within the Eastern Rural HRM area is characterized by residency in single detached houses, with an average household size of 2.3 ppd (people per dwelling) (Halifax Partnership 2018). The housing suitability and condition data indicates that approximately 10% (compared to 7% in HRM as a whole) of homes need major repairs, indicating that housing stock in the area is in generally good repair. As of February 26th, there were approximately 35 residential dwellings available for sale and no rental units listed on MLS. This indicates that there is not significant availability of homes for rent or purchase. The area is typified by large parcels of vacant land.

6.15.3.1.7 *Public Safety*

The Eastern Shore area of HRM is serviced by the Royal Canadian Mounted Police, based in Sheet Harbour. It provides services such as criminal records checks, non- emergency complaints, outside detachment emergency phone, general information, reporting a crime, fingerprints and police certificates. It is open Monday to Friday, 8 am to 4 pm. No recent crime statistics are available for the Sheet Harbour area. There are also RCMP detachments in Musquodoboit Harbour and Middle Musquodoboit.

Fire Station 28 in Sheet Harbour is a composite fire service (containing both professional and volunteer fire fighters). Fire Station 39 located in Upper Musquodoboit is a volunteer fire department which provides service to the rural parts of HRM as does the composite Fire Station 38 in Middle Musquodoboit. Other volunteer fires stations are located in Three Harbours, Mushaboom and Tangiers.

6.15.3.1.8 *Recreation and Tourism*

The Eastern Shore promotes itself as a tourism destination, as does Nova Scotia as a whole. Nova Scotia saw an increase of 8% in visitors in 2018, however the room night accommodations indicate that the Eastern Shore saw no growth in 2018 and had the lowest number of licensed room nights sold of any region in Nova Scotia (Tourism Nova Scotia 2019).

WITAP is actively promoting the Eastern Shore as an ecotourism destination and is conducting research on the area. Destination Eastern and Northumberland Shores is a non-profit organization focused on facilitating, sustainable and economic tourism growth through marketing, communication and education in partnership with community stakeholders. Sheet Harbour has limited tourism amenities but does have the MacPhee House Community Museum, that interprets the history of Sheet Harbour and also showcases local artworks.

There are many recreational amenities within the RAA. Those located closest to the FMS Mine Site include a freshwater beach in Malay Falls operated by HRM, a skate park, playgrounds, and church and organization halls, Taylor's Head Beach (47 km away), is a provincial park which includes hiking trails, scenic look-offs, picnic areas and boardwalks. Sprybay Lighthouse and Trails, located in proximity to Taylor's Head Beach, also offers trails and other active recreational activities.

The Halifax Public Library branch in Sheet Harbour, as of March 19th, 2019, is open approximately 25 hours a week and offers book lending, community rooms and programming. In the same building, HRM also has a gym facility for use.

There are active outdoor recreational groups in the area such at the Sheet Harbour ATV Club and the Sheet Harbour Wildlife Association, both of which make use of the surrounding forested areas for recreational use. Recreation usage is more fully described in Section 6.15.3.2.3

6.15.3.1.9 *First Nations Communities*

The closest Mi'kmaq community is the Sheet Harbour IR, located within the community of Sheet Harbour. The Beaver Lake IR is located on Hwy 224. Both these communities are approximately 25 km from the FMS Study Area.

6.15.3.2 Land and Resource Use

6.15.3.2.1 *Existing Land Use*

The Project is located in the HRM, 31 km northwest of Sheet Harbour. The surrounding area is undeveloped and is used primarily for forestry and recreational purposes. The FMS Study Area is accessed by a private road that is also used to access other private resource roads that forestry companies and NSPI use to access the interior areas of the region. The network of roads is extensive and provides access to the public for recreational activity. There is no residential development with the FMS Study Area.

6.15.3.2.2 *Land Ownership and Tenure*

The land on which the FMS Study Area is situated is primarily owned by the MacGregor Properties Ltd, with whom the Proponent has a lease. The remainder of the land within the FMS Study Area is owned by the Crown.

An agreement to explore, develop and mine is in place with MacGregor Properties Ltd. Acadian signed an Access Agreement and Option to Lease with MacGregor Properties Limited on April 8, 2010, which provides the Proponent with exclusive rights to conduct exploration on the MacGregor Properties Ltd. land and thereafter the option to lease the lands for mining. The exploration period timeframe extended until December 31, 2019, at which time the Proponent exercised the lease option of the agreement. The lease period timeframe extends from the lease commencement date until December 31, 2034. If a mine is operating on the area on December 31, 2034, then the lease period may be extended by agreement.

6.15.3.2.3 *Tourism and Recreation*

The FMS Study Area is used for outdoor recreational activity. The local ATV club, the Sheet Harbour Snowmobile and ATV Club, actively uses a trail for both ATV and snowmobiling activities and holds twice yearly rallies which, at its most recently rally on March 9th, 2019, hosted in excess of 140 people. In previous years this rally had over 600 participants. The trail, known as route 110 on the ATV mapping, is located to the southwest of Seloam Lake and is used to access an informal area near the NSPI dam where people fish and camp. It has been reported to have as many as six camp sites in use during the summer (Mike Butler, personal communication, March 2017). East Lake has been reported as a fishing area for anglers; however, this lake has been assessed as having low quality fish habitat. During baseline evaluations for this EIS, no fish were caught after 100 hours of trap efforts. Anti-Dam Flowage and Seloam Lake has also been reported as sites for recreational fishing (Mike Butler, personal communication, March 2017).

The FMS Study Area has lands with different levels of provincial protection located in proximity to the FMS Study Area (Table 6.15-2). These include:

- Game Sanctuaries – Game Sanctuaries were established early in the 20th century to protect wildlife and a “nucleus of breeding stock”. Today, wildlife management tools reduce the risk of extinction, but the game sanctuary designation remains as a tool for government to regulate lands, “where unusual concentrations of wildlife are vulnerable to site specific threats” (NSNDR 2018b). Game Sanctuaries are enabled under the *Wildlife Act.*
- Wilderness Areas – These are provincially significant protected areas which are designated under Nova Scotia’s *Wilderness Areas Protection Act*. Forestry and road development are not permitted. Other activities such as mining, vehicle use, building structures or trails, and managing or removing plants are prohibited except in certain circumstances as outlined in the *legislation* (NSE 2007). Hunting is permitted.
- Nature Reserves – Nature reserves are areas selected to preserve and protect, in perpetuity, representative and special nature ecosystems, plant and animal species, features and natural processes (NSE 2007). Scientific research and education are the primary uses of nature reserves and recreation is generally restricted. Nature Reserves are protected under the *Special Places Protection Act*.

The FMS Mine Site is within the Liscomb Game Sanctuary and encompasses less than 2% of the Game Sanctuary. The Game Sanctuary was created in 1928, and its boundaries were last amended in 1983. The Sanctuary encompasses a total of 43244 hectares, of which 12836 hectares is privately owned. The *Liscomb Game Sanctuary Regulations* made under section 14 and 113 of the *Wildlife Act (RSNS 1989, C504)* permit hunting by muzzle loading firearms, bows and crossbows. Both mining and timber harvesting are permitted within the Sanctuary.

There are several properties that have some level of provincial regulation for conservation purposes within the RAA. The two closest are Toad Fish Lakes Wilderness Area and Boggy Lake Wilderness Area. Toad Fish Wilderness Area, designated in December of 2015 and totalling 6322 ha, is within 500 m East of the FMS Study Area. Boggy Lake Wilderness Area, which was expanded in December of 2015 to include almost 4680 ha, is within 1 km east of the FMS Study Area and overlaps a portion of the Liscomb Game

Sanctuary. The Boggy Lake Wilderness Area includes several campsite leases. Figure 2.1-4 shows the location of Wilderness Areas and Nature Reserves.

Table 6.15-2: Lands in Proximity to FMS Study Area with a Provincial Designation

Provincially Designated Areas	Distance from FMS Study Area	Direction	Type of Designation
Toad Fish Lakes	Less than 500 metres	*South*	*Wilderness Area*
Boggy Lake	Within 1 kilometer	*Southeast*	*Wilderness Areas*
Denis Lakes	3.5 kilometers	*East*	*Wilderness Area*
Liscomb River	FMS Study Area sits within	*East*	*Wilderness Area*
Rush Lake	Approximately 5 kilometres	*Northeast*	*Nature Reserve*
Abraham Lake	Approximately 5 kilometers	*Northwest*	*Nature Reserve*
Twelve Mile Stream	Approximately 4 kilometers	*Southwest*	*Wilderness Areas*

Visual impacts of the FMS Mine Site from Highway 374 will be minimal given the remote location, the distance of the FMS infrastructure from the public road and the natural topography (Appendix G.13). A series of hills between the public road and the mine infrastructure create a visual barrier for the users of the public road. The closest infrastructure to Hwy 374 is the WRSA, estimated at 1.28 km to the northeast. It is anticipated that the height of the waste rock pile will be 160 m, with the elevation of the land between the WRSA and the public road at 140 m. The zone of visual influence included in Appendix G.13 demonstrates vantage points from where the WRSA will be visible.

6.15.3.2.4 *Natural Resource Use*

The RAA has historical and active natural resource industries include forestry, mining and power generation.

NSPI constructed the East River hydroelectric power generating system between 1923 and 1926. As of 2009, the system has seven controlled reservoirs, two generating stations, several dams, two head ponds, five storage reservoirs and other significant pieces of power generating infrastructure. Malay Falls has a series of power canals that conduct water from the Malay Falls head ponds to the generating station intake and is capable of producing 3.6 MW of power (Nova Scotia Power Inc 2009). The generating system is provincially regulated and undergoes periodic approval processes.

Timber harvesting and logging have a long history within the RAA. Sawmill operations have been in place for well over 100 years in Sheet Harbour, with many operators who took advantage of the adjacent forests and water systems. The Harvest Plans Map Viewer maintained by the Province of Nova Scotia, as of March 18th, 2019, shows that there are no current Crown Land Harvest Plans for the LAA but the RAA has been subject to a number of Harvest Plans in the last few years, indicating that timber harvesting is actively occurring in the area.

Mining has been ongoing in the LAA since gold was discovered in 1867. Later that century, underground mining activity and stamp milling occurred. More recently, since 1980 there has been a variety of drilling and survey work completed, and at least two bulk samples occurred. There is also evidence of historical tailings along Seloam Brook. Details regarding historical mining activities and tailings locations can be found in Section 6.4.

6.15.4 Consideration of Engagement and Engagement Results

During public and Mi'kmaw engagement relating to socio-economic considerations, potential adverse effects mentioned by the public included:

- Natural environment impacts such as surface water, groundwater and seepage into adjacent water bodies, impacts on fish and wildlife;
- Impacts on recreational activities within and near the PA, most specifically in relation to the access road to Seloam Lake;
- Spills and malfunctions concerns;
- Impacts on Liscomb Game Sanctuary; and
- Traffic Issues, particularly on Hwy 374 and Trunk 7.

The outputs from the public engagement sessions are considered in the environmental effects assessment, including the Proponent's commitments on mitigation and monitoring measures and proposed compliance and effects monitoring programs.

6.15.5 Effects Assessment Methodology

6.15.5.1 Boundaries

6.15.5.1.1 *Spatial Boundaries*

The spatial boundaries used for the assessment of effects to the socio-economic environment are the PA, LAA and RAA. The PA consists of the Touquoy Mine Site and the FMS Study Area (Figure 6.15-1).

The LAA was established using a 15 km buffer from the PA, with the portion of that buffer outside of the HRM excluded (Figure 6.15-1). The LAA is remote and the impacts to the local economy extends beyond the footprint of the PA as there is no opportunity for the purchase or exchange of goods and services within the footprint.

A RAA was established that encompasses the eastern rural component of HRM, which includes the local service centre of Sheet Harbour (Figure 6.15-1). Local labour and purchases will be accommodated within this area. Tourism impacts will also be considered within this boundary, as will housing and transportation impacts. The bulk of the analysis is related to the areas surrounding the FMS Mine Site as it will have the most potential impacts due to the Project labour force, potential population growth and impacts on local services and community infrastructure. The Touquoy Mine Site will not see any additional growth in employees or activity as a result of the Project activities. However, given the scale of the Project, the RAA is seen as the most appropriate boundary for analysis.

The LAA for the Touquoy Mine Site is within the RAA and requires no additional analysis as the proposed activities at this location will be captured by the RAA analysis.

6.15.5.1.2 *Temporal Boundaries*

The Project has three phases that include construction (1 year), Operations (7 years) and Closure (reclamation and closure; and post-closure) (2-3+ years) that will define the temporal boundary for assessment of the socio-economic components of the Project. The maximum Project life is 11 years plus any monitoring requirements through the post-closure phase.

6.15.5.1.3 *Technical Boundaries*

Economic effects potential is a qualitative and quantitative assessment based on a comparison of the relative scale of predicted Project-related employment levels with existing opportunities with a portion of the HRM. A Socio-Economic Impact Study, completed in 2019, projected employment numbers and economic spin offs using the Statistics Canada Input-Output (I-O) model. This model is designed to simulate the activity of a project, a company or an industry and measure its direct and indirect effects on the national and provincial economies.

Primary and secondary data sources are used to supplement socio-economic data.

6.15.5.1.4 *Administrative Boundaries*

The Project is located within the HRM. The Province of Nova Scotia delegated authority to HRM through the *Halifax Regional Municipality Charter* (Chapter 39 of the Acts of 2008) to enact and enforce planning regulations through the Halifax Regional Municipal Planning Strategy (October 2014). The PA is governed by the Municipal Planning Strategy (MPS) for Eastern Shore (East) (1996), which established land use policies and regulations for specific uses. The MPS enables a Land Use Bylaw and Subdivision Bylaw that control specific land uses.

Mining, however, is regulated by the Province of Nova Scotia, as per the *Mineral Resources Act* and is not controlled by local government.

The Provincial Government, through its "Our Parks and Protected Areas: A Plan for Nova Scotia" establishes the framework for creating protected areas. The *Wilderness Areas Protection Act* establishes the legal framework for planning and managing wilderness areas. The Liscomb Game Sanctuary Designation, made under section 113 of the *Wildlife Act*, regulates activities within the Liscomb Game Sanctuary. The FMS Study Area exists within the Liscomb Game Sanctuary.

The administrative responsibilities for recreation sites in the RAA most often fall to the HRM, which maintains recreational infrastructure such as libraries, some playgrounds, beaches and other similar municipal recreational assets. The *Municipal Government Act* enables municipalities to provide recreational services.

NSTIR is responsible for public roads and highways under the *Public Highways Act*. This Act also provides the Minister with the "supervision, management and controls of the highways and all matters relating thereto" (Public Highways Act 1989).

6.15.5.2 Thresholds for Determination of Significance

To determine significance, the following factors were considered and overall significance was determined based on review of the balance of positive impacts versus negative impacts, and a review of the reversibility and duration of identified negative impacts.

- Duration of Impact – The shorter the projected impact, the less significant the impact. Longer term or permanent impacts were deemed as more significant.
- Reversibility – If an impact was reversable then it was deemed less significant than those impacts where were not reversable.
- Positive or Negative – If the impact is seen as a positive, then the significance of the impact is deemed less than a negative impact.
- Data Source – In some cases if the data is insufficient to draw a solid conclusion, the potential impact was not included in the table but was identified as a vulnerability in the text of this section.

6.15.6 Project Activities and Socio-economic Conditions Interactions and Effects

The Project has three distinct phases with specific Project activities. The Project activities will be assessed for interactions and effects (Table 6.15-3).

Table 6.15-3: Potential Interactions with Project Activities and Socioeconomic Conditions

Project Phase	Duration	Relevant Project Activity
Site Preparation and Construction Phase	1 Year	• Clearing, grubbing and grading • Drilling and rock blasting • Topsoil, till and waste rock management • Watercourse and wetland alteration • Seloam Brook Realignment construction and dewatering • Mine site road construction, including lighting • Surface infrastructure installation and construction, including lighting • Collection ditch and water management pond construction, including lighting • Local traffic bypass road construction • Culvert and bridge upgrades and construction • Environmental monitoring • General waste management
Operations Phase	7 years	• Drilling and rock blasting • Open pit dewatering • Ore management • Waste rock management • Surface water management • Dust and noise management • Petroleum products management • Site maintenance and repairs, including lighting • Ore processing and plant site operations • Concentrate loading and haulage • Environmental monitoring • General waste management
Closure Phase: Reclamation Stage	2-3 years	• Infrastructure demolition • Site reclamation • Environmental monitoring • General waste management

It is considered unlikely that ore dust deposition from the FMS Mine Site at the rates considered in HHRA would result in levels of metals in country foods, soils and dust that would be harmful to human health, based on the risk assessment conducted. Adverse health effects from soil and dust exposure, the consumption of country foods harvested from the vicinity of the FMS Mine Site, and recreational water use (i.e., swimming) are not anticipated. Details relating to the HHRA completed for this Project can be found in Section 6.13. The HHRA was completed to evaluate broad human health considerations, not just the health of the Mi'kmaq communities, and therefore is appropriate for all recreational users surrounding the FMS Mine Site from the perspective of plant gathering, berry, game, and fish consumption, and recreational swimming in Anti-Dam Flowage. Refer to Section 6.13 for details of methodology and conclusions relating to the HHRA.

The Proponent commissioned an economic impact study in March 2019 regarding the Project using the Statistics Canada Input-Output model, which is, "designed to simulate the activity of a project, a company or an industry and measure its direct and indirect effects on the national and provincial economies." The findings as described in Table 6.15-4 and Table 6.15-5 were as follows:

- Between 2014 and 2018, 14.6 million was spent on exploration and generated 10.6 million value added in Nova Scotia, supporting 93 jobs.
- The construction phase will generate 81.4 million in value added for the Nova Scotia economy, support 778 jobs and generate 4.4 and 2.4 million in provincial and municipal government revenues, respectively.
- Operating activities would generate 18.6 million in value added annually, (111.4 million over the entire operating phase) support 323 jobs annually in NS and provide 13 million and 0.9 million in provincial and municipal government revenues (referenced in Appendix E.1).

Table 6.15-4: Distribution of Spending: FMS Project

Spending Category	**Spending (In M$)**	**As a % of the Total**
Exploration	14.6	*3.7%*
Construction (1 year)	123.4	*30.9%*
Operation (6.75 years)	234	*58.6%*
Sustaining Capital	27.4	*6.9%*

Table 6.15-5: Direct and Indirect, Municipal Provincial and Federal Government Revenues from Construction (in millions)

Detailed tax revenues	**Personal income tax**	**Taxes on Projects**	**Taxes on production**	**Total**
Municipal	-	0	2.4	2.4
Nova Scotia (Provincial)	3.6	0.4	0.4	4.4
Canada (Federal	4.0	0.3	0.0	4.3

Note: Due to rounding, the sum of items may not add up to the total.

In Nova Scotia, the Construction phase of the Project will create 666 Full Time Equivalents (FTEs) directly by the Proponent, along with another 189 FTE's in indirect jobs. The impact for Canada from the construction is estimated at 915 additional jobs totaling 93.1

million. The construction phase will also have an impact on government tax revenues, expected to be 4.2 million for Nova Scotia, 2.2 million for the Federal Government and 1.2 million for the municipal government, mainly in the form of property tax revenues.

During operations, the Project will generate almost 23.7 million dollars a year in additional tax revenue, with 13 million paid to the NS government, 8.9 million to the Federal government and 0.9 million to the Municipal government (Table 6.15-6).

Table 6.15-6: Tax Revenues (in millions) Municipal Provincial and Federal -Operations

Detailed tax revenues	**Corporate and income tax royalties**	**Personal income tax**	**Taxes on products**	**Taxes on Production**	**Total**
Municipal	-	*0*	*0*	*0.9*	*0.9*
Nova Scotia (Provincial)	9.9	*1.1*	*1.9*	*0.1*	*13*
Canada (Federal	7.2	*0.8*	*0.9*	*0.0*	*8.9*

During operation it is projected that there will be 235 FTE per year with another 88 FTE in indirect employment by contractors. This totals 12.9 million dollars a year from direct employment, 10.7 million in indirect effects, totaling 23.7 million in total of impacts.

The Project will have positive impacts on the local and regional employment market. Given the lower labour participation rates in the RAA, the Project could increase participation in the labour force, and provide opportunities for in-migration and population growth of adjacent communities, as the commuting distance to the FMS Mine Site may discourage employees from living in urban Halifax. As compared to the more urban parts of Halifax, the Eastern Shore tends to have fewer households at the very top or bottom of the income distribution. The Project is not expected to have any significant impact on this wage distribution given the salary ranges for employees.

The Proponent is developing an employment strategy to attract workers and is partnering with Women Unlimited to advertise any trades vacancies through their established social media network. Additionally, the Proponent continues to identify ways to host a virtual career fair for their members and other interested women, and potential site tours and job shadowing (once the current pandemic has receded). Apprentices attend NSCC for their academic blocks in between their practical on the job training.

The Proponent also advertises to Dalhousie engineering students and strives to employ grads of NSCC or Dalhousie in addition to seeking them out specifically for summer jobs and coops. The Proponent has provided specific roles for First Nations youth to work at the Touquoy Gold Mine in environment, clean energy and mining. The Proponent is working to grow this program in 2021. Finally, the Proponent is also building a relationship with a not-for-profit called Techsploration who promote career opportunities in STEM to female students in Nova Scotia.

Employment will be of a fix term nature and upon closing of the mine, the jobs will cease. The Proponent does have other mine sites, such as Beaver Dam Mine Project and Cochrane Hill Gold Project, and there will be opportunity to transfer to them if these other gold projects are ultimately approved. The Proponent is also actively undertaking mineral exploration in Nova Scotia and the development of other gold projects may occur. This could potentially provide further employment opportunities.

The FMS Mine Site is not currently served by internet. It is, however, part of the area that falls within Connecting Canadian Project, which is a to provide internet to rural areas of Nova Scotia. The Proponent will require high speed internet service for the Project and will explore internet options that could be of benefit to the surrounding communities. The Touquoy Mine Site is already serviced by internet.

With potential population growth and activity associated with the mine, the ESMH or other local health care service providers may experience increased pressure for medical services. However, these is a lack of data on which to make final conclusions and there are many variables that could impact health care services, such as if another doctor is recruited to the area and if the labour force associated with the Project lives in the catchment for ESMH. Health Care service providers and infrastructure may be vulnerable if increased population growth occurs.

With local employment opportunities, there may be increases in population, creating pressure on local housing markets, both ownership and rental, to accommodate new workers or immigration to the area. Given the lack of a rental market, this provides opportunity for local builders and developers to meet a market need.

The Proponent is working to establish an office in Sheet Harbour to provide a place for the public to ask questions and provide a point of contact for community members. In this location, the public will be able to submit resumes, ask questions about the mine, integrate into the local business community and create connections with the local non-profit community. As with its Touquoy site, the Proponent will continue provide donations to local community groups and organizations.

Visual impacts relating to the Project will be minor in nature, given the rural location of the mine, the distance of the nearest seasonal residents to the FMS Mine Site and the distance from the public road to the mine Recreational users of trails may have a view into the mine, depending on the specific location of any new private road/trail relocation (Appendix G.13). Light intrusion beyond the proposed property boundaries for the mine is predicted to be limited with light spill only extending a maximum of 2 km from infrastructure depending on topography (the broadest light spill will occur to the north and northwest). Noise is predicted to meet the Pit and Quarry guidelines at the proposed property boundaries.

6.15.7 Mitigation

Mitigation measures are described in Table 6.15-7. Recreational activities at the FMS Mine Site will be restricted and the existing private road will be rerouted in keeping with consultation with local user groups (Figure 2.1-7). Recreational users will be notified of restricted area by signage and access will be restricted in flyrock management areas during blasting. Operation impacts on recreational users will be communicated with local recreational groups with a focus on minimizing impacts on users to the greatest extent practicable.

Construction of local by-pass routes will be completed to allow recreational traffic to travel around the FMS Mine Site to reach Seloam Lake and other recreational areas east of the FMS Mine Site. These bypass roads were established in consultation with the ATV Association of Nova Scotia and other local ATV clubs. The Proponent will continue to work with all interested parties to ensure the proposed bypass roads meet the needs of the local community members, Mi’kmaq of Nova Scotia and recreational groups and users in the local area. These bypass roads are shown on Figure 2.1-7.

No monitoring, except restricting access for safety, will be undertaken after the start of construction. The Proponent may conduct additional socio-economic studies to assess changes to confirm findings.

Table 6.15-7: Mitigation for Socio-economic Conditions

Project Phase	Mitigation Measures
C, O	Restriction of recreational activities within the spatial boundaries of the Project. Notification to be provided by signage.
C	Construction of local by-pass routes to allow recreational traffic to travel around the FMS Mine Site to reach Seloam Lake and other recreational areas east of the FMS Mine Site.
C	Liaison with recreation groups, such as the Sheet Harbour Snowmobile and ATV Club
O	Update of Socio-economic impact statement to assess impact. This may occur at the discretion of the Proponent. Impact Study projections are calculated to reflect conservative estimates.
CL	N/A

Note: C = Construction Phase, O = Operations Phase, CL = Closure Phase

6.15.8 Residual Effects and Significance

There are no significant residual effects anticipated once mitigation measures are applied. Positive impacts are anticipated in the form of direct and indirect employment, and tax revenues for municipal, provincial and federal governments (Table 6.15-8). There may be some vulnerability to the health care system and in the housing market if the local population increases as a result of the FMS Mine Site labour needs. However, a population increase would also have possible benefits to increasing school age populations, increase labour force participation rates and potentially encouraging increase residential building and construction activity.

Table 6.15-8: Residual Effects of the Project on Socio Economic

Project - VC Interactions	Mitigation and Compensation Measures	Nature of Effect	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect
			Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility		
Construction, Operations and Closure- FMS Mine Site Direct and indirect employment opportunities	N/A	P	H High change from baseline conditions. There will be significant jobs created during the construction phase	RAA	N/A VC is not expected to be affected by timing	LT	C Effects occur once during the construction phase	PR Skills will be gained and indirect (contractors) may retain skills and employees	Increase in employment opportunity	Not Significant
Construction, Operations and Closure- FMS Mine Site Site access route adjustments	Construction of bypass roads. Communicate with local recreational groups, regular equipment maintenance, operator training and proper signage at intersections to inform public and reduce accidents	A	L Existing private roads will be relocated adjacent to the FMS Mine Site to allow for access to Seloam Lake and other interior lands for recreational use	LAA Relocation of private roads.	N/A VC is not expected to be affected by timing	P	C Effects occur continuously throughout the Project	IR	Change in access	Not Significant

Legend (refer to Table 5.10-1 for definitions)

Nature of Effect	Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility
A Adverse	N Negligible	PA Project Area	N/A Not Applicable	ST Short-Term	O Once	R Reversible
P Positive	L Low	LAA Local Assessment Area	A Applicable	MT Medium-Term	S Sporadic	IR Irreversible
	M Moderate	RAA Regional Assessment Area		LT Long-Term	R Regular	PR Partially Reversible
	H High			P Permanent	C Continuous	

6.15.9 Proposed Compliance and Effects Monitoring Program

Given the nature of the potential impacts, there is no need for effects monitoring. Ongoing communication with the public will occur regarding the relocation of recreational transportation routes to accommodate the recreational user.

Proposed follow-up and monitoring programs have been reviewed with the Mi'kmaq of Nova Scotia during engagement efforts including meetings, sharing of technical documents (Draft EIS, poster boards, Summary of Mi'kmaq Effects and Proposed Mitigation Measures, Plain Language Summary). On-going engagement with the Mi'kmaq will continue through the EA process and associated permitting relating to follow-up programs and monitoring.

6.16 Assessment of Valued Components within Federal Jurisdiction

6.16.1 Environmental Effects within Federal Jurisdiction

This section summarizes those changes to the environment that may be caused by the Project on environmental components listed in paragraph 5(1)(a) of *CEAA 2012*. This includes fish and fish habitat as defined in the *Fisheries Act*, migratory birds as defined in the *Migratory Birds Convention Act, 1994,* and species designated by the *Species at Risk Act.* These VCs have been discussed in greater detail in other sections of the EIS (in particular Sections 6.8, 6.11, and 6.12) and are summarized below. It is not anticipated that changes to the environment arising as a result of a federal decision will affect migratory birds or species at risk, once appropriate mitigation and compensation is considered. It has been determined that fish and fish habitat as defined in the *Fisheries Act* is the only Project component for which a federal authorization/decision will be required. This is discussed in greater detail in the following sections.

6.16.1.1 Fish and Fish Habitat

Development of the mine will cause direct impacts to fish and fish habitat mostly within the construction phase of the Project during development of the open pit and its associated infrastructure, including the Seloam Brook Realignment. Continuing impacts to fish and fish habitat are possible during operations of the mine from on-going dewatering efforts within the open pit, and potential siltation and release of substances to downstream receiving surface water systems adjacent to the mine infrastructure.

The development of the open pit will require dewatering a 1 km braided section of Seloam Brook below the outlet of Seloam Lake. The Proponent will construct an open pit perimeter berm around the open pit to deflect flow away from the open pit. Flow from Seloam Brook and its multiple small tributaries will be diverted through an integrated floodplain as part of the Seloam Brook Realignment. This realignment will collect flows from WC12 and Seloam Brook, and convey them through an integrated floodplain on the north side of the pit, flowing west to reconnect to Seloam Brook through WC4 and WC42. The impacted area includes multiple braided channels of Seloam Brook, open water ponds, small tributaries, and wetlands and is inhabited by several fish species including brook trout and white sucker. The Seloam Brook Realignment and associated fish habitat loss is considered an unavoidable impact of the Project development. The estimated area impact to fish and fish habitat from the Project is approximately 8.05 ha of direct impact to open water features, linear watercourses and wetland habitat accessible to fish. Potential indirect impacts to fish and fish habitat through flow reduction in WC2 and East Brook and increased erosion and sedimentation downstream of the realignment and upstream of the proposed water control structures are expected to result in an additional maximum impact of 1.28 ha.

Further work to understand potential fish habitat and fish presence at specific alteration locations will be required to support surface water permitting (wetlands and watercourse alteration and Fisheries Act Authorization). Mitigation will be implemented to reduce the potential for direct fish mortality where fish were observed through fish rescue efforts prior to commencement of construction and completion of relevant construction activities within confirmed fish habitat within approved timing windows, whenever practicable, for construction (June 1st to Sept 30th to reduce potential for mortality of eggs and juvenile fish. Furthermore, the integration of fish habitat within the Seloam Brook Realignment (Appendix J.5) will mitigate fish habitat loss within the FMS Study Area, and the implementation of water control structures downstream of the realignment channel (Appendix B.9) will limit the spatial extent of indirect impacts to fish and fish habitat. Maintaining water quality and quantity downstream in the PA and LAA is paramount for limiting broader fish and fish habitat impacts within each affected watershed associated with the Project. However, indirect impacts to down-gradient watershed water quality and quantity within the PA and LAA that may affect fish and fish habitat are not expected.

6.16.1.2 Migratory Birds

Site preparation and construction, and operation of the Project will cause temporary and medium-term loss of habitat for birds and may cause disturbance or displacement of species. Habitat fragmentation may alter habitat suitability for those species which rely on interior forest conditions.

Lighting at the FMS Mine Site may cause disturbance or displacement of species, while attracting other species, or may cause general behavioral changes (DaSilva, Valcu and Kempenaers 2015). For those species which may be attracted to lights (i.e., insectivores), lights may increase potential for direct mortality of these species or may increase habitat suitability by supplementing their source of prey.

Increased truck and vehicular traffic will increase noise levels, which may displace and/or disturb birds. Heavy machinery operation during open pit development, road construction, and construction of mine infrastructure for crushing and hauling will increase dust emissions, which may affect surrounding vegetation and, consequently, birds (Farmer, 1993). Blasting and drilling of in-situ rock during open pit mining will increase dust emissions, which may affect surrounding vegetation and, consequently, birds (Farmer, 1993).

There is the potential for migratory bird mortality during clearing activities. Birds (particularly injured or fledglings) may get trapped in the open pit or collide with other Project infrastructure (crushers or trucks), which could lead to death or injury. Vehicle activity and heavy machinery operation may cause bird injury or mortality.

The overall effects of the Project on birds and bird habitat is assessed as not significant after mitigation measures have been implemented.

6.16.1.3 Species at Risk

6.16.1.3.1 *Fish*

No federally listed fish species at risk have been documented, or are expected, within the FMS Study Area. While not currently listed under provincial or federal endangered species legislation, DFO has indicated that American eel is currently being reviewed for protection under SARA. American eel has been documented in the lower reaches of the East River Sheet Harbour in the NSPI relicensing report (Ruth Falls and Marshall Falls). Passage of American eel into the FMS Study Area is limited by the presence of a series of hydroelectric dams. However, young eel are capable of travel over rough wet surfaces, and may be able to access upper reaches of the East River system, despite presence of hydroelectric dams. No American eel were identified in the FMS Study Area.

Atlantic salmon was not observed during any fish sampling programs within the FMS Study Area. However, Atlantic salmon were historically abundant within the East River Sheet Harbour river system. With the installation of hydroelectric dams and increased acidification of the river system, the East River Sheet Harbour has been determined to be “largely inaccessible to anadromous fishes since the early 1920s” (O’Neil et al. 1997) and “partially impacted by acidification, and may yet have remnant populations of salmon” (DFO 2000).

During the 1990s, this species was released into Fifteen Mile Stream through a trap and truck system as part of a five-year management plan for anadromous fisheries resources in the East River Sheet Harbour (O'Neil et al. 1997). The species is therefore presumed to have populated several tributaries to this watercourse, including tributaries found within the FMS Study Area. However, despite the considerable amount of resources directed towards managing the Atlantic salmon on the East River Sheet Harbour, adult returns to the river from 2004-2007 averaged less than five fish and the program was discontinued (NSPI 2009). Watt (1997) described salmon in the East River Sheet Harbour watershed as a remnant population where some may survive in one or two higher pH tributaries. No salmon were reported in the NS Fisheries and Aquaculture surveys completed in 1973, 1993 and 1995 in the local watershed around the FMS Study Area. Research is also suggesting that factors [unknown] other than acidification are reducing salmon production in fresh water throughout the Southern Upland (Gibson et al. 2010). The presence of Atlantic salmon within the FMS Study Area is unlikely, and any Atlantic salmon which may be present in watercourses found within the FMS Study Area would be remnant individuals of an isolated population.

Standard mitigation and monitoring for fish and fish habitat (Section 6.8.7 and 6.8.9) will address direct and indirect effects to Atlantic salmon and American eel.

6.16.1.3.2 *Flora*

No vascular flora species listed under SARA were observed within the FMS Study Area. Blue felt lichen, listed as special concern under SARA was documented within the FMS Study Area. Micro-siting of infrastructure has been completed to avoid lichen species at risk and has reduced the direct impact of the Project where practicable. Further micro-siting may allow for avoidance of blue felt lichen within the Plant and Ancillary Building; however the Proponent has committed to translocation of lichen SAR (blue felt lichen) which cannot be avoided by the Project (Section 6.12).

Indirect effects to habitat and flora described in Section 6.9 are relevant to flora SAR as well. Lichens are sensitive to changing environmental conditions, particularly air quality. As such, Project activities may indirectly affect priority lichen species which have been avoided but exist in close proximity to Project infrastructure. A Blue Felt Lichen Translocation Plan will be developed and implemented through regulatory consultation.

6.16.1.3.3 *Terrestrial Fauna*

Terrestrial fauna priority SAR observed during field surveys within the PA includes the mainland moose, listed as endangered under the NSESA. This species is not listed under SARA. No federally listed terrestrial fauna (mammals, herpetofauna and invertebrates) have been documented within the FMS Study Area.

6.16.1.3.4 *Avifauna*

Six avian species at risk have been documented within the FMS Study Area: Canada warbler, common nighthawk, and olive sided flycatcher (SARA threatened), and evening grosbeak, eastern wood pewee and rusty blackbird (SARA special concern).

With appropriate mitigation and monitoring, no direct mortality of avian SAR is anticipated, with the exception of the low potential for a bird strike with a haul truck. Avian usage of the PA during construction and operation of the Project will largely be driven by changes to habitat, resulting in localized avoidance of the PA by some species. Some avian SAR may avoid the PA in favor of undisturbed habitat in the surrounding landscape. Others (i.e., common nighthawk) are anticipated to be attracted to the mine infrastructure and newly created habitat.

Most direct and indirect impacts on birds, including SAR, are accounted for in general mitigation/monitoring for all birds, since many have legislated protection under the *Migratory Birds Convention Act* (primarily through avoiding clearing/grubbing during nesting season, and conducting detailed pre-construction nest searches if clearing or grubbing must occur during nesting season). These pre-construction nest searches are particularly important in wetlands which provide suitable breeding habitat for the olive-sided flycatcher, Canada warbler and rusty blackbird.

6.16.2 Environmental Effects on Federal or Transboundary Lands

There are no federal or transboundary lands located within or adjacent to the PA. Given the distance from the Project site to federal lands and the analysis completed in Section 6 for each VC, the Project has limited potential to result in a change to the environment on federal lands. The nearest federal lands to the PA are the Beaver Lake IR 17 and the Sheet Harbour IR, both located approximately 25 km from the FMS Study Area. They are discussed further in the following section.

6.16.3 Environmental Effects on Indigenous Peoples

A MEKS was undertaken in 2018 to characterize past and present traditional use of the FMS Study Area. Based on the findings presented in the MEKS report, and direct engagement with the Millbrook First Nation, Sipekne'katik First Nation and the KMKNO, it is understood that there is direct use of the Project site for subsistence harvesting of food, medical plants or hunting or furbearing animal harvesting. There is a confirmed Burial site north of the FMS Study Area on an island in Seloam Lake. There is a low likelihood of pre-contact artifacts as per the archaeological study, once mitigation/avoidance is applied along the shores of Seloam Lake. Two bypass roads are proposed to allow for local access to Seloam Lake and the lands east of the FMS Mine Site.

The Mi'kmaq community harvest plant species throughout Nova Scotia, and the area around the Project is no exception. Harvesting of trees and plants such as maple, ash, and birch for tools and crafts continue wherever these resources are known to occur. This is also true for blueberries, cranberries, strawberries and fox berries. The MEKS noted that several species of medicinal plants continue to be collected in the region. While plant species of significance to Mi'kmaq were identified within the MEKS study area, these same species also exist within the surrounding area. While the destruction of some specimens is a Project effect, it does not pose a threat to Mi'kmaq use of the species; therefore, permanent loss of some specimens of plant species of significance to Mi'kmaq is not expected to be significant as per the MEKS. Based on the relatively small footprint of the Project (400 ha of disturbed footprint for infrastructure), existing disturbance in the FMS Mine Site (historical mining and forestry activities), and proposed mitigation, monitoring, and follow-up associated with other VCs, the direct effects of the Project on hunting, gathering and trapping activities has been determined by the Proponent to be not significant. These conclusions have been shared with the Mi'kmaq of Nova Scotia through a draft Mi'kmaq Impact Statement (Appendix K.2) and engagement and feedback relating to these impacts is expected to continue through the environmental assessment process. There are available tracts of Crown land surrounding the FMS Mine Site, as demonstrated in Section 6.13 for Mi'kmaq traditional practices to continue for the 11 year temporal scale when the Project is constructed, operational, and active reclamation is completed.

There are limited expected indirect effects on the Mi'kmaq of Nova Scotia, based on the effects assessment of the other VCs. This conclusion is based on the implementation of the mitigation and monitoring proposed for these other VCs as outlined in this EIS.

6.16.4 Power or Duty by Federal Authority

Should the Project require a federal authority to exercise a power or perform a duty, Section 5(2)(b) of *CEAA, 2012* requires the following environmental effects to be considered:

a) a change, other than those referred to in paragraphs (1)(a) and (b) [of Section 5, *CEAA 2012*], that may be caused to the environment and that is directly linked or necessarily incidental to a federal authority's exercise of a power or performance of a duty or function that would permit the carrying out, in whole or in part, of the physical activity, the designated Project or the Project; and

b) an effect, other than those already described related to aboriginal peoples, of any change referred to in paragraph (a) on

    i. health and socio-economic conditions;

    ii. physical and cultural heritage; or

    iii. any structure, site or thing that is of historical, archaeological, paleontological or architectural significance.

Any physical activities in wetlands, watercourses or waterbodies may require authorization in accordance with the *Fisheries Act.* A significant adverse effect from the Project on fish and fish habitat is defined as an effect that results in an unmitigated or uncompensated net loss of fish habitat as defined under the *Fisheries Act*, and its associated no-net loss policy. An adverse effect that does not cause a permanent loss to fish or fish habitat, with consideration of offsetting, is considered to be not significant. A

Fisheries Act Authorization is expected for the Project, and a Fish Habitat Offset Plan is described in detail in Section 6.8 and Fish Habitat Offset Plan: Preliminary Concept Update included in Appendix J.7.

Direct impact to 8.05 ha of fish habitat is proposed to allow for development of the open pit, Seloam Brook Realignment and associated mine infrastructure within the FMS Study Area. An additional 1.28 ha of fish habitat is expected to be indirectly impacted by flow reduction in WC2 and East Brook, and by erosion and sedimentation downstream of the Seloam Brook Realignment, upstream of the water control structures.

The predicted residual environmental effects of Project development, operations and closure on fish and fish habitat are determined to be present. The overall residual effect of the Project on fish and fish habitat is assessed as not significant after mitigation measures including compensation have been implemented. During permitting, detailed design will focus on reduction of impact to fisheries resources as much as is practicable.

6.16.5 Environmental Effects Incidental of Decisions Made by a Federal Authority

Section 5(2)(b) of *CEAA, 2012* identifies that if the Project requires a federal authority to exercise a power or perform a duty or function required by an Act to allow the Project to proceed, environmental effects must be taken into account, including effects on the following:

a) Health and socio-economic conditions;

b) Physical and cultural heritage; or

c) Any structure, site or thing that is of historical, archaeological, paleontological or architectural significance.

As a result of the predicted residual environmental effects on fish and fish habitat, associated changes to the environment are described in accordance with 5(2) of *CEAA 2012*. Table 6.16-1 described the linkages to relevant VCs (if any), where the related effects assessment is present within the EIS, and additional effects assessment, if necessary.

Table 6.16-1: Linkages to Environmental Effects Assessment for Relevant VCs

Federal Permit/Decision Required	Project Component(s)	Linkage to other Valued Component	Effects Evaluation Location in EIS	Additional Evaluation Needed
Fisheries Act Authorization	WRSA, Stockpiles, TMF and Open Pit within mine footprint. Seloam Brook Realignment	Wetlands	Section 6.7	none
		Surface Water	Section 6.6	none
		Groundwater	Section 6.5	none
		Habitat/Flora	Section 6.9	none
		Fauna	Section 6.10	none
		Birds	Section 6.11	none
		Species at Risk	Section 6.12	none

The FMS Study Area is currently accessible to humans with a network of existing forestry access roads, and small truck/ATV trails. Seasonal camping occurs at the outlet of Seloam Lake, as evidenced by presence of a fire pit, and occasional observations of RVstyle campers. This land is owned by NSPI. Forestry activity surrounding the FMS Study Area is substantial and the PA is located in a remote location without any significant human settlement/town/village/city.

Loss of fish habitat within the FMS Mine Site will result from the development of the open pit, stockpiles, TMF, other mine infrastructure, and the Seloam Brook Realignment. Fish habitat will be lost in linear watercourse, small open water features, and wetland habitat. The Project and the Seloam Brook Realignment will require federal Approval, and offsetting for lost fish habitat.

Stream habitat lost is low to moderate quality habitat which generally provides support for feeding, passage, refuge and overwintering for fish, as defined in Section 6.8. Some stream habitat was observed to be deep enough to potentially support overwintering for fish populations. However, these streams are not quality commercial or aboriginal fishing locations. Fish habitat within the FMS Study Area is relatively low quality due to low pH levels, elevated temperatures and decreased summed dissolved oxygen levels. Furthermore, the installation of several hydroelectric dams along the East River Sheet Harbour has limited upstream migration of fish for decades. As a result, the potential effect of a Fisheries Act Authorization on non-Aboriginal health and socio-economic conditions (e.g., reduction of fishing activity) is expected to be very low.

Fish habitat loss via wetland alteration within the FMS Study Area will also result from the development of the Project. Wetland habitat that will be altered has been determined to support passage for fish, refuge habitat for fish, and feeding habitat for fish. Several wetlands also have sufficient depth to potentially support overwintering populations of fish. These wetland habitats do provide some hiking, berry picking, bird watching, hunting and recreational opportunities, but provide limited to no fishing opportunities. As a result, the potential effect of a Fisheries Act Authorization on non-Aboriginal health and socio-economic conditions (e.g., reduction of hiking, hunting, and fishing activity) is expected to be very low due to the loss of fish habitat associated with the Project development

6.17 Accidents and Malfunctions

6.17.1 Rationale for Valued Component Selection

In relation to accidents and malfunctions, Section 19(1) of the *CEAA 2012* states that:

"The environmental assessment of a designated project must take into account the following factors:

> (a) the environmental effects of the designated project, including the environmental effects of malfunctions or accidents that may occur in connection with the designated project and any cumulative environmental effects that are likely to result from the designated project in combination with other physical activities that have been or will be carried out; and
>
> (b) the significance of the effects referred to in paragraph (a)".

Accidents and malfunctions refer to events that are contrary to the design, and not part of any planned activity or normal operation of the Project, as has been proposed by the Proponent. Many accidents and malfunctions are preventable, and their likelihood and consequences are minimized during planning and design, and by developing thorough emergency response procedures and ensuring mitigation measures are incorporated into standard operating procedures. However, even with the implementation of best management practices and preventative measures, accidents and malfunctions still have the potential to occur and create adverse effects to the environment and worker health and safety. By identifying potential accidents and malfunctions and assessing their effects should they occur, the Proponent has developed preventative and responsive procedures to reduce the likelihood of and control the adverse effects of accidents and malfunctions should they occur. Preventative and responsive procedures will be developed via the following principles:

- best management practices and proven technologies will be utilized to undertake the Project and all planned releases to the environment and their effects will be properly managed;
- worker health and safety will be the central focus of process and mine safety management;
- develop and apply procedures and training that will aim to promote safe operation of mining equipment and facilities; and
- develop and implement emergency response procedures that will reduce and control the adverse effects of an accident or malfunction.

The Project will be designed to implement preventative and mitigation procedures throughout its entire life that will minimize the potential for accidents and malfunctions to occur. Should those accidents or malfunctions occur, emergency response procedures would be implemented to reduce or control the resulting adverse effects.

6.17.2 Assessment Methodology

The assessment of effects from potential accidents and malfunctions were based on a worst-case scenario, which employs a risk-based approach that involves identifying potential hazards associated with Project infrastructure and activities, as well as the consequences should they result in an accident or malfunction. The identification of potential accidents and malfunctions was completed utilizing the operational expertise of the Proponent and experience of the EA Study Team and consulting other projects similar to the Project. The identification of worst-case scenarios/consequences were determined using a qualitative risk assessment to determine the likelihood that facilities or activities could result in an accident or malfunction and the level of magnitude of those accidents and malfunctions should they occur.

Accidents and malfunctions that are considered either likely to occur, or unlikely to occur but have a potential significant effect should they occur, are included in this assessment. For each potential accident and malfunction, the following details will shape the effects assessment:

- a threshold for determination of significance is provided to set a benchmark for significance of an accident and malfunction;
- the interactions between the accident and malfunctions and specific VCs and the resulting effects are discussed in reference to their significance;
- mitigation measures are presented and designed to prevent the occurrence of accidents and malfunctions; and
- preliminary emergency response measures are discussed to lessen the magnitude of accidents and malfunctions should they occur.

Accidents and malfunctions have the potential to occur through every phase of the Project. In order to decrease the likelihood of occurrence and level of magnitude should these accidents or malfunctions occur; the Proponent has incorporated mitigation measures into the design and will implement a preventative system approach to environmental protection and worker health and safety. Contractors will be subject to the same health, safety, and environment policies and procedures, and all personnel will receive site specific training to prevent and mitigate accidents and malfunctions. The Proponent has developed an Environmental Management System and Health and Safety Plans at the fully approved and operating Touquoy Gold Project and have developed a framework EMS for the Project (Appendix L.1). These Plans will extend to the activities at the Touquoy Mine Site for all phases of the processing of FMS concentrate. These Plans will be examined and refined where needed to reflect BMP prior to the time that the FMS concentrate is processed at the Touquoy Mine Site. Revised versions of these Plans will also be developed specific to the FMS Mine Site and operations.

6.17.3 Hazard Identification

Nearly all Project components and activities outlined in Sections 2 of this EIS, including the processing of FMS concentrate at the Touquoy Mine Site, have the potential to create accidents and malfunctions; however, the likelihood is often extremely low. Those accidents and malfunctions that are considered either likely to occur, or unlikely to occur but have a potential significant effect should they occur, are outlined by Project phase in Table 6.17-1.

Table 6.17-1: Summary of Potential Accidents and Malfunctions

Hazard Categories	Potential Accidents and Malfunctions Scenarios	Construction Phase	Operations Phase	Closure Phase
Structural Failures	Open Pit Mine Slope Failure	○	●	○
	Stockpile Slope Failure	○	●	○
	Water Management Pond Failure	○	●	○
	TMF Dam Failure	○	●	●
	Infrastructure Failure	○	●	○
Accidents	Fuel and/or Other Spills	●	●	○
	Unplanned Explosive Event	○	●	-

Hazard Categories	Potential Accidents and Malfunctions Scenarios	Construction Phase	Operations Phase	Closure Phase
	Mobile Equipment Accident	●	●	○
	Tailings and Reclaim Water Pipeline Spills at FMS Mine Site	N/A	●	N/A
	Tailings and Reclaim Water Pipeline Spills at Touquoy Mine Site	N/A	●	N/A
	Cyanide Spills at Touquoy Mine Site	N/A	●	N/A
Other Accidents and Malfunctions	Forest and/or Site Fires	●	●	○

Legend
Potential for Adverse Effects
● High potential for adverse effects
○ Low potential for adverse effects

6.17.4 Structural Failures

6.17.4.1 Open Pit Mine Slope Failure

All phases of the Project have the potential for structural failures of slopes within the footprint of the open pit. The potential slope failures are as follows:

- failure of overburden slopes caused by erosion from vegetation stripping and surface water runoff; and
- failure of bedrock faces caused by improperly designed benches and erosion/fracturing from groundwater inflow.

A worst-case scenario is the severe collapse of areas directly adjacent to the open pit and ground surface slump of the surrounding area possibly affecting the site's infrastructure, haul roads, and on-site access roads and worker safety. However, the site's components and infrastructure have been designed as far from the perimeter of the open pit as practicable so it is not expected that slope failure would affect the site's components and infrastructure.

During the initial stages of site preparation and construction, potential slope failures caused by erosion from vegetation stripping and surface water runoff will be limited to overburden; however, as blasting, and ore and non-ore bearing waste rock extraction commences, bedrock faces have the potential to fail if not properly designed and groundwater inflow is not properly managed. Based on the current delineation of ore, the mine will be excavated through bedrock to an end depth of approximately 150 m below ground surface. Currently, bench heights of 5 - 10 m are designed with 9 m wide berms placed every 20 m. Actual bench face angles will be implemented for specific depths and zones of the open pit as prescribed by a qualified professional based upon a geotechnical study.

Geotechnical site investigations have or will be completed to determine appropriate design parameters based on industry standard factors of safety. These design parameters will be applied to the final design of the FMS Mine Site infrastructure. The soil and bedrock at the site are well understood from a geotechnical and construction standpoint including extreme conditions such as drought, freeze-thaw cycles, and weather (high rainfall events or storm events and wind), including factors attributable to the predicted effect of climate change. All of these "extreme" factors have been accounted for in the design of the Project and will be for all phases of the Project.

6.17.4.1.1 *Threshold for Determination of Significance*

The criteria that would determine a significant effect should an overburden or bedrock slope fail, is based primarily on worker health and safety, and secondarily on property damage. Should a slope failure result in injury or death to a worker, or loss of mobile equipment the event will be considered significant.

6.17.4.1.2 *Potential Interactions and Effects*

The potential interactions between an open pit mine slope failure and VCs is outlined in Table 6.17-2. Only those interactions with a high potential to cause adverse effects should they occur are discussed in detail.

Table 6.17-2: Open Pit Mine Slope Failure Interactions with VCs

Valued Component	Potential Surface Open Pit Mine Slope Failure and VC Interaction	Potential for Adverse Effects
Noise	Failure of overburden slopes could potentially cause temporary noise generation	Low
Air and Greenhouse Gases	Failure of overburden slopes could potentially cause temporary dust generation	Low
Light	No potential interaction anticipated	-
Geology, Soil, and Sediment Quality	No potential interaction anticipated	-
Surface Water Quality and Quantity	No potential interaction anticipated	-
Groundwater Quality and Quantity	No potential interaction anticipated	-
Wetlands	No potential interaction anticipated	-
Fish and Fish Habitat	No potential interaction anticipated	-
Habitat and Flora	No potential interaction anticipated	-
Avifauna	No potential interaction anticipated	-
Fauna	No potential interaction anticipated	-
Species of Conservation Interest and Species at Risk	No potential interaction anticipated	-
Mi'kmaq of Nova Scotia	No potential interaction anticipated	-
Physical and Cultural Heritage	No potential interaction anticipated	-
Health and Socio-economic Considerations	Failure of overburden slopes and bed rock faces could potentially result in injury or death to mine workers	High

Dust and noise generated from the failure of an open pit slope would be temporary and localized to the area directly around the slope failure. In addition, the direct physical impact of any open pit slope failure will be confined to the developed pit area. Any physical and cultural heritage artifacts in the area would likely have be identified and dealt with appropriately prior to mine development. As a result, potentially adverse effects to air, noise and physical and cultural heritage are considered low.

Surface mines with improperly designed benches and slopes and poor surface water and groundwater management pose a health and safety risk to workers during the construction and operation phases, as well as a financial liability risk related to mobile equipment damage or loss.

The maximum effect of an overburden or bedrock face slope failure as it relates to worker health and safety would be a death caused by falling objects. The maximum effect of an overburden or bedrock face slope failure as it relates to financial liability would be a total loss of one or more pieces of mobile equipment.

Overburden or bedrock face slope failure may also occur during the closure phase of the Project as the open pit fills with water via surface water runoff and groundwater inflow. Surface water runoff may erode overburden to a point of failure, while groundwater inflow may weaken major bedrock joints or discontinuities and cause a failure. However, as this decommissioning activity is passive, it will not involve direct interaction between workers and slopes and given a lack of environmental receptors in the open pit and that all effects from a slope failure will be contained to the open pit, potential adverse effects to other VCs from an overburden slope failure or bedrock face failure are anticipated to be non-existent.

6.17.4.1.3 *Mitigation and Emergency Response*

A daily inspection of pit slopes by qualified personnel will be undertaken for any work area within the pit prior to employees or machinery entering. An independent qualified professional will undertake a geotechnical review of pit slopes on at least an annual basis.

Design pit slopes are based on recommendations of the independent qualified professional with appropriate design safety factors applied. Slopes will be monitored for movement and evidence of instability throughout the life of the operation.

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

Based on the current delineation of ore, the open pit will be excavated through bedrock to an end depth of approximately 150 m below ground surface. Bench heights and bench face angles as prescribed by independent geotechnical review will be implemented for specific depths and zones of the open pit.

If slope failure were to occur, emergency procedures would be implemented that will be outlined in the site Emergency Response Plan, which will be developed to support the EMS Framework Document (Appendix L.1). Generally, slope failure emergency response includes evacuation of all equipment and personnel from the area and areas up-slope and down-slope from the slope failure area. An assessment is then made using on-site staff and possibly external resources (geotechnical specialists) to make a determination if the area can be accessed to make repairs, what repairs are needed and actions to prevent future incidents. This will be detailed in a Recovery Plan, which will be developed to support the EMS Framework Document (Appendix L.1). Depending on the regulator involvement there may be a requirement to file incident reports with certain regulatory agencies prior to initiating the repairs and return to work in the area; these are very case specific and often dependent on whether personnel were injured or equipment damaged as a result of the slope failure.

6.17.4.2 Stockpile Slope Failure

All phases of the Project have the potential for structural failures of stockpiled materials, including topsoil, till, low grade ore and waste rock. Failure of stockpile slopes may be caused by weak foundation materials, improper design or construction, and/or erosion from surface water runoff.

The worst-case scenario of a stockpile slope failure could result in disturbance to surrounding area, including the potential for stockpiled material to enter nearby watercourses, damage to infrastructure and worker safety. As discussed below, stockpiles will be designed and constructed to minimize the likelihood for such failures to occur and to reduce the consequences of such failures should they occur.

The Project general arrangement plan calls for construction of six stockpiles: a NAG stockpile, a PAG stockpile, a till stockpile, an LGO stockpile, an organics stockpile, and a topsoil stockpile. With the exception of the organics and topsoil stockpiles, all of the stockpiles have been located in the area south of the open pit and between the open pit and the TMF and the processing faculty. This has been done to minimize the overall footprint of the Project and also to confine the potential for effects to the smallest area practicable.

The WRSA and the till stockpile are located upslope of the open pit and a failure of the main slope of any of these stockpiles would be contained within the area of the open pit and surrounding diversion berm. This leaves the LGO stockpile and organics stockpile as being located in areas where a slope failure could potentially reach fish and fish habitat. Both of these stockpiles are temporary with the LGO being processed toward the end of the mine life and the organics stockpile being recovered and used in reclamation. Each of the proposed stockpiles is discussed in more detail below.

The organics stockpile will be constructed to a height of approximately 10 m with an overall 7:1 or 8 degree slope. The stockpile will be located northwest of the open pit approximately 50 m from the proposed Seloam Brook realignment channel. A toe berm will be constructed around the perimeter of the stockpile to contain sloughing and minor erosion events. The stockpile will be hydro seeded as completed in order to maintain soils quality and minimize erosion during storage, and subsequently removed through use in progressive reclamation of the till and waste rock stockpiles during operation and closure and will have no significant presence prior to or shortly after closure commences.

The till stockpile will be constructed to a height of approximately 16m with an overall slope of 3:1 or 19 degrees. The stockpile is located east of the open pit and south of the diversion berm and internal haul road such that any failure would most likely be contained within this area. The till stockpile will be progressively capped with topsoil excavated from the open pit area and hydro seeded as completed or at the end of operations. This should allow for revegetation to being prior to or shortly after the closure phase commences.

The NAG stockpile will be constructed to a height of approximately 44m in lifts of 10 m with a catch berm in between for an overall slope to 3:1 or 19 degrees. The NAG stockpile is located within in the WRSA south of the open pit such that any failure would be contained within the open pit or in the area to the area immediately south and west of the pit. Construction of the NAG stockpile will begin during the construction phase and will be completed prior to or shortly after the closure phase commences. The NAG stockpile will be progressively capped with topsoil excavated from the open pit area and hydro seeded prior to or during the closure phase.

The PAG stockpile will be constructed to a height of approximately 24m in lifts of 10 m with a catch berm in between for an overall slope to 3:1 or 19 degrees. The PAG stockpile is located within in the WRSA south and east of the open pit and between the NAG stockpile and till stockpile such that any failure would be contained within the open pit. Construction of the PAG stockpile will begin during the construction phase and will be completed prior to or shortly after the closure phase commences. The PAG stockpile will be progressively capped with an impermeable clay cover and hydro seeded prior to or during the closure phase.

The LGO stockpile will be constructed to a height of approximately 48m in 10 m lifts with a catch berm in between for an overall slope to 3:1 or 19 degrees. The LGO stockpile is locate east of the Till stockpile and between it and the TMF, and just to the north of the mill facility for proximity to the crusher for future re-handling and processing. The toe of the LGO stockpile will be located approximately 125m from WC12 (tributary to Seloam Brook) and separated from the stream by a haul road such that the potential for a failure of the LGO stockpile to reach the system and affect fish and fish habitat will be minimized. Low-grade ore will remain until near the end of the operation phase. Much smaller quantities of high grade ore will be temporarily stockpiled near the crusher on the ROM and facilities pad. The high grade ore stockpiles will be added to by mine trucks and subtracted from by front end loaders in accordance with the respective mine delivery and mill processing rates. All ore stockpiles will be removed prior to the closure phase.

6.17.4.2.1 *Threshold for Determination of Significance*

The criteria that would determine a significant effect should a stockpile slope fail, is based primarily on worker health and safety, and secondarily on property damage and environmental effects. Should a slope failure result in injury or death to a worker, a loss of mobile equipment, or deposition of material into the aquatic or terrestrial environment beyond the Project property boundaries, the event will be considered significant.

6.17.4.2.2 *Potential Interactions and Effects*

The potential interactions between a stockpile slope failure and the VCs are outlined in Table 6.17-3. Only those interactions with a high potential to cause adverse effects should they occur are discussed in detail.

Table 6.17-3: Stockpile Slope Failure Interactions with VCs

Valued Component	**Potential Stockpile Slope Failure and VC Interaction**	**Potential for Adverse Effects**
Noise	No potential interaction anticipated	-
Air	Failure of stockpile slopes could potentially cause temporary dust generation	Low
Light	No potential interaction anticipated	-
Geology, Soils, and Sediment	Failure of stockpile slopes could potentially inundate natural soil and impact sediment release to water management ponds	Low
Groundwater Quality and Quantity	No potential interaction anticipated	-
Surface Water Quality and Quantity	Failure of stockpile slopes could expose material to erosion and weathering and affect discharge quality to/from water management ponds. Organics stockpile could directly affect downstream aquatic environment.	Low
Wetlands	Failure of stockpile slopes could potentially inundate downstream wetland areas, alter mitigation measures and affect discharge to/from water management ponds	Low

Valued Component	Potential Stockpile Slope Failure and VC Interaction	Potential for Adverse Effects
Fish and Fish Habitat	Failure of stockpile slopes could potentially inundate the downstream aquatic environment, alter mitigation measures and affect discharge to/from water management ponds. Organics stockpile could directly affect downstream aquatic environment.	Low
Habitat and Flora	Failure of stockpile slopes could potentially inundate down slope terrestrial environment.	Low
Terrestrial Fauna	No potential interaction anticipated	-
Avifauna	No potential interaction anticipated	-
Species of Conservation Interest and Species at Risk	No potential interaction anticipated beyond that identified for fish and fish habitat VC (above)	-
Mi'kmaq of Nova Scotia	No potential interaction anticipated	-
Physical and Cultural Heritage	No potential interaction anticipated	-
Socio-economic Conditions	Failure of stockpile slopes could potentially result in injury or death of mine workers	High

Dust suspended from the failure of a stockpile slope would be temporary and localized to the area directly around the slope failure. In addition, effects to discharges to receiving watercourses in the area is unlikely due to all surface water runoff being directed to water management ponds for collection and monitoring prior to discharge to the environment or return to the TMF, with the exception of the organics stockpile which could result in a direct release to the downstream aquatic environment (Seloam Brook). The organics stockpile is designed to be only 10 m high and sloped at a gentle 8:1 slope. The likelihood of slope failure is low. As a result, potentially adverse effects to air, geology, soil, and sediment, surface water quality and quantity, wetlands, and fish and fish habitat are considered low. Given the locations of stockpiles within the development area there is minimal potential for slope failures to extend beyond the currently planned disturbed area into "greenfield" environment. As a result, potentially adverse effects to habitat and flora, avifauna, fauna, species at risk or conservation interest, indigenous peoples or heritage resources are considered low.

Improperly designed or constructed stockpiles with poor surface water management could pose a health and safety risk to workers and a financial liability risk related to mobile equipment damage or loss through all phases of the Project.

The maximum effect of a stockpile slope failure as it relates to worker health and safety would be a death caused by falling objects. The maximum effect of a stockpile slope failure as it relates to financial liability would be damage to or a total loss of one or more pieces of mobile equipment.

Given proper stockpile design and surface water management, as well as progressive and final reclamation practices for the till and waste rock stockpiles, a major stockpile slope failure is unlikely to occur during any phase of the Project. Surface water runoff may result in minor and easily remedied erosion events particularly in the topsoil, organics, and till stockpiles. Stockpiles will be back-sloped away from slope faces to minimize the potential for such erosion.

6.17.4.2.3 *Mitigation and Emergency Response*

Geotechnical investigations have or will been undertaken to determine the suitability of foundation materials to support designed stockpiles and incorporated into the design of all stockpiles. Weak or unstable foundation materials will be removed prior to stockpile construction. Stockpile slopes will be designed at an angle determined by geotechnical analysis and acceptable safety factors, thereby reducing the likelihood of a slope failure. Placement of materials in the stockpiles would follow a plan developed for the stockpile that would consider thickness of the lift, compaction – if needed, load size, start and stockpile physical limits. Slopes will be monitored throughout the life of the operation with routine inspections by qualified staff and repairs made if warranted.

Stockpile design, construction, and monitoring will follow applicable regulations and recommendations provided by a qualified geotechnical professional. Stockpile slopes will be monitoring periodically by qualified personnel in accordance with recommendations provided by a qualified geotechnical professional.

If a stockpile slope failure were to occur, emergency procedures would be implemented that will be outlined in the site Emergency Response Plan, which will be developed to support the EMS Framework Document (Appendix L.1). Generally, stockpile slope failure emergency response includes evacuation of all equipment and personnel from the area, and areas up-slope and down-slope from the stockpile slope failure area. An assessment is then made using on-site staff and possibly external resources (geotechnical specialists) to make a determination if the area can be accessed to make repairs, what repairs are needed and actions to prevent future incidents. This will be detailed in a Recovery Plan, which will be developed to support the EMS Framework Document (Appendix L.1). Depending on the regulator involvement there may be a requirement to file incident reports with certain regulatory agencies prior to initiating the repairs and return to work in the area, these are very case specific and often dependent on whether personnel were injured or equipment damaged as a result of the stockpile slope failure.

6.17.4.3 Water Management Pond Failure

All phases of the Project have the potential for a water management pond failure. A failure at a water management pond is defined as a breach of retaining embankment through overflow or embankment structure failure resulting in the release of sediment laden water to the environment. A worst-case scenario would be complete failure at a water management pond, resulting in uncontrolled discharge of sediment laden water into the surrounding environment.

All contact water from the mine development area, including surface water run-off from the WRSA, LGO stockpile, topsoil stockpiles, and till stockpile, as well as from site roads and seepage from the TMF, will flow by gravity, with the aid of berms and channels, to water management ponds located down gradient of these structures. Open pit dewatering flows will also be pumped to and managed in a water management pond located at the toe of the ore stockpile. Water collected in the water management ponds will be monitored and if of suitable quality released to the downstream environment or pumped back to the TMF for use as process water.

The final design of the water management ponds, seepage collection ponds, and any additional required water management measures will be submitted as part of the IA process.

Water Management ponds and associated water management structures will typically be designed to accommodate a 1-in-10 year, 24 hr storm event (approximately 116 mm) plus direct precipitation from a 1-in-200 year, 24-hr storm event (approximately 184 mm) falling directly on the surface of the pond. Water management infrastructure has been sized to pump back collected flows to the TMF supernatant pond over a 10-day drawdown period. Storm events and their design factors are adjusted as appropriate to reflect the predicted effects of climate change. Overflow weirs will be constructed in water management pond embankments to facilitate safe discharge of flows exceeding the design flows of the pond, up to the Inflow Design Flood (IDF) for the ponds. The IDF for each pond will be estimated based on dam classification of the retaining embankments for the ponds, and will be greater than or equal to a 1-in-100 year return period storm event. The dam classification for the seepage collection pond dams will be evaluated as part of the IA process. In the case of a storm event water management ponds will be monitored regularly.

6.17.4.3.1 *Threshold for Determination of Significance*

The criteria that would determine a significant effect should a water management pond fail, is based primarily on environmental protection. Should a water management pond failure result in an uncontrolled discharge of sediment laden water to Seloam Brook the event will be considered significant.

Comparison of surface water samples to CCME FWAL TSS guidelines and MDMER TSS guidelines will be utilized to determine if sediment laden water will have an impact on downstream surface water quality in Seloam Brook and subsequently on fish and fish habitat.

6.17.4.3.2 *Potential Interactions and Effects*

The potential interactions between water management pond failure and the VCs are outlined in Table 6.17-4. Only those interactions with a high potential to cause adverse effects should they occur are discussed in detail.

Table 6.17-4: Water Management Pond Failure Interactions with VCs

Valued Component	**Potential Water Management Pond Failure and VC Interaction**	**Potential for Adverse Effects**
Noise	No potential interaction anticipated	-
Air	No potential interaction anticipated	-
Light	No potential interaction anticipated	-
Geology, Soils, and Sediment	Failure of water management pond could potentially cause the release of suspended solids to settle in Seloam Brook and affect sediment quality	Low
Groundwater Quality and Quantity	No potential interaction anticipated	-
Surface Water Quality and Quantity	Failure of water management pond could potentially cause the release of suspended solids into the downstream aquatic environment via Seloam Brook and affect water quality	High
Wetlands	Failure of water management pond could potentially cause sediment laden water to discharge to downstream wetlands in the Seloam Brook drainage	High
Fish and Fish Habitat	Failure of water management pond could potentially cause the release of suspended solids into the downstream aquatic environment and affect water quality in Seloam Brook	High
Habitat and Flora	No potential interaction anticipated	-
Terrestrial Fauna	No potential interaction anticipated	-
Avifauna	No potential interaction anticipated	-

Valued Component	Potential Water Management Pond Failure and VC Interaction	Potential for Adverse Effects
Species of Conservation Interest and Species at Risk	Failure of water management pond could potentially cause the release of suspended solids into the downstream aquatic environment and affect water quality in Seloam Brook	High
Mi'kmaq of Nova Scotia	No potential interaction anticipated	-
Physical and Cultural Heritage	No potential interaction anticipated	-
Socio-economic Conditions	No potential interaction anticipated	-

The volume of suspended solids expected to settle out of solution in a concentrated area should a failure at the water management ponds occur is considered minimal. As a result, potentially adverse effects to the sediment quality portion of the geology, soil, and sediment quality VC are considered low. Similarly, the relatively small size and volume for the seepage collection pond structures (design capacities of approx. 15,000 to 20,000 m^3) would suggest the capacity for impacts beyond the aquatic environment to be low.

Improper design and construction, inadequate water management pond capacity and water level monitoring, combined with a significant precipitation event, may cause a water management pond failure and thus, pose a risk to surface water quality, wetlands, fish and fish habitat, and SOCI/SAR through all phases of the Project.

The maximum effect of a water management pond failure as it relates to VCs above would be heavy siltation of wetlands and Seloam Brook and subsequent stresses on fish and other aquatic species.

6.17.4.3.3 *Mitigation and Emergency Response*

The water management ponds will be designed by a qualified professional and lined with suitable materials, such as clay or a geosynthetic liner. In the event of a 1 in 100 year precipitation event that creates volumes in excess of the capacity available in ponds and ditching, a spillway will be used for overflow to minimize the potential for an infrastructure failure. Water management ponds will be monitored regularly to ensure stability and acceptable freeboard. In the case of a storm event, monitoring frequency will be increased.

If a water management pond failure were to occur, emergency procedures would be implemented that will be outlined in the site Emergency Response Plan, which will be developed in accordance with the EMS Framework Document (Appendix L.1). Generally, water management pond failure emergency response includes raising the alarm and mobilizing equipment and personnel to the area in order to effect repairs and minimize releases. An assessment is then made using on-site staff and possibly external resources (including surface water and environmental specialists) as to what repairs are needed and actions to prevent future incidents. This will be detailed in a Recovery Plan, which will be developed to support the EMS Framework Document (Appendix L.1). Depending on the regulator involvement there may be a requirement to file incident reports with certain regulatory agencies prior to initiating the repairs and return to work in the area, these are very case specific and often dependent on whether personnel were injured or equipment damaged as a result of the water management pond failure.

A TMF Operation, Maintenance and Surveillance (OMS) Manual and an Emergency Response Plan will be developed in accordance with the EMS Framework Document (Appendix L.1) for the Project and will outline emergency response procedures, trigger levels for monitoring pond levels, and any mitigation measures that may be in place (such as standby pump systems for increased flows, etc.).

6.17.4.4 TMF Dam Failure

All phases of the Project have the potential for a TMF dam failure. A failure of the TMF dam is defined as a breach of the TMF containment structure through overflow or dam structural failure resulting in the release of tailings solids and supernatant water to the environment. A worst-case scenario would be complete failure of the main dam at its highest point, resulting in uncontrolled discharge of the stored tailings mass and supernatant water into the surrounding environment.

The FMS TMF will be active throughout the 7 year mine life and has been designed to accommodate and permanently and safely store 13.0 million tonnes of tailings along with 800,000 m3 of water with sufficient freeboard to accommodate wave run-up and the design flood.

Several alternative TMF site locations were evaluated for the FMS Mine Site with the primary considerations being the storage capacity and water balance, surface area, the number and size of containment structures required including their design and stability, proximity to other facilities (particularly the mill for the purposes of tailings transport and reclaim water) and potential for impacts on fisheries and aquatic resources and other VCs.

The selected TMF option is located to the east and up-gradient of the proposed open pit, and is situated in a position that limits impacts to wetlands and streams to the maximum practical extent. The TMF positioned in this manner allows the mine facilities to be clustered upstream of the open pit and simplifies surface water and groundwater management requirements for the mine site.

The TMF embankment will be raised in 3 stages by downstream method. The ultimate embankment will be approximately 25 m high from crest to toe in maximum section and the maximum depth of stored tailings within the facility will be approximately 20 m.

Construction of the TMF will commence during the construction phase prior to commencement of operations and water will be allowed to collect behind the Stage 1 dam in sufficient volume to support process water requirements. The TMF will be contained on three sides by a continuous embankment and on one side by natural ground. A rockfill causeway will separate the facility into two cells to increase filling efficiency and allow for positioning of the reclaim water pumps and pipeline.

The TMF embankment is designed as an earthfill-faced rockfill embankment and appropriately graded filter and transition zones. The primary construction materials for the embankment will be NAG rockfill and clay fill sourced locally from the open pit and surrounding borrow areas. The tailings slurry will be conveyed to the TMF by pipeline to create a subaerial tailings beach along the upstream embankment crest to minimize seepage. An upstream liner of compacted fine-grained earthfill is included in the Stage 1 design to reduce seepage gradients prior to development of the tailings beach.

The anticipated scenario for closure of both TMF facilities is that exposed tailings beaches will be covered and then re-vegetated. A spillway invert will be lowered within the tailings pond to allow free flow of runoff out of the facility once water quality monitoring indicates pond water to be suitable for direct discharge, or until such time to direct this runoff to the open pit.

6.17.4.4.1 *Threshold for Determination of Significance*

The criteria that would determine a significant effect should a tailings dam fail, is based primarily on environmental protection as well as worker health and safety. Should a tailings dam failure result in an uncontrolled discharge of stored tailings solids and water, the event will be considered significant.

Comparison of surface water samples to CCME FWAL TSS guidelines and MDMER TSS guidelines will be utilized to determine how far sediment laden water will have an impact on downstream surface water quality and subsequently on fish and fish habitat.

6.17.4.4.2 *Potential Interactions and Effects*

The potential interactions between tailings dam failure and the VCs are outlined in Table 6.17-5. Only those interactions with a high potential to cause adverse effects should they occur are discussed in detail.

Table 6.17-5:FMS TMF Dam Failure Interactions with VCs

Valued Component (VC)	Potential Water management Pond Failure and VC Interaction	Potential for Adverse Effects
Noise	No potential interaction anticipated	-
Air	No potential interaction anticipated	-
Light	No potential interaction anticipated	-
Geology, Soils, and Sediment	Failure of TMF dam would cause the release of tailing solids and supernatant water into the downstream environment affecting soil and sediment quality	High
Groundwater Quality and Quantity	No potential interaction anticipated	-
Surface Water Quality and Quantity	Failure of TMF dam would cause the release of tailing solids and supernatant water into the downstream environment affecting water quality	High
Wetlands	Failure of TMF dam would cause the release of tailing solids and supernatant water into the downstream environment affecting wetlands	High
Fish and Fish Habitat	Failure of TMF dam would cause the release of tailing solids and supernatant water into the downstream environment affecting fish and fish habitat	High
Habitat and Flora	Failure of TMF dam would cause the release of tailing solids and supernatant water into the downstream environment affecting habitat and flora	High
Terrestrial Fauna	Failure of TMF dam would cause the release of tailing solids and supernatant water into the downstream environment affecting fauna	High
Avifauna	Failure of TMF dam would cause the release of tailing solids and supernatant water into the downstream environment affecting birds	High
Species of Conservation Interest and Species at Risk	Failure of TMF dam would cause the release of tailing solids and supernatant water into the downstream environment affecting SOCI and SAR	High
Mi'kmaq of Nova Scotia	Failure of TMF dam would cause the release of tailing solids and supernatant water into the downstream environment affecting traditional use of the land and resources	High

Valued Component (VC)	Potential Water management Pond Failure and VC Interaction	Potential for Adverse Effects
Physical and Cultural Heritage	Failure of TMF dam would cause the release of tailing solids and supernatant water into the downstream environment potentially affecting heritage resources	High
Socio-economic Conditions	Failure of TMF dam could cause death or injury to persons in the path of the event and would likely result in the suspension of operations at the FMS Mine Site resulting in layoffs and economic consequences	High

The residual effects from a catastrophic TMF dam failure would be significant and regional in extent, and effects could endure well into the future. A conservative qualitative assessment of the temporal and geographical extent of the effects of a catastrophic dam break is presented here for downstream receptors. While much of the tailings would be expected to report to the open pit at the FMS Mine Site, the most significant effects would be felt locally in WC12 and the Seloam Brook drainage basin, and regionally into Fifteen Mile Stream.

The potential effects of a tailing dam breach on soil and sediment quality are expected to be high and have regional geographic extent. The effects would be felt long-term but are considered reversible. Effects to soils and sediments would include covering of soil, with tailings, due to erosion, and alteration of soil and sediment chemistry as a result of extensive sediment (tailings) deposition.

The potential effects of a tailing dam breach on surface water quality include increases in the concentration of suspended material through direct sediment loading from tailings release, as well as from scouring of streambeds, altered chemical composition of the water, and altered sediment quality. The magnitude of this effect is considered high in terms of exceedances of applicable water quality guidelines for the protection of aquatic life and the effect is expected to be regional in scale. A breach would be expected to lead to exceedance of applicable guidelines for suspended sediment loads for the protection of aquatic life from tailings and increased scouring. The effects would be most apparent in the short term, but could be felt long-term and are considered reversible in the long term as remediation efforts will augment natural recovery processes.

The potential effects of a tailing dam breach on wetlands downstream of the TMF, in the area of Seloam Brook, would be significant due to scouring effects and/or inundation with tailings solids deposition. The sudden release of supernatant water and tailings solids would scour wetlands in its path. The deposition of tailings solids would likely alter wetland morphologies, including soil and water regimes. The geographic extent of this effect is considered regional and the effects would be significant in the medium-term. The effects will likely be reversible for some occurrences, particularly over the longer term and through the implementation of adaptive mitigation measures, including possible remediation, or habitat off-setting.

A catastrophic dam failure would have direct and indirect effects to fish and fish habitat, and these effects would likely be regional to the directly affected waterbodies and those downstream through decreases in water quality. The sudden release of water and tailings would directly affect fish and fish habitat, and aquatic resources by washing or smothering fish and aquatic organisms out of the downstream environment and scouring the creek beds. TMF supernatant water would flow into Seloam Brook, mixing with and displacing creek water and likely continue downstream and beyond. If a large enough volume of tailings were released, the creek and lake bottom would be partly or completely covered, potentially affecting or eliminating more fish habitat. The magnitude of the effect on fish and fish habitat is considered high and regional in geographic extent. The potential effects are considered reversible in the long-term.

Vegetation would be affected by a catastrophic tailings dam failure by direct damage to riparian, wetlands, or any other vegetation communities or rare plants occurring downstream of the TMF. As the tailings flow downstream, they would most likely create a fan, smothering any vegetation in the fan's footprint. The direct effects from a catastrophic dam failure are be predicted to be regional and long-term because of the natural processes of dispersion and regrowth. These effects are expected to be partially reversible after clean-up and restoration efforts, as by their nature, the more sensitive ecosystems and rare plants require particularly unique conditions.

A catastrophic dam failure would have direct effects to any wildlife, including birds, other fauna and species at risk, caught in the path of the outflow event, as these individuals could be killed by the event itself. However, this effect would most likely be limited to a few occurrences. Although direct mortality effect on an individual is permanent, any population-level effects are reversible in the long-term. The more prominent and persistent effect would be the indirect effect of loss or alteration of habitat, particularly for any species that are highly dependent on wetland and riparian areas. Food resources such as aquatic invertebrates, fish, or plants could be directly or indirectly affected. These effects are expected to be local to the affected area and may persist long term, although abundant equivalent habitat would likely be available in adjacent areas given the rural location of this Project. They would be reversible over time and would be enhanced through potential fish habitat offsetting efforts, which would provide appropriate habitat for some wildlife species.

A catastrophic dam failure would have direct effects to Mi'kmaq traditional land use, as fish resources downstream of the TMF dam would be unavailable after the event. Fish and fish habitat would be affected over the long-term. As well, even if the fish and fish habitat recover fully from the event, perceived potential contamination concerns could limit their use in the longer term. Traditional use access may also be affected if access routes are washed out from the event. These effects would be at least partially reversible due to clean-up and restoration efforts, which may include repairing any access routes. It is difficult to predict the reversibility of the use of fish resources as the perception of contamination may persist even if analyses show the fish are safe for human consumption.

A catastrophic dam failure would have significant effects on any cultural or heritage resources in the direct path of the event. However, no culturally sensitive areas have been identified in the inundation zone. of either TMF dam. A tailings dam breach could obliterate any such unidentified resources, however, it is also possible that such an event may also uncover previously unidentified resources.

From a socio-economic perspective, a catastrophic TMF failure would likely cause the Project to be put on care and maintenance, at least temporarily. This could cause the Proponent to lay off staff, although significant numbers could be retained to undertake restoration measures. Such an event could have significant economic consequences for the regional economy. This effect would be regional in extent and would be reversible if the Project can restart, which would most likely occur over the medium-term.

From a health perspective, there is no permanent population downstream of either TMF, and the only temporary population likely to be present would be mine workers and is estimated to be fewer than 10 people at any one time. However, in the event of a dam failure the potential for loss of life for those in the immediate area is high.

6.17.4.4.3 *Mitigation and Emergency Response*

The TMF is designed, and construction is overseen and approved by qualified professional design engineers (the Design Engineer/Engineer of Record) with specific and extensive experience in designing, constructing, operating, monitoring and maintaining such structures.

The design and location of the TMF has taken into account the following general design requirements:

- situating the TMF away from sensitive environmental features including fish bearing drainages;
- clustering the facilities to minimize the overall footprint;
- staged development of the facility over the life of the Project;

- permanent, secure, and total confinement of all tailings solids within engineered disposal facilities;
- control, collection, and removal of free-draining liquids from the tailings facilities during operations for recycling as process water to the maximum practical extent; and
- release suitable quality supernatant from the pond through an engineered spillway post-closure.

The TMF design process includes extensive geotechnical investigations of foundation materials underlying the footprint of the dam. The Design Engineer/Engineer of Record specifies requirements for removal of weak or unstable materials from the footprint prior to construction of the starter dam in order to ensure foundation stability. As well, the Design Engineer/Engineer of Record specifies and tests the quality of materials for use in dam construction in order to meet the dam design criteria. In addition to the detailed dam design, the Design Engineer/Engineer of Record will undertake a Dam Breach Inundation Study for incorporation into an Emergency Response Plan, which will be developed in accordance with the EMS Framework Document (Appendix L.1). This will be completed in conjunction with development of the TMF Final Design Report which will be completed prior to construction of the TMF. The Design Engineer/Engineer of Record will also develop the Operation, Monitoring and Surveillance (OMS) Manual which will be completed prior to operation of the TMF. The OMS Manual will outline a schedule for routine inspection and instrumentation monitoring to be developed in conjunction with the mine construction and operation schedule.

The results of the inspection and monitoring program will be used to measure the success of the management strategies and to identify where additional mitigation may be necessary. Monitoring will continue for a period of time after mine closure to confirm that reclamation objectives are being achieved and to identify repair or maintenance requirements. Inspection and monitoring may include:

- visual inspection of embankments, crests, and slopes to check for signs of cracking, settlement, or bulging;
- visual inspection of the TMF embankment toe areas to check for signs of ground heave or seepage;
- installation of piezometers during operation to monitor water pressures in the clay core and foundation;
- installation of surface survey monuments during TMF construction; and
- recording of TMF operating parameters, as required.

Monitoring and responding to any deformation of TMF embankments is critical to maintaining their stability. Instrumentation monitoring will be routinely completed during construction and operations. Measurements during construction will be conducted and analyzed on a routine basis to monitor the response of the embankment fill and the foundation from the loading of the embankment fill. Surface monuments will be surveyed at least twice per year during Operations. The OMS Manual will be prepared following initial construction and prior to commissioning of the TMF, and will provide comprehensive operating instructions and monitoring frequencies for the TMF and related facilities.

Volumes of tailings deposited in the TMF will be monitored by reference to the records kept as part of the mine plan. These records will provide a basis for the purpose-designed monitoring of the performance of the TMF, which will also include visually checking the condition of embankment slopes and surface water control structures. The monitoring program will also include pond elevation, bathymetric surveys to determine pond depth and volume, as well as recording of reclaim water rates. A tailings deposition strategy will be implemented to selectively develop tailings beaches along the embankments, thereby producing an extensive low permeability zone that facilitates seepage control and maintains the operational supernatant pond away from the crest of the embankment.

In addition to the instrumentation monitoring described above, the TMF dams would be inspected at least annually by the design geotechnical Engineer-of-Record. The reviewer would be a Qualified Professional Engineer. Any problem areas identified would be repaired immediately. Independent Dam Safety Reviews (DSR), to further monitor operation, maintenance, surveillance, and performance of the dams during Operations and Closure, will be conducted. DSR frequencies will meet or exceed regulatory requirements.

The TMF dams have been designed to meet Canadian Dam Association (CDA) Dam Safety Guidelines (CDA, 2013 & 2014) and to handle the design flood while maintaining a minimum freeboard between the water level and the dam crest. As per the Guidelines, each structure is assigned a “Dam Class”. The TMF dam classification considers the potential incremental consequences of an embankment failure defined as the total adverse effect from an event with dam failure compared to the adverse effect that would have resulted from the same event had the dam not failed. Four areas are evaluated under the conditions; potential impacts to downstream populations, potential loss of life, potential loss of environmental or cultural values, and potential infrastructure or economic losses. The Dam Class determines the minimum target levels for Inflow Design Flood (IDF) and Earthquake Design Ground Motion (EDGM) for the design of the dam structure and water management systems.

Based on an assessment of the consequences of a dam failure, which was based on a worst-case scenario predictive model, the hazard consequence classification, the TMF embankments have been assigned a dam classification of **HIGH**.

The following design flood and earthquake levels were adopted from the CDA guidelines (CDA, 2013 & 2014) for a **HIGH** dam hazard classification for the construction and operations phases of the Project:

- IDF: 1/3 between the 1/1,000 year return period event and the Probable Maximum Flood (PMF); and
- EDGM: the 1/2,475 year return period seismic event.

For a **HIGH** dam classification during the passive care phase (i.e., post-closure), CDA guidelines recommend that the TMF be designed to withstand the following seismic and precipitation events.

- IDF: 2/3 between the 1/1,000 year return period event and the PMF; and
- EDGM: 1/2 between the 1/2,475 year and the 1/10,000 year (or MCE) return period seismic events.

The IDF is the most severe inflow flood (peak, volume, shape, duration, timing) for which a dam and its associated facilities are designed (CDA 2014). The IDF is used to determine spillway and freeboard requirements, while the EDGM is used to confirm the stability of the design TMF embankments under seismic loading conditions. Based on the High dam hazard consequence classification and the applied design criteria, the design incorporates increased conservatism to reduce the likelihood of failure.

As per the CDA requirement for a High hazard classification, the IDF should be 1/3 between the 1:1000 year event and the Probable Maximum Flood (PMF). The PMF is a flood that results from a precipitation event known as the Probable Maximum Precipitation (PMP). The PMP is defined as the most extreme precipitation event physically possible in the area.

These design floods and the criteria upon which they are based are reviewed and revised as appropriate to reflect and incorporate predicted effects of climate change.

A detailed ERP specific to the TMF will be developed in conjunction with development of the OMS Manual prior to commissioning of the TMF The OMS manual and the ERP will be aligned, to ensure there are no functional gaps between normal operations and emergency response, and that procedures are in place to transition from normal conditions to an emergency situation that may arise. Carrying out operations, maintenance, and surveillance activities as outlined in the OMS Manual will help to minimize the potential for an emergency at the TMF. Personnel involved in operations, maintenance, and surveillance at the TMF will be familiarized with the ERP.

Major storm events or unforeseen operational circumstances may still result in an emergency related to the TMF. The ERP for the site discusses in detail the definition of various levels of emergency situations and response for each emergency situation. The ERP outlines the triggers associated with specific emergencies related to the overall mine site and specifically to TMF operations.

The ERP will:

- Identify possible emergency situations that could occur during the initial construction, operations and ongoing construction, closure, and post-closure phases of the life cycle of a tailings facility, and which could pose a risk to populations, infrastructure, and the environment; and,
- Describe measures to respond to emergency situations and to prevent and mitigate on and off site environmental and safety impacts associated with emergency situations.

Examples of possible emergencies addressed in ERP include:

- structural failures of the facility;
- rising water levels within the facility;
- cracking of a dam;
- a sudden loss of environmental containment of the facility; and
- or other events typically linked to the loss of one or more critical controls that present a risk to the facility.

In the event of upset conditions related to failure of the TMF embankment, an on-site staff member tasked with the responsibility of coordinating the Emergency Response Plan, which will be developed to support the EMS Framework Document (Appendix L.1), would launch an investigation of the incident and the following emergency response approach will be initiated:

- ensure the safety of the employees, site personnel, and the public;
- notify the appropriate stakeholders, including government agencies and any nearby communities or landowners; and
- mobilize the necessary equipment and crews to contain and clean up the incident and rehabilitate the site to protect the environment.

A site-wide communication system (including access roads) will ensure rapid notification of dam failure. The site will have a trained Emergency Response Team with resources to contain and recover spills, or to reduce the size of a spill if complete containment and recovery is not possible. Following a dam failure incident, a program would be implemented to monitor any residual effects in the freshwater environment, including water quality, sediment quality, aquatic resources, fish, and fish habitat.

6.17.4.5 Infrastructure Failure

All phases of the Project have the potential for failures of infrastructure. Failure of these structures may be caused by improper design and construction, or natural causes such as hurricanes or earthquakes. A worst-case scenario would be failure of multiple operational components as a result of a natural cause impacting worker health and safety and the surrounding environment. The following operational facilities will be installed or constructed to support the Project:

- concentrator building;
- crusher and conveyors;

- underground septic tanks and leach drains;
- reclaim barge, pipeline and reclaim water tank;
- raw water pumphouse, pipeline and raw water tank;
- tailings pipeline;
- diesel fuel storage and distribution system;
- electrical substation and overhead transmission lines;
- pole mounted lighting;
- vehicle washdown facility;
- pre-fabricated office facility and maintenance building; and
- fire protection systems.

These components are described in detail in Section 2.2.1 of this EIS.

6.17.4.5.1 *Threshold for Determination of Significance*

The criteria that would determine a significant effect should an infrastructure failure occur is based primarily on worker health and safety and environmental impact, and secondarily on property damage. Should an infrastructure failure result in injury or death to a worker or a loss of infrastructure the event will be considered significant.

Should an infrastructure failure event result in the loss of any quantity of fuel, oil, lubricant, or other Project-related raw materials to the environment, such that a measurable contamination of soil, surface water, or groundwater results, the event will be considered significant.

Contamination is defined as the following:

- Soil
  - when concentrations of any contaminant exceed the guidelines provided in the Nova Scotia Contaminated Sites Regulations – Tier 1 Environmental Quality Standards for Soil at a Non-potable Site, Section 1, Table 1B;
- Surface Water
  - when concentrations of any contaminant exceed the guidelines provided in the Nova Scotia Contaminated Sites Regulations – Tier 1 Environmental Quality Standards for the Protection of Freshwater Aquatic Life in Surface Water, Section 1, Table 3;
- Groundwater
  - when concentrations of any contaminant exceed the guidelines provided in the Nova Scotia Contaminated Sites Regulations – Tier 1 Environmental Quality Standards for Groundwater at a Non-potable Site, Section 1, Table 4.

6.17.4.5.2 *Potential Interactions and Effects*

The potential interactions between infrastructure failure and VCs are outlined in Table 6.17-6. Only those interactions with a high potential to cause adverse effects should they occur are discussed in detail.

Table 6.17-6: Infrastructure Failure Interactions with VCs

Valued Component	Potential Infrastructure Failure and VC Interaction	Potential for Adverse Effects
Noise	No potential interaction anticipated	-
Air	An infrastructure failure event could potentially cause a fuel oil spill or small fire and release particulate matter, carbon monoxide, sulphur dioxide, nitrous oxides, and volatile organic compounds to the atmosphere	Low
Light	No potential interaction anticipated	-
Geology, Soils, and Sediment	An infrastructure failure event could potentially cause a release of fuel oil to soil if released to the terrestrial environment, or sediment if released to the aquatic environment	Low
Groundwater Quality and Quantity	No potential interaction anticipated	-
Surface Water Quality and Quantity	No potential interaction anticipated	-
Wetlands	No potential interaction anticipated	-
Fish and Fish Habitat	No potential interaction anticipated	-
Habitat and Flora	No potential interaction anticipated	-
Terrestrial Fauna	No potential interaction anticipated	-
Avifaunas	No potential interaction anticipated	-
Species of Conservation Interest and Species at Risk	No potential interaction anticipated	-
Mi’kmaq of Nova Scotia	No potential interaction anticipated	-
Physical and Cultural Heritage	No potential interaction anticipated	-
Socio-economic Conditions	Failure of infrastructure could potentially cause injury or death to mine workers	High

The emissions produced through volatilization of fuel oil or through a small fire from an infrastructure failure event would be temporary and localized to the area directly around the failure. In addition, a release of fuel oil, lubricants or other Project-related raw materials relating to infrastructure failure would be minor in volume and likely contained and cleaned up prior to significantly effecting soil. As a result, potentially adverse effects to the air and greenhouse gases, and geology, soil, and sediment quality are considered low.

Infrastructure that is improperly designed or constructed poses a health and safety risk to workers during the construction, and operation phases, as well as a financial liability risk related to infrastructure damage or loss.

The maximum effect of an infrastructure failure as it relates to worker health and safety would be a death caused by falling objects or collapsing structures. The maximum effect of an infrastructure failure as it relates to financial liability would be damage to or a total loss of one or more pieces of infrastructure and/or a loss of production.

Given proper design and construction of infrastructure, failure has the most potential to occur during the operation phase of the Project when infrastructure is being worn and torn through operational processes and used and maintained by site personnel. Infrastructure with moving components, such as the crusher and conveyor, are more likely to fail than static infrastructure, such as the office and workshop facilities.

As a consequence of Project design considerations, infrastructure is located in close proximity within a relatively small footprint area. As a result, a release of fuel oil, lubricants or other Project-related raw materials would likely be contained and cleaned up within the FMS property boundaries. Given infrastructure failure would likely not result in disturbance to a "greenfield" environment, potential adverse effects to other VCs from an infrastructure failure occurrence are anticipated to be low to non-existent.

6.17.4.5.3 *Mitigation and Emergency Response*

Infrastructure at the FMS Mine Site will be designed and constructed in accordance with good engineering practice and applicable building codes. Given the relatively short life of the Project, failure would not be expected to occur without being acted upon by extreme natural causes, such as a hurricane or earthquake, or human error. Experienced and certified trained personnel will be employed at the site to operate and maintained equipment and infrastructure. All personnel will receive an appropriate level of training in respect of their operating area and responsibilities,

On-site infrastructure would be informally inspected by site personnel for signs of premature failure through the normal course of the working shift. More rigorous inspection would occur with routine preventative maintenance. Existing legislation is well established and understood by the Proponent personnel through the development and operation of the Touquoy Gold Project.

A Health and Safety Plan, which will be developed in accordance with the EMS Framework Document (Appendix L.1), will be developed and implemented for the FMS Mine Site, which will include evacuation procedures, proper housekeeping procedures for the storage and use of small equipment, and materials.

6.17.5 Accidents

6.17.5.1 FMS Study Area

6.17.5.1.1 *Fuel and/or Other Spills*

All phases of the Project have the potential for fuel and/or other spills to occur. The potential for a spill is most likely during the construction and operation phases when the following is occurring at the FMS Mine Site:

- bulk transport and storage of diesel fuel;
- routine transfer and handling of diesel fuel;
- operation and maintenance of mobile equipment;
- generation of waste fluids such as oils, lubricants, and antifreeze;

- reagents usage in the mill process; and
- transportation of concentrate.

The closure phase of the Project will have reduced risk due to a number of these listed activities ceasing once the operation phase is over.

Spills associated with these activities may occur through failure of storage tanks, improper fuel transfer procedures, fuel/hydraulic line breaks or leaks, spillage or failure of storage containers, and/or mobile equipment and refueling truck accidents.

A worst-case scenario would be a transportation collision or bulk storage tank failure causing the entire amount of material being transported or stored to be spilled. The effects of the spill would vary depending on the material spilled, the location of the spill, and whether the spill was contained to land or escaped into a water body. Diesel fuel and gasoline are toxic to aquatic life and would have the greatest impact to the aquatic environment.

Diesel fuel will be delivered to a 60,000 litre double-walled aboveground storage tank or tanks via licensed tanker trucks and will be used in all large mobile equipment. Gasoline use is expected to be minor, as required for light vehicles only, and will be satisfied either by purchase from local retail suppliers or from a small double-walled aboveground storage tank located near the maintenance building. Other petroleum based and non-petroleum based liquids will be used for equipment maintenance.

Diesel fuel and lubricant storage will be located near the maintenance shop and ROM stockpile and accessed by authorized personnel only using a cardlock system. A dedicated refueling truck will also deliver these materials as needed to the mine and maintenance mobile fleet. The fleet of highway trucks required to transport FMS concentrate to Touquoy Mine Site will be refueled at the FMS Mine Site as needed.

Reagents to be used in the mill include PAX, MIBC, W34 frother and flocculant, and will be delivered by truck in either 25kg bags (PAX and W34 frother) or bulk liquid totes (MIBC). All reagents will be stored and prepared in a separate, self-contained area within the process plant and delivered by dedicated metering pumps to their respective addition points in the process.

The gold concentrate produced will consist of a gravity concentrate and a float concentrate. The gravity concentrate represents a small portion of the gold concentrate produced and will be stored and transported in specialized hoppers. Hoppers will be transported on the back of a flatbed once a hopper has been filled and delivered directly to the Touquoy processing facility. The majority of concentrate to be hauled will be float concentrate. Up to 100,000 t will be hauled on an annual basis in purpose-built side dump haul trucks. The trucks will be loaded inside the concentrate loadout area by front-end loader. The concentrate will be covered to prevent any losses and the trucks weighed prior to leaving to ensure appropriate loading.

With regards to a concentrate spill, a worst-case scenario would be a transportation accident causing the entire amount of concentrate being hauled to be spilled. Concentrate has a fine sand consistency and is insoluble. As such any spill would be limited in extent and given the high value of the product immediately contained and cleaned up to minimize losses.

6.17.5.1.1.1 Threshold for Determination of Significance

The criteria that would determine a significant effect should a fuel and/or other spill occurs is based primarily on environmental protection. Should a spill result in the loss of any quantity of fuel, oil, lubricant, or other Project-related raw materials to the environment such that a measurable contamination of soil, surface water, or groundwater results, the event will be considered significant.

Contamination is defined as the following:

- Soil
    - when concentrations of any contaminant exceed the guidelines provided in the Nova Scotia Contaminated Sites Regulations – Tier 1 Environmental Quality Standards for Soil at a Non-potable Site, Section 1, Table 1B;
- Surface Water
    - when concentrations of any contaminant exceed the guidelines provided in the Nova Scotia Contaminated Sites Regulations – Tier 1 Environmental Quality Standards for the Protection of Freshwater Aquatic Life in Surface Water, Section 1, Table 3;
- Groundwater
    - when concentrations of any contaminant exceed the guidelines provided in the Nova Scotia Contaminated Sites Regulations – Tier 1 Environmental Quality Standards for Groundwater at a Non-potable Site, Section 1, Table 4.

6.17.5.1.1.2 Potential Interactions and Effects

The potential interactions between fuel and/or other spills and VCs are outlined in Table 6.17-7. Only those interactions with a high potential to cause adverse effects should they occur are discussed in detail.

Table 6.17-7: Fuel and/or Other Spills Interactions with VCs

Valued Component	Potential Fuel and/or Other Spills and VC Interaction	Potential for Adverse Effects
Noise	No potential interaction anticipated	-
Air	Fuel and/or other spills could potentially volatilize into the atmosphere	Low
Light	No potential interaction anticipated	-
Geology, Soils, and Sediment	Fuel and/or other spills could potentially contaminate bedrock and soil if released to the terrestrial environment Fuel and/or other spills could potentially contaminate sediment if released to the aquatic environment	High
Groundwater Quality and Quantity	Fuel and/or other spills could potentially contaminate groundwater if released to the terrestrial environment and soil/bedrock conditions allow vertical migration	High
Surface Water Quality and Quantity	Fuel and/or other spills could potentially contaminate surface water if released to the aquatic environment	High
Wetlands	Fuel and/or other spills could potentially contaminate wetlands if released to the aquatic or terrestrial environment	High
Fish and Fish Habitat	Fuel and/or other spills could potentially adversely affect fish and fish habitat if released to the aquatic environment	High

Valued Component	Potential Fuel and/or Other Spills and VC Interaction	Potential for Adverse Effects
Habitat and Flora	Fuel and/or other spills could potentially contaminate flora if released to the terrestrial environment	High
Terrestrial Fauna	Fuel and/or other spills could potentially adversely affect fauna	Low
Avifauna	Fuel and/or other spills could potentially adversely affect birds	Low
Species of Conservation Interest and Species at Risk	Fuel and/or other spills could potentially adversely affect species of conservation interest and species at risk if released to the terrestrial environment and/or aquatic environment	High
Mi’kmaq of Nova Scotia	Fuel and/or other spills could potentially adversely affect traditional usage of land and resources by Indigenous Peoples.	High
Physical and Cultural Heritage	No potential interaction anticipated	-
Socio-economic Conditions	Fuel and/or other spills could potentially be hazardous to employee health.	Low

Volatilization of fuel oil and/or other substances should they be spilled would be localized to the area directly around the spill. In addition, only a minor portion of diesel fuel oil, the most widely used substance for the Project, is considered volatile. Adverse effects to birds and fauna are considered low due to the developed nature and lack of habitat in areas (FMS Mine Site) considered being at the greatest risk for fuel and/or other spills. As a result, potentially adverse effects to the atmospheric environment, avifauna, and fauna are considered low.

Accidents or malfunctions that result in a fuel and/or other spill pose a high environmental risk to the following VCs:

- geology, soils, and sediment;
- surface water quality and quantity;
- groundwater quality and quantity;
- wetlands;
- habitat and flora;
- fish and fish habitat;
- SOCI/SAR; and
- Mi’kmaq of Nova Scotia.

The greatest potential for a fuel and/or other spills to occur is during the construction and operation phases when the greatest amount of fuel is being stored, handled, and transferred on-site.

Small spills like those seen due to improper transfer procedures during refueling of equipment will likely have negligible environmental effects, while a larger spill, such as that resulting from a storage tank failures or transport tanker truck accident may have significant environmental effects.

The location of the spill will also determine the magnitude of effects. A spill occurring within the FMS Mine Site is unlikely to cause significant environmental effects as the area will be largely devoid of ecological receptors and the presence of hundreds of workers and a significant water management system in place will likely lead to quick and efficient containment and cleanup efforts. The primary receiver for spills in this area is the soil portion of the geology, soil, and sediment quality VC. Spills are unlikely to reach surface water, sediment, groundwater, wetlands, native flora, and fish habitat due to anticipated spill response times, existing surface water management systems on site, as well as containment and cleanup efforts. A spill occurring due to an accident along the highway may have more significant environmental effects if the accident occurs in close proximity to a watercourse or wetland. If not, the primary receiver for spills along the highway is the soil portion of the geology, soil, and sediment quality VC.

Indigenous Peoples' use of land and resources for traditional purposes has the potential to be adversely affected from the underlying changes to other VCs that a fuel and/or other spill would cause. Depending on the location and timing of a potential fuel and/or other spill, both groundwater and surface water quality could be affected, which in turn could directly affect traditional practices and drinking water of Indigenous people, although there are no confirmed groundwater or surface water potable water sources within 5 km of the FMS Mine Site. There also could be potential indirect effects as a result of a spill event to the current land and resource use due to potential adverse effects to fish, fish habitat, wetlands and terrestrial habitats and species. As above, emergency response plans and procedures and rapid spill response times will serve to mitigate the potential for effects on traditional use.

6.17.5.1.1.3 Mitigation and Emergency Response

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

The contract for transportation and delivery of diesel fuel will be awarded to a reputable third party licensed commercial fuel supply company. All fuel delivery drivers will have proper certification and training in fuel transport in compliance with Transportation of Dangerous Goods (TDG) and Workplace Hazardous Materials Information System (WHMIS) legislation. Fuel suppliers will be required to provide proper documentation supporting their authority to transport fuel and present their procedures and measures to minimize the risk of and to respond to the accidental release of fuel.

The Proponent will take possession of the fuel once it has been transferred to the bulk storage tank. As a result, fuel delivery will be the contractor's responsibility up to that point. All fuel deliveries will be supervised by a Proponent employee. A preliminary Petroleum Management Plan has been developed in accordance with the EMS Framework Document (Appendix L.1) and will govern the storage and dispensing of petroleum products on the site.

Preventative procedures will be undertaken and fuel storage and transfer areas will be designed to accommodate these procedures, such as limiting areas of fuel transfer. Staff will be trained in spill response measures and spill response kits will be accessible and dedicated in areas of fuel storage and transfer. The contingency measures developed as part of the Spill Contingency Plan, which has been developed in accordance with the EMS Framework Document (Appendix L.1), focus on areas of high ecological importance and areas used by the Mi'kmaq of Nova Scotia and will provide a plan on how such areas could/would be protected in the event of a spill.

If a spill were to occur, emergency procedures would be implemented that will be outlined in the site Spill Contingency Plan, which was developed in accordance with the EMS Framework Document (Appendix L.1). Generally, spill response includes raising the alarm, evacuation of all equipment and personnel from the area and possibly the area down wind, away from any vapour cloud, and establishment of a 500-1000 m radius exclusion zone from the spill location. An assessment is then made using on-site staff and possibly external resources (air quality specialists) to determine the type, quantity and source of the spill and whether Emergency Services are required. If required, Emergency Services will be contacted. The safety data sheet for the spilled material will be reviewed and will be made available to Emergency Services. A plan to contain and clean up the spill, as well as actions to prevent future incidents, will be detailed in a Recovery Plan, which will be developed to support the EMS Framework Document (Appendix L.1). If it is safe to do so, the spill source will be shut down and any ignition sources will be isolated. Barriers and signs to prevent access to the affected area may be required until the spill is completely contained and cleaned up. Depending on the regulator involvement there may be a requirement to file incident reports with certain regulatory agencies prior to initiating the clean up and return to work in the area, these are very case specific and often dependent on whether personnel were injured or equipment damaged as a result of the spill.

6.17.5.1.2 *Unplanned Explosive Event*

An unplanned explosive event is limited to the construction and operation phases of the Project. The worst-case scenario would be bodily harm as a result of improperly handling explosives.

A contract explosives supplier will provide the blasting materials for the mine. Emulsion will be the primary blasting agent as the majority of holes will be wet. Explosives and all accessories will be supplied on an as needed basis from the contractor's base location off-site and delivered to the contractors on site explosive storage facilities or directly to the blast holes, using the contractor's equipment. All on and off-site explosives permitting requirements will be the responsibility of the contractor through Natural Resources Canada for this Project.

6.17.5.1.2.1 Threshold for Determination of Significance

The criteria that would determine a significant effect should an unplanned explosive event occur is based primarily on worker health and safety and secondarily on property damage and environmental protection.

Should an unplanned explosive event result in injury or death to a worker or a loss of infrastructure or mobile equipment the event will be considered significant.

Should an unplanned explosive event result in the loss of any quantity of fuel, oil, lubricant, or other Project-related raw materials to the environment such that a measurable contamination of soil, surface water, or groundwater results, the event will be considered significant.

Contamination is defined as the following:

- Soil
    - concentrations of any contaminant exceed the guidelines provided in the Nova Scotia Contaminated Sites Regulations – Tier 1 Environmental Quality Standards for Soil at a Non-potable Site, Section 1, Table 1B;
- Surface Water
    - concentrations of any contaminant exceed the guidelines provided in the Nova Scotia Contaminated Sites Regulations – Tier 1 Environmental Quality Standards for the Protection of Freshwater Aquatic Life in Surface Water, Section 1, Table 3;

- Groundwater
    - concentrations of any contaminant exceed the guidelines provided in the Nova Scotia Contaminated Sites Regulations – Tier 1 Environmental Quality Standards for Groundwater at a Non-potable Site, Section 1, Table 4.

6.17.5.1.2.2 Potential Interactions and Effects

The potential interactions between an unplanned explosive event and VCs are outlined in Table 6.17-8. Only those interactions with a high potential to cause adverse effects should they occur are discussed in detail.

Table 6.17-8: Unplanned Explosive Event Interactions with VCs

Valued Component	Potential Unplanned Explosive Event and VC Interaction	Potential for Adverse Effects
Noise	An unplanned explosive event could potentially cause temporary elevated noise levels	Low
Air	An unplanned explosive event could potentially cause suspension of dust particles into the atmosphere	Low
Light	An unplanned explosive event could potentially cause a instantaneous flare of light	Low
Geology, Soils, and Sediment	An unplanned explosive event could potentially cause a release of fuel oil and/or ammonium nitrate to soil	Low
Groundwater Quality and Quantity	No potential interaction anticipated	-
Surface Water Quality and Quantity	No potential interaction anticipated	-
Wetlands	No potential interaction anticipated	-
Fish and Fish Habitat	No potential interaction anticipated	-
Habitat and Flora	No potential interaction anticipated	-
Terrestrial Fauna	An unplanned explosive event could potentially cause sensory disturbance to fauna in the area	Low
Avifauna	An unplanned explosive event could potentially cause sensory disturbance to birds in the area	Low
Species of Conservation Interest and Species at Risk	An unplanned explosive event could potentially cause sensory disturbance to species of conservation interest and species at risk in the area	Low
Mi'kmaq of Nova Scotia	No potential interaction anticipated	-
Physical and Cultural Heritage	An unplanned explosive event could potentially destroy undiscovered archaeological, historical, and/or paleontological artifacts	Low

Valued Component	Potential Unplanned Explosive Event and VC Interaction	Potential for Adverse Effects
Socio-economic Conditions	An unplanned explosive event could potentially cause injury or death to mine workers	High

Dust suspended from an unplanned explosive event would be temporary and localized to the area directly around the explosion. There would be elevated noise and light disturbance for an instantaneous moment. In addition, a release of ammonium nitrate or fuel oil to the environment is considered unlikely as the majority of these substances will be consumed should an explosion occur. Effects to avifauna, fauna, and SOCI/SAR will likely be minimal due to the Mine Site active operational area having limited native habitat present. Effects to physical and cultural heritage will likely be minimal as well; it is anticipated that anywhere an unplanned explosive event as the potential to occur, the ground will already be disturbed by site preparation and construction activities. As a result, potentially adverse effects to the atmospheric environment (air, noise, light), avifauna, fauna, SOCI/SAR, and physical and cultural heritage are considered low.

Explosives that are improperly handled pose a health and safety risk to workers during the construction and operation phases of the Project, as well as a financial liability risk related to infrastructure and mobile equipment damage or loss.

The maximum effect of an unplanned explosive event as it relates to worker health and safety would be a death caused by direct interaction or from falling objects or collapsing structures damaged from the explosion. The maximum effect of an unplanned explosive event as it relates to financial liability would be damage to or a total loss of one or more pieces of infrastructure or mobile equipment.

6.17.5.1.2.3 Mitigation and Emergency Response

Blasting will be undertaken by a qualified explosives contractor who will be responsible for all licensing and approvals as required by Natural Resources Canada for this Project. Transportation, storage and handling of explosives will be carried out in compliance with the *Explosives Act* and any other relevant legislation. If an unplanned explosive event were to occur, emergency procedures would be implemented that will be outlined in the site ERP. Generally, unplanned explosive event response includes raising the alarm and evacuation of all equipment and personnel from the area. No attempt to approach or extinguish any fire should be made. An assessment is then made using on-site staff to determine whether Emergency Services are required. If required, Emergency Services will be contacted. A safe zone around the affected area will be established, the size of which will be determined by on-site staff and possibly external resources (explosive specialists). Barriers and signs to prevent access to the affected area may be required until clean-up is complete. Depending on the regulator involvement there may be a requirement to file incident reports with certain regulatory agencies prior to initiating the clean-up and return to work in the area, these are very case specific and often dependent on whether personnel were injured or equipment damaged as a result of the unplanned explosive event.

6.17.5.1.3 *Mobile Equipment Accident*

All phases of the Project will have the potential for vehicular accidents to occur. A worst-case scenario would be a severe accident causing injury or death.

The majority of mobile equipment traffic will be limited to the FMS Mine Site where site personnel will work to restricted traffic patterns, speed limits, right-of-way signage, and provide necessary training to minimize the risk of vehicular accidents. The remaining mobile equipment will include highway haul trucks, which will transport concentrate along public roads from the FMS Mine Site to the Touquoy Mine Site. The number of return truck trips will average approximately 8 to 11 per day, for the anticipated duration of the Project.

6.17.5.1.3.1 Threshold for Determination of Significance

The criteria that would determine a significant effect should a mobile equipment accident occur is based primarily on worker health and safety and secondarily on property damage and environmental protection.

Should a mobile equipment accident result in injury or death to a worker or a loss of infrastructure or mobile equipment the event will be considered significant.

Should a mobile equipment accident result in the loss of any quantity of fuel, oil, lubricant, or other Project-related raw materials to the environment such that a measurable contamination of soil, surface water, or groundwater results, the event will be considered significant.

Contamination is defined as the following:

- Soil
    - concentrations of any contaminant exceeding the guidelines provided in the Nova Scotia Contaminated Sites Regulations – Tier 1 Environmental Quality Standards for Soil at a Non-potable Site, Section 1, Table 1B;
- Surface Water
    - concentrations of any contaminant exceeding the guidelines provided in the Nova Scotia Contaminated Sites Regulations – Tier 1 Environmental Quality Standards for the Protection of Freshwater Aquatic Life in Surface Water, Section 1, Table 3;
- Groundwater
    - concentrations of any contaminant exceeding the guidelines provided in the Nova Scotia Contaminated Sites Regulations – Tier 1 Environmental Quality Standards for Groundwater at a Non-potable Site, Section 1, Table 4.

6.17.5.1.3.2 Potential Interactions and Effects

The potential interactions between a mobile equipment accident and VCs are outlined in Table 6.17-9. Only those interactions with a high potential to cause adverse effects should they occur are discussed in detail further.

Table 6.17-9: Mobile Equipment Accident Interactions with VCs

Valued Component (VC)	Potential Mobile Equipment Accident and VC Interaction	Potential for Adverse Effects
Noise	No potential interaction anticipated	-
Air	A mobile equipment accident could potentially cause a fuel oil spill or small fire and release particulate matter, carbon monoxide, sulphur dioxide, nitrous oxides, and volatile organic compounds to the atmosphere	Low
Light	No potential interaction anticipated	-

Valued Component (VC)	Potential Mobile Equipment Accident and VC Interaction	Potential for Adverse Effects
Geology, Soils, and Sediment	A mobile equipment accident could potentially cause a release of fuel oil to soil if released to the terrestrial environment A mobile equipment accident could potentially cause a release of fuel oil to sediment if released to the aquatic environment.	Low
Groundwater Quality and Quantity	No potential interaction anticipated	-
Surface Water Quality and Quantity	A mobile equipment accident could potentially cause a release of fuel oil to watercourses	High
Wetlands	A mobile equipment accident could potentially cause a release of fuel oil to wetlands	High
Fish and Fish Habitat	A mobile equipment accident could potentially cause a release of fuel oil to fish habitat	High
Habitat and Flora	No potential interaction anticipated	-
Terrestrial Fauna	A mobile equipment accident could potentially cause fauna mortality through direct strikes	Low
Avifauna	A mobile equipment accident could potentially cause bird mortality through direct strikes	Low
Species of Conservation Interest and Species at Risk	A mobile equipment accident could potentially cause a release of fuel oil to watercourses A mobile equipment accident could potentially cause aquatic based species of conservation interest and species at risk mortality through direct strikes	High / Low
Mi'kmaq of Nova Scotia	No potential interaction anticipated	-
Physical and Cultural Heritage	No potential interaction anticipated	-
Socio-economic Conditions	A mobile equipment accident could potentially cause injury or death to mine workers	High

The emissions produced from a mobile equipment accident would be temporary and localized to the area directly around the accident. In addition, a release of fuel oil, lubricants or other Project-related raw materials would be minor in volume and likely contained and cleaned up prior to significantly effecting soil or sediment quality. Effects to avifauna, fauna, and SOCI/SAR would be limited to death by direct strike, which would be limited to individuals rather than species populations. As a result, potentially adverse effects to the atmospheric environment, geology, soil, and sediment quality, avifauna, fauna, and SOCI/SAR are considered low.

Mobile equipment accidents pose a high environmental risk to the following VCs:

- surface water quality and quantity;

- wetlands;
- fish and fish habitat; and
- SOCI/SAR.

The greatest potential for a mobile equipment accident to occur and cause adverse environmental effects is during the construction and operation phases when the largest amount of mobile equipment is in use. The primary risk for the VCs listed above is associated with the release of fuel oil to the environment.

The magnitude of a release from mobile equipment is dependent on the severity and type of accident that occurs. A large spill can occur if an accident results in the complete destruction of a storage tank, or a small spill can occur if an accident results in a fuel line leak.

The location of the mobile equipment accident will also determine the magnitude of effects. An accident occurring within the FMS Mine Site boundaries is unlikely to cause significant environmental effects as the area is an active work area with little native habitat present, and the presence of site water management system, and hundreds of workers will likely lead to quick and efficient containment and cleanup efforts. The primary receiver for spills as a result of accidents in this area is the soil portion of the geology, soil, and sediment quality VC. Spills are unlikely to reach surface water, sediment, groundwater, wetlands, and fish habitat due to anticipated spill response times, as well as containment and cleanup efforts. A spill occurring due to an accident along public transportation route(s) may have more significant environmental effects if the accident occurs in close proximity to a watercourse or wetland. Should this occur, the effects to surface water quality, wetland health, fish and fish habitat, and SOCI/SAR may be more pronounced.

A mobile equipment accident may pose a health and safety risk to workers during all phases of the Project, as well as a financial liability risk related to mobile equipment damage or loss. The risk of a mobile equipment accident may decrease once the operations phase ceases, as closure will likely require fewer pieces of mobile equipment.

The maximum effect of a mobile equipment accident as it relates to worker health and safety would be a death caused by a collision of two pieces of mobile equipment, a single equipment crash, or a direct strike from mobile equipment. The maximum effect of a mobile equipment accident as it relates to financial liability would be damage to or a total loss of one or more pieces of mobile equipment.

6.17.5.1.3.3 Mitigation and Emergency Response

The majority of mobile equipment traffic will be limited to the FMS Mine Site where restricted traffic patterns, speed limits, right-of-way signage, and training will minimize the risk of vehicular accidents. All highway haul truck operators will receive operator training to minimize the risk of haul truck collisions. Highway haul trucks will be remotely tracked and monitored. Communications will be maintained between vehicles using radios to minimize adverse interactions and ensure prompt response to any incident. The operators training will include proper procedures for daily travel to minimize the risk of vehicular accidents, as well as procedures related to emergency response should there be a vehicular accident.

Good maintenance practices for equipment and vehicle maintenance will be undertaken, including regular maintenance as specified by suppliers.

An ERP will be developed for the Project and will include procedures to be followed in the event of a mobile equipment accident. The legislation is well established and understood by the Proponent's staff and will be conveyed to any contractors at the site so that all know of actions to take and reporting requirements.

If a mobile equipment accident were to occur, emergency procedures would be implemented that will be outlined in the site Spill Contingency Plan, which has been developed in accordance with the EMS Framework Document (Appendix L.1). Generally, mobile equipment accident response includes raising the alarm, providing first aid to any injured persons, and securing all equipment in the area. An assessment is then made using on-site staff to determine whether Emergency Services are required and the cause of the accident. If required, Emergency Services will be contacted. A plan to determine what repairs are needed and actions to prevent future incidents will be detailed in a Recovery Plan, which will be developed in accordance with the EMS Framework Document (Appendix L.1). Depending on the regulator involvement there may be a requirement to file incident reports with certain regulatory agencies prior to initiating the clean up and return to work in the area, these are very case specific and often dependent on whether personnel were injured or equipment damaged as a result of the mobile equipment accident.

6.17.5.1.4 *Tailings and Reclaim Water Pipelines Spills*

Tailings storage and reclaim water recycling at the FMS Mine Site will be achieved using the TMF and associated infrastructure. Once in operation, tailings will flow by gravity from the mill building to the TMF via a tailings pipeline for permanent storage within the TMF. Reclaim water will be withdrawn from the supernatant pond in the TMF using a reclaim water pump and barge, and pumped via a pipeline to the process water tank located adjacent to the mill building. As storage from rainfall will exceed process water demand in wet months. Wet months refers to the spring or fall months, and assuming precipitation meets or exceeds the climate normal conditions. Fresh water makeup from Seloam Lake will be minimal.

The sections of the tailings and reclaim pipelines between the plant site and TMF will be run in lined trenches to an adequately sized lined collection pond capable of containing the volume of the pipeline. Monitoring systems will be installed on the pipelines for leak detection and triggering shutdown procedures.

An OMS Manual for the planned TMF will be generated outlining procedures for the safe operation, maintenance and surveillance of the TMF. The OMS manual will be prepared and in place upon commissioning, and maintained thereafter until closure, providing a clear, documented framework for operations. The manual will be revised throughout the life of the operation with respect to changes in, operational performance, environmental factors, personnel, or regulatory considerations with a view to continual improvement. In conjunction with the OMS Manual, a Spill Contingency Plan has been developed and will be updated throughout the operation. A Spill Contingency Plan has been developed to support the EMS Framework Document (Appendix L.1). Environmental monitoring will be implemented.

6.17.5.1.4.1 Threshold for Determination of Significance

The criteria that would determine a significant effect should a tailings or reclaim water pipeline fail, is based primarily on environmental protection. Should a pipeline failure result in an uncontrolled discharge of tailings and/or process water to the receiving surface water environment, the event will be considered significant.

Comparison of receiving surface water samples to CCME FWAL TSS guidelines and MDMER TSS guidelines will be utilized to determine if tailings/process water will have an impact on surface water quality and subsequently on fish and fish habitat.

6.17.5.1.4.2 Potential Interactions and Effects

The potential interactions between a tailings or reclaim water pipeline accident and VCs are outlined in Table 6.17-10. Only those interactions with a high potential to cause adverse effects should they occur are discussed in detail further.

Table 6.17-10: Unplanned Tailings/Reclaim Water Line Event Interactions with VCs

Valued Component	Potential Unplanned Tailings/Reclaim Line Event and VC Interaction	Potential for Adverse Effects
Noise	No potential interaction anticipated	-
Air	No potential interaction anticipated	-
Light	No potential interaction anticipated	-
Geology, Soils, and Sediment	No potential interaction anticipated	-
Groundwater Quality and Quantity	No potential interaction anticipated	-
Surface Water Quality and Quantity	Failure of a tailings or reclaim water pipeline could potentially cause tailings solids and/or contaminated process water to discharge to surface waters	Low
Wetlands	No potential interaction anticipated	-
Fish and Fish Habitat	Failure of a tailings or reclaim water pipeline could potentially cause tailings solids and/or contaminated process water to discharge to surface waters	Low
Habitat and Flora	No potential interaction anticipated	-
Terrestrial Fauna	No potential interaction anticipated	-
Avifauna	No potential interaction anticipated	-
Species of Conservation Interest and Species at Risk	No potential interaction anticipated	-
Mi'kmaq of Nova Scotia	No potential interaction anticipated	-
Physical and Cultural Heritage	No potential interaction anticipated	-
Socioeconomic Conditions	No potential interaction anticipated	-

6.17.5.1.4.3 Mitigation and Emergency Response

The tailings and reclaim pipelines between the plant site, the TMF and open pit will be designed and constructed to minimize the potential for release. Measures may include double walls tailings pipes, lined service trenches, and adequately sized lined collection pond capable of containing the volume of the pipeline. The catchment pond would be lined with suitable materials, such as clay or a geosynthetic liner.

Process controls will be in place to detect a pipeline leak or spill and initiate shutdown procedures.

The potential for accidents and malfunctions at the FMS Mine Site will continue to be mitigated through the application of environmental management plans, operating procedures and monitoring programs, including the OMS Manual and ERP. Tailings and reclaimed pipelines will be monitored visually by qualified personnel daily. Remote monitoring of pipelines is also conducted by process control technicians.

Given the location of the pipelines, trench and catchment pond within the FMS mine production area and near to process facilities and personnel, detection and response to any spill would be expected to be rapid and confined to the mine footprint area and not result in significant release to the receiving environment.

If a tailings and/or reclaim water pipeline spill were to occur, emergency procedures would be implemented that will be outlined in the site ERP. Generally, tailings and/or reclaim water pipelines emergency response includes evacuation of all equipment and personnel from the area. If tailings and/or reclaim water encroach on neighboring properties or public roadways, appropriate authorities will be notified and construction of bunds and/or diversion drains may be required to contain tailings and/or reclaim water on-site. Other immediate responses may include lowering tailing pond levels, stopping the inflow into the tailings pond from the mill, stabilizing unstable slopes, and mitigating downstream consequences. An assessment is then made using on-site staff and possibly external resources (surface water specialists) as to what repairs are needed and actions to prevent future incidents. This will be detailed in a Recovery Plan, which will be developed in accordance with the EMS Framework Document (Appendix L.1). Depending on the regulator involvement there may be a requirement to file incident reports with certain regulatory agencies prior to initiating the repairs and return to work in the area, these are very case specific and often dependent on whether personnel were injured or equipment damaged as a result of tailings and/or reclaim water pipelines spill.

6.17.5.2 Touquoy Mine Site

The Project will utilize the existing processing facility at the Touquoy Mine Site to process FMS concentrate. The Touquoy Mine Site is a fully permitted and approved facility currently operating as part of the Touquoy Gold Project in Moose River, Halifax County, Nova Scotia.

Only minor changes to the existing works will be necessary to modify the Touquoy Mine Site to process FMS concentrate. The minor modifications to the processing facility can be accommodated within the existing footprint and do not result in a change the processing flowsheet. Tailings produced from processing of FMS concentrate will be in the mined out Touquoy open pit. The tailings and reclaim water lines will be re-routed in order to transport tailings to the Touquoy open pit and return process water to the mill. The Touquoy Mine Site footprint will, as a result, be maintained as originally permitted.

An amendment to the Touquoy Gold Project IA will be sought as necessary to accommodate these changes. As well, the currently approved Reclamation Plan will be updated to reflect the above changes and re-submitted.

The continued operation of the Touquoy processing plant and the use of the open pit for tailings storage will create the potential for accidents and malfunctions to occur at the Touquoy Mine Site for an additional four years. The potential for accidents and malfunctions at the Touquoy Mine Site will continue to be mitigated through the application of existing environmental management plans, operating procedures and monitoring programs.

6.17.5.2.1 *Tailings and Reclaim Water Pipelines Spills*

Upon completion of open pit mining operations at the Touquoy Mine Site, the tailings line will be routed to the mined out Touquoy pit in preparation to receive tailings. Tailings will flow by gravity from the mill to the open pit. Initially, reclaim water will continue to be withdrawn from the supernatant pond in the existing TMF via the existing reclaim works to supply processing water needs for the FMS concentrate. A reclaim water pump and barge, with a new pipeline to the process water tank, will be installed when process water accumulation from the tailings slurry deposited in the open pit reaches an adequate volume. The transition from the TMF to the open pit reclaim water system is expected to require minimal downtime, as storage from rainfall will exceed process water demand in wet months. Wet months refers to the spring or fall months, and assuming precipitation meets or exceeds the climate normal conditions. Fresh water makeup from Scraggy Lake will continue to be required during this transition period at rates that are consistent with the existing water withdrawal approval for the Touquoy Gold Project. Should the timing of the transition occur during a drier period when such as in the winter or in a dry summer, process water from the pit will be supplemented from Scraggy Lake in addition to the or an alternative water source make up water from Scraggy Lake.

Supernatant water collected in the open pit will be pumped to the process water tank located next to the pre-leach thickener. The sections of the tailings and reclaim pipelines between the plant site and open pit will be double-walled and run in HDPE lined trenches to an adequately sized lined collection ponds capable of containing the volume of the pipeline. Monitoring systems will be installed on the pipelines for leak detection and triggering shutdown procedures.

The Touquoy Gold Project currently employs an OMS Manual for the existing TMF. This manual will be updated in advance of using the open pit for storage of tailings in order to reflect changes in operating conditions and environmental factors. As well, Touquoy Gold Project also currently employs a Spill Contingency Plan which will also be updated. A Spill Contingency Plan has been developed to support the EMS Framework Document (Appendix L.1). Environmental monitoring will continue as prescribed under the Touquoy Gold Project IA, which will be amended as necessary to reflect the changes in processing of FMS concentrate and storage of FMS concentrate tailings.

6.17.5.2.1.1 Threshold for Determination of Significance

The criteria that would determine a significant effect should a tailings or reclaim water pipeline fail, is based primarily on environmental protection. Should a pipeline failure result in an uncontrolled discharge of tailings and/or process water to the receiving surface water environment, the event will be considered significant.

Comparison of receiving surface water samples to CCME FWAL TSS guidelines and MDMER TSS guidelines will be utilized to determine if tailings/process water will have an impact on surface water quality and subsequently on fish and fish habitat.

6.17.5.2.1.2 Potential Interactions and Effects

The potential interactions between a tailings or reclaim water pipeline accident and VCs are outlined in Table 6.17-11. Only those interactions with a high potential to cause adverse effects should they occur are discussed in detail further.

Table 6.17-11: Unplanned Tailings/Reclaim Water Line Event Interactions with VCs

Valued Component (VC)	Potential Unplanned Tailings/Reclaim Line Event and VC Interaction	Potential for Adverse Effects
Noise	No potential interaction anticipated	-
Air	No potential interaction anticipated	-
Light	No potential interaction anticipated	-
Geology, Soils, and Sediment	No potential interaction anticipated	-
Groundwater Quality and Quantity	No potential interaction anticipated	-
Surface Water Quality and Quantity	Failure of a tailings or reclaim water pipeline could potentially cause tailings solids and/or contaminated process water to discharge to surface waters	Low

Valued Component (VC)	Potential Unplanned Tailings/Reclaim Line Event and VC Interaction	Potential for Adverse Effects
Wetlands	No potential interaction anticipated	-
Fish and Fish Habitat	Failure of a tailings or reclaim water pipeline could potentially cause tailings solids and/or contaminated process water to discharge to surface waters	Low
Habitat and Flora	No potential interaction anticipated	-
Terrestrial Fauna	No potential interaction anticipated	-
Avifauna	No potential interaction anticipated	-
Species of Conservation Interest and Species at Risk	No potential interaction anticipated	-
Mi'kmaq of Nova Scotia	No potential interaction anticipated	-
Physical and Cultural Heritage	No potential interaction anticipated	-
Socioeconomic Conditions	No potential interaction anticipated	-

6.17.5.2.1.3 Mitigation and Emergency Response

The sections of the tailings and reclaim pipelines between the plant site and the TMF and open pit will be double-walled and run in HDPE lined trenches to an adequately sized lined collection pond capable of containing the volume of the pipeline. The catchment pond will be lined with suitable materials, such as clay or a plastic liner.

Process controls will be in place to detect a pipeline leak or spill and initiate shutdown procedures.

The potential for accidents and malfunctions at the Touquoy Mine Site will continue to be mitigated through the application of existing environmental management plans, operating procedures and monitoring programs, including the OMS Manual and ERP.

Given the location of the pipelines, trench and catchment pond within the Touquoy Mine Site production area and in close proximity to other facilities and personnel, detection and response to any spill would be expected to be rapid and confined to the mine footprint area and not result in significant release to the receiving environment.

If a tailings and/or reclaim water pipelines spill were to occur, emergency procedures would be implemented that will be outlined in the site ERP. Generally, tailings and/or reclaim water pipelines emergency response includes evacuation of all equipment and personnel from the area. If tailings and/or reclaim water encroach on neighboring properties or public roadways, appropriate authorities will be notified and construction of bunds and/or diversion drains may be required to contain tailings and/or reclaim water on-site. Other immediate responses may include lowering tailing pond levels, stopping the inflow into the tailings pond from the mill, stabilizing unstable slopes, and mitigating downstream consequences. An assessment is then made using on-site staff and possibly external resources (surface water specialists) as to what repairs are needed and actions to prevent future incidents. This will be detailed in a Recovery Plan, which will be developed to support the EMS Framework Document (Appendix L.1). Depending on the regulator involvement there may be a requirement to file incident reports with certain regulatory agencies prior to initiating the repairs and return to work in the area, these are very case specific and often dependent on whether personnel were injured or equipment damaged as a result of tailings and/or reclaim water pipelines spill.

6.17.5.2.2 *Cyanide Release*

Cyanide Handling

Sodium cyanide (NaCN) is a key reagent used in the Carbon-In-Leach (CIL) process to leach gold from a sold matrix to form a gold cyanide complex that can be extracted from the slurry by adsorption onto activated carbon.

NaCN is delivered to the Touquoy Mine Site in the form of in dry briquettes from an approved supplier as per International Cyanide Management Code (ICMC) standards. NaCN deliveries are made by truck in one tonne secured (strapped) wooden crates. Within the crates the NaCN is double wrapped and sealed closed. Upon receipt at the Touquoy Mine Site, the sodium cyanide is stored in a locked, fenced area within the secure reagent building and kept under camera surveillance. The cyanide storage area is visibly identified with prominently displayed warning signs and readily available MSDS's.

Prior to use, NaCN is mixed with water and sodium hydroxide (NaOH) for dilution and pH control within a mixing tank. Prior to mixing, operators suit up in full personnel protective equipment (PPE) including Tyvek suits and powdered air purifying respirators (PAPR). Water and NaOH are added to the cyanide mix tank. The wooden crates are opened, and a gantry crane lifts the bags out and transports them to the mix tank. The bags are lifted by crane into the bag cutter on top of the mix tank and the door is shut to enclose the bag. The bag is slowly lowered onto the bag cutter and the dry solids are emptied into the mix tank. The bag cutter has water sprays to clean the cyanide bags prior to removing from the enclosure. This process is repeated for 4 cyanide (NaCN) bags to achieve a mix concentration of ~22%. Once the NaCN storage tank level drops below 20% the contents of the mix tank are then transferred to the storage tank for distribution throughout the plant.

Cyanide is added into three areas; Leach tank #1, Intensive Leach Reactor (ILR) and Barren Eluate tank #12. Leach tank #1 is a continuous addition whenever the leach circuit is being fed with ore. It is controlled based on constant cyanide titrations throughout the leach/CIL circuit. The ILR and Barren Eluate tank are dosed based on a batch process. When a batch is ready, the dosage is controlled based on a flowmeter to a targeted concentration. All these addition points have pH control reagents (NaOH or Lime) with automated interlocks that will not permit NaCN addition until a suitable pH is achieved to avoid the formation of hydrogen cyanide (HCN) gas.

Cyanide target concentrations are as follows:

- Leach tank # 1 = 55-60 ppm (0.006%). By the end of the CIL circuit (CIL tank #6), the remaining cyanide is about 30ppm (0.003%).
- ILR = 14, 000ppm (1.4%). Once the process is complete, this small volume (5.2m3) is transferred and diluted in the much larger Leach/CIL circuit (9,100m3) for consumption.
- Barren Eluate Tank #12 = 1000ppm (0.1%). Once the process is complete, the remaining cyanide stays in the tank to be re-used during the next batch. Each new batch, the cyanide is just topped up to the target concentration.

Cyanide Detoxification

Cyanide detoxification occurs within the cyanide destruction circuit. Slurry passing through the carbon safety screen gravitates to two 300 m3 cyanide detoxification tanks which are designed on the conventional air-SO2 process and can operate in series or parallel for operational flexibility. The average slurry residence time at 250 t/h is 1.5 hours.

The tanks utilize high shear agitators and air injection to enhance high oxygen dissolution in the slurry to meet the high oxygen demand of the cyanide destruction process. Sodium metabisulphite and copper sulphate solutions are dosed into either tank providing the oxidizing agent and catalyst respectively for the cyanide destruction. Acid generation is neutralized by the addition of lime slurry to the detox tanks via a ring main.

The detoxified slurry stream gravitates to the tailings hopper from where it is pumped through a single pipeline to the TMF by variable speed tailings pumps (1 duty/1 standby). The tailings slurry is then discharged at selected outlet points around the periphery of the facility. Pipe runs are designed to be self-draining to avoid dead legs.

Contingency measures for cyanide detoxification include primary linear and secondary rotary vezin tailings samplers taking representative tailings samples after the slurry has been detoxified and prior to entering the tailings hopper. The cyanide destruction and tailings hopper area has a dedicated bunded concrete area for collecting spillage. A local sump pump returns any spillage to the carbon safety screen. The area is enclosed for cold weather protection. A CNWAD analyzer automatically monitors slurry levels and a HCN detector provides monitoring for airborne gas.

Shutdown procedures are in place in the event of process upsets including cyanide detoxification.

6.17.5.2.2.1 Threshold for Determination of Significance

The criteria that would determine a significant effect should an unplanned cyanide release occur is based primarily on worker health and safety and environmental impact. Should an unplanned cyanide release result in injury or death to a worker or contamination of the receiving environment the event will be considered significant.

6.17.5.2.2.2 Potential Interactions and Effects

The potential interactions between an unplanned cyanide release and VCs are outlined in Table 6.17-12. Only those interactions with a high potential to cause adverse effects should they occur are discussed in detail further.

Table 6.17-12: Unplanned Cyanide Event Interaction with VCs

Valued Component (VC)	Potential Unplanned Cyanide Event and VC Interaction	Potential for Adverse Effects
Noise	No potential interaction anticipated	-
Air	An unplanned cyanide release event could potentially cause short term toxic effects within the localized area	Low
Light	No potential interaction anticipated	-
Geology, Soils, and Sediment	No potential interaction anticipated	-
Groundwater Quality and Quantity	An unplanned cyanide release event could potentially affect groundwater within the localized area	Low
Surface Water Quality and Quantity	An unplanned cyanide release event could potentially cause toxic effects within the localized area	Moderate
Wetlands	No potential interaction anticipated	-
Fish and Fish Habitat	An unplanned cyanide release event could potentially cause toxic effects within the localized area	Moderate

Valued Component (VC)	Potential Unplanned Cyanide Event and VC Interaction	Potential for Adverse Effects
Habitat and Flora	An unplanned cyanide release event could potentially cause toxic effects within the localized area	Low
Terrestrial Fauna	An unplanned cyanide release event could potentially cause toxic effects within the localized area	Low
Avifauna	An unplanned cyanide release event could potentially cause toxic effects within the localized area	Low
Species of Conservation Interest and Species at Risk	An unplanned cyanide release event could potentially cause toxic effects within the localized area	Low
Mi'kmaq of Nova Scotia	An unplanned cyanide release event could potentially affect land use in short or long term	Low
Physical and Cultural Heritage	No potential interaction anticipated	-
Socio-economic Conditions	An unplanned cyanide release event could potentially cause effects to safety and land use	Moderate

6.17.5.2.2.3 Mitigation and Emergency Response

Cyanide handling and use is highly regulated and subject to strict practices and procedures. Cyanide will be transported, stored and handled in accordance with applicable regulatory requirements and the International Cyanide Management Code. Cyanide is delivered in dry briquette form and is relatively safe from spills and easy to clean up in the event of a transportation or handling incident. The cyanide storage area is isolated from the remainder of the mill and the fire water suppression system, and first responders have been apprised of the need for the use of an alkali powder quenching agent as opposed to water or CO2 due to off gas potential. Cyanide in solution is stored and handled inside the plant within a restricted area, and restricted to use within the processing facility with an abundance of design and process controls, adequate containment, as well as occupational health and safety practices, to prevent release of cyanide solution or gas within and outside the building structure. Cyanide solution is detoxified by a proven and efficient process and tested by an automated in-line sampler prior leaving the processing facility, making the release of a high concentration (ie, non-detoxified) cyanide solution outside the confines of the process facility a highly unlikely event.

A detailed ERP has been developed of the Touquoy Mine Site. If cyanide exposure were to occur, emergency procedures would be implemented that will be outlined in the site Emergency Response Plan, which will be developed to support the EMS Framework Document (Appendix L.1). Generally, cyanide exposure response includes raising the alarm, contacting Emergency Services, evacuation of all personnel from the area to fresh air, removal of contaminated clothing, washing of cyanide residue from affecter personnel, administering oxygen, and securing the area. A plan to determine what repairs are needed and actions to prevent future incidents will be detailed in a Recovery Plan, which will be developed in accordance with the EMS Framework Document (Appendix L.1). Depending on the regulator involvement there may be a requirement to file incident reports with certain regulatory agencies prior to initiating the clean up and return to work in the area, these are very case specific and often dependent on whether personnel were injured as a result of the cyanide exposure.

6.17.6 Other Malfunctions

6.17.6.1 Forest and/or Site Fires

All phases of the Project will have the potential for forest and/or site fires to occur. A worst-case scenario is an extreme fire that results in worker injury or death or that causes significant damage to the environment. A forest fire may occur through human or natural causes, while a site fire may occur due to an equipment failure and/or human error. Forest fires have the potential to affect the Project at both the FMS Mine Site and at the Touquoy Mine Site; however, due to the clearing of vegetation within the active mining areas at both the FMS Mine Site and Touquoy Mine Site, it is unlikely that a site fire would spread to and affect the surrounding forest.

6.17.6.1.1 *Threshold for Determination of Significance*

The criteria that would determine a significant effect should a forest and/or site fire occur is based primarily on worker health and safety and secondarily on property damage and environmental protection.

Should a forest and/or site fire result in injury or death to a worker or a loss of infrastructure or mobile equipment the event will be considered significant.

Should a forest and/or site fire result in the loss of any quantity of fuel, oil, lubricant, or other Project-related raw materials to the environment such that a measurable contamination of soil, surface water, or groundwater results, the event will be considered significant.

Contamination is defined as the following:

- Soil
  - concentrations of any contaminant exceed the guidelines provided in the Nova Scotia Contaminated Sites Regulations – Tier 1 Environmental Quality Standards for Soil at a Non-potable Site, Section 1, Table 1B;
- Surface Water
  - concentrations of any contaminant exceed the guidelines provided in the Nova Scotia Contaminated Sites Regulations – Tier 1 Environmental Quality Standards for the Protection of Freshwater Aquatic Life in Surface Water, Section 1, Table 3;
- Groundwater
  - concentrations of any contaminant exceed the guidelines provided in the Nova Scotia Contaminated Sites Regulations – Tier 1 Environmental Quality Standards for Groundwater at a Non-potable Site, Section 1, Table 4.

6.17.6.1.2 *Potential Interactions and Effects*

The potential interactions between a forest and/or site fire and VCs are outlined in Table 6.17-13. Only those interactions with a high potential to cause adverse effects should they occur are discussed further.

Table 6.17-13: Forest and/or Site Fire Interactions with VCs

Valued Component	Potential Forest and/or Site Fire and VC Interaction	Potential for Adverse Effects
Noise	No potential interaction anticipated	-
Air	A forest and/or site fire could potentially release particulate matter, carbon monoxide, Sulphur dioxide, nitrous oxides, and volatile organic compounds to the atmosphere.	Low
Light	A forest and/or site fire could potentially increase light intrusion for a temporally limited period of time	Low
Geology, Soils, and Sediment	No potential interaction anticipated	-
Surface Water Quality and Quantity	A forest and/or site fire could potentially cause surface water runoff to erode and entrain suspended solids for deposition into watercourses A forest and/or site fire could potentially reduce surface water quantity through extraction to extinguish the fire.	Low
Groundwater Quality and Quantity	No potential interaction anticipated	-
Wetlands	A forest and/or site fire could potentially cause wetland destruction through burning of vegetation	Low
Fish and Fish Habitat	A forest and/or site fire could potentially cause surface water quality and quantity issues that may indirectly effect fish and fish habitat	Low
Habitat and Flora	A forest and/or site fire could potentially cause destruction of habitat and flora	High
Terrestrial Fauna	A forest and/or site fire could potentially cause destruction of fauna habitat and/or direct mortality	High
Avifauna	A forest and/or site fire could potentially cause destruction of bird habitat and/or direct mortality	High
Species of Conservation Interest and Species at Risk	A forest and/or site fire could potentially cause destruction of species of conservation interest and species at risk	High
Mi'kmaq of Nova Scotia	A forest and/or site fire could potentially cause effects to the current use of land and resources for traditional purposes by Indigenous Peoples	Low
Physical and Cultural Heritage	No potential interaction anticipated	-
Socio-economic Conditions	A forest and/or site fire could potentially result in injury or death of mine workers	High

The topographic profile of the region allows for precipitation to be retained in soil and numerous watercourses and wetlands to form. As a result, large forest and/or site fires are unlikely to occur. In the unlikely event a forest and/or site fire occurs, the following adverse effects to VCs are considered low:

- emissions and light produced from a forest and/or site fire would be temporary; however, may adversely affect ambient air and viewshed quality in the area;
- surface water run-off created from extinguishing the fire may transport sediment and potential contaminants towards watercourses; thereby affecting surface water quality;
- surface water quantity in watercourses near the FMS Mine Site may be slightly affected through extraction and use of surface water for extinguishing the fire; however, these watercourses will only be utilized to aid in extinguishing small localized fires;
- effects to wetlands and fish and fish habitat are expected to be minimal due to the presence of water and saturated soils and flora; and
- it is unlikely that the Mi'kmaq of Nova Scotia will be adversely affected by site fires; an extensive forest fire could affect traditional usage of land and resources.

As a result, potentially adverse effects of fires associated with mining activity to the atmospheric environment, surface water quality and quantity, wetlands, fish and fish habitat, and Mi'kmaq of Nova Scotia are considered low.

The greatest potential for a forest and/or site fire to occur as a result of the Project is during the construction and operation phases when the greatest amount of physical activity is occurring at the at the FMS Mine Site. The primary risk for the environment is associated with physical habitat destruction and death of terrestrial species.

A forest and/or site fire caused by the Project has the potential to modify terrestrial habitat and cause direct mortality to wildlife populations, especially during the breeding season when the mobility of immature individuals is limited. The destruction of habitat may result in the loss of breeding, nesting, rearing, and/or other habitat for birds, fauna, and SOCI/SAR. Habitat fragmentation created by a fire may cause potential adverse effects for species that migrate throughout a landscape based on resources that are seasonally available.

Although a forest and/or site fire caused by the Project is likely to be extinguished before it creates a significant effect to the local area, it is unlikely that terrestrial habitat loss or direct individual mortality would create population viability issues if an uncontrollable fire was allowed to burn. It is likely that mobile terrestrial species will move to adjacent areas and any habitat loss would lead to regrowth within a few generations. In addition, habitat types in the area of the Project are not unique and would be easily supplanted with minor migration efforts by terrestrial species.

A forest and/or site fire created by the Project would be most likely to result from a structural failure or accident as identified in Sections 6.17.4 and 6.17.5 of this EIS. Should the mitigation measures identified for these potential structural failures or accidents be implemented, it is extremely unlikely that a forest and/or site fire created by the Project would occur.

6.17.6.1.3 *Mitigation and Emergency Response*

Fire protection for the plant site will be via a "wet system" with hydrants located around the plant site area. The water contained within the lower portion of the raw water tank will be reserved for fire protection. Fire detection systems will be installed in buildings and key areas of the FMS Mine Site.

In each area, a combination of heat and smoke detectors will be provided with break-glass units mounted externally to the buildings. The large primary mining fleet including excavators, front end loader, haul truck, dozers and drills will be fitted with fire suppression systems in case of fire.

The water truck can be fitted with a pump and 2.5 inch hydrant hose reel for firefighting if needed. Supplementary hand held fire extinguishers, each suitable for its specific area, will be mounted in all buildings and vehicles. The site will have fire-fighting and fire-suppression capabilities that will be supplemented by support from the local community.

Fire response training and fire extinguisher training will be provided to all staff. An ERP will be developed for the FMS Mine Site, which will include fire response.

The site will be staffed to varying levels 24 hours a day with personnel in all areas of the FMS Mine Site. Fires, if they occur, would be quickly detected and emergency procedures able to be acted on. The availability of water, equipment and nearby personnel from volunteer fire departments and NSL&F staff with expertise in forest fire control are all benefits to the Project and greatly reduce the possibility of fires that would not be able to be quickly controlled, and damage limited.

If a forest fire were to occur, emergency procedures would be implemented that will be outlined in the site ERP. Generally, forest fire response includes raising the alarm and evacuation of all personnel from the area. If required, Emergency Services will be contacted.

6.17.7 Mitigation

Accidents and malfunctions refer to events that are contrary to the design, and not part of any planned activity or normal operation of the Project, as has been proposed by the Proponent. Many accidents and malfunctions are preventable, and their likelihood and consequences are minimized during planning and design, and by developing thorough emergency response procedures and ensuring mitigation measures are incorporated into standard operating procedures. However, even with the implementation of best management practices and preventative measures, accidents and malfunctions still have the potential to occur and create adverse effects to the environment and worker health and safety.

Preventative and responsive procedures will be developed via the following principles:

- best management practices and proven technologies will be utilized to undertake the Project and all planned releases to the environment and their effects will be properly managed;
- worker health and safety will be the central focus of process and mine safety management;
- develop and apply procedures and training that will aim to promote safe operation of mining equipment and facilities; and
- develop and implement emergency response procedures that will reduce and control the adverse effects of an accident or malfunction.

The Project will be designed to implement preventative and mitigation procedures throughout its entire life that will minimize the potential for accidents and malfunctions to occur. Should those accidents or malfunctions occur, emergency response procedures would be implemented to reduce or control the resulting adverse effects. Table 6.17-14 describes proposed mitigation measures relating to accidents and malfunctions.

Table 6.17-14: Mitigation for Accidents and Malfunctions

Potential Accident or Malfunction	Mitigation Measures
Open Pit Mine Slope Failure	Ensure that pit slope design, construction and monitoring follow applicable regulations and recommendations provided by a qualified geotechnical professional.
Stockpile Slope Failure	Ensure that stockpile design, construction and monitoring follow applicable regulations and recommendations provided by a qualified geotechnical professional.
Water Management Pond Failure	Ensure that the water management ponds are designed by a qualified professional and lined with suitable materials, such as clay or a geosynthetic liner.
TMF Dam Failure	Ensure that TMF designed, and construction is overseen and approved by qualified design engineers (the Design Engineers/Engineer of Record). A tailings deposition strategy will be implemented to selectively develop tailings beaches along the embankments, thereby producing an extensive low permeability zone that facilitates seepage control and maintains the operational supernatant pond away from the crest of the embankment.
Infrastructure Failure	Ensure that infrastructure is designed following applicable regulations and recommendations provided by a qualified professional.
Fuel and/or other spills	All fuel delivery suppliers and their personnel will have proper certification and training in fuel transport and delivery in compliance with applicable regulatory requirements. Onsite storage and dispensing of fuel products will be conducted in accordance with applicable regulatory requirements and adhere to the Petroleum Management Plan and related site-specific procedures. Staff will be trained in spill response measures. Spill response kits will be accessible and dedicated in areas of fuel storage and transfer.
Mobile Equipment Accident	The FMS Mine Site will have restricted traffic patterns, speed limits, right-of-way signage and training that will minimize the risk of mobile equipment accidents. Highway haul trucks will be remotely tracked and monitored. Communications will be maintained between vehicles using radios to minimize adverse interactions and ensure prompt response to any incident.
Tailings and Reclaim Water Pipelines Spills	The tailings and reclaim pipelines between the plant site, TMF and open pit will be designed and constructed to minimize the potential for release. Measures may include double walled tailings pipes, lined service trenches and adequately sized, lined, collection pond capable of containing the volume of the pipeline. The catchment pond would be lined with suitable materials, such as clay or a geosynthetic liner.
Cyanide Release (Touquoy Mine Site)	Cyanide is transported stored and handled in accordance with applicable regulatory requirements and the International Cyanide Management Code. Cyanide is stored and handled inside the plant footprint within a restricted area that has adequate impermeable containment.
Forest and/or Site Fires	Fire protection for the plant site will be via a “wet system” with hydrants located around the plant site area.

Potential Accident or Malfunction	Mitigation Measures
	The water contained within the lower portion of the raw water tank will be reserved for fire protection. Fire detection systems will be installed in buildings and key areas of the FMS Mine Site.
General Commitment	Development of the Environmental Management System (EMS) and all associated management and monitoring plans.

6.17.8 Risk Assessment

Each potential accident and malfunction identified in the previous sections was assessed considering the likelihood of occurrence and the magnitude of the consequences should these accidents and malfunctions occur.

The likelihood of occurrence is given a score of 1 to 5 with an associated rating as defined below:

1. **Negligible:** accident or malfunction not likely to occur with a less than 1 in 10,000 probability of occurrence per year;
2. **Low:** accident or malfunction unlikely to occur with a less than 1 in 1,000 probability of occurrence per year;
3. **Moderate:** accident or malfunction has potential to occur with a less than 1 in 100 probability of occurrence per year;
4. **High:** accident or malfunction may occur with a less than 1 in 10 probability of occurrence per year; and
5. **Extreme:** accident or malfunction is likely to occur with a greater than 1 in 10 probability of occurrence per year.

The magnitude of the consequences should these accidents and malfunctions occur is also given a score of 1-5 with an associated rating as defined below:

1. **Negligible**
   - preventative requirements are minimal;
   - no long term effects are expected; and
   - readily remediated with funds in the $0 to $10,000 range.
2. **Low**
   - preventative requirements are minimal;
   - limited long term effects are expected; and
   - limited remediation required with funds in the $10,000 to $100,000 range.
3. **Moderate**
   - preventative requirements are moderate;
   - moderate long term effects are expected; and
   - moderate remediation required with funds in the $100,000 to $1,000,000 range.

4. **High**

    - preventative requirements are high;
    - significant long term effects are expected; and
    - significant remediation required with funds in the $1,000,000 to $10,000,000 range.

5. **Extreme**

    - Preventative requirements are very high;
    - permanent effects are expected; and
    - highly significant remediation required with funds in the $10,000,000 plus range.

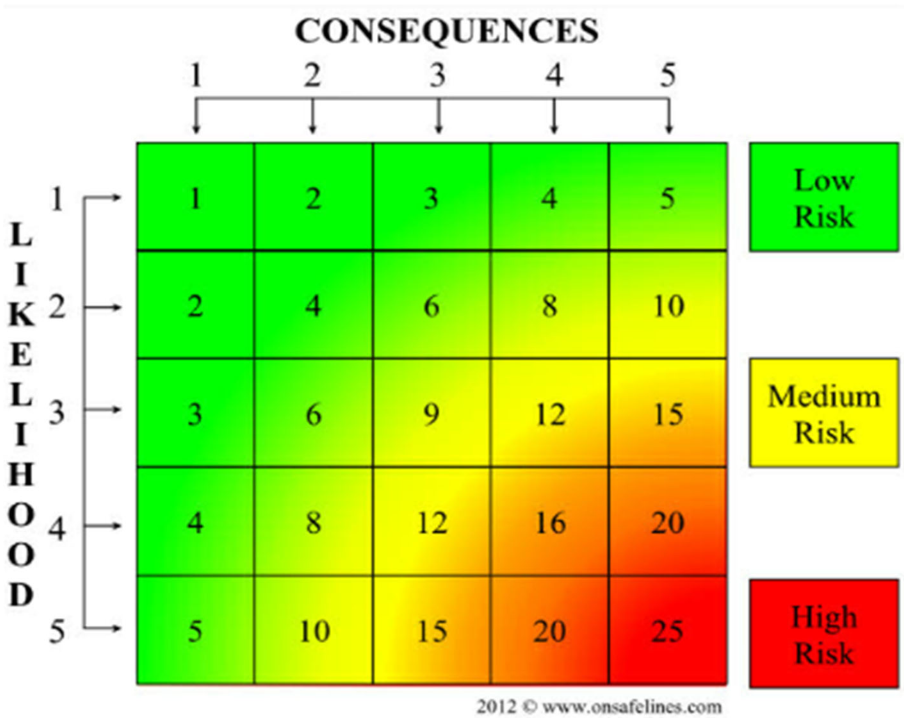

Figure 6.17-1: Risk Rating Matrix

Each potential accident and malfunction was assigned a likelihood rating and consequence rating based on the definitions provided above, activities associated with the Project, and the professional knowledge and judgment of the Project Team. The two ratings are multiplied and plotted on the Risk Rating Matrix provided on Figure 6.17-1 to obtain a risk rating for each accident and malfunction. Risk ratings can range from 1 to 25 – an accident and malfunction having a rating of 1 presents a negligible risk, while an accident and malfunction having a rating of 25 presents an extreme risk. As shown in the Risk Rating Matrix (Figure 6.17-1), the level of risk associated with an accident or malfunction is proportionally related to its likelihood of occurrence and the magnitude of effects it may cause. Table 6.17-15 provides the breakdown of ratings used to obtain the risk rating for each accident and malfunction, as well as summarizes the key VCs that would likely be affected.

Table 6.17-15: Characterization Criteria for Risk Rating Matrix

Accident/ Malfunction	Worst-case Scenario (Potential Consequences)	Key VC(s) Potentially Affected	Likelihood Rating	Magnitude Rating	Risk Rating 1 = Minimum 25 = Maximum
Open Pit Mine Slope Failure	Mine wall failure affecting the FMS Mine Site's mine equipment and infrastructure, Haul Roads and worker safety.	• Socio-economic Conditions	2	4	8
Stockpile Slope Failure	Potential for till, topsoil, mine rock and low-grade ore to enter nearby watercourses, damage to infrastructure and to worker safety.	• Socio-economic Conditions • Surface Water Quality and Quantity • Fish and Fish Habitat	2	4	8
Water Management Pond Failure	Uncontrolled discharge of sediment laden water into the surrounding environment.	• Surface Water Quality and Quantity • Wetlands • Fish and Fish Habitat • Species of Conservation Interest/Species at Risk	2	3	6

Accident/ Malfunction	Worst-case Scenario (Potential Consequences)	Key VC(s) Potentially Affected	Likelihood Rating	Magnitude Rating	Risk Rating 1 = Minimum 25 = Maximum
TMF Dam Failure	Catastrophic failure of tailings dam and release of stored tailings solids and water to the surrounding environment.	• Geology, Soils, and Sediment • Groundwater Quality and Quantity • Habitat and Flora • Wetlands • Surface Water Quality and Quantity • Fish and Fish Habitat • Avifauna • Terrestrial Fauna • Species of Conservation Interest/Species at Risk • Mi'kmaq of Nova Scotia • Physical and Cultural Heritage • Socio-economic Conditions	1	5	5
Infrastructure Failure	Failure of multiple operational components as a result of a natural cause impacting worker health and safety and surrounding environment.	• Socio-economic Conditions	1	3	3

Accident/ Malfunction	**Worst-case Scenario (Potential Consequences)**	**Key VC(s) Potentially Affected**	**Likelihood Rating**	**Magnitude Rating**	**Risk Rating** **1 = Minimum** **25 = Maximum**
Fuel and/or Other Spills	Transportation collision causing the entire amount of fuel or hazardous material being transported to be spilled into a water body.	• Geology, Soils, and Sediment • Surface Water Quality and Quantity • Groundwater Quality and Quantity • Wetlands • Fish and Fish Habitat • Species of Conservation Interest/Species at Risk • Mi'kmaq of Nova Scotia	2	4	8
Unplanned Explosive Event	Bodily harm and infrastructure damage as a result of improperly handling explosives.	• Socio-economic Conditions	1	4	4
Mobile Equipment Accident	Severe accident causing injury or death, property damage and environmental impacts.	• Surface Water Quality and Quantity • Wetlands • Fish and Fish Habitat • Species of Conservation Interest/Species at Risk • Socio-economic Conditions	2	4	8
Tailings/Reclaim Water Pipeline Spill	Uncontrolled discharge of tailings and/or contaminated water into the surrounding environment.	• Surface Water Quality and Quantity • Fish and Fish Habitat	2	3	6

Accident/ Malfunction	Worst-case Scenario (Potential Consequences)	Key VC(s) Potentially Affected	Likelihood Rating	Magnitude Rating	Risk Rating 1 = Minimum 25 = Maximum
Cyanide Release	Uncontrolled release of cyanide into the workplace and/or surrounding environment resulting in worker injury or death and/or causing significant damage to the environment.	• Air • Surface Water Quality and Quantity • Fish and Fish Habitat • Avifauna • Terrestrial Fauna • Species of Conservation Interest/Species at Risk • Socio-economic Conditions	1	5	5
Forest and/or Site Fire	An extreme fire that results in worker injury or death and causes significant damage to the environment.	• Habitat and Flora • Avifauna • Terrestrial Fauna • Species of Conservation Interest/Species at Risk • Socio-economic Conditions	2	5	10

6.17.8.1 Discussion

Potential accidents and malfunctions assigned a risk rating of 1-5 are considered low risk, those assigned a risk rating of 6-15 are considered moderate risk, and those assigned a risk rating of 16-25 are considered high risk. If an accident or malfunction is assigned a risk rating of 16 or higher, it would be considered significant and would require further consideration during the Project's detailed design phase.

The results of this qualitative analysis indicate that all identified potential accidents and malfunctions have a low or moderate risk rating and are therefore considered not significant from the perspective of requiring further design consideration or modification.

A mobile equipment accident and fuel and/or other spill are considered the riskiest with a combined likelihood and consequence rating of 8; A catastrophic tailings dam failure clearly has the most extreme consequences with a maximum rating of 5; however, with proper engineering design and construction and applied preventative mitigation measures, the likelihood of such a failure is negligible with a minimum rating of 1, resulting in a combined likelihood and consequence rating of 5 or low risk.

6.17.9 Proposed Compliance and Effects Monitoring Program

The Project will be designed to implement monitoring procedures throughout its entire life that will minimize the potential for accidents and malfunctions to occur. Should those accidents or malfunctions occur, emergency response procedures would be implemented to reduce or control the resulting adverse effects. Table 6.17-16 describes proposed monitoring programs related to accidents and malfunctions.

Table 6.17-16: Monitoring for Accidents and Malfunctions

Potential Accident or Malfunction	Monitoring Commitments
Open Pit Mine Slope Failure	A daily inspection of pit slopes by qualified personnel will be undertaken for any work area within the pit prior to employees or machinery entering. An independent qualified geotechnical professional will undertake a geotechnical review of pit slopes on at least an annual basis.
Stockpile Slope Failure	Stockpile slopes will be monitored periodically by qualified personnel in accordance with recommendations provided by a qualified geotechnical professional.
Water Management Pond Failure	Water management ponds will be monitored regularly to ensure stability and acceptable freeboard. In the case of a storm event, monitoring frequency will be increased.
TMF Dam Failure	The TMF dams will be inspected at least annually by the design geotechnical engineer-of-record. Independent Dam Safety Reviews (DSR), to further monitor operation, maintenance, surveillance, and performance of the dams during Operations and Closure, will be conducted. DSR frequencies will meet or exceed regulatory requirements. Instrumentation monitoring will be routinely conducted during construction and operations. Measurements during construction will be taken and analyzed on a routine basis to monitor the response of the embankment fill and the foundation from the loading of the embankment fill. Surface monuments will be surveyed at least twice per year during Operations. An operational monitoring program will include pond elevation, bathymetric surveys to determine pond depth and volume, as well as recording of reclaim water rates.

<table>
<tr><th>Potential Accident or Malfunction</th><th>Monitoring Commitments</th></tr>
<tr><td></td><td>Monitoring will continue for a period of time after mine closure to confirm that reclamation objectives are being achieved and to identify repair or maintenance requirements. Inspection and monitoring may include:
visual inspection of embankments, crests, and slopes to check for signs of cracking, settlement, or bulging;
visual inspection of the TMF embankment toe areas to check for signs of ground heave or seepage;
installation of piezometers during operation to monitor water pressures in the clay core and foundation;
installation of surface survey monuments during TMF construction; and
recording of TMF operating parameters, as required.
All monitoring will follow applicable regulations, guidelines and recommendations provided by qualified design engineers (the Design Engineers/Engineer of Record).</td></tr>
<tr><td>Infrastructure Failure</td><td>Infrastructure will be informally inspected by site personnel for signs of premature failure through the normal course of the working shift. More rigorous inspection will occur with routine preventative maintenance.</td></tr>
<tr><td>Tailings and Reclaim Water Pipelines Spills</td><td>Tailings and reclaim pipelines will be monitored visually by qualified personnel daily.
Remote monitoring of pipelines is also conducted by process control technicians.</td></tr>
<tr><td>Cyanide Release (Touquoy Mine Site)</td><td>Cyanide solution is detoxified by a proven and efficient process and tested (monitored) by an automated in-line sampler prior to leaving the processing facility.</td></tr>
</table>

7.0 Effects of the Environment on the Project

7.1 Environmental Considerations

The effects of the environment on the Project must also be considered as part of the EIS. This includes how local conditions, natural hazards, climate change and external events could affect the Project. Additionally, it is important to consider how the effects of these local conditions, natural hazards, and external events on the Project may in turn affect the environment, such as accidents or malfunctions occurring on the Project site.

The natural environment has the ability to potentially adversely impact the Project through events which may include the following:

- flooding;
- drought;
- extreme temperatures;
- severe weather events, including snow, ice, rain, and windstorms;
- lightning strikes;
- landslides, erosion, or subsidence;
- fire; and
- seismic events.

Infrastructure will be designed to accommodate the conditions imposed by the natural environment and to accommodate the effects of external events on the Project, as much as possible.

7.1.1 Climate

ECCC provide typical weather conditions published as Climate Normals datasets for various locations throughout Canada. The values presented in the dataset contain at least 15 years of data over a 30-year period. The datasets include measurements of average and extreme temperature and precipitation.

The nearest climate station with historical data is the Halifax International Airport climate station (Appendix D.1). The station is located approximately 15 km northwest of the Mine Site, near Middle Musquodoboit (45° 04'N, 63° 06'N). The following is a summary of average climate conditions at the Halifax International Airport station.

In general, the climate of the Project is characterized by a relatively moderate temperature regime, which fluctuates between a typical low of approximately -6 ºC in January and a high of 19 ºC in July and August as shown in Table 7.1-1. Precipitation is greatest in the fall and winter months, and the proportion of snowfall in winter months is less than 50%, further indicating moderate climate conditions at the FMS Study Area. Potential evapotranspiration is about 40% of the total precipitation received on an average annual basis.

KP prepared a Preliminary Engineering Hydrometeorology Report for the Moose River Consolidated Phase II (FMS Project and proposed Cochrane Hill Project) in September 2018 (Appendix D.1). This report described in detail the climatic conditions based on available data from multiple regional stations and the preferred regional station (Halifax International Airport).

As described by KP, the majority of precipitation falls as rain even in the winter months, which is expected for a moderate coastal region such as Nova Scotia. The rain to snow distribution is similar for all stations with 83-90% rain and 10-17% snow annually, indicating consistent pattern throughout the region. Based on the Halifax Airport station, 83% of the precipitation falls as rain, and the remaining 17% falls as snow annually. The mean annual precipitation (MAP) estimate for the FMS Mine Site is equivalent to 1,440 mm with mean monthly values ranging from a low of 93 mm in July to a high of 164 mm in December as shown in Table 7.1-2 (Appendix D.1).

Table 7.1-1: Long-Term Mean Monthly Air Temperatures for the Project Area Based on Halifax Airport

Station	Value	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Halifax Airport	Max Monthly Mean (˚C)	-1.5	-1.1	2.6	7.3	13.0	17.4	21.0	20.7	18.5	12.4	6.0	1.5	21.0
	Mean Monthly (˚C)	-5.8	-5.6	-1.5	3.9	9.8	14.9	18.7	18.6	14.5	8.9	3.5	-2.4	6.5
	Min Monthly Mean (˚C)	-10.3	-10.0	-5.0	0.7	6.5	13.2	15.3	16.2	11.8	5.6	1.0	-9.6	-10.3

Table 7.1-2: Long-Term Mean Monthly Precipitation for the Project Area Based on Halifax Airport

Station	Value	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Halifax Airport	Max Monthly Mean (mm)	313	210	263	228	319	307	190	387	309	335	268	295	1,931
	Mean Monthly (mm)	138	118	122	113	108	97	93	99	103	134	150	164	1,440
	Min Monthly Mean (mm)	21	30	19	30	26	18	8	17	18	28	37	44	1,048

The wet and dry annual precipitation values for various return periods are presented in the KP 2018 report (Appendix D.1), which indicates a 1 in 200 year wet annual precipitation of 1,981 mm and a 1 in 200 year dry annual precipitation of 895 mm. During the full period of record, the maximum annual precipitation was 1,931 mm at the Halifax Airport station, which is between the 1 in 100 and 1 in 200 year wet event, and the minimum annual precipitation was 1,048 mm, which is between the 1 in 20 and 1 in 50 dry event.

As described by KP, extreme 24 hour precipitation values were estimated for the PA using a frequency factor approach, as presented in the Rainfall Frequency Atlas (RFA) for Canada (Hogg and Carr, 1985 as referenced in Appendix D.1). This approach involves using estimates of the mean and standard deviation of the annual 24 hour extreme precipitation and utilizes frequency factors based on the Extreme Value Type I (Gumbel) distribution. Estimates of the mean and standard deviation were derived directly from the RFA. Additionally, the mean and standard deviations of the annual 24 hour extreme precipitation were calculated based on the precipitation record from Halifax Airport station. A factor of 1.13 was applied to the daily precipitation record to account for potential differences between the daily and 24 hour precipitation (Hershfield, 1961, as referenced in Appendix D.1). The resulting mean and standard deviation values are 71 mm and 27 mm from the RFA, and 80 mm and 28 mm from the Halifax Airport recorded data, respectively.

The resulting return period estimates based on the two methods are provided in Table 7.1-3. Given the uncertainty inherent in the two sets of estimates, the larger return period values were selected as appropriately conservative. Accordingly, the values generated using the measured record at the Halifax Airport station are recommended to be used for the design of various structures in the PA.

Table 7.1-3: Estimated 24 Hour Extreme Precipitation in the Project Area.

Return Period (years)	RFA 24 Hour Extreme Event (mm)	Halifax Airport Data (mm)
2	67	75
5	90	100
10	106	116
15	115	126
20	121	132
25	126	137
50	141	153
100	156	168
200	170	184
500	190	204
1000	204	219
PMP[24]	509	531

The 100 year, 200 year, and PMP 24 hour extreme precipitation values for the PA are estimated to be 168 mm, 184 mm, and 531 mm, respectively.

Wind speed and wind direction are important parameters used in the design of various structures, as they impact evaporation and dust transportation capacity. Wind speed and wind direction are available in the Canadian Climate Normals for the Halifax Airport station for period from 1981 to 2010. The data are presented in terms of mean monthly wind speed, maximum hourly speed, and maximum gust speed, including their respective directions within the KP report (Appendix D.1). The mean annual wind speed is 4.6 m/s, and the predominant wind direction is from the south. (Appendix D.1)

7.1.2 Extreme Weather

7.1.2.1 Flood and Drought Conditions

Flooding or drought conditions may occur during the lifespan of the Project. These events can generally be accommodated in the Project design and construction. The mean annual precipitation (MAP) estimate for the Project area is equivalent to 1,440 mm with mean monthly values ranging from a low of 93 mm in July to a high of 164 mm in December. Based on the Halifax Airport station, 83% of the precipitation falls as rain, and the remaining 17% falls as snow annually.

Although extreme precipitation events may occur at any time during the year, rainfall in the Project area is generally highest during autumn months. The 24 hour extreme precipitation, as shown in Table 7.1-3, 100 year, 200 year, and PMP values for the Project area are estimated to be 168 mm, 184 mm, and 531 mm, respectively (Appendix D.1). The 1 in 200 year wet annual precipitation value is estimated to be 1,962 mm, and the 1 in 200 year dry annual precipitation is estimated to be 918 mm.

The effects of a drought or flood on the Project may include increased dust and decreased availability of water for site operations or an excess of water on the mine site. Potable water will be brought to the site and therefore a reduction in the availability of potable groundwater is not anticipated to be an adverse effect. Water from the settling ponds could be re-used during times of potential drought for dust suppression purposes, as required, and only if water quality in the ponds meets appropriate regulatory guidelines.

The final design of the water management ponds, seepage collection ponds, and any additional required water management measures will be submitted as part of the IA process.

Water management ponds and associated water management structures will typically be designed to accommodate a 1-in-10 year, 24 hr storm event (approximately 116 mm) plus direct precipitation from a 1-in-200 year, 24-hr storm event (approximately 184 mm) falling directly on the surface of the pond. Water management infrastructure has been sized to pump back collected flows to the TMF supernatant pond over a 10-day drawdown period. Storm events and their design factors are adjusted as appropriate to reflect the predicted effects of climate change. Overflow weirs will be constructed in water management pond embankments to facilitate safe discharge of flows exceeding the design flows of the pond, up to the IDF for the ponds. The IDF for each pond will be estimated based on dam classification of the retaining embankments for the ponds, and will be greater than or equal to a 1-in-100 year return period storm event. The dam classification for the seepage collection pond dams will be evaluated as part of the IA process. In the case of a storm event water management ponds will be monitored regularly.

7.1.2.2 Extreme Temperatures, Storms, and Wind

Air temperatures vary seasonally. As stated above, the mean annual temperature is estimated to be 6.5°C, with minimum and maximum mean monthly temperatures of -5.8°C and 18.7°C occurring in January and July, respectively (Appendix D.1). The Project will be designed to accommodate these temperature ranges.

Extreme temperatures and storms (ice, snow) could cause damage to site infrastructure or could directly impact site workers. A Health and Safety Plan, which will be developed in accordance with the EMS Framework Document (Appendix L.1), will be implemented to ensure worker safety during extreme temperature events and storm events.

The estimated mean annual wind speed is approximately 4.6 m/s, with the wind direction being predominantly from the northwest in the winter and from the south in the summer. Maximum hourly wind speeds can range from 17.8 m/s in May to 25.8 m/s in November. (Appendix D.1). The Project will be designed to accommodate these wind speed ranges.

7.1.3 Climate Change

Climate change is anticipated to cause an increase in frequency and intensity of extreme weather events, warmer average temperatures, higher sea levels, and more extreme rainfall and flooding events (DeRomilly and DeRomilly Limited et al. 2005). More frequent and intense extreme weather events could cause an increased risk of flooding and snow and ice storms. Increased flood events would also increase the risk of erosion. Existing infrastructure in Canada was generally not intended to withstand the more extreme and frequent storms that may be experienced in coming years; however, new construction, such as the construction of the Project is designed taking changing weather patterns and extreme events into consideration. In particular, Nova Scotia Environment's *Guide to Considering Climate Change in Environmental Assessments in Nova Scotia* states the importance of environmental assessments as planning tools for the consideration of climate change into project planning, development, operation and decommission (NSE, 2011c).

Over the last several decades, Nova Scotia has already experienced a significant number of adverse impacts of extreme weather events and is experiencing changes in its historical climate. It is very likely that a further increase in temperature, precipitation and other climate drivers will continue to occur throughout the 21st century. It is forecasted that temperature will rise by 2˚C to 4˚C and that storm surges that happened only once in the 20st century could happen up to ten times in the 21st century (NSE, 2009a).

To prepare for adaption to climate change, the NSE Climate Change Unit has published scenarios of possible future climate for 13 regions within Nova Scotia. For each region, historical climate data (1961-1990) and future projections generated using the statistical downscaling method are available. Climate data provided in future projections includes minimum and maximum temperatures, precipitation, extreme precipitation and growing season length. Although advancements in climate modelling projections have occurred over the last decade, the results are not meant to be interpreted as absolutes, but rather used as guidance in the design and planning stages to facilitate climate change adaptation (W. Richards Climate Consulting, 2011).

7.1.3.1 Regional Future Projections

The closest of the 13 regions to the Project is the HRM. Future projections are provided for 2020s, 2050s and 2080s. Since the duration for the Project is relatively short, approximately 11 years including reclamation (excluding ongoing monitoring) the future climate projections for the 2020s were used for the assessment of the effects of climate change on the Project.

While a significant change in the range of average monthly temperatures is not anticipated for the HRM, it is very likely average temperatures will increase by approximately 1.5˚C on average across all seasons in the 2020s (W. Richards Climate Consulting, 2011). Approximately 2 days a year are projected to be over 30˚C with no days reaching a temperature higher than 35˚C. Approximately 243 days a year are projected to have daily mean temperature is greater than 0°C and two days a year are projected to be less than -10 ˚C compared to the historical average of 224 days and 3 days respectively (W. Richards Climate Consulting, 2011). The average growing season length in the 2020s is projected to be approximately 209 days, which is 11 days longer than the average historical growing season (W. Richards Climate Consulting, 2011).

Annual precipitation amounts are projected to be 1453 mm a year, which is an 83 mm increase from the historical average (W. Richards Climate Consulting, 2011). Warmer winter temperatures (14 more days with a daily mean temperature is greater than 0°C) will lead to more precipitation falling as rain instead of snow. Rainstorm events are projected to be more extreme with a 5 percent change in the current 20-year return value of the 24-hour precipitation rate used in building design (W. Richards Climate Consulting, 2011).

7.1.3.2 Effects of Climate Change on the Project

Key potential effects of climate change that could impact the Project include:

- Increasing frequency of unusually high or low daily temperature extremes.
- Long-term increasing or decreasing mean annual temperatures and/or precipitation.
- Increasing or decreasing frequency of storm events (e.g., rainfall, snowfall, extreme wind).

Although the Project is relatively short in duration (approximately 11 years including reclamation and not including ongoing monitoring) and therefore the effects of climate change on the Project will likely be insignificant, climate change was still considered for each phase of the Project:~~;~~ site preparation; operation and maintenance; and decommissioning and reclamation. Details relating to this analysis completed by KP can be found in Appendix D.1.

The KP report summarizes the following conclusions relating to climate change:

- Based on the available regional climate data, it is not possible to make strong conclusions about future climatic conditions. There appears to be a general trend towards slightly warmer temperatures, while precipitation trends are less apparent, as they are increasing at some stations, but decreasing at others.
- Based on the available regional hydrologic data, it is not possible to make strong conclusions about future streamflow conditions. There is no strong indication on whether mean annual discharge and annual peak flows are increasing or decreasing.
- The available climate change models predict increased storm intensity in the Project area, which suggests annual peak flows may also increase.
- It is recommended that peak design flows are increased by 15% for structures with a design life longer than 30 years.
    - Both the TMF and Seloam Brook Realignment have been designed with considerations for a 15% increase in peak design flows.

7.1.3.3 Forest Fires

Since the limited duration of the Project on a whole indicates that warming air temperatures will not affect the Project, and as the FMS Mine Site will be primarily cleared land, the potential for forest fires is considered to be low.

7.1.3.4 Climate Change Mitigation and Adaptation

7.1.3.4.1 *Mitigation*

In order to minimize or offset the effects of the Project on climate change, in particular to reduce the GHG emissions associated with the construction, operation and reclamation of the mine, mitigation measures will be implemented. The federal guidance document *Incorporating Climate Change Considerations in Environmental Assessment: General Guidance for Practitioners* defines mitigation measures as "Measures to eliminate, reduce or control the adverse environmental effects of a project, including restitution for any damage to the environment caused by such effects through replacement, restoration, compensation or any other means" (CCCEAC, 2003, Page 23). Mitigation measures include actions such as utilizing different technologies and construction materials. Impact Management Measures and BMPs to reduce the Project's effect on the environment will be determined and implemented at the onset of each stage of the Project. Possible BMP/ Mitigation measures include:

- Implement and enforce an anti-idling policy for all vehicles and machinery on-site during the construction stage and operation stage;
- Try to utilize materials that have a lower carbon footprint and a long lifespan; and,
- Replace and plant additional native vegetation to create a carbon sink.

Further mitigation measures to reduce the potential effects of the environment on the Project are discussed in Section 7.2.

7.1.3.4.2 *Adaptation*

Climate change adaptation is focused on addressing effects of climate change on the Project. The federal guide defines adaptation as an "Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities" (CCCEAC, 2003, Page 23). Although it was determined that climate change will have no significant adverse effects on the Project due to the relatively short duration of the Project, the identification of possible adaptation measures was undertaken to increase both Project and ecosystem resilience to climate change.

Adaptation measures that will be aimed at strengthening and increasing the resilience of the Project include:

- Designing comprehensive water management measures;
- Choosing vegetation known to withstand erosion and climatic stressors such as extreme heat, drought tolerance, and flood resistance; and,
- Planting additional vegetation as required.

The above is by no means a comprehensive list of the additional adaption measures that will be considered. The development of BMP's implemented at the mine will be prepared in a way that they can flexible enough to adapt to a changing climate.

7.1.4 Slope Stability

All phases of the Project have the potential for slope failures within the footprint of the open pit, the TMF, and the topsoil, till, organics, and waste rock stockpiles. All of these slopes will be designed at an angle determined by geotechnical analysis and acceptable safety factors. However, in the event of an extreme weather event or seismic event, slope failure may be possible.

Features constructed from site materials such as waste rock stockpiles and overburden stockpiles will use the FMS Mine Site's geotechnical data for final design to produce features with appropriate safety factors to reduce the possibility of landslides, slope erosion and subsidence. With multiple-stockpiles, it is common for minor subsidence to occur in the short term creating a landscape that is varied in topography. This approach aligns with NSL&F reclamation objectives for surfaces that are not uniform but that offer safe long-term landscapes with a variety of features.

7.1.5 Seismic Events

Although seismic activity is unpredictable, the Province of Nova Scotia as a whole is located in a next-to-lowest hazard zone, with moderate to high-hazard zones located offshore in the southern Bay of Fundy and along the Laurentian Slope (NRCAN 2015).

A seismic hazard analysis conducted for the Project recommended specific design parameters for the TMF and other structures using the National Building Code of Canada (2015) specifications (Appendix D.1).

Site specific seismic ground motion parameters were determined for the Project site using the probabilistic seismic hazard database of Natural Resources Canada (NRC). The results included the peak horizontal ground accelerations (PGAs) and spectral accelerations for earthquake events having return periods from 100 years to 2,475 years (the maximum return period provided by NRC). The PGA for a return period of 475 years is only 0.023 g, indicating the Project is located in a region of low seismic hazard (Appendix D.1). A site-specific probabilistic seismic hazard analysis was undertaken to provide seismic parameters for return periods of up to 10,000 years. Based on this analysis, an earthquake magnitude of 7.25 was recommended for seismic design studies of site infrastructure (Appendix D.1).

If an earthquake were to occur, the Project may experience slight infrastructure damage caused by ground vibrations and secondary impacts such as fires from spilled materials or broken natural gas conduits. The Project is sufficiently far inland to remain unaffected by potential tsunamis. Given that Nova Scotia is located in a low earthquake hazard zone, the potential risk of seismic activity affecting the Project is very low.

Site infrastructure will be built to National Building Code of Canada standards to aid in mitigating damage to infrastructure or injury to site workers in the event of an earthquake in the Project area.

7.2 Mitigation

The Project will be designed to use commonly utilized infrastructure which will be designed to consider extreme weather events. Climate change is not anticipated to have a significant effect on the Project, based on the relatively short duration of the Project and on the climatic scenarios and events outlined above.

The following mitigation measures (Table 7.2-1) will be applied to reduce the potential effects of the environment on the Project:

- Project design will consider potential flood or drought conditions to minimize the impacts of these events on mine infrastructure.
- Project design will accommodate temperature extremes, storms, and wind speed ranges identified for the FMS Mine Site.
- Structures with a life span longer than 30 years (TMF and Seloam Brook Realignment) have been designed with a 15% climate change factor applied to peak flow estimates in order to account for potential future increases in storm intensity as a result of climate change
- Project design will follow industry standards, including the National Building Code of Canada, to prevent damage to equipment or injury to site workers.
- Topsoil, till, and waste rock stockpiles will be designed with slopes designed at an angle determined by geotechnical analysis and acceptable safety factors. Stockpiles will be constructed using collected geological data for final design and reduce the possibility of landslides, slope erosion, and subsidence.
- An Emergency Response Plan, which will be developed in accordance with the EMS Framework Document (Appendix L.1), will be implemented for the FMS Mine Site and will consider measures that may be required during an extreme weather event to secure site infrastructure, mobile equipment, stockpiles, fuel storage, and electrical equipment.

- A Health and Safety Plan, which will be developed in accordance with the EMS Framework Document (Appendix L.1), will be implemented for the FMS Mine Site and will consider measures that may be required during an extreme weather or temperature event, flood or drought, or storm event.

Table 7.2-1: Mitigation for Effects of the Environment on the Project

Project Phase	Mitigation Measures
C	Project design will follow industry standards, including the National Building Code of Canada.
C,O	Project design to consider extreme weather events, temperature extremes, wind speed ranges, flood or drought conditions, lightning strikes.
C, O, CL	Minimize the potential for slope failure.
C, O, CL	Stockpile design will consider collected geological data and will be designed with slopes at the angle determined by geotechnical analysis and acceptable safety factors.
C, O, CL	A Health and Safety Plan will be developed and implemented in accordance with the EMS Framework Document (Appendix L.1) to protect worker health and safety
C, O, CL	An Emergency Response Plan will be developed and implemented in accordance with the EMS Framework Document (Appendix L.1)

Note: C = Construction Phase, O = Operations Phase, CL = Closure Phase

7.3 Residual Effects

There are no significant adverse environmental effects anticipated due to the environment, once mitigation measures are applied. Potential effects of the environment on the Project will be reduced as much as practicable through proper design and planning and mitigation measures outlined above. Extreme weather events cannot be predicted, but through proper design and planning the majority of the effects of these events on the Project may be minimized.

8.0 Cumulative Effects Assessment

8.1 Introduction

Section 19(1)(a) of the *CEAA 2012* requires that an EA of a designated project take into account any cumulative environmental effects that are likely to result from the designated project in combination with the environmental effects of other physical activities that have been or will be carried out[1]

This section presents methodology of the Cumulative Effects Assessment (CEA) that was carried out to meet the general requirements of the *CEAA 2012*, as well as the specific requirements laid out in the FMS EIS Guidelines (CEAA, 2018).

8.2 Types of Cumulative Effects

When considering possible cumulative effects on VCs it is important to understand how the effects may interact and manifest in order to make reasonable and technical sound predictions about the significance of the cumulative effects[2].

There are four main ways that cumulative effects can interact, additive, synergistic, compensatory and masking. The definitions as presented in the draft Technical *Guidance for Assessing Cumulative Environmental Effects under the Canadian Environmental Assessment Act, 2012* (2018) are as follows:

- "An **additive cumulative effect** is the sum of individual effects of two or more physical activities" (page 42).
- "A **synergistic cumulative effect** occurs as a result of the interaction between two or more effects, when the resultant combination is greater or different than the simple addition of the effects" (page 42).
- "**Compensatory cumulative effects** are effects from two or more physical activities that "offset" each other" (page 43).
- **Masking cumulative effects** are "the effects of one project might mask the effects of another in the field" (page 44).

8.3 Cumulative Assessment Methodology

The general approach of the cumulative impact assessment is based on the Agency's Operational Policy Statement entitled Addressing Cumulative Environmental Effects under the *CEAA 2012* and the guide entitled Cumulative Effects Assessment Practitioners' Guide, 1999 (Hegmann *et al.,* 1999).

The main steps involved in this approach are as follows:

- The initial steps cover the <u>scoping</u> of the Cumulative Effects Assessment and include:
    - o Identification of the VCs that will constitute the focus of the Cumulative Effects Assessment.
    - o Determining the spatial and temporal boundaries for each VC.

[1] *Assessing Cumulative Environmental Effects under the Canadian Environmental Assessment Act, 2012.* https://www.canada.ca/en/environmental-assessment-agency/news/policy-guidance/assessing-cumulative-environmental-effects-under-canadian-environmental-assessment-act-2012.html

[2] Ibid

- Identification, selection and description of physical activities (projects) in the area.
- Confirmation of the VCs to be carried forward to the assessment stage.

- The following steps constitute the analysis of the CEA and are presented separately for each VC selected at the scoping stage:
  - Description of the baseline conditions.
  - Description of the residual effects of the proposed Project.
  - Description of the effects of other projects in the area.
  - Description of the cumulative effects.
  - Proposed mitigation and monitoring.
  - Residual Cumulative Effects and Significance Assessment.
  - Follow-up.
  - Scoping Approach.

8.3.1 Scoping Approach

The scoping methodology as depicted in the draft Technical Guidance for Assessing Cumulative Environmental Effects under the Canadian Environmental Assessment Act, 2012 (2018)[3] is presented in Figure 8.3-1 below.

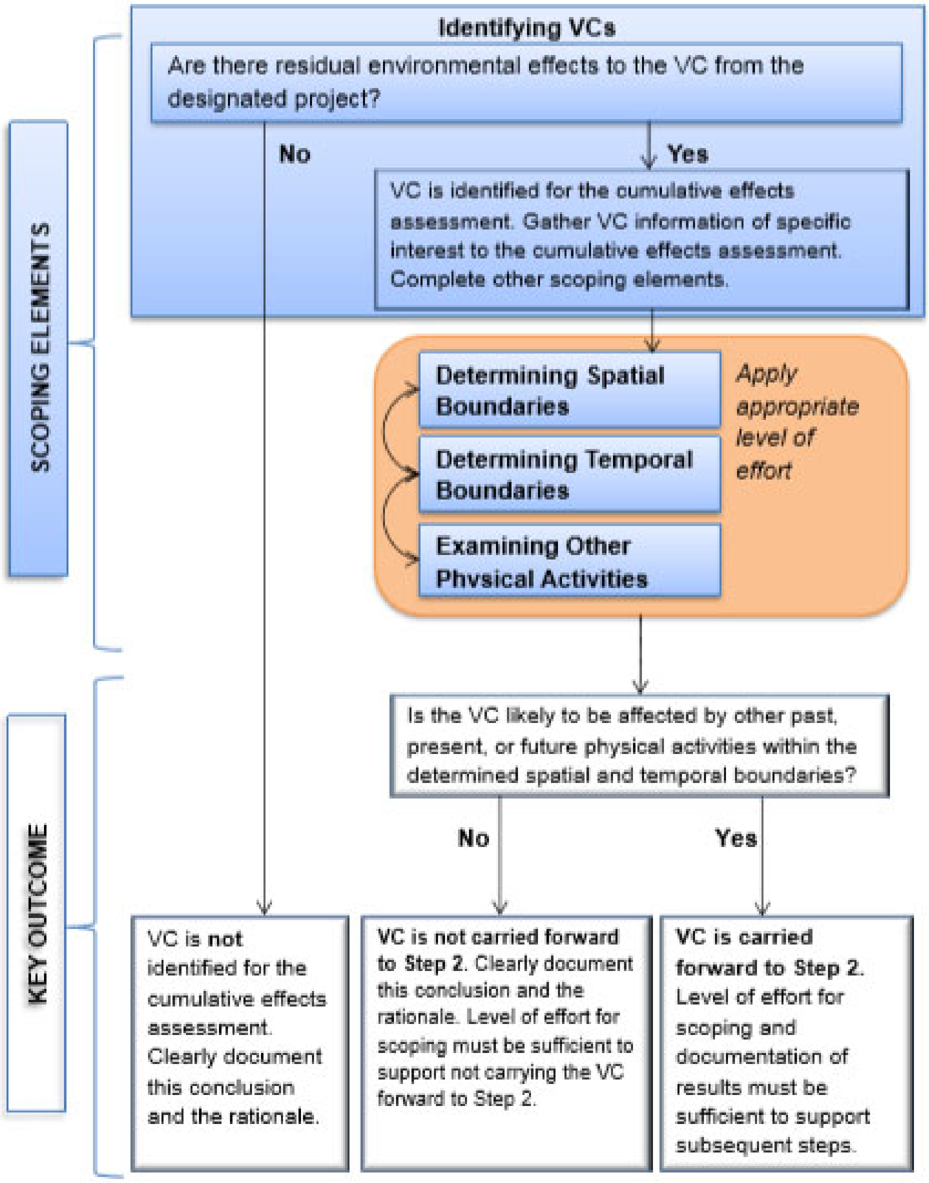

Figure 8.3-1 Generic Approach to Scoping for Cumulative Effects Assessment Adapted from the Technical Guidance for Assessing Cumulative Environmental Effects under the *Canadian Environmental Assessment Act, 2012* .

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[3] Canadian Environmental Assessment Agency. (2014). *Technical Guidance for Assessing Cumulative Environmental Effects under the Canadian Environmental Assessment Act, 2012*

The methodology followed for the four main steps associated with scoping for CEA is described below:

Step 1 - Identification of the Valued Components (VCs) That Will Constitute the Focus of the Cumulative Effects Assessment.

In order to identify the VCs that are likely to be affected by cumulative effects resulting from the proposed Project and other projects in the area, each of the VCs taken into account in the environment effects assessment of the proposed Project (Section 6) was analyzed. In order to be included in the CEA, adverse residual effects must have been identified for the VC. As per the Agency's *Guidelines for the Preparation of an Environmental Impact Statement pursuant to the Canadian Environmental Assessment Act, 2012* and *Nova Scotia Registration Document pursuant to the Nova Scotia Environment Act – Fifteen Mile Stream Gold Project – Atlantic Gold Corporation* the following valued components at a minimum must be considered:

- fish and fish habitat;
- birds (including migratory birds);
- species at risk; and
- Mi'kmaq of Nova Scotia.

As stated in the FMS EIS Guidelines (CEAA, 2018); "Valued components that would not be affected by the project or would be affected positively by the project can therefore be omitted from the cumulative effects assessment" (page 40). As such, if any VCs were only positively affected, or if it was determined through the EIS that a particular VC had no residual effects, they were not carried forward to the assessment phase. Documentation of the step is provided in Section 8.4.1.

Step 2 - Determining the Spatial and Temporal Boundaries for Each VC.

The spatial and temporal boundaries to be considered in the cumulative effects assessment are determined individually for each selected VC. The Regional Assessment Area (RAA) outlined in each VC section is used as the basis for the cumulative effects assessment. The RAA for each VC was determined based on the potential for cumulative effects.

The main points taken into consideration in determining spatial boundaries were:

- Whether the effects of different projects to a VC could be additive if felt at separate locations;
- The expected geographical extent of the project effects on the VC; and,
- The determination of the appropriate geographic scale required to assess the effects on a biological population. In most cases, a broad, regional area was considered appropriate, though the existence of physical boundaries between populations was taken into account. For example, effects to fish populations were considered cumulative within a watershed.

In the determination of temporal boundaries, the following points were taken into account:

- Duration of the expected environmental effects;
- The timing of the expected environmental effects; and,
- Whether or not the effects are only additive if felt simultaneously.

For example, it was considered for most physical VCs that effects could only be cumulative if the effects of two projects overlap in time and space. For instance, cumulative effects on water quality that exceed those assessed for an individual project are only possible if two projects affect the same body of water. However, for other VCs, such as wildlife or bird populations, effects from projects that do not overlap in space or time may have cumulative effects if their effects reach the same population. The spatial cumulative effects boundaries for such VCs may therefore be wider than those used to assess the effects of an individual project and should generally be determined in a way that is ecologically defensible.

Temporal cumulative effect boundaries take into account the timing at which a type of effect has occurred, is occurring or is expected to occur in the future, as well the expected duration of the effect. For example, the cumulative effects of habitat loss could start with the first historical effects on the habitat in question and end with the recovery of the lost habitat. Documentation of the step is provided in Section 8.4.2.

<u>Step 3 - Identification, Selection and Description of Projects in the Area.</u>

Information regarding upcoming and past projects (also referred to as physical activities under IAAC guidance) was obtained from a review of new and existing projects listed on the NSE Environmental Assessment Division website as well as the IAAC online registry. In addition, a generalized internet search was used to identify other anticipated or ongoing projects.

A search was conducted to identify all major projects within the region with a potential to have cumulative effects with the Project. Each VC's RAA was used to determine which projects were included in the CEA. Each VC's RAA is considered appropriate for this analysis, because the effects will be assessed within a boundary that is relevant to that particular VC. The Project is not expected to have any direct effects on any VCs outside of their RAA. The RAAs used for the cumulative effects assessment were determined given the social and ecological context of each VC (i.e. – the RAA and pursuant cumulative effects assessment for socio-economic impacts is based on municipal boundaries, whereas effects to aquatic ecosystems are based on watershed boundaries). Identified projects in the RAAs were included in the evaluation, regardless of their respective temporal boundaries. Documentation of this step is provided in Section 8.4.3.

<u>Step 4 - Confirmation of the VCs to be Carried Forward to the Assessment Stage.</u>

Upon completion of the three steps listed above, the residual effects to VCs that would likely interact with the effects from other past, present, or future physical activities within the spatial and temporal boundaries of each VC were determined through the application of screening criteria.

The following screening criteria were used:

- level of concern noted during engagement;
- current state of the VC (health/status/condition);
- potential for significant cumulative effects;
- uncertainty in predictions of cumulative effects; and
- potential for follow-up or additional mitigation.

The results of the application of the screening criteria for each VC were documented along with a rationale for each VC, which describes whether the VC was carried forward to the CEA or not with an accompanying rationale. Where significant adverse effects are identified, the EIS will discuss the likelihood or probability that the effect will occur.

8.3.2 Assessment Approach

8.3.2.1 Baseline Conditions

A description of the baseline conditions is given, for each of the selected VCs through the scoping phase carried forward for analysis, within their designated spatial and temporal boundaries. Emphasis is put on aspects of the VC that are likely to be affected by cumulative effects between the Project and the other identified projects in the area.

8.3.2.2 Identification and Assessment of the Cumulative Effects

The first step in the assessment of the cumulative effects is to describe the residual effects of the Project, based on the results of the environmental effects assessment presented in Section 6. The environmental effects assessment methodology used for the Project is presented in Section 5.

This is followed by the identification of any effects of the other projects identified in the area that may act in combination with the residual effects of the Project. If available, environment impact statements or environmental assessments for identified projects with potential cumulative effects were consulted. In addition, information contained in the baseline conditions for a VC often included a description of the effects of past and ongoing activities as these have left their mark on the current conditions.

In the case of past activities, their effects can be used to contextualize the current state of the VC as described in the baseline conditions. Taking this information into consideration, the total cumulative effects of all projects having an effect on the selected VC is then described as to their nature, scope and intensity. An assessment of the relative contribution of the Project on the overall cumulative effects is given by comparing these effects with and without the inclusion of the proposed project.

As indicated in the *Guidelines for the Preparation of an Environmental Impact Statement pursuant to the Canadian Environmental Assessment Act, 2012* – And *Nova Scotia Registration Document pursuant to the Nova Scotia Environment Act – Fifteen Mile Stream Gold Project – Atlantic Gold Corporation*, the assessment of cumulative effects on current use of lands and resources for traditional purposes by Mi'kmaq of Nova Scotia focusses on the effects on specific activities such as hunting, fishing, trapping and plant harvesting.

8.3.2.3 Mitigation

As a first step, an assessment of whether any additional mitigation measures beyond those proposed in the environmental effects assessment of the Project (Section 6) is made. If additional technically and economically feasible measures are warranted to reduce the cumulative effects, these are proposed.

Given the large spatial and temporal cumulative effects boundaries of certain VCs, the implementation of mitigation measures may exceed the scope of the Proponent's responsibility. In such cases the parties that have the authority to act are identified and any discussions that have taken place in order to implement the necessary measures over the long term are summarized.

8.3.2.4 Residual Cumulative Effects and Significance Assessment

The residual cumulative effects, taking into account the implementation of the mitigation measures, are described. These are then compared to the significance thresholds identified for each VC in order to determine if they are significant.

8.3.2.5 Follow-up and Monitoring

If it is considered warranted, after taking into account the confidence level of the predictions of the residual cumulative effects and the expected scale of the effects, a follow-up program is proposed to verify the accuracy of the assessment or to dispel the uncertainty concerning the effectiveness of mitigation measures for certain cumulative effects.

8.3.3 Consideration of Engagement and Engagement Results and Aboriginal Traditional Knowledge

Key issues raised during public and Mi'kmaq engagement relating to Mi'kmaq of Nova Scotia include potential habitat loss and access, and effects on individual flora and fauna used in traditional hunting, fishing and trapping activities and medicinal food and plants.

From a socio-economic perspective, interest has been expressed by the Mi'kmaq of Nova Scotia to work toward benefit agreement(s) with the Assembly of Nova Scotia Mi'kmaq Chiefs, as well as the two nearest Mi'kmaq communities of Millbrook and Sipekne'katik.

8.4 Scoping of the Valued Components

8.4.1 Identification of the Valued Components

All of the VCs (as listed below) included in the environmental effects assessment of the Project (Section 6) were taken into consideration in the scoping exercise for the CEA.

- Physical Environment
  - Noise;
  - Air;
  - Light;
  - Geology, Soil and Sediment;
  - Groundwater Quality and Quantity;
  - Surface Water Quality and Quantity;
- Biophysical Environment
  - Wetlands;
  - Fish and Fish Habitat;
  - Habitat and Flora;
  - Terrestrial Fauna;
  - Avifauna;
  - Species of Conservation Interest and Species at Risk;
- Socio-Economic Environment
  - Mi'kmaq of Nova Scotia;
  - Physical and Cultural Heritage;

- Socio-Economic Conditions.

The initial screening of the VCs listed above is based on the outcome of the environmental effects assessment (Section 6) and is summarized in Table 8.4-1. The table provides the possible pathways for VCs to cause cumulative effects as well as possible linkage of the residual effects on a VC to other VCs. Both the pathway of an effect and possible linkages of the residual effect to other VCs are important to consider from a cumulative effects perspective, specifically when determining the possible interaction of the Project's residual effects with the effects from other activities in the area.

The residual effects of 14 of the 15 identified VCs for the Project were determined not to be significant but were assessed as adverse. The Projects' effects to Socioeconomic Condition are determined to be positive. As described above, VCs with positive residual impacts are not carried forward through the CEA exercise. All other VCs were carried forward for additional consideration in the scoping process.

8.4.2 Determining the Spatial and Temporal Boundaries

8.4.2.1 Spatial Boundaries

Spatial boundaries for cumulative effects assessment are based on setting adequate spatial boundaries that represent anticipated geographic limits that will aid in defining the scale and range of interactions between Project activities and VCs.

A regional map of the PA is presented in Figure 1.1-1. The PA used for the environmental effects assessment for all VCs and the LAA and RAA used for each specific VC, as described in Section 6, were established to capture areas broader than the expected Project impacts in considerations of other project boundaries as per cumulative effects methodology. Therefore, the spatial boundaries (PA, LAA, and RAA), established for the environmental effects assessment are appropriate for determining potential cumulative effects. Each boundary is discussed below and presented on a figure in each per VC in Section 6 of this EIS.

8.4.2.1.1 *Project Area (PA)*

The PA encompasses the immediate area in which direct Project activities may occur and are likely to cause direct and indirect effects to VCs. The PA includes two components: the FMS Study Area and the Touquoy Mine Site. The PA is the same for each VC.

8.4.2.1.2 *Local Assessment Area (LAA)*

The LAA encompasses adjacent areas outside of the PA where Project related direct and indirect effects to VCs are reasonably expected to occur. Generally, the LAA is limited to the area in which Project activities are likely to have indirect effects on VCs; however, the size of the LAA can vary depending on the VC being considered, and the biological and physical variables present. The LAA for each VC is defined in Table 8.4-1 and are described in detail in relevant VC sections in Section 6 of this EIS.

8.4.2.1.3 *Regional Assessment Area (RAA)*

The RAA encompasses all Project and VC interactions and are defined intending to be spatially larger than expected for direct and indirect Project interactions, with the exception of VCs that may have diffuse or longer-range effects such as those from Project activities on socio-economic environments. The RAA varies in size depending on the VC being considered, and the biological and physical variables present. The RAA for each VC is defined in Table 8.4-1 and are described in detail in relevant VC sections in Section 6 of this EIS.

8.4.2.2 Temporal Boundaries

The Project has three distinct phases - Construction (1 year), Operations (7 years), and Closure (3+ years), which includes site decommissioning and the reclamation stage (2-3 years), and the post-closure stage (1+ years after the active reclamation stage), dependent on water quality and monitoring requirements - that define the maximum temporal boundary for assessment of impacts on each VC. The maximum Project life is 11 years for the construction, operation and closure (active reclamation stage) phases. Monitoring and water treatment, as required, is expected be required for longer during the post-closure stage of Closure.

Table 8.4-1: Initial Screening of the Valued Components based on the Outcome of the Environmental Effects

Project VC	EIS Section	Spatial Boundaries		Temporal Boundaries	Summary of A Significant Effect*	Pathway	Adverse Residual Effects			Include in Scoping Exercise	Rationale
		Local Assessment Area (LAA)	Regional Assessment Area (RAA)				Summary	Significance	Linkages to Other VCs (If Applicable)		
PHYSICAL ENVIRONMENT											
Noise	6.1	The LAA for Noise encompasses the distance at which noise sources from Project components diminish to 45 dBA, which constitutes a 3 km buffer of the PA. See Figure 6.1-3.	The RAA for Noise encompasses a 5 km radius of the PA, see Figure 6.1-3.	The temporal boundary for the assessment of effects to air quality includes the construction, operation and closure (active reclamation and decommissioning) phases.	A repeated or sustained noise level being emitted from the Mine Site that exceeds the NSE Pit and Quarry Guidelines beyond the property boundary of the Project and exceeds maximum noise or vibration limits at fixed dwellings where occupants are present (seasonal or permanent).	Atmospheric	Increased ambient noise.	Adverse, not significant	Fauna, Birds, SAR/SOCI, Mi'kmaq of Nova Scotia	Yes	Adverse residual effects were identified within VC evaluation
Air	6.2	The LAA encompasses a 1.5 km zone in all directions from the FMS Study Area. (Figure 6.2-1).	The RAA encompasses 40 km buffer from the FMS Study Area, which represents the maximum zone of influence. The RAA covers the anticipated maximum extent of particulate deposition under worst case scenarios (Figure 6.2-1).	The temporal boundary for the assessment of effects to air quality includes the construction, operation and closure (active reclamation and decommissioning) phases.	A repeated or sustained release of contaminants from the Mine Site to the atmospheric environment that exceeds the NSE Maximum Permissible Ground Level Concentrations listed in the Nova Scotia *Air Quality Regulations* and that exceeds the Canadian Ambient Air Quality Standards for fine particulate matter and ozone.	Atmospheric	Increased ambient dust.	Adverse, not significant	Flora, SAR/SOCI, and Mi'kmaq of Nova Scotia	Yes	Adverse residual effects were identified within VC evaluation
Light	6.3	The LAA for light is a 2 km radius of the PA, which represents expected maximum direct light trespass. See Figure 6.3-3.	The RAA for light encompasses a 5 km radius around both components of the PA. These buffers represent the nearest receptors See Figure 6.3-3.	The temporal boundary for the assessment of effects to air quality includes the construction, operation and closure (active reclamation and decommissioning) phases.	A repeated or sustained direct light trespass exceeding 0 lux into windows at the nearest receptor.	Atmospheric	Increased ambient light.	Adverse, not significant	Fauna, birds, SAR/SOCI, Mi'kmaq of Nova Scotia	Yes	Adverse residual effects were identified within VC evaluation
Geology, Soil and Sediment	6.5	The LAA is defined by the tertiary watersheds that encompass or intersect the FMS Study Area, and contains surface water features upstream, downstream and within the FMS Study Area. See Figure 6.4-11.	The RAA in the context of Geology, Soil and Sediment encompasses the Secondary Watershed (East River Sheet Harbour), see Figure 6.4-11.	Project-related impacts may occur during construction, operation and closure (active reclamation and decommissioning stage) phases of the Project.	A repeated or sustained release of sedimentation that exceeds CCME water quality guidelines for the protection of life. Detailed definition provided in Section 6.4.	Soils and Sediment	Erosion, soil and sediment quality	Adverse, not significant	Surface Water, Wetlands, Fish Groundwater, Flora, Fauna.	Yes	Adverse residual effects were identified within VC evaluation
Groundwater	6.6	The LAA for Groundwater Quality and Quantity represents the extent of the groundwater numerical model for the FMS Study Area, and the tertiary watershed at the Touquoy Mine Site. See Figure 6.5-9.	The RAA for Groundwater Quality and Quantity encompasses Secondary Watersheds intersecting the two components of the PA. See Figure 6.5-9.	The temporal boundary for the assessment of effects to Groundwater Quality and Quantity includes the Construction, Operation and Closure Phases.	An effect that is likely to cause negative effects on groundwater quality or quantity including exceeding the applicable CCME groundwater quality criteria and NSEQs for groundwater. Detailed definition provided in Section 6.5	Groundwater	Disturbance to groundwater quality and quantity	Adverse, not significant	Surface Water, fish, wetlands, SAR/SOCI, Mi'kmaq of Nova Scotia	Yes	Adverse residual effects were identified within VC evaluation

Project VC	EIS Section	Spatial Boundaries		Temporal Boundaries	Summary of A Significant Effect*	Pathway	Adverse Residual Effects			Include in Scoping Exercise	Rationale
		Local Assessment Area (LAA)	Regional Assessment Area (RAA)				Summary	Significance	Linkages to Other VCs (If Applicable)		
Surface Water	6.7	The LAA is defined by the tertiary watersheds that encompass or intersect the PA, and contains surface water features upstream, downstream and within the PA (FMS Study Area and Touquoy Mine Site). The lakes and watercourses that are included as part of the baseline programs and/or predictions of effects are located within the LAA boundary. See Figure 6.6-16.	The RAA in the context of surface water quality and quantity encompasses Secondary Watersheds (East River Sheet Harbour and Fish River), see Figure 6.6-16.	The temporal boundary for the assessment of effects to Surface Water Quality and Quantity includes construction, operation and closure phases.	A repeated or sustained change in water flows that are beyond the existing natural variability in the LAA (tertiary watersheds). In addition, a repeated or sustained exceedance of MDMER maximum allowable concentration limits for water quality within the LAA. Detailed definition provided in Section 6.6.	Surface Water	Change in Water Quality and Quantity Habitat Loss and disturbance Change in hydrology in Seloam Brook	Adverse, not significant	Fish, Wetlands, SAR/SOCI, Mi'kmaq of Nova Scotia	Yes	Adverse residual effects were identified within VC evaluation
BIOPHYSICAL ENVIRONNENT											
Wetlands	6.8	The LAA is defined by the tertiary watersheds that encompass or intersect the PA (FMS Mine Site and Touquoy Mine Site), and contains surface water features upstream, downstream and within the PA. The lakes and watercourses that are included as part of the baseline programs and/or predictions of effects are located within the LAA boundary. See Figure 6.6-16.	The RAA in the context of wetlands encompasses Secondary Watersheds (East River Sheet Harbour and Fish River), see Figure 6.6-16.	The temporal boundary for the assessment of effects to wetlands includes the construction, operation and closure (active reclamation and decommissioning) phases.	An effect that is likely to cause an unmitigated or uncompensated loss of wetland habitat, or an effect to wetlands that is likely to cause a permanent loss of >10% wetland habitat for a SAR species identified in the PA within the LAA.	Vegetation, Hydrology	Habitat loss and disturbance	Adverse, not significant	Fauna, fish, birds, SAR/SOCI, Mi'kmaq of Nova Scotia	Yes	Adverse residual effects were identified within VC evaluation
Fish and Fish Habitat	6.9	The LAA is defined by the tertiary watersheds that encompass or intersect the PA, and contains surface water features upstream, downstream and within the PA. The lakes and watercourses that are included as part of the baseline programs and/or predictions of effects are located within the LAA boundary. See Figure 6.6-16.	The RAA in the context of fish and fish habitat encompasses Secondary Watersheds (East River Sheet Harbour and Fish River), see Figure 6.6-16.	The temporal boundary for the assessment of effects to fish and fish habitat includes the construction, operations and closure (active reclamation and decommissioning) phases.	A significant adverse effect from the Project on fish and fish habitat is defined as an effect that results in an unmitigated or uncompensated net loss of fish habitat as defined under the *Fisheries Act*, and its associated no-net loss policy. A significant adverse effect on fish and fish habitat would also result from a discharge of deleterious substance into fish habitat that is not authorized through the MDMER, and which could result in a violation of the *Fisheries Act*. For fish populations, a significant adverse effect would result from a Project-related destruction of fish that was not authorized under Section 35 of the *Fisheries Act*.	Aquatic Resources	Habitat loss and disturbance Increased habitat connectivity Decreased water quality	Adverse, not significant	SAR/SOCI, Mi'kmaq of Nova Scotia	Yes	Adverse residual effects were identified within VC evaluation

Project VC	EIS Section	Spatial Boundaries		Temporal Boundaries	Summary of A Significant Effect*	Pathway	Adverse Residual Effects			Include in Scoping Exercise	Rationale
		Local Assessment Area (LAA)	Regional Assessment Area (RAA)				Summary	Significance	Linkages to Other VCs (If Applicable)		
Habitat and Flora	6.10	The LAA for Habitat and Flora includes a 2km buffer from the FMS Study Area. See Figure 6.9-3.	The RAA encompasses a portion of Ecodistrict 440 constrained in the east by the boundary of the Liscomb Game Sanctuary, and west by the western edge of Lake Alma. The RAA was extended north of the FMS Study Area to incorporate the entirety of the Liscomb Game Sanctuary and as such encompasses this portion of Ecodistrict 450. See Figure 6.9-3	The temporal boundary for the assessment of effects to habitat and flora includes the construction, operations and closure (active reclamation and decommissioning) phases.	A significant adverse effect from the Project on flora and habitat is defined as an effect that is likely to cause a permanent, unmitigated, alteration to habitat that supports flora species distribution.	Vegetation	Disturbance and loss of habitat	Adverse, not significant	Fauna, birds, SAR/SOCI, Mi'kmaq of Nova Scotia	Yes	Adverse residual effects were identified within VC evaluation
Terrestrial Fauna	6.11	The LAA for Terrestrial Fauna includes a 500m buffer from the Touquoy Mine Site and a 2km buffer form the FMS Study Area. See Figure 6.10-2.	The RAA encompasses a portion of Ecodistrict 440 constrained in the east by the boundary of the Liscomb Game Sanctuary, and west by the northern end of Lake Charlotte. The RAA was extended north of the FMS Study Area to incorporate the entirety of the Liscomb Game Sanctuary and as such encompasses this portion of Ecodistrict 450. See Figure 6.10-2	The temporal boundary for the assessment of effects to terrestrial fauna includes the construction, operations and closure (active reclamation and decommissioning) phases.	A significant adverse effect from the Project on terrestrial fauna is defined as an effect that is likely to cause a permanent, unmitigated, alteration to habitat that supports fauna species distribution.	Wildlife	Disturbance	Adverse, not significant	SAR/SOCI, Mi'kmaq of Nova Scotia	Yes	Adverse residual effects were identified within VC evaluation
Avifauna	6.12	The LAA for Avifauna includes a 500m buffer from the Touquoy Mine Site and a 2km buffer form the FMS Study Area. See Figure 6.10-2.	The RAA encompasses a portion of Ecodistrict 440 constrained in the east by the boundary of the Liscomb Game Sanctuary, and west by the northern end of Lake Charlotte. The RAA was extended north of the FMS Study Area to incorporate the entirety of the Liscomb Game Sanctuary and as such encompasses this portion of Ecodistrict 450. See Figure 6.10-2	The temporal boundary for the assessment of effects to avifauna includes the construction, operations and closure (active reclamation and decommissioning) phases.	A significant adverse effect from the Project on avifauna is defined as an effect that is likely to cause a permanent, unmitigated, alteration to habitat that supports avian species distribution.	Wildlife	Disturbance and loss of habitat	Adverse, not significant	SAR/SOCI, Mi'kmaq of Nova Scotia	Yes	Adverse residual effects were identified within VC evaluation

Project VC	EIS Section	Spatial Boundaries		Temporal Boundaries	Summary of A Significant Effect*	Pathway	Adverse Residual Effects			Include in Scoping Exercise	Rationale
		Local Assessment Area (LAA)	Regional Assessment Area (RAA)				Summary	Significance	Linkages to Other VCs (If Applicable)		
Species at Risk (SAR) /Species of Conservation Interest (SOCI)	6.13	The LAA for SOCI and SAR is equivalent to those described for Habitat and Flora, Terrestrial Fauna, Fish and Fish Habitat, and Birds.	The RAA for SOCI and SAR is equivalent to those described for Habitat and Flora, Terrestrial Fauna, Fish and Fish Habitat, and Birds.	The temporal boundary for the assessment of effects to SAR and SOCI includes the construction, operations and closure (active reclamation and decommissioning) phases.	A significant adverse effect from the Project on SAR and SOCI is defined as an effect that is likely to cause a permanent, unmitigated alteration to habitat that supports a species' distribution, or alteration of critical habitat. An adverse effect that does not cause a permanent alteration to habitat of a SAR or SOCI species is not considered to be significant. Sedentary species such as vascular and non-vascular flora do not have the opportunity to move to avoid direct or indirect impact. For these species, the loss of an individual or individuals of a SAR species that is important in the context of the province, or that species' overall abundance or distribution, may be considered significant, if appropriate mitigation measures are not implemented.	Wildlife, Vegetation, Aquatic Resources	Habitat loss and disturbance	Adverse, not significant	Mi’kmaq of Nova Scotia	Yes	Adverse residual effects were identified within VC evaluation
SOCIO-ECONOMIC ENVIRONMENT											
Mi’kmaq of Nova Scotia	6.14	The LAA for Mi’kmaq of Nova Scotia encompasses a 5 KM radius from the FMS Study Area, see Figure 6.13-1.	The RAA for the assessment of the Mi’kmaq of Nova Scotia is defined as the territorial boundaries of the *Eskikewa’kik* (meaning 'skin dressers territory'). See Figure 6.13-1.	The temporal boundary for the assessment of effects to the Mi’kmaq of Nova Scotia includes the Construction Phase, Operation Phase, and Reclamation and Decommissioning stage of the Closure Phase.	An effect that results in long-term (greater than 20 years) loss of the availability of, or access to, land and resources currently relied upon for traditional use practices or the permanent loss of traditional use areas within a large portion of the PA; effects on health and/or socioeconomic conditions of affected Mi’kmaq communities to the extent that they are associated, detectable, and sustained decreases in the quality of life of a community; or an unmitigated loss of a physical or cultural feature of significance to the Mi’kmaq. Detailed definition provided in Section 6.13.	Physical and Biophysical pathways and Socio-economic conditions	Loss of plant specimens and habitat Loss of fish habitat Change in species movement pattern Sensory disturbance Visual change Increased Traffic Loss of Access	Adverse, not significant	NA	Yes	Adverse residual effects were identified within VC evaluation
Physical and Cultural Heritage	6.15	The LAA for Physical and Cultural Heritage encompasses a 1.5km buffer of the FMS Study Area. See Figure 6.14-2.	The RAA for Physical and Cultural Heritage encompasses a 5 km radius of the FMS Study Area, see Figure 6.14-2.	The temporal boundaries used for the assessment of effects to physical and cultural heritage are limited to the construction phase of the Project. Construction is estimated to take approximately one year.	A significant adverse effect is an uncontrolled disturbance to, or destruction of, any unassessed and unmitigated historical or cultural resource of importance in context of the *Special Places Act.*	Cultural Heritage	No adverse residual effects as there the defined identified heritage resources that have been identified are associated with historic mining only within the Project site	Adverse, not significant	Mi’kmaq of Nova Scotia	Yes	Adverse residual effects were identified within VC evaluation

Note: A summary of each VCs threshold for determination of a significant effect is presented herein. For the full definition of a significant effect, including determination of the magnitude, see the effects assessment methodology for each VC in Section 6.

8.4.3 Identification, Selection and Description Past, Present and Future Physical Activities

Major industrial projects that have taken place, are taking place or are known to potentially take place in the future within the RAA for each VC are described in the following sections. Projects were identified as per the methods described in section 8.3.1 and consider major industrial projects (i.e., those requiring federal or provincial environmental assessment) as well as projects that are known to be present in the area from engagement efforts, common knowledge, aerial imagery review of the local area, or other methods as available. This list is meant to be inclusive, but the Proponent acknowledges the limitations of these methods of project identification; some projects may have been excluded due to ignorance on the part of the EIS team and limited publicly available data.

The ability to draw conclusions from publicly available data is a considerable limitation for the cumulative effects assessment. The best source of publicly available data for other projects being considered lies in the provincial and federal environmental assessment websites. Some of the projects identified below do not trigger an EA process, but would be regulated under provincial Approvals (i.e. Water Approvals, Integrated Resource Management approvals, or Industrial Approvals). These approval documents, and the supporting information are not readily publicly available. Projects which do trigger a formal environmental assessment process have EARDs or EISs available online, but they do not necessarily follow consistent methodology in the assessment or determination of effects. Furthermore, the details associated with information requests or insufficient information requests are not readily publicly available. Some projects (such as the Aerotech Connector Project) are currently under review so the outcome of that decision is unknown. As such, there is a risk in using conclusions presented in environmental assessments, because the Proponent is unable to confirm whether the effects assessment determinations presented therein were satisfactory, rigorous or appropriate.

A preliminary assessment of the potential cumulative effects of these projects with the Project is presented. A summary of the identified projects and their potential cumulative effects can be found in Section 8.4.3.1. Where possible, the distance of the identified projects from the FMS Mine Site and the Touquoy Mine Site were determined along with the anticipated duration of the identified projects in order to determine potential interaction of the effects of those projects with the Project's adverse residual effects.

If a project falls within a particular VCs RAA, it is considered in that VCs cumulative effects assessment. As such, for each Project listed below, a list of relevant VCs is provided based on the RAA spatial boundary for each VC. Socioeconomic effects have already been screened out of the CEA, based on predicted residual positive effects.

There is a direct spatial overlap with the Project PA and several projects. These include:

- Historic and current mining activity at the Touquoy Mine Site;
- Historic mining activity at the FMS Study Area;
- Regional forestry operations at FMS Study Area; and,
- The historic installation and current and historic operation of NSPI hydroelectric infrastructure (East River Sheet Harbour Hydro System) at the FMS Study Area.

As a result of the direct spatial overlap with the Project PA, these projects are considered in the CEA for all VCs.

There is also a direct spatial overlap associated with the proposed transportation route for the Project with the Beaver Dam Mine Project proposed Haul Road. The broad transportation route is not included in the Project PA as per discussions with IAAC during early consultation on the FMS Project. The Project proposes use of the Beaver Dam Mine Project Haul Road for concentrate transport to the Touquoy Mine Site, once the Beaver Dam Mine Project is approved and constructed. Quantitative evaluation of the cumulative effects of the haul road (considering the FMS Project and others) is addressed in the Beaver Dam Mine Project EIS (given the quantitative modelling for the Haul Road was completed for that project). However, for appropriate VCs in this CEA, the cumulative effects of the FMS trucking on the Haul Road have been evaluated qualitatively for completeness. The proposed Cochrane Hill Gold Project also plans to have concentrate transported along this Haul Road and as a result, the transportation of concentrate from the Cochrane Hill Gold Project has also be qualitatively evaluated herein, along with the Project, and the Beaver Dam Mine Project. Forest harvesting may also occur within close proximity to the Beaver Dam Haul Road and this road may also see traffic from forestry activities during the life of the Project, the Beaver Dam Mine Project and the Cochrane Hill Gold Project. As a result, forestry activities have also been considered in the cumulative effects assessment for particular VCs where applicable along the Beaver Dam Haul Road.

8.4.3.1 Current and Past Projects

8.4.3.1.1 *Fifteen Mile Stream Historic Mining Operations (Past)*

Gold mining is known to have occurred in the FMS Study Area since 1874, when development along the Jackson Lead took place, approximately 300 m south of the Egerton-MacLean area). Between 1874 and 1893, a number of different companies were active in the Old Egerton and MacLean Shaft area. At this time, small mines were worked from various shafts with the deepest recorded workings located on the Egerton Lead. In 1879, gold was discovered in the Hudson area, west of Egerton-MacLean, and some mining took place here until 1887, when a fire destroyed the mill and hoist. Mining operations appear to have stopped between 1903-1938. Very little, if any work, occurred between 1941-1980, with the exception of a tailings sampling program which occurred at the Egerton Stamp Mill in 1973. Exploration activities recommenced in the 1980’s, but little activity occurred between 1990-2008.

In 2009, Acadian Mining started re-examining some of the historic drill core and in 2010, Acadian took 2139 samples representing previously unsampled intervals from 22 of the historic drill holes. They demonstrated that much of the previously unsampled core was mineralized and that mineralization was more extensive than had been recognized. In 2011, Acadian drilled 29 diamond holes for 3,741 m. Twenty holes were drilled in the Egerton – MacLean area, ten holes in the Hudson area and the remaining hole in the 149 East Zone. This new information was used, together with the historic drill data by Snowden Consulting for a 2012 estimate of resources.

In 2014, Acadian Mining was acquired by Atlantic Gold Corporation. FSSI Consultants completed a resource update using the same database as that used by Snowden Consulting in the 2012 estimate. In 2016, Atlantic Gold commenced an exploration drilling program to determine mineralization extents at the FMS site. A total of 11 holes were drilled for 945 m. The program was continued in 2017 with a further 180 holes drilled for 23,044 m. In the same year Atlantic Gold commenced infill drilling to improve resource confidence and supplement drilling completed in the early 1980s. A total of 186 holes were drilled for 26,062 m. These additional holes were used, together with the historical drill data, by FSSI Consultants to complete a 2017 resource update. Historic mining activities within the FMS Study Area resulted in some habitat fragmentation and general disturbance, in addition to deposition of tailings along Seloam Brook. Historic mining activities are described in further detail in Section 2.

Upon approval of the proposed Project, extraction will commence in 2024. Concentrate from FMS will be shipped to the Touquoy Mine Site for processing. Tailings from FMS concentrate will be deposited into the exhausted Touquoy pit. From 2024 to 2030, the FMS Concentrate will be processed at the Touquoy Mine Site along with ore from Beaver Dam and concentrate from Cochrane Hill.

- Spatial overlap with the following RAAs: All VCs

8.4.3.1.2 *Beaver Dam Mining Operations (Past and Future)*

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

The Proponent secured the mine site in 2014 and immediately executed an exploration program whereby 38 diamond drill holes for 7,810 m were completed over the proposed open pit area with the goal of converting inferred resources to measured or indicated resources. An EIS was submitted to IAAC in 2017 and is currently being assessed by IAAC in the IR stage. The Beaver Dam Mine Site is in Marinette, Halifax County, Nova Scotia. It is located on land owned by Northern Timber Nova Scotia Corp., and access to the land will be granted by a lease.

As part of the Beaver Dam Mine Project, a Haul Road will be constructed to transport ore to the Touquoy Mine Site. The effects assessment for construction and operation of the Haul Road are presented in the Beaver Dam Mine Project EIS. However, when the Haul Road is completed, gold concentrate from the current proposed Project and the proposed Cochrane Hill Gold Project will also use the Haul Road to transport gold concentrate to the Touquoy Mine Site. The cumulative effects of increase traffic levels on the Haul Road are assessed herein as a stand-alone project (qualitative approach). The quantitative evaluation of cumulative effects is presented in the Beaver Dam Mine Project EIS.

Upon approval and the commencement of mining operations, ore from the Beaver Dam gold deposit will be transported and processed at the existing plant at the Touquoy Mine Site. The Beaver Dam Mine Project is anticipated to commence construction in 2022, come into production in 2023, cease operations in 2028, and then be reclaimed. Ore from Beaver Dam Mine Project will be processed at the Touquoy Facility along with concentrate from the Project and the proposed Cochrane Hill Gold Project.

- Spatial overlap with the following RAAs: Air, Habitat and Flora, Terrestrial Fauna, Avifauna, SAR and SOCI, Mi'kmaq of Nova Scotia.

8.4.3.1.3 *Touquoy Mining Operations (Past, Present and Future)*

The Touquoy Mine Site is a fully permitted and approved gold mine in Moose River, Halifax County, Nova Scotia. It is located on land owned by the Proponent and NSL&F. This area has a long history of gold mining, with mining activities occurring periodically since the 1890's. Further details related to the Touquoy Mine Site are presented in Section 2. The Touquoy Gold Project has been fully operational since October 2017 and is described in detail in the Project Description as it relates to the current Project. The current proposed Project involves a temporal extension of the operation of the Touquoy Processing Facility as part of its project description and the effects of the temporal extension are evaluated as effects of the proposed Project.

In the future, it is proposed that the Touquoy pit be expanded to extract additional high grade ore (Appendix I.7). To support cumulative effects assessment for the Project, this expansion is considered herein.

In the future, it is currently proposed that tailings from the processing of ore or ore concentrates from four deposits at the Touquoy mill will be disposed of in the Touquoy pit. These tailings include the processing of lower grades of ore stockpiled for the Touquoy Project, processing of ore transported from the Beaver Dam Project, and processing of ore concentrates from the Fifteen Mile Stream Gold Project and Cochrane Hill Gold Project. Each of these proposed tailings depositions into the Touquoy pit are being evaluated separately as required to reach regulatory approvals. However, to support this cumulative effects assessment for the Project, the cumulative effects from the disposal of tailing from all four projects on Water Resources are assessed in (Appendix I.7). This cumulative assessment memo also considers the proposed expansion of the Touquoy pit.

Possible cumulative effects on the VCs are summarized in Table 8.4-2

- Spatial overlap with the following RAAs: All VCs

8.4.3.1.4 *Regional Forestry Operations (Past, Present and Future)*

Some properties to the north and west of the FMS Mine Site are owned by Northern Timber Nova Scotia Corp, however, the majority of land surrounding the Project area is Crown land. Leases allow forestry to occur on Crown land. In addition to the current forestry activity in the area, evidence of historical forestry is present; clearcutting is a widespread practice throughout the region. The FMS Study Area contains a diversity of habitat types and landscape features but has experienced a considerable amount of disturbance and habitat fragmentation as a result of historic mine operations, and current and historic timber harvesting practices.

Forestry activities occur in the region surrounding Touquoy Mine Site and FMS Mine Site. Due to these operations, the regional area spanning between the FMS Mine Site and the Touquoy Mine Site is a mosaic of forested habitats at different stages of regeneration, including some relatively undisturbed mature forest. Harvested wood in this area is transported from the area by road. Regional forestry operations are likely to continue into the future following current forest management practices. Forest harvesting may also contribute to traffic on the Beaver Dam Haul Road during the life of the mine projects.

MEL consulted the Nova Scotia Harvest Map Plan Viewer (NSL&F, 2019) and NSL&F to attempt to quantify timber harvesting activity on Crown Lands, to help advise the assessment of potential cumulative effects. NSL&F confirmed that the Harvest Map available to view online identifies forest patches that are proposed or approved for timber harvesting on crown land. This tool has limited application in quantifying harvest operations, because its' intention is for public consultation purposes, and NSL&F does not use this tool to confirm if and when any approved forest patch has been actually harvested. As such, the total area of past, current and proposed Crown land timber harvesting within the RAA could not be quantified. Furthermore, this layer applies to Crown lands only, and there is no equivalent tracking system for timber harvesting operations on private land (which accounts for approximately 66% of the RAA). As such, timber harvesting operations cannot be discussed in any meaningful, quantitative way. Given the limitations of available data, discussions related to timber harvesting are qualitative in nature. Timber harvesting practices and standards are currently being reviewed under recommendations provided in the Leahy Report (2018). The details associated with which recommendations will be implemented are unknown at this time, though the general intent is to promote more ecologically driven timber harvesting. As a result, the implementation of recommendations outlined in the Leahy report are only anticipated to reduce residual effects of timber harvesting moving into the future, rather than increase residual effects.

- Spatial overlap with the following RAAs: All VCs

8.4.3.1.5 *East River Sheet Harbour Hydro System (Past, Present and Future)*

The East River Sheet Harbour Hydro System operates a series of seven hydroelectric dams in the East River Sheet Harbour secondary watershed, under Water Approval No. 1271. According to the NSPI relicensing report (NSPI 2009), hydroelectric infrastructure construction commenced in 1923-1924 at Malay Falls, though saw mills and smaller dams had been in place to support timber harvesting since the early 1800's. From 1970 to 2006, it has produced on average 43.31 GWh (giga watt hours) per year, representing approximately 4.5% of the average annual production of hydropower by NSPI.

The primary environmental effect of this system of hydroelectric infrastructure is related to fish passage limitations, and alteration of natural flow through this system. This hydro system has a long history of negotiations between DFO and NSPI to improve both upstream and downstream fish passage. Upstream fish passage is provided by a fish ladder at the Ruth Falls Dam which is located just north of the mouth of the river near the ocean. Fish passage had been supported by a trap and truck operation until 2007, when low returns made the continued operation unfeasible. Measures taken to improve fish passage within the East River Sheet Harbour hydro system have been generally unsuccessful and declining returns of migratory species such as Atlantic Salmon have been well documented. From 2004-2007, an average of fewer than 5 adult Salmon returned to the East River Sheet Harbour.

The FMS Study Area is located between two hydroelectric facilities. One is located at the outlet of Seloam Lake, which corresponds with the northeastern property boundary. The outlet of this system is Seloam Brook which flows through the FMS Study Area, joining with the Fifteen Mile Stream at the western end of the FMS Study Area. Fifteen Mile Stream flows into Anti Dam Flowage, which is a reservoir created by the nearest downstream hydroelectric facility. Fish are present within the FMS Study Area and the nearest upstream and downstream reservoirs, and each reservoir allows for the downstream passage of fish, but upstream passage of fish is limited by presence of hydroelectric facilities.

- Spatial overlap with the following RAAs: All VCs

8.4.3.1.6 *Goldboro Gas Plant – Sable Offshore Energy Project (Past)*

The Goldboro Gas Plant was built to collect and distribute natural gas from the Sable Offshore Energy Project in 1999. The gas plant completed initial processing to prepare natural gas to be sent via pipeline to the Point Tupper Fractionation Plant for additional processing. The gas plant operated for more than ten years, and decommissioning studies and planning commenced in 2012. Well plug and abandonment commenced in 2017. This site is approximately 70 km east of the FMS Mine Site, and 100 km east of the Touquoy Mine Site.

- Spatial overlap with the following RAAs: Mi'kmaq of Nova Scotia

8.4.3.1.7 *Port of Sheet Harbour (Present)*

The Port of Sheet Harbour is a deep-water port located 26 km south of the FMS Mine Site and 35 km southeast of the Touquoy Mine Site on the coast of the Atlantic Ocean. The terminal consists of a 152 m wharf with a minimum draft of 10 m and is capable of handling ships of up to 214 m (Port of Sheet Harbour, 2017).

This facility has the capacity to handle aggregates and dry bulk, scrap metal and a variety of large bulky equipment such as neobulk marshalling and load out, fabrication modules including construction equipment and heavy lift project cargo, pipes and tubulars, boilers and transformers, and wind turbines (Port of Sheet Harbour, 2017).

- Spatial overlap with the following RAAs: Air, Mi'kmaq of Nova Scotia

8.4.3.1.8 *Cook's Brook Sand and Gravel Pit (Present and Future)*

Gallant Aggregates Limited operates a sand and gravel pit in Cooks Brook, located approximately 63 km west of the FMS Mine Site and 29 km west of the Touquoy Mine Site. An eastward extension of the site was approved in 2013 and scheduled to commence that same year. The sand and gravel pit is approximately 500 m long by 250 m wide.

- Spatial overlap with the following RAAs: Mi'kmaq of Nova Scotia

8.4.3.1.9 *ScoZinc Ltd. Mine (Past and Future)*

ScoZinc Limited owns and operates a zinc/lead operation in Cooks Brook, approximately 67 km west of the FMS Mine Site and 31 km west of the Touquoy Mine Site. The footprint of this mine is approximately 1.6 km by 0.6 km. It is anticipated to be in operation for the next ten plus years.

The mine was first developed in the 1980s, but no active mining is currently taking place. ScoZinc Ltd. continues to monitor zinc and lead prices, the exchange rate between the Canadian and United States dollars, and the financing environment for the potential restart of the mine. ScoZinc Ltd. has all of the necessary permits to restart the mine, which is currently on care and maintenance.

- Spatial overlap with the following RAAs: Mi'kmaq of Nova Scotia

8.4.3.1.10 *National Gypsum Quarry (Present)*

National Gypsum operates a large quarry in Milford Station, approximately 73 km west of the FMS Mine Site and 36 km west of the Touquoy Mine Site. It is the largest gypsum quarry in the world and was first constructed in 1955 (National Gypsum 2015). The footprint of the quarry is approximately 2.5 km by 1.1 km. It is anticipated to be in operation for the next 40 plus years.

- Spatial overlap with the following RAAs: Mi'kmaq of Nova Scotia

8.4.3.1.11 *Murchyville Gypsum Mine (Past)*

A small, approximately 275 m by 200 m, gypsum quarry is located in Murchyville, 53 km southwest of the FMS Mine Site and 18 km west of the Touquoy Mine Site. This quarry is not currently operational and is currently on care and maintenance.

- Spatial overlap with the following RAAs: Mi'kmaq of Nova Scotia

8.4.3.1.12 *Tangier Gold Mine (Past and Future)*

The Tangier Gold Mine is located approximately 40 km southwest of the FMS Mine Site. The footprint of this mine is approximately 500 m by 150 m, as measured on Google Earth.

The area of the Tangier Gold Mine has seen mining activity since the 1860s. The existing mine began its activities in the 1980s and is currently inactive. It was recently purchased by Resource Capital Gold Corp and plans are being developed for re-opening the mine within the next 18 months. However, according to a press release dated January 29, 2019, the proponent had filed a Notice of Intention to make a proposal under the Bankruptcy and Insolvency Act. The planned activities are limited to mining as no processing is planned at this site. Processing would take place at the Dufferin Gold Mine (Resource Capital Gold Corp. 2017).

- Spatial overlap with the following RAAs: Air, Mi'kmaq of Nova Scotia

8.4.3.1.13 *Dufferin Gold Mine (Past, Present and Future)*

The Dufferin Gold Mine is located approximately 21 km southeast of the FMS Mine Site. The footprint of this mine is approximately 375 m by 150 m.

Mining has been active in this area for more than a century. The site of the Dufferin Gold Mine began activity in the 1980s and has had sporadic development over the years. In 2014, the mine operated for a short period of time before closing. It is currently under the same ownership as Tangier Gold Mine and there were plans for re-opening to begin in 2017. A bulk sampling program and associated milling was completed in 2018, but in 2019 the proponent (Resources Capital Gold Corporation) filed a Notice of intention to make a proposal under the Bankruptcy and Insolvency Act so future plans for this Project are uncertain.

- Spatial overlap with the following RAAs: Air, Habitat and Flora, Terrestrial Fauna, Avifauna, SAR and SOCI, Mi'kmaq of Nova Scotia

8.4.3.1.14 *Great Northern Timber Wood Chipping and Shipping (Present)*

Great Northern Timber owns and operates a chipping and ship loading facility in Sheet Harbour, approximately 26 km south of the FMS Mine Site. Great Northern Timber procures wood chips and roundwood fibre from industrial landowners, sawmills, Crown lands, Private land contractors and Private woodlot management organizations in Nova Scotia, Prince Edward Island, New Brunswick and Quebec.

- Spatial overlap with the following RAAs: Air, Mi'kmaq of Nova Scotia

8.4.3.1.15 *Taylor Lumber Co. Ltd. Mill (Present)*

Taylor Lumber Co. Ltd. has operated a mill in Middle Musquodoboit since 1945. This site, located approximately 50 km west of the FMS Mine Site and 17 km northwest of the Touquoy Mine Site, includes a saw mill, a finishing plant, a pallet plant, a power plant, a dry-kiln, and a chipping plant. The power plant is a co-generation facility that burns biomass produced from their operation that provides power to their operation as well as to homes and businesses within a 30 km radius (Taylor Lumber, 2017).

- Spatial overlap with the following RAAs: Mi'kmaq of Nova Scotia

8.4.3.1.16 *Regional Wind Power Projects (Present)*

A total of at least five Wind Power Projects (WPP) are present within the broadest RAA (Mi'kmaq of Nova Scotia) to be considered in the cumulative effects assessment. Wind power Projects within this RAA range from single turbines projects with a 1.5MW capacity to projects with 6 turbines with a capacity of 13.8MW. The closest WPP to the Study Area is the Sheet Harbour WPP, 23km south of the FMS Study Area. The projects reviewed include the Mulgrave WPP, Chebucto – Pockwock WPP, Sable WPP, Gaetz Brook WPP, and Chebucto Terence Bay WPP.

Given the distance between regional WPPs and the proposed Project, and the comparatively small scale of WPPs, and the limited expected residual effects of these wind projects post mitigation efforts, these projects are determined to be unlikely to contribute to cumulative effects with the Project. As such, they are not discussed in any further detail in this Cumulative Effects Assessment. These WPPs fall within the RAA for Mi'kmaq of Nova Scotia, and except at the sites of the turbines themselves, they are not believed to limit land and resource use by the Mi'kmaq of Nova Scotia.

- Wind Power Projects spatially overlap with the RAA for Mi'kmaq of Nova Scotia, however these projects are not specifically considered in any VCs, based on justification provided above.

8.4.3.1.17 *Porcupine Mountain Quarry (Present)*

Porcupine Mountain Quarry is a large aggregate quarry located at Porcupine Mountain, near Mulgrave, Guysborough County. This aggregate quarry exceeds 200 hectares in disturbed area. It has been in operation for more than 70 years, having been used as the source of rock for construction of the Canso Causeway in the 1950's. This site is 123km northeast of the FMS Study Area and 138km northeast of the Touquoy Mine Site.

- Spatial overlap with the following RAAs: Mi'kmaq of Nova Scotia

8.4.3.1.18 *Mosher Lake Limestone Co. (Present)*

Mosher Limestone processing facility is located approximately 35 km west of the FMS Mine Site Dam Mine and 16 km north of the Touquoy Mine Site. Mosher Limestone processes and sells limestone products in Nova Scotia and Atlantic Canada. Products include pelletized limestone, powdered limestone, granular limestone, powdered gypsum, pelletized gypsum, and traction sand. The processing facility crushes, packages and ships product.

- Spatial overlap with the following RAAs: Air, Mi'kmaq of Nova Scotia

8.4.3.1.19 *Great Northern Timber Pellet Facility (Present)*

Great Northern Timber Group owns and operates a wood pellet manufacturing facility at Upper Musquodoboit – Great Northern Pellets, since 2017, located approximately 38 km west of the FMS Mine Site and 16 km north of the Touquoy Mine Site. The plant has had a capacity for processing 60,000 tons of wood pellets per year. Past operators shipped product to Europe through the Port of Halifax.

- Spatial overlap with the following RAAs: Air, Mi'kmaq of Nova Scotia

8.4.3.1.20 *Goff's Quarry Expansion (Present and Future)*

Scotian Materials currently operates a quarry on private land, approximately 90 km southwest of the FMS Mine Site and 52 km southwest of the Touquoy Mine Site. Currently, the quarry is permitted under an industrial approval, as it operates under 4.00 ha. Scotian Materials has submitted an EA registration document to expand the quarry to approximately 41 hectares, extending the life of the quarry by an estimated 25-50 years.

A provincial EA was registered August 7th, 2018 for the proposed undertaking. The Minister released a decision on September 25th, 2018 requesting additional information. On 25 October 2019, the Minister granted Approval for a 14-ha expansion (Phase 1 and Phase 2) of the Project described in the registration document, to ta total quarry footprint of 18 hectares. Spatial overlap with the following RAAs: Mi'kmaq of Nova Scotia

8.4.3.1.21 *Lake Major Dam Replacement (Present)*

On December 16, 2016, Halifax Water submitted a provincial Environmental Assessment Registration Document for the replacement of a dam on Lake Major in Halifax County. The Project is located 55 km southwest of the Touquoy Mine Site and 88km southwest of the FMS Mine Site. The Minister approved the Project on February 9th, 2017, subject to a number of conditions.

- Spatial overlap with the following RAAs: Mi'kmaq of Nova Scotia

8.4.3.1.22 *Loch Katrine Quarry (Present and Future)*

On November 2nd, 2016, Dexter Construction Company Limited submitted a provincial Environmental Assessment Registration Document. The proposed undertaking involves an expansion of the existing 3.94 ha aggregate quarry in Loch Katrine, Guysborough County. The expanded quarry will occupy a maximum footprint of 27.3 ha, providing aggregate for road and local construction industries for up to 40 years. This site is located 55 km northeast of the FMS Mine Site and 90 km northeast of the Touquoy Mine Site. This project was granted ministerial approval on December 22nd, 2016.

- Spatial overlap with the following RAAs: Mi'kmaq of Nova Scotia

8.4.3.1.23 *Chedabucto Aggregates Quarry (Present and Future)*

On September 17th, 2014, Chedabucto aggregates Limited submitted a provincial Environmental Assessment Registration Document. The proposed undertaking involves an expansion of the existing hectares aggregate quarry in Queensport, Guysborough

County to a maximum size of 11.4 ha. This site is located 98 km east of the FMS Mine Site and 130 km northeast of the Touquoy Mine Site. This project was granted ministerial approval on November 6th, 2014.

- Spatial overlap with the following RAAs: Mi'kmaq of Nova Scotia

8.4.3.1.24 *Highway 107 – Bedford to Burnside (Present)*

In June of 2017, Nova Scotia Transportation and Infrastructure Renewal submitted a provincial Environmental Assessment Registration Document for the construction of an extension to Highway 107, from Bedford to Burnside. The Project involves construction of a four-lane highway, approximately 9km in length, connecting Akerley Boulevard and Burnside Drive to the west end of Duke Street. This project also proposes to widen approximately 1.5 km of Duke Street in Bedford which leads to Highway 102. On August 25th, 2017, the Minister released a decision requesting supplemental information. This was provided on June 18, 2018, and the Project was approved on August 7th, 2018.The registration document submitted in June 2018 proposed a construction schedule of 5 years (2018-2022). The project lies approximately 63 km southwest of the Touquoy Mine Site and 98 km southwest of the FMS Mine Site. Construction commenced on this project in September 2019.

- Spatial overlap with the following RAAs: Mi'kmaq of Nova Scotia

8.4.3.2 Future Physical Activities (Certain, Reasonably Foreseeable or Hypothetical)

It is expected that the forestry industry will continue into the foreseeable future throughout the RAA for Mi'Kmaq of Nova Scotia (the largest RAA). The mining industry could become more active if the price of minerals, notably gold, increases. This could hypothetically lead to the expansion of existing projects or the proposal of other new mining projects as exploration for mining is active in the region.

In addition to the ongoing forestry industry and the potential increase in general mining activities, two projects proposed by the Proponent, the Beaver Dam Mine Project and the Cochrane Hill Gold Project that are associated with the Touquoy Mine Site were identified as potential future projects. As neither project has been approved, as they are both currently undergoing federal environmental assessments, they are therefore are determined as reasonably foreseeable projects for the purpose of this CEA.

8.4.3.2.1 *Cochrane Hill Gold Project (Future)*

The proposed Cochrane Hill Gold Project comprises the development, operation, closure and reclamation of a surface gold mine in association with the Touquoy mine, which would produce approximately two million tonnes of gold-bearing ore a year. The Cochrane Hill surface mine is located within Guysborough County, in central Nova Scotia, approximately 145 km northeast of Halifax, 45 km to the northeast of the FMS Mine Site and 62 km northeast of the Beaver Dam Mine Project. The property covers the historic Cochrane Hill Gold District located on NTS sheets 11E01/D, 11E08/A, and 11E05/B. Concentrate from Cochrane Hill Mine Site will be trucked to the Touquoy Mine Site for processing, along with FMS concentrate and ore from Beaver Dam. This proposed transportation route includes the use of the Beaver Dam Haul Road.

Processing the gold concentrate produced the Cochrane Hill Gold Project at the Touquoy facility will eliminate the need for a separate processing facility at the Cochrane Hill Mine Site. It is anticipated that 350,000 tonnes of tailings would be deposited into the Touquoy exhausted pit as a result of processing the gold concentrate from the Cochrane Hill Gold Project.

To facilitate the processing of the gold concentrate produced at the Cochrane Hill Mine Site, minor changes to the Touquoy facility would be needed. Additional concentrate storage and the addition of a second gravity concentrate leach reactor and a gravity electrowinning cell would have to be added. However, all of these items can be accommodated within existing footprint at the Touquoy mine.

There is also potential for cumulative effects associated with the effects resulting from the continued use of the Touquoy Mine Site.

The residual effects for the Cochrane Hill Gold Project resulting from use of the Touquoy Mine Site would be a temporal extension of the residual effects defined for the Touquoy Gold Project. The cumulative impacts of the addition of the Cochrane Hill Gold Project must take into account the extension of the temporal boundaries for the effects at the Touquoy Mine Site, alongside the same extension from the Project and the Beaver Dam Mine Project. Also, any such effects that are lasting could accumulate over time. Possible cumulative effects on the VCs are summarized in Table 8.4-2.

- Spatial overlap with the following RAAs: Air, Mi'kmaq of Nova Scotia

8.4.3.2.2 *Beaver Dam Haul Road use by the Project, Cochrane Hill (Future), Beaver Dam Mine Project, and Forestry Activities (Future)*

The gold concentrate from the Cochrane Hill Mine Site and FMS Mine Site as well as ore from the Beaver Dam Mine Site will be transported to the Touquoy Mine Site, in part, via the Beaver Dam Haul Road, for processing. The Beaver Dam Haul Road is proposed for construction in 2022 as part of the Beaver Dam Mine Project, at which point, it will be used to transport ore and concentrate from the Project to the Touquoy Mine Site. A total of 95 return trips are expected to travel on the Beaver Dam Mine Haul Road to facilitate transportation of Beaver Dam ore to the Touquoy Mine Site. Both Cochrane Hill and FMS Projects will contribute an additional 11 return trips each per day.

In addition, the Haul Road may also occasionally be used by forestry harvesters in the local area. This traffic would be occasional and sporadic, on the order of 7 round trips per day (varying seasonally) (pers. comm., Rick Archibald, 27 Nov, 2020). In addition to the heavy truck traffic summarized above, it is estimated 3/4-ton service trucks would make up to approximately 20 round trips per day on the Haul Road.

The Project Team was unable to ascertain specific data regarding schedule or frequency of cutting within this area, or the resulting number of trucks that could be present from harvesting activities in the same temporal boundary as the projects as the Beaver Dam, Fifteen Mile Stream and Cochrane Hill Projects. As a result, this activity has been evaluated in a qualitative way as part of this cumulative effects assessment, where possible, given the data limitations.

The possible cumulative effect includes an expected increase in traffic on the Beaver Dam Haul Road between Highway 224 and the Mooseland Road, and the small contribution of each project to the overall disturbance of natural habitats at the regional scale for both humans (traditional usage and local residents) and flora and wildlife.

- Spatial overlap with the following RAAs: Noise, Air, Light, Habitat and Flora, Terrestrial Fauna, Avifauna, SAR and SOCI, Mi'kmaq of Nova Scotia.
- Quantitative evaluation of this cumulative effect has been detailed in the Beaver Dam Mine Project cumulative effects analysis within the EIS. Within this section, the projects are considered cumulatively through quantitative methods where possible, or qualitative methods.

8.4.3.2.3 *Anaconda Gold Mine (potential Future)*

In August 2018, Anaconda Mining Inc. submitted a provincial Environmental Assessment Registration Document for construction and operation of a gold mine in Goldboro, Guysborough County. This site is approximately 70 km east of the FMS Mine Site, and 100 km east of the Touquoy Mine Site. The proposed Project would involve operation of surface and underground mine facility producing 575 tonnes per day, 24 hours/day, 7 days/week, within a project footprint of approximately 126 ha. An on-site concentrator and tailings facility would be built as well. The proposed Project timeline involved production commencing in 2020, with project completion occurring in 2029, pending approval. On September 19th, 2018, the Minister released a decision, indicating that additional information would be required before approval could be granted. The Minister released terms of reference for a Focus Report to be submitted by the Proponent. The proponent withdrew their Environmental Assessment Registration Document on September 16, 2019.

The Goldboro area has been an active and productive mining area around the turn of the century from 1893-1910. There are historic mine workings as well as contamination throughout the area due to this history of mining.

- Spatial overlap with the following RAAs: Mi'kmaq of Nova Scotia

8.4.3.2.4 *Sheet Harbour Quarry (Future)*

On January 31st, 2019, Dexter Construction registered an Environmental Registration Document with Nova Scotia Environment. The Minister released a decision on November 8th, 2019, approving the proposed undertaking. It is unknown whether the project has commenced.The Project is located in the community of Mushaboom, Halifax, County, Nova Scotia, approximately 30 km south of the FMS Mine Site, 6.6 km south of the community of Sheet Harbour, and 4 km southwest of the Port of Sheet Harbour. The total infrastructure footprint of the project is approximately 85 ha.

The purpose of the undertaking is to meet local and regional aggregate demand for projects carried out by Dexter Construction in the Sheet Harbour regional area. There is future potential for aggregate material to be sold offshore using the Port of Sheet Harbour as a shipping point. This quarry will replace existing smaller quarries in the region that are nearly exhausted and will be reclaimed. The extractable reserves in the quarry as designed is anticipated to be 50 plus years with production commencing at approximately 50,000 tonnes per year and increasing to 500,000 tonnes per year by Year 16 depending on markets.

Site activities will include the drilling, blasting, crushing, stockpiling, and transporting by trucks of aggregate for sale or for use in projects that are contracted to Dexter Construction. The operation will consist of a lay down area for the portable crushing equipment and screens, various aggregate stockpiles, and weigh scales, as well as the physical features of the site such as the quarry floor and active working faces, and site settling pond(s).

Assuming the mitigation, monitoring, and progressive reclamation measures specified in this report are implemented, and the quarry is operated according to provincial guidelines and approvals, no significant adverse residual environmental or socio-economic effects are likely. Effects are expected to be of small spatial magnitude, low frequency, short duration, and/or limited geographical extent. Operation of the quarry will result in economic benefits, including employment and an economic source of quality aggregates to local demand markets.

Environmental effects will include the loss of some habitat within the proposed quarry property area. The property has been the subject of past forestry activities.

Localized impacts on air quality can be expected through the formation of airborne particulate matter. These impacts are readily controlled through standard mitigation measures (e.g., dust suppression) and follow-up monitoring as necessary to ensure compliance with the Pit and Quarry Guidelines at the property boundaries.

- Spatial overlap with the following RAAs: Air, Mi'kmaq of Nova Scotia

8.4.3.2.5 *Black Point Quarry (Future)*

On March 4th, 2014, Black Point Aggregates Inc. submitted a Provincial Environmental Assessment Registration Document and federal EIS for the operation of a granite quarry in Guysborough County. It is located 113km east of the FMS Mine Site and 143km northeast of the Touquoy Mine Site. On April 26, 2016 federal and provincial approval was granted for this project to proceed. On March 29th, 2018, the Minister authorized an extension for the commencement of work. The Proponent must commence work on or before April 26th, 2020 unless granted an extension by the Minister.

- Spatial overlap with the following RAAs: Mi'kmaq of Nova Scotia

8.4.3.2.6 *Bearpaw Pipeline (Future)*

On March 30th, 2016, Bear Paw Pipeline Corporation Inc. submitted a provincial Environmental Assessment Registration Document for the construction and operation of a 62.5 km high pressure steel natural gas pipeline from Goldboro to the future location of the Bead Head LNG liquefied natural gas export facility in Richmond County, Nova Scotia. The project will include a compressor facility to deliver natural gas pressure to Bear Had LNG. On November 2nd, 2016, the Proponent submitted an addendum to the Registration Document. The Minister granted approval to this project on December 22nd, 2016. The western extent of this proposed pipeline in in Goldboro, approximately 70 km east of the FMS Mine Site, and approximately 100 km northeast of the Touquoy Mine Site. The proposed pipeline route runs northeast across Guysborough County towards the Strait of Canso.

- Spatial overlap with the following RAAs: Mi'kmaq of Nova Scotia

8.4.3.2.7 *Goldboro LNG Facility (Future)*

In September 2013, Pieridae Energy (Canada) Ltd. Submitted a provincial Environmental Assessment Registration Document for the construction and operation of a Natural Gas Liquefaction Plant and Marine Terminal in Goldboro, Guysborough County. The Project received ministerial approval on March 21st, 2014, and an extension for the commencement of work on October 24th, 2017. This site is approximately 70 km east of the FMS Mine Site, and 100 km east of the Touquoy Mine Site.

- Spatial overlap with the following RAAs: Mi'kmaq of Nova Scotia

8.4.3.2.8 *Canso Spaceport Facility (Future)*

Maritime Launch Services Ltd. (MLS) has proposed to construct and operate a private commercial space launch site near the communities of Little Dover, Hazel Hill, and Canso, within the Municipality of the District of Guysborough (MODG) of Nova Scotia. The purpose of the Project is to establish a commercially-controlled, commercially-managed, launch site that would provide launch site options in North America, in support of the growing commercial space transportation industry. The site location is approximately 120 km northeast of the FMS Mine Site and 155 km northeast of the Touquoy Mine Site.

The Project will be situated on a portion of Crown Land designated by Property Identification Number (PID) 35096320 and consist of three components; the Launch Control Center (LCC), the Horizontal Integration Facility (HIF), and the Vertical Launch Area (VLA) connected by a transportation route. Access to the Project site is expected to coincide, in part, with the access road to the Sable Wind Farm, owned and operated by the MODG, in partnership with Nova Scotia Power.

A provincial EA was registered in June of 2018 for the proposed undertaking. The Minister released a decision in August 2018 requesting additional information. A focus report was submitted on March 11th, 2019, and Minister issued an Approval for the Project on June 4th, 2019.

- Spatial overlap with the following RAAs: Mi'kmaq of Nova Scotia

8.4.3.2.9 *Waste Dangerous and Non-Dangerous Goods Temporary Storage Facility (Future)*

On August 7 2019, Envirosystems Incorporated (Envirosystems) registered an environmental assessment for the Waste Dangerous and Non-Dangerous Goods Temporary Storage Facility at 11 Brownlow Avenue in Burnside, NS. The Minister decided additional information was required to make a decision on this Project. On 11 February 2020, the Minister decided to approve the undertaking. The project lies approximately 63 km southwest of the Touquoy Mine Site and 98 km southwest of the FMS Mine Site. The Project involves construction and operation of a new waste dangerous and non-dangerous goods temporary storage facility (Storage Facility) at their existing site at 11 Brown Avenue, a fully permitted Used Oil Collection and Storage operation (Approval No. 2001-024626-R10). The existing site is approximately 20,940 square metres (m^2) in size with the proposed facility occupying roughly 1.55% of the site.

- Spatial overlap with the following RAAs: Mi'kmaq of Nova Scotia

8.4.3.2.10 *Liquid Asphalt Storage Facility (Future)*

On 1 May 2020, General Liquids Canada and the municipal Group of Companies registered an environmental assessment document for a proposed Liquid Asphalt Storage Facility Project. This facility is proposed to be located on Pleasant Street in Dartmouth, which is approximately 61 km southwest of the Touquoy Mine Site and 96 km southwest of the FMS Mine Site. This facility would allow transferring, storage and preparation of liquid asphalt for shipment. On 22 June 2020, the Minister decided to approve the undertaking, subject to a number of conditions.

- Spatial overlap with the following RAAs: Mi'kmaq of Nova Scotia

8.4.3.2.11 *Highway 102 Aerotech Connector Road Project (potential Future)*

On 20 September 2019, Nova Scotia Transportation and Infrastructure Renewal submitted a provincial Environmental Assessment Registration Document for the construction of a connector road from Highway 102 Aerotech Interchange (Exit 5A) to Trunk 2 in Wellington. This 5km connector road is designed as a four-lane road. According to the registration document, the project may commence in 2020 and is expected to take 5 years to complete. The Minister of Environment released a decision about this project on October 30, 2019. The Minister determined that the registration document was insufficient. This project is currently under review, pending submission of supplemental information to support the registration document. The project lies approximately 108km southwest of the Touquoy Mine Site and 180 km southwest of the FMS Mine Site.

- Spatial overlap with the following RAAs: Mi'kmaq of Nova Scotia

8.4.4 Confirmation of Valued Components to be Carried Forward Cumulative Effects Assessment

The three steps listed above include identification of the valued components, determination of spatial and temporal boundaries, and identification of past, present and future physical activities or projects relevant to the selected VCs based on identified RAAs for each VC. This exercise allowed for the identification of pathways for potential cumulative effects per VC based on:

- The extent of predicted Project effects on each VC;
- Potential extent of other Projects' impacts based on publicly available or published data;
- The timeframe of Project impacts;
- The timeframe of other Projects potential impacts, based on publicly available or published data; and,
- Types of potential cumulative effects (additive, synergistic, compensatory and masking).

This fourth step takes these confirmed pathways and potential intersections with other Projects, and then identifies which VCs will be brought forward to the CEA, based on the following criteria:

- level of concern noted during engagement;
- current state of the VC (health/status/condition);

- potential for significant cumulative effects with other projects as identified for each VC; and,
- uncertainty in predictions of cumulative effects especially project knowledge and data limitations.

As described in Table 8.4-2 the following VCs warrant further assessment:

- Physical Environment
  - Air
  - Noise
  - Light
  - Surface Water Quality and Quantity
  - Groundwater Quality and Quantity
- Biophysical Environment
  - Wetlands
  - Fish and Fish Habitat
  - Habitat and Flora
  - Terrestrial Fauna
  - Avifauna
  - Species of Conservation Interest and Species at Risk
- Socio-Economic Environment
  - Physical and Cultural Heritage
  - Mi'kmaq of Nova Scotia

Noise and light VCs associated with the defined Fifteen Mile Stream Gold Project do not trigger evaluation of cumulative effects based on confirmed Project Areas and VC spatial boundaries (RAAs) and locations of other identified projects. However, due to the proposed interactions of the Beaver Dam Mine Project with the Project and Cochrane Hill Gold Project, as well as forestry trucking activities, relating to the use of the Beaver Dam Haul Road for transportation of gold concentrate from the Project, the noise and light VCs are carried forward to evaluation for cumulative effects herein only in consideration of the plan to use the Beaver Dam Haul Road for transportation of gold concentrate to the Touquoy Mine Site. Trucks associated with the transportation of this concentrate have additive cumulative potential for increased dust, light intrusion into the forest, and noise when considered with the Beaver Dam Haul Road truck traffic, and also the truck traffic associated with the proposed Cochrane Hill Gold Project (additional transportation of gold concentrate using this Haul Road) and potential forestry traffic. The quantitative analysis of these potential cumulative effects is addressed in the Beaver Dam Mine Project EIS and associated regulatory information requests. However, a summary analysis is provided within this section to support the Project cumulative effects assessment.

Table 8.4-2: Selection of Valued Components for the Cumulative Effects Assessment

Project VC	Residual Adverse Effects	EIS Finding	Boundaries		Criteria for Determining Whether Further Assessment Is Required				Carried Forward to Cumulative Effects Assessment	
			Spatial – Geographical Extent of Residual Effects	Temporal - Timeframe Associated with Residual Effects	Level of Concern Noted During Engagement	Current State of The VC (Health/Status/ Condition)	Potential for Cumulative Effects: Screening Evaluation Summary	Uncertainty in Prediction of Cumulative Effects	Yes/No	Rationale
Noise	Increased ambient noise	Not Significant	Residual effects related to ambient noise levels are not anticipated to extend outside the PA	Residual effects to ambient noise levels may occur throughout the duration of the project including Construction, Operation and Closure (reclamation stage) phases	Medium. Local residents and Mi'kmaq are concerned with potential noise from the mine Noise along the Beaver Dam Haul Road is a concern for the Millbrook First Nation and local residents	Good. Project noise is predicted to be in compliance with the Pit and Quarry Guideline nighttime guideline of 55 dBA at the proposed property boundaries for the FMS Mine Site There are no predicted impacts from the Project at the Touquoy Mine Site	No. It is likely that forestry operations will occasionally coincide with those of the FMS Project within the RAA and cause increased ambient noise levels, compared to the levels that these operations produce individually. However, such additive periods are likely to be limited in duration and frequency and are not expected to be significant. No other projects were identified within the RAA for noise Cumulative effects of transportation of gold concentrate with the Beaver Dam Mine Project and the Cochrane Hill Gold Project is possible (trucking on Beaver Dam Haul Road)	Moderate. The principal assumption behind the potential of significant cumulative effects is that local forestry practices will not change in any substantial, meaningful way throughout the Project. This assumption is considered as having a moderate uncertainty No data was available to confirm this statement	Yes.	The predicted cumulative effects are not anticipated to be significant and the residual effects of the Project are anticipated to revert back to baseline conditions upon completion of the project However, due to potential for cumulative effects of trucking on the Beaver Dam Haul Road, further evaluation (qualitative) is warranted specific to this location only. Quantitative analysis within the Beaver Dam Mine Project EIS
Air	Increased ambient dust	Not Significant	Residual effects related to air quality are not anticipated to extend outside the LAA	Residual effects to ambient air quality levels may occur throughout the duration of the project including Construction, Operation, and Closure (reclamation) phases	Medium. Concerns were specifically expressed by the Mi'kmaq relating to atmospheric environment include potential dust from mining operations at FMS Mine Site and the Touquoy Mine Site relating to use of the landscape for traditional harvesting purposes Dust along the Beaver Dam Haul Road is a concern for the Millbrook First Nation and local residents.	Good. Concentrations of all parameters are predicted to be in compliance with appropriate regulatory criteria at the proposed property boundaries for the FMS Mine Site, with consideration of mitigation equivalent to twice daily dust suppression (via water) and application of chemical dust suppressants when required, during dusty times There are no predicted impacts from the Project at the Touquoy Mine Site	No. It is likely that forestry operations will occasionally coincide with those of the FMS Project and cause increased ambient dust levels, compared to the levels that these operations produce individually. However, such additive periods are likely to be limited in duration and frequency and are not expected to be significant. Cumulative effects of transportation of gold concentrate with the Beaver Dam Mine Project and the Cochrane Hill Gold Project is possible (trucking on Beaver Dam Haul Road)	Moderate. The principal assumption behind the potential of significant cumulative effects is that local forestry practices will not change in any way throughout the Project. This assumption is considered as having a moderate uncertainty No data was available to confirm this statement	Yes.	Further assessment is required to determine if there is the possibility of significant residual cumulative effects to Air at the FMS Mine Site Also, due to potential for cumulative effects of trucking on the Beaver Dam Haul Road, further evaluation (qualitative) is warranted specific to this location. Quantitative analysis within the Beaver Dam Mine Project EIS
Light	Increased ambient light	Not Significant	Residual effects related to ambient light levels are not anticipated to extend outside the LAA	Residual effects to ambient light levels may occur throughout the duration of the project including Construction, Operation and Reclamation phases	Low. Local residents and Mi'kmaq are concerned with potential light from the FMS Mine Site and the Touquoy Mine Site Light intrusion into the forest along the Beaver Dam Haul Road is a concern for the Millbrook First Nation and local residents	Good. The LAA is a rural, remote area and is mostly wooded. Ambient nighttime light conditions would be minimal and typical of an undeveloped rural area There are no predicted impacts from the Project at the Touquoy Mine Site	No. It is likely that forestry operations will occasionally coincide with those of the FMS Project and cause increased ambient light levels, compared to the levels that these operations produce individually. However, such additive periods are likely to be limited in duration and frequency and are not expected to be significant Cumulative effects of transportation of gold concentrate with the Beaver Dam Mine Project and the Cochrane Hill Gold Project is possible (trucking on Beaver Dam Haul Road)	Moderate. The principal assumption behind the potential of significant cumulative effects is that local forestry practices will not change in any way throughout the Project. This assumption is considered as having a moderate uncertainty	Yes.	The predicted cumulative effects are not anticipated to be significant and the residual effects of the Project are anticipated to revert back to baseline conditions upon completion of the project However, due to potential for cumulative effects of trucking on the Beaver Dam Haul Road, further evaluation (qualitative) is warranted specific to this

Project VC	Residual Adverse Effects	EIS Finding	Boundaries		Criteria for Determining Whether Further Assessment Is Required				Carried Forward to Cumulative Effects Assessment	
			Spatial – Geographical Extent of Residual Effects	Temporal - Timeframe Associated with Residual Effects	Level of Concern Noted During Engagement	Current State of The VC (Health/Status/ Condition)	Potential for Cumulative Effects: Screening Evaluation Summary	Uncertainty in Prediction of Cumulative Effects	Yes/No	Rationale
								No data was available to confirm this statement.		location only. Quantitative analysis within the Beaver Dam Mine Project EIS
Geology, Soil and Sediment Quality	Erosion, soil and sediment quality, (i.e. flora and fauna/habitat, etc.)	Not Significant	Residual effects related to erosion, soil and sediment quality are not anticipated outside of the FMS Study Area	Residual effects to Geology, Soil and Sediment Quality may occur throughout the duration of the project including Construction, Operation and Closure (reclamation) phases	Medium. Concerns were expressed relating to potential ARD, suspended solids and mobilization of historical tails from the FMS Mine Site, which may affect receiving water and its fish habitat	Good. Based on a number of conservative assumptions, the results indicate that there is very low potential for acidic conditions to occur during operations During closure phase, there is potential for acidic conditions to occur, however, through mitigation these conditions can be mitigated Historical tailings present at FMS will be delineated, tested and managed on site before new mining activities commence. Options for disposal on-site or off-site are being considered in conjunction with regulatory consultation	No. Potential cumulative effects related to sediment release are not anticipated. Historic FMS mining operations and forestry are the only activities identified within the RAA for Soil, Sediment and Geology. Effects of historic tailings will be mitigated during construction including "working in the dry" and effective water management. Effects of forestry on sediment transport are expected to be minimal, providing forestry operators adhere to Provincial Wildlife Habitat and Watercourse Protection Regulations. Furthermore, FMS Mine Site erosion and sedimentation control measures will have a localized compensatory effect of any sediment release from local forestry activities. Therefore, it is unlikely that other projects would interact with this VC	Low. Based on the residual effects being confined to the FMS Study Area with proper mitigation, it is unlikely that other projects would interact with this VC. This assumption is considered as having a low uncertainty	No.	As the predicted cumulative effects are not anticipated to be significant with only two projects overlapping spatially with the Project, and the residual effects of the Project are anticipated to limited to the FMS Study Area, no further assessment is warranted

Project VC	Residual Adverse Effects	EIS Finding	Boundaries		Criteria for Determining Whether Further Assessment Is Required				Carried Forward to Cumulative Effects Assessment	
			Spatial – Geographical Extent of Residual Effects	Temporal - Timeframe Associated with Residual Effects	Level of Concern Noted During Engagement	Current State of The VC (Health/Status/ Condition)	Potential for Cumulative Effects: Screening Evaluation Summary	Uncertainty in Prediction of Cumulative Effects	Yes/No	Rationale
Groundwater Quality and Quantity	Disturbance to groundwater quality and quantity	Not Significant	The potential for residual groundwater quality effects are limited to the PA	Residual effects to groundwater quality and quantity may occur throughout the duration of the project including Construction, Operation and Closure phases	Low. Concerns were also expressed regarding groundwater drawdown and potential effects on surface water. There are no potable water wells within 5 km of the PA, reducing the level of concern from neighboring landowners	Good. Maximum radius of influence (groundwater drawdown) is predicted at 830m from the pit during operations, and less that this during closure, when the pit is re-filling with water. The nearest potable well is 8.7 km south of the Project. Groundwater seepage has been predicted through modelling efforts and these seepage rates have been included in operational and closure surface water modelling efforts to understand potential effect of groundwater seepage on surrounding surface water features for both the FMS Mine Site and the Touquoy Mine Site	No. Historic mining activities within the PA and forestry are the only projects within the RAA for groundwater quantity and quality. Potential cumulative effects on groundwater are not anticipated at the mine site because of the lack of other activities affecting this VC at this location. Furthermore, the potential groundwater seepage at the Touquoy site has been evaluated as part of the surface water VC	Low. Uncertainty will be addressed through the monitoring and follow-up programs established for the Project	No.	The predicted cumulative effects are not anticipated to be significant due to the spatial boundaries of the residual effects (zone of influence for groundwater interactions). Therefore, no further assessment is warranted
Surface Water Quality and Quantity	Change in Water Quality and Quantity Habitat Loss and disturbance Change in hydrology through Seloam Brook	Not Significant	The potential for residual surface water quality and quantity effects are limited to the PA and LAA	Residual effects to surface water quality and quantity may occur throughout the duration of the project including Construction, Operation and Closure phases	Moderate. Key issues raised during stakeholder engagement was the concern about effect on water quantity in downstream receiving environments. Given the ecological context of the East River Sheet Harbour and historical alteration due to installation of hydroelectric dams, the level of concern was moderate. Concerns relating to potential impacts to the Moose River from deposition of tailings in the exhausted Touquoy pit.	Moderate to poor. All mine contact water during operations will be directed to the TMF. During closure, all mine contact water will be directed to the pit, to facilitate pit filling Discharge water will meet MDMER at the end of pipe. There is a 100m modelled mixing zone from the water discharge point within Anti-Dam Flowage During closure, a cover planned for the PAG portion of the WRSA to improve water quality No chemical water treatment is anticipated to be required during operations, but will be available. Water treatment, as required, will be completed during the closure phase	Yes. Historic mining activities within the PA and forestry are the only projects within the RAA for surface water quantity and quality. Potential cumulative effects on surface water are not anticipated at the FMS Mine Site because of the lack of other activities affecting this VC at this location. Cumulative impacts based on forestry are expected to be low, providing forestry operators adhere to Wildlife Habitat and Watercourse Protection legislation. The use of the Touquoy processing plant and deposition of tails into the exhausted pit at Touquoy extends the temporal scale of potential effects to surface water. Deposition of tails into the exhausted pit are considered for cumulative effects. Also, the Project will require an extension to the use of Scraggy Lake as one of the sources of fresh water to process concentrate. The cumulative effect of the combined projects could mean a reduction in the streamflow from Scraggy Lake to the Fish River system. In addition, subsequent deposition of tails into the exhausted Touquoy Pit will result in release of discharge into the Moose River once the pit has filled	Low. Uncertainty will be addressed through refinement of modelling, and the monitoring and follow-up programs established for the Project	Yes	Further assessment is required to determine if there is the possibility of significant residual cumulative effects to Surface Water Quality and Quantity at both the FMS Mine Site and the Touquoy Mine Site
Wetlands	Habitat loss and disturbance	Not Significant	The potential for residual effects to wetlands are	Residual effects to wetlands may occur throughout the duration	Low-moderate. Key issues raised during stakeholder engagement was the concern about wetlands	Good. Wetlands and buffer areas generally offer high quality wildlife habitat and good water quality	No. The loss of wetlands from the FMS Mine Site results in a direct loss of 69.08 hectares of wetlands and potential indirect impacts to 10.78 hectares, which will require	A moderate level of uncertainty exists in the potential effect of increased	No.	The predicted cumulative effects are not anticipated to be significant due to the limited

Project VC	Residual Adverse Effects	EIS Finding	Boundaries		Criteria for Determining Whether Further Assessment Is Required				Carried Forward to Cumulative Effects Assessment	
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			limited to the PA and LAA	of the project including Construction, Operation and Closure (reclamation) phases	being impacted at the FMS Mine Site and future compensation, and potential reduction in habitat, water quality and flood control due to loss of wetlands	functions. All wetlands assessed were determined to provide high plant community integrity as the plants are generally composed of native species characteristic of the wetland type with a very minor component of non-native species. Wetlands within the FMS Mine Site, have experienced disturbance from historic mining activity, timber harvesting in adjacent uplands, and hydrological disturbances from operation of the hydroelectric dam on Seloam Lake	compensation under the Nova Scotia Wetland Conservation Policy A cumulative effects assessment exercise was carried out in Section 6.7, which determined that there was no expected significant effect on wetland loss within the LAA Within the RAA, other activities are limited to historic mining and forestry. Effects of historic tailings will be mitigated. Effects of forestry on sediment transport are expected to be minimal, providing forestry operators adhere to Provincial Wildlife Habitat and Watercourse Protection Regulations and the Nova Scotia Wetland Conservation Policy No additional wetland impacts are proposed at the Touquoy Mine Site	water levels on wetland habitats downstream of the Seloam Brook Realignment. Little to no uncertainty exists related to direct wetland impacts. The potential cumulative effects (loss of wetlands within the Project footprint) is based on the planned footprint of the Project which is unlikely to change		spatial boundaries of the residual effects (LAA) and the magnitude of these effects (Low). Therefore, no further assessment is warranted
Fish and Fish Habitat	Habitat loss and disturbance Decreased water quality and quantity	Not Significant	The potential for adverse residual effects to fish and fish habitat is limited to the PA and LAA	Residual effects to fish and fish habitat may occur throughout the duration of the project including Construction, Operation and Closure (reclamation) phases	Moderate to High. Key issues raised during public and Mi'kmaq engagement relating to fish and fish habitat include Seloam Brook Realignment project, and potential indirect effects from wetland alteration or changes to surface water and groundwater quality and quantity on fish and fish habitat. Concerns relating to potential impacts to fish and fish habitat in the Moose River from deposition of tailings in the exhausted Touquoy pit.	Moderate. Spawning habitat for species known or expected is limited in the FMS Study Area. Physical barriers (dams), pH, dissolved oxygen levels and temperatures were limiting factors to fish habitat quality. Atlantic Salmon access to the FMS Study Area has been limited by installation of hydroelectric dams and increased acidification since the 1920's	Yes. Within the RAA, other activities are limited to historic mining and forestry, and current and historic operation of the East River Hydro System. Effects of historic tailings will be mitigated. Effects of forestry on sediment transport are expected to be minimal, providing forestry operators adhere to Provincial Wildlife Habitat and Watercourse Protection Regulations. Effects associated with the historic and current operation of the Hydro System decreases the potential significance of effects, given the long history of fish passage barriers on this system Development of the FMS Pit and associated mine infrastructure will require the realignment of Seloam Brook and several smaller tributaries and side channels Seloam Brook Realignment will provide mitigation for fish habitat lost, along with enhancement of fish habitat downstream of Seloam Brook Realignment (flooded habitat) A Fish Habitat Offset Plan: Preliminary Concept Update has been developed to facilitate this realignment and compensate for loss of fish habitat (Appendix J.7) Site infrastructure has been micro-sited for fish habitat avoidance where ever practicable A Fisheries Authorization will be required for the Project, and Fish Habitat Offset Plan: Preliminary Concept Update for compensation/restoration is provided (Appendix J.7).	Low. The uncertainty as to the Project effects on fish and fish habitat would be addressed through monitoring and follow-up programs established for the Project	Yes.	Although the potential for significant cumulative effects to fish and fish habitat is not anticipated at the FMS Mine Site given appropriate mitigation, the VC was carried forward due to the concern expressed relating to fish and fish habitat including the Seloam Brook Realignment, baseline nature of the watershed (NSPI infrastructure) and potential indirect effects from wetland alteration or changes to surface water and groundwater quality and quantity on fish and fish habitat Further assessment is required to determine if there is the possibility of significant residual cumulative effects to Fish and Fish Habitat at the Touquoy Mine Site from tailings deposition in the exhausted Touquoy pit.

Project VC	Residual Adverse Effects	EIS Finding	Boundaries		Criteria for Determining Whether Further Assessment Is Required				Carried Forward to Cumulative Effects Assessment	
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							The use of the Touquoy processing plant and deposition of tails into the exhausted pit at Touquoy extends the temporal scale of potential effects to fish and fish habitat in Moose River. Deposition of tails into the exhausted pit are considered for cumulative effects.			
Habitat and Flora	Disturbance and loss of habitat	Not Significant	The potential for adverse residual effects to habitat and flora is limited to the PA and LAA No change in footprint at the Touquoy Mine Site is required to accommodate the FMS Project	Residual effects to habitat and flora may occur throughout the duration of the project including Construction, Operation and Closure (reclamation) phase	Low to Medium. Concerns were raised during public and Mi'kmaq engagement relating to habitat and flora include potential effect on biodiversity and loss of habitat associated within the PA.	Moderate. Soils are nutrient poor, acidic, and the landscape is dominated by mixedwood and conifer forest stands often with a shrub layer Historical mining, disturbances from timber harvesting and hydroelectric power generating infrastructure (dams) have affected the habitat and flora communities with the FMS Study Area	No. Projects which lie within the RAA for Habitat and Flora include current and proposed mining activities at Touquoy Gold Project, Beaver Dam Gold Project and Dufferin Gold Mine, along with various regional forestry activities Project effects on Habitat and Flora for the FMS Study Area are limited to the LAA, which does not overlap the LAA for the proposed Project. While spatial boundaries for potential residual effects for the Dufferin Project were not available, it is expected that effects to habitat and flora would occur on a similar spatial scale to the proposed Project (2km buffer of the Study Area). Provided this is a reasonable assumption, project effects to Habitat and Flora would not overlap spatially Forestry activities within the RAA could result in a cumulative impact to habitat and flora	Little to no uncertainty. The generalized disturbance of the landscape by forestry is well documented in the NSL&F Forest Inventory. Therefore, there is little uncertainty with regards to this information or as to the nature of the predicted Project effects (loss of habitat within the Project footprint)	No.	Overall, the generalized disturbance of the landscape by forestry activities, past, present and future are the main source of cumulative effects of habitats throughout the area. Without the Project, the loss of habitat in the FMS Mine Site during the construction and operation phases would be avoided, however the current observed generalized disturbance of the landscape would be unaffected. Any potential significant cumulative effect based on habitat fragmentation will be discussed in the context of SAR and SOCI
Terrestrial Fauna	Disturbance and loss of habitat	Not Significant	The potential for adverse residual effects terrestrial fauna occurs within the LAA and possibly may extend into the RAA when considering habitat fragmentation	Residual effects to habitat and flora may occur throughout the duration of the project including Construction, Operation and Closure (reclamation) phases	Low. Concerns raised during public and Mi'kmaq engagement relating to terrestrial fauna include potential effects on fauna from permanent loss of habitat associated with the footprint of the Project	Moderate. The FMS Study Area was evaluated for bat hibernacula potential through both desktop and field evaluations. No evidence of bat usage or suitable hibernacula habitat were observed While not observed, it is possible that Snapping Turtle (SAR) uses portions of the FMS Study Area, at least periodically	No. Projects which lie within the RAA for Terrestrial Fauna include current and historic operation of hydro power infrastructure, current and proposed mining activities at Touquoy Gold Project, Beaver Dam Mine Project and Dufferin Gold Mine, along with various regional forestry activities The presence of NSPI hydro power infrastructure may act as a barrier to some species of terrestrial fauna, though not likely to the extent that it affects species distribution. Project effects on Terrestrial Fauna from Beaver Dam Mine Project are limited to the LAA, which does not overlap the LAA for the proposed Project. While spatial boundaries for potential residual effects for the Dufferin Project were not available, it is expected that effects to habitat and flora would occur on a similar spatial scale to the proposed Project (2km buffer of the Study Area).	Low. The main assumption behind this assessment is that the overall patterns of land use in the region will remain unchanged in the foreseeable future	No.	As the potential cumulative effects are not anticipated to be significant and loss of habitat will be restored during the reclamation stage no further assessment is warranted. SAR/SOCI is being evaluated with regards to cumulative effects for rare species, including Mainland Moose. As such, cumulative effects to terrestrial fauna more generally will be addressed through the effects assessment for Mainland Moose

Project VC	Residual Adverse Effects	EIS Finding	Boundaries		Criteria for Determining Whether Further Assessment Is Required				Carried Forward to Cumulative Effects Assessment	
			Spatial – Geographical Extent of Residual Effects	Temporal - Timeframe Associated with Residual Effects	Level of Concern Noted During Engagement	Current State of The VC (Health/Status/ Condition)	Potential for Cumulative Effects: Screening Evaluation Summary	Uncertainty in Prediction of Cumulative Effects	Yes/No	Rationale
							Provided this is a reasonable assumption, project effects to Terrestrial Fauna would not overlap spatially Although both the FMS Project and the Touquoy Gold Project will cause the loss and disturbance of habitats within the PA, these effects are relatively small given the fact that most of the affected areas are already disturbed			
Avifauna	Disturbance and loss of habitat Contamination	Not Significant	The potential for adverse residual effects to birds is limited to the PA and LAA	Residual effects to birds may occur throughout the duration of the project including Construction, Operation and Closure (reclamation) phases	Low. Concerns raised during public and Mi'kmaq engagement relating to birds include potential for direct mortality and indirect effects on other VCs, such as dust, noise and light, as well as potential effects on birds associated with loss of habitat from construction of the Project	Good. Abundance and diversity of avian species observed was moderate to high based on observer experience in the geographic area. The common species assemblage of forest birds was observed, along with a cohort of species more typically found in intact or interior forest	No. Projects which lie within the RAA for Avifauna include current and proposed mining activities at Touquoy Gold Project, Beaver Dam Mine Project and Dufferin Gold Mine, along with various regional forestry activities Project effects on Avifauna from Beaver Dam Mine Project are limited to the LAA, which does not overlap the LAA for the proposed Project. While spatial boundaries for potential residual effects for the Dufferin Project were not available, it is expected that effects to habitat and flora would occur on a similar spatial scale to the proposed Project (2km buffer of the Study Area). Provided this is a reasonable assumption, project effects to Avifauna would not overlap spatially. Within the RAA, there is some potential additive cumulative effects with respect to habitat loss on the broad scale. Overall habitat loss and potential additive cumulative effects will be addressed in SAR-SOCI cumulative effects Although both the FMS Project and the Touquoy Gold Project will cause the loss and disturbance of habitats within the PA, these effects are relatively small given the fact that most of the affected areas are already disturbed	Low. The main assumption behind this assessment is that the overall patterns of land use in the region will remain unchanged in the foreseeable future	No.	The predicted cumulative effects are not anticipated to be significant and loss of habitat will be restored during the reclamation stage. As such, the VC was not carried forward to the Cumulative Effects Assessment. SAR/SOCI is being evaluated with regards to cumulative effects for rare species, including Avifauna. As such, cumulative effects to avifauna more generally will be addressed through the effects assessment for Avifauna SAR

Project VC	Residual Adverse Effects	EIS Finding	Boundaries		Criteria for Determining Whether Further Assessment Is Required				Carried Forward to Cumulative Effects Assessment	
			Spatial – Geographical Extent of Residual Effects	Temporal - Timeframe Associated with Residual Effects	Level of Concern Noted During Engagement	Current State of The VC (Health/Status/ Condition)	Potential for Cumulative Effects: Screening Evaluation Summary	Uncertainty in Prediction of Cumulative Effects	Yes/No	Rationale
Species of Conservation Interest (SOCI) and Species at Risk (SAR)	Habitat loss and disturbance	Not Significant	The potential for adverse residual effects to SOCI and SAR is limited to the PA and LAA, with the exception of Moose, which is evaluated at the RAA level relating to potential habitat fragmentation	Residual effects to SOCI and SAR may occur throughout the duration of the project including Construction, Operation and Closure (reclamation) phases	High. Key issues raised during public and Mi'kmaq engagement relating to SAR and SOCI include potential direct effects on rare flora and fauna associated with construction of the Project and potential indirect effects associated with changes to other VCs, such as wetlands, surface water and groundwater	Good. Multiple Mainland Moose (NSESA: E) observations were recorded across the FMS Study Area Six (6) SAR and sixteen (16) SOCI bird species were recorded Three (3) vascular plant SOCI species were recorded One (1) SAR lichen species and eight (8) SOCI lichen species were recorded. Two SOCI fish species were observed Direct habitat loss is expected as a result of the Project. Vascular plant loss includes southern twayblade and Wiegand's sedge, and lichen loss include blue felt lichen, fringe lichen, corrugated shingles lichen, and eastern candlewax lichen	Yes. Projects overlapping the RAA for SAR fish, flora, terrestrial fauna and avifauna, and potential interactions therein, are discussed in respective VCs above	Low. The main assumption behind this assessment is that the overall patterns of land use in the region will remain unchanged in the foreseeable future	Yes.	Although, the potential for significant cumulative effects to SOCI and SAR is not anticipated, the VC was carried forward due to the concern expressed by the Mi'kmaq of Nova Scotia relating to SAR and SOCI and as required by the per the FMS EIS Guidelines (See 8.3.1). Concerns included the potential direct effects on rare flora and terrestrial fauna associated with construction of the Project and the potential indirect effects associated with changes to other VCs, such as wetlands, surface water and groundwater
Mi' kmaq of Nova Scotia	Loss of plant specimens Habitat loss Sensory Disturbance Visual Change Aesthetics effect Loss of Access	Not Significant	The potential for adverse residual effects to Mi'kmaq of Nova Scotia are limited to the PA and LAA	Residual effects to Mi'kmaq of Nova Scotia may occur throughout the duration of the project including Construction, Operation and Closure (reclamation) phases	High. Key issues raised during public and Mi'kmaq engagement relating to Mi'kmaq of Nova Scotia include concerns related to pathways of adverse effects, primarily related to access and resources and harvesting, from Project activities during construction and operation	Moderate. The nearest Mi'kmaw communities are located in Sheet Harbour (Millbrook First Nation Sheet Harbour IR) and on Highway 224 in Marinette (Millbrook First Nation Beaver Lake IR), both about 33km from the FMS Study Area	Yes. Potential significant adverse cumulative effects to surface water, could cause effects on the use of surface water bodies and the fish inhabiting them by the Mi'kmaq of Nova Scotia. There is also the potential for cumulative effects on habitats, flora, terrestrial fauna and birds to lead to effects on current use of land and resources for traditional purposes	Moderate. Effects are linked to a number of VCs and therefore can be more difficult to predict	Yes.	Further assessment is required to determine if there is the possibility of significant residual cumulative effects to Mi'kmaq of Nova Scotia

Project VC	Residual Adverse Effects	EIS Finding	Boundaries		Criteria for Determining Whether Further Assessment Is Required				Carried Forward to Cumulative Effects Assessment	
			Spatial – Geographical Extent of Residual Effects	Temporal - Timeframe Associated with Residual Effects	Level of Concern Noted During Engagement	Current State of The VC (Health/Status/ Condition)	Potential for Cumulative Effects: Screening Evaluation Summary	Uncertainty in Prediction of Cumulative Effects	Yes/No	Rationale
Physical and Cultural Heritage	Loss of archaeological features	Not significant	The potential for adverse residual effects to Physical and Cultural Heritage are limited to the PA	Residual effect to Physical and Cultural Heritage are anticipated to occur through the Construction phase	Low. Concern was noted during Mi'kmaq engagement regarding areas of elevated potential for Mi'kmaq resources on the shores of Seloam Lake and Anti-Dam Flowage	Good. Seven archaeological sites were identified with the FMS Study Area. All sites are associated with historical mining activities and all seven sites will be impacted by mining infrastructure. The area of elevated Mi'kmaq potential at Seloam Lake will be avoided	No. While other archaeological features may be present in the LAA or RAA, there is no pathway for disturbance of these features outside of the PA	Low. The expected disturbance to archeological features is assessed and well understood	No.	As the potential cumulative effects are not anticipated to be significant no further assessment is warranted
Socio-Economic Conditions	Disturbance to recreational usage of site.	Not Significant	Positive residual effects are expected to occur through the RAA	Residual effects to socio-economic conditions may occur throughout the duration of the project including Construction, Operation and Closure (reclamation) phases	Medium. Concern about volumes of truck traffic in context of safety on public roadways and recreational access into the FMS Study Area to fish, hunt and for ATV access and throughflow access	Good. The area sees public use for access to hunting, fishing and ATV activity. Between 2014-2018, 93 jobs were created for exploration. An estimated 289 jobs will be created during construction and operation	No. Disturbance to recreational usage is restricted to the PA so no cumulative effects are anticipated. The overall effect of the Project on Socio-economic Conditions is positive. Two bypass roads are planning to allow continued access around the FMS Mine Site	Low. Prediction made on the assumption that the local road usage will not change	No.	As the overall potential effect of the Project on Socio-economic Conditions is positive, no further assessment is warranted

8.5 Cumulative Effects Assessment of the Valued Components

Using appropriate data and information is critical to the analysis of cumulative effects. Exhaustive baseline studies have been completed to characterize the environment within the PAA, LAA and RAA for the Project. Baseline information for all VC's is described in detail in Section 6 of the EIS, and for the reader, has also been summarized in the subsequent sections for those VC's that have been carried forward for the cumulative effects assessment. Baseline information provided for each VC is limited by the evaluation methods and frequency of surveys. It is representative of the current status of the Project footprint. However, there are limitations to this data collection and analysis.

The following VCs have been carried forward for cumulative effects assessment based on the parameters and screening tools described in the previous sections:

- Noise (Beaver Dam Haul Road component of the Beaver Dam Mine Project only- qualitative/summary)
- Air
- Light (Beaver Dam Haul Road component of the Beaver Dam Mine Project only- qualitative/summary)
- Surface Water
- Fish and fish habitat
- Species at Risk (SAR) and Species of Conservation Interest (SOCI)
- Mi'kmaq of Nova Scotia

Data and information for the other projects considered in the cumulative effects section is provided from public sources of information only. Data is collected from environmental assessment websites (both federal and provincial) and review of publicly available documents. There are significant limitations in this approach. Environmental assessments do not follow a standard methodology so often the data available is not in a format that can be directly comparable to the data available for the Project, or the same level of data analysis was not completed (air dispersion modelling for example, or quantitative predictive water quality modelling). Past projects can be devoid of published information (historical tailings for example) limiting the ability to quantitatively evaluate the potential cumulative impact of this project with the Project. Furthermore, projects that do not require environmental assessment (forestry industry as an example) have very limited data available for review and inclusion in these cumulative effects analyses. The EIS team has attempted to avoid sweeping qualitative statements and conclusions and has acknowledged data limitations where necessary in this section and in some instances, these data limitations limit conclusions.

8.5.1 Noise Cumulative Effects Assessment

8.5.1.1 Baseline Conditions

8.5.1.1.1 *Baseline Noise Levels*

Baseline ambient noise levels were recorded over a 24-hour period between November 20th –22nd, 2017 at two locations surrounding the FMS Study Area that were representative of local conditions. Baseline monitoring was completed during suitable weather conditions using a System 824 Sound Level Meter/Real Time Analyzer and Sound Track Model LxT. Noise prediction model SPM9613 developed by Power Acoustics Inc was used to provide an order of magnitude estimation of the predicted operational noise from the Project.

The model included meteorological parameters, ground attenuation, pit geometry, along with octave sound power levels, proposed locations and 3D dimensions of over 20 significant noise sources. The significant noise sources were modelled to conservatively reflect the worst-case scenario, predicted to be during Year 5 when the largest amount of material (20 Mt) will be mined requiring the most equipment. Pit and Quarry Guideline lists noise thresholds (in decibels) at the FMS property boundaries based on daytime (65 dBA), evening (60 dBA) and nighttime (55 dBA). The 55 dBA contour does not extend beyond the property boundary. Sensitive receptors include seasonal camps and residences were identified in the surrounding area, with the nearest being 4.9 and 8.7km south of the FMS Study Area, respectively.

Although outside of the Project PA, a portion of the proposed transportation route for the Project concentrate has the potential for cumulative noise effects as the concentrate route plans to utilize the Beaver Dam Haul Road. Noise has not been considered along this section of road from the Project as it is outside the PA; however, is considered cumulatively in a qualitative fashion herein for completeness. The detailed quantitative evaluation of cumulative noise from the Beaver Dam Mine Project on the Haul Road, along with the Project and the Cochrane Hill Project is included in the Beaver Dam Mine Project cumulative effects assessment.

8.5.1.1.2 *Regional baseline Noise conditions*

The relatively steady ambient noise of the surrounding area is a conglomeration of distant noise sources including wind in trees, bird and animal noise, rainfall, distant aircraft, logging activities, traffic and all-terrain vehicle use. The acoustic monitoring completed in the vicinity of the FMS Study Area is considered representative of the local baseline conditions.

8.5.1.2 Analysis of Effects

8.5.1.2.1 *Residual Effects of Proposed Project*

The predicted residual environmental effects of Project development and production of noise are assessed to be adverse, but not significant within the PA. During construction, operations and closure phases, the noise levels defined in the Pit and Quarry Guidelines will be met at the property boundary, while baseline noise levels are met at the RAA boundary. No noise effects are expected to occur during the closure phase once the reclamation stage is complete.

8.5.1.2.2 *Effects of Other Projects in the Area*

The RAA for noise, and projects which fall within this RAA are shown on Figure 8.5-1. Current and historic operation of the East River Sheet Harbour Hydro System has a spatial and temporal overlap with the Projects' RAA for noise. However, this project is not being discussed in the context of cumulative noise, because the hydro infrastructure within the Project noise RAA does not generate additional sources of considerable noise. The East River Hydro System has two power generation facilities which could generate noise (Ruth Falls and Malay Falls), but those pieces of infrastructure are outside of the noise RAA.

8.5.1.2.2.1 Current Regional Forestry Operations

The local forestry industry has the potential to have cumulative effects on noise levels due to timber harvesting and trucking of timber. Anthropogenic sources of noise have been excluded from noise modelling calculations. Data is publicly unavailable to quantify the level of noise expected from timber harvesting and trucking due to regional forestry operations. However, noise associated with timber harvesting is likely to be relatively seasonal and sporadic, and not likely to affect regional noise levels in any significant or sustained manner. Furthermore, it should be noted that noise modelling was based on topography and infrastructure, in a tree-less landscape in order to be conservative. As such, the removal of trees from timber harvesting (and associated loss of noise buffering capacity) in the LAA or RAA do not change the conclusions about significant noise effects from the Project.

8.5.1.2.2.2 Touquoy Mine Site

The predicted total sound level range at the Touquoy Mine Site property boundary presented in the 2018 Noise Impact Study completed in support of the Beaver Dam Mine Project EIS is 39.2 to 53.9 dBA (GHD 2018), which are below the most conservative threshold (nighttime hours of 55 dBA) set in the Pit and Quarry Guidelines (NSDEL 1999). Additionally, ambient baseline sound levels at the Touquoy Mine Site are reached at approximately 5 km from the PA. The FMS Project includes only processing of concentrate (<5% of ore removed from the pit at FMS and transported to Touquoy) at the Touquoy Mine Site and disposal of these concentrate tails. Thus, noise generated at the Touquoy Mine Site associated with the FMS Project is estimated to be considerably lower than results presented above for the Beaver Dam Mine Project, which already met compliance at the Touquoy Mine Site property boundaries.

The Touquoy Mine Site is currently operational. The primary effect of the continued use of the Touquoy Mine Site for the FMS Project is the continued generation of noise due to haul truck traffic on the site and the processing of FMS concentrate. There are no new or additional effects from noise anticipated to be caused by the processing of concentrate and the management of tailings from the FMS Mine Site, just an extension of the operational timeline of the Touquoy Mine Site. To date, no noise complaints have been received or are anticipated.

8.5.1.2.2.3 Beaver Dam Haul Road Use by the Project, Cochrane Hill Gold Project and Regional Forestry

During the operation phase of the Project and the proposed Cochrane Hill Gold Project, gold concentrate from each of these surface mines will be transported to the Touquoy Mine Site for final processing into gold doré bar. The proposed transportation route for each project is expected to overlap with the proposed Beaver Dam Haul Road west of the Highway 224 to the Mooseland Road. Beaver Dam ore will be trucked to the Touquoy Mine Site via 95 return trip trucks per day (190 single trips per day), which could also be compounded with forestry activity on the road. The FMS and Cochrane Hill Projects are each expected to add up to 11 round trip truckloads to the haul road per day to transport concentrate to the Touquoy Mine Site for processing. A total of 44 single-trips per day will be added to the Beaver Dam Haul Road from the Project and Cochrane Hill Project. Trucking associated with timber harvesting is anticipated to contribute approximately 7 round trips per day (14 single trips), though it is recognized that this will vary seasonally (pers. comm., Rick Archibald, 27 Nov, 2020).

In addition to the heavy truck traffic summarized above, it is estimated 3/4-ton service trucks would make up to approximately 20 round trips per day on the Haul Road. Noise emissions from these service trucks have also been included in the cumulative effects noise model.

The additional 58 vehicle trips per day associated with Fifteen Mile Stream, Cochrane Hill and forestry operations results in 3.6 additional vehicles per hour (over the 16-hour operational period for the Haul Road). This vehicular traffic increases the sound level at the worst-case point of reception (POR) along the haul road by 2 dBA (from 53 to 55 dBA) which would not result in an exceedance of the day or evening noise limits of the NSEL Guidelines for Environmental Noise Measurement and Assessment.

Overall, the findings summarized in the Noise Impact Study, and the EIS for Beaver Dam Mine Project will remain valid, and the cumulative effects of noise along the Haul Road are predicted to remain within the guideline limits specified by Nova Scotia Environment and Labour (NSEL) at all of the identified receptors, and with consistent conclusions relating to the property boundary along the Haul Road. Based on those predictions, noise levels at all nearby residential receptors are anticipated to be within the NSEL noise level limits with the additional vehicles included in the assessment. Speed limits would be implemented as a part of each of these projects will mitigate the potential increase in ambient noise from the associated trucking operations.

8.5.1.2.3 *Cumulative Effects on Noise Levels*

It is likely that forestry operations will occasionally coincide with activities at the FMS Mine Site and cause greater disturbance to noise levels that these operations produce individually. However, such additive periods are likely to be limited in duration and frequency and are not expected to be significant. This cannot be quantified for the purpose of this CEA due to a lack of available data relating to forestry activities and future plans for harvesting. The principal assumption behind this assessment is that local forestry practices are not expected to change in any important way during the life of the Project. Data to support the quantification of timber harvesting is limited, particularly related to noise levels.

The gold concentrate transportation and processing activities associated with the Project and the Cochrane Hill Gold Project overlap in both time and space with Beaver Dam Mine Project. Therefore, the potential effects from the transportation and processing from the three projects, along with forestry activities on the Beaver Dam Haul Road, have the potential to act in an additive and cumulative nature. The additive cumulative effects on noise from transportation to the Touquoy Mine Site from the cumulative projects are not expected to be significant, provided mitigation measures for noise are implemented.

The processing of FMS concentrate and deposition of FMS concentrate tailings is not expected to affect noise levels at the Touquoy Mine Site in any noticeable way. This will be confirmed through monitoring.

8.5.1.3 Mitigation

Standard mitigation measures for noise generated by the Project at the FMS Mine Site and Touquoy Mine site are presented in Section 6.1.7, and mitigation measure associated with use of the Beaver Dam Haul Road are described in the Beaver Dam Mine Project EIS. As no pathway for significant cumulative effects are identified, no additional mitigation measures are warranted.

8.5.1.4 Residual Cumulative Effects and Significance Assessment

A significant adverse effect to noise at the FMS Mine Site is defined as a repeated or sustained noise level being emitted from the Mine Site that exceeds the NSE Pit and Quarry Criteria and exceeded at residential receptors surrounding the FMS Mine Site. The residual cumulative effects on noise levels are considered to be adverse but not significant (Table 8.5-1).

Table 8.5-1: Residual Cumulative Environmental Effects for Noise

Residual Adverse Cumulative Effects (After Mitigation)	Significance Levels						Overall Significance of Residual Adverse Effects (and Rationale)
	Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility	
Cumulative increased noise levels (Noise from construction, operation, reclamation, and operation of mining, haul trucks, forestry activities and haul road usage)	L Noise levels are expected to be less than or equal to appropriate guidelines or threshold values at the FMS Mine Site property boundary. Additive cumulative effects may occur when forestry operations occasionally coincide with Project activities and hauling ore from Beaver Dam, FMS and Cochrane Hill to Touquoy Mine Site for processing	PA The cumulative effects causing increased background noise levels will not extend beyond the PA Exception to this is the cumulative noise along the Beaver Dam Haul Road which is outside of the Project LAA but described herein	A VC is expected to be affected by timing, with sporadic nature of timber harvesting	LT Effects may extend beyond 7 years.	R Additive periods of potential effects from the Project and forestry operations are likely to be limited in frequency. However, cumulative effects to baseline noise levels from the use of the Beaver Dam Haul Road by Beaver Dam, Fifteen Mile Stream and Cochrane Hill Gold Projects will occur regularly throughout the operational phase of the Project	R VC will recover to baseline conditions once operations have stopped	Low Adverse Effect (Not Significant) Effects are limited to the PA based on Project interactions and usage of the Beaver Dam Haul Road by various activities. Furthermore the VC is anticipated to recover to baseline conditions once the operation of the mine has stopped. Effects would be confirmed through monitoring

Legend (refer to Table 5.10-1 for definitions)

Magnitude		Geographic Extent		Timing		Duration		Frequency		Reversibility	
N	Negligible	PA	Project Area	N/A	Not Applicable	ST	Short-Term	O	Once	R	Reversible
L	Low	LAA	Local Assessment Area	A	Applicable	MT	Medium-Term	S	Sporadic	PR	Partially reversible
M	Moderate	RAA	Regional Assessment Area			LT	Long-Term	R	Regular	IR	Irreversible
H	High					P	Permanent	C	Continuous		

8.5.1.5 Follow-up and Monitoring Programs

No additional follow-up or monitoring beyond that presented in Section 6.1.9 is warranted.

8.5.2 Air Cumulative Effects Assessment

8.5.2.1 Baseline Conditions

8.5.2.1.1 *Baseline Air Quality Monitoring Program*

The proposed FMS Mine Site is located in a primarily rural area and with very few nearby residents. As a result, the ambient air concentrations for particulate are expected to be low due to the lack of sources in the area. Baseline ambient air samples were collected for TSP, PM10 and baseline metals (arsenic and mercury) at two locations near the FMS Study Area boundary on November 21st, 2017. Data collected in Seal Harbour (70 km east of FMS) in 2004 was used for $PM_{2.5}$, NO_2 and SO_2 baseline conditions

Baseline results indicated that the TSP concentrations for a 24 hour sampling period ranged from a low of 9.6 µg/m^3 to a high of 14.0 µg/m^3. The PM_{10} concentrations for a 24 hour sampling period ranged from a low of 9.2 µg/m^3 to a high of 9.5 µg/m^3. Neither arsenic (<0.00071 to <0.0013 µg/m^3) nor mercury (<0.000035 to <0.000067 µg/m^3) were detected in the TSP samples. The highest monitored 24-hour NO_2 was 2.0 parts per billion (ppb) and the highest SO_2 value was 4.0 ppb (2004 results collected in Seal Harbour, as referenced in Appendix J.2). The highest monitored $PM_{2.5}$ value was 4.0 µg/m^3 (2004 result from Seal Harbour).

Air dispersion modelling, using AERMOD, was completed to predict concentrations of SO_2, NO_2, TSP and PM_{10} at the proposed property boundaries for the Project at the FMS Mine Site. Predictions are compared to NS Ambient Air Quality Guidelines and the Canadian Council of Ministers of the Environment (CCME) Canada Wide Standards (CWS). Results indicate that concentrations of all parameters will comply with criteria at the proposed property boundaries, with consideration of mitigation equivalent to twice daily dust suppression (via water) during dusty times.

No specific air dispersion modelling was completed at the Touquoy Mine Site to determine effects of the Project at that location. The effects of fugitive dust production and deposition throughout the operational period of the Project at the Touquoy Mine Site is considered to be insignificant for the following reasons:

- The FMS gold concentrate has limited exposure to the open atmospheric environment upon arrival at the Touquoy Mine Site; and
- The produced FMS tails will be a wet slurry solution and not prone to being dispersed through the surrounding atmospheric environment.

Fugitive dust production and deposition at the Touquoy Mine Site is considered to be insignificant during the FMS operational period, and therefore, the potential effects of dust at the Touquoy Mine Site are not further discussed in this assessment. Also, no evaluation of effects of dust deposition on human exposure (metal concentrations in soils and vegetation and potential exposures related to harvesting) was completed for the Touquoy Mine Site from the Project.

Although outside of the Project PA, a portion of the proposed transportation route for the Project concentrate has the potential for cumulative dust effects as the concentrate trucking route plans to use the Beaver Dam Haul Road. Dust has not been considered along this section of road from the Project as it is outside the PA; however, is considered cumulatively in a qualitative fashion herein for completeness. The detailed quantitative evaluation of cumulative dust from the Beaver Dam Mine Project on the Haul Road, along with the Project and the Cochrane Hill Gold Project is included in the Beaver Dam Mine Project cumulative effects assessment.

8.5.2.1.2 *Regional ambient air quality*

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

- Sulphur dioxide (SO_2);
- $PM_{2.5}$;
- volatile organic compounds (VOCs);
- Ozone (O_3); and
- Oxides of Nitrogen (NO_2, NO, and total NOx).

Data collected at these stations is used by NSE to report the Air Quality Index and by Environment and Climate Change Canada to report the Air Quality Health Index. There are currently no permanent air monitoring stations within the vicinity of the Project.

The Project is located in a relatively undeveloped rural region of Nova Scotia with infrequent industrial operations that would affect air quality. As the NAPS monitoring stations are typically located in areas with local industry, measured concentrations of indicators are likely lower at the Project than at NAPS stations.

The National Pollutant Release Inventory (NPRI) is a publicly accessible inventory of pollutants released in Canada. Total dust and particulate matter were the largest contributor to air pollutants in Nova Scotia in 2015. Dust and particulates are predicted to be the greatest source of concern for local air quality as a result of the Project.

8.5.2.2 Analysis of Effects

8.5.2.2.1 *Residual Effects of Proposed Project*

Dust emissions are the primary atmospheric issue for the Project. Air-borne particulate matter will be generated during construction and operation phases of the Project. During operation, most of the dust will be generated at the FMS Mine Site from crushing processes and trucking operations.

Due to the proposed site operation and configuration, air emissions sources will be close to ground-level or below grade. There will likely be negligible impacts to the residential area due to the surrounding topography, the surrounding forested area, and the distance to the nearest residential area. Applicable criteria for air dispersion will be met at the proposed FMS Mine Site property boundaries.

The overall significance of these exceedances is therefore assessed as low or not significant. As the nearest receptor is located at 4.9 km from the FMS Study Area, no air monitoring is recommended. A Complaints Protocol will be followed to provide a mechanism to register concerns and discuss them with Project representatives. Additional air monitoring will be determined in consultation with regulatory agencies and will be described in the application for an IA for the site development following the EA process.

8.5.2.2.2 *Effects of Other Projects in the Area*

The RAA for air, and other projects which fall within this RAA are shown on Figure 8.5-2. Current and historic operation of the East River Sheet Harbour Hydro System has a spatial and temporal overlap with the Projects' RAA for air. It is not being discussed in the context of that projects' effects on air quality, because the hydro system infrastructure within the air RAA is not expected to generate air emissions.

8.5.2.2.2.1 Current Regional Forestry Operations

The local forestry industry has the potential to have cumulative effects on air quality. As the forestry industry is ongoing in the region and has been for many decades, its effects on air quality are already accounted for in the local baseline conditions. The largest effect noted from the baseline data was the measurement of the highest suspended particulate concentrations from a monitoring station located in a recently clear-cut area. As a result of the expected inclusion of forestry contributions to air quality in baseline data, no additional analysis for cumulative effects of this industry related to air is necessary.

8.5.2.2.2.2 Tangier Gold Mine (Historic and Proposed)

The Tangier Gold Mine is located approximately 40 km southwest of the FMS Mine Site. The footprint of this mine is approximately 500 m by 150 m, as measured on Google Earth. The Tangier Gold Mine was recently was purchased by Resource Capital Gold Corp and plans are being developed for re-opening the mine. However, according to a press release dated January 29th, 2019, the proponent had filed a Notice of Intention to make a proposal under the Bankruptcy and Insolvency Act. The planned activities are limited to mining as no processing is planned at this site. Processing would take place at the Dufferin Gold Mine (Resource Capital Gold Corp. 2017). The potential temporal overlap of this project and the FMS Project are unknown. Should the project proceed and overlap with the FMS Project temporally, the potential spatial overlap of effects to Air needs to be considered. Details associated with the effects of the project on air are limited. Considering the FMS Project is able to mitigate residual effects on Air within the LAA (1.5 km buffer of the FMS Study Area), the relatively small size of the proposed operation at the Tangier site, and the distance between the two (40 km), a spatial or temporal overlap between these projects is unlikely. Therefore, there is little potential for cumulative effects on air quality.

8.5.2.2.2.3 Dufferin Gold Mine (Historic and Proposed)

The Dufferin Gold Mine is located approximately 21 km southeast of the FMS Mine Site, and the footprint of this mine is approximately 375 m by 150 m. A bulk sampling program and associated milling was completed in 2018, but in 2019 the proponent (Resources Capital Gold Corporation) filed a Notice of intention to make a proposal under the Bankruptcy and Insolvency Act so future plans for this Project are uncertain. As such, the potential temporal overlap of this project and the FMS Project are unknown. Should the project proceed and overlap with the FMS Project temporally, the potential spatial overlap of effects to Air needs to be considered. Details associated with the effects of the project on air are limited. Considering the FMS Project is able to mitigate residual effects on Air within the LAA (1.5 km buffer of the FMS Study Area), the relatively small size of the proposed operation at the Dufferin site, and the distance between the two (21 km), a spatial or temporal overlap between these projects is unlikely. Therefore, there is little potential for cumulative effects on air quality.

8.5.2.2.2.4 Beaver Dam Mine Project (proposed)

Residual effects on air quality from operation of the proposed Beaver Dam Mine Project include dust from onsite activities, vehicle travel, material handling and crushing of ore prior to transportation to the Touquoy Mine Site for processing. These effects are expected to be adverse, but not significant, and limited to the LAA. These effects will be mitigated through equipment maintenance, dust suppression, enforcement of speed limits, stabilization of stockpile slopes, covering of haul trucks and minimizing blasting events. Given the nature of effects of the project on air quality, and the distance between projects, there is little potential for cumulative effects.

8.5.2.2.2.5 Cochrane Hill Gold Project (proposed)

The Cochrane Hill Gold Project is currently in the process of modelling effects of the Project on Air quality. While results of this modelling are not yet available, it is expected that they will be consistent with findings reported herein for FMS, which indicate compliance with Air Quality Guidelines at the property boundary, based on similar infrastructure requirements and project descriptions. Given the relatively small spatial scale of the projects' effects on air quality and given the distance between them (38 km), cumulative effects are not predicted. This conclusion cannot be confirmed until such time that the Cochrane Hill air dispersion modelling is completed. This confirmation will be addressed in the Cochrane Hill Gold Project EIS submission (pending).

8.5.2.2.2.6 Touquoy Gold Project (Current)

As described in the EARD (CRA 2007), the Touquoy Touquoy Gold Project generates air emissions through several key pathways. These include fugitive dust emissions from construction and operation of the mine and related trucking operations, site vehicle use, and dust from the waste rock piles. The operation of the processing facility results in intermittent emissions of propane exhaust (CO, CO_2, NO_X), SO_2 and ammonia from the smelting furnace, and SO_2 and ammonia from the electrowinning cells will be controlled through use of exhaust scrubbers. The large volume of air drawn by the fans above these operations ensures very low concentrations of any off gasses. Water vapor, CO and CO_2 are similarly extracted from the carbon regeneration kiln. Monitoring has indicated that the Touquoy Gold Project complies with air quality guidelines at the Property Boundary, with implementation of dust suppressants.

No new construction will occur at the Touquoy Mine Site to facilitate processing of concentrate and deposition of tailings from the FMS Mine. The processing facility will continue to operate at the current capacity. Processing the small volume of concentrate from the FMS Mine Site is not expected to affect air quality in any important way.

8.5.2.2.2.7 Beaver Dam Haul Road Use by the Project, Cochrane Hill Gold Project and Regional Forestry

During the operation phase of the Project and the Cochrane Hill Gold Project, gold concentrate from each surface mine will be transported to the Touquoy processing site for final processing into gold doré bar. The proposed haul route for each project would overlap with the Beaver Dam Mine Haul Road west of the Highway 224. Trucking of ore from Beaver Dam along the haul road will amount to 190 trucks per day (95 return trips). A total of 22 additional trucks (11 return trips per day) will be added to the haul road from the Project and Cochrane Hill Gold Project (11 return trips per day, per site), which could be further compounded by forestry truck activity (approximately 7 return trips per day). In addition to the heavy truck traffic summarized above, it is estimated 3/4-ton service trucks would make up to approximately 20 round trips per day on the Haul Road. Mitigation measures proposed in the Beaver Dam Mine Project EIS will result in an 80% targeted dust suppression efficiency.

The combined trucking of concentrate from the Project and the Cochrane Hill Gold Project represent approximately 20% of the anticipated traffic on this road (based on projected Beaver Dam traffic rates and estimated forestry traffic rates). Assuming the trucks used for the Project and Cochrane Hill Gold Project are similar to the proposed haul vehicles for the Beaver Dam Mine Project, the addition of these vehicles will result in a 20% increase (10% increase attributed to each of the Projects, FMS and Cochrane Hill) in the maximum predicted concentration of airborne particulate associated with road traffic, as particulate modelling is completed over 24-hour and annual periods. The maximum predicted concentrations of particulate (all size fractions) was predicted to occur immediately adjacent to the road, which will be presented in the pending Beaver Dam Mine Project Round 2 Information Request response. Furthermore, predicted concentrations of all size fractions of particulate dropped off rapidly with distance.

The Proponent has committed to dust mitigation along the haul road between the Beaver Dam Mine Site and the Touquoy Mine Site to reduce the potential effects of all particulate size fractions. Based on this commitment, the cumulative effects for resuspended road dust was remodeled and will be reported in the second round of Information Requests for regulatory review. The Cochrane Hill and FMS Projects are predicted to contribute no more than 20% of the total traffic on the haul road.

8.5.2.2.2.8 Port of Sheet Harbour and Great Northern Timber Wood Chipping and Shipping (Present)

The Port of Sheet Harbour is a deep water port located 23 km southeast of the Beaver Dam Mine Site and 35 km southeast of the Touquoy Mine Site on the coast of the Atlantic Ocean. The terminal consists of a 152 m wharf with a minimum draft of 10 m and is capable of handling ships of up to 214 m (Port of Sheet Harbour, 2017).

At this same location, Great Northern Timber owns and operates a chipping and ship loading facility in Sheet Harbour, approximately 25 km southeast of the Beaver Dam Mine Site. Great Northern Timber procures wood chips and roundwood fibre from industrial landowners, sawmills, Crown lands, Private land contractors and Private woodlot management organizations in Nova Scotia, Prince Edward Island, New Brunswick and Quebec.

Data to support conclusions about residual effects of these projects on Air quality is unavailable, however it is not expected that either of these projects would result in a significant additive effect to Air quality with the Project. Neither of these projects triggered provincial or federal environmental assessment processes. As such, no air dispersion modelling was completed for either of these activities, and neither is expected to result in cumulative effects with the Project. There is some uncertainty in this conclusion, however, due to lack of available data.

8.5.2.2.2.9 Sheet Harbour Quarry (Future)

On January 31, 2019, Dexter Construction Company Limited submitted an Environmental Assessment Registration Document for the Sheet Harbour Aggregate Quarry Project, located approximately 30km southwest of the FMS Study Area, and 35km southeast of the Touquoy Mine Site. According to the EARD, Project activities will result in release of dust and exhaust type emissions through construction, operation and reclamation phases of this proposed quarry. Mitigation measures proposed include wet suppression of unpaved surfaces, equipment maintenance, and the use of low-sulphur fuel. Assuming appropriate mitigation measures are employed, the EARD indicates that the effect of the Project on air quality are minor. The EARD does not predict air quality concentrations from the project, nor does it predict the spatial extent of this potential dust deposition. The spatial boundaries used to make this determination are not provided in the EARD. However, the Projects' effects on air is not expected to spatially overlap with the proposed FMS Project, based on the distance between the two sites. The EARD was determined to provide insufficient information for the Minister to grant approval to the Project. On March 22nd, 2019, the Minister requested submission of additional information. The Minister approves this undertaking on November 8, 2019, but it is unclear in the public records whether operation has commenced. As such, there is additional uncertainty in the potential temporal overlap between this project and the Project.

8.5.2.2.2.10 Mosher Lake Limestone Co.

Mosher Limestone processing facility is located approximately 35 km west of the FMS Mine Site and 16 km north of the Touquoy Mine Site. As such, the project lies within the RAA for Air for the FMS Project, and there is a potential spatial overlap of residual effects. Mosher Limestone processes and sells limestone products in Nova Scotia and Atlantic Canada. Products include pelletized limestone, powdered limestone, granular limestone, powdered gypsum, pelletized gypsum, and traction sand. The processing facility crushes, packages and ships product. While very little data is publicly available, the Moser Lake Limestone Quarry is expected to generate dust and exhaust type emissions similar to other construction projects. This site has the potential for an additive cumulative effect on air quality with the FMS Project, though it is expected to be minor given the distance between the two projects. No additional information is available to predict potential cumulative effects in a quantitative manner. This project did not trigger an environmental assessment and no publicly available data was found to provide air quality results associated with this project.

8.5.2.2.3 *Cumulative Effects on Ambient Air Quality*

It is likely that forestry operations will occasionally coincide with those of the Project and cause greater disturbance to air quality that these operations produce individually. However, such additive periods are likely to be limited in duration and frequency and are not expected to be significant.

The gold processing and transportation activities associated with the Beaver Dam Mine Project, the Project and the Cochrane Hill Gold Project overlap in both time and space, with additional consideration to potential forestry activities that could also overlap spatially and temporally. Therefore, effects from the transportation and processing of gold from the three projects and forestry activities have the potential to act in an additive and cumulative nature. The operation of Beaver Dam Mine Project, the Project and the Cochrane Hill Gold Project are proposed roughly to occur during the same timeframe, with all three mines operating at the same time from 2024 to 2027. During this time, all three projects will use the portion of the Beaver Dam Haul Road west of the Highway 224 to transport gold concentrate to the Touquoy Mine Site resulting in potential additive cumulative effects to air quality through increased ambient dust levels along the Beaver Dam Haul Road. The addition of trucking from the Project and Cochrane Hill Gold Project will result in a 20% increase in the maximum predicted concentration of airborne particulate associated with road traffic, as particulate modelling is completed over 24-hour and annual periods. This is not expected to result in a significant cumulative effect. Forestry trucks represent approximately 7 round trips per day, which represents less than 5% of anticipated traffic along the Haul Road.

The principal assumption behind this assessment is that local forestry practices will not change in any important way during the Project, the Beaver Dam Mine Project or the Cochrane Hill Gold Project. Limitations related to data availability do not allow meaningful conclusions related to cumulative effects and project interactions for regional forestry operations, the Port of Sheet Harbour and Great Northern Timber Wood Chipping and Shipping. There is potential for additive cumulative effects on air from the Sheet Harbour Quarry, the Beaver Dam Mine Project, Touquoy Gold Project and Cochrane Hill Gold Project, and their combined use of the Beaver Dam Haul Road. However, given the limited spatial scale of the individual project effects, the mitigation measures proposed, and the distance between the projects, it is unlikely that any cumulative effects would be significant.

8.5.2.3 Mitigation

As the cumulative effects are not anticipated to be significant, additional mitigative measures (beyond those proposed to mitigate Project related effects, Section 6.2.7) for cumulative effects to air are not warranted.

8.5.2.4 Residual Cumulative Effects and Significance Assessment

A significant adverse effect to air at the FMS Project is defined as a repeated or sustained release of contaminants to the air that exceeds the NSE Maximum Permissible Ground Level Concentrations listed in the Nova Scotia *Air Quality Regulations* and that exceeds the Canadian Ambient Air Quality Standards for fine particulate matter, and all parameters discussed in Section 6.2.

The residual cumulative effects on the atmospheric environment are considered to be adverse but not significant (Table 8.5-2)

Table 8.5-2 Residual Cumulative Environmental Effects for Air

Residual Adverse Cumulative Effects (After Mitigation)	Significance Levels						Overall Significance of Residual Adverse Effects (and Rationale)
	Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility	
Increased cumulative dust during operation of the Project (Dust from mining and haul trucks)	M Possible exceedance of guidelines or threshold values when forestry operations occasionally coincide with hauling concentrate along the FMS Mine Site to the Touquoy Processing Facility along with ore or concentrate from Beaver Dam and Cochrane Hill Projects.	LAA The cumulative effects causing increased background air concentrations will not extend beyond the LAA. Exception to this is the cumulative noise along the Beaver Dam Haul Road which is outside of the Project LAA but described herein.	A VC will be affected by timing – drier periods will increase fugitive dust emissions relative to wetter times of the year.	LT Effects may extend beyond 7 years.	R Additive periods of potential effects from the Project and forestry operations are likely to be limited in frequency. However, cumulative effects to ambient dust levels from the use of the Beaver Dam Haul Road by Fifteen Mile Stream and Cochrane Hill Gold Projects will occur regularly throughout the operational phase of the Project.	R VC will recover to baseline conditions once operations have stopped.	Moderate Adverse Effect (Not Significant) Effects are limited to the LAA where there are limited sensitive receptors, and the use of the Beaver Dam Haul Road. Furthermore, the VC is anticipated to recover to baseline conditions once the operation of the FMS Mine Site has been completed. Effects would be confirmed through monitoring.

Legend (refer to Table 5.10-1 for definitions)

Magnitude		Geographic Extent		Timing		Duration		Frequency		Reversibility	
N	Negligible	PA	Project Area	N/A	Not Applicable	ST	Short-Term	O	Once	R	Reversible
L	Low	LAA	Local Assessment Area	A	Applicable	MT	Medium-Term	S	Sporadic	IR	Irreversible
M	Moderate	RAA	Regional Assessment Area			LT	Long-Term	R	Regular		
H	High					P	Permanent	C	Continuous		

8.5.2.5 Follow-up and Monitoring Programs

No additional follow-up or monitoring beyond that presented in Section 6.2.9 is warranted.

8.5.3 Light Cumulative Effects Assessment

8.5.3.1 Baseline Conditions

8.5.3.1.1 *Baseline Light Levels*

Baseline ambient light levels were recorded on the night of Sept 9th, 2018 using a Digi-Sense data logging electronic photometer and a UnihedronSky Quality Meter at four monitoring stations. Monitoring locations are considered representative of the area surrounding the proposed mine and were selected in areas that minimized interference from existing artificial light sources. Baseline results show that ambient light levels are low (<0.01 lux) and sky brightness on clear dark nights was classified as intrinsically dark.

Predictive effects of light spill are determined by "line of sight" methodology and using elevation contours for impact limits. This is used to represent the 0.1 Lux light level which is otherwise considered the limit of possible impact. There are no regulatory criteria applicable for ambient light. The threshold of determination of significant effects from light at the FMS Study Area was determined to be 0 lux light trespass into windows at the nearest receptor. This was determined as a result of the baseline environmental light classification of E1 at the FMS Study Area.

The predicted light propagation extends between up to 2 km from the FMS property boundary. The assessment of light propagation is inherently conservative as the potential light shielding from the forest are ignored. Based on professional judgement from similar scenarios, the maximum extent of light propagation at 1 lux is predicted to be 0 - 500 m from the proposed FMS property boundary. The nearest seasonal residence is located outside of the predicted area of light trespass at ~5 km south of the FMS Study Area. Therefore, no impact of light trespass is expected to occur at the nearest receptor.

Additionally, site infrastructure and equipment will be sources of light that are not anticipated to produce a significant area of illumination. Therefore, the effects of sky glow are anticipated to be limited to within 2 km of the FMS Study Area and not likely noticeable at the nearest receptor.

8.5.3.1.2 *Residual Effects of Proposed Project*

The predicted residual environmental effects of Project development and production of light are assessed to be adverse, but not significant. Quantitative modelling was completed for the operations phase of the Project as this phase was predicted to be the worst-case scenario for light propagation. At the FMS Mine Site, predictive effects of light spill are determined by "line of sight" methodology and use elevation contours for impact limits. The inverse square methodology was also evaluated to predict light propagation from the FMS Mine Site. This is used to represent the 0.1 lux light level which is otherwise considered the limit of possible impact. For the purpose of this assessment, the threshold of determination of significant effects from light at the FMS Study Area was determined to be 0.1 lux light trespass into windows at the nearest receptor. This was determined as a result of the baseline environmental light classification of E1 at the FMS Study Area. The maximum light shed was predicted to be 2 km from the FMS Mine Site proposed property boundary.

FMS concentrate will be trucked to the operating Touquoy Mine Site for processing. The primary effect of the continued use of the Touquoy Mine Site is the continued lighting of facilities and vehicular traffic during the processing of FMS concentrate. There are no new or additional effects from light anticipated to be caused by the processing of concentrate and the management of tailings from the Project and are therefore not further evaluated in this cumulative effects assessment.

Although outside of the Project PA, a portion of the proposed transportation route for the Project concentrate has the potential for cumulative light effects as the concentrate trucking route plans to utilize the Beaver Dam Haul Road. Light has not been considered along this section of road from the Project as it is outside the PA; however, is considered cumulatively in a qualitative fashion herein for completeness. The detailed evaluation of cumulative light from the Beaver Dam Mine Project on the Haul Road, along with the Project and the Cochrane Hill Gold Project is included in the Beaver Dam Mine Project cumulative effects assessment.

8.5.3.1.3 *Effects of Other Projects in the Area*

The RAA for light, and projects which fall within this RAA are shown on Figure 8.5-3. Current and historic operation of the East River Hydro System has a spatial and temporal overlap with the Projects' RAA for light. It is not being discussed in the context of that projects' effects on light levels, because the infrastructure within the light RAA does not generate any light (i.e., mobile light plants located at the dams).

8.5.3.1.3.1 Current Regional Forestry Operations

The local forestry industry has the potential to have cumulative effects on light. As the forestry industry is ongoing in the region and has been for many decades, its effects on light are already accounted for in the local baseline conditions. Impacts on light associated with timber harvesting would be limited to temporary increases in light based on transportation to timber, and cannot be quantified in a meaningful with publicly available data.

8.5.3.1.3.2 Beaver Dam Haul Road Use by the Project and Cochrane Hill Gold Project and Regional Forestry

During the operation phase of the Project and the Cochrane Hill Gold Project, gold concentrate from each surface mine will be transported to the Touquoy processing site for final processing into gold doré bar. The proposed haul route for each project would overlap with the Beaver Dam Haul Road west of the Highway 224, along with potential trucking activity associated with the forest industry. Eleven round-trips are proposed to carry gold concentrate from each of the Cochrane Hill and the FMS Projects per day (totaling 22 vehicle round-trips per day or 44 1-way trips), plus 95 round-trips per day (or 190 1-way trips) between Beaver Dam Mine Site and Touquoy Mine Site (pers. Communication, Rick Archibald, Nov 27, 2020). In addition to the heavy truck traffic summarized above, it is estimated 3/4-ton service trucks would make up to approximately 20 round trips per day on the Haul Road.

The assessment of light impacts along the Beaver Dam Haul Road was completed by considering a "worst case" scenario when two trucks are closest to each receptor and shining light towards the receptor. Because receptors along the Beaver Dam Haul Road are not located on any road bends, with limited line of site to the travelling trucks, the assessed light impacts to these receptors were likely overestimated.

The 22 additional vehicle round trips along this Haul Road are not anticipated to change the assessment presented. The worst-case would still occur when two trucks are close to a single receptor and shining lights toward that receptor. As the road is only 2 lanes, only two trucks could approach a receptor at one time (one from each direction). During daylight hours, the truck lights are insignificant compared to ambient light levels, and in the dawn, dusk and evening hours (until 11 PM when curfew is implemented), potential light impacts which will be presented in the Beaver Dam Mine Project Round 2 Information Request response.

Within the Beaver Dam Mine Project EIS, it was reported that of the three light receptors assessed for light impacts from the Haul Road, all receptors will not experience any exceedences of ILP Guide light standard of 5 lux during pre-curfew (11pm) conditions as a result of road traffic (ILP 2020). This will be unchanged with the additional vehicles from Fifteen Mile Stream and Cochrane Hill.

8.5.3.1.4 *Cumulative Effects on Light*

It is likely that forestry operations will occasionally coincide with those of the FMS Project and cause localized elevated light levels relative to what these operations produce individually, especially along the Beaver Dam Haul Road. However, such additive periods are likely to be limited in duration and frequency and are not expected to be significant. There are no available data to quantify timber harvesting accurately on crown land or on private land. This is a substantial data limitation, which prevents making any more meaningful conclusions related to cumulative effects on light from the Project, in the context of a resource driven landscape with unknown amounts of timber harvesting. Based on the current understanding of proposed lumbering operations, a further 7 truck trips per day have been added to the total, but it clear that forestry will not be a significant source of traffic on the Haul Road.

The gold concentrate processing and transportation activities associated with the Beaver Dam Mine Project, the Project and the Cochrane Hill Gold Project overlap in both time and space. Therefore, the potential effects from the transportation from the three projects have the potential to act in an additive and cumulative nature. The operation of Beaver Dam Mine Project (2023-2028), the Project (2024 to 2030) and the Cochrane Hill Gold Project (2024 to 2029) are proposed roughly to occur during the same timeframe, with all three mines operating at the same time from 2024 to 2027. During this time all three projects will use the portion of the Beaver Dam Haul Road west of the Highway 224 to transport gold concentrate to the Touquoy Mine Site resulting in potential additive cumulative effects to light levels from trucking along the Haul Road. The additional truck traffic represents an 20% increase in daily traffic along the haul road between Beaver Dam Mine Site and the Touquoy Mine Site. Given the limitations of traffic on the Beaver Dam Haul Road (2 lanes, only 2 trucks can be in one place at one time), the 20% increase in volume of traffic will not result in a cumulative impact on light levels, particularly related to light levels at reception points.

The principal assumptions behind this assessment is that local forestry practices will not change in any important way during the Project, the Beaver Dam Mine Project or the Cochrane Hill Gold Project. These assumptions are considered to have a low uncertainty.

8.5.3.2 Mitigation

As the cumulative effects are not anticipated to be significant, additional mitigative measures (beyond those proposed to mitigate Project related effects, Section 6.3.7) for cumulative effects to light are not warranted.

8.5.3.3 Residual Cumulative Effects and Significance Assessment

For the purpose of this assessment, the threshold of determination of significant effects from light at the FMS Study Area was determined to be 0 lux light trespass into windows at the nearest receptor. This was determined as a result of the baseline environmental light classification of E1 at the FMS Study Area. For the Beaver Dam Haul Road, the significance determination was based on a 5 lux threshold as per the ILE guidelines for day and evening light trespass (pre-curfew). The residual cumulative effects on the atmospheric environment are considered to be adverse but not significant (Table 8.5-3)

Table 8.5-3 Residual Cumulative Environmental Effects for Light

Residual Adverse Cumulative Effects (After Mitigation)	Significance Levels						Overall Significance of Residual Adverse Effects (and Rationale)
	Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility	
Increased light levels during operation of the Project (operational light levels and light from transportation of gold concentrate and use of the Beaver Dam Haul Road by other projects)	L Less than or equal to appropriate guidelines or threshold values.	LAA The cumulative effects causing increased background light concentrations will not extend beyond the LAA. Exception to this is the cumulative light along the Beaver Dam Haul Road which is outside of the Project LAA but described herein.	N/A VC is not expected to be affected by timing.	LT Effects may extend beyond 7 years.	R Additive periods of potential effects from the Project and forestry operations are likely to be limited in frequency. However, cumulative effects to ambient light levels from the use of the Beaver Dam Haul Road Use by Fifteen Mile Stream and Cochrane Hill Gold Projects will occur regularly throughout the operational phase of the Project.	R VC will recover to baseline conditions once operations have stopped.	Low Adverse Effect (Not Significant) Effects are limited to the LAA where there are limited sensitive receptors, and the use of the Beaver Dam Haul Road. Furthermore, the VC is anticipated to recover to baseline conditions once the operation of the FMS Mine SIte has been completed.

Legend (refer to Table 5.10-1 for definitions)

Magnitude		Geographic Extent		Timing		Duration		Frequency		Reversibility	
N	Negligible	PA	Project Area	N/A	Not Applicable	ST	Short-Term	O	Once	R	Reversible
L	Low	LAA	Local Assessment Area	A	Applicable	MT	Medium-Term	S	Sporadic	PR	partially reversible
M	Moderate	RAA	Regional Assessment Area			LT	Long-Term	R	Regular	IR	Irreversible
H	High					P	Permanent	C	Continuous		

8.5.3.4 Follow-up and Monitoring Programs

No additional follow-up or monitoring beyond that presented in Section 6.3.9 is warranted.

8.5.4 Surface Water Quality and Quantity Cumulative Effects Assessment

8.5.4.1.1 *Baseline conditions*

8.5.4.1.1.1 Surface Water Features

FMS Study Area

Watercourse identification and descriptions, as well as wetland delineation and evaluation were completed across the FMS Study Area in 2016, 2017, and 2018. Forty-two (42) linear watercourses and their associated open water systems, two waterbodies (Anti-Dam Flowage, East Lake), and 274 wetlands were identified and evaluated within the FMS Study Area. The primary surface water feature within the FMS Study Area is Seloam Brook, with its many small tributaries and side channels. Seloam Brook drains from the northeast from Seloam Lake, through a NSPI dam, limiting natural flows through Seloam Brook. Bulk release of water generally occurs in late Fall and early Spring from the lake.

Seloam Brook drains west to Fifteen Mile Stream, west of the FMS Study Area, which drains south into Anti-Dam Flowage, just south of the FMS Study Area. A NSPI dam is also located at the south end of Anti-Dam Flowage. This dam is generally open in the summer months, and the Anti-Dam Flowage drainsrun of river. When the dam is closed, the Anti-Dam Flowage is a reservoir/lake.

Watercourses, included Seloam Brook, have been historically adjusted and degraded as a result of historical mining. Sections of the streams have been straightened/ditched. The dam at Seloam Lake affects the hydrology of the downstream watercourses and associated wetland habitat within the FMS Study Area. East Lake is present within the southeastern extent of the FMS Study Area. The FMS Study Area has several small open water features, primarily associated with wetland complexes which vary in condition from natural to those created by historic mining activity.

Touquoy Mine Site

There are several watercourses in the vicinity of the Touquoy Mine Site. Moose River is the largest watercourse adjacent to the property and flows along the western border of the mine site. A tributary to the Moose River (known as WC4) flows south through the property, between the open pit and tailing management area. Scraggy Lake is located to the south of the property and is a water supply source for the Touquoy Mine Site. Fish River drains Square Lake to Scraggy Lake and both lakes are part of the Fish River Watershed that flows west and then south into Lake Charlotte, eventually emptying into Ship Harbour.

8.5.4.1.1.2 Surface Water Quality

FMS Mine Site

The surface water quality observed in the FMS Study Area is typical of lakes and watercourses that are present within the geological terrain of the southern mainland of Nova Scotia. The geology within this region is dominated by Cambrian-aged bedrock and the hydrology is strongly controlled by bedrock outcrops that create irregular flow patterns. As drainage moves through the watersheds within this region, the surface water is subjected to water-rock interactions and weathering processes associated with the bedrock and overburden – these natural processes influence the baseline water quality.

The baseline surface water quality at the stations monitored in the FMS Study Area can be generally characterized as having acidic to near-neutral pH, low alkalinity and hardness, and low concentrations of nutrients. The baseline water quality dataset is presented in detail in Golder (2019b). Concentrations of most parameters were observed to be consistently below the CCME CWQGs and NSEQSs. However, concentrations of aluminum were observed to be greater than surface water quality guideline criteria in all samples, arsenic was greater than criteria in 35% of samples, iron was greater than criteria in 18% of samples, zinc was greater than criteria in 10% of samples and copper and mercury were greater than criteria in 2% of samples. Background environmental baseline concentrations of some parameters exceeding surface water quality criteria is not uncommon, including within areas that are relatively pristine and not disturbed.

Lastly, a site-specific water quality objective (SSWQO) for arsenic of 0.03 mg/L has been developed for the Project (Appendix C.2), which is a risk-based benchmark that is protective of fish and other aquatic life. Baseline arsenic concentrations greater than the SSWQO have been observed at SW4, SW5 and SW14.

<u>Touquoy Mine Site</u>

Based on a review of the 2017 baseline 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 NSE Tier 1 EQS. In addition, cobalt, manganese, silver and mercury exceeded the Canadian Council of Ministers of the Environment (CCME 2018) guideline for the protection of freshwater aquatic life. 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.

8.5.4.1.1.3 Surface Water Quantity

<u>FMS Mine Site</u>

In general, the climate of the Project is characterized by a relatively moderate temperature regime. Precipitation is greatest in the fall and winter months, and the proportion of snowfall in winter months is less than 50%, further indicating moderate climate conditions at the FMS Study Area. Potential evapotranspiration is about 40% of the total precipitation received on an average annual basis.

Records from this regional hydrological station indicate that the lowest flows occur during the summer months, which coincide with less precipitation and higher potential evapotranspiration. The consistency of flows through the winter months is supported by the presence of rainfall throughout the winter that moves water through the watersheds rather than storing precipitation in snowpack. The average annual runoff estimated at this station is 1,002 mm, or about 70% of the total annual precipitation.

The primary surface water drainage system through the FMS Mine Site consists of Seloam Lake and its discharge point into Seloam Brook. Seloam Brook flows through the FMS Study Area, through the proposed Pit location, into Fifteen Mile Stream which flows into Anti Dam Flowage, which is part of the East River Sheet Harbour system. The proposed TMF location lies on a tertiary sub-tertiary watershed divide, with the eastern portion of the TMF draining east, away from Seloam Brook. The eastern portion flows into East Lake, which flows as a tributary called East Brook, eventually flowing into Antidam Flowage. Further details about flow rates and drainage basins flows are presented in Section 6.6.

<u>Touquoy Mine Site</u>

The Touquoy Mine Site was divided into five sub-catchment areas based on the available LiDAR topography (Leading Edge 2013) and the water management at the site. The catchment areas for each of the mine facilities include the mill site (13.8 ha), TMF (94.0 ha), open pit (40.4 ha), waste rock area (55.1 ha), and polishing pond (16.9 ha).

8.5.4.2 Analysis of Effects

8.5.4.2.1 *Residual Effects of Proposed Project*

8.5.4.2.1.1 FMS Water Quantity Summary

Water quantity at the FMS project was assessed through the integration of facility designs, baseline data and the development of a numerical model to simulate the watersheds encompassing the project footprint. The watersheds model was developed to simulate the existing conditions, and to compare those streamflows with those resulting from the Operations and Closure phases of the Project. As an overall conclusion, the project footprint and site water management strategies have a low magnitude effect on the macro-scale overall discharge through the receiving watersheds. Similarly, the proportion of groundwater and surface water contributions was assessed as unlikely to be altered over the life cycle of the Project.

The Seloam Brook Realignment will mitigate lost fish and fish habitat and will be a permanent feature. The realignment will result in sedimentation downstream, mitigated in part by the proposed installation of water control structures downstream of the realignment.

On a smaller scale, the flow through East Lake will be decreased as a result of the footprint of the TMF; the overall effect of this flow change is an approximate 5 cm decrease in water level within the lake itself. The outflow from East Lake is predicted to see a maximum reduction in flow of 45%. The flow through the WC2 system will also be decreased as a result of the infrastructure footprints, which has a high magnitude effect in the system. The flow through the WC12 system will also be decreased as a result of the infrastructure footprints, which has a low magnitude effect in the system. Finally, the flow through the WC18 system will be decreased as a result of the infrastructure footprints, which has a moderate magnitude effect in the system.

8.5.4.2.1.2 FMS Water Quality Summary

During operations, the predicted TMF pond effluent concentrations using base and upper case source terms are predicted to be lower than the MDMERs.

The residual effect relevant to the surface water quality VC during the operations (EOM) phase is a change in water quality associated with Project activities. The predicted average and 95th percentile concentrations of modelled parameters are below the applicable guidelines and/or background concentrations on an annual and monthly basis, using both base case and upper case source terms. The magnitude of the effect on surface water quality during the operations phase ranges from Negligible to Low.

Intrinsik Corp. further concluded that while the predicted levels in the receiver slightly exceed the 75th percentile of baseline, they remain within the range of baseline and are unlikely to pose a risk to aquatic life. As a result of these predictions, no water treatment is predicted to be necessary during the Operations Phase.

During Post-Closure, the predicted open pit effluent concentrations (using both base case and upper case geochemical source terms) are predicted to be lower than the MDMERs for all parameters.

The residual effect relevant to the surface water quality VC during the post-closure stage of the Closure Phase is a change in water quality associated with Project activities. With mitigation measures (covers on the PAG WRSA and the tailings beach) in place, and using base case geochemical source terms as model inputs, the predicted average and 95th percentile receiver concentration of the modelled parameters are below the applicable guidelines and/or background concentrations on an annual and monthly basis. Therefore, the magnitude of the effect for the base case ranges from Negligible to Low (depending on parameter).

Using upper case geochemical source terms as the model input, the predicted average receiver concentrations of the modelled parameters are below the applicable guidelines and/or background concentrations on an annual and monthly basis. The 95th percentile concentrations of cadmium are predicted to be greater than the FEQG in May, October and November at EMZ-2; this corresponds to a Moderate magnitude for cadmium. The 95th percentile concentrations of cobalt are predicted to be greater than the CCME CWQG in January, February, April, May, October, November and December at EMZ-2 and October and November at SW6; this corresponds to a Moderate magnitude for cobalt. The 95th percentile concentrations of zinc are predicted to be greater than the CCME CWQG in November at EMZ-2; this corresponds to a Moderate magnitude for zinc. It should be noted that these predictions of Moderate magnitude represent a non-typical condition of upper case geochemical source terms combined with infrequent low flow climate conditions.

Intrinsik Corp. further conclude that, in the Post Closure scenario, all predicted constituent concentrations were consistently below selected water quality benchmarks or baseline, when considered on an annual average basis with the exceptions of cobalt, which marginally exceeded the FEQG at EMZ-2, and iron, which marginally exceeded the respective 75th percentile baseline at SW6 and EMZ-2.

Additional modelling was conducted for all parameters to examine the potential for exceedances on a monthly average basis. When examined on a monthly basis, cadmium is predicted to be greater than the CCME water quality guideline at EMZ-2 in the months of May, October and November, based on the 95th percentile predictions. In addition, cobalt exceeds the FEQG in January, February, April, October, November and December at EMZ-2, and in October and November at SW6. Zinc also exceeds the CCME water quality guideline at EMZ-2 in the month of November, but no exceedances are predicted in any other month. These exceedances are discussed further as follows:

- **Cadmium:** The predicted 95th percentile concentrations of cadmium at EMZ-2 in the months of May, October, and November (0.000041 – 0.000049 mg/L) exceeded the CCME water quality guideline of 0.00004 mg/L. The 95th percentile results represent an upper bound scenario, which would only result in the instance that low flow precipitation events occur in conjunction with upper bound source term conditions, which is unlikely. Hence, the likelihood of toxicity is considered to be low.
- **Cobalt**: Predicted concentrations of cobalt do not exceed the NSEQS of 0.01 mg/L in any of the prediction nodes. Only the predicted 95th percentile cobalt concentration at EMZ-2 in the months of January, February, April, October, November and December (0.00080 – 0.00125 mg/L) and at SW6 in the months of October and November (0.00084 – 0.00096 mg/L) exceeded the FEQG of 0.00078 mg/L. The 95th percentile concentrations are up to 1.6 times the FEQG of 0.00078 mg/L. The 95th percentile results represent an upper bound scenario, which would only result in the instance that low flow precipitation events occur in conjunction with upper bound source term conditions, which is unlikely. The FEQG considers hardness as a modifying factor, but the SSD model developed by Environment Canada in this guideline setting approach is very conservative, and the data used in the assessment do not fit the selected model of the SSD in the lower quartile of the dataset well (see Figure 1 of Appendix C.2). This results in the estimated HC5 value being considerably lower than it should be, relative to the toxicity dataset. This indicates that the selected guideline is over predicting toxicity of cobalt, and hence, the marginal exceedances indicated in Table 3-6 are considered to represent a low risk potential, with respect to toxicity to aquatic species, particularly considering that the upper case source terms and precipitation events would have to co-occur in the 95th percentile calculations outlined below in Table 3-6 of Appendix C.2.
- **Zinc:** Predicted concentrations of zinc do not exceed the NS Tier 1 standard of 0.030 mg/L in any of the prediction nodes. Only the predicted 95th percentile concentration at EMZ-2 in the month of November (0.0078 mg/L) exceeds the CCME CWQG of 0.007 mg/L. The lowest observed effect concentration (LOEC) listed in the CCME (2018) fact sheet is 0.00989 mg/L (11 week study; development; Chironomid sp.; normalized to 50 mg/L CaCO3 and Dissolved Organic Carbon (DOC) of 0.5 mg/L). Since the predicted exceedance is marginal, relative to the guideline, and only occurs in the month of November, the likelihood of toxicity occurring in the Baseline + Project scenario is considered to be low.
- **Iron:** Figure B-75 of Appendix B.6 provides the monthly predictions for iron in the Post closure, upper case scenario. The exceedances noted in EMZ-2 and SW6 in Table 3-4 remain fairly constant over the monthly intervals, and only marginally exceed

the 75th percentile of baseline, and remain within the range of baseline. As per the discussion related to the operations upper case scenario related to iron, these predicted concentrations are unlikely to result in aquatic effects.

8.5.4.2.1.3 Touquoy Surface Water Quality

The use of the exhausted Touquoy facility for tailings storage from the Project will result in degraded water quality in the pit during filling, and that may discharge to the receiving environment (Moose River) through seepage and effluent discharge. The pit water will be managed and treated as required to MDMER limits regulatory closure criteria, and/or site-specific guidelines prior to discharge. Therefore the magnitude of the effect is expected to be negligible on Moose River quality and downstream tributaries.

- The predicted receiving environment concentration of arsenic is 0.024 mg/L; risks to aquatic life associated with predicted arsenic concentrations are anticipated to be low.
- The aluminum concentration of 0.184 mg/L for aluminum is predicted below the 75th percentile receiver quality in Moose River.
- Elevated concentrations of cobalt, copper and nitrite in groundwater were predicted in the model to meet CCME FAL/NSE EQS after mixing with Moose River 100 m downstream of the discharge point.
- Predicted WAD concentrations in the receiving environment of 0.0024 mg/L are below the NSE Tier 1 guideline of 0.005 mg/L free cyanide, indicating acceptable levels of risk to aquatic life.

8.5.4.2.1.4 Touquoy Surface Water Quantity

The use of the exhausted Touquoy facility for tailings storage will result in the accelerated filling of the pit from that of the Touquoy reclamation plan.

- Tailings will be deposited in the Touquoy pit for a total of 77 months reaching an elevation in the pit of 17.6 m (CGVD2013). This amounts to approximately 98 m of water cover over the deposited tailings based on a spillway elevation of 108 m (CGVD2013) and will limit oxygen, reduce metal leaching conditions and further improve water quality.
- No surface water will be discharged from the exhausted Touquoy pit to Moose River until the pit reaches the spillway elevation in Year 14. Water withdrawal from Scraggy Lake will require to be extended for an additional 7 years for processing of FMS ore concentrate associated with the Project.

8.5.4.2.2 *Effects of Other Projects in the Area*

The RAA for surface water quality and quantity, and projects which fall within this RAA are shown on Figure 8.5-4. There is direct spatial overlap between the Project and historic mining operations in the FMS Study Area and the Touquoy Mine Site. Any potential cumulative effects from these projects related to surface water would be based on potential impacts to water quality from mobilization of historic tailings. The potential impact of this interaction will be mitigated by implementation of the Historical Tailings Management Plan (Appendix I.1). As such, these historic operations are not carried through the CEA process. All other projects are described herein.

8.5.4.2.2.1 Regional forestry operations

The local forestry industry has the potential to have cumulative effects on surface water. As the forestry industry is ongoing in the region and has been for many decades, its effects on surface water quantity and quality are already accounted for in the local baseline conditions. Furthermore, in Nova Scotia forestry operations are regulated under the *Wildlife Habitat and Watercourse Protection* regulations, which imposes various restrictions on timber harvesting with the purpose of limiting impact of forestry on aquatic habitats. Presuming forestry operators adhere to these regulations, the likelihood of a cumulative effect on surface water from timber harvesting and the Project is limited.

8.5.4.2.2.2 East River Sheet Harbour Hydro System

The East River Hydro System operation overlaps both spatially and temporally with the RAA for surface water surrounding the FMS Study Area. According to the NSPI relicensing report (2009), hydro power generation commenced in the East River Sheet Harbour in the 1920's, however saw mills have been in place to support timber harvesting since the 1820's. The two most proximal hydropower dams to the FMS Mine Site are located at Seloam Lake and Anti-dam Flowage outflows. Both of these dams have resulted in current and historic alteration of surface water flows throughout the FMS Study Area. NSPI has a Water Approval to operate these dams, with conditions which stipulate release requirements for ecological maintenance flow.

While the operation of the hydro system is anthropogenic in nature, it is considered as baseline conditions in the FMS Study Area and the operational rules for the infrastructure has been considered and incorporated in water quality and quantity modelling completed for the Project. Furthermore, the effect of the Project on surface water quality and quantity involved predictive modelling, which has taken into account the effects of the hydro system operation. As such, all effects assessment determinations related to surface water quality and quantity already account for the presence of the hydro system. There is no other potential pathway for cumulative effects to occur between the Project and the NSPI hydro system.

8.5.4.2.2.3 Touquoy Gold Project

The effects of the Touquoy Gold Project on surface water include (based on CRA 2007a and GHD 2017b):

- Reduced water quality from sedimentation/siltation, deposition of fines during construction, operation and decommissioning;
- Introduction of contaminants (e.g., nitrate) from blasting operations and pit dewatering;
- Effluent released into Scraggy Lake from the tailings and polishing ponds;
- Water withdrawal from Scraggy Lake; and
- Potential impact to surface water quality from spills of hazardous materials stored on site during mine construction and operation.

Given the implementation of mitigation measures to control erosion and sedimentation, significant adverse effects from operation of the Touquoy Gold Project are not anticipated on surface water resources. The Touquoy Gold Project currently holds an Industrial Approval for water withdrawal, permitting withdrawal of up to 720 m^3 per day, to a maximum of 262,800 m^3 annually from Scraggy Lake (Approval #2017-103502-01). Treated effluent is released form the polishing pond into Scraggy Lake, with monitoring completed under the EEMP to ensure compliance with MDMER.

The discharge of treated mine effluent is controlled by MDMER regulations. The effluent must meet the limits put in place to protect the aquatic environment and the effects monitoring program will ensure that operational discharges are compliant. Therefore, no significant adverse effects on surface water resources from tailings effluent on Scraggy Lake are expected. Water monitoring completed under the EEMP for release of water to Scraggy Lake, and authorization for water withdrawal, it Is not expected that the Touquoy Gold Project results in a significant adverse effect to aquatic resources in Scraggy Lake.

8.5.4.2.2.4 Touquoy Gold Project, Beaver Dam Mine Project and Cochrane Hill Gold Project- deposition of tailings in Touquoy exhausted pit

The Proponent proposes the operation and closure of a tailings management facility in the exhausted Touquoy pit developed for the Touquoy Project. Tailings from the processing of ore, or ore concentrates, from four deposits at the Touquoy mill are proposed to be disposed of in the Touquoy pit. These include the processing of lower grades of ore stockpiled for the Touquoy Project, processing of ore transported from the Beaver Dam Mine Project, and processing of ore concentrates from the Fifteen Mile Stream Gold Project (the Project) and Cochrane Hill Gold Project.

The total capacity of the expanded Touquoy pit at the proposed spillway elevation of 108.0 m is 11.83 million cubic metres (Mm^3). This is sufficient to store tailings using subaqueous deposition. Considering subaqueous deposition, the exhausted Touquoy pit can accommodate the estimated total deposited volume of 7.91 Mm^3 based on an average tailings density of 1.3 tonnes per cubic metre (t/m^3) from the four projects (Appendix I.7).

Modelling conducted for the FMS project simulates the filling of the Touquoy pit with tailings, which are assumed to have a hydraulic conductivity of 1×10^{-6} m/s (Appendix I.7). The volumes of tailings disposed of in the Touquoy pit are the only important difference between the groundwater models prepared for the Beaver Dam, Fifteen Mile Stream, and Cochrane Hill projects.

In addition to the deposition of tailings from the Beaver Dam, Fifteen Mile Stream, and Cochrane Hill projects, an expansion of the Touquoy open pit is proposed to extract additional high-grade ore. Groundwater modelling was conducted to assess the dewatering of the expanded open pit (Appendix I.7). This model forms the basis of the modelling for the cumulative effects, following the scenarios generally described in Appendix I.4.

The cumulative effects of the various projects on groundwater are simulated through the deposition of tailings in the expanded Touquoy open pit. The processed tailings were assumed to share the same source terms for the prediction of downstream groundwater quality effects. These source terms are based on the geochemical testing conducted on the Touquoy tailings (Appendix I.7).

Cumulative Conclusions (Water Quality) (provided in Appendix I.7):

- As presented in the assimilative capacity study of Moose River (Appendix I.5) the effluent concentrations under normal discharge from the filled exhausted Touquoy pit, combined with the groundwater seepage contributions in Moose River under the same climate conditions are predicted for the cumulative scenario. Moose River will primarily be driven by climatic conditions, with April flows representing a worst-case dilution ratio between the effluent discharge from the exhausted Touquoy pit and Moose River. Based on results of the assimilative capacity model, once mixed with the background water quality in Moose River, the concentration 100 m downstream of SW-2 is predicted to be 0.0238 mg/L for arsenic and 0.184 for aluminum. Although the simulated arsenic concentration is above the NSE Tier 1 and CCME guidelines of 0.005 mg/L, the background levels at SW-2 also exceed the guidelines at 0.018 mg/L. The aluminum concentration is predicted below the 75th percentile receiver quality in Moose River.

- Similar to the approach used in the Project assimilative capacity modelling, water quality that is predicted to exceed the MDMER discharge limits will be treated prior to discharge (arsenic and ammonia) (Appendix I.5). The pit lake will be treated to meet MDMER discharge limits for an existing mine prior to discharge to Moose River. As the pit lake is simulated to take about 10 years to fill from commencement of tailings deposition in the exhausted Touquoy pit, the final water treatment design will be fully developed during operation and pit filling.

- The effects of the cumulative discharge of effluent from the Touquoy open pit when considering all four project tailings in the Touquoy pit together, combined with groundwater discharge, indicates that the water quality from the Touquoy open pit at or below MDMER discharge limits will meet CCME FAL or NSE Tier 1 EQS guidelines for parameters with the exception of arsenic. An assessment of the potential environmental effects of elevated arsenic in the downstream environment in Moose River are presented in Appendix C.2 and the cumulative effects of operating the four projects are not likely to result in adverse arsenic concentrations for the existing aquatic environment.

- Based on the predictive modelling conducted for the cumulative scenario, only Total cyanide and cobalt were predicted to exceed the selected benchmarks. For Total cyanide, the selected benchmark was the NS Tier 1 guideline, which is based on free cyanide, and hence not a relevant benchmark for comparison purposes. Based on the available toxicity data and predictions, Total cyanide is unlikely to be present in concentrations of concern to aquatic life. Cobalt predictions exceed the new FEQG for cobalt (ECCC, 2017), but do not exceed the NS Tier 1 guideline. The conservative nature of the SSD calculation within the FEQG for cobalt is potentially resulting in a biased low guideline, and based on comparisons to available toxicity data, cobalt at the predicted concentrations is not expected to result in adverse effects in aquatic life in the receiving environment (Appendix C.2).

Cumulative Conclusions (Water Quantity) (provided in Appendix I.7):

- The potential effect of the addition of tailings from Touquoy, FMS, Beaver Dam and Cochrane Hill Projects to the Touquoy Pit has been outlined in (Appendix I.7). The results of the water balance model show that tailings will be deposited in the exhausted Touquoy pit for a total of 44 months reaching an elevation of 91.9 m CGVD2013. As presented in the Touquoy Gold Mine Project Reclamation Plan, the inflow of groundwater, surface runoff and precipitation into the pit will naturally create a lake upon closure of the site. The water balance model simulated that it would take an additional 63 months or a total of 107 months from commencement of tailings deposition in the exhausted Touquoy pit to fill the pit to the spillway invert elevation.

- The proposed Touquoy pit extension and subsequent tailings deposition from all four deposits has been evaluated (Appendix I.7). The inflow rates decrease from 813 m3/d when the pit stage elevation is at -25 m CGVD2013, to 408 m3/d at a pit stage of 108 m CGVD2013, at which point the pit lake will overflow to Moose River through a constructed spillway. The net baseflow to Moose River at SW-2 under pit full conditions is simulated to be 29,596 m3/d. Compared to the existing conditions, the groundwater inflows to the Touquoy pit filled to 108 m CGVD2013 is anticipated to reduce the baseflow in Moose River at SW-2 by 1082 m3/d. This accounts for 4.2% of the mean annual flow at Moose River at SW-2.

- Water supply in the Touquoy pit is adequate for operation of the Project under normal and wet climate conditions, considering the 5.8% fresh water make-up from Scraggy Lake. Should operation commence under dry climate conditions, there will be little water available in the TMF for reclaim and insufficient time to store water in the Touquoy pit prior to start-up. The water balance simulated a water deficit under dry climate conditions that would require takings exceeding the permitted water volume from Scraggy Lake for Touquoy operation. Therefore, under dry climate conditions or based on the operational requirements of pumping infrastructure, start-up water in the Touquoy pit may be supplied from Scraggy lake (subject to provincial permitting) and/or effluent from the effluent treatment plant.

8.5.4.2.2.5 FMS Historic Mining Operations

Historic mining operations in the FMS Study Area resulted in disturbance to the landscape within and surrounding the proposed pit, and deposition of tailings along Seloam Brook. In late 2018, Stantec (Appendix I.3) sampled historic tailings and waste rock from 21 test pits excavated within the FMS Study Area. Possible tailings were visually observed at 9 of the 21 test pits. Analytical results of 22 soil samples were compared to the Tier 1 Environmental Quality Standards (EQS) for an industrial site with non-potable groundwater use and coarse-grained soil. The results indicate that arsenic, lead and mercury are elevated above Tier 1 guidelines. The historic tailings deposits have been identified and assessed, and a Historical Tailings Management Plan (Appendix I.1) has been developed, to reduce impact of tailings mobilization on the downstream receiving environments. Potential cumulative effects of historic mining activity and the proposed Project are expected to be positive, given removal of contaminated tailings.

8.5.4.2.3 *Cumulative Effects on the Surface Water Quality and Quantity*

The use of the Touquoy processing plant and waste disposal systems by the Beaver Dam Mine Project (2023 to 2028), the Project (2024 to 2030), and the Cochrane Hill Gold Project (2024-2029) extends the period in which effects to the surrounding surface water (both Scraggy Lake and the Moose River) may occur by up to 7 years. Water withdrawal from Scraggy Lake will need to be extended for the life of the Beaver Dam, FMS and Cochrane Hill Projects. An extension to the existing approval will be requested by the Proponent. Incremental effects to surface water quantity at Scraggy Lake is not expected, due to the extended withdrawal period and small daily operational water withdrawal needs in comparison to the large size of the lake. Water will also be recycled from the exhausted Touquoy pit when sufficient supply is available. However, with the application of the mitigation measures proposed for the operation of the site for both projects, the residual effects of both projects are predicted to be not significant.

The cumulative effect of the combined projects could mean a reduction in the streamflow from Scraggy Lake to the Fish River system; however, assuming that the rate of withdrawal is consistent with current needs of the project, then it has been shown that the withdrawal from Scraggy Lake is sustainable given the current level of inputs to the watershed. The cumulative effects of the three projects using the Touquoy processing facilities and the Touquoy Gold Project itself are therefore also expected to be not significant. There is some uncertainty as to the effects assessments for these projects. These would be addressed through the monitoring and follow-up programs established for the Project (Section 6.6.9).

No surface water will be discharged from the exhausted Touquoy pit to Moose River until the pit reaches the spillway elevation in Year 14 of the Project. Water withdrawal from Scraggy Lake will require to be extended for an additional four years for processing of FMS concentrate associated with the Project. As the pre-development and post-development catchment areas draining to the ultimate discharge location at Moose River are similar, Moose River is capable of handling the resultant flow. No cumulative effects to surface water quantity in the Moose River are predicted. Modelling for the cumulative scenario (all four projects tailings deposition into the exhausted pit) predict water levels in the pit will reach the spillway elevated in 10 years.

The use of the Touquoy processing plant and waste disposal systems by the proposed extension of the Touquoy pit and deposition of these tailings into the exhausted pit, the Beaver Dam Mine Project, the Project, and the Cochrane Hill Gold Project have been modelled (Appendix I.7) and predict the same conclusions relating to surface water quality in the receiving environments (Moose River) as that described in Section 6.6 for the Project. The potential effects of these projects to surface water quality in the receiving environment will be mitigated by a commitment to treat effluent to MDMER discharge limits and water quality objectives prior to release.

8.5.4.3 Mitigation

The effects of each project with the potential to result in a cumulative effect to surface water all require a suite of mitigation to ensure compliance with MDMER, and water quality objectives. Through monitoring and aquatic effects assessment, there is no expectation that these projects will result in a cumulative adverse effect to fish and aquatic species. As the potential effects are limited to the area surrounding the Project's LAA, no mitigation measures beyond those already presented to mitigate Project effects (Section 6.6.7) are warranted.

8.5.4.4 Residual Cumulative Effects and Significance Assessment

The thresholds for the determination of significant effects to surface water quality and quantity are thoroughly defined in Section 6.6, but it includes a repeated or sustained change in water flows that are beyond the existing natural variability in the LAA (tertiary watersheds). In addition, a repeated or sustained exceedance of MDMER maximum allowable concentration limits for water quality within the LAA. Overall, the residual cumulative effects are considered to be not significant (Table 8.5-4).

Table 8.5-4: Residual Cumulative Environmental Effects for Surface Water

Residual Adverse Cumulative Effects (After Mitigation)	Significance Levels						Overall Significance of Residual Adverse Effects (and Rationale)
	Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility	
Potential for residual cumulative effects to all surface water systems within each RAA (Touquoy Mine Site and FMS Mine Site).	L With mitigation strategies, predicted receiver concentrations are below the water quality guideline, or the 95th percentile baseline concentration for parameters where the baseline is greater than the water quality guideline.	LAA Cumulative effects are confined to the LAA.	A Cumulative effect would be more significant during low flow conditions and/or sensitive spawning windows.	LT Effects may extend beyond 7 years.	R Effects will occur at regular intervals throughout operations.	PR Mitigation cannot guarantee a return to baseline conditions.	Minor Adverse Effect (Not Significant) Given implementation of proposed mitigation methods, no significant adverse cumulative effect is expected.

Legend (refer to Table 5.10-1 for definitions)

Magnitude		Geographic Extent		Timing		Duration		Frequency		Reversibility	
N	Negligible	PA	Project Area	N/A	Not Applicable	ST	Short-Term	O	Once	R	Reversible
L	Low	LAA	Local Assessment Area	A	Applicable	MT	Medium-Term	S	Sporadic	PR	Partially reversible
M	Moderate	RAA	Regional Assessment Area			LT	Long-Term	R	Regular	IR	Irreversible
H	High					P	Permanent	C	Continuous		

8.5.4.5 Follow-up and Monitoring Programs

No additional follow-up or monitoring beyond that presented in Section 6.6.9 is warranted.

8.5.5 Fish and Fish Habitat Cumulative Effects Assessment

8.5.5.1 Baseline conditions

8.5.5.1.1 *Fish Habitat*

<u>FMS Mine Site</u>

Spawning habitat for species known or expected is limited in the FMS Study Area. Physical barriers, pH, dissolved oxygen levels and temperatures were limiting factors to fish habitat quality. Atlantic Salmon access to the FMS Study Area has been limited by installation of hydroelectric dams and increased acidification since the 1920's.

Development of the FMS Pit and associated mine infrastructure will require realignment of Seloam Brook and several smaller tributaries and side channels. A feasibility design for the Seloam Brook Realignment has been completed (Appendix D.4), along with a Seloam Brook Realignment Hydraulic Modelling report (Appendix B.9) which models the predicted downstream effect of the realignment channel on fish and fish habitat. A Fish Habitat Offset Plan: Preliminary Concept Update (Appendix J.7) has been developed to compensate for loss of fish habitat. Site infrastructure has been micro-sited for fish habitat avoidance wherever practicable. A *Fisheries Act* Authorization will be required for the Project.

<u>Touquoy Mine Site</u>

Moose River, which runs along the western extent of the Touquoy Mine Site, was determined to provide habitat for Atlantic salmon and brook trout during surveys conducted in 2005 as part of the Environmental Assessment (CRA, 2007a). Atlantic salmon (juveniles) were observed and suitable rearing and potential spawning habitat is available for the species. It was presumed that the Atlantic salmon observed were landlocked due to their proximity to a known landlocked population within Scraggy Lake. American Eel, White Sucker, and various forage fish species were also observed in Moose River. Although not observed, surveys determined that there is good adult and juvenile Brook Trout feeding habitat, fair rearing habitat, and potential spawning habitat available within Moose River (CRA, 2007a).

8.5.5.1.2 *Fish Species*

<u>FMS Mine Site</u>

Fish surveys were completed throughout the FMS Study Area using a variety of methods selected based on site-specific conditions. Methods employed include electrofishing, minnow traps, eel pots and fyke nets. All fish surveys resulted in identification of 116 individual fish, representing 8 species. Species identified were (in decreasing order of abundance): White Sucker, Lake Chub, Brook Trout, Ninespine Stickleback, Golden Shiner, Brown Bullhead, Banded Killifish and Pearl Dace.

Within the FMS Study Area, two priority species of fish were identified: brook trout and pearl dace (both ranked S3 by the ACCDC). No fish SAR were identified during any fish surveys completed in the FMS Study Area.

<u>Touquoy Mine Site</u>

Fish observed from 2006 electrofishing surveys of Moose River as part of the EARD include; American Eel, White Sucker, and various forage fish (CRA 2007a). Further aquatic baseline studies completed by Stantec Consulting Ltd. In 2017 and 2018 confirmed presence of alewife, American eel, Atlantic salmon, banded killifish, brown bullhead, brook trout, golden shiner, lake chub, lake trout, white perch, white sucker and yellow perch.

8.5.5.2 Analysis of Effects

8.5.5.2.1 *Residual Effects of Proposed Project*

The development of the proposed open pit within the FMS Mine Site will require dewatering a 1km long braided section of Seloam Brook below the outlet of Seloam Lake. The Proponent will construct open pit perimeter berms on the upstream and downstream sides of the open pit to deflect flow away from the pit. Flow from Seloam Brook and its smaller tributaries will be diverted to a realignment channel located on the north side of the open pit, as described in Appendix D.4, Appendix J.5 and Appendix J.7).

The impacted area includes multiple braided channels of Seloam Brook, open water ponds, small tributaries and wetlands. While these aquatic habitats are inhabited by fish, as described in this baseline conditions section, the quality of the habitat is suboptimal, partially attributed to historic mining activities, and general watershed condition (low pH and historic-current operation of the East River Sheet Harbour Hydroelectric System/barriers to fish movement). The pit development and associated fish habitat loss is considered an unavoidable impact of the Project development. The development of site infrastructure, primarily the pit is anticipated to result in a total direct impact area of 8.05 ha of fish habitat. Mortality is anticipated to be low, given the implementation of appropriate mitigation measures, such as a fish rescue prior to the completion of the Seloam Brook Realignment. The Seloam Brook Realignment and enhancement of downstream habitat for fish, is considered mitigation for lost fish and fish habitat as a result of the pit development (Appendix J.5 and Appendix J.7).

Development of the Project may result in a high magnitude of reduced flow in two local catchment areas. The potential indirect loss of fish habitat associated with flow reductions in East Brook and WC2 could result in an additional indirect impact. Indirect impacts are also anticipated downstream of the realignment channel due to locally increased velocity and resultant erosion and sedimentation, with consideration to mitigation proposed (water control structures downstream of the realignment channel). The total expected indirect impacts to fish and fish habitat is expected to be 1.28 ha. Direct and potential indirect impacts to fish habitat are expected to require HADD authorization under the *Fisheries Act*, and both are incorporated into the Fish Habitat Offset Plan (Appendix J.7).

Effects of the Project related to the release of effluent to Anti Dam flowage are described in detail in Section 6.6. During the operations phase, surplus water from the TMF pond will be discharged to the environment (at Anti-Dam Flowage). During the post-closure stage of the closure phase, surplus water from the flooded open pit will be discharged to the environment (at Anti-Dam Flowage until such time that water quality allow for direct passive release from the pit to Seloam Brook). Effluent will be treated at the PAG portion of the WRSA, if required, prior to mixing in the pit, such that concentrations meet federal and provincial requirements and regulations. The resultant discharge through the Anti Dam Flowage generally increases, indicating the mine water management and discharge from the FMS Study Area has a greater influence on this system than the overall Project footprint change. The predicted flow increases in the Anti Dam Flowage, approximately 7,000 m^3/day on an average annual basis, are generally within the simulated existing conditions range. The exception to this is during April, when discharge increases by approximately 27,400 m^3/day, or about 3%. This corresponds to a low magnitude classification, and therefore is not likely to cause significant adverse effect.

At the reclamation stage of the Closure Phase, effluent discharge from the Project site is not discharged to Anti Dam Flowage. Consequently, flow through the reservoir decreases relative to existing conditions and operations phase. The lowest simulated discharge in existing conditions was predicted in August (95,200 m^3/day); this was predicted to decrease to 94,600 m^3/day during the reclamation stage (less than 1% change). This was a Low magnitude predicted change and therefore is not likely to cause significant adverse effect.

Under the Post Closure scenario, predicted annual water concentrations for the baseline + future scenario were consistently below selected water quality guidelines or benchmarks. As discussed previously, baseline arsenic concentrations at SW5 are elevated, which could be related to the presence of historical gold mine tailings in this area. However, predicted arsenic concentrations at SW5 are below the 75th percentile of baseline and the lowest measured toxicity value within the SSD calculation of the SSWQO, and therefore adverse effects to aquatic life are not anticipated. Additional modelling was also conducted on a monthly basis for the Post Closure scenario. Using upper case source terms, the predicted 95th percentile guideline exceedances are expected for cadmium (May, October and November at EMX-2), cobalt (January, February, April, May, October, November and December at EMZ-2 and October and November at SW6), and zinc (November at EMZ-2). However, based on further investigation, adverse effects to aquatic life are not anticipated from the predicted concentrations, as these predictions are based on an upper bound scenario, which would only result in the instance that low flow precipitation events occur in conjunction with upper bound source term conditions, which is unlikely. Note that source terms will continue to be developed and revised, as well as water quality modelling, and it is likely that these exceedances predicted during the post closure stage will reduce as refined modelling inputs become available.

The Project activities during the post-closure stage of the Closure Phase are not likely to cause significant adverse effects to surface water quality when mitigation measures are taken into account. Significant residual effects based on discharge of effluent to water quality and quantity in Anti Dam flowage are not anticipated during any phase of the Project. As such, the likelihood of cumulative effects to water quantity and quality here are low.

Changes to the Touquoy Mine Site as a result of the Project are anticipated to be minimal. Only minor changes to the existing processing facility at the Touquoy Mine Site will be required, including the addition of concentrate storage and the addition of a second gravity concentrate leach reactor and a gravity electrowinning cell. These changes can be accommodated within the existing facility footprint; as such, no additional direct impacts to fish or fish habitat from the Touquoy Mine Site from processing are anticipated.

There will be tailings deposition into the mined out Touquoy pit as a result of processing concentrate from the Project. Source terms from FMS tailings supernatant has been used to update the Touquoy water quality model to predict potential changes in water quality in the Touquoy open pit as a result of the addition of tailings from processing of FMS concentrate at the Touquoy mine. All other aspects of the Touquoy mine will remain the same as previously assessed including the disturbed footprint, tailings management aspects, and the size and locations of stockpiles.

The Project has potential effects on water quality in Moose River due to discharge of treated effluent into Moose River, which are described in detail in Section 6.6.8.4.3. During operations, concentrations of arsenic, cobalt, copper and nitrite in groundwater were predicted in the model above the CCME FAL (Freshwater Aquatic Life guidelines) or NSE EQS (Nova Scotia Environment Environmental Quality Standards 2018) in the untreated pit water at discharge. Based on the assimilative capacity model in Moose River these parameters meet CCME FAL/NSE EQS after mixing with Moose River 100 m downstream of the discharge point.

The water quality discharged from the pit to Moose River will be treated to meet MDMER discharge/regulatory closure criteria or site-specific guidelines (arsenic and ammonia), if required. Without treatment, arsenic concentrations of 0.363 mg/L are predicted to slightly exceed the MDMER discharge criteria of 0.3 mg/L in Year 14 based on climate normal conditions. Therefore, arsenic concentrations in the discharge to Moose River are predicted to be 0.3 mg/L (post treatment). Once mixed with the background water quality in Moose River, the concentration 100 m downstream of SW-2 is predicted to be 0.024 mg/L for arsenic and 0.184 mg/L for aluminum. Although this arsenic concentration is above the NSE Tier 1 and CCME guidelines of 0.005 mg/L, the background levels at SW-2 also exceed the guidelines at 0.018 mg/L. Based on the CCME guideline (2001 as referenced in Appendix C.2), the arsenic concentration is below the reported lowest toxic levels for fish, algae and aquatic plants.

If required during the Closure Phase, the water level in the Touquoy pit will be maintained through pumping to a water treatment plant at or beneath the permeable bedrock layer at 104 m elev. until water quality improves to meet discharge criteria. As the pit water is planned to be treated to MDMER and any regulatory closure criteria or site-specific guidelines prior to discharge, the magnitude of the effect is expected to be negligible on Moose River quality and downstream tributaries. Discharge and seepage flow from the pit to Moose River during closure will be permanent and will occur regularly based on climate conditions. The change on water quality of Moose River will be irreversible. The environmental effect is considered not significant after mitigation measures have been implemented.

8.5.5.2.2 *Effects of Other Projects in the Area*

The RAA for fish and fish habitat, and projects which fall within this RAA are shown on Figure 8.5-4. There is direct spatial overlap between the Project and historic mining operations in the FMS Study Area and the Touquoy Mine Site. Any potential cumulative effects from these projects related to surface water would be based on potential impacts to water quality from mobilization of historic tailings. The potential impact of this interaction will be mitigated by implementation of a Historical Tailings Management Plan (Appendix I.1). As such, these historic operations are not carried through the CEA process.

8.5.5.2.2.1 Regional Forestry Operations

Forestry operations have been ongoing through the region for many decades. As such, the effects of these operations are included in the baseline conditions. Forestry operators are obliged to follow provincial *Wildlife Habitat and Watercourse Protection* regulations, which provide restrictions to timber harvesting with the purpose of protecting wildlife habitat and water quality. Presuming forestry operators adhere to these regulations, the potential for cumulative impacts occurring where the Project and forestry operations overlap is minimal.

8.5.5.2.2.2 East River Sheet Harbour Hydro System

The East River Hydro System operation overlaps both spatially and temporally with the RAA for surface water surrounding the FMS Study Area. According to the NSPI relicensing report (2009), hydro power generation commenced in the East River Sheet Harbour in the 1920's, however saw mills have been in place to support timber harvesting since the 1820's. The two most proximal hydro power dams to the FMS Mine Site are located at Seloam Lake and Anti-dam Flowage outflows. Three additional hydro power dams are present downstream of the FMS Study Area, at Marshall Falls, Malay Falls, and Ruth Falls, all within the SW RAA.

The series of dams constructed and operated between the mouth of the East River Sheet Harbour and the FMS Study Area has limited fish passage through the East River system for decades. This is clearly documented in the NSPI relicensing report (2009). While the operation of the hydro system is anthropogenic in nature, it is considered as baseline conditions in the FMS Study Area, and the historic impacts are incorporated into the discussion of fish populations and fish habitat quality. The operation of hydro power infrastructure spans decades and has limited upstream and downstream passage of fish. Combined with low pH values, fish productivity within the East River Sheet Harbour is poor.

The proposed Project could potentially result in an additive cumulative effect to fish and fish habitat, however a few key considerations must be made. Residual impacts to fish and fish habitat that could result from the Project would occur in a system which has degraded productivity due to natural and anthropogenic stressors. For instance, historic tailings are currently present within the FMS Study Area, which will be removed prior to commencement of the operational phase, effectively removing a stressor to water quality. Furthermore, fish habitat loss proposed within the FMS Study Area will be mitigated and appropriate compensation will be applied. Preliminary offsetting plans involve loss of low to medium quality habitat, with construction of high-quality habitat within the FMS Study Area. Historic anthropogenic disturbances in this system will be re-naturalized in the new Seloam Brook Realignment (see Appendix J.7). Given the appropriate mitigation and compensation measures are followed, significant cumulative effects are not anticipated, especially given the ecological context of this VC.

8.5.5.2.2.3 Touquoy Gold Project, Beaver Dam Mine Project and Cochrane Hill Gold Project- deposition of tailings in Touquoy exhausted pit

The deposition of tailings from the Project, the proposed use of the exhausted pit for Touquoy tailings deposition, the Beaver Dam Mine Project and the Cochrane Hill Gold Project at the Touquoy Mine Site has potential to affect water quality in the receiving environment (Moose River), and ultimately the fish and other aquatic organisms which inhabit it. The effect of tailings deposition on surface water quality in the receiving environment is described in Section 6.6, and the potential cumulative effect thereof is discussed in Section 8.5.4 and Appendices C.2, I.5 and I.7. Overall, the residual effect of tailings deposition in the Touquoy Pit, and the potential cumulative effect is expected to be minimal, considering that treatment to meet MDMER and water quality objectives will be implemented where necessary.

8.5.5.2.2.4 FMS Historic Mining Operations

Historic mining operations in the FMS Study Area resulted in disturbance to the landscape within and surrounding the proposed Pit, and deposition of tailings along Seloam Brook. In late 2018, Stantec (Appendix I.3) sampled historic tailings and waste rock from 21 test pits excavated within the FMS Study Area. Possible tailings were visually observed at 9 of the 21 test pits. Analytical results of 22 soil samples were compared to the Tier 1 Environmental Quality Standards (EQS) for an industrial site with non-potable groundwater use and coarse-grained soil. The results indicate that arsenic, lead and mercury are elevated above Tier 1 guidelines. The historic tailings deposits have been identified and assessed, and a Historical Tailings Management Plan (Appendix I.1) has been developed, to reduce impact of tailings mobilization on the downstream receiving environments. Potential cumulative effects of historic mining activity and the proposed Project are expected to be positive, given removal of contaminated tailings.

8.5.5.2.3 *Cumulative Effects on the Fish and Fish Habitat*

Residual effects on fish and fish habitat within the FMS Study Area are primarily related to loss of fish habitat from the development of the pit and other infrastructure. The key mitigation measures associated with this loss of fish habitat involve the Seloam Brook Realignment, and associated downstream enhancement of fish habitat, and fish rescue. Fish habitat offsetting is proposed (Appendix J.7).

The deposition of tailings from the Beaver Dam Mine Project, Touquoy Gold Project and the Cochrane Hill Gold Project in the Touquoy pit overlap the current Project both spatially and temporally. As discussed, with appropriate mitigation to ensure compliance with MDMER criteria and water quality objectives, the potential for residual cumulative effect on fish and fish habitat is expected to be minimal. The remediation of historic tailings present in the FMS Study Area is anticipated to result in a positive residual impact to water quality, sediment quality, and ultimate fish habitat quality. Any potential residual impacts on fish associated with the East River Sheet Harbour Hydro Power project are accounted for in baseline conditions of fish communities. There is some uncertainty as to the Project effects on fish and fish habitat. This uncertainty is addressed through the monitoring and follow-up programs established for the Project (Section 6.8.9). No significant cumulative effects on fish habitat beyond the effects assessed for the Project are anticipated.

8.5.5.3 Mitigation

No mitigation measures beyond those proposed in Section 6.8.7 are warranted.

8.5.5.4 Residual Cumulative Effects and Significance Assessment

A significant adverse effect from the Project on fish and fish habitat is defined as an effect that results in an unmitigated or uncompensated net loss of fish habitat as defined under the *Fisheries Act*, and its associated no-net loss policy. A significant adverse effect on fish and fish habitat would also result from a discharge of deleterious substance into fish habitat that is not authorized through the MDMER, and which could result in a violation of the *Fisheries Act.* For fish populations, a significant adverse effect would result from a Project-related destruction of fish that was not authorized under Section 35 of the *Fisheries Act.*

The predicted residual cumulative effects on fish and fish habitat are assessed to be adverse, but not significant (Table 8.5-5).

8.5.5.5 Follow-up and Monitoring Programs

No additional follow-up or monitoring beyond that presented in Section 6.8.9 is warranted.

Table 8.5-5: Residual Cumulative Environmental Effects for Fish and Fish Habitat

Residual Adverse Cumulative Effects (After Mitigation)	Significance Levels						Overall Significance of Residual Adverse Effects (and Rationale)
	Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility	
Cumulative disturbance to fish and fish habitat within each RAA (Touquoy Mine Site and FMS Mine Site).	M Differing from the existing environment/ baseline conditions and natural variation, and marginally exceeding a guideline or threshold value	LAA Potential adverse cumulative effect to fish habitat outside of the PA.	A Cumulative effect would be more significant during sensitive spawning windows.	LT Effects may extend beyond 7 years.	R Effects will occur at regular intervals throughout operations.	R VC will recover to baseline conditions upon the completion wetland restoration.	Moderate Adverse Effect (Not Significant) Fish habitat offsetting is anticipated to compensate for lost fish habitat from the Project itself. No other pathway for residual effects from surrounding projects has been identified.

Legend (refer to Table 5.10-1 for definitions)

Magnitude		Geographic Extent		Timing		Duration		Frequency		Reversibility	
N	Negligible	PA	Project Area	N/A	Not Applicable	ST	Short-Term	O	Once	R	Reversible
L	Low	LAA	Local Assessment Area	A	Applicable	MT	Medium-Term	S	Sporadic	PR	Partially reversible
M	Moderate	RAA	Regional Assessment Area			LT	Long-Term	R	Regular	IR	Irreversible
H	High					P	Permanent	C	Continuous		

8.5.6 Species of Conservation Interest and Species at Risk Cumulative Effects Assessment

8.5.6.1 Baseline conditions

8.5.6.1.1 *Priority Fish Species*

Within the FMS Study Area, two priority species (brook trout and pearl dace) were identified during electrofishing and fish collection. Habitat provision for other priority fish species is limited by historic installation and current operation of a series of hydroelectric dams along the East River Sheet Harbour system. The two dams in closest proximity to the FMS Study Area are at Anti Dam Flowage (downstream) and at the outlet of Seloam Lake (upstream). Water temperature, pH and dissolved oxygen also present limiting factors on fish habitat quality.

Moose River, within the Touquoy Mine Site, provides habitat for Atlantic salmon and brook trout. Good juvenile and rearing habitat and potential spawning habitat is available for Atlantic salmon. Several juvenile Atlantic salmon were observed, however, these species were believed to be from the landlocked population known to Scraggy Lake. Good adult and juvenile brook trout feeding habitat, fair rearing habitat, and potential spawning habitat is available within Moose River (CRA 2007a).

The Nova Scotia Department of Agriculture and Fisheries conducted a fisheries resource study in Scraggy Lake in July of 1975. Fish captured included; brook trout and American eel. Atlantic salmon smolts were recorded during creel census in 1979. Fingerling landlocked Atlantic salmon and brook trout were stocked in Scraggy Lake between 1998-2000 and 1994-1996, respectively (CRA 2007a). Additional fish community and fish habitat assessments were completed under the EEM to support MDMER regulations under the *Fisheries Act*. These baseline aquatic environment surveys were completed by Stantec Consulting Ltd. in 2017 and 2018. According to the 2017 report, fish surveys completed in Scraggy Lake identified a total of 1,091 individual fish, representing 12 species of fish. Priority species observed include American eel, Atlantic salmon, brook trout, and lake trout.

8.5.6.1.2 *Priority Vascular Flora and Lichens*

8.5.6.1.2.1 Priority Vascular Flora Species

During field assessments throughout the FMS Study Area, a total of 277 species of vascular flora have been identified within the FMS Study Area. No SAR vascular flora species were identified within the FMS Study Area. Of the 277 species identified, three are considered Priority Species: Southern twayblade (*Neottia bifolia* syn. *Listera australis*); silvery flowered sedge (*Carex argyrantha*), and Wiegand's sedge (*Carex wiegandii*).

The silvery flowered sedge was identified in one location within the FMS Study Area. In Nova Scotia, silvery flowered sedge is considered Apparently Secure/Vulnerable by the ACCDC (S3S4). One clump of the silvery flowered sedge was found south of WL211 in upland habitat on a side of a road.

Wiegand's sedge was identified in one location within the FMS Study Area. Wiegand's sedge was observed in a large bog (Wetland 27) with peat accumulations of over 40 cm. In Nova Scotia, Wiegand's sedge is considered vulnerable by ACCDC (S3). Wiegand's sedge grows in clumps or clusters of many individual plants. One observation of C*. wiegandii* was observed and the population consisted of 1 clump, approximately 1m^2 in size.

Southern Twayblade is a small inconspicuous member of the orchid family (Orchidaceae), characterized by its reddish snake-tongue-like labellum, opposite ovate-oblong basal leaves and scape lacking cauline leaves. This species belongs to the unique Atlantic Coastal Plain Flora community with an affinity for peatlands such as bogs, fens and swamps which usually contain variable microtopography and microhabitats. Often this species is found on the toe of hummocks. Six observations, with a total of 13 individuals were observed within Wetlands 1, 18, 40, 64 and 180. Its distribution is scattered throughout Nova Scotia and is considered vulnerable by the ACCDC (S3).

Surveys of the Touquoy site did not detect any plant species of special status within surveyed area (CRA 2007a). During follow-up evaluation for wetland alteration permitting in 2015, a single black ash (NSESA Threatened) was identified in Wetland 2, within the (at the time) proposed TMF. Through consultation with NSE and the Mi'kmaq of Nova Scotia, this tree was harvested prior to construction of the TMF. No other Priority species of vascular flora were identified in the Touquoy Study Area.

8.5.6.1.2.2 Priority Lichen Species

In total, nine priority lichen species were observed during lichen surveys (one SAR and eight SOCI) within the FMS Study Area. Although BFL predictive habitat polygons were present within the FMS Study Area, due to the amount of fragmentation, lack of indicator species and lack of continuous mature balsam fir swamps, BFL habitat suitability was determined to be poor.

Within the FMS Study Area, direct loss to populations of eastern candlewax lichen, corrugated shingles lichen and fringe lichen are expected due to the placement of the infrastructure. A translocation plan is proposed for the Blue Felt Lichen. The locations of all the priority lichen species documented within the FMS Study Area are provided in Figure 6.9-2.

Lichen surveys conducted in the Touquoy Mine Site in 2004 and 2005 as part of the EARD process found the presence of blue felt lichen (*Pectenia plumbea* syn. *Degelia plumbea*). An additional lichen survey in 2007 found seven additional SOCI including; salted shell lichen (*Coccocarpia palmicola*), corrugated shingles lichen (*Fuscopannaria ahlneri*), powdered fringe lichen (*Heterodermia speciosa*), blistered jellyskin lichen (*Leptogium corticola*), blue-gray moss shingle lichen (*Moelleropsis nebulosa*), naked kidney lichen (*Nephroma bellum*), and peppered moon lichen (*Sticta fuliginosa*) (CRA 2007a). These lichens were observed in the northern, southern and south eastern portions of the Project Area. Both locations of blue felt lichen have not been directly impacted by infrastructure from the Touquoy Project, however, direct impacts to corrugated shingles lichen and blue-gray moss shingle lichen have occurred.

8.5.6.1.3 *Priority Terrestrial Fauna*

8.5.6.1.3.1 Priority Mammal Species

Through all targeted surveys and incidental observations, evidence of a single mammalian priority species was observed. Twenty-eight observations (4 track observations; 24 observations were pellets) of mainland moose were documented within, and adjacent to the FMS Study Area through baseline environmental work completed in 2017 and 2018.

Seventy-seven AMOs within the FMS Study Area were assessed to determine suitability for bat hibernacula. Of the AMOs assessed, all were either in-filled, blocked with a concrete cap or flooded. No bat hibernacula or bats were observed during the assessments and according to the ACCDC report, no bat hibernacula is present within 5 km of the FMS Study Area. Foraging habitat and food sources for bats is abundant in the FMS Study Area, while roosting and maternal roosting habitat (over-mature cavity trees) are relatively scarce. No bats, or evidence thereof, were observed incidentally during biophysical surveys, particularly bird surveys which are conducted when bats are more active.

Mainland moose tracks were observed within the Touquoy Mine Site in a bog during field surveys to support the Touquoy Gold Project EARD in 2006. Moose are known to the Tangier Grand Lake Wilderness Area, and evidence of moose is reported every year by NSL&F in the Moose River Gold Mines area during deer pellet surveys (CRA, 2007a).

In addition to the information above, a Post-Construction Moose Monitoring Program for Mainland Moose has been underway in lands surrounding the Touquoy Mine Site during winter and spring in 2017 and 2018. Surveys are ongoing throughout 2019 and include a combination of winter tracking surveys and spring pellet group inventory surveys. Surveys are completed on foot along transects surrounding the Touquoy Mine Site throughout a diversity of habitat types. During surveys, moose observations are recorded including a description of moose sign observed, a GPS location and a microhabitat assessment. To date, three observations of Mainland Moose Sign (scat and tracks) were documented during 2017, and two sightings of moose were encountered during 2018 surveys. 2019 surveys are ongoing. Annual reports have been provided to NSL&F as per the Touquoy Gold Project IA conditions.

No suitable bat hibernacula were found within the Touquoy Mine Site during environmental screening to support the Touquoy Gold Project EA (CRA, 2007a).

8.5.6.1.3.2 Priority Herpetofauna Species

Targeted surveys for wood turtles within the FMS Study Area did not reveal any sightings of wood turtles, however, several potential suitable habitats for nesting and overwintering were observed within Seloam Brook. No opportunistic observations of wood turtles were documented during any wetland or watercourse surveys throughout the entirety of the FMS Study Area.

No snapping turtles were observed during the opportunistic surveys which were concurrent with the fish surveys and wetland and watercourse evaluations. However, areas within Seloam Brook and its' tributaries provide the appropriate water depths (greater than 1 m) and substrate for nesting and overwintering habitat.

No wood turtle or suitable habitat were observed within the Touquoy Mine Site during Wood Turtle habitat surveys conducted in 2004 (CRA 2007a). No snapping turtles were recorded within the Touquoy Mine Site during the EARD process. A WMMP was implemented upon commencement of operations of the Touquoy Mine Site. Under this Plan, wildlife sightings, particularly turtles, were reported to the site Environmental Technicians. Between 19 June 2017 and 27 June 2018, nine observations of snapping turtles were recorded by Atlantic Gold staff and contractors at various locations throughout the Touquoy Project Area, typically in close proximity to the Moose River.

8.5.6.1.3.3 Priority Invertebrates

Surveys for benthic invertebrates were completed as part of the fish habitat assessment. No priority invertebrate species were identified through sampling for benthic invertebrates. No observations of priority odonates were recorded within the vicinity of the FMS Study Area by Odonata Central. No other targeted surveys were completed for invertebrates and no opportunistic observations of priority invertebrate species were recorded. No other priority invertebrate species were identified during the desktop review or field surveys.

Aquatic benthic invertebrates were surveyed during the aquatic surveys. No priority invertebrate (terrestrial and aquatic) species were observed within the Touquoy Mine Site during environmental screening to support the Touquoy Environmental Assessment (CRA, 2007).

8.5.6.1.4 *Priority Avifauna*

Across all survey seasons completed within the FMS Study Area, a total of 22 priority species were observed either during dedicated survey periods or incidentally. All avifauna SAR observed were as expected based on habitat and geographic range. The presence of wetlands, forested uplands, watercourses, clearings and fragmented habitats (resulting in edge habitats) provided suitable habitat for many of the priority bird species in Nova Scotia.

During all breeding bird surveys, evidence of breeding behavior was recorded for all species, with particular attention towards SAR and SOCI. Breeding evidence was recorded in accordance with guidance provided by Bird Studies Canada (2016), which defines behavior in terms of possible, probable, and confirmed breeders. Any species observed during breeding season singing in suitable habitat is identified as a possible breeder. Signs of probable breeding observed are agitation and established territories. Evidence of confirmed breeders observed includes distraction displays, feeding young or carrying food, nests with young, or recently fledged young. Two SAR are identified as possible breeders (evening grosbeak and common nighthawk), and two as probable (Canada warbler and olive-sided flycatcher) were documented. Six SOCI are identified as possible breeders, while nine show evidence of probable breeding.

The 2005 breeding bird surveys of the Touquoy Mine Site found ten priority species. They are as follows; pine grosbeak, willow flycatcher, yellow-bellied flycatcher, barn swallow, boreal chickadee, ruby-crowned kinglet, rusty blackbird, bay-breasted warbler, Swainson's thrush, and pine siskin.

8.5.6.2 Analysis of Effects

8.5.6.2.1 *Residual Effects of Proposed Project*

8.5.6.2.1.1 Priority Fish Species

The geographic extent, timing, duration, frequency, and reversibility of direct impacts to priority fish species remains the same as is with non-priority specific fish and fish habitat, however, the magnitude of impact increases. Direct fish habitat alteration includes work associated with the development of the pit and other infrastructure. These impacts, and additional indirect impacts of the Project will trigger a Fisheries Act Authorization. Mitigation (Seloam Brook Realignment and downstream enhancement of fish habitat) and offsetting are proposed (Appendix J.7). Alterations which have the potential to directly impact priority fish will occur during the construction phase within the FMS Mine Site. Given the limitations to fish passage by the network of hydroelectric dams along the East River Sheet Harbour, and the fish habitat offsetting plan to be implemented on site, Project activities are not expected to result in significant adverse effect to fish and fish habitat in general, or specifically to priority fish species, with appropriate offsetting in place. The development of the pit will result in loss of low to moderate quality fish habitat for brook trout, but fish mitigation and offsetting measures will establish new moderate to high quality habitat for this species within the Seloam Brook Realignment, downstream of the realignment, and within the FMS Mine Site, and work to improve water quality in the system through remediation of historical tailings and waste rock, as required.

Alterations will occur to several watercourses and wetlands. Wetland habitat which is accessible to fish is directly accounted for in the offsetting plan. Continued wetland and surface water monitoring will be conducted to monitor direct fish habitat alterations. No direct impact to fish habitat will occur at the Touquoy Mine Site from project activities during construction, operation or closure.

Similar to the direct impacts to priority fish habitat, the significance criteria for residual environmental effects in relation to indirect impacts to priority fish species remains the same as is with non-priority specific fish and fish habitat, except for an increase in magnitude of impact. Indirect fish habitat alteration includes potential changes to water quality, sedimentation, and changes to watercourse hydrology at the FMS Mine Site, and temporal extensions to impacts at the Touquoy Mine Site. Downstream water quantity/quality is unlikely to be affected at the Touquoy Mine Site from an additional discharge location into the Moose River once the exhausted pit at Touquoy is filled with water (and tailings from the Project).

Groundwater seepages from the FMS Mine Site is not predicted to affect water quantity or quality within downstream receiving environments. Water treatment is not anticipated to be required during the operational phase of the Project, but will be available if required based on monitoring results. Wetland and surface water monitoring will be conducted to monitor potential indirect fish habitat alterations. Water quality sampling will be completed prior to release to the receiving environment at the FMS Mine Site and Touquoy Mine Site during the operational phase of the Project, and water will not be released until such time its quality meets regulatory requirements. During the post-closure stage of the closure phase, modelling is predicting elevated concentrations of cobalt, cadmium, zinc and iron (during low flow periods and using upper case source terms) at the FMS Mine Site. Intrinsik (2019) concluded that these concentrations pose a low risk to the ecological environment. Water treatment will be available if required during post-closure and has been conceptually designed to treat discharge from the PAG portion of the WRSA prior to discharge into the pit. Modelling has also predicted that water treatment may be required at the Touqouy Mine Site from the exhausted pit discharge into the Moose

River, once the pit is filled with tailings and covered in water. Water treatment will be available and completed, as required, prior to discharge to the receiving environments (Anti-Dam Flowage at FMS Mine Site, and the Moose River at Touquoy Mine Site) until such time that it is no longer required to meet regulatory requirements.

Water quality of the discharge, with necessary treatment, into Anti-Dam Flowage and the Moose River will meet regulatory requirements during operations and during post-closure stage of closure. As a result, significant indirect impacts to fish and fish habitat from the Project are not predicted. Indirect alterations have a larger geographic extent, across the LAA, because sediment or water with changed water quality released from site can migrate to downstream receiving surface water systems outside of the PA. The magnitude of potential impacts to priority fish species is determined to be low.

8.5.6.2.1.2 Priority Vascular Flora and Lichens

Clearing and grubbing will occur during the construction phase of the Project and is limited to the FMS Mine Site where infrastructure is proposed. No additional clearing and grubbing are required at Touquoy Mine Site to support the Project. Clearing and grubbing requires full vegetative removal which will directly affect vascular and non-vascular individuals, and to flora communities at the full or partial forest stand level.

Heavy machinery operation and vehicle activity will occur within the FMS Mine Site during the construction phase and throughout the PA during the operation and closure phases. Both heavy machinery operation and vehicle activity can cause impacts to vascular and non-vascular flora from dust, erosion, and accidents (e.g., spills). Sediment and erosion control, spill preparedness, emergency response measures, and best management practices will minimize the likelihood of a broader indirect impact to habitat and flora, deeming the magnitude for residual environmental effects as low.

8.5.6.2.1.3 Priority Terrestrial Fauna

Clearing and grubbing is limited to the FMS Mine Site during the construction phase. Clearing and grubbing are not required at the Touquoy Mine Site. Clearing and grubbing will result in habitat loss for priority fauna. Best management practices will be used to limit unnecessary loss of habitat, and infrastructure layout has been planned to limit unnecessary clearing and grubbing. Grubbed material will be stockpiled and used for remedial efforts during the closure phase of the Project. Clearing and grubbing is expected to have a low magnitude of impact on priority fauna. This is based on the lack of direct impact to Fauna SAR and the recognition that the loss of habitat within the PA is expected to be temporary in nature (considering reclamation of habitat following operations). Clearing and grubbing will reduce cover for priority turtle species (e.g., snapping turtle), indirectly affect water quality, and can isolate populations (ECCC 2016c), Regarding Mainland Moose, it is documented that habitat loss and fragmentation caused by clearing and grubbing interferes with the long-term population viability and is a serious threat to the species (NSDNR 2007).

The RAA is generally remote, with a moderate network of roads and forestry activity, though large tracts of forest landscape undisturbed by roads still exist in this region (NSDNR 2015b). A total of 56,573 ha of predicted interior forest has been identified within the RAA. The maximum Project edge effect as discussed in Section 6.9.5.2, will affect 275 ha of interior forest habitat, which accounts for 0.49% of predicted interior forest in the RAA.

Project activities are expected to result in increased habitat fragmentation and a decrease in habitat quality for those species which rely especially on interior forest conditions. This decrease in habitat quality for species relying on interior forest condition is based on increased activity and sensory disturbance, along with increased physical fragmentation. Increase in physical fragmentation is expected to be low, based on the current high level of disturbed habitat and the limited Project edge effect impact to predicted interior forest patches. Moose tend to stick close to areas of protection and do not move more than 80 to 200 m from cover avoiding large open areas (Eastman 1974, Hamilton et al. 1980, Tomm and Beck 1981, Peek et al. 1987, Jackson et al. 1991, Thompson et al. 1995 as cited in Snaith, Beazley, MacKinnon and Duinker 2002). Undisturbed, unfragmented habitat is present in the RAA, and the larger tracts are maintained around the FMS Mine Site, particularly on the south and eastern side. The FMS infrastructure footprint is situated primarily on an area of high existing disturbance and will only have fringe effects on the interior forest availability. There will be some limited isolation of habitat that is currently contiguous limiting some movement to this area particularly in the area between Seloam Lake and the TMF. However, broadly speaking, accessible routes to provide movement through and across the larger region at the LAA and RAA level still exist for wildlife and are un-impacted by the development of the Project.

Vehicle and haul truck activity will occur throughout the PA during the construction, operation, and closure phases. Vehicle and haul truck activity can cause impacts to priority fauna from wildlife vehicle collisions, dust, noise, and accidents (e.g., spills). Wildlife vehicle collisions can directly affect priority fauna and noise can indirectly affect priority fauna by encouraging avoidance behaviour. Mitigation measures such as spill preparedness, emergency response measures, and best management practices (e.g., noise/dust control, speed limits) will minimize the likelihood of a negative impact.

Blasting and drilling of in-situ rock is expected to occur weekly at the FMS Mine Site during the operational phase of the Project. Blasting could negatively affect priority fauna from the noise associated with the specific blasting activity, as well as broader mining construction and operational noise. For example, a noise disturbance can cause flight behaviour in all terrestrial fauna but the impact to the energy balance of a mainland moose may have more severe consequences compared to a non-priority fauna species because stress on an already endangered (NSESA) population may impede its biological success in turn having a greater impact on the species.

The Environment Code of Practice for Metal Mines (EC, 2012c) has established parameters for ambient noise levels for wildlife. These parameters indicate that ambient noise observed above 55 dBA during the day and 45 dBA at night can affect wildlife in a number of ways. Noise can simply act as a sensory disturbance resulting in avoidance. Noise can affect communication between individuals, including mating calls and alarm calls. Additionally, a literature review conducted by Shannon et al. (2016) found that an increase in stress and decrease in reproductive success in terrestrial mammals has the potential to occur at noise levels ranging from 52 to 68 dBA, levels higher than those cited by Environment Canada (2012c). According to the results of the Noise Impact Study for the Project (Appendix J.1), noise measured at 45 dBA is predicted to travel from the proposed property boundaries at the FMS Mine Site to an approximate range of 1-1.5km. Terrestrial fauna within these maximum approximate ranges of noise distribution surrounding the FMS Study Area have the potential to result in localized avoidance due to noise during the day and overnight.

Light propagation from the Project has been determined to extend between 0 and 2 km from the FMS proposed property boundary. Light modelling has not been completed at the Touquoy Mine Site specifically for the addition of FMS tailings but was modelled for the Touquoy Project. The primary effect of the continued use of the Touquoy Mine Site is the continued lighting of facilities and vehicular traffic during the processing of FMS concentrate. There are no new or additional effects from light anticipated to be caused by the processing of concentrate and the management of tailings from the Project, with the exception of temporal increase of the life span of the Touquoy Mine Site.

While research is limited and often species specific, in general, the plausible effects of artificial lighting on mammals (especially nocturnal mammals) may include disruption of foraging behavior, increased risk of predation, disruption of biological clocks, increased deaths in road collisions, and disruption of dispersal movements and corridor use. Some of these effects have also been observed, apart from artificial light, in correlation to moon cycles (Rich & Longcore, 2006). Within the FMS Study Area, light impacts on fauna will be reduced by installing lights facing downward and wherever practicable using motion-sensing lights.

Overall, the magnitude of the Project's effect on priority fauna species is determined to be low. A low magnitude of effect on priority species is defined as an effect which results in no direct loss of SAR individuals, and loss of habitat for those species is mitigated in the long term through reclamation planning.

8.5.6.2.1.4 Priority Avifauna

The geographic extent, timing, duration, frequency, and reversibility of the effects of clearing and grubbing to priority birds remains the same as is with non-priority specific birds. Clearing and grubbing is limited to the FMS Mine Site during the construction phase. No clearing and grubbing is required at the Touquoy Mine Site. Clearing and grubbing will result in habitat loss for avifauna.

Mitigation measures such as bird awareness and best management practices will be used. Best management practices include the avoidance of clearing and grubbing during the breeding season for migratory birds where practical. Where this is not practicable, a Bird Nest Mitigation Plan should be developed prior to construction and in consultation with ECCC and provincial regulators. Material will be stockpiled and used for remedial efforts during the closure phase of the Project. Clearing and grubbing is expected to result in loss of habitat for priority avifauna. Similar to the effects of the Project on terrestrial fauna stated above, noise levels can result in localized avoidance of the Project due to increased ambient noise levels. Given that no direct impact to priority avifauna is anticipated post mitigation, and loss of habitat will be temporary in nature (considering long term reclamation planning), the magnitude of the Projects' effect to priority avifauna is determined to be low.

8.5.6.2.2 *Effects of Other Projects in the Area*

For SAR and SOCI, the RAAs align with taxa specific RAAs defined previously and as shown on Figure 8.5-5. There is direct spatial overlap between the Project and historic mining operations in the FMS Study Area and the Touquoy Mine Site. Any potential cumulative effects from these projects related to SAR and SOCI would be based on potential impacts to water quality from mobilization of historic tailings. The remediation of historic tailings is expected to result in a positive effect of the Project. The potential impact of this interaction will be mitigated by implementation of the Historical Tailings Management Plan (Appendix I.1). As such, these historic operations are not carried through the CEA process.

8.5.6.2.2.1 Current Regional Forestry Operations

Habitat throughout the region exhibits fragmented conditions related to current and historic timber harvesting activity. This has led to habitat fragmentation and an increase in young regenerating stands to the detriment of older undisturbed forest, and the species which rely on these forests.

The existing roads that service the regional forestry industry contribute to the disturbance and risk of collision to species such as Moose. Timber harvesting is expected to have direct and indirect impacts to priority avifauna. According to Freedman, Woodley & Loo (1994), the effects of timber harvesting on birds is reflective of the physical and botanical changes in the structure of the forest in a given landscape. Habitat preferences for avifauna vary quite widely, so the effects of timber harvesting can result in creation of habitat for some species, while negatively affecting habitat for others. As described previously, this can be particularly important for species relying on old forest conditions, which is not supported in a landscape with abundant timber harvesting activity. Generally speaking, the removal of trees for timber harvesting is anticipated to have a negative effect on priority avifauna species. The extent of the impact of timber harvesting on priority avifauna within the LAA is not well documented in literature. The likelihood that timber harvesting would have an adverse residual effect on priority fish species is moderate, presuming forestry operators adhere to provincial Wildlife Habitat and Watercourse Protection regulations. These regulations also provide stipulations to reduce the effect of habitat fragmentation on terrestrial and avifauna, by requiring stream buffers (to act as corridors) and patches of live trees, protection of Moose shelter patches, allowing for passage of wild species across clear-cut landscapes. As such, while habitat loss and fragmentation do occur as a result of timber harvesting, some level of habitat connectivity is provided by these regulations and provincial oversight and integrated resource management processes.

8.5.6.2.2.2 East River Sheet Harbour Hydro System

The operation of the East River Hydro System and its' effects on fish and fish habitat are described in Section 8.5.5.2.2.2. The potential cumulative effects on fish and fish habitat described therein apply to priority fish as well, as much of the conversation related to the impacts of hydroelectric power on fish was driven by the Atlantic Salmon and American Eel. These conditions contribute to the baseline fish and fish habitat quality within the FMS Study Area. Water level management may have had some effect on priority flora species in the riparian or upper littoral zone of the reservoirs. As the dams have been in place for decades, any potential loss of historic priority vascular flora species is unknown.

The presence of hydroelectric dams has created a series of reservoirs within the East River Sheet Harbour watershed that are anthropogenic in origin. For smaller terrestrial fauna species, these can act as a barrier to passage across the landscape. None of the hydroelectric reservoirs are expected to affect distribution of larger species, such as the Mainland Moose, to any greater degree than natural lakes and rivers that are natural in origin. Reservoirs could potentially provide habitat for some priority species such as Snapping Turtle.

8.5.6.2.2.3 Touquoy Gold Project

Some loss of Mainland Moose habitat, although limited to the Touquoy Project footprint, has occurred through the construction of the Touquoy Mine Site. Snapping Turtles have been observed in the riparian zone of the Moose River, and the Moose River is known to support priority fish species such as Atlantic Salmon and Brook Trout. The construction of this facility has resulted in some loss of habitat for avifauna, including priority species. The Touquoy Project has resulted in the loss of a single Black Ash to allow construction of the TMF. While the Touquoy Gold Project is discussed in terms of a cumulative effects assessment, the extension of the operation of this facility is also tied directly to the FMS Project. As such, the effects assessment of the temporal extension of the Touquoy Gold Project is presented herein. The effects of the Touquoy Gold Project are similar in nature to the effects of the addition of the FMS Project to the Touquoy facility, with the primary difference related to the temporal extension of effects.

Potential impacts to priority species include direct mortality (vehicles), alteration or loss of habitat, disturbance of reproductive or feeding activities (generally due to noise or site activity), increased predation (natural predators, vehicle collision or hunting/trapping) due to improved access and traffic or disruption of migration patterns and habitat fragmentation. Accidental events could result in similar impacts. Vehicle use on-site could result in accidental mortality of Mainland Moose and Snapping Turtles. As few moose are in the area, it is unlikely that encounters will occur; however, the importance of individual moose within this area is recognized. As collisions can be avoided by ensuring on-site vehicle speeds are under 50 km/hr, speed limits below this level will be enforced year-round.

A WMMP has been implemented at the Touquoy Mine Site, requiring reporting of wildlife, particularly turtles and Mainland Moose observations to the site Environmental Technicians. No additional clearing or grubbing is required at the Touquoy Mine Site to facilitate deposition of FMS tailings, so additional habitat loss is not an important factor in assessing cumulative effects to SAR/SOCI at the Touquoy Mine Site. Aside from trucking of gold concentrate and deposition of tailings, the effects of the FMS Project and the Touquoy facility do not overlap spatially or temporally, reducing potential cumulative effects to SAR and SOCI.

8.5.6.2.2.4 Beaver Dam Mine Project

Some loss of Mainland Moose habitat, although limited to the Beaver Dam Mine Project footprint, is expected to occur through the construction of the Beaver Dam Mine Project. While no evidence of snapping turtles was documented, it is possible that this species uses the habitats within the PA. Three priority fish species have been identified or are expected within the PA (brook trout, American eel and Atlantic salmon – though American eel were only observed within the Haul Road portion of the PA). The construction of this mine will result in some loss of habitat for avifauna, including priority species.

Project interactions for the Beaver Dam Mine Project are detailed in the Projects' EIS. The projects' effects on SAR and SOCI were determined to be adverse, but not significant, and limited to the Projects' LAA. The LAA associated with the proposed Beaver Dam Haul Route overlaps the FMS Project both spatially and temporally due to trucking of gold concentrate to the Touquoy Mine Site, which is described below. While the effects of each project are anticipated to be limited to their respective LAA's, there is some potential additive cumulative effect to priority species due to habitat fragmentation ad sensory disturbance, especially given the concurrent timelines of the Beaver Dam Mine Project and the Project.

8.5.6.2.2.5 Beaver Dam Haul Road Use by the Project and Cochrane Hill Gold Project

As stated above, during the operation phase of Project and the Cochrane Hill Gold Project, gold concentrate from each surface mine will be transported to the Touquoy Mine Site for final processing into gold doré bar. The proposed haul route for each project is proposed to overlap with the Beaver Dam Haul Road west of the Highway 224, which will be constructed to transport ore from Beaver Dam Mine Site to the Touquoy Mine Site. It is expected that the FMS Mine Site and the Cochrane Hill Mine Site will each transport 11 round-trip truckloads of gold concentrate to Touquoy Mine Site per day for final processing. This accounts for a total of 44 single trip trucks per day from both projects, in addition to the 190 single-trip trucks (95 two-way trips) using the road to transport Beaver Dam ore, and average of 14 single-trips per day anticipated from timber harvesting operations.

The trucking operations associated with the Project and Cochrane Hill Gold Project along the Beaver Dam Haul Road west of Highway 224 has the potential to increase the potential impact SAR and SOCI from wildlife vehicle collisions, dust, noise, and accidents (e.g. spills) due to cumulative truck traffic from these projects. The pathway for effects of this activity to SAR and SOCI involves disturbance through increased air, noise and light, potential physical interaction with trucks, and habitat disturbance from construction of the haul road. The incremental effects related to disturbance are expected to be similar with respect to impact to SAR and SOCI. Adherence to provincial and federal guidance, along with mitigation measures presented in the Beaver Dam Mine Project EIS will limit the effects to priority species from trucking on the Beaver Dam Haul Road.

8.5.6.2.2.6 Dufferin Gold Mine

The Environmental Assessment Registration Document for this project is not currently publicly available. As such, a thorough cumulative effects assessment for the Dufferin Gold Mine is limited to the Project's description on the companies' website and a review of satellite images in Google Earth, along with MEL biologists' experience with SAR and SOCI in that region of the Province.

According to the proponents' website, "The Dufferin Mine is a high-grade underground gold mine and fully permitted mill in Nova Scotia, Canada, with historic and recent production, a planned near-term restart, and potential for extensive expansion. RCG has a project turnaround plan and team in place so that production can recommence during the second quarter of 2017. The mine has a 300 tpd gravity and flotation mill and, with certain upgrades and refurbishment, all necessary infrastructure in place to conduct full-scale gold mining operations" (Resource Capital Gold Corp, 2019).

"The Company has completed refurbishment of the major mill components and is performing test milling. As part of the test milling process, the Company produced its first gold on the project in early March 2017. RCG is preparing to begin trial mining of an initial approximately 15,000 tonnes in order to confirm mineralization grade and prepare for a full restart of the mine and mill. The project comprises 1,684 ha, accessible by gravel road 25 km from Sheet Harbour in southeastern Nova Scotia, about 135 km northeast of Halifax " (Resource Capital Gold Corp, 2019).

The Dufferin deposit consists of mineralized gold in quartz veins, mined by underground shafts, rather than an open pit. Milling operations continued through 2017, and according to a press release dated January 29th, 2018, the bulk sampling program was completed with favorable results. A press release dated January 29th, 2019 indicated, however, that the company has filed a Notice of Interest to make a proposal under the Bankruptcy and Insolvency Act. According to the press release, "The initial NOI period will allow RCG to evaluate, with its partners, all available legal recourses and financial alternatives that may allow the Company to resume its operational production efforts as soon as possible and continue as a going concern" (Resource Capital Gold Corp, 2019).

Given this most recent press release, the future development of the Dufferin Project is uncertain. In its current state, the shaft, plant site and access road has resulted in some habitat fragmentation which could impact habitat quality for SAR and SOCI at a localized level. Given the uncertainty moving forward, it is unknown whether the Dufferin Project will overlap temporally with the FMS Project. The Dufferin Project Area is located more than 20km south of the FMS Mine Site, though there is potential for an additive cumulative effect between the projects, based on habitat fragmentation.

8.5.6.2.3 *Cumulative Effects on the Species of Conservation Interest and Species at Risk*

Cumulative effects to SAR and SOCI are specific to each species, meaning that cumulative effects are only considered for species on which the Project has adverse residual effects and for which adverse effects from other identified projects in the area are expected.

8.5.6.2.3.1 Priority Fish

Projects which overlap within the RAA for fish and fish habitat include historic mining operations at both FMS and Touquoy Mine Sites, current operation of the Touquoy Mine Site, regional forestry operations and the operation of the East River Hydro System, and additional trucking on the Beaver Dam Haul Road. Historic mine operations at FMS Mine Site resulted in deposition of tailings along Seloam Brook, which, if not mitigated properly, could result in a cumulative effect with the current proposed Project. Historic tailings have been identified, and will be delineated in soil and sediments as required, and then will be managed in accordance with the Historical Tailings Management Plan (Appendix I.1), as detailed in Section 6.4. During construction, water from the pit development area where tailings are present, will also be managed and, as necessary, treated prior to discharge to the receiving environment. Potential cumulative impacts from historic mining operations to priority fish species are expected to be minimal, with appropriate management of historical tailings in conjunction with NSE.

Timber harvesting is occurring within the LAA and RAA for fish and fish habitat. As such, timber harvesting is expected to overlap with the Project both spatially and temporally. Residual effects of timber harvesting on fish and fish habitat, including priority fish, is difficult to quantify as discussed in Section 8.4.3.1.4. Provided forestry operators adhere to federal and provincial regulations, the effects of timber harvesting on priority fish species is expected to be minimal. As such, the cumulative effects of timber harvesting on priority fish species is likely negligible.

The effects of the East River Hydro System on fish in general are described in Section 8.5.5, and relevant to effects on priority species as well. As these dams have been in place on the East River for decades, the effects of this system on fish are considered part of the baseline conditions. Providing the Project adhered to federal and provincial regulations, including the implementation of a Fish Habitat Offset Plan (Appendix J.7), the Project is not likely to have cumulative effects to fish in the context of the East River Hydro System.

There is limited uncertainty as to the Project effects on priority fish species. Follow-up monitoring programs established for the Project (i.e., monitoring the effectiveness of fish habitat offsetting measures) will be used to address any uncertainty (Section 6.8.9).Surface water quality and quantity monitoring completed at the FMS Mine Site and Touquoy Mine Site will identify any potential indirect cumulative effects to fish and fish habitat.

8.5.6.2.3.2 Priority Vascular Flora and Lichens

Projects which overlap the RAA for priority vascular flora and lichens include historic mining operations at both FMS and Touquoy Mine Sites, current operations of the Touquoy Mine Site, the East River Hydro System, regional forestry operations, the Beaver Dam Mine Project, and the Dufferin Gold Project. No significant adverse effects to priority vascular flora and lichens are anticipated as a result of the Touquoy Gold Project or Beaver Dam Mine Project. Residual effects to priority vascular flora and lichens as a result of the East River Hydro System, timber harvesting, historic mining operations and the Dufferin Gold Project are unknown, and little information is available, with the exception of the general understanding that habitat loss results in potential loss of priority flora and lichen species. The general habitat disturbances from historic and ongoing forestry activities, and these projects listed above, are likely to have had some effect on species that prefer undisturbed habitat, such as priority lichens.

There is a significant level of uncertainty as to the cumulative effects, especially as to the effects from past disturbances and other projects in the region. However, given the small footprint of the Project on the regional scale there is some confidence that the Project's effects on priority flora contributes only a small portion to the total cumulative effects, and that any additive cumulative effects would be negligible.

8.5.6.2.3.3 Priority Terrestrial Fauna

Projects which overlap within the RAA for priority terrestrial fauna include historic mining operations at both FMS and Touquoy Mine Sites, current operations of the Touquoy Mine Site, the East River Hydro System, regional forestry operations, the Beaver Dam Mine Project, and the Dufferin Gold Project. No significant adverse effects to priority terrestrial fauna are anticipated as a result of the Touquoy Gold Project or Beaver Dam Mine Project.

Residual effects to priority terrestrial fauna as a result of timber harvesting, the East River Hydro system, historic mining operations and the Dufferin Gold Project are unknown, and little information is available. Given the distance between the Dufferin Gold Project and either component of the PA, a spatial overlap in effects is unlikely. Given the current state of the Dufferin Gold Project (detailed above), it is unlikely that there will be a temporal overlap with the current proposal.

The reservoirs on the East River Hydro system could potentially act as a barrier to small terrestrial fauna species, not unlike a lake that is natural in origin. The mainland moose is an adept and capable swimmer, and it is not expected that the presence of dams and their reservoirs would act as a significant barrier to this species. The presence of reservoirs along the East River Sheet Harbour may result in a positive effect for species such as snapping turtle, which would have some level of habitat provision in the reservoirs.

The general habitat disturbances and fragmentation from historic and ongoing forestry activities are likely to have had some effect on species that prefer undisturbed habitat. Specifically, timber harvesting and the Project, the Beaver Dam Mine Project and the Touquoy Gold Project are expected to have an adverse effect on the mainland moose. The effects are the result of loss of habitat and from the risk of collision with vehicles. Habitat loss and disturbance, and traffic from other activities in the region contribute to the resulting cumulative effects.

Similar cumulative effects are expected for the snapping turtle, which have been observed using roadsides near Moose River at the Touquoy Mine Site during nesting season. Increasing traffic levels will increase risk of collisions to snapping turtles. A WMMP has been implemented at the Touquoy Mine Site to reduce potential impact to wildlife, specifically turtles. No other specific project causing loss of habitat for this species has been identified.

There is a significant level of uncertainty as to the cumulative effects on priority terrestrial fauna. Given the small footprint of the Project on the regional scale there is some confidence that the Project's effects on priority terrestrial fauna contributes only a small portion to the total cumulative effects, and that there is low potential for significant additive cumulative effects.

8.5.6.2.3.4 Priority Avifauna

Projects which overlap within the RAA for priority avifauna include historic mining operations at both FMS and Touquoy Mine Sites, current operations of the Touquoy Mine Site, the East River Hydro System, regional forestry operations, the Beaver Dam Mine Project, and the Dufferin Gold Project. No significant adverse effects to priority avifauna are anticipated as a result of the Touquoy

Gold Project or Beaver Dam Mine Project. Residual effects to priority avifauna as a result of the East River Hydro System, timber harvesting, historic mining operations and the Dufferin Gold Project are unknown, and little information is available. Given the distance between the Dufferin Gold Project and either component of the PA, a spatial overlap in effects is unlikely. Given the current state of the Dufferin Gold Project (detailed above), it is unlikely that there will be a temporal overlap with the current proposal. The presence of reservoirs is not expected to have any significant adverse effect on birds, especially given the length of time they have been in place. Water level management may decrease nesting success for species which nest along shorelines.

The general habitat disturbances from historic and ongoing forestry activities are likely to have had some effect on species that prefer undisturbed habitat. The cumulative effects to priority birds are therefore driven by habitat loss and disturbance and are essentially the same as those noted for birds in general. Overall, the generalized disturbance of the landscape by proposed and active gold projects, and forestry activities (past, present and future) are the main source of cumulative effects to priority birds throughout the area. The largest adverse effects expected would be to species preferring undisturbed and unfragmented habitats, although the impact to interior forest has been determined to be low.

The main assumptions behind this assessment is that the overall patterns of land use in the region will remain unchanged in the foreseeable future and that the Project will be approved and carried out during the anticipated timelines. Overall, the assessment is considered as having moderate levels of uncertainty, based primarily on data limitations.

8.5.6.3 Mitigation

No specific mitigations are recommended to reduce cumulative effect, other than those presented in Sections 6.8 to 6.12 (Fish and Fish Habitat, Habitat and Flora, Terrestrial Fauna, Avifauna and SAR/SOCI, respectively). The Touquoy Gold Project and Beaver Dam Mine Project will adhere to their own mitigation measures as outlined in their Approval and EIS, respectively. It is presumed that NSPI will continue to operate the East River Hydro System under the conditions of their Water Approval. The mitigation of the effects originating from regional forestry and land management practices falls outside the scope of the Proponent's authority and responsibility.

8.5.6.4 Residual Cumulative Effects and Significance Assessment

A significant adverse effect from the Project on SAR and SOCI is defined as an effect that is likely to cause a permanent, unmitigated alteration to habitat that supports a species' distribution, or alteration of critical habitat. Sedentary species such as vascular and non-vascular flora do not have the opportunity to move to avoid direct or indirect impact. For these species, the loss of an individual or individuals of a SAR species that is important in the context of the province, or that species' overall abundance or distribution, may be considered significant, if appropriate mitigation measures are not implemented.

Within the Project, the Beaver Dam Mine Project, the Touquoy Gold Project and the use of the Beaver Dam Haul Road by all three projects, there is no expectation of significant cumulative effects.

The alteration of the disturbance of habitats throughout the region from historic and current land use is likely to have affected the local distribution and abundance of various species, especially those associated with undisturbed mature habitats. However, the overall footprint of mining activities in the area, including the FMS and Touquoy Mine Sites, is quite small in relation to the VCs respective RAAs. As such, no significant residual cumulative effects are anticipated (Table 8.5-6).

8.5.6.5 Follow-up and Monitoring Programs

No additional monitoring beyond that indicated for the Project in section 6.12.9 is proposed.

Table 8.5-6: Residual Cumulative Environmental Effects for SOCI and SAR

Residual Adverse Cumulative Effects (After Mitigation)	Significance Levels						Overall Significance of Residual Adverse Effects (and Rationale)
	Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility	
Cumulative loss, alteration and the disturbance of habitats throughout the RAA relating to SOCI and SAR	L The maximum Project edge effect will affect 275 ha of interior forest habitat, which accounts for 0.49% of predicted interior forest in the RAA. There is limited additional development pressures from projects in the RAA, as demonstrated by the few projects identified within this evaluation	RAA Loss of habitat used by priority species has occurred on a regional scale	A Cumulative effect would be more significant during sensitive period for each priority species	LT Effects may extend beyond 7 years	S The loss of habitat associated with the FMS Mine Site will occur once. However, the potential future loss of habitat associated with the Fifteen Mile Stream Gold Project and other regional projects in the future could occur throughout the lifetime of the Project	PR Reclamation cannot guarantee a return to baseline conditions	Low Adverse Effect (Not Significant) The small proportion of regional habitat that supports priority species that would be lost as a result of this Project will be restored during the reclamation stage of Closure Phase. There is limited additional development pressure from projects in the RAA

Legend (refer to Table 5.10-1 for definitions)

Magnitude		Geographic Extent		Timing		Duration		Frequency		Reversibility	
N	Negligible	PA	Project Area	N/A	Not Applicable	ST	Short-Term	O	Once	R	Reversible
L	Low	LAA	Local Assessment Area	A	Applicable	MT	Medium-Term	S	Sporadic	PR	Partially reversible
M	Moderate	RAA	Regional Assessment Area			LT	Long-Term	R	Regular	IR	Irreversible
H	High					P	Permanent	C	Continuous		

8.5.7 Mi'kmaq of Nova Scotia Cumulative Effects Assessment

8.5.7.1 Baseline conditions

There are 13 Mi'kmaq communities in Nova Scotia, with two First Nation (Mi'kmaq) reserves in the vicinity of the Project: Beaver Lake IR 17 (49.4 ha) is located approximately 24 km from the FMS Study Area, and Sheet Harbour IR 36 (32.7 ha) is located 24 km south of the Project. Both these reserves belong to the Millbrook First Nation in Truro, Nova Scotia, part of the broader Mi'kmaw Nation. The 2017 Census reports 21 and 25 Mi'kmaw residents at Beaver Lake and Sheet Harbour, respectively (Statistics Canada 2017a,b).

The Pictou Landing First Nation, located in Pictou Landing, Nova Scotia, is the next closest First Nation to the Project, approximately 59 km north of the Project. The 2017 Census reports a total of 485 people living on reserve at Fishers Grant ID 24. No residents are reported at Merigomish Harbour IR 31, and no Census data is available for Boat Harbour IR 37.

The Sipekne'katik First Nation, located in Indian Brook, Nova Scotia, is the next closest First Nation to the Project, approximately 65 km northwest of the FMS Study Area. The 2016 Census reports a total of 1,268 people living on reserve at Indian Brook IR 14, New Ross IR 20, Pennal IR 19, Shubenacadie IR 13, and Wallace Hill IR 14A.

Mi'kmaq rights are communal rights and therefore shared amongst all members of the Mi'kmaq Nation in Nova Scotia. Community profiles of the 13 Mi'kmaw First Nations in Nova Scotia have been included in Table 6.13-1 (Stantec 2018c).

8.5.7.1.1 *Historic Mi'kmaq Land and Resource Use*

As described by MAPS in the MEKS for the Project, Mi'kma'ki, the district of Eskikewa'kik, and the MEKS Study Area have been occupied by Mi'kmaq and their ancestors since the deglaciation some 12,000 years ago. The so far earliest physical traces of the presence of Mi'kmaq and their ancestors are archaeological finds unearthed at Debert, NS dating from 11,500 BP, a period labelled as Paleo-Indian by archaeologists or Sa'giwe'k L'nuk by Mi'kmaq (Appendix H.1).

In general, Mi'kmaw land use and occupancy involved semi-permanent and permanent settlement at resource-rich locations. Based on the overlapping seasonal fluctuations in the local availability and abundance terrestrial and aquatic resources, Mi'kmaw groups exploited singular or multiple resources in a succession of habitats throughout their territory. More details outlining historic land and resource use by the Mi'kmaq of Nova Scotia are presented in Section 6.13.

8.5.7.1.2 *Current Mi'kmaq Land and Resource Use*

Drawing from information provided through the MEKS completed in 2018, direct information gathered from engagement activities between the Proponent and the KMKNO, Millbrook First Nation and Sipekne'katik First Nation, and the Project team's knowledge of the PA, the following summary of current Mi'kmaq land and resource use has been prepared as a basis from which to understand and evaluate Project interactions and potential effects of the Project on the Mi'kmaq of Nova Scotia.

The following key aspects were considered and requested from the Mi'kmaw communities during collection of baseline data (either through direct engagement or the completion of the MEKS or through a shared questionnaire in Dec 2019/Jan 2020):

- General information about Mi'kmaq of Nova Scotia populations;
- General description of baseline conditions within the FMS Study Area and surrounding landscape to support an understanding of the current experience of the traditional practice for the Mi'kmaq of Nova Scotia;

- Sites or areas that are used by the Mi'kmaq of Nova Scotia either for permanent residences or on a seasonal/temporary basis and the number of people that use each site/area identified;
- Drinking water sources (permanent, seasonal, periodic, or occasional);
- Consumption of country foods (also known as traditional foods) including food that is trapped, fished, hunted, harvested, or grown for subsistence or medicinal purposes, outside of the commercial food chain;
- Which country foods are consumed by which groups, how frequently, and where these country foods are harvested;
- How are different subpopulations of the Mi'kmaq communities using the land;
- How often is the right practiced or exercised and timing/seasonality of the practice; the context in which the right is practiced;
- Commercial activities (e.g. fishing, trapping, hunting, forestry, outfitting) and the frequency, duration and timing of these activities including maps and data sets; and,
- Recreational uses and the frequency, duration and timing of these activities.

Baseline information that was shared and available for the Project is described in this section. It is important to note that several limitations relating to baseline information are present and thus, evaluation of Project interactions and potential effects to the Mi'kmaq of Nova Scotia within this section of the Project EIS are provided in a general format, with limitations on specific analysis:

- **Drinking Water Sources:** No surface drinking water sources were identified through the MEKS, direct engagement activities with the communities, or the questionnaire shared in Dec 2019/Jan 2020. As a result, no analysis of specific surface water drinking water sources is included in this section. However, a discussion of impact of drinking water at EMZ-2 (discharge location from the Project within Anti Dam Flowage) is included as it is considered the reasonable worst case predicted water quality conditions stemming from the Project.
- **Residences (Permanent or Seasonal):** No specific detail relating to location of seasonal or temporary camps/cottages/residences were provided to the Proponent. The MEKS identified a cabin, but no general or specific location was provided. Thus, no analysis of specific Mi'kmaq residential receptors has been included in this Project EIS. It is expected that a number of Mi'kmaw residents maintain or regularly use cabins or cottages in the region. However, no Mi'kmaw owned or utilized cottages or cabin have so far been recorded in or directly surrounding the FMS Study Area with the exception of the cabin noted in the MEKS. No further information was provided in the MEKS, from direct engagement with the Mi'kmaq communities and the KMKNO, or the questionnaire shared in Dec 2019/Jan 2020 relating to specific locations of seasonal residences/cottages/camps. The Proponent team requested additional information via email from the KMKNO relating to the general location of this cabin(s) identified within the MEKS on March 12, 2020. To date, no specific detail has been provided. However, conclusions relating to Project impacts at the FMS Mine Site property boundaries have been provided for each valued component in Table 6.13-5 and these conclusions can support analysis of particular camps/cottages that may be present surrounding the FMS Mine Site.
- **Consumption of Country Foods:** Details relating to **locations, frequency, duration and timing of harvesting** for specific fish, wildlife species, plants or other natural resources were not shared at this time with the Proponent. Traditional land use activities are an integral part of the domestic economy of many households and make an important contribution to their food security. Of the sample of Mi'kmaw individuals interviewed for the MEKS, 84% identified the traditional sector of their domestic economy, the harvesting of wildlife and plant resources, as an indispensable component of their families' food security (Appendix H.1).

Mi'kmaq individuals or families from all surrounding communities were, and are, involved in harvesting and other land use activities in the region including the FMS Study Area. However, specific details regarding the frequency, duration and timing of the harvesting or wildlife and plant resources, or which groups practice the activities (women, elders, youth, families) were not shared with the Proponent. Thus, detailed analysis of specific current traditional use in relation to Project development and potential impacts/effects is limited. However, analysis was completed (Appendix C.1) related to the evaluation of potential human exposures and risks related to emissions from the Project (Dust Deposition; Recreational Water Usage; Country Foods) and this analysis has been based on assumptions of traditional use**.**

- **Ceremonial/Spiritual Activities and Sites:** General information about a sacred site was provided in the MEKS, but details relating to its specific location was not shared with the Proponent due to privacy concerns. If a general location was provided, analysis could be completed at this location to evaluate change in noise, light, and viewshed analysis from the Project. The Proponent team requested additional information via email from the KMKNO relating to the general location of this sacred site identified within the MEKS on March 12, 2020. To date, no specific detail has been provided, although the Proponent anticipates the KMKNO will provide analysis and recommendations with their EIS review.

Additional information relating to strengthening the Proponent understanding of current Mi'kmaq land use was requested from the Mi'kmaq of Nova Scotia as documented in detail in Section 4.0.

Requests for more detailed information were made of the KMKNO, Millbrook First Nation, Sipekne'katik First Nation in April and May 2019 related to camp/cabin locations, potable water supply locations (even occasional water usage), swimming and fishing locations, recreational uses, and frequency, duration and timing of traditional practices in and around the proposed FMS Mine Site. A detailed questionnaire was provided in December 2019/January 2020 with a request for feedback by February 15, 2020, and a draft Mi'kmaq Impact Statement was shared in July 2020 with the KMKNO, and Millbrook, Sipekne'katik, Pictou Landing and Paqtnkek First Nations, with a request for feedback by August 14, 2020.

The Proponent team also requested additional information from the KMKNO archaeological team in an email dated March 12, 2020 relating to specific information regarding locations of burial sites, sacred sites, and cabins, beyond what was documented in the MEKS (Appendix H.1).

As described herein, this information has been requested of all Mi'kmaq communities and organizations over the course of the last eighteen months to two years. No specific information has been provided relating to the Proponent requests. The feedback that has been received from the Mi'kmaq indicates that specificity of traditional use data may be difficult to obtain during the EA process, and if documented, may not be shared with the Proponent due to privacy considerations. However, if data is obtained and if it is in a format that can be shared, it is most likely to become available through the formal EIS review period, once the EIS is publicly available through IAAC. The Proponent will continue to work with the Mi'kmaq of Nova Scotia to identify any outstanding information related to the Project.

8.5.7.2 Analysis of Effects

8.5.7.2.1 *Residual Effects of Proposed Project*

The predicted residual environmental effects of the Project on the Mi'kmaq of Nova Scotia are assessed to be adverse, but not significant following implementation of applicable mitigation measures (Table 6.13-8). Potential residual effects to the Mi'kmaq of Nova Scotia's physical health from Project-related changes to the environment (e.g., changes to country foods, water, and soils) are anticipated to be not significant. Potential pathways of effects on human health associated with consumption of, or contact with, country foods, water and soils will be minimized by implementing mitigation measures such as dust control and water management infrastructure, water treatment and processes. Mitigation measures to reduce atmospheric emissions will be implemented to minimize potential related effects on human health, and the residual risk to human health from inhalation of Project-related dust and airborne contaminants is considered low.

Mitigation measures and conclusions relating to impacts to traditional practices and socio-economic and mental well-being will continue to be discussed directly with the Mi'kmaq communities throughout the life of the environmental assessment process. Access to Seloam Lake and lands east of the Project via bypass roads, as well as the availability and suitability of nearby crown land as partial mitigation for loss of access during the eleven years that the mine will be limiting access to the FMS Mine Site area have and will also continue to be discussed with the Mi'kmaq. Feedback on all summary of impacts and proposed mitigation measures has been requested and this dialogue will continue.

8.5.7.2.2 *Effects of Other Projects in the Area*

The Project is located in a rural area, with limited development pressures, with the exception of regional forestry activities. The RAA for the Mi'kmaq of Nova Scotia is spatially large, based on historical migration patterns and movements of the Mi'kmaq and territorial boundaries of the *Eskikewa'kik (Skin Dressing Territory).* This RAA allows for impacts that may be felt locally from the Project to be contextualized within the geographical setting of *Eskikewa'kik* land and resource use.

There are 40 identified projects within the RAA for the Mi'kmaq of Nova Scotia (Figure 8.5-6). Cumulative effects on the Mi'kmaq of Nova Scotia are indirect and will be caused by effects to other VCs from the Project and other projects that have been shown to act cumulatively with overlapping effects within the RAA.

The 40 projects can be categorized in five categories by activity:

- **Mining** including Fifteen Mile Stream (historical mining), Touquoy (historical and current mining), Cochrane Hill (historical mining and potential future mining), Beaver Dam (potential future mining), Beaver Dam Haul Road (potential future use), Anaconda Gold Mine (potential future mining), Scozinc Mine (historical and current), Tangier and Dufferin Gold Mines (historical and current), and the Goldboro Gold Mine (potential future mining).
- **Pits and Quarries** including Cooks Sand and Gravel (current), National Gypsum (current), Murchyville Gypsum (historical), Porcupine Mountain (current), Chedabucto Quarry (current), Black Point Quarry (potential future), Sheet Harbour Quarry (potential future), Goff's Quarry (current), Mosher Lake Limestone (current), and Loch Katrine Quarry (current).
- **Forestry and Associated** including forestry activities (historical, current and potential future), Taylor Lumber Mill (present), Great Northern Timber Wood Chipping and Shipping (current), and Great Northern Timber Pellet Facility (current).
- **Wind Power Projects (WPP)** including Gaetz, Mulgrave, Chebucto/Pockwock, Sable, Terence Bay WPPs.
- **Other Industries** including the Sable Offshore Energy Project (past), Port of Sheet Harbour (historical and current), East River Sheet Harbour Hydro System (historical and present), Canso Spaceport (potential future), Lake Major Dam Replacement (current), Hwy 107 Burnside to Bedford (Present), Bearpaw Pipeline (potential future), Goldboro Gas Plant (historical) and Goldboro LNG Facility (potential future), Waste Dangerous and Non-Dangerous Goods Temporary Storage Facility (Future), Liquid Asphalt Storage Facility (Future), and Highway 102 Aerotech Connector Road Project..

8.5.7.2.3 *Cumulative Effects on the Mi'kmaq of Nova Scotia*

Cumulative effects on the Mi'kmaq of Nova Scotia are indirect and will be caused by effects to other VCs from the Project and other projects that have been shown to act cumulatively with overlapping effects within the RAA.

Assessment of the potential for cumulative effects to the Mi'kmaq of Nova Scotia is included in consideration of its socio-economic, socio-cultural, and/or traditional importance; in recognition of potential or established Aboriginal and Treaty rights; and due to the nature of potential Project-VC interactions, and cumulative-VC interactions of other projects in the RAA. Additionally, subparagraph 5(1)(c) of *CEAA 2012* and the FMS EIS Guidelines (CEAA, 2018) require assessment of potential effects to Indigenous Peoples including consideration of:

- Health and socio-economic conditions;
- Physical and cultural heritage, including any structure, site or thing that is of historical, archaeological, paleontological or architectural significance; and
- Current use of lands and resources for traditional purposes.

In order to evaluate the potential cumulative effect to the Mi'kmaq from the Project and other projects within the RAA, a summary of VC cumulative conclusions identified within Section 8 has been prepared and is presented in Table 8.5-7. These conclusions are then considered in the context of the broader categories of projects within the RAA provided in Section 8.5.7.2.2, and then finally reviewed to evaluate the potential effect to the health and socio-economic condition, physical and cultural heritage and current use of the lands for traditional purposes of the Mi'kmaq of Nova Scotia.

Table 8.5-7: Analysis of Cumulative Effect on the Mi'kmaq of Nova Scotia

Valued Component	Cumulative Effects Residual Effect Summary	Projects (by Category) within RAA and interaction with VC cumulative effects conclusions	Impact to the Mi'kmaq of Nova Scotia			Residual Effect
			Health/Socio	Physical/ Cultural	Traditional Use	
Noise	Additive periods of potential effects from the Project and forestry operations are likely to be limited in frequency. Additive cumulative effects may occur when forestry operations occasionally coincide with Project activities, and hauling ore from Beaver Dam, FMS and Cochrane Hill to Touquoy for processing. Cumulative effects to baseline noise levels from the use of the Beaver Dam Haul Road by Beaver Dam, FMS and Cochrane Hill Gold Projects will occur regularly throughout the operational phase of the Project.	Within the noise RAA, only forestry operations were considered in the cumulative effects assessment, and cumulative noise impacts along the BD Haul Road from truck traffic from the Project, Cochrane Hill Gold Project, the Beaver Dam Mine Project, and forestry activity. There is no further cumulative impact from noise to the Mi'kmaq within the broader RAA. Individual projects as described in Section 8.5.7.2.2. contribute spatially isolated noise impacts within the RAA, but do not overlap with the Project.	Limited to cumulative effects described within Noise sub-section of Section 8. Specific to BD Haul Road and potential for additive (sporadic) Project + Forestry activities within the FMS Mine Site	No impact from noise to physical and cultural including any structure, site or thing that is of historical, archaeological, paleontological or architectural significance	Limited to cumulative effects described within Noise sub-section of Section 8. Noise impacts from other projects would be felt in isolation of the Project and its cumulative effects	No additional residual effect beyond that defined in the subsection of Section 8 dedicated to the Noise VC.
Air	Additive periods of potential effects from the Project and forestry operations are likely to be limited in frequency. Elevated dust levels are possible when forestry operations occasionally coincide with hauling concentrate from the FMS Mine Site to the Touquoy Processing Facility along with ore or concentrate from Beaver Dam and Cochrane Hill Projects. Cumulative effects to ambient dust levels from the use of the Beaver Dam Haul Road by the Project and Cochrane Hill Gold Project will occur regularly throughout the operational phase of the Project. These cumulative effects are not considered significant, and the Proponent has committed to 80-90% dust suppression along the Beaver Dam Haul Road to reduce dust levels.	Within the air RAA, only forestry operations were considered in the cumulative effects assessment, and cumulative air impacts along the BD Haul Road from truck traffic from the Project, Cochrane Hill Gold Project, the Beaver Dam Mine Project, and forestry activity. There is no further cumulative impact from air to the Mi'kmaq within the broader RAA. Individual projects as described in Section 8.5.7.2.2. contribute spatially isolated air impacts within the RAA, but do not overlap with the Project.	Limited to cumulative effects described within Air sub-section of Section 8. Specific to BD Haul Road and potential for additive (sporadic) Project + Forestry activities within the FMS Mine Site	No impact from air to physical and cultural including any structure, site or thing that is of historical, archaeological, paleontological or architectural significance	Limited to cumulative effects described within Air sub-section of Section 8. Air impacts from other projects would be felt in isolation of the Project and its cumulative effects	No additional residual effect beyond that defined in the subsection of Section 8 dedicated to the Air VC.
Light	Additive periods of potential effects from the Project and forestry operations are likely to be limited in frequency. However, cumulative effects to ambient light levels from the use of the Beaver Dam Haul Road Use by Fifteen Mile Stream, Cochrane Hill Gold Projects and forestry activities will occur regularly throughout the operational phase of the Project.	Within the light RAA, only forestry operations were considered in the cumulative effects assessment, and cumulative light impacts along the BD Haul Road from truck traffic from the Project, Cochrane Hill Gold Project, the Beaver Dam Mine Project, and forestry activity. There is no further cumulative impact from light to the Mi'kmaq within the broader RAA. Individual projects as described in Section 8.5.7.2.2. contribute spatially isolated light impacts within the RAA, but do not overlap with the Project.	Limited to cumulative effects described within Light sub-section of Section 8. Specific to BD Haul Road and potential for additive (sporadic) Project + Forestry activities within the FMS Mine Site	No impact from light to physical and cultural including any structure, site or thing that is of historical, archaeological, paleontological or architectural significance	Limited to cumulative effects described within Light sub-section of Section 8. Light impacts from other projects would be felt in isolation of the Project and its cumulative effects	No additional residual effect beyond that defined in the subsection of Section 8 dedicated to the Light VC.

Valued Component	Cumulative Effects Residual Effect Summary	Projects (by Category) within RAA and interaction with VC cumulative effects conclusions	Impact to the Mi'kmaq of Nova Scotia			Residual Effect
			Health/Socio	Physical/ Cultural	Traditional Use	
Surface Water	Additive periods of potential effects from the Project and forestry operations are likely to be limited in frequency and limited in scale, assuming forestry activities are well managed. The East River Hydro System is considered in background conditions of the East River Sheet Harbour and also in predictive modelling scenarios. The Beaver Dam Mine Project and the Project interaction cumulatively at the Touquoy Mine Site with the deposition of tailings into the exhausted pit and the resulting effect to the Moose River. With water treatment, this residual effect is considered low magnitude. The presence of historical tailings at FMS Mine Site has an additive effect with the Project, resulting in a positive residual effect through improvement of water quality with property management and disposal of historical tailings during Project development.	Within the surface water RAA, there were several projects which were considered in the cumulative effects assessment. There is no further cumulative impact of surface water to the Mi'kmaq within the broader RAA. Individual projects as described in Section 8.5.7.2.2. contribute spatially isolated surface water impacts within the RAA, but do not overlap with the Project.	Limited to cumulative effects described within Surface Water sub-section of Section 8. Recreational swimming within Anti-Dam Flowage has been evaluated from Project water quality. Adverse health effects from recreational water use (swimming) are not anticipated. Swimming in Moose River has been discounted due to low water levels.	No impact from surface water to physical and cultural including any structure, site or thing that is of historical, archaeological, paleontological or architectural significance	Limited to cumulative effects described within Surface Water sub-section of Section 8.	No additional residual effect beyond that defined in the subsection of Section 8 dedicated to the Surface Water VC.
Fish and Fish Habitat	Additive periods of potential effects from the Project and forestry operations are likely to be limited in frequency and limited in scale, assuming forestry activities are well managed. The East River Hydro System is considered in background conditions of the East River Sheet Harbour and also in predictive modelling scenarios for water quality. Water quality will meet CCME Freshwater Aquatic Guidelines with necessary water treatment and thus will not impact fish and fish habitat in the receiving environment (Anti-Dam Flowage) The Beaver Dam Mine Project and the Project interaction cumulatively at the Touquoy Mine Site with the deposition of tailings into the exhausted pit and the resulting effect to the Moose River. With water treatment, this residual effect is considered low magnitude and the effect to Mi'kmaq consumption of country foods (fish) has been concluded to be low. The presence of historical tailings at FMS Mine Site have an additive effect with the Project, resulting in a positive residual effect through improvement of water quality and fish habitat with property management and disposal of historical tailings during Project development.	Within the fish RAA, there were several projects which were considered in the cumulative effects assessment. There is no further cumulative impact of fish to the Mi'kmaq within the broader RAA. Individual projects as described in Section 8.5.7.2.2. contribute spatially isolated fish impacts within the RAA, but do not overlap with the Project.	Limited to cumulative effects described within Surface Water sub-section of Section 8. It is unlikely that effluent releases will result in levels of metals in country foods (fish) that would be harmful to human health.	No impact from fish to physical and cultural including any structure, site or thing that is of historical, archaeological, paleontological or architectural significance	Limited to cumulative effects described within Fish sub-section of Section 8. Fishing activities to support Mi'kmaq traditional uses and commercial fisheries will not be affected by the Project or its cumulative impact with identified projects as described in the Fish sub-section of Section 8.	No additional residual effect beyond that defined in the subsection of Section 8 dedicated to the Fish VC.

The cumulative effect of all projects within the RAA combined result in a loss of potential access to lands for traditional or spiritual purposes. The total area of the identified projects in the RAA was calculated in order to quantify the area of land (for the purposes of this exercise, limited to crown land only) which may be lost for traditional purposes. The total estimated project footprint was calculated for each individual project, using publicly available study area boundaries where available, property boundaries, and aerial photo interpretation of project infrastructure if a study area boundary was not publicly available. As the calculations were based on each project's study area or property boundary rather than actual infrastructure, this method is considered an overestimate of land lost to traditional purposes. Furthermore, all projects were considered, regardless of the temporal nature of a project's implementation (past, present or future). As such, this exercise presents a worst-case scenario, assuming all projects overlap temporally to limit access for the Mi'kmaq for their traditional practices.

Two projects were excluded from this spatial land use exercise. The East River Sheet Harbour Hydro System was not considered as removing land available for traditional or spiritual purposes. These habitats are still available, but the nature of the aquatic habitat has changed in some areas from lotic to lentic, based on operation of hydro power facilities. Secondly, timber harvesting was not considered as a loss of access to land for traditional or spiritual purposes. Reliable, accurate data quantifying the area of timber harvesting which occurs on private land and Crown land is not available. Secondly, timber harvesting changes the habitat type for some time, but it does not result in permanent change in the capacity of the forest to support habitats and species (i.e., natural succession will, in time, allow forest habitat to regenerate), and it does not result in loss of access to the land on any time frame, with the exception of during active cutting periods. As such, these two projects were not quantified for this cumulative effects' assessment exercise.

The total area of projects within the RAA, and the proportion of Crown land is presented in Table 8.5-8. All projects quantified within the RAA account for 6282 ha of total area, 2494 ha of which is Crown land. The loss of access to a maximum area of 2,494 ha from all identified projects in the RAA accounts for 0.25% of all land within the RAA, and 0.75% of available Crown land within the RAA. The maximum project footprints used for this calculation are presented on Figure 8.5-7a through Figure 8.5-7d.

Table 8.5-8: Analysis of Cumulative Effect on access to crown land within the Mi'kmaq of Nova Scotia RAA

	Total Area (ha)	**Total Area of Crown Land**
RAA	1,014,397	331,057
CEA Projects within RAA	6,282	2,494

8.5.7.3 Mitigation

In part to mitigate the adverse effects on the use of surface waters and the fish that inhabit them for traditional purposes, the Proponent has committed to water treatment, if required, during operations at the FMS Mine Site, and has committed to water treatment, if required, for discharge from the PAG portion of the WRSA prior to mixing within the pit, during the post-closure phase prior to release into Anti-Dam Flowage. In order to mitigate the adverse effects of dust dispersion onto plants and berries for traditional purposes that inhabit the forests surrounding the FMS Mine Site, the Proponent has committed to twice-daily watering of mine roads and the use of chemical dust suppressants where needed to limit dust on the main site roads (Pit to Plant, and Plant to Highway 374).

The Proponent is committed to engaging in fisheries offsetting plans, and wetland compensation activities for the fish habitat and wetland loss associated with the Project as required by the Fisheries Act Authorization Process and provincial wetland alteration process for the Project.

The mitigation of the effects on land use and resources for traditional purposes originating from regional forestry and land management practices falls outside the scope of the project Proponent's authority and responsibility.

8.5.7.4 Residual Cumulative Effects and Significance Assessment

A significant cumulative adverse residual effect on the Mi'kmaq of Nova Scotia is defined as an environmental effect that results in one or more of the following outcomes:

- Long-term (greater than 20 years) or permanent loss of the availability of, or access to, land and resources currently relied on for traditional use practices; or if long-term or permanent loss is expected, no allowance for agreed-upon compensation with the affected Mi'kmaq community(s).
- An adverse health effect, as defined through the Human Health Risk Assessment outcomes, is predicted for affected population of Mi'kmaw communities.

Short-term (less than 20 years) loss of availability of land and resources caused by displacement due to Project activities are not considered to be significant.

The significance of potential effects on potential or established Aboriginal or treaty rights is a matter of consideration by the Crown and Mi'kmaq representatives (Assembly of Nova Scotia Chiefs and the Governments of Canada and Nova Scotia).

Assuming that the proposed mitigation and compensation measures are applied for the Project, and that they achieve their objectives, the predicted residual cumulative effects on the Mi'kmaq of Nova Scotia are assessed to be adverse, but not significant (Table 8.5-9).

Historical and current land use with the region has affected the local habitats in ways that have affected the local distribution and abundance of several species of flora and fauna. However, the total area of crown land that has been limited by all projects identified within the RAA is only 0.75% of available Crown land present within the RAA.

Table 8.5-9: Residual Cumulative Environmental Effects on the Mi'kmaq of Nova Scotia

Residual Adverse Cumulative Effects (After Mitigation and Compensation if required)	**Significance Levels**						**Overall Significance of Residual Adverse Effects (and Rationale)**
	Magnitude	**Geographic Extent**	**Timing**	**Duration**	**Frequency**	**Reversibility**	
Effects to Mi'kmaq of Nova Scotia and their traditional land use as a result from impacts to air quality, noise, light, surface water, fish habitat, and human health, and cumulative limitations to land use for traditional purposes from multiple projects within the RAA	L Mitigation and best management strategies reduce magnitude of impact The loss of access to a maximum area of 2,494 ha from all identified projects in the RAA accounts for 0.25% of all land within the RAA, and 0.75% of available crown land within the RAA	LAA Direct cumulative effects within PA, indirect cumulative effects within LAA BD Haul Road cumulative effects within LAA for BD Haul Road. Quantitative evaluation within BD EIS	A Seasonal windows applicable. Air dispersion affected by season and wind direction, noise and light effects will be limited by foliage when present on trees, effects to fish and fish habitat are more sensitive during spawning windows (spring and fall)	LT Effects will extend beyond 7 years – will extend to eleven years (11) of limited access to the FMS Mine Site, less than the defined 20 years in the context of the Mi'kmaq of Nova Scotia VC significant threshold	R VC interaction will occur regularly	R VC interaction will recover to baseline after Project activities are completed	Moderate Adverse Effect. (Not Significant). Assuming that the proposed compensation measures are applied for the Project and that they achieve their objectives, the predicted residual cumulative effects on the Mi'kmaq of Nova Scotia with regards to impacts to air quality, noise, light, surface water, fish habitat, and human health, are assessed to be adverse, but not significant. Loss of access is limited to 0.75% of available crown land within the RAA

Legend (refer to Table 5.10-1 for definitions)

Magnitude		Geographic Extent		Timing		Duration		Frequency		Reversibility	
N	Negligible	PA	Project Area	N/A	Not Applicable	ST	Short-Term	O	Once	R	Reversible
L	Low	LAA	Local Assessment Area	A	Applicable	MT	Medium-Term	S	Sporadic	IR	Irreversible
M	Moderate	RAA	Regional Assessment Area			LT	Long-Term	R	Regular		
H	High					P	Permanent	C	Continuous		

8.5.7.5 Follow-up and Monitoring Programs

No additional monitoring is recommended, beyond that provided in each VC section and associated cumulative effects section. The monitoring and follow-up of the residual cumulative effects, primarily caused by past and ongoing forestry practices, falls outside the scope of the project Proponent's authority and responsibility.

However, follow-up and monitoring of the site reclamation for the FMS Mine Site will need to be undertaken. In addition, it is expected that the development of benefit agreement(s) and implementation of the overall Mi'kmaq engagement strategy with regards to the Project will include regular review of compliance and effects monitoring programs associated with other VCs, as well as monitoring of Project benefits to the Mi'kmaq of Nova Scotia.

8.6 Cumulative Effects Summary

A Cumulative Effects Assessment was carried out in order to meet the general requirements of the *CEAA 2012*, as well as the specific requirements laid out in the FMS EIS Guidelines (CEAA, 2018).

The VCs included in the Cumulative Effects Assessment into consideration were the following:

- Physical Environment
  - Noise
  - Air
  - Light
  - Surface Water Quality and Quantity.
- Biophysical Environment
  - Fish and Fish Habitat
  - Species of Conservation Interest and Species at Risk
- Socio-Economic Environment
  - Mi'kmaq of Nova Scotia

Major industrial projects that have or are taking place within each VC's respective RAA were identified. Figures 8.5-1 through Figure 8.5-7d identify the Projects which were considered in the Cumulative Effects Assessment.

The main conclusions of the Cumulative Effects Assessments are as follows:

- The cumulative effects to Noise, Air and Light are considered to be adverse but not significant. The primary pathway for cumulative effects for these VCs is through increased traffic along the Beaver Dam Haul Road. Logging trucks, and traffic from both the FMS and Cochrane Hill Projects will account for approximately 24.6% of the total proposed traffic rates. This is not expected to result in a significant cumulative effect to any of these three VCs, as described in Sections 8.5.1 to 8.5.3.
- The primary pathway for cumulative effects regarding surface water quantity and quality is through the addition of the Project, the proposed expansion of the Touquoy pit and subsequent disposal of Touquoy tailings in the exhausted pit, the Beaver Dam Mine Project and Cochrane Hill Gold Project to the processing and waste disposal facilities at the Touquoy

Mine Site. The cumulative effects of these combined projects on the receiving environments are considered to be adverse, but not significant, provided all mitigation measures are implemented.

- Cumulative effects to fish and fish habitat can occur directly (through direct loss of fish habitat, for instance), or indirectly through effects of projects on water quantity and quality. No significant cumulative effects to surface water quantity and quality is expected. Timber harvesting is a predominant land use within the fish and fish habitat RAA. It is expected that timber harvesting be carried out under the Wildlife and Watercourse Protection Regulations, reducing the potential cumulative effect on fish and fish habitat. Therefore, the primary pathway for cumulative effects to fish and fish habitat is through direct fish habitat loss. The FMS Project will result in approximately 8.05 ha of direct loss of fish habitat to allow for construction of the Open Pit and associated infrastructure. The Project is expected to result in an additional 1.28 ha of indirect impact to fish habitat based on erosion and sedimentation downstream of the Seloam Brook Realignment, and due to flow reduction in local catchment areas. The presence of the East River Sheet Harbour Hydro Facility, in a sense, negates the cumulative effect of the Project on fish and fish habitat. This long history of barriers to fish passage has diminished the productive capacity and fish habitat quality of this area for anadromous fish for decades. As such, the potential for adverse significant effects to fish and fish habitat is determined to be low, with required mitigation (Seloam Brook Realignment and downstream fish habitat enhancement) and Fish Offsetting in place.

- Overall, the generalized disturbance of the landscape by forestry activities, past, present and future are the main source of cumulative effects of habitats, flora, terrestrial fauna and birds throughout the area. These cumulative effects also lead to effects on current use of land and resources for traditional purposes by the Mi'kmaq of Nova Scotia and to effects to priority species (SOCI and SAR). The maximum Project edge effect will affect 275 ha of interior forest habitat, which accounts for 0.47% of predicted interior forest in the RAA. There is limited additional development pressures from other projects in the RAA, as demonstrated by the few projects identified within this evaluation with small footprints of disturbance.

- The main pathways for cumulative effects to the Mi'kmaq of Nova Scotia are described as any adverse effect to the health and socioeconomic conditions, physical and cultural heritage, and current use of lands and resources for traditional purposes, as described in detail in Section 8.5.7. Cumulative effects of the Project on the Mi'kmaq of Nova Scotia, considering these three primary pathways, has been assessed as adverse, but not significant. The loss of access to a maximum area of 2,494 ha from all identified projects in the RAA accounts for 0.25% of all land within the RAA, and 0.75% of available crown land within the RAA. The largest regional impact to the landscape appears to be from regional forestry activities based only on aerial photography review. This impact could not be quantified herein due to a lack of publicly available data to support quantitative analysis.

Once the mitigation measures are taken into account, there are no significant residual cumulative effects anticipated for the VCs evaluated herein. The predicted residual cumulative effects on the Mi'kmaq of Nova Scotia with regards to indirect effects from impacts to water quality, wetland habitats, and road safety, are assessed to be adverse, but not significant.

Historical and current land use within the region has undeniably affected the local habitats in ways that have affected the local distribution and abundance of several species of flora terrestrial fauna and birds, including SOCI and SAR. However, the mitigation of the effects originating from regional forestry and land management practices falls outside the scope of the Project Proponent's authority and responsibility.

A summary of the cumulative effects assessment is provided in Section 9.

9.0 Summary of Environmental Effects Assessment

This section provides tables summarizing the following key information:

- Proposed mitigation measures to address the effects identified above as described in Section 6.0 of this EIS. The Proponent acknowledges that responsibility for implementation of all mitigation measures proposed within this EIS during the Project phases (construction, operation, and closure) ultimately rests with the Proponent; and,
- Potential residual effects and the significance of the residual environmental effects for each VC (Section 6.0) and the cumulative effects assessment (Section 8.0).

9.1 Summary of Environmental Impact Statement

As described throughout the EIS, Project-environment interactions are expected to occur throughout the life of the Project during the construction, operations, and closure phases. These interactions are well understood and are typical of environmental impacts associated with mineral extraction projects in the region and can be mitigated through proper planning, execution, mitigation measure, and monitoring and follow-up of the Project.

Table 9.1-1 summarizes all key mitigation measures and commitments made by the Proponent which will more specifically mitigate any significant adverse effects of the Project on VCs in order to ensure that the Project will not result in any significant residual adverse environmental effects post-mitigation. Proposed mitigation measures are described in greater detail in the effects assessment for each individual VC in Section 6.0. Throughout the EA planning process, a broad assortment of mitigation measures was considered as effects to each VC were described, quantified, and measured. All practicable, technically and ecologically feasible mitigation measures have been proposed within this EIS in order to ensure residual effects are not significant. Additional mitigation measures that may have been considered throughout the EA planning process would have been rejected for one or more of three reasons: not technically feasible; not ecologically feasible; or unnecessary based on predicted effects. Mitigation measures (Section 9.0) and proposed monitoring and follow-up programs (Section 10.0) have been reviewed with the Mi'kmaq of Nova Scotia during engagement activities (face to face meetings, email and telephone exchanges) and provision of summary documents (EIS poster boards, draft EIS (October 2019), Summary of Mi'kmaq Effects and Proposed Mitigation Measures document, and Plain Language Summary). Engagement will continue with the Mi'kmaq of Nova Scotia regarding mitigation and monitoring during the formal review of the EIS.

Mitigation measures for potential accidents and malfunctions are summarized in Table 9.1-2.

Table 9.1-3 provides a summary of residual cumulative effects. Details relating to justifications and rationales associated with residual effects can be found in Sections 6.1 to 6.15, and in Section 8.0 (cumulative effects) for the Project.

The Proponent acknowledges that responsibility for all mitigation commitments ultimately rest with the Proponent.

Table 9.1-1: Summary of Mitigation Measures by Valued Component

Project Phase	Mitigation Measures	Corresponding EIS Section Number and/or Appendix
Noise		
C	Consider placement of stockpiles and infrastructure to mitigate noise migration from processing equipment	6.1.7
C	Consider the use of natural landforms when available as noise barriers when designing final site details and when placing fixed equipment	6.1.7
C	Noise-reduction as criteria in equipment selection	6.1.7
C, O	Restrict blasting to a specific and regular daytime schedule during weekdays	6.1.7,
C, O	Communicate general blasting schedule to the local community	6.1.7
C, O	Regular check by site supervisors for excessive noise on site and in relation to sensitive receptors so that resolution can be timely	6.1.7, 6.10.7
C, O	Use equipment that meets appropriate noise emission standards for off-road diesel equipment	6.1.7
C, O	Speed reduction	6.1.7, 6.2.7, 6.10.6.3, Appendix L.1
C, O	Subcontractor agreements will include an obligation to comply with environmental protection including noise reduction	6.1.7
C, O	Site design to minimize the need for reversing and vehicle reversing alarms	6.1.7
C, O	A procedure will be developed that will allow the public to register complaints regarding noise concerns and will require the Proponent to respond in a timely and effective manner.	6.1.7, Appendix L.1
C,O,CL	Implement preventative maintenance plans for all mobile and stationary equipment	6.1.7, Appendix L.1
Air		
C, O, CL	A procedure will be developed that will allow the public to register complaints regarding dust concerns and will require the Proponent to respond in a timely and effective manner.	6.2.7, Appendix L.1

Project Phase	Mitigation Measures	Corresponding EIS Section Number and/or Appendix
C, O	Utilize paved surfaces where available	6.2.7
C, O	Speed reduction	6.1.7, 6.2.7, 6.10.6.3, Appendix L.1
C, O	Apply dust suppressants, when and where practicable, to target 55% effectiveness (twice daily watering of roads during dusty periods) and 75% effectiveness (chemical dust suppressants) on main site road from pit to plant and from plant to Highway 374	6.2.7, 6.9.7
C, O	Use mechanical sweeper on paved surfaces to prevent dust from remobilizing	6.2.7
O	Implement appropriate dust suppression measures for crusher trains and associated activities/stockpiles	6.2.7
O	Apply stabilized covers on inactive stockpiles, where necessary	6.2.7
O	Size and select haul vehicles appropriately to minimize trip frequency	6.2.7
O	Minimize dust during transportation through use of specialized hoppers (fully contained) for concentrate between the FMS and the Touquoy Mine Sites	6.2.7, 6.17.5.1.1
O	Implement Fugitive Dust Management Plan, which is included in the EMS Framework Document	6.2.7, Appendix L.1
CL	Stabilize slopes on inactive stockpiles to a safe and long-term angle of repose	6.2.7
CL	Use soil and organics stockpiles for final capping and stabilization. Hydroseed as required.	6.2.7
Light		
C, O, CL	Temporary lighting will be directly focused on work areas and shielded where practicable to avoid light trespass	6.3.7
C, O, CL	Use of only downward-facing lights on site infrastructure and mine site roads	6.3.7, 6.11.7, Appendix L.1
C, O, CL	Install motion-sensing lights, where practicable	6.3.7, 6.22.7, Appendix L.1
C, O, CL	All floodlights will employ full horizontal cut-off, as appropriate	6.3.7

Project Phase	Mitigation Measures	Corresponding EIS Section Number and/or Appendix
C, O, CL	Only use direct and focused light when needed for worker safety	6.3.7
C, O, CL	Lighting not in use will be turned off, whenever practicable	6.3.7, 6.10.7
C, O, CL	Site perimeter lighting will be directed to minimize offsite light trespass	6.3.7
C, O, CL	A procedure will be developed that will allow the public to register complaints regarding light concerns and will require the Proponent to respond in a timely and effective manner.	6.3.7, Appendix L.1
C, O, CL	Utilize efficient sources of light, such as LED, to reduce overall magnitude of light, wherever practicable	6.3.7
Geology, Soils and Sediment		
C, O, CL	Implement Erosion Prevention and Sediment Control Plan, which will be developed to support the EMS Framework Document	6.4.7, Appendix L.1
C, O, CL	Complete pre-construction site meetings for all relevant staff/contractors related to working around wetlands and watercourses and communicate the importance of implementing the Erosion Prevention and Sediment Control Plan	6.4.7, 6.9.7, Appendix L.1
C, O, CL	Construct site management ponds, and direct all site contact water into these ponds and to the TMF during operations, and to the pit during closure	6.4.7
C, O, CL	Re-vegetate slopes adjacent to wetlands and watercourses to limit erosion and sediment release	6.4.7, Appendix L.1
C	Construct settling pond(s) with geosynthetic liners at appropriate locations around the site that will facilitate the management of contact water during pit and other infrastructure development.	6.4.7
C	A modular effluent treatment plant for contact water will be available during construction if required.	6.4.7
C	Complete the Seloam Brook Realignment “in the dry” to, in part, reduce likelihood of erosion and sediment releases. Certain areas along the diversion berm may require additional bank protection from erosion, which will be considered when final designs for the Realignment are submitted to NSE as part of the IA application process.	6.4.7, Appendix L.1
C	Monitor stormwater pond discharges on a regular schedule, as stipulated in the provincial permit, prior to discharge (where practicable based on water quality).	6.4.7
C, O	Direct runoff through natural vegetation, wherever practicable	6.4.7

Project Phase	Mitigation Measures	Corresponding EIS Section Number and/or Appendix
C, O	Conduct vegetation management (cutting and clearing) in or near wetlands and watercourses in accordance with applicable guidelines	6.4.7, 6.7.7, Appendix L.1
Groundwater		
C, O, CL	Implement a Surface Water and Groundwater Management and Contingency Plan, which is included in the EMS Framework Document	6.5.7.1.1, Appendix L.1
C, O, CL	Construct the TMF water management to include a toe drain or equivalent, which collects seepage and gravity drains to seepage collection ponds.	6.5.7.1.1, 6.5.7.2.1
C, O, CL	Construct a water management system to collect stockpile and WRSA runoff and infiltrated water that exceeds baseline concentrations via a perimeter ditch system.	6.5.7.1.1, 6.5.7.2.1, 6.6.7.1
O	Collect open pit water via sumps and direct to the TMF	6.4.7, 6.5.7.1.1, 6.5.7.2.1
O	Manage groundwater flow from bedrock -overburden contact via a cut off trench up-gradient of the pit located below top of rock. Direct this groundwater flow from bedrock -overburden contact to the TMF with the pit water	6.5.7.1.1, 6.5.7.2.1
CL	Implement a cover system over the PAG portion of the WRSA to reduce infiltration and thereby by reducing groundwater seepage quantity, also reducing oxygen thereby reducing acid generation potential	6.5.7.1.1, 6.5.7.2.1, Appendix L.1
CL	Minimize the size of the TMF pond to reduce seepage through the tailings and minimizing tailings water interaction	6.5.7.1.1, 6.5.7.2.1
Surface Water		
C, O, CL	Develop and implement Surface Water and Groundwater Management and Contingency Plan to support the EMS Framework Document during pre-construction, and construct engineered water management systems to collect run-off and seepage from the PAG and NAG stockpiles, LGO stockpile, and TMF during operations and closure phases	6.6.7.1, Appendix L.1
C, O, CL	Development and Implement an Erosion Prevention and Sediment Control Plan, to support the EMS Framework Document	6.6.7.1, Appendix L.1
C, O, CL	Implement the Acid Rock Drainage Prediction and Mine Rock Management Plan including best practice mine rock mitigation strategies that may be considered should the results from the monitoring program indicate mitigation is necessary	6.6.7.1, Appendix F.2, Appendix F.3, Appendix L.1

Project Phase	Mitigation Measures	Corresponding EIS Section Number and/or Appendix
C, O, CL	Develop and implement an Emergency Response Plan (ERP), to support the EMS Framework to provide information on incident prevention, response procedures, training, isolation and disposal of contaminants	6.6.7.1, Appendix L.1
C	Construct engineered facilities complying with All applicable regulatory and technical requirements to store waste rock (PAG and NAG stockpiles), ore stockpiles, and tailings (TMF)	6.6.7.1
C	Develop a routing analysis and engineering controls to balance hydrological and ecological plans for the Seloam Brook Realignment Project	6.6.7.1
C	Design and install a berm along the eastern end of the organic stockpile to protect it from predicted flood events	6.6.7.1
O	Implement explosive use (blasting) BMPs to decrease the quantities of water-soluble residual explosives in the open pit, PAG and NAG stockpiles, and LGO stockpile	6.6.7.1
O	Collect and treat (if determined to be required) contact water (effluent) that is comprised of inflows and runoff from the pit walls, runoff and seepage from the PAG and NAG stockpiles, and runoff and seepage from the TMF, prior to discharge to the environment	6.6.7.1
CL	Treat the runoff from the PAG stockpile (if determined to be required), prior to discharge into pit and subsequent discharge to the environment	6.6.7.1
O, CL	Effluent will meet federal metal mining sector (MDMER) effluent limits and aquatic toxicity requirements prior to being discharged to the environment (FMS Mine Site and Touquoy Mine Site)	6.6.7.1, 6.6.8.2.2, 6.6.8.4.2
O, CL	Follow BMPs for effluent outfall design to optimize mixing and minimize disturbance to the surface water receiver	6.6.7.1
O, CL	Design and implement a TMF seepage collection system	6.6.7.1
CL	Implement an engineered cover system over the PAG stockpile portion of the WRSA	6.6.7.1
CL	Cover the TMF with material sourced from the till and topsoil stockpiles	6.6.7.1
Wetlands		
C, O, CL	Development Implement Erosion Prevention and Sediment Control Plan to support the EMS Framework Document	6.7.7, Appendix L.1

Project Phase	Mitigation Measures	Corresponding EIS Section Number and/or Appendix
C, O, CL	Complete pre-construction site meetings for all relevant staff/contractors related to working around wetlands and watercourses to minimize unauthorized disturbance, such as the introduction of invasive species	6.7.7, 6.7.9, Appendix L.1
C, O, CL	Maintain pre-construction hydrological flows through wetland habitats and partially altered wetlands, wherever practicable	6.6.7, 6.7.7
C, O, CL	Re-vegetate slopes adjacent to wetlands to limit erosion and sediment release	6.7.7, 6.9.7, Appendix L.1
C	Ensure all wetlands are visually delineated (e.g. flagged)	6.7.7
C	Translocation of blue felt lichen from wetlands where avoidance is not practicable	6.7.7, 6.12.7.2, Appendix L.1
C	Complete detailed design and micro-siting of Project Infrastructure to avoid or minimize wetland impact	6.7.7, 6.7.9
C	Acquire and adhere to wetland alteration permits	6.7.7
C	Implement construction methods that reduce the potential to drain or flood surrounding wetlands	6.7.7, Appendix L.1
C, O	Direct runoff through natural vegetation, wherever practicable	6.6.7, 6.7.7, Appendix L.1
C, O	Minimize erosion of wetland soils by limiting flow velocities by means of hydraulic dissipation techniques	6.6.7, 6.7.7, Appendix L.1
C, O	Minimize the rutting of wetland habitat by limiting the use of machinery within wetland habitat and use of swamp mats/corduroy bridges as required	6.7.7, Appendix L.1
C, O	Conduct vegetation management (cutting and clearing) in or near wetlands and watercourses in accordance with applicable guidelines	6.7.7, 6.9.7, Appendix L.1
CL	Compensate for permanent loss of wetland function through implementation of the Preliminary Wetland Compensation Plan, subject to NSE approval	6.7.7, Appendix G.4

Project Phase	**Mitigation Measures**	**Corresponding EIS Section Number and/or Appendix**
Fish and Fish Habitat		
C, O, CL	Complete offsetting for HADD including for permanent loss of fish habitat through fish habitat restoration activities, subject to DFO approval, based on the *Fisheries Act* current at time of the Project construction	6.7.7, 6.8.7, 6.8.7.2, 6.8.7.3, 6.8.7.4, 6.8.9, 6.13.6, Appendix J.7, Appendix L.1
C, O, CL	Develop and Implement Erosion Prevention and Sediment Control Plan to support the EMS Framework Document	6.4.7, 6.6.7.1, 6.7.7, 6.8.7.4, 6.9.7, Appendix L.1
C, O, CL	Complete pre-construction and periodic site meetings with relevant staff/contractors to educate and confirm policies related to working around fish bearing surface water systems including schedule of construction activities to minimize unauthorized disturbance and limit vegetation clearing	6.8.7, 6.8.7.4, Appendix L.1
C, O, CL	Maintain pre-construction hydrological flows into and out of down-stream surface water habitats, to the extent practicable, to limit indirect impacts to fish habitat	6.7.7, 6.8.7.4, Appendix L.1
C	Provide signage on fish habitat streams	6.8.7.3.1, 6.8.7.4
C	Complete micro-siting of mine infrastructure to avoid or minimize fish habitat impact	6.8.7.1, 6.8.7.4
C	Complete fish rescue within Seloam Brook Realignment footprint prior to commencement of mine development with DFO approval if required	6.8.7.2.1, 6.8.7.4
C	Implement water control features along North and South Channels to limit erosion and sedimentation downstream of the Seloam Brook Realignment	6.8.6.1.1, 6.8.7.2.1, 6.8.7.2.2, 6.8.7.4
C	Implement construction methods that reduce potential interaction with fish habitat and limit vegetation clearing around watercourses	6.8.7.2, 6.8.7.4
C	Complete culvert installations and upgrades in accordance with the NSE Watercourse Standard (2015b) or as updated at time of construction. Limit vegetation clearing	6.8.7.2, 6.8.7.4
C	Minimize the removal of vegetation upgradient of watercourses and stabilize shorelines or banks disturbed by any activity associated with Project activities	6.8.7.2, 6.8.7.4

Project Phase	Mitigation Measures	Corresponding EIS Section Number and/or Appendix
C	Minimize the temporal extent of in-stream works as much as practicable	6.8.7.4
C, O	Develop and Implement Surface Water and Groundwater Management and Contingency Plan to support the EMS Framework Document	6.6.7.1, 6.8.7.4, Appendix L.1
C, O	Follow DFO-advised *Measures to avoid causing harm to fish and fish habitat including aquatic species at risk* pertaining to blasting (DFO, 2018)	6.8.7.4
C, O	Select appropriate type of explosive that will minimize nitrogen release to surface water and groundwater	6.5.8.2.2, 6.6.7.1, 6.8.7.2, 6.8.7.4
C, O	Use clean, non-ore-bearing, non-watercourse derived and non-toxic materials for erosion control methods	6.6.7, 6.8.7.4
C, O	Incorporate drainage structures, where necessary, to dissipate hydraulic energy and maintain flow velocities sufficiently low to prevent erosion of native soil material	6.8.7.4
C, O	Limit clearing within confirmed fish habitat outside of approved alteration areas	6.8.7.4
C, O	Acquire and follow watercourse alteration permits and Fisheries Authorizations	6.6.6.1, 6.8.7.4
C, O	Adhere to applicable timing windows, as directed by DFO, for construction where infilling has been approved in wetlands and watercourses where fish habitat is present	6.8.7.4
C, O	Ensure fueling areas are a minimum of 30 m from waterbodies	6.8.7.4, 6.17.7, Appendix L.1
C, O	Ensure that machinery arrives on site in a clean condition and is maintained and free of fluid leaks	6.8.7.4, 6.17, Appendix L.1
C, O	Use and maintain properly sized screens on any water intakes or outlet pipes to prevent entrainment or impingement of fish	6.8.7.4, 6.17, Appendix L.1
C, O	Maintain 30 m riparian wetland and watercourse buffer, where practicable	6.8.7.2, 6.8.7.4

Project Phase	Mitigation Measures	Corresponding EIS Section Number and/or Appendix
Habitat and Flora		
C, O	Develop and Implement Erosion Prevention and Sediment Control Plan to support the EMS Framework Document	6.4.7, 6.4.9, 6.6.7, 6.7.7.1, 6.8.7.4, 6.9.7, 6.10.7, Appendix L.1
C, O	Maintain existing vegetation cover whenever practicable and minimize overall areas of disturbance	6.9.7, 6.10.7
C, O	Avoid frequent or unnecessary travel over erosion prone areas through communication with personnel and project planning	6.9.7, 6.10.7
C, O	Conduct vegetation management by cutting (e.g., no use of herbicides)	6.9.7
C, O	Implement construction methods that reduce the potential to drain or flood surrounding wetlands	6.7.7, 6.9.7
C, O	Employ measures to reduce the spread of invasive species (such as cleaning and inspecting vehicles) to maintain the quality of remaining habitat	6.7.7, 6.9.7
CL	Hydroseed areas that have erosion potential to return the area to pre-disturbance and stable conditions in a timely fashion upon final reclamation	6.9.7
CL	Implement reclamation program within the FMS Study Area to re-establish native vegetation communities	6.7.1.3.4.1, 6.9.7, Appendix L.1
Terrestrial Fauna		
C, O, CL	Provide wildlife awareness training to site personnel to reduce interactions between site personnel and wildlife	6.10.7, Appendix L.1
C	Reduce habitat fragmentation by minimizing new road construction wherever practicable	6.10.7, Appendix L.1
C	Complete detailed design of mine infrastructure to avoid major faunal habitat	6.10.7, Appendix L.1
C	Properly install culverts to improve or maintain habitat and connectivity for fauna	6.10.7, Appendix L.1
C, O	Maintain existing vegetation cover whenever practicable and minimize overall areas of disturbance	6.10.7, 6.9.7

Project Phase	Mitigation Measures	Corresponding EIS Section Number and/or Appendix
C, O, CL	Develop and implement an Erosion Prevention and Sediment Control Plan to support the EMS Framework Document	6.4.7, 6.4.9, 6.6.7, 6.7.7.1, 6.8.7.4, 6.9.7, 6.10.7, Appendix L.1
C, O, CL	Implement Emergency Response and Spill Contingency Plans to protect fauna and their habitat from accidental spills	6.10.7, 6.17, 6.1.3, Appendix L.1
C, O	Store hazardous and non-hazardous waste in designated locations, in appropriate containers to reduce potential for spills, and to prevent attracting wildlife (e.g., food waste in bear proof containers)	6.10.7, Appendix L.1
C, O, CL	Vehicles will yield to wildlife on roads	6.10.6.3, 6.10.7, Appendix L.1
C, O, CL	Implement speed limits within the FMS and Touquoy Mine Sites of 40 km/hr to reduce potential collisions with fauna	6.10.6.3, 6.10.7, 6.11.7, Appendix L.1
C, O, CL	Install signage where specific wildlife concerns have been identified	6.10.7, Appendix L.1
C, O	Install fencing, where practicable, to prevent wildlife from accessing areas with increased risk of injuries to wildlife	6.10.7, Appendix L.1
C, O	Monitor in and around site infrastructure for wildlife and if present work to relocate in accordance with the Wildlife Monitoring and Management Plan	6.10.7, Appendix L.1
C, O	Develop and implement Wildlife Monitoring and Management Plan in accordance with the EMS Framework Document	6.10.7, 6.11.7, Appendix L.1
C, O	Follow the *Pit and Quarry Guidelines* to reduce impact of noise and vibration on wildlife	6.10.7, Appendix L.1
C, O	Limit use of lights to the amount necessary to ensure safe operation within the FMS Study Area, with the recognition that excessive lighting can be disruptive to wildlife	6.3.7, 6.10.7, 6.11.7, Appendix L.1
C, O	Restrict blasting to a specific and regular daytime schedule during weekdays to allow time for wildlife to recover from potential noise disturbance	6.1.7, 6.10.7, Appendix L.1
C, O	Implement bird and wildlife deterrent program at the FMS TMF and the open pits at FMS and Touquoy, and continue bird deterrent programs at Touquoy during post closure	6.10.7, 6.11.6.1.3, 6.11.7, Appendix L.1

Project Phase	Mitigation Measures	Corresponding EIS Section Number and/or Appendix
CL	Implement reclamation plans to restore natural habitat and food source re-establishment to support fauna	6.10.7, Appendix L.1
Avifauna		
C, O	Avoid construction on native vegetation during the regional breeding season for migratory birds where practicable (beginning of April to end of August for migratory birds; EC 2015b). Where this is not practicable, a Bird Nest Mitigation Plan will be developed	6.11.7, Appendix L.1
C, O	If a raptor nest is found within the forested areas to be cleared, a buffer zone appropriate to the species (as determined in consultation with NSL&F) would be placed around the nest	6.11.7, 6.11.9, Appendix L.1
C, O	Limit the amount of exposed soil during nesting season	6.4.7, 6.11.7, Appendix L.1
C, O	Discourage ground-nesting or burrow-nesting species (such as common nighthawk and bank swallows), by limiting large piles or patches of bare soil during the breeding season, wherever practicable	6.10.7, 6.11.7, Appendix L.1
C, O	Communicate regulations related to nesting birds to all site personnel, particularly focused on those priority bird species which may be attracted to Project activities. If nesting behaviour is observed, site personal are to report this activity to the Proponent so appropriate mitigation measures can be implemented as necessary	6.11.7, 6.11.9, Appendix L.1
C, O	Should any ground- or burrow-nesting species initiate breeding activities on stockpiles or exposed areas, the Proponent will work with ECCC and NSE to develop buffer zones that incorporate adaptive management	6.11.7, 6.11.9, Appendix L.1
C, O	Maintain speed limits on mine roads (max. 40 km/hr. within the FMS Study Area) to minimize collisions with birds	6.10.6.3, 6.11.7, Appendix L.1
C, O	Implement dust suppression mitigation (refer to Air Mitigation)	6.2.7, 6.11.7, Appendix L.1
C, O	Install downward-facing lights on site infrastructure and site roads. Wherever practicable, install motion-sensing lights to ensure lights are not turned on when they are not necessary	6.3.7, 6.11.7, Appendix L.1
C, O	Conduct mobile refueling at least 30 m from any identified breeding locations	6.11.7
C, O	Monitor known nests around stockpiles and exposed areas from a distance with a spotting scope or binoculars to verify the effectiveness of an identified buffer until the nests are inactive	6.11.7, 6.11.9, Appendix L.1

Project Phase	Mitigation Measures	Corresponding EIS Section Number and/or Appendix
C, O	Conduct routine inspections of the open pit area to remove any trapped or injured birds. If identified, determine a plan for removal in consultation with an avian expert	6.11.7
C, O	Notify ECCC within 24 hours in the event of the mortality or injury of ten or more migratory birds in a single event or in the event of the mortality or injury of a migratory bird SAR	6.11.7, 6.11.9, 6.12.7.4, 6.12.7.5, Appendix L.1
O	Implement bird deterrent program at the FMS TMF if required, and continue current bird deterrent program at the Touquoy (expanding to the exhausted pit if necessary)	6.10.6.5, 6.11.6.1.3, 6.11.7, Appendix L.1
Species of Conservation Interest and Species at Risk		
C, O, CL	Blue Felt Lichen: Complete further detailed design, as is practicable, of FMS Mine Site infrastructure to avoid priority lichen species Reduce disturbance through buffering of habitat - maintain 100 m buffer, wherever practicable Implement air quality monitoring and dust suppression plans Flag host trees Provide map of all priority vascular and non-vascular flora to site personnel during site orientation Wherever avoidance of priority lichen species is not practicable, the Proponent will consult with a lichen specialist to determine the likelihood of successful transplantation of SAR lichens (blue felt lichen) to adjacent areas with suitable habitat. Where avoidance and transplantation are not feasible, specimens will be collected for submission to Frances Anderson or equivalent contact at time of construction (Lichen Specialist, Research Associate, and Nova Scotia Museum)	4.4, 6.2.7, 6.7.7, 6.9.7, 6.12.6.2, 6.12.7.2, Appendix L.1

Project Phase	Mitigation Measures	Corresponding EIS Section Number and/or Appendix
C, O, CL	<u>Mainland Moose:</u> Implement WMMP - including activities such as repeated winter track surveys and pellet group inventories, and collaboration with the Mi'kmaq of Nova Scotia to study Mainland Moose in a broader context Implement wildlife observation reporting to appropriate site personnel during construction, operation, and decommissioning of Project Vehicles will yield to wildlife on roads Vehicles will adhere to safe speed limits, particularly around blind corners. An un-vegetated buffer along roadsides will be maintained, where practicable, to improve visibility along roadsides and reduce the potential for collisions with wildlife Install fencing, where practicable, to prevent wildlife from accessing areas with increased risk of injuries to wild species - appropriate dimensions to address and eliminate accidental falls of species of varying size including deer and moose into the open pit	6.10.2.2, 6.10.3.2.1.1, 6.10.7, 6.12.3.3.2, 6.12.7.3, 6.12.7.5, Appendix L.1
C, O, CL	<u>Common Nighthawk:</u> Avoid clearing/grubbing activities during nesting season If construction is required during the active nesting season, an avian specialist will monitor for nesting activity. If evidence of nesting is observed, the Proponent will consult with appropriate regulatory agencies to determine an appropriate spatial and temporal buffer, based on site and seasonal specific parameters at the time of the observation To limit attraction of CONI to the Project, the amount of exposed soil during nesting season should be limited, and cover or revegetate soil wherever practicable. Limit light use to direct and focused light when needed for worker safety Implement noise management including use of mufflers on equipment and regular maintenance All site workers shall comply with regulations outlined in the Migratory Bird Convention Act, which prohibits the disturbance of migratory birds, their nests and eggs. If any nest is identified, the Proponent Environmental Technician must be notified immediately, so steps can be taken to identify the species and determine appropriate mitigation or avoidance if required. Species identified of particular risk and several species of birds known to nest around active construction sites will be included in the Wildlife Sighting Report Card similar to those required at the Touquoy Mine Site	6.1.7, 6.2.7, 6.3.7, 6.9.7, 6.11.7, 6.12.7.4, 6.12.7.5, Appendix L.1

Project Phase	Mitigation Measures	Corresponding EIS Section Number and/or Appendix
C, O, CL	Canada Warbler: Avoid clearing/grubbing activities during nesting season If construction is required during the active nesting season, an avian specialist will monitor for nesting activity. If evidence of nesting is observed, the Proponent will consult with appropriate regulatory agencies to determine an appropriate spatial and temporal buffer, based on site and seasonal specific parameters at the time of the observation Limit light use to direct and focused light when needed for worker safety Implement air quality monitoring and dust suppression plans Implement noise management including use of mufflers on equipment and regular maintenance All site workers shall comply with regulations outlined in the Migratory Bird Convention Act, which prohibits the disturbance of migratory birds, their nests and eggs. If any nest is identified, the Proponent Environmental Technician must be notified immediately, so steps can be taken to identify the species and determine appropriate mitigation or avoidance if required. Species identified of particular risk and several species of birds known to nest around active construction sites will be included in the Wildlife Sighting Report Card similar to those required at the Touquoy Mine Site	6.1.7, 6.2.7, 6.3.7, 6.9.7, 6.11.7, 6.12.7.4, 6.12.7.5, Appendix L.1
C, O, CL	Rusty Blackbird: Avoid clearing/grubbing activities during nesting season If construction is required during the active nesting season, an avian specialist will monitor for nesting activity. If evidence of nesting is observed, the Proponent will consult with appropriate regulatory agencies to determine an appropriate spatial and temporal buffer, based on site and seasonal specific parameters at the time of the observation Limit light use to direct and focused light when needed for worker safety Implement air quality monitoring and dust suppression plans Implement noise management including use of mufflers on equipment and regular maintenance All site workers shall comply with regulations outlined in the Migratory Bird Convention Act, which prohibits the disturbance of migratory birds, their nests and eggs. If any nest is identified, the Proponent Environmental Technician must be notified immediately, so steps can be taken to identify the species and determine appropriate mitigation or avoidance if required. Species identified of particular risk and several species of birds known to nest around active construction sites will be included in the Wildlife Sighting Report Card similar to those required at the Touquoy Mine Site	6.1.7, 6.2.7, 6.3.7, 6.9.7, 6.11.7, 6.12.7.4, 6.12.7.5, Appendix L.1

Project Phase	Mitigation Measures	Corresponding EIS Section Number and/or Appendix
C, O, CL	<u>Evening Grosbeak:</u> Avoid clearing/grubbing activities during nesting season If construction is required during the active nesting season, an avian specialist will monitor for nesting activity. If evidence of nesting is observed, the Proponent will consult with appropriate regulatory agencies to determine an appropriate spatial and temporal buffer, based on site and seasonal specific parameters at the time of the observation Limit light use to direct and focused light when needed for worker safety Implement noise management including use of mufflers on equipment and regular maintenance Implement air quality monitoring and dust suppression plans All site workers shall comply with regulations outlined in the Migratory Bird Convention Act, which prohibits the disturbance of migratory birds, their nests and eggs. If any nest is identified, the Proponent Environmental Technician must be notified immediately, so steps can be taken to identify the species and determine appropriate mitigation or avoidance if required. Species identified of particular risk and several species of birds known to nest around active construction sites will be included in the Wildlife Sighting Report Card similar to those required at the Touquoy Mine Site	6.1.7, 6.2.7, 6.3.7, 6.9.7, 6.11.7, 6.12.7.4, 6.12.7.5, Appendix L.1
C, O, CL	<u>Olive-sided Flycatcher:</u> Avoid clearing/grubbing activities during nesting season If construction is required during the active nesting season, an avian specialist will monitor for nesting activity. If evidence of nesting is observed, the Proponent will consult with appropriate regulatory agencies to determine an appropriate spatial and temporal buffer, based on site and seasonal specific parameters at the time of the observation Limit light use to direct and focused light when needed for worker safety Implement noise management including use of mufflers on equipment and regular maintenance Implement air quality monitoring and dust suppression plans All site workers shall comply with regulations outlined in the Migratory Bird Convention Act, which prohibits the disturbance of migratory birds, their nests and eggs. If any nest is identified, the Proponent Environmental Technician must be notified immediately, so steps can be taken to identify the species and determine appropriate mitigation or avoidance if required. Species identified of particular risk and several species of birds known to nest around active construction sites will be included in the Wildlife Sighting Report Card similar to those required at the Touquoy Mine Site	6.1.7, 6.2.7, 6.3.7, 6.9.7, 6.11.7, 6.12.7.4, 6.12.7.5, Appendix L.1

Project Phase	Mitigation Measures	Corresponding EIS Section Number and/or Appendix
C, O, CL	Eastern Wood-peewee: Avoid clearing/grubbing activities during nesting season If construction is required during the active nesting season, an avian specialist will monitor for nesting activity. If evidence of nesting is observed, the Proponent will consult with appropriate regulatory agencies to determine an appropriate spatial and temporal buffer, based on site and seasonal specific parameters at the time of the observation Limit light use to direct and focused light when needed for worker safety Implement noise management including use of mufflers on equipment and regular maintenance Implement air quality monitoring and dust suppression plans All site workers shall comply with regulations outlined in the Migratory Bird Convention Act, which prohibits the disturbance of migratory birds, their nests and eggs. If any nest is identified, the Proponent Environmental Technician must be notified immediately, so steps can be taken to identify the species and determine appropriate mitigation or avoidance if required. Species identified of particular risk and several species of birds known to nest around active construction sites will be included in the Wildlife Sighting Report Card similar to those required at the Touquoy Mine Site	6.1.7, 6.2.7, 6.3.7, 6.9.7, 6.11.7, 6.12.7.4, 6.12.7.5, Appendix L.1
C	The Proponent will transplant priority flora species, where deemed reasonable and appropriate, in consultation with regulators and the Mi'kmaq of Nova Scotia, that are located within the direct footprint of the Project infrastructure to nearby areas where suitable habitat is present. Where avoidance or transplanting is not practicable, vascular flora SOCI from areas proposed for direct impact will be collected for herbarium records or for preservation of seeds in a seed bank through Acadia University	6.12.7.2, 6.12.7.5
Mi'kmaq of Nova Scotia		
EIS Review	Support Mi'kmaq third party review of the Proponent's EIS, including mitigation and monitoring programs	4.1, 4.4, 6.13.6
EIS Review	Continuing to work with the Mi'kmaq to delineate the specificity of Mi'kmaq traditional use, and meet with the Mi'kmaq to receive feedback on EIS conclusions and impacts	4.1, 4.4, 6.13.6
C	Provide Mi'kmaq land users the opportunity to walk the FMS Study Area with Proponent representatives to identify and document sensitive sites prior to construction	6.13.6, Appendix K.2
C	Provide a tour of the FMS Mine Site and information on Project operations to interested Mi'kmaq peoples	6.13.6, Appendix K.2
C	Develop a Mi'kmaq Communication Plan with the Mi'kmaq of Nova Scotia that outlines an ongoing two-way communication process throughout the lifecycle of the Project	4.4, 6.13.6, Appendix K.2

Project Phase	Mitigation Measures	Corresponding EIS Section Number and/or Appendix
C	As part of the existing communications process, the Proponent will build upon and strengthen a Complaints Management and Action Program for Mi'kmaq input in advance of Project commencement, as an opportunity for having grievances heard and addressed, and development of an emergency communication protocol.	4.4, 6.13.6, Appendix K.2
C	Possible establishment of an environmental protection committee to review proposed and develop additional environmental mitigation protocols, oversee monitoring procedures and review/evaluate results. This committee should have representation from Proponent environmental experts, as well as Mi'kmaw representatives from Unama'ki Institute of Natural Resources, the Mi'kmaq Conservation Group, and NSE.	4.4, 6.13.6, Appendix K.2
C	Designed bypass roads allow for travel routes to by-pass the FMS Mine Site and allow access to Seloam Lake and areas east of the Project.	4.4, 6.13.6, Appendix K.2
C	In the event that Mi'kmaw archaeological features are encountered during construction or operation of the Project, all work in the area will be halted and immediate notification made to the Special Places Coordinator, Nova Scotia Museum, the KMKNO and the communities of Sipekne'katik and Millbrook. As part of the EMS Framework, the Proponent will ensure mitigation measures are undertaken to prevent irreversible damage to Mi'kmaq archaeological resources and burial site, including ensuring activities are within defined Project area.	6.13.6, Appendix L.1
C, O, CL	The Proponent would like to ensure there are various opportunities for Mi'kmaq participation in the Project, including opportunities to participate in environmental monitoring and implementation of Mi'kmaq projects such as fish habitat offsetting, wetland compensation, and others. The Proponent will continue to engage with the Mi'kmaq on various project benefits	4.4, 6.13.6, Appendix K.2
C, O, CL	Engage in open dialogue with affected communities relating to issues of limited Mi'kmaq access to the FMS Mine Site for the 11 year project window and discuss mitigation options including suitable alternative crown land access in close proximity to the FMS Mine Site	4.4, 6.13.6, Appendix K.2
CL	Continue to engage with the Mi'kmaq of Nova Scotia to determine how they would like to participate and integrate traditional knowledge into the Reclamation and Closure Plan for the Project. The Proponent will also provide the opportunity for the Mi'kmaq to provide input on species used in revegetation, reclamation techniques, and the opportunity for Mi'kmaq members to join the reclamation team to execute this Project phase	4.4, 6.13.6, Appendix K.2
C, O, CL	Commitment to developing and conducting a Mi'kmaq Cultural Awareness Program for staff and contractors. Scope to be determined based on further discussions	4.4, 6.13.6, Appendix K.2

Project Phase	Mitigation Measures	Corresponding EIS Section Number and/or Appendix
Physical and Cultural Heritage		
C	Any further changes in the layout of the mine and associated facilities will be evaluated as to the potential impacts to archeological resources	6.14.7
C	Areas of potential archeological significance (Area 2) will be avoided, in the design and development of the Project	6.14.7
C	Intensified historical research, archeological shovel testing, where required, and detailed documentation will be conducted in advance of disturbance at Sites 1-6 and the historical road associated with Site 7	6.14.7
C	If the area of elevated archeological potential (Area 2) is to be impacted by future development, a program of archeological shovel testing will be conducted in advance of disturbance to allow for micro-siting of infrastructure	6.14.7
C	If archeological deposits or human remains are encountered during construction activities associated with the Project, all work in the immediate vicinity will be halted and the Special Places Program will be contacted	6.14.7
Socio-economic Conditions		
C	Restriction of recreational activities within the spatial boundaries of the Project. Notification to be provided by signage	6.15.7
C	Construction of local by-pass routes to allow recreational traffic to travel around the FMS Mine Site to reach Seloam Lake and other recreational areas east of the mine site	6.13.6, 6.14.6.1, 6.15.7
C	Liaison with recreation groups, such as Sheet Harbour Snowmobile and ATV Club	6.15.7
O	Restriction of recreational activities within the spatial boundaries of the Project. Notification will be provided by signage	6.15.7
O	Update of Socio-economic impact statement to assess impact. This may occur at the discretion of the Proponent. Impact Study projections are calculated to reflect conservative estimates	6.15.7
Effects of the Environment on the Project		
C	Project design will follow industry standards, including the National Building Code of Canada.	7.1.5, 7.2, Appendix D.1

Project Phase	Mitigation Measures	Corresponding EIS Section Number and/or Appendix
C, O	Project design to consider extreme weather events, temperature extremes, wind speed ranges, flood or drought conditions, lightning strikes.	7.2, Appendix L.1
C, O, CL	Minimize the potential for slope failure	6.17.4.2.2, 7.2, Appendix L.1
C, O, CL	Stockpile design will consider collected geological data and will be designed with slopes at the angle determined by geotechnical analysis and acceptable safety factors	6.17.4.2.2, 7.2, Appendix L.1
C, O, CL	A Health and Safety Plan will be developed and implemented in accordance with the EMS Framework Document to protect worker health and safety	7.2, Appendix L.1
C, O, CL	An Emergency Response Plan will be developed and implemented in accordance with the EMS Framework Document	7.2, Appendix L.1

Note: C = Construction Phase, O = Operation Phase, CL = Closure Phase.

Table 9.1-2: Summary of Accidents and Malfunctions Mitigations

Potential Accident or Malfunction	Mitigation Measures
Open Pit Mine Slope Failure	Ensure that pit slope design, construction and monitoring follow applicable regulations and recommendations provided by a qualified geotechnical professional.
Stockpile Slope Failure	Ensure that stockpile design, construction and monitoring follow applicable regulations and recommendations provided by a qualified geotechnical professional.
Water Management Pond Failure	Ensure that the water management ponds are designed by a qualified professional and lined with suitable materials, such as clay or a geosynthetic liner.
TMF Dam Failure	Ensure that TMF designed, and construction is overseen and approved by qualified design engineers (the Design Engineers/Engineer of Record). A tailings deposition strategy will be implemented to selectively develop tailings beaches along the embankments, thereby producing an extensive low permeability zone that facilitates seepage control and maintains the operational supernatant pond away from the crest of the embankment.

Potential Accident or Malfunction	**Mitigation Measures**
Infrastructure Failure	Ensure that infrastructure is designed following applicable regulations and recommendations provided by a qualified professional.
Fuel and/or other spills	All fuel delivery suppliers and their personnel will have proper certification and training in fuel transport and delivery in compliance with applicable regulatory requirements. Onsite storage and dispensing of fuel products will be conducted in accordance with applicable regulatory requirements and adhere to the Petroleum Management Plan and related site-specific procedures. Staff will be trained in spill response measures. Spill response kits will be accessible and dedicated in areas of fuel storage and transfer.
Mobile Equipment Accident	The FMS Mine Site will have restricted traffic patterns, speed limits, right-of-way signage and training that will minimize the risk of mobile equipment accidents. Highway haul trucks will be remotely tracked and monitored. Communications will be maintained between vehicles using radios to minimize adverse interactions and ensure prompt response to any incident.
Tailings and Reclaim Water Pipelines Spills	The tailings and reclaim pipelines between the plant site, TMF and open pit will be designed and constructed to minimize the potential for release. Measures may include double walled tailings pipes, lined service trenches and adequately sized, lined, collection pond capable of containing the volume of the pipeline. The catchment pond would be lined with suitable materials, such as clay or a geosynthetic liner.
Cyanide Release (Touquoy Mine Site)	Cyanide is transported stored and handled in accordance with applicable regulatory requirements and the International Cyanide Management Code. Cyanide is stored and handled inside the plant footprint within a restricted area that has adequate impermeable containment.
Forest and/or Site Fires	Fire protection for the plant site will be via a “wet system” with hydrants located around the plant site area. The water contained within the lower portion of the raw water tank will be reserved for fire protection. Fire detection systems will be installed in buildings and key areas of the FMS Mine Site.
General Commitment	Development of the Environmental Management System (EMS) and all associated plans.

Table 9.1-3: Summary of Residual Effects by Valued Component

Valued Component	Area of Federal Jurisdiction	Potential Effects of the Project on the Environment	Mitigation and Compensation Measures	Nature of Effect	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect	Corresponding EIS Residual Effects Section Number
					Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility			
Noise	N/A	Construction and Operations – FMS Mine Site at Property Boundary	Equipment maintenance, best management practices, and minimize blasting events	A	L	PA	A	MT	R	R	Increased ambient noise	Not significant	6.1.8
		Construction and Operations – FMS Mine Site at Points of Reception		A	L	LAA	A	MT	R	R	Increased Ambient noise	Not significant	
		Operational – Touquoy Mine Site at Property Boundaries		A	L	PA	N/A	MT	R	R	Increased Ambient noise	Not significant	
		Closure – FMS Mine Site at Property Boundary		A	L	PA	A	MT	R	R	Increased Ambient noise	Not significant	
Air	N/A	Construction and Closure- FMS Mine Site, Dust and Air Pollutant concentrations at Property Boundary	Dust suppressants targeting 55% and 75% effectiveness; Regular equipment maintenance	A	L	LAA	A	MT	R	R	Increased ambient dust and air pollutants	Not significant	6.2.8
		Operational - FMS Mine Site, Dust and Air Pollutant concentrations at Property Boundary		A	L	LAA	A	MT	R	R	Increased ambient dust and air pollutants	Not significant	
		Construction and Closure - FMS Mine Site, Human Exposure to COPC from Dust Deposition at Property Boundary and 1 km from Property Boundary		A	L	LAA	N/A	MT	R	R	Increased Human Exposure to COPCs	Not significant	
		Operational- FMS Mine Site, Human Exposure to COPC from Dust Deposition at Property Boundary and 1 km from Property Boundary		A	L	LAA	N/A	MT	R	R	Increased Human Exposure to COPCs	Not significant	
		Construction, Operation and Closure - FMS Mine Site, GHG emission levels	Regular equipment maintenance	A	N	RAA	N/A	LT	R	R	Increased GHG emissions	Not significant	
Light	N/A	Construction and Closure – FMS Mine Site	Limited vegetation clearing. Minimize lighting (downward facing lighting, motion sensor lights, light positioning away from property boundaries where practicable).	A	L	LAA	N/A	MT	R	R	Increased Ambient Light	Not significant	6.3.8
		Operation – FMS Mine Site and Touquoy Mine Site		A	L	LAA	N/A	MT	R	R	Increased Ambient Light	Not significant	

Valued Component	Area of Federal Jurisdiction	Potential Effects of the Project on the Environment	Mitigation and Compensation Measures	Nature of Effect	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect	Corresponding EIS Residual Effects Section Number
					Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility			
Geology, Sediment and Soils	N/A	Construction, Operations and Closure – FMS Mine Site, Sediment discharge to watercourses/wetlands	Erosion and sediment control measures and stormwater management measures including system design described in EMS and monitored during site construction.	A	L	LAA	A	LT	S	R	Sediment Release	Not significant	6.4.8
		Construction, Operations and Closure – FMS Mine Site, Removal of historic waste rock and tailings		P	M	LAA	A	P	O	IR	Removal of Contaminant Source	Not significant, Moderately Positive	
Groundwater	N/A	Construction/Operation-- FMS Study Area Groundwater Quantity, Increased permeability in the bedrock around the blast holes used to create the open pit.	Groundwater collected in the open pit due to this enhanced permeability is conveyed away via the water management system	A	H	PA	A	P	C	IR	Enhanced rock permeability adjacent to the open pit	Not significant	6.5.9
Surface Water (Quality) FMS Mine Site	N/A	Construction FMS Mine Site – Surface Water Quality, Ground disturbance associated with earthworks increases transport of suspended solids to adjacent surface water bodies, Reduction in surface flow within local catchment areas	Best Management Practices (BMPs) for erosion/ sediment control	A	L	PA (FMS only)	A	ST	R	PR	Change in Water Quality	Not significant	6.6.8
		Operations FMS Mine Site – Surface Water Quality, Discharge of effluent from the TMF pond to Anti-Dam Flowage Reservoir increases parameter concentrations in the receiver (assessment point EMZ-2 and SW6)	BMPs for erosion/sediment control, BMPs for explosives use, Engineered water management systems to collect runoff and seepage, Remedial action (i.e., water treatment) (if warranted) triggered by monitoring	A	L	LAA	A	LT	R	PR	Change in Water Quality	Not significant	
		Operations FMS Mine Site – Surface Water Quality, Seepage from the TMF that bypasses the collection system and reports to assessment points SW5 (Seloam Brook) and SW15 (East Lake) increases parameter concentrations in the receivers.	Engineered water management systems to collect runoff and seepage	A	L	LAA	A	LT	C	PR	Change in Water Quality	Not significant	
		Operations FMS Mine Site – Surface Water Quality, Seepage from the TMF that bypasses the collection system and potentially reports to WC12 increases parameter concentrations in the receiver.	Engineered water management systems to collect runoff and seepage	A	L	PA (FMS only)	A	LT	C	PR	Change in Water Quality	Not significant	
		Reclamation FMS Mine Site – Surface Water Quality, Ground disturbance associated with earthworks increases transport of suspended solids to adjacent surface water bodies	Best Management Practices (BMPs) for erosion/ sediment control, Engineered water management systems to collect runoff and seepage and direct to open pit	A	L	PA (FMS only)	A	MT	R	PR	Change in Water Quality	Not significant	

Valued Component	Area of Federal Jurisdiction	Potential Effects of the Project on the Environment	Mitigation and Compensation Measures	Nature of Effect	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect	Corresponding EIS Residual Effects Section Number
					Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility			
Surface Water (Quality) FMS Mine Site (continued)	N/A	Post-Closure FMS Mine Site – Surface Water Quality, Discharge of effluent from the flooded open pit to Anti-Dam Flowage Reservoir increases parameter concentrations in the receiver (EMZ-2 and SW6)	Engineered water management systems to collect runoff and seepage, Placement of cover over the PAG stockpile, Placement of cover over the tailings beach, Treatment of discharge from PAG portion of WRSA prior to discharge to environment (if/as required)	A	M	LAA	A	P	R	IR	Change in Water Quality	Not significant	6.6.8
		Post-Closure FMS Mine Site– Surface Water Quality, Seepage from the TMF that bypasses the collection system and reports to assessment points SW5 (Seloam Brook) and SW15 (East Lake) increases parameter concentrations in the receivers.	Engineered water management systems to collect runoff and seepage, Placement of cover over the tailings beach	A	L	LAA	A	P	C	IR	Change in Water Quality	Not significant	
		Post-Closure FMS Mine Site – Surface Water Quality, Seepage from the TMF that bypasses the collection system and reports to WC12 increases parameter concentrations in the receiver.	Engineered water management systems to collect runoff and seepage	A	L	PA (FMS only)	A	LT	C	PR	Change in Water Quality	Not significant	
Surface Water (Quantity) FMS Mine Site	N/A	Construction FMS Mine Site – Surface Water Quantity, Construction of Open Pit perimeter berms redirects Seloam Brook Further described in Wetlands, Fish and Fish Habitat sections.	Selection of realignment channel routing to minimize upstream standing water and maintain habitat downstream.	A	H	PA (FMS only)	A	P	C	IR	Change in hydrological conditions	Not significant	
		Construction/Operations FMS Mine Site – Surface Water Quantity, Clearing and grubbing, altered hydrology, and altered surface water quality Sediment loading and resulting change in geomorphology of channels downstream of the Seloam Brook Realignment	Sediment and Erosion control, best management practices, spill preparedness, and engagement in the watercourse permitting process. Seloam Brook Realignment downstream water control structures	A	L	PA (FMS only)	A	P	S	IR	Disturbance	Not significant	
		All Phases FMS Mine Site – Surface Water Quantity, Reduction in flow in LCA for WC12 Further described in Wetlands, Fish and Fish Habitat sections.	Monitoring to confirm	A	L	PA (FMS only)	A	P	C	IR	Change in hydrological conditions	Not significant	
		All Phases FMS Mine Site– Surface Water Quantity, Reduction in flow in LCA for WC26 Further described in Wetlands, Fish and Fish Habitat sections.	Monitoring to confirm	A	M	PA (FMS only)	A	P	C	IR	Change in hydrological conditions	Not significant	

Valued Component	Area of Federal Jurisdiction	Potential Effects of the Project on the Environment	Mitigation and Compensation Measures	Nature of Effect	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect	Corresponding EIS Residual Effects Section Number
					Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility			
Surface Water (Quantity) FMS Mine Site (continued)	N/A	All Phases FMS Mine Site – Surface Water Quantity, Reduction in flow in LCA for WC2 Further described in Wetlands, Fish and Fish Habitat sections.	Monitoring to confirm	A	H	PA (FMS only)	A	P	C	IR	Change in hydrological conditions	Not significant	6.6.8
		Operations FMS Mine Site – Surface Water Quantity, Change in surface water flow quantity to assessment locations SW2, SW5, SW6 and SW14	Monitoring to confirm	A	L	RAA	A	MT	R	PR	Change in hydrological conditions	Not significant	
		Operations FMS Mine SIte – Surface Water Quantity, Change in surface water quantity to assessment location SW15. Further described in Wetlands, Fish and Fish Habitat sections.	Monitoring to confirm	A	H	LAA	A	P	R	IR	Change in hydrological conditions	Not significant	
		Operations/Reclamation/Post-Closure FMS Mine Site – Surface Water Quantity, Change in groundwater contribution to streamflow	Monitoring to confirm	A	L	LAA	A	MT	C	PR	Change in hydrological conditions	Not significant	
		Reclamation FMS Mine Site – Surface Water Quantity, Change in surface water quantity to assessment location SW5, SW14, SW6, During pit filling	Monitoring to confirm	A	L	RAA	A	MT	R	PR	Change in hydrological conditions	Not significant	
		Reclamation FMS Mine Site– Surface Water Quantity, Change in surface water quantity to assessment location SW15, During pit filling Further described in Wetlands, Fish and Fish Habitat sections.	Monitoring to confirm	A	H	PA (FMS only)	A	MT	R	IR	Change in hydrological conditions	Not significant	
		Reclamation FMS Mine Site – Surface Water Quantity, Change in groundwater contribution to streams during pit filling	Monitoring to confirm	A	L	LAA	A	MT	C	PR	Change in hydrological conditions	Not significant	
		Closure FMS Mine Site – Surface Water Quantity, Change in surface water flow quantity to assessment locations SW5, SW6 and SW14	Monitoring to confirm	A	L	LAA	A	P	R	IR	Change in hydrological conditions	Not significant	
		Closure FMS Mine Site – Surface Water Quantity, Change in surface water quantity to assessment location SW15 Further described in Wetlands, Fish and Fish Habitat sections.	Monitoring to confirm	A	H	LAA	A	P	R	IR	Change in hydrological conditions	Not significant	

Valued Component	Area of Federal Jurisdiction	Potential Effects of the Project on the Environment	Mitigation and Compensation Measures	Nature of Effect	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect	Corresponding EIS Residual Effects Section Number
					Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility			
Surface Water (Quantity) FMS Mine Site (continued)	N/A	Closure FMS Mine Site– Surface Water Quantity, Change in surface water quantity to assessment location SW5 and SW6 post treatment as required and direct discharge to Seloam Brook	Monitoring to confirm	A	L (SW6) M (SW5)	LAA	A	P	R	IR	Change in hydrological conditions	Not significant	6.6.8
		Closure FMS Mine Site – Surface Water Quantity, Change in groundwater contribution to streamflow	Monitoring to confirm	A	L	LAA	A	MT	C	PR	Change in hydrological conditions	Not significant	
Surface Water (Quality) Touquoy Mine Site	N/A	Closure Touquoy Mine Site – Water Quality, Discharge into Moose River	Water Treatment as required, monitoring to confirm	A	L	LAA	A	P	C	IR	Change in Water Quality	Not significant	
Surface Water (Quantity) Touquoy Mine Site	N/A	Closure Touquoy Mine Site – Water Quantity, Discharge into Moose River and groundwater seepage	Monitoring to confirm	A	L	LAA	A	P	R	IR	Change in Hydrological Conditions	Not significant	
Wetlands	N/A	Construction – FMS Mine Site, Direct alteration of wetland habitat	Sediment and erosion control, best management practices, spill preparedness, and engagement in the wetland permitting process.	A	M	PA	A	P	O	IR	Habitat loss and disturbance	Not significant	6.7.8
		Construction and Operations – FMS Mine Site, Potential indirect impacts to wetlands including groundwater drawdown, Seloam Brook Realignment, flooding and local hydrological alterations	Sediment and erosion control, best management practices, spill preparedness, wetland monitoring and water management.	A	L	LAA	A	LT	R	PR	Disturbance	Not significant	
		Operations – Touquoy Mine Site, Potential indirect impacts to wetlands downstream of proposed discharge location in Moose River.	Sediment and erosion control, best management practices, spill preparedness, wetland monitoring and water management.	A	N	LAA	A	LT	R	PR	Disturbance and change in hydrological conditions	Not significant	
		Reclamation – FMS Mine Site, Wetland restoration	Sediment and erosion control, best management practices, and spill preparedness.	P	L	PA	A	LT	O	PR	Habitat restoration	Not significant	

Valued Component	Area of Federal Jurisdiction	Potential Effects of the Project on the Environment	Mitigation and Compensation Measures	Nature of Effect	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect	Corresponding EIS Residual Effects Section Number
					Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility			
Fish and Fish Habitat	☑ 5(1)(a)(i)	Construction – FMS Mine Site, Direct watercourse, open water, and wetland alteration, including the Seloam Brook Realignment	Sediment and erosion control, best management practices, spill preparedness, and engagement in the watercourse and fish habitat alteration permitting processes. Seloam Brook Realignment downstream water control structures. Implementation of Fish Habitat Offset Plan	A	M	LAA	A	P	O	IR	Habitat loss and disturbance	Not significant	6.8.8
		Construction – FMS Mine Site, Clearing and grubbing, altered hydrology, and altered surface water quality Sediment loading and resulting change in geomorphology of channels downstream of the Seloam Brook Realignment	Sediment and erosion control, best management practices, spill preparedness, and engagement in the watercourse permitting process. Seloam Brook Realignment downstream water control structures.	A	M	LAA	A	P	S	IR	Disturbance	Not significant	
		Operations – FMS Mine Site, Indirect impacts including: altered surface water hydrology in the LCA for WC2 and regional catchment area SW15	Sediment and erosion control, best management practices, and spill preparedness. Implementation of Fish Habitat Offset Plan	A	M	LAA	A	P	R	IR	Habitat loss and disturbance	Not significant	
		Operations – FMS Mine Site, Indirect impacts including: altered surface water hydrology in other local or regional catchment areas, altered surface water quality	Sediment and erosion control, best management practices, and spill preparedness.	A	L	LAA	A	P	R	IR	Disturbance	Not significant	
		Operations and Post Closure – FMS Mine Site, Surface water quality	Water treatment (if/as required)	A	N	LAA	A	P	R	PR	Change in water quality	Not significant	
		Operations and Post Closure – Touquoy Mine Site, Altered surface water hydrology and surface water quality	Water treatment (as required)	A	N	LAA	A	P	R	PR	Change in water quality	Not significant	
Habitat and Flora	N/A	Construction of FMS Mine Site, Clearing and grubbing	Limit habitat disturbance and minimize Project footprint during detailed design, sediment and erosion control, re-stablish habitat and associated vegetation communities during reclamation	A	M	PA	N/A	LT	O	PR	Habitat loss	Not significant	6.9.8
		Operations and Closure – FMS Mine Site, Heavy machinery operation, vehicle activity	Monitor dust conditions on roads in periods with low rain. Sediment and erosion control. Dust mitigation Practice spill preparedness.	A	L	PA	N/A	MT	R	R	Disturbance	Not significant	
		Reclamation Stage of Closure – FMS Mine Site, Re-vegetation using stockpiled materials	N/A	P	L	PA	N/A	LT	O	PR	Habitat restoration	Not significant	

Valued Component	Area of Federal Jurisdiction	Potential Effects of the Project on the Environment	Mitigation and Compensation Measures	Nature of Effect	Residual Environmental Effects Characteristics: Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility	Residual Effect	Significance of Residual Effect	Corresponding EIS Residual Effects Section Number
Terrestrial Fauna	N/A	Construction – FMS Mine Site, Habitat loss and fragmentation from clearing and grubbing, sensory disturbance related to noise, light, dust deposition and vehicle collisions	Limit habitat disturbance and minimize Project footprint during detailed design, implement speed limits, install fences where necessary, and minimize lighting.	A	M	LAA	A	MT	O	PR	Habitat loss	Not significant	6.10.8
		Construction – FMS Mine Site, Disturbance (noise, light, and wildlife vehicle collisions) from construction activities		A	L	LAA	A	ST	R	R	Disturbance	Not significant	
		Operations and Closure – FMS Mine Site and Touquoy Mine Site, Disturbance (light and wildlife vehicle collisions) from haul trucks and heavy machinery		A	L	LAA	A	MT	R	R	Disturbance	Not significant	
		Reclamation Stage of Closure– FMS Mine Site, Re-establishment of habitat for fauna	N/A	P	L	LAA	A	LT	O	PR	Habitat restoration	Not significant	
Avifauna	☑ 5(1)(a)(iii)	Construction – FMS Mine Site, Loss of habitat from clearing and grubbing	Limit habitat disturbance and minimize Project footprint during detailed design, implement speed limits, install fences where necessary, and minimize lighting, re-stablish habitat and associated vegetation communities during reclamation.	A	M	LAA	A	MT	O	PR	Disturbance and habitat loss	Not significant	6.11.8
		Construction – FMS Mine Site, Disturbance (noise, light and wildlife vehicle collisions) from construction activities	Implement speed limits and minimize lighting.	A	L	LAA	A	ST	R	R	Disturbance	Not significant	
		Operations and Closure – FMS Study Area, Disturbance (noise, light and wildlife vehicle collisions) from haul trucks and heavy machinery		A	L	LAA	A	MT	R	R	Disturbance	Not significant	
		Operations – FMS Mine Site and Touquoy Mine Site, Tailings deposition	Best management practices Bird Deterrent Program implementation	A	L	PA	A	LT	R	PR	Creation of potential open water habitat; decreased water quality	Not significant	
		Reclamation Stage of Closure – FMS Mine Site, Re-establishment of habitat for avifauna	N/A	P	L	LAA	A	LT	O	PR	Habitat restoration	Not significant	

Valued Component	Area of Federal Jurisdiction	Potential Effects of the Project on the Environment	Mitigation and Compensation Measures	Nature of Effect	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect	Corresponding EIS Residual Effects Section Number
					Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility			
Species of Conservation Interest and Species at Risk	☑ 5(1)(a)(ii)	Construction – FMS Mine Site, Habitat loss and fragmentation from clearing and grubbing	Limit habitat disturbance and minimize Project footprint during detailed design, implement speed limits, install fences where necessary, and minimize lighting.	A	M	LAA	A	MT	O	PR	Habitat loss	Not significant	6.12.8.1, 6.12.8.2, 6.12.8.3, 6.12.8.4
		Construction – FMS Mine Site, Operations – FMS Mine Site and Touquoy Mine Site, Reclamation Stage of Closure – FMS Mine Site, Disturbance (noise, light, and wildlife vehicle collisions) from Project activities		A	L	LAA	A	LT	R	R	Disturbance	Not significant	
		Operations – FMS Mine Site and Touquoy Mine Site, Tailings management, deposition of tailings and controlled release of effluent	Implement bird and wildlife deterrent systems at FMS Mine Site TMF and Touquoy exhausted pit	A	L	LAA	A	LT	R	R	Creation of potential open water habitat; decreased water quality	Not significant	
		Reclamation Stage of Closure– FMS Mine Site, Re-establishment of habitat for SAR/SOCI	N/A	P	L	LAA	A	LT	O	PR	Habitat restoration	Not significant	
Mi'kmaq of Nova Scotia	☑ 5(1)(c)	Construction - FMS Mine Site, Direct effect on archaeological resources and burial site	Ensure no Project activities occur outside of PA, education and procedures in place as part of the EPP to halt work and notify the Mi'kmaq if archaeological deposits are encountered.	A	N	PA	N/A	ST	O	IR	None	Not significant	6.13.7
		Construction - FMS Mine Site, Direct habitat loss, including wetlands, and loss of plants of significance to the Mi'kmaq	Minimize footprint as per Project design, implementation of mitigation and monitoring as per other VCs to minimize indirect effects, engagement and involvement of the Mi'kmaq throughout Project (including monitoring and compensation)	A	L	PA	A	ST	O	PR	Habitat loss, loss of plant specimens, reclamation will restore some native plant species but not expected to return to baseline	Not significant	

Valued Component	Area of Federal Jurisdiction	Potential Effects of the Project on the Environment	Mitigation and Compensation Measures	Nature of Effect	Residual Environmental Effects Characteristics						Residual Effect	Significance of Residual Effect	Corresponding EIS Residual Effects Section Number
					Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility			
Mi'kmaq of Nova Scotia (continued)	☑ 5(1)(c)	Construction and Operations - FMS Mine Site, Direct and indirect impacts to fish and fish habitat	Minimize footprint as per Project design, erosion and sediment control to minimize impact, and water quality treatment, if required. Fisheries Act Authorization and Fish Habitat Offset Plan	A	L	PA/LAA	A	MT	O/S	IR	Habitat loss, change in water quality/quantity, positive change in water quality due to historical tailings management	Not significant	6.13.7
		Construction and Operations - FMS Mine Site, Indirect impacts to fauna - loss of habitat; noise and fragmentation	Minimize footprint as per Project Design, utilize existing roads wherever practicable, provision of bypass roads to maintain access.	A	L	PA/LAA	A	MT	R	PR	Habitat loss, potential change in species movement patterns	Not significant	
		Construction and Operations - FMS Mine Site, Predicted noise and air potential interaction with traditional practices surrounding the Project	Utilize berms and other mitigation where required to reduce noise levels to minimize indirect impact to Mi'kmaq; share noise study results and involve Mi'kmaq in data collection. Twice daily watering of mine site when dusty and use of chemical dust suppressants on main road to plant from pit, and plant to Highway 374 as required.	A	L	LAA	N/A	MT	R	R	Sensory disturbance	Not significant	
		Construction and Operations - FMS Mine Site, Predicted light levels and potential interaction with traditional practices surrounding the Project	Maintenance of forested canopy wherever practicable within the Project property boundaries. Limit unnecessary lighting at FMS Mine Site; utilization of potential green energy options	A	L	LAA	A	MT	R	R	Sensory disturbance	Not significant	
		Construction, Operations and Closure, FMS Mine Site, Potential impact to human health from the Project	Implement mitigation and monitoring measures identified for each VC for the life of the Project as required	A	L	LAA	N/A	MT	R	R	Human Health	Not significant	
		Construction, Operations and Closure - FMS Mine Site, Potential impact to the economic, social, and mental wellbeing of the Mi'kmaq of Nova Scotia from the Project	Continue discussions with the Mi'kmaq to determine appropriate mitigation and compensation requirements, where appropriate. Potentially suitable alternative large tracts of crown land are available surrounding the FMS Mine Site. Mi'kmaq participation in monitoring programs and development of Reclamation and Closure Plan for the Project	A/P	L	LAA	A	MT	C	PR	Change in economic, social, and mental wellbeing of the Mi'kmaq of Nova Scotia	Not significant	

Valued Component	Area of Federal Jurisdiction	Potential Effects of the Project on the Environment	Mitigation and Compensation Measures	Nature of Effect	Residual Environmental Effects Characteristics: Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility	Residual Effect	Significance of Residual Effect	Corresponding EIS Residual Effects Section Number
Mi'kmaq of Nova Scotia (continued)	☑ 5(1)(c)	Construction, Operations and Closure - FMS Mine Site, Restriction and loss of access for traditional practice during construction, operations and active reclamation of the FMS Mine Site	Continue discussions with the Mi'kmaq to determine appropriate mitigation and compensation requirements, where appropriate. Potentially suitable alternative large tracts of crown land are available surrounding the FMS Mine Site	A	L	LAA	N/A	MT	R	R	Loss of access	Not significant	6.13.7
		Construction, Operations and Closure - FMS Mine Site, Development of Project	Continue confidential discussions with the Mi'kmaq of Nova Scotia (parallel to the federal environmental assessment) to identify employment, community and economic benefits.	P	L	RAA	N/A	MT to LT	C	R	Benefits to the Mi'kmaq of Nova Scotia	Not significant	
Physical and Cultural Heritage	N/A	Construction – FMS Mine Site, Identification and/or damage to physical and cultural heritage resources – Sites 1-6 and the historic road associated with Site 7)	Evaluate changes to layout for potential impacts to archeological resources. Complete intensified historical research, shovel pit testing, where required, and detailed documentation at archeological features prior to disturbance cause by Project activities, in conjunction with Mi'kmaq agencies as required. Contact the Special Places Program, Nova Scotia Communities, Culture & Heritage Department if human remains or archeological deposits are identified.	A	L	PA	N/A	P	O	IR	Loss of resource	Not significant	6.14.8
Socio Economic-conditions	N/A	Construction, Operations and Closure- FMS Mine Site, Direct and indirect employment opportunities	N/A	P	H	RAA	N/A	LT	C	PR	Increase in Employment Opportunities	Not significant	6.15.8
		Construction, Operations and Closure- FMS Mine Site, Site access route adjustments	Communicate with local recreational groups, regular equipment maintenance, operator training and proper signage at intersections to inform public and reduce accidents.	A	L	LAA	N/A	P	C	IR	Change in access	Not significant	

Legend (Refer to Table 5.10-1 for definitions)

Nature of Effect	Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility
A Adverse	N Negligible	PA Project Area	N/A Not Applicable	ST Short-Term	O Once	R Reversible
P Positive	L Low	LAA Local Assessment Area	A Applicable	MT Medium-Term	S Sporadic	IR Irreversible
	M Moderate	RAA Regional Assessment Area		LT Long-Term	R Regular	PR Partially Reversible
	H High			P Permanent	C Continuous	

Table 9.1-4: Summary of Residual Cumulative Effects by Valued Component

Cumulative Effect (After Mitigation)	Significance Levels						Overall Significance of Residual Adverse Effect (and Rationale)	Corresponding EIS Cumulative Residual Effects Section Number
	Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility		
NOISE: Cumulative increased noise levels (Noise from construction, operation, reclamation, and operation of mining, haul trucks, forestry activities and haul road usage)	L	LAA	A	LT	R	R	Low Adverse Effect (Not Significant) Effects are limited to the LAA based on Project interactions and usage of the Beaver Dam Haul Road by various activities. Furthermore the VC is anticipated to recover to baseline conditions once the operation of the mine has stopped. Effects would be confirmed through monitoring.	8.5.1.4
AIR: Increased cumulative dust during operation of the Project (Dust from mining and haul trucks)	M	LAA	A	LT	R	R	Moderate Adverse Effect (Not Significant) Effects are limited to the LAA where there are limited sensitive receptors, and the use of the Beaver Dam Haul Road. Furthermore, the VC is anticipated to recover to baseline conditions once the operation of the FMS Mine Site has been completed. Effects would be confirmed through monitoring.	8.5.2.4
LIGHT: Increased light levels during operation of the Project (operational light levels and light from transportation of gold concentrate and use of the Beaver Dam Haul Road by other projects)	L	LAA	N/A	LT	R	R	Low Adverse Effect (Not Significant) Effects are limited to the LAA where there are limited sensitive receptors, and the use of the Beaver Dam Haul Road. Furthermore, the VC is anticipated to recover to baseline conditions once the operation of the FMS Mine Site has been completed.	8.5.3.3

Cumulative Effect (After Mitigation)	Significance Levels						Overall Significance of Residual Adverse Effect (and Rationale)	Corresponding EIS Cumulative Residual Effects Section Number
	Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility		
SURFACE WATER: Potential for residual cumulative effects to all surface water systems within each RAA (Touquoy Mine Site and FMS Mine Site).	L	LAA	A	LT	R	PR	Minor Adverse Effect (Not Significant) Given implementation of proposed mitigation methods, no significant adverse cumulative effect is expected.	8.5.4.4
FISH AND FISH HABITAT: Cumulative disturbance to fish and fish habitat within each RAA (Touquoy Mine Site and FMS Mine Site)	M	LAA	A	LT	R	R	Moderate Adverse Effect (Not Significant) Fish habitat offsetting is anticipated to compensate for lost fish habitat from the Project itself. No other pathway for residual effects from surrounding projects has been identified.	8.5.5.4
SPECIES OF CONSERVATION INTEREST AND SPECIES AT RISK: Cumulative loss, alteration and the disturbance of habitats throughout the RAA relating to SOCI and SAR.	L	RAA	A	LT	S	PR	Low Adverse Effect (Not Significant) The small proportion of regional habitat that supports priority species that would be lost as a result of this Project will be restored during the reclamation stage of Closure Phase. There is limited additional development pressure from projects in the RAA.	8.5.6.4

Cumulative Effect (After Mitigation)	Significance Levels						Overall Significance of Residual Adverse Effect (and Rationale)	Corresponding EIS Cumulative Residual Effects Section Number
	Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility		
MI'KMAQ OF NOVA SCOTIA: Effects to Mi'kmaq of Nova Scotia and their traditional land use as a result from impacts to air quality, noise, light, surface water, fish habitat, and human health, and cumulative limitations to land use for traditional purposes from multiple projects within the RAA.	L	LAA	A	LT	R	R	Moderate Adverse Effect (Not Significant) Assuming that the proposed compensation measures are applied for the Project and that they achieve their objectives, the predicted residual cumulative effects on the Mi'kmaq of Nova Scotia with regards to impacts to air quality, noise, light, surface water, fish habitat, and human health, are assessed to be adverse, but not significant. Loss of access is limited to 0.75% of available crown land within the RAA.	8.5.7.4

9.2 Project Conclusions

The Project proposed by the Proponent is planned to be permitted and operated as a separate satellite open pit mine operating at a production rate of approximately two million tonnes (Mt) of gold-bearing ore per year, and an average nominal processing rate of approximately 5,500 t/day. Ore will be crushed and concentrated on site to produce a gold concentrate which will be hauled by on-road highway trucks to the Touquoy mine CIL processing facility for final processing into gold doré bar, a distance of just over 76 km on existing public roads. The transport of gold concentrate will eliminate the need for a separate CIL cyanide leach circuit at the FMS Mine Site.

The Project is anticipated to begin construction in 2023, come into production in 2024, cease operations in 2030 and then be reclaimed. Water treatment, if and as required, and monitoring will continue into a post-closure phases, where required, at both the FMS Mine Site and the Touquoy Mine Site.

The Proponent wishes to develop this resource in line with all applicable regulatory requirements and recognizes the significant benefits to the local economy, the Province of Nova Scotia, the Mi’kmaq of Nova Scotia, and the company in completing this Project. The Proponent has designed a Project in keeping with the intent of the Province of Nova Scotia for efficient use of mineral resources and which promotes the concepts of environmental responsibility and sustainable development, stewardship of the mineral resource sector, and integrated resource planning.

All phases of the Project will provide employment opportunities for local residents and the Mi’kmaq of Nova Scotia, as well as provide tax revenue for the municipal, provincial, and federal levels of government. It is anticipated that additional labour force will be required during construction and a smaller, but still significant, labour force will be required during operation. Indirect employment will be generated by the Project through the use of external contractors and suppliers. Tax revenue in the millions of dollars per year will be generated through corporate income taxes paid by the Proponent, as well as its contractors and suppliers.

The construction phase will generate 81.4 million in value added for the Nova Scotia economy, support 778 jobs and generate 4.4 and 2.4 million in provincial and municipal government revenues, respectively. Operating activities will generate 18.6 million in value added annually, (111.4 million over the entire operating phase) support 323 jobs annually in Nova Scotia, and provide 13 million and 0.9 million in provincial and municipal government revenues (Appendix E.1).

As described throughout the EIS, Project-environment interactions are expected to occur throughout the life of the Project during the construction, operations, and closure phases. These interactions are expected, manageable through effective mitigation measures, monitoring programs and adaptive management, and are typical of environmental impacts associated with mineral extraction projects in the region.

The FMS Study Area is located within a historically active mining area with documented historical tailings and waste rock, concentrated near and within Seloam Brook, where the pit is proposed. This Project will manage historical tailings and waste rock that interact spatially with Project infrastructure. This, coupled with the commitment to complete the Seloam Brook Realignment, are key mitigation measures provided within this EIS, which will result in a net benefit to the local environment, water quality, fish habitat, recreational value for the area, and value for the area for traditional rights practices by the Mi’kmaq of Nova Scotia. The Proponent is also committed to the construction of bypass roads to allow recreational users, local community members, the Mi’kmaq of Nova Scotia and interested groups to access Seloam Lake and the lands east of the FMS Mine Site.

The Proponent is committed to developing a long-term, positive and productive relationship with the Mi’kmaq of Nova Scotia based on principles of mutual respect, transparency, honesty and integrity, and a partnership approach to engagement. The Proponent is committed to ongoing Mi’kmaq engagement and participation for the life the Project – prior to, during and post environmental assessment. This includes communication and information sharing, face-to-face meetings, discussion of impacts and mitigations, and any other issues that may arise as the Project develops. The Proponent is equally committed to on-going public engagement and participation for the life of the Project with the local community members, and key stakeholder groups.

Given the considerations identified above and based on baseline studies and assessment of effects completed for each of the identified VCs and cumulative effects assessment, the Project is not predicted to result in any significant residual adverse environmental effects once mitigation measures have been applied. Monitoring and follow-up programs will continue throughout the life of the Project to verify the effects of the Project on the surrounding environment relative to predictions made in the effects assessment. The Proponent is committed to implementing the planned mitigation measures and monitoring programs, as well as ongoing stakeholder and Mi'kmaq engagement as outlined in this submission.

Table 9.2-1 outlines Proponent Project commitments. These commitments should be reviewed in conjunction with VC-specific mitigation measures, mitigation measures provided for accidents and malfunctions, and proposed monitoring programs.

Table 9.2-1: Proponent Commitments

Project Phase	General Commitments	EIS Section
Pre-construction	The Proponent will voluntarily establish an Independent Tailings Review Board for design, construction and operational phases of project infrastructure including the TMF.	Section 1.0 Introduction
Pre-construction	The Proponent intends to maintain adequate insurance and bonding to ensure its commitments are met. This includes maintaining financial bonding to ensure that adequate reclamation security is in place at all times during the construction, development and operational phases of the mining projects, as well as appropriate environmental impairment liability insurance.	Section 1.0 Introduction
Pre-construction	The Proponent commits to completing its operations in adherence with best available practices (BAPs) and industry standards as per guides developed by Mining Association of Canada, such as the Towards Sustainable Mining initiative, and the Canadian Dam Association.	Section 1.0 Introduction
On-going	The Proponent is committed to maintaining its CLC for the life of the Project.	Section 3.0 Public Engagement
On-going	The Proponent is committed to developing a long-term, positive and productive relationship with the Mi'kmaq of Nova Scotia based on principles of mutual respect, transparency, honesty and integrity, and a partnership approach to engagement.	Section 4.0 Indigenous Peoples Engagement
Construction and Operation to plan for Closure	Commitment to reclamation with Mi'kmaq participation in planning and implementation to restore habitats and allow traditional practices to resume within the Mine Site.	Section 4.0 Indigenous Peoples Engagement
Construction	The Proponent is committed to removing the historical tailings that may be disturbed as a part of site construction and operation. This tailings removal will be conducted during the construction phase.	Section 6.5 Groundwater Quality and Quantity

Project Phase	General Commitments	EIS Section
Construction (baseline EEM work was initiated in 2020)	Preparation of an Environmental Effects Monitoring Program in conjunction with submission of the Provincial Industrial Approval and the Metal and Diamond Mining Effluent Regulations	Section 6.6 Surface Water Section 6.8 Fish and Fish Habitat
Pre-construction (during permitting)	Development of a Seloam Brook Realignment Construction Plan in conjunction with submission of the Provincial Industrial Approval and Fisheries Act Authorization	Section 6.6 Surface Water
Construction, Operation, Closure	There will be a modular effluent treatment plant present on site during the construction phase and this system can be adapted and utilized throughout the life of mine, as required based on site effluent quality.	Section 6.6 Surface Water
Pre-construction (during permitting)	Development of Detailed Design for Seloam Brook Realignment and associated downstream water control structures and a Fish Rescue Plan to support the Fisheries Act Authorization. This detailed design will be developed through engagement with the Mi'kmaq of Nova Scotia and through consultation with DFO and IAAC.	Section 6.6 Surface Water Section 6.8 Fish and Fish Habitat
Pre-construction	Development of a Bird Nest Mitigation Plan if clearing and grubbing is required within the approved breeding bird timing window	Section 6.11 Avifauna Section 6.12 SAR/SOCI
Pre-construction (on-going)	On-going refinement of a communication protocol which will describe how the Proponent will communicate with the Mi'kmaq of Nova Scotia during ongoing exploration and operational phases of the projects, and in the event of a release or spill of a hazardous substance	Section 6.13 Mi'kmaq of Nova Scotia
On-going	The Proponent is committed to ongoing Mi'kmaq engagement and participation for the life the Project – prior to, during and post environmental assessment. This includes communication and information sharing, face-to-face meetings, discussion of impacts and mitigations, and any other issues that may arise as the Project develops.	Section 4.0 Indigenous Peoples Engagement Section 6.13 Mi'kmaq of Nova Scotia
On-going	The Proponent will continue to work with the Mi'kmaq of Nova Scotia to provide specificity in analysis, where possible, to support comprehensive conclusions of Project impacts and to support mitigation and accommodation opportunities.	Section 6.13 Mi'kmaq of Nova Scotia
On-going and Pre-construction	The results of Mi'kmaq engagement have been considered and incorporated in the environmental effects assessment and are reflected in the Proponent's commitments to involve the Mi'kmaq in the development and implementation of mitigation and monitoring measures and proposed compliance and effects monitoring programs.	Section 6.13 Mi'kmaq of Nova Scotia
Pre-construction	Develop potential partnerships with Mi'kmaq environmental groups on specific ecological monitoring and restoration projects.	Section 6.13 Mi'kmaq of Nova Scotia

Project Phase	General Commitments	EIS Section
Construction	Development of a Dam Breach Inundation Study for incorporation into an Emergency Response Plan.	Section 6.17 Accidents and Malfunctions
Construction, Operation	Development of an Operation, Monitoring and Surveillance Manual (OMS) which provides a documented framework for actions, and a basis for measuring performance and demonstrating due diligence during the operational phase of the Project.	Section 6.17 Accidents and Malfunctions
Pre-construction	Development of the Environmental Management System (EMS) and all associated management and monitoring plans.	Section 10.1 Environmental Management System (EMS)

10.0 Follow-up and Monitoring Programs Proposed

Monitoring commitments for the Project aew described in Table 10.1-1 and will be implemented by the Proponent. The follow-up program is designed to verify the accuracy of the effects assessment and to determine the effectiveness of the measures implemented to mitigate the adverse effects of the project. Considerations for developing a follow-up program include:

- whether the Project will impact environmentally sensitive areas/VCs or protected areas or areas under consideration for protection;
- the nature of Mi'kmaq of Nova Scotia and public concerns raised about the Project;
- suggestions from the Mi'kmaq of Nova Scotia regarding the design of and involvement in follow-up and monitoring programs;
- incorporation of Mi'kmaq of Nova Scotia knowledge, where available;
- the accuracy of predictions;
- whether there is a question about the effectiveness of mitigation measures;
- the nature of cumulative environmental effects;
- the nature, scale and complexity of the program; and,
- whether there was limited scientific knowledge about the effects in the EA.

The goal of a monitoring program is to ensure that proper measures and controls are in place in order to decrease the potential for environmental degradation during all phases of Project development, and to provide clearly defined action plans and emergency response procedures to account for human and environmental health and safety.

Mitigation measures (Section 9.0) and proposed monitoring and follow-up programs (Section 10.0) have been reviewed with the Mi'kmaq of Nova Scotia during engagement activities (face to face meetings, email and telephone exchanges) and provision of summary documents (EIS poster boards, draft EIS (October 2019), Summary of Mi'kmaq Effects and Proposed Mitigation Measures document, and Plain Language Summary). Engagement will continue with the Mi'kmaq of Nova Scotia regarding mitigation and monitoring during the formal review of the EIS.

10.1 Environmental Management System (EMS) and Monitoring Commitments

The Proponent has designed and will implement a series of management procedures and monitoring programs that integrate engineering design and environmental planning to maximize the mitigation of potential impacts of the mine on the environment.

The individual plans together with supporting documentation form the basis for an Environmental Management System (EMS) to be implemented throughout the mine life (Appendix L.1). The plans have been designed to ensure that practices employed during each of the construction, operation and closure phases of the Project minimize the effects of the mine and promote the protection of the environment and human health.

By implementing the EMS consisting of three key elements:

- a series of integrated environmental management plans;
- a formal employee site induction and training program with an environmental awareness and management component; and
- a series of ongoing environmental monitoring programs.

This document provides an overarching framework for the series of management plans that have been developed by the Company to provide guidance for site operation. These plans include information on how the mine's interaction with the environment, including but not limited to the handling of all wastes and water, will be managed during the various phases of mine life, as well as contingencies in cases where unexpected events may occur.

The following Environmental Management Plans (EMP) are being developed in conjunction with the Environmental Impact Statement (EIS) for the Project and form part of the development plan for approval by the federal government under the IAAC and NSE. As the Project is currently under active development and assessment, the management plans are still being developed and finalized. EMP that have drafts available for preliminary stakeholders and regulators are attached to this EMS framework, and are denoted as having a draft attached to this document by being identified in bold below:

EMP 1 Environmental Protection Plan

EMP 2 Erosion Prevention and Sediment Control Plan

EMP 3 Acid Rock Drainage Prediction and Mine Rock Management Plan

EMP 4 Historical Tailings Management Plan

EMP 5 Fugitive Dust Management Plan

EMP 6 FMS TMF Management Plan

EMP 7 Touquoy Pit Integrated Water and Tailings Management Plan

EMP 8 TMF Operation, Monitoring and Surveillance Plan

EMP 9 Surface Water and Groundwater Management and Contingency Plan

EMP 10 Health and Safety Plan

EMP 11 Emergency Response Plan

EMP 12 Wildlife Management and Monitoring Plan

EMP 13 Archaeological and Cultural Heritage Resources Management Plan

EMP 14 Hazardous Material Management Plan

EMP 15 Solid Waste Management Plan

EMP 16 Petroleum Management Plan

EMP 17 Spill Contingency Plan

EMP 18 Explosives Management Plan

EMP 19 Reclamation and Closure Plan

EMP 20 Recovery Plan

EMP 21 Stakeholder Engagement Plan

EMP 22 Indigenous Peoples Engagement Plan

The Proponent understands that the management plans developed in conjunction with the EMS will be “living documents” and that they, along with their supporting documents, will evolve as conditions change, additional information is collected, and detailed engineering is completed, during each of the mine construction, operation, and closure phases of the Project. Modifications will likely also be required as a result of adaptive management decisions, or changes resulting from directions received from regulatory bodies.

The Proponent is committed to an open and transparent process, providing regulatory agencies and interested stakeholders with updates to the Project activities and management plans in annual reports, or in a series of facility-specific or management plan-specific reports, as appropriate. These reports will include monitoring results and progress updates on the Project related terms, conditions and commitments defined under the various permits, licenses and other authorizations, as applicable.

Table 10.1-1: Monitoring Commitments

Valued Component	General Monitoring Commitments	Detailed Monitoring Commitments (if applicable)	Corresponding EIS Section Number
Noise	No noise monitoring required, nearest residence is approximately 5 km south of the FMS Mine Site	IA - only required on request by NSE	6.1.9
Air	Frequency and specific details of air monitoring will be confirmed during IA application	Air monitoring at the FMS Mine Site property boundary	6.2.9
Light	No light monitoring required, nearest residence is 5 km south of the FMS Mine Site	IA - only required on request by NSE	6.3.9
Geology, Soils, and Sediment	Construction techniques, erosion and sediment control measures, and a sediment monitoring program for the receiving environment will be described in the Erosion Prevention and Sediment Control Plan, developed in collaboration with environmental regulators, as part of the company's Environmental Management System and Industrial Approval Application for the Project.	Operational Geochemical Testing Program: confirmatory testing of open pit blast hole drill cuttings to confirm geochemical predictions of mine rock at a frequency to be determined by the Project geochemists, geologists, and with consideration of available NRCAN and comparable guidance documents.	6.4.9
		Delineation and subsequent management of historical tailings and waste rock (soil and sediment) that is located within the footprint of Project infrastructure.	
		Geochemical source term predictions heavily rely on theoretical constraints, representative geochemical test work, and the availability of site analogue data. To close data gaps that would increase the confidence in the geochemical source term predictions for future model iterations, the following recommendations are made:	
		Continued operation of FMS PAG humidity cells to assess the long-term effect of metal leaching behaviour in site-specific materials as well as to understand material-specific metal mobility under acidic conditions.	

Valued Component	General Monitoring Commitments	Detailed Monitoring Commitments (if applicable)	Corresponding EIS Section Number
Geology, Soils, and Sediment (continued)	Construction techniques, erosion and sediment control measures, and a sediment monitoring program for the receiving environment will be described in the Erosion Prevention and Sediment Control Plan, developed in collaboration with environmental regulators, as part of the company's Environmental Management System and Industrial Approval Application for the Project. (continued)	Additional sampling and static testing of waste rock material to increase the confidence in the sulphur and NP contents as well as PAG proportions within this population, since these parameters have a direct impact on the source term model results.	6.4.9
		Collection of site-specific topsoil samples to understand and assess this material's geochemical variability and in support of topsoil stockpile source terms.	
		Continued tracking and reporting of Touquoy WRSF tonnage, footprint, and lithological proportions along with continued waste rock drainage monitoring to allow for better calibration of model and scaling factors which can be applied to the FMS WRSF in future model iterations. This is especially relevant for nitrogen- specific source terms, since nitrogen commonly shows lag times in its release from larger waste rock facilities.	
		Concentrate from the FMS processing plant will be shipped to the Touquoy site where the final ore extraction step will be conducted using cyanidation. It is expected that the relatively small quantity of tailings generated during this process will be co-deposited with Beaver Dam tailings in the Touquoy open pit. To understand the geochemical impact of this tailings disposal plan, it is recommended that this material be tested via ABA and potentially other characterization methods.	
Groundwater	Monthly water levels and quarterly water quality sampling program Groundwater predictive models will be updated, as warranted, during the Industrial Approval process.	FMS Study Area has a network of 27 monitoring wells located within the LAA. Based upon the predicted groundwater effects the Proponent has committed to install additional monitoring wells in two areas within the FMS LAA: 1. Two additional monitoring well nests will be located adjacent to the open pit to confirm the predicted groundwater radius of influence towards the south of the open pit. 2. Several additional monitoring well nests will be placed around the TMF to monitoring groundwater levels.	6.5.10

Valued Component	General Monitoring Commitments	Detailed Monitoring Commitments (if applicable)	Corresponding EIS Section Number
Groundwater (continued)		Groundwater monitoring will be conducted from all on-site FMS Study Area wells with water levels being collected monthly and chemistry samples will be collected quarterly throughout construction/pre-production and operations.	6.5.10
		The Proponent has also committed to installing an additional groundwater well southeast of the Touquoy pit.	
Surface Water	Proposed SW locations at FMS (23 locations) and at all existing locations at TQ (on-going) as per applicable federal and provincial regulations Surface water predictive models will be updated, as warranted, during the Industrial Approval process.	The surface water monitoring program will include the following, as well as potentially additional monitoring as determined through discussions with regulatory agencies:	6.6.9.3
		Surface water quality and quantity monitoring at select baseline sampling locations, for frequency and parameters required under applicable federal and provincial regulations;	
		The MDMER program would involve detailed surface water quantity and quality sampling as well as effluent sampling to determine final EEM specifications; and,	
		Ongoing surface water quality monitoring at the Touquoy facility.	
Wetlands	A detailed Wetland Monitoring Plan will be established to support the Industrial Approval application, through the life cycle of the permitting process and will commit to monitoring during baseline/pre-construction to establish baseline conditions, and through the operational phase, reclamation and post closure (as determined to be required). Wetland monitoring will be completed for the Project on selected representative wetlands that have been predicted to have direct or indirect effects from Project development.		6.7.9

Valued Component	**General Monitoring Commitments**	**Detailed Monitoring Commitments (if applicable)**	**Corresponding EIS Section Number**
Fish and Fish Habitat	A Surface Water Monitoring Plan will be established through the life cycle of the permitting process and will commit to monitoring during baseline/pre-construction to establish baseline conditions, and through the operational phase, reclamation and post closure (as determined to be required). Surface water monitoring will be completed for the Project on selected representative watercourses that have been predicted to have direct or indirect effects on fish and fish habitat from project development. Both direct and indirect effects are expected related to the Seloam Brook Realignment. Monitoring of the extent of indirect effects from erosion and sedimentation at the outlet of the Realignment Channel will be required, along with monitoring the effectiveness of water control features along the North and South Channel and associated predicted flooding. As part of a detailed offset plan, and once the offset measures have been selected, a monitoring program will be developed in consultation with DFO, and included in the final offset plan and Fisheries Authorization. Fish assessment metrics such as catch per unit effort, age, length, and weight will be considered as part of the study design. Physical parameters such as lake levels, lake inflow and outflow, water temperature, lab water quality, and in-situ water quality will be incorporated to the monitoring plan. Criteria (performance measures) for the effectiveness monitoring will be developed through discussions with DFO, the Province, and other interested parties. The results of compliance and effectiveness monitoring will be compiled annually and submitted to DFO for review. After the third year of effectiveness monitoring, a summary report will be written with recommendations based on the success of the offsetting measures. Indirect effects related to flow reduction are predicted in WC2 and East Brook (SW15) due to construction of the WRSA and TMF, respectively. These habitat losses will be included in the application for HADD authorization under the *Fisheries Act*, and have been included in the Fish Habitat Offset Plan: Preliminary Concept Update (Appendix J.7). On-going assessments are currently underway and will continue through 2019 to support understanding of the WC43 system and observed barrier to fish passage under various flow regimes.		6.8.9
Habitat and Flora	No specific monitoring recommended		6.9.9
Fauna	A Wildlife Management Monitoring Program (WMMP) has been established, outlining wildlife mitigation and specific protocols for monitoring Mainland Moose during baseline/pre-construction to establish baseline conditions, and through the operational phase, reclamation and post closure (as determined to be required in consultation with provincial regulators). Monitoring associated with the WMMP will be completed for the Project on selected transects within suitable Mainland Moose habitat within the FMS Study Area and in regional reference locations for which baseline data has already been collected. Mainland Moose survey methods will be consistent with methods presented in the EIS, described in detail in Section 6.12.		6.10.9

Valued Component	General Monitoring Commitments	Detailed Monitoring Commitments (if applicable)	Corresponding EIS Section Number
Avifauna	No specific avifauna monitoring required	Clearing or grubbing that could potentially impact breeding birds will be conducted outside the breeding season. If avoidance of clearing during nesting is not practicable, a nest survey will be completed, in consultation with CWS, prior to clearing activities.	6.11.9
Species at Risk and Species of Conservation Interest	No specific monitoring requirements beyond what is identified in flora, fauna, wetlands, fish, and avifauna with the exception of monitoring for moose. Permitting may be required for Species at Risk, and any monitoring requirements will be determined during permitting, in consultation with NSL&F.	WMMP: moose monitoring will be completed on selected transects within suitable habitat WMMP: outlines protocols to minimize interactions between wildlife and Project activities. If construction is required during the active nesting season, an avian specialist will monitor for nesting activity.	6.12.9
Physical and Cultural Heritage	No monitoring of archaeological features required	Remaining features will be buffered and flagged in the field to ensure avoidance	6.14.9
Mi'kmaq of Nova Scotia	The Proponent commits to Mi’kmaq participation in community-based monitoring programs and development of the Reclamation and Closure Plan. Discussions will continue with the Mi'kmaq of Nova Scotia regarding participation in the development, implementation and evaluation of proposed compliance and effects monitoring programs which could include programs such as wetland monitoring, wildlife monitoring, including moose, and other monitoring programs including air, surface water, groundwater and noise. In addition, the Proponent will hold periodic meetings with the Mi'kmaq of Nova Scotia, including Millbrook and Sipekne'katik First Nations, to review overall environmental compliance and effects monitoring programs associated with other VCs, provide data and results of monitoring programs, and report on Project benefits. The effects monitoring programs will verify the effectiveness of mitigation measures associated with minimizing any potential effects to human health from consumption of, or contact with, country foods, water and soils, and results will be shared with local Indigenous groups.		6.13.8

The Proponent is committed to provision of detailed scope, methodology, locations, frequency, and duration for monitoring events for each valued component as described in Table 10.1-1. These detailed monitoring scopes will be described in the appropriate Management Plans, as described in Section 10.1. These management plans will include monitoring plans for wildlife, wetlands, fish and fish habitat, dust, surface and groundwater, geochemistry, and others, and will be developed over the course of the environmental assessment process and subsequent permitting processes.

10.2 Limitations

The following general limitations for the environmental impact statement are provided:

- There are a potentially infinite number of methods in which human activity can influence wildlife behaviours and populations and merely demonstrating that one factor is not operative does not negate the influence of the remainder of possible factors.
- The environmental assessment provides an inventory based on acceptable industry methodologies. A single assessment may not define the absolute status of site conditions and site conditions can and will change over time.
- The aerial photos used in the mapping and spatial exercises may not represent actual on the ground conditions due to the age of the aerial photo.
- The aerial photos are reviewed from online sources. There can be inherent error in the GIS positioning of aerial photos with respect to actual coordinates in the field. If that occurs, when the placement of specific field observations from GPS coordinates are overlaid on these aerial photos, errors can occur but cannot be corrected. If there are errors in photo positioning and if figures are scaled, it may not appear as setbacks or distances to features are being adhered to.
- Global Positioning Systems: GPS coordinates taken in the field using Garmin GPS 64sx Series GPS units have inherent accuracy limitation between 3 to 5 m, or the SXBlue II GPS receiver unit which is capable of sub-metre accuracy with a handheld SXPad field computer. GPS coordinates identified in this document are based upon GPS readings. The reader should be aware of this accuracy limitation when reviewing GPS coordinates.
- Classification and identification of soils, vegetation, wildlife, and general environmental characteristics have been based upon commonly accepted practices in environmental assessment. Classification and identification of these factors are judgmental and even comprehensive sampling and testing programs, implemented with the appropriate equipment by experienced personnel, may not identify all factors.
- Different assessors may come to different results (i.e., bird count numbers) and conclusions and analysis based upon the collected information.
- All reasonable assessment programs will involve an inherent risk that some conditions will not be detected and reports summarizing such investigations will be based on assumptions of what characteristics may exist between the sample points.
- The placement of Project infrastructure using GIS methods will not correlate directly to final constructed infrastructure locations and routes.
- An environmental assessment is an assessment of environmental characteristics and how the Project might interact with those characteristics. As environmental features change from day to day; month to month; year to year; those interactions will also change. Therefore, the environmental assessment is an attempt to reduce the impacts to natural systems by managing risk associated with a Project but cannot mitigate all risks over time.

11.0 References

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11.2 Personal Communications

Rick Archibald, Northern Timber, personal communication (Phone call), May 2019.

Mike Butler, President of the Sheet Harbour Snowmobile and ATV Club, personal communication (Phone call), March 2017.

Ian Bryson, Nova Scotia Environment Wetland Specialist, personal communication (Email), September 2020.

Don Cameron, Nova Scotia Lands and Forest, personal communication (Email) May 2019.

Greg Campbell, Atlantic Chapter of Bird Studies Canada Senior Project Biologist, personal communication (Email) April 2015.

Bruce Crowell, Local landowner of nearby seasonal dwelling, personal communication (Phone call) April 2018.

Jeremy Higgins, former Nova Scotia Environment Wetland Specialist, personal communication (Email), March 2019.

Dr. Ken McKenna, Butterfly Specialist, personal communication (Email) August 2017.

Thea Langille, Principal Planner, Halifax Regional Municipality, personal communication (Email) April 2018.

Jolene Laverty, Nova Scotia Lands and Forestry Regional Biologist, personal communication (Email) February 2019.

Chris Pepper, Independent Biologist and Lichenologist, personal communication (Phone call) March 2019.

Dr. Cynthia Staicer, Professor of Biology, Dalhousie University, personal communication (Phone call) October 2018.