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2018 Supplemental Baseline Aquatic Environmental Technical Report

Atlantic Gold
A St Barbara Ltd Company

Touquoy Mine: 2018 Supplemental Baseline Aquatic Environment Technical Report

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Table of Contents

LIST OF TABLES

LIST OF PHOTOS

LIST OF FIGURES

LIST OF APPENDICES

EXECUTIVE SUMMARY

Atlantic Gold Mining Corporation (Atlantic Gold) operates the Touquoy Gold Mine (the Mine), located in Moose River Gold Mines, approximately 110 km northeast of Halifax, NS. The Project includes an open-pit mine and processing to extract gold on site. The Project began discharging effluent from the polishing pond into Scraggy Lake, NS, in July 2018.

Stantec Consulting Ltd. (Stantec) was contracted by Atlantic Gold to undertake supplemental baseline aquatic monitoring in 2018. This report provides background information on the mine and the aquatic receiving environment prior to effluent discharge from the Mine and provides the results of aquatic sampling conducted in 2018 to supplement results obtained in 2017. Baseline aquatic information will provide the basis for tracking change over time for environmental effects monitoring (EEM) required under the *Metal and Diamond Mining Effluent Regulations* (MDMER). A desktop study was also undertaken to assist in identifying historical mining locations in the study area to provide guidance on selection of potential reference lakes.

The proposed Phase 1 EEM program would consist of a multiple control-impact design, with controls (i.e., reference lakes unaffected by current mining activities to reflect background conditions) and impact (i.e., future effluent exposure) locations in Scraggy Lake. Two exposure locations consisting of a nearfield (< 250 m downstream from the final discharge point (FDP)) and a farfield site (i.e., ~ 4.5 km downstream of the FDP) would be monitored in Scraggy Lake. The baseline sampling design in 2017 and 2018 was set up to mirror the biological information that would be anticipated to be required in Phase 1 EEM under MDMER, based on regulatory guidance. The focus was on Scraggy Lake as the receiving environment for effluent, including a nearfield area and far field area, plus two reference lakes with similar habitat but without the influence of mining effluent. The two reference lakes studied were Long Lake and Alma Lake.

The supplemental baseline program design included the following components:

- Fish habitat survey;
- Fish community study;
- Fish tissue study;
- Benthic invertebrate community (BIC) survey;
- Supporting environmental variables (water and sediment quality); and
- Historical mining locations in the study area

A fish habitat survey was conducted in Alma Lake to assess the similarity of habitats to Scraggy Lake. Fish habitat surveys in Scraggy and Long Lake were conducted in 2017. The fish habitat in Alma Lake was similar to that observed in Long Lake and Scraggy Lake in 2017. All the lakes had rocky shorelines with sparse areas of aquatic vegetation and the majority of the habitat within the lakes is generally shallow (<3m).

A fish community survey was undertaken and Long Lake and Alma Lake to determine the abundance and suitability of the sentinel species selected in Scraggy Lake (i.e., white sucker (*Catostomus commersoni*) and yellow perch (*Perca flavescens*). The fish community survey indicated that there were similar fish species (i.e., a least six different species) within Long Lake, Alma Lake and Scraggy Lake. Long Lake possessed both the desired sentinel species, yellow perch and white sucker however Alma Lake only possessed white sucker.

A fish tissue study for whole-body white sucker and muscle fillet as well as whole-body yellow perch was undertaken, using lower detection limits for trace metals than had been used for baseline sampling in 2017. There were an increased number of detections of trace metals in tissue using the lower detection limits compared to 2017. For mercury concentration in fish tissue, four of ten muscle tissue samples and one of ten whole-body samples from yellow perch exceeded the Health Canada fish consumption guideline for human consumption of 0.5 mg/kg at the nearfield sites in Scraggy Lake. None of the whole-body white sucker samples exceeded the Health Canada fish consumption guideline for human consumption for mercury of 0.5 mg/kg. Whole-body and muscle tissue samples from yellow perch and whole-body white sucker from Scraggy Lake showed an increasing trend in mercury concentration with fish length.

A benthic invertebrate community (BIC) study was conducted to assess baseline conditions in the nearfield and farfield locations in Scraggy Lake prior to effluent discharge, but not at reference lakes. The BIC in the nearfield and farfield were similar, with Diptera being the predominant taxon. For the endpoints assessed, taxa richness, Simpson’s Eveness Index, Simpson’s Diversity Index and biomass were similar between nearfield and farfield locations. Density of organisms was higher in the nearfield than the farfield sampling location. Overall, given the lack of suitable substrate in littoral areas for quantitative sampling in Scraggy Lake, the use of the petit ponar at depths between 3-4 m is recommended.

Surface water samples were collected to provide additional baseline conditions in Scraggy Lake prior to effluent discharge and determine similarities or differences to reference lakes. In all lakes, surface water was “soft” meaning they contained low concentrations of dissolved minerals (i.e., hardness), had low pH and was nutrient poor. Total aluminum concentrations were elevated in all lakes relative to the Canadian Water Quality Guideline Protection of Aquatic Life (Freshwater) (CWQG PAL) guidelines and inferring that water quality is influenced by the regional geology.

Sediment samples were collected to provide additional baseline conditions in Scraggy Lake, Long Lake and Alma Lake. There were no exceedances of the Canadian Sediment Quality Guideline Probable Effects Limit (CSQG PEL) for cadmium, chromium, copper, lead, mercury and zinc in any of the lakes sampled. Arsenic levels were above the CSQG PEL at one nearfield station (SGL-001; 18 mg/kg versus guideline of 17 mg/kg) in Scraggy Lake and at a reference station in Long Lake (LL-002; 21 mg/kg versus guideline of 17 mg/kg).

The aquatic study in 2018 supplements information collected in 2017 to provide baseline information for Scraggy Lake prior to effluent discharge from the Mine for the benthic invertebrate community, water and sediment quality, and fish. The biological information collected at the nearfield and farfield locations described above supports the use of these sites during Phase 1 EEM anticipated to begin in 2020. The surveys also confirmed the suitability of Long Lake as a reference lake. Alma Lake had similar fish habitat characteristics, water and sediment quality to Scraggy Lake. Given that only one of the sentinel fish species is present (i.e., white sucker) and relatively common in Alma Lake it is suggested that another reference lake should be considered for Phase 1 EEM that contains both white sucker and yellow perch.

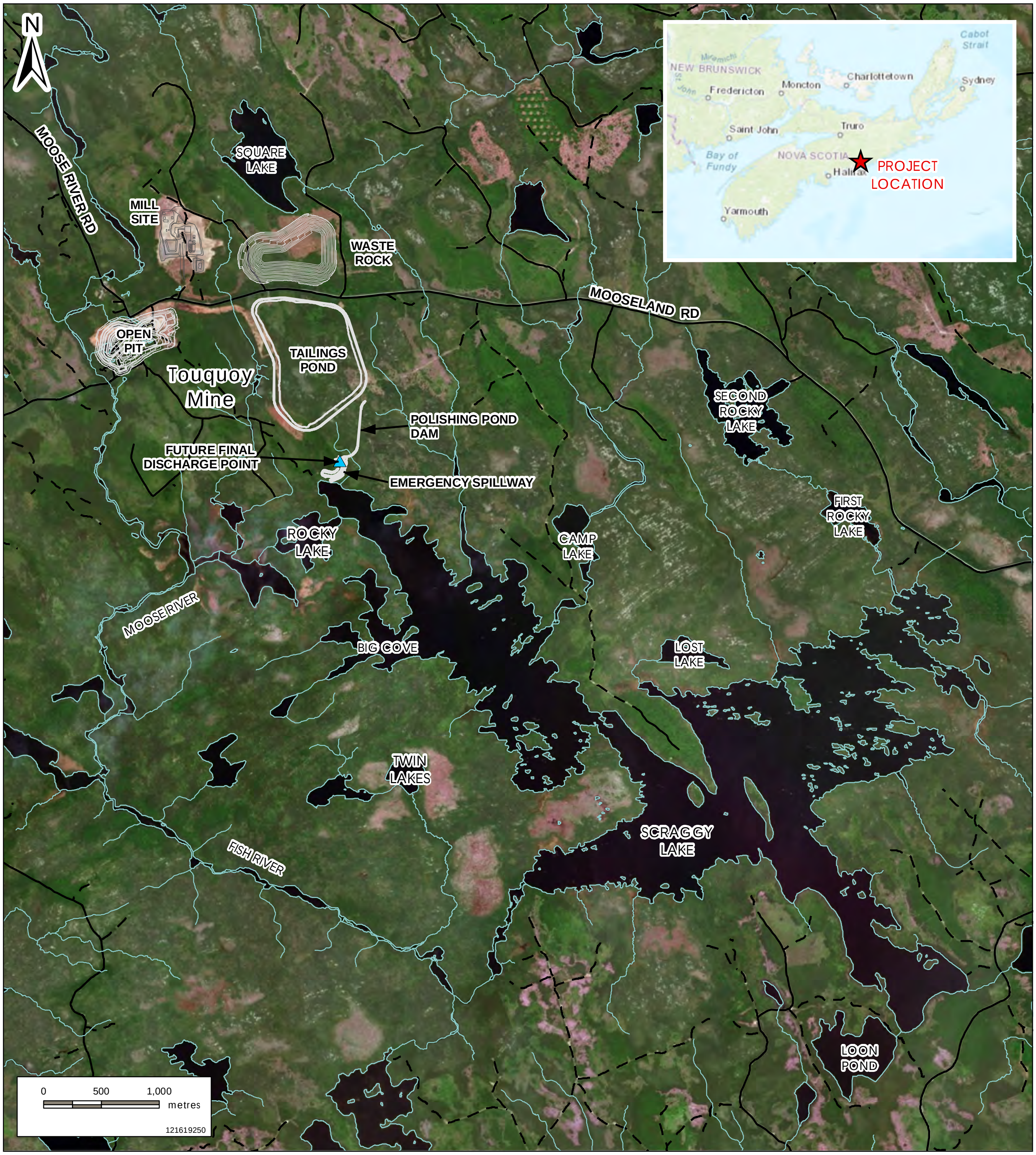
The results of this program will be used to develop the EEM study design required under MDMER and provide context for interpretation of results from future EEM programs.

1.0 INTRODUCTION

Atlantic Gold Mining Corporation (Atlantic Gold) operates the Touquoy Gold Mine (the Mine), located in Moose River Gold Mines, approximately 110 km northeast of Halifax, NS (Photo 1, Figure 1.1). The Project includes open-pit mine and processing for gold on site. The Project began discharging effluent from the polishing pond and into Scraggy Lake, NS, in July 2019.

Stantec Consulting Ltd. (Stantec) was contracted by Atlantic Gold to undertake additional baseline aquatic monitoring in 2018. This report provides background information on the mine and the future aquatic receiving environment and provides the results of the supplemental baseline sampling program conducted in 2018 to establish the existing conditions in Scraggy Lake prior to effluent discharge from the Mine to assist in interpretation of results of future environmental effects monitoring (EEM) programs that are required under the *Metal and Diamond Mining Effluent Regulations* (MDMER), pursuant to the federal *Fisheries Act*. The Mine became subject to MDMER on July 20, 2018 when it began discharging treated effluent to Scraggy Lake. Baseline sampling is also used to support design of the first (Phase 1) EEM program, which is due to be submitted to Environment and Climate Change Canada by July 20, 2019.

Photo 1 Touquoy Gold Mine in Moose River Gold Mines, NS.



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Notes
1. Coordinate System: NAD 1983 CSRS UTM Zone 20N
2. Baedata Source: Government of Nova Scotia
3. Imagery Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong),

Client/Project

ATLANTIC GOLD CORPORATION
TOUQUOY GOLD PROJECT

Figure No.
1.1

Title
LOCATION OF TOUQUOY GOLD MINE IN MOOSE RIVER GOLD MINES, NS

1.1 MINE BACKGROUND

The Mine is in an area of historic gold mining activity. Gold production from Moose River Gold Mines, near the Mine site, commenced around 1877 and continued intermittently until the First World War. An estimated 21,500 ounces of gold were produced. Most gold was recovered from underground operations from quartz veins in bedded leads with lesser amounts from shallow quarries working both bedrock and eluvia deposits (Ausenco, 2015).

An attempt to re-open the underground workings was made in 1935/36 ending in a mine collapse on Easter Sunday 1936 with the subsequent highly publicized mine rescue event. The site then became dormant (Ausenco, 2015).

Modern exploration commenced in 1983 by Seabright Explorations Inc. (Seabright); Seabright staked the property and focused activities on aggressive exploratory drilling. In 1987, Westminer took over Seabright and continued the drilling program. By the end of 1989, a 57,000 tonne bulk sample had been taken from the north-western end of the deposit and processed by flotation at the Gays River Mill, 40 km from Moose River Gold Mines (Ausenco, 2015).

After multiple changes in ownership over the next decade, in May 2003, Atlantic Gold NL (then known as Diamond Ventures NL) and Atlantic Mining NS Corp., entered into an option agreement with Moose River Resources Inc. In August 2014, a merger between Atlantic Gold Corporation and Atlantic Gold NL was completed.

In 2016, the detailed design of the tailings management facility (TMF) was completed and submitted to Nova Scotia Environment (NSE) for Industrial Approval. Approval was given on February 24, 2017 (NSE 2017). The Touquoy Gold Mine was officially opened on October 11, 2017 with commercial production achieved in March 2018 with an anticipated life of Mine of five years.

The major project components related to water management at Touquoy are the mill, tailings pond, process water treatment plant and the polishing pond (Photo 1). Process water is primarily sourced from the TMF area and supplemented by make-up water from Scraggy Lake, where withdrawal began in 2017. All waste water and surface runoff are directed to the TMF for treatment. Excess tailings water is treated by adding 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 an engineered wetland and discharged into the northwestern end of Scraggy Lake. Effluent discharge from Touquoy Mine began on July 20, 2018.

1.2 LOCAL GEOLOGY

The description of local geology herein is summarized from information provided in Ausenco (2015). At Touquoy gold mineralization broadly conforms to bedding over a strike length of approximately 700 m. Most gold occurs within the 25-180 m thick Touquoy Argillite, which is part of the lowermost unit of the Goldenville Formation, the Moose River Member. Gold is mostly disseminated within the Touquoy Argillite close to, and on both limbs of, the Moose River-Fifteen Mile Stream Anticline, but also occurs within thin bedding-parallel quartz veins within the Touquoy Argillite. Subordinate gold mineralization in the adjacent greywackes is mostly restricted to more typical “Meguma-style”, narrow quartz vein hosted gold mineralization. At the small, Meguma-style Higgins & Lawlor and Stillwater deposits at the western end of the Property, gold mineralization is hosted entirely in mostly bedding-parallel quartz veins.

Sulphide minerals accompanying the gold mineralization are pyrrhotite (1-2%), usually aligned along the sub-vertical axial plane cleavage within the argillite, arsenopyrite (1%), often as coarse porphyroblasts and pyrite (<1%). Other sulphides are rare. At a macro scale there is poor correlation between arsenic and gold content. Distinctive carbonate (ankerite) alteration accompanies the mineralization.

Gold occurs as native gold and had been observed in hand specimen and microscopic settings, mostly along fractures and grain boundaries or as disseminations within sulphides (mostly arsenopyrite), and as isolated grains along cleavage planes or within quartz veins. Gold grain size, as indicated by petrographic studies varies, from one micron to greater than one millimetre and gold grains up to 1.5 mm in size have been observed.

Trace metals are found in soils and sediments of various forms and are released into the water by weathering processes. The interactions between rain water and geological materials in the form of weathering, results in the dissolution of minerals and introduction of dissolved and suspended materials into groundwater and surface water runoff. Weathering, which results in increased concentrations of major ions (e.g., calcium, magnesium, sodium, potassium, bicarbonate, chloride) in the water, also results in higher concentrations of trace metals (including aluminum, iron, and other metals). Not surprisingly, concentrations of major ions and trace metals in surface water at the Touquoy Mine site have been found to be reflective of the local geology (Stantec 2018a).

1.3 BACKGROUND ON ENVIRONMENTAL EFFECTS MONITORING AND THE AQUATIC RECEIVING ENVIRONMENT

In 2017 a baseline environmental effects monitoring program was conducted to establish baseline conditions in the future aquatic receiving environment for effluent in Scraggy Lake (Stantec 2018b). It was designed to mirror the requirements for future EEM under MDMER to support interpretation of results. The Metal Mining Technical Guidance for Environmental Effects Monitoring (Environment Canada 2012) was used to inform the design and methods.

The 2017 baseline aquatic environment study on Scraggy Lake included:

- Adult fish survey (EEM endpoints);
- Fish tissue study (whole-body);
- Benthic invertebrate community (BIC) survey (kick and sweep method); and
- Supporting environmental variables (water and sediment quality).

Following the 2017 aquatic baseline work, it was recommended that additional EEM sampling be conducted prior to effluent discharge, focusing on additional fish tissue samples (i.e., whole-body and muscle tissue) and an alternative approach to sampling the BIC to obtain quantitative results.

In 2017, fish tissue samples were collected from whole-body white sucker and yellow perch at nearfield and farfield locations on Scraggy Lake. Following analysis of the results, it was recommended that additional tissue samples be collected to provide whole-body and muscle tissue samples from sentinel fish species with lower detection limits for the metals of interest for baseline comparison in the event that an ecological risk assessment is required in the future.

The BIC survey in 2017 was attempted using a petit ponar and Eckman grab in the shallow littoral areas of Scraggy Lake (i.e., ~1 m water depth). As this was not feasible given the lack of soft substrates and abundance of hard substrates, the method was modified to use a D-net kick method. Field conditions (e.g., lack of water flow and challenging substrate) made it difficult to obtain a quantitative sample for a fixed area and sampling time. A quantitative sample is required for EEM sampling under MDMER if feasible. Stantec recommended re-sampling the BIC in 2018 using a petit ponar to collect a quantitative sample, focusing on depositional areas in deeper parts of the lake instead of the shallow littoral area that was sampled in 2017. No benthic invertebrate samples were collected from Long Lake or Alma Lake in 2017 or 2018 as the lakes had not been selected as suitable reference lakes at the time of sampling.

A reconnaissance survey in support of EEM in 2017 was proposed for Long Lake and Alma Lake to assess their suitability as reference lakes. A reconnaissance survey on Long Lake took place and included a preliminary fish community survey and collection of supporting environmental variables (water and sediment quality). There was insufficient field time in the fall of 2017 to allow for additional baseline sampling in Long Lake and reconnaissance in Alma Lake. Additional sampling was recommended for 2018 to supplement/provide additional information for the proposed reference lakes (i.e., Alma Lake and Long Lake) for comparison to Scraggy Lake prior to development of the Phase 1 study design.

The 2017 reconnaissance survey in Long Lake did not confirm if adult white sucker were present (Stantec 2018b). Therefore, it was recommended that additional fish community sampling in Long Lake be conducted to confirm the presence and abundance of white sucker for use in the EEM program. As no work was conducted on Alma Lake in 2017, a fish habitat survey, fish community survey, and water and sediment quality were collected from Alma lake for comparison to Scraggy Lake to determine its suitability as a reference lake in 2018.

The details of those surveys are outlined in the Section 2 and 3.

Given the history of mining in the area, a review of where historical mining activities could influence the EEM study design (i.e., selection of reference areas) was recommended for 2018, and is described in Section 4.

2.0 METHODOLOGY

Stantec conducted additional baseline EEM surveys from July 1 to 6, 2018 including the following:

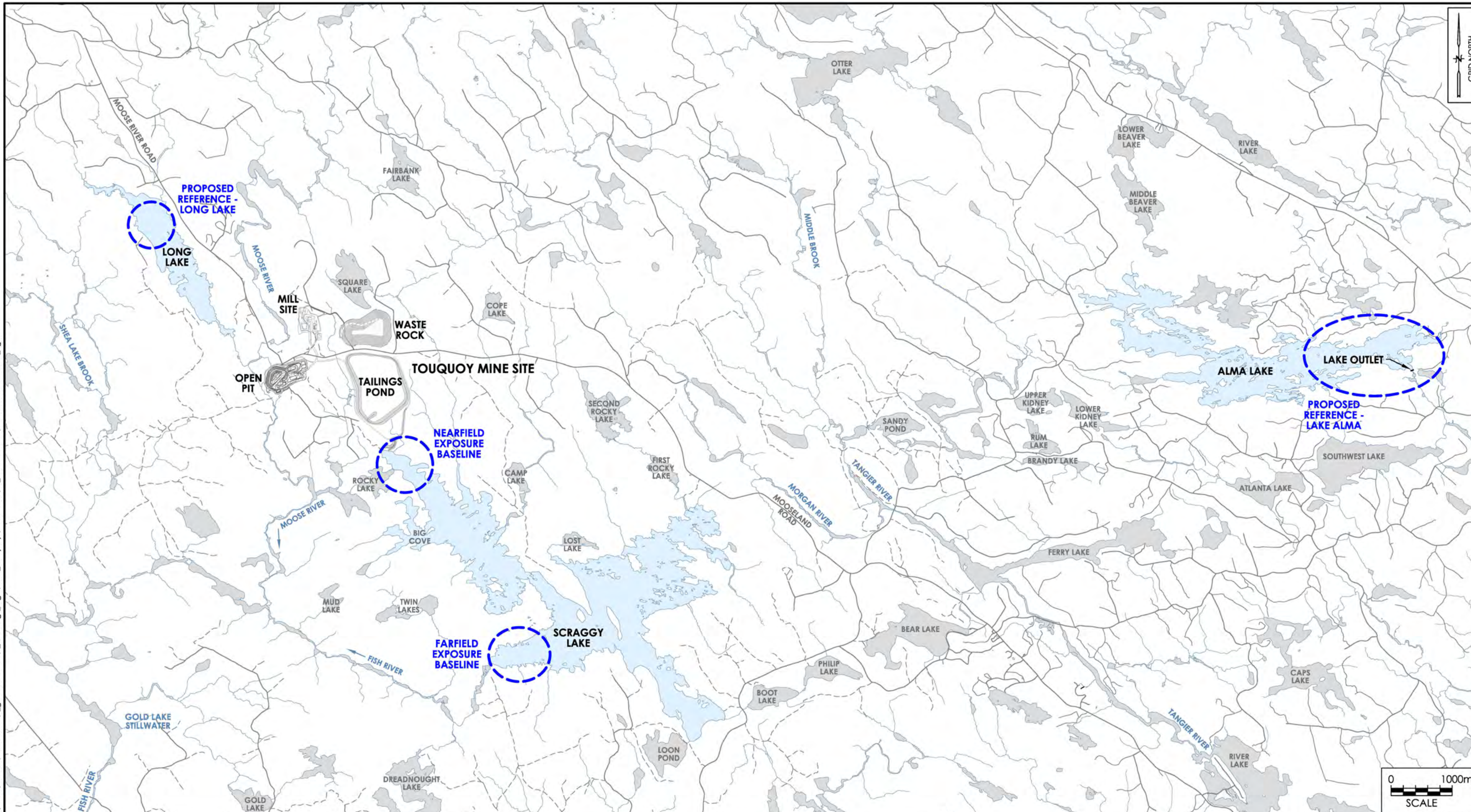
- fish habitat survey on Alma Lake;
- adult fish community survey on Long Lake and Alma Lake;
- fish tissue study on Scraggy Lake;
- BIC survey on Scraggy lake; and
- supporting environmental variables on all lakes.

Figure 2.1 shows the general area of the baseline environmental effects monitoring study locations relative to the Touquoy Mine site.

Table 2.1 provides a summary of the surveys conducted at each lake in 2018.

Table 2.1 Summary of 2018 Baseline Aquatic Surveys for EEM at Touquoy Mine, NS

Survey	Scraggy Lake	Long Lake	Alma Lake
Fish Habitat	-	-	✓
Fish Community	-	✓	✓
Fish Tissue	✓	-	-
Benthic Invertebrate Community	✓	-	-
Water	✓	✓	✓
Sediment	✓	✓	✓
Note: ✓ indicates sampled, - indicates not sampled			



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Notes
1. PROVINCIAL BASE DATA REPRODUCED AND DISTRIBUTED WITH THE PERMISSION OF SERVICE NOVA SCOTIA & MUNICIPAL RELATIONS (SNSMR, 2006) AS PER THE TERMS OF USE OUTLINED IN THE UNRESTRICTED DATA USE LICENSE AGREEMENT FOR GEOGRAPHIC DATA.

LEGEND
- EXISTING ROAD - PAVED
- EXISTING ROAD - DIRT
- EXISTING WATERCOURSE
- EXISTING WATERBODY - OTHER
- EXISTING WATERBODY - STUDY AREA

Client/Project
ATLANTIC GOLD CORPORATION
2018 BASELINE AQUATIC ENVIRONMENT TECHNICAL REPORT

Project No.
121619250

Title
BASELINE ENVIRONMENTAL EFFECTS MONITORING STUDY LOCATIONS

Revision	Date
REV-0	2019.02.19
Reference Sheet	Figure No.
-	2.11

2.1 FISH HABITAT SURVEY

Habitat characteristics for shoreline and aquatic habitat were documented using a GPS unit, photographic records, and a boat-mounted chart plotter (Garmin GPSmap 531, Olathe, Kansas, USA) on Alma Lake. No fish habitat surveys were conducted on Scraggy Lake and Long Lake as they were done previously, as part of baseline sampling in 2017 (Stantec 2018b).

2.2 FISH COMMUNITY SURVEY

A fish community survey was conducted on Long Lake and Alma Lake in 2018. A fish community survey was not conducted on Scraggy Lake in 2018, as it was conducted in 2017; however, bycatch associated with the fish tissue sampling are reported below.

The fish surveys were conducted in accordance with DFO Scientific Collection Licence #321156. Overnight sets of gill nets were the primary method used to target yellow perch and white sucker. Mesh size ranged from 13 mm to 64 mm and nets were 30.5 m in length and 1.82 m in height. Gill nets were set late in the day and checked early in the morning to reduce soak times and potential for bycatch. Three sets of three minnow traps were baited with small quantities of cat food to catch fish. Location and effort for all gear were recorded.

All fish captured were identified to species. Any fish not retained for the fish tissue study described below were measured to the nearest millimeter as time and weather permitted. Body weight was measured using a A&D® balance (EJ-300) (Toshima, Tokyo, Japan) accurate to 0.01 g. Following measuring and weighing, fish were released.

2.3 FISH TISSUE STUDY

A fish tissue study was conducted on fish in Scraggy Lake in 2018. Gill nets were set in the nearfield and farfield locations using the methods described in the adult fish community survey to collect fish for the fish tissue study. A total of ten mature white sucker and ten mature yellow perch were collected for fish tissue analysis with equal numbers of each species being desired from nearfield and farfield locations (i.e., five fish of each species). Fish were euthanized by a blow to the head and stored immediately on ice in labelled bags. Non-target species were identified, counted and released. Non-target species and immature yellow perch and white sucker were measured for length and weight as time permitted.

Fish selected for tissue analysis were transferred from the collection site to a field laboratory. Dissecting tools (e.g., scalpel, forceps, cutting board) were rinsed with tap water, followed by Versa-clean multi-purpose cleaner (Fisher Scientific), denatured alcohol (Fisher Scientific) followed by de-ionized water between individual fish samples, to prevent cross-contamination between samples. Nitrile gloves were worn during dissections and were changed between samples to prevent cross contamination.

Ten white sucker were measured to the nearest 1 mm and weighed using A&D® balance (EJ-300) accurate to 0.01 g. Each one was transferred to a large Ziploc® bag for whole-body analysis. Ten yellow perch were measured to the nearest 1 mm and weighed. The skinless, boneless muscle fillet of ten yellow perch were removed using a scalpel, tweezers and a fillet knife. The skinless, boneless muscle fillet was weighed and placed in a Whirl-Pak® bag for analysis. The remaining carcass was put in a separate Whirl-Pak® bag for analysis. Samples were labelled with a unique sample number and placed immediately into a freezer for storage prior to being submitted in a cooler on ice for trace metals analysis to Maxxam Analytics in Bedford, NS.

Fish tissue samples were analyzed for several parameters, including a complete scan for metals, using Inductively Coupled Plasma Mass Spectrometry (ICP-MS), lipids (i.e., crude fat) and moisture. None of the skinless, boneless fillets samples from yellow perch were analyzed for moisture as sufficient weights for analysis were not met. The total wet weight body metal concentration of yellow perch was calculated by adding the metal concentration in the skinless, boneless fillet and carcass.

Results are presented on a wet weight basis.

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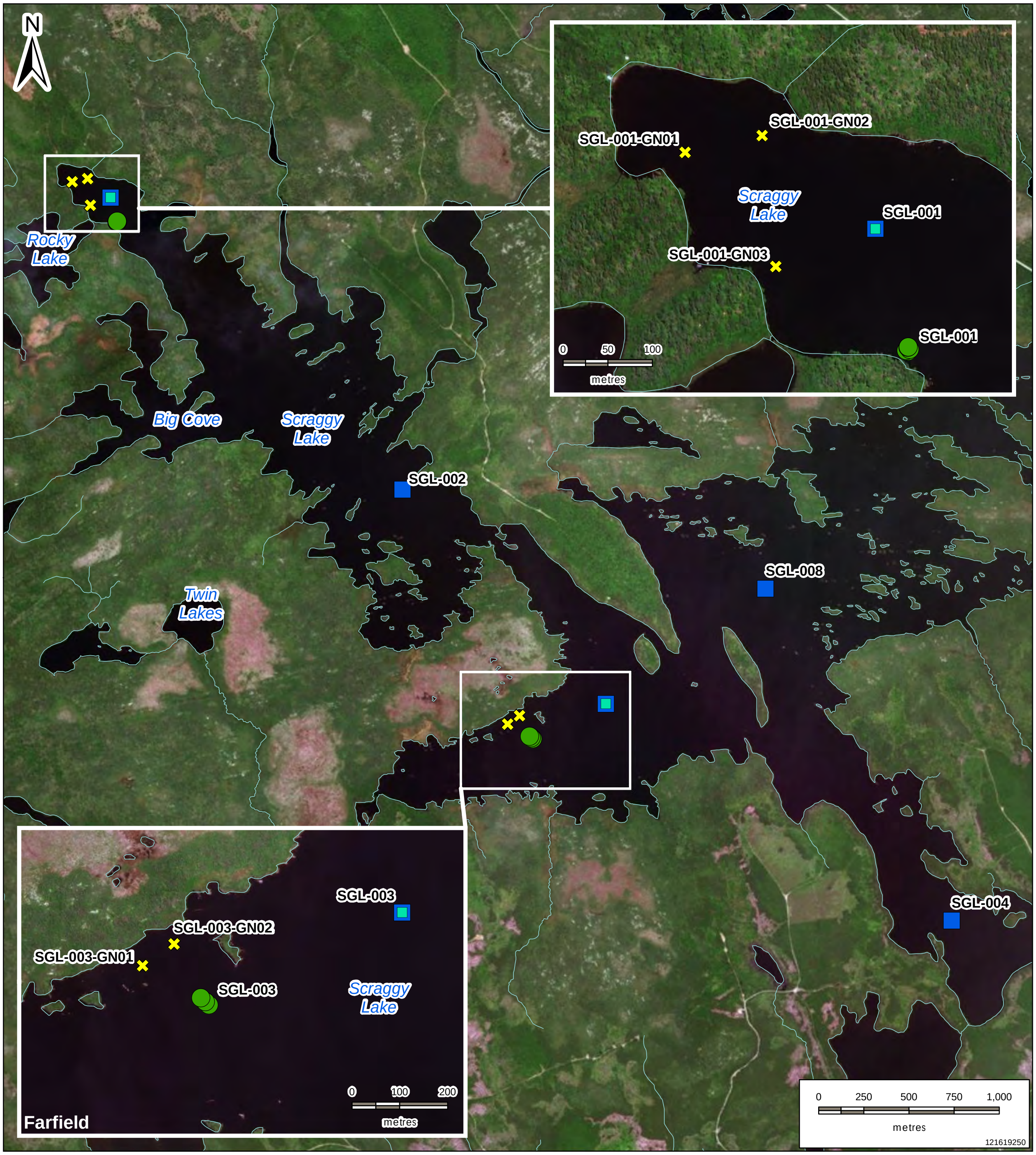

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Legend

Sample Location

- Benthic
- Gill Net
- Water
- Sediment

Notes

1. Coordinate System: NAD 1983 CSRS UTM Zone 20N
2. Basedata Source: Government of Nova Scotia
3. Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Client/Project
ATLANTIC GOLD CORPORATION
TOUQUOY GOLD PROJECT

Figure No.
2.2

Title
LOCATIONS FOR 2018 BASELINE AQUATIC SAMPLING ON SCRAGGY LAKE

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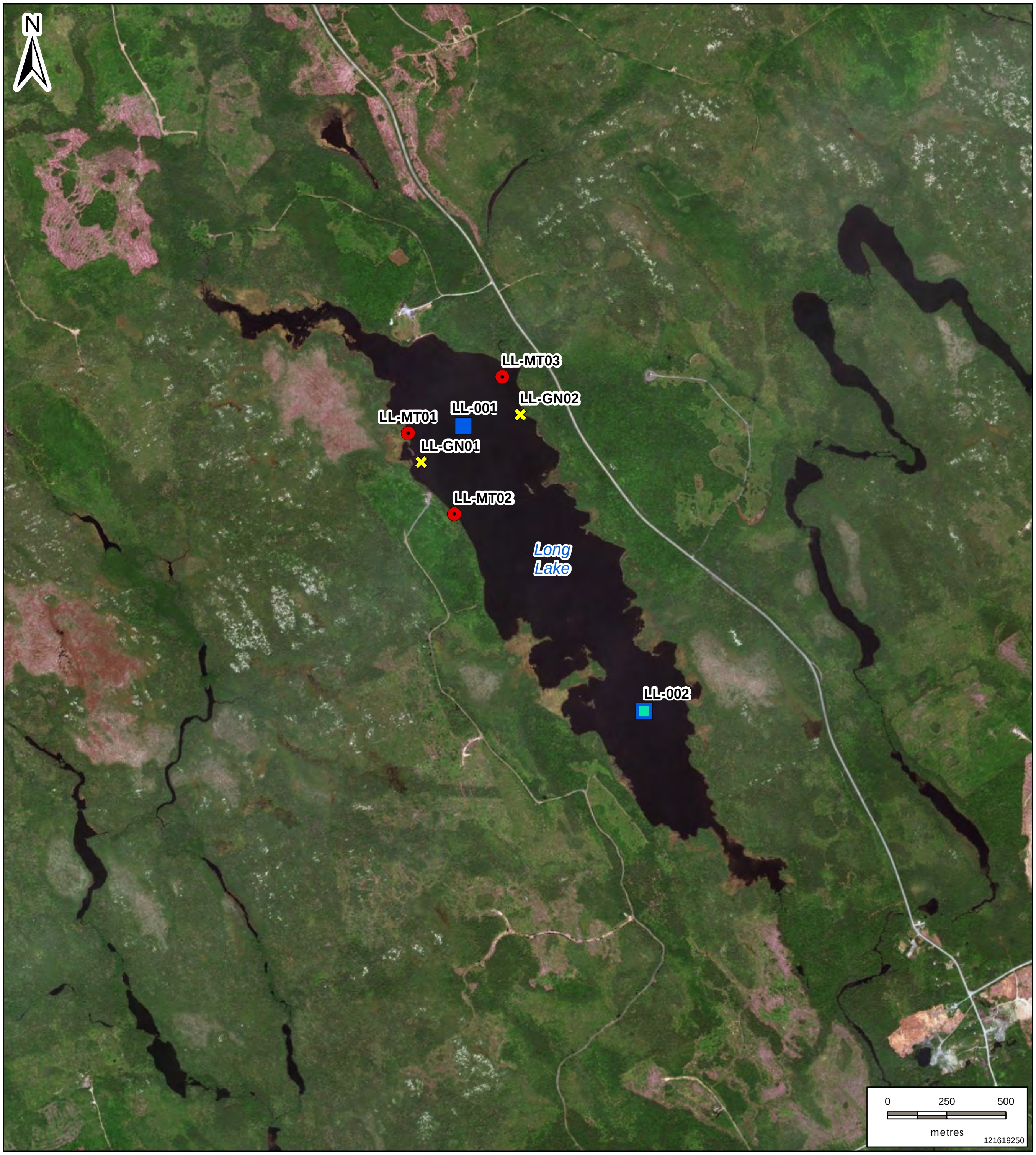

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Legend

Sample Location

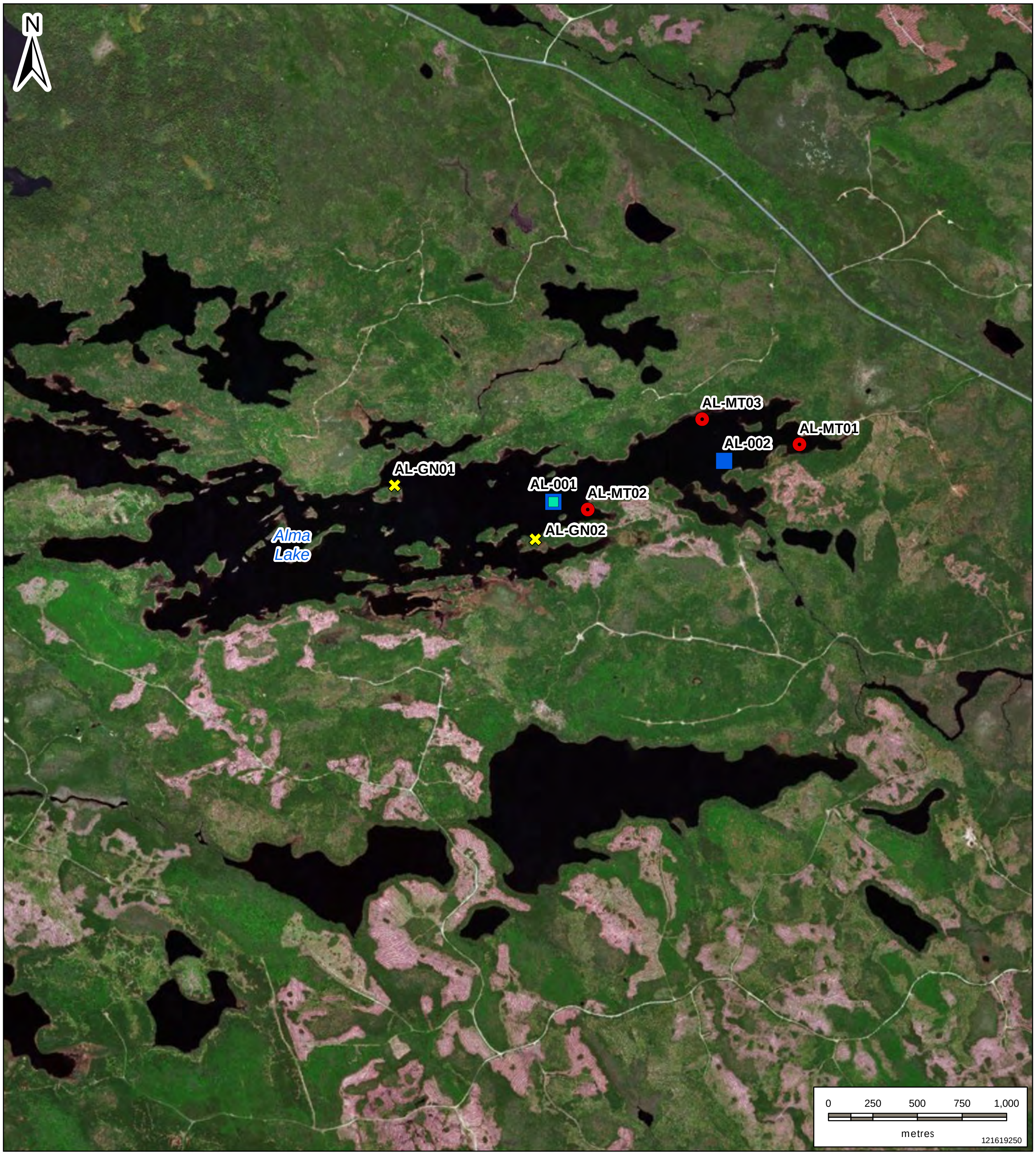
- Gill Net
- Minnow Trap
- Water
- Sediment

Notes
1. Coordinate System: NAD 1983 CSRS UTM Zone 20N
2. Basedata Source: Government of Nova Scotia
3. Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Client/Project
ATLANTIC GOLD CORPORATION
TOUQUOY GOLD PROJECT

Figure No.
2.3

Title
LOCATIONS FOR 2018 BASELINE
AQUATIC SAMPLING ON LONG LAKE



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Legend

Sample Location

- Gill Net
- Minnow Trap
- Water
- Sediment

Notes
1. Coordinate System: NAD 1983 CSRS UTM Zone 20N
2. Basedata Source: Government of Nova Scotia
3. Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Client/Project
ATLANTIC GOLD CORPORATION
TOUQUOY GOLD PROJECT

Figure No.
2.4

Title
LOCATIONS FOR 2018 BASELINE AQUATIC SAMPLING ON ALMA LAKE

2.3.1 Data Analysis

For yellow perch, wet weight metal concentrations of both muscle tissue and whole-body were desired. To determine the whole-body concentration of yellow perch the following formula was used.

$$WB_c = \frac{\left((P_c \; x \; M_{wt}) + (P_c \; x \; C_{wt})\right)}{(M_{wt} + C_{wt})}$$

Where:

- WB_c = Whole-body concentration (mg/kg) wet weight
- P_c = Parameter concentration (mg/kg)
- M_{wt} = Muscle Weight (kg)
- C_{wt} = Carcass Weight (kg)

Minimum, maximum, and number of detections were calculated for each tissue parameter by fish species and location captured. Several metals were selected for detailed analysis, including aluminum, arsenic, cadmium, copper, iron, lead, mercury, selenium and zinc. Selection of metals was based on elevated concentrations of these parameters in surface water quality data (Stantec 2017a) or their relevance for monitoring under MDMER. The results of fish tissue analysis were compared to applicable federal consumption guidelines for mercury and can be found in Section 4.2.

The Health Canada fish consumption guideline for human consumption for mercury is 0.5 mg/kg (Health Canada 2007).

As there are no provincially specific guidelines for Nova Scotia, the Ontario Ministry of Environment (OMOE) guidelines for fish muscle tissue were used for comparison. The OMOE (2013) has established the following guidelines:

- a complete restriction consumption guideline level of 0.52 mg/kg total mercury in fish muscle tissue (fillets);
- a partial restriction of 0.26 mg/kg, for women of child bearing age and children under the age of 15 years old; and
- a complete restriction consumption guideline of 1.84 mg/kg has also been established for the general population.

The data presented in the report are for whole fish and fish muscle tissue, however the guidelines are for fish muscle tissue (e.g., fillet). Fork length versus mercury concentration in whole body and muscle tissue samples was plotted as mercury is a parameter relevant to fish consumption guideline for human consumption.

2.4 BENTHIC INVERTEBRATE COMMUNITY ASSESSMENT

Five samples were collected at each of the nearfield and farfield locations of Scraggy lake in July 2018 for BIC assessment. No benthic invertebrate samples were collected from Long Lake or Alma Lake as the lakes had not been confirmed as suitable reference lakes based on the habitat and/or fish community.

BIC samples were collected in the nearfield and farfield locations using a petit ponar grab. As in 2017, attempts were made to sample within the littoral zone (~ 1 m water depth). Following extensive testing at various depths (1-4 m) within the nearfield and farfield basins it was determined that appropriate substrate was available only at depths greater than 3 m. Based on the bathymetry and substrate testing it appeared that hard rocky substrates with little depositional substrates existed around the perimeter of the lake in the nearfield and farfield locations at depths less than the 3 m bathymetric contour. It is speculated that these hard substrates may be related to shorelines that were submerged as a result of the past construction of the water control structure at the outlet of Scraggy Lake, prior to Atlantic Gold's acquisition of the property.

BIC samples were collected in deposition areas at ~3.5 m water depth at each of the nearfield and farfield stations using a petit ponar grab. The petit ponar had a surface area of 0.0255 m^2. Depth of the BIC samples was verified using a digital depth sounder (HawkEye H22PX Handheld Sonar System). Each sample consisted of a composite of three subsamples. Subsamples were collected at least 5 m apart. Samples were sieved through a 500 µm bucket sieve prior to preservation, in accordance with the Technical Guidance (EC 2012). The samples were preserved using 95% denatured alcohol diluted? to 75% (Fisher Scientific HC1300) and labelled on the inside and outside of each sample container. Samples were switched over to 95% denatured alcohol within 48 hours of collection for longer-term preservation.

Benthic invertebrates were sorted and identified to the lowest practical level by a qualified taxonomist at Envirosphere Consultants Limited in Windsor, NS. None of the samples were sub-sorted. A reference collection was retained in archive for potential future taxonomic verification and calculations of sorting efficiency were provided.

2.4.1 Data Analysis

BIC data were analyzed using four effect endpoints: total invertebrate density, taxa richness, Simpson's Evenness Index, Simpson's Diversity Index and biomass. Total invertebrate density, taxa richness, Simpson's Evenness Index and Bray-Curtis Dissimilarity Index are required endpoints in the Technical Guidance (EC 2012), however the Bray-Curtis Dissimilarity Index was not calculated as per the Technical Guidance (EC 2012) because it requires a reference location for comparison.

Data were summarized at the family level as per the Technical Guidance (EC 2012) since there were several taxa with a low number of individuals (e.g., one or two) and generally one species identified per family.

The EEM benthic invertebrate community endpoints and descriptors are defined below.

- Mean invertebrate abundance: number of organisms per m^2
- Mean taxa richness: mean number of taxa
- Mean Simpson's Evenness Index (E): a measure of the distribution of individuals among sampled taxa (range: 0 to 1) and calculated at the family level; a more equitable distribution (values approaching 1) indicates how evenly the individual species in the community are distributed. The evenness value for such a community would be 1.
- Mean Simpson's Diversity Index (D): the probability that two organisms, selected at random, are from a different taxonomic group (range: 0 to 1, with larger values indicative of more diverse communities); this index is influenced by the numerically dominant taxa and calculated at the family level.

- Biomass: a measure of the total weight of all organisms per sample; integrated measure of growth and survival; can be used to quantify productivity / energy flow within food chains.

Simpson's Evenness (E) was calculated using the formula:

$$E = \frac{1}{\frac{\sum_{i=1}^{s}(p_i)^2}{S}}$$

where 'p_i' is the proportion of individuals of the 'i^{th}' taxon in a community of 'S' taxa:

($_i$ = 1 to S).

Simpson's Diversity was calculated using the formula:

$$D = 1 - \sum (p_i)^2$$

where 'p_i' is the proportion of individuals of the 'i^{th}' taxon in a community of 'S' taxa (i = 1 to S).

Data for each of the endpoints are presented using boxplots, wherein the centre line is the median, the ends of the box indicate the lower and upper quartiles, the ends of the whiskers indicate the quartile ±1.5 times the interquartile spread, the asterisks indicate values falling within the quartile ± 3 times the interquartile spread and the open circles indicate values falling outside the quartile ± 3 times the interquartile spread.

2.5 WATER AND SEDIMENT QUALITY ASSESSMENT

Water sampling and sediment sampling were conducted on Scraggy Lake to obtain baseline information prior to effluent discharge from the Mine and on Long Lake and Alma Lake to characterize water and sediment quality for comparison to Scraggy Lake.

2.5.1 Water Sampling

Two samples (near-surface, near-bottom) were collected at each location on Scraggy Lake (SGL-001, -002, -003, -004 and -008), Long Lake (LL-01 and -02) and Alma Lake (AL-01 and -02) for laboratory analysis which included general chemistry, dissolved metals, total metals, strong acid dissociated cyanide and chlorophyll a (Figures 2.2 - 2.4). Surface samples were grab samples, while the near bottom samples were collected using a food-grade battery-powered pump with food grade tubing. Prior to use on each lake, the pump and associated tubing were rinsed with a 5% hydrochloric acid solution as per USGS (2004). Prior to each sample collection, the pump was rinsed for several minutes with lake water from the sampling location. Samples were collected using the appropriate containers as defined by the accredited laboratory. Trace metals samples were field-filtered using disposable 45 µm syringe filters. Samples submitted for chlorophyll *a* analysis were collected using plastic bottles covered with foil paper to further limit light penetration. Water samples were immediately placed in coolers and stored at 4°C for transport to the laboratory. Two field duplicates and one field blank were submitted to the laboratory for quality assurance and quality control (QA/QC).

In-situ temperature, dissolved oxygen, and conductivity profiles were collected at each sampling location using a YSI Multi-Meter (Model Pro2030, Ohio, USA). Readings were done at 0.5 m intervals from the surface to the bottom and again from bottom to surface. In addition, *in-situ* pH was measured at each location using a Hanna Instruments pH meter (Model HI98127, Quebec, Canada).

2.5.2 Sediment Sampling

A composite sediment sample consisting of two grabs was collected at each of the benthic invertebrate sampling station using the petit ponar (SGL-001 and SGL-003), and at one location on Long Lake at (LL-02) and one location on Alma Lake (AL-001). One field duplicate was collected (SGL-020) for QA/QC. Samples were analyzed by the laboratory for total organic carbon, particle size and total metals.

2.5.3 Data Analysis

Surface and near bottom water quality data were compared to the Canadian Environmental Quality Guidelines for water for the protection of aquatic life (CEQG-Water; CCME 2018). Sediment quality data were compared with the Interim Sediment Quality Guidelines (ISQG) and with Probable Effects Levels (PEL) guidelines (CCME 2018).

2.6 QUALITY ASSURANCE AND QUALITY CONTROL

A QA/QC program was implemented to confirm that data produced would be of acceptable and of verifiable quantity and meet the data quality objectives in support of future EEM requirements under MDMER. For the field component of the study, the program included a field plan, standard operating procedures for sampling, consistent sampling techniques, and the use of standardized field data collection sheets. The field sampling was conducted by a team of experienced staff, who have conducted lethal fish, benthic invertebrate community, water and sediment sampling for EEM for metal mining projects.

Each fish was weighed using a calibrated digital scale (± 0.01 g) and measured for total length using a measuring board (± 1 mm). Where possible all efforts were made to increase accuracy; fish were weighed in an enclosed room or container to minimize the effects of wind on the balance, the balance was tared prior to weighing between fish, and efforts were made to reduce the residual amounts of water on fish.

All water and sediment sampling equipment were checked to confirm normal operation prior to using and calibrated as applicable. QA/QC measures included the pre-labelling of sampling bottles, eliminating the need to label samples under field conditions. All sample locations were identified and assigned either a name or number identifier prior to starting the field surveys. Pertinent sample identification information was recorded on a data sheet and/or field book. Samples were stored at the appropriate temperature (e.g., in the freezer for fish tissue samples or on ice for water and sediment samples) until they were submitted to the laboratory. Samples were then packaged in coolers containing ice, issued chain-of-custody forms, and submitted to the laboratory for analysis.

Field blanks were used to check contamination from all potential sources of contamination of the sample (e.g., contaminated sample bottles, caps, equipment, atmospheric contamination, sampling techniques, analysis). Duplicate field samples were collected to verify analytical results, equipment reliance, the homogeneity of the site, and the reproducibility of the sampling approach.

For water quality sampling, field duplicates were collected for approximately 10% of the samples as well as using field and trip blanks throughout the field program. Field duplicates were collected for approximately 10% of the samples (1 sample total). The field duplicate (SGL-020) was collected at SGL-003-BT and was submitted blind to the laboratory for analysis. A field blank and trip blank were also submitted to the laboratory for analysis. The results were used to verify consistency in technical sample collection and handling to avoid sample contamination. The relative percent difference (RPD) between the field duplicate and the parent field sample was calculated to determine if quality assurance and quality control had been met. A RPD from the mean for individual parameters below 20% was interpreted to indicate that sample collection was technically sound.

For sediment quality sampling, a field duplicate was collected representing approximately 10% of the samples. The field duplicate (SGL-020) was collected at station AL-001. The relative percent difference (RPD) between the field duplicate and the parent field sample was calculated to determine if quality assurance and quality control had been met. A RPD from the mean for individual parameters below 20% indicated that sample collection was technically sound.

The laboratory that analyzed tissue, water and sediment samples (Maxxam Analytic) has a rigorous internal QA/QC program that includes use of chain-of-custody forms, sampling tracking and holding conditions, standard operating procedures for analysis and reporting, incorporation of laboratory duplicates and blanks, use of well-maintained equipment and qualified staff. Maxxam Analytics is accredited and certified by the Canadian Association of Laboratory Accreditation Inc for environmental analyses. QA/QC results are provided with the laboratory certificates in Appendix C and indicate that results are acceptable.

The benthic invertebrate samples were sorted and identified by a qualified taxonomist and in accordance with the Technical Guidance (EC 2012). A reference collection of representative benthic invertebrate taxa was retained for future verification (if warranted) and estimates of sorting efficiency were performed as described in the Technical Guidance (EC 2012) and were confirmed to be within 10% criterion for acceptability.

2.7 HISTORICAL MINING LOCATIONS

Stantec undertook a review of publicly available information to determine the location of past and present mining activity in the study area that may influence the selection of reference lakes or where we sample for Phase 1 EEM at Touquoy Mine. The review included an approximately 36 by 38 km area around the Touquoy Mine focusing on the area within the Tangier major watershed and areas of similar surficial geology as that found surrounding Scraggy Lake (e.g., stony till plain). The primary method of identifying historical mining locations was through the Nova Scotia Abandoned Mine Openings Database (Hennick and Poole 2017).

Historical mining activity often consisted of numerous shafts. Mining activity was grouped into areas based on the spatial distribution of the activity or activities which were associated with a specific mining company or feature (i.e., Lake Charlotte).

3.0 RESULTS

3.1 FISH HABITAT SURVEY

A fish habitat survey on Scraggy Lake and Long Lake was conducted in 2017 and is described in Stantec (2018b). A description of the habitat survey conducted on Alma Lake in 2018 is described below.

Alma Lake is in the St. Mary's River Watershed. It is surrounded by forested land some of which is harvested for timber. There is a small amount of development on the lake (i.e., cottages). The lake provides opportunities for recreational users though a rough woods road to the lake where a narrow boat can be launched (Appendix A). Shorelines are rocky (i.e., boulder and cobble) with intermittent patches of submerged and emergent aquatic vegetation (i.e., pond lilies). The lake has over 30 small (< 250 m wide) forested islands.

Alma Lake is characterized by two large basins (Figure 2.1). The eastern most basin is approximately 4.5 km in length and 0.8 km in width. Water depths at the time of the site visit were generally shallow (< 6 m), however a deeper area (8 - 10 m) runs approximately 50% of the length of the basin though the middle. There is another deep hole with a maximum depth of approximately 12 m at the western end of the basin (NSDNR 2018).

The western basin is approximately 2.5 km in length by 1 km in width. Water depths are generally deeper than the eastern basin. There are a number of deep holes within this basin, one of which has a maximum depth of 18 m (NSDNR 2018).

Fish habitat in Alma Lake was comprised principally of shallow water rocky habitats (< 6 m water depth) with sparse amounts of emergent vegetation near the shoreline (e.g., water lilies) (Appendix A). Substrate was a mix of cobble, rock, and some sand in littoral areas. The profundal zone of the lake was characterized by rich organic flocculent/mucky substrate. Alma Lake provides habitat for fish with a range of depth preferences and species which prefer rocky littoral substrates or sparse amounts of aquatic vegetation.

Overall, Alma Lake is smaller (440 ha) but has similar habitat to Scraggy Lake (645 ha) despite being located in a different watershed. Alma Lake is long and has defined basins like Scraggy Lake. The surrounding land use (i.e., few cottages surrounded by forested land) and fish habitat was similar (i.e., boulder littoral areas with sparse amounts of aquatic vegetation) in Alma Lake compared to Scraggy Lake. Alma Lake does have a higher percentage of deeper areas than Scraggy Lake but given the sentinel species selected (i.e., white sucker and yellow perch), Alma Lake would be a suitable reference lake in terms of the type of fish habitat available for these species.

3.2 FISH COMMUNITY SURVEY

A fish community survey was undertaken on Long Lake and Alma Lake to confirm the presence and abundance of suitable sentinel species (i.e., white sucker and yellow perch) for future EEM for comparison with Scraggy Lake as the exposure site. On Scraggy Lake, a fish tissue study was undertaken in 2018, but no fish community survey was completed because it was previously conducted in 2017. However, fish captured as part of the fish tissue study are provided to further document the fish community in Scraggy Lake in 2018. The results of all the fish species captured in each of the three lakes from 2018 are presented below in Table 3.1. Locations of gill nets and minnow trap sets are shown in Figures 2.2- 2.4. Raw data are provided in Appendix B.

Over a six-day period in July 2018, over 400 fish were collected from Scraggy, Long and Alma Lakes, representing eleven different species from ten different families (Table 3.1). The dominant fish species sampled from Scraggy Lake were yellow perch and white sucker, from Long Lake were banded killifish, brown bullhead and white perch, and from Alma Lake were banded killifish and golden shiner. No yellow perch were captured in Alma Lake. A local anger indicated that yellow perch were not present in Alma Lake.

White sucker fork length ranged from 22 to 28 cm in Long Lake and 15 to 38 cm in Alma Lake, respectively. Yellow perch fork length in Long Lake ranged from 10 to 12 cm. Fork lengths of each fish measured are shown in Appendix B.

Gill nets and minnow traps were used as the primary collection method in lakes (Table 3.1).

Table 3.1 Total Number of Fish Captured in Scraggy Lake, Long Lake, and Alma Lake, NS for EEM Fish Survey.

Species	Scraggy Lake	Long Lake	Alma Lake
Alewife (*Alosa pseudoharengus*)	20	-	-
American eel (*Anguilla rostrata*)	1	1	3
Banded Killifish (*Fundulus diaphanus*)	-	30	103
Brown Bullhead (*Ameiurus nebulosus*)	16	32	24
Brook Trout (*Salvelinus fontinalis*)	3	1	3
Golden Shiner (*Notemigonus crysoleucas*)	6	12	39
Lake Chub (*Couesius plumbeus*)	-	1	-
Ninespine stickleback (*Pungitius pungitius*)	-	1	-
White Perch (*Morone americana*)	-	33	-
White Sucker (*Catostomus commersonii*)	66	8	34
Yellow Perch (*Perca flavescens*)	31	7	-
Grand Total	143	126	206

Catch per unit effort for gill nets was highest in Long Lake and lowest in Scraggy Lake (Table 3.2). The catch per unit effort for minnow traps was higher in Alma Lake (16.2 fish/trap day) compared to Long Lake (5.9 fish/trap day).

Table 3.2 Summary of Catch Per Unit Effort (CPUE) by Fishing Method

Waterbody name	Gill Nets			Minnow Traps		
	Total Effort (neta hours)	Total Catch	CPUE (fish / neta / day)	Total Effort (trap hours)	Total Catch	CPUE (fish / trap / day)
Scraggy Lake	119.7	143	29.7	-	-	-
Long Lake	47.6	73	36.8	215.3	53	5.9
Alma Lake	47.4	60	30.4	214.7	145	16.2
Note: [a] One net is equivalent to a 30.5 m (100 ft) gill net						

3.3 FISH TISSUE STUDY

A total of ten whole-body fish samples were collected from white sucker and ten muscle fillet and whole-body fish samples were collected from yellow perch, in roughly equal proportions from the nearfield and farfield locations in Scraggy Lake in 2018.

All parameters were detected for each whole-body white sucker submitted to the laboratory for analysis, with the exception of crude fat (one non-detect). The parameters were relatively similar (less than an order of magnitude) for white sucker from the nearfield versus farfield. Detailed results are found in Appendix C.

Table 3.3 Minimum, Maximum, and Count for Trace Metal Parameters of Concern and Crude Fat and Moisture for Analysis for White Sucker

Parameter	Reportable Detection Limit	Nearfield Whole-Body (n = 5)			Farfield Whole-Body (n = 5)		
		Detections	Min	Max	Detections	Min	Max
Aluminum (mg/kg)	0.2	5	1.71	33.7	5	3.22	28.2
Arsenic (mg/kg)	0.005	5	0.0826	0.187	5	0.0734	0.13
Cadmium (mg/kg)	0.002	5	0.0284	0.0611	5	0.0355	0.0746
Copper (mg/kg)	0.01	5	0.472	0.918	5	0.653	1.4
Iron (mg/kg)	1	5	13.5	98.6	5	19.4	87.6
Lead (mg/kg)	0.002	5	0.108	0.458	5	0.191	0.28
Mercury (mg/kg)	0.002	5	0.182	0.348	5	0.115	0.167
Nickel (mg/kg)	0.01	5	0.01	0.045	5	0.022	0.065
Selenium (mg/kg)	0.01	5	0.603	0.959	5	0.691	1.37
Zinc (mg/kg)	0.04	5	15.3	26.9	5	13.8	24
Crude fat (%)	0.5	4	<0.50	2.6	5	0.5	1.1
Moisture (%)	1	5	77	81	5	79	83

All parameters were detected for each whole-body yellow perch submitted to the laboratory for analysis. Three of the yellow perch carcasses did not possess sufficient tissue for analysis of moisture (one nearfield and two farfield). The parameters were relatively similar (less than an order of magnitude) for whole-body analysis of yellow perch from the nearfield versus farfield, with the exception of aluminum, copper and iron which were elevated in the farfield location. The maximum values were not all obtained from the same fish. Maximum values of aluminum and iron were observed in the carcass of SGL-003-YLPR-07 and maximum values of copper were observed in the carcass of SGL-003-YLPR-06. The muscle tissue aluminum, copper, and iron concentrations for those fish were within the range observed in the other yellow perch muscle tissue samples collected indicating that the elevated carcass concentrations in SGL-003-YLPR-07 and SGL-003-YLPR-06 were a result of the carcass and not the muscle tissue submitted for laboratory analysis.

All parameters were detected in all of the yellow perch muscle fillets submitted to the laboratory for analysis, with the exception of aluminum, cadmium, nickel and crude fat (Table 3.4). All of the parameters of concern were relatively similar (less than an order of magnitude) for the yellow perch muscle tissue from the nearfield versus farfield.

Table 3.4 Minimum, Maximum, and Count for Trace Metal Parameters of Concern and Crude Fat and Moisture for Muscle Tissue and Whole-Body Analysis for Yellow Perch

Parameter	Reportable Detection Limit	Nearfield Whole-Body (n = 4)			Farfield Whole-Body (n = 6)		
		Detections	Min	Max	Detections	Min	Max
Aluminum (mg/kg)	0.2	4	1.56	15.29	6	1.09	101.29
Arsenic (mg/kg)	0.005	4	0.04	0.14	6	0.04	0.16
Cadmium (mg/kg)	0.002	4	0.02	0.04	6	0.02	0.05
Copper (mg/kg)	0.01	4	0.35	0.78	6	0.47	2.36
Iron (mg/kg)	1	4	13.09	54.25	6	14.10	256.78
Lead (mg/kg)	0.002	4	0.12	0.28	6	0.12	0.33
Mercury (mg/kg)	0.002	4	0.34	0.58	6	0.15	0.25
Nickel (mg/kg)	0.01	4	0.01	0.04	6	0.02	0.14
Selenium (mg/kg)	0.01	4	0.56	1.20	6	0.93	1.25
Zinc (mg/kg)	0.04	4	21.05	35.96	6	19.13	30.36
Crude fat (%)	0.5	4	1.24	3.22	6	0.90	2.66
Moisture (%)[a,b]	1	3	73	75	4	73	76
Aluminum (mg/kg)	0.2	1	<0.20	0.21	2	0.10	0.22
Arsenic (mg/kg)	0.005	4	0.04	0.07	2	<0.20	0.22
Cadmium (mg/kg)	0.002	1	<0.0020	0.0026	0	<0.0020	<0.0020
Copper (mg/kg)	0.01	4	0.172	0.284	6	0.193	0.258

Table 3.4 Minimum, Maximum, and Count for Trace Metal Parameters of Concern and Crude Fat and Moisture for Muscle Tissue and Whole-Body Analysis for Yellow Perch

Parameter	Reportable Detection Limit	Nearfield Whole-Body (n = 4)			Farfield Whole-Body (n = 6)		
		Detections	Min	Max	Detections	Min	Max
Iron (mg/kg)	1	4	1.5	2.9	6	1.6	2.6
Lead (mg/kg)	0.002	4	0.0025	0.0118	6	0.0028	0.0086
Mercury (mg/kg)	0.002	4	0.661	0.815	6	0.311	0.463
Nickel (mg/kg)	0.01	0	<0.010	<0.010	0	<0.010	<0.010
Selenium (mg/kg)	0.01	4	0.569	1.19	6	1.06	1.51
Zinc (mg/kg)	0.04	4	3.5	4.17	6	3.53	4.46
Crude fat (%)	0.5	0	<0.50	<0.50	1	<0.50	0.5

Note: [a] Moisture calculated from the carcass only, as insufficient muscle tissue was available for analysis.
[B] Moisure samples for whole-body yellow perch were n = 3 and n = 4, for the nearfield and farfield respectively, as a result of insufficient tissue weight for laboratory analysis.

Yellow perch and white sucker from Scraggy Lake show an increasing trend in mercury concentration with fish length for both whole-body samples and muscle tissue samples, as applicable (Figure 3.1). This trend is not surprising given that methylmercury is easily absorbed by aquatic organisms and becomes concentrated further up the aquatic food web (CCME 2003). Methylmercury is accumulated almost exclusively by diet with the highest concentrations occurring in large, older predatory fish (CCME 2003). Mercury concentrations in muscle tissue were also higher than in whole-body analysis which is consistent with other findings (Goldstein et al. 1996).

Of the yellow perch muscle tissue samples, four of ten had concentrations of total mercury that exceeded the OMOE muscle fillet total restriction guideline of 0.52 mg/kg for women of childbearing age and children under 15, and the Health Canada fish consumption guideline for human consumption of 0.5 mg/kg, and six of 10 samples had concentrations above the OMOE muscle fillet partial restriction guideline for human consumption (0.26 mg/kg) (Figure 3.1). Of the yellow perch whole-body samples, one of ten had concentrations of total mercury that exceeded the OMOE muscle fillet total restriction guideline of 0.52 mg/kg for women of childbearing age and children under 15 and the Health Canada fish consumption guideline for human consumption of 0.5 mg/kg, three of 10 samples had concentrations above the muscle fillet partial restriction guideline for human consumption (0.26 mg/kg) and six of the ten samples were below the muscle fillet partial restriction guideline for human consumption (0.26 mg/kg) (OMOE 2013) (Figure 3.1).

Of the white sucker whole-body samples, two of ten samples had concentrations above the muscle fillet partial restriction guideline for human consumption (0.26 mg/kg) and eight of ten were below the muscle fillet partial restriction guideline for human consumption (0.26 mg/kg) (OMOE 2013) (Figure 3.1).

All of the yellow perch and white sucker samples were below total restriction guideline of 1.84 mg/kg (OMOE 2013).

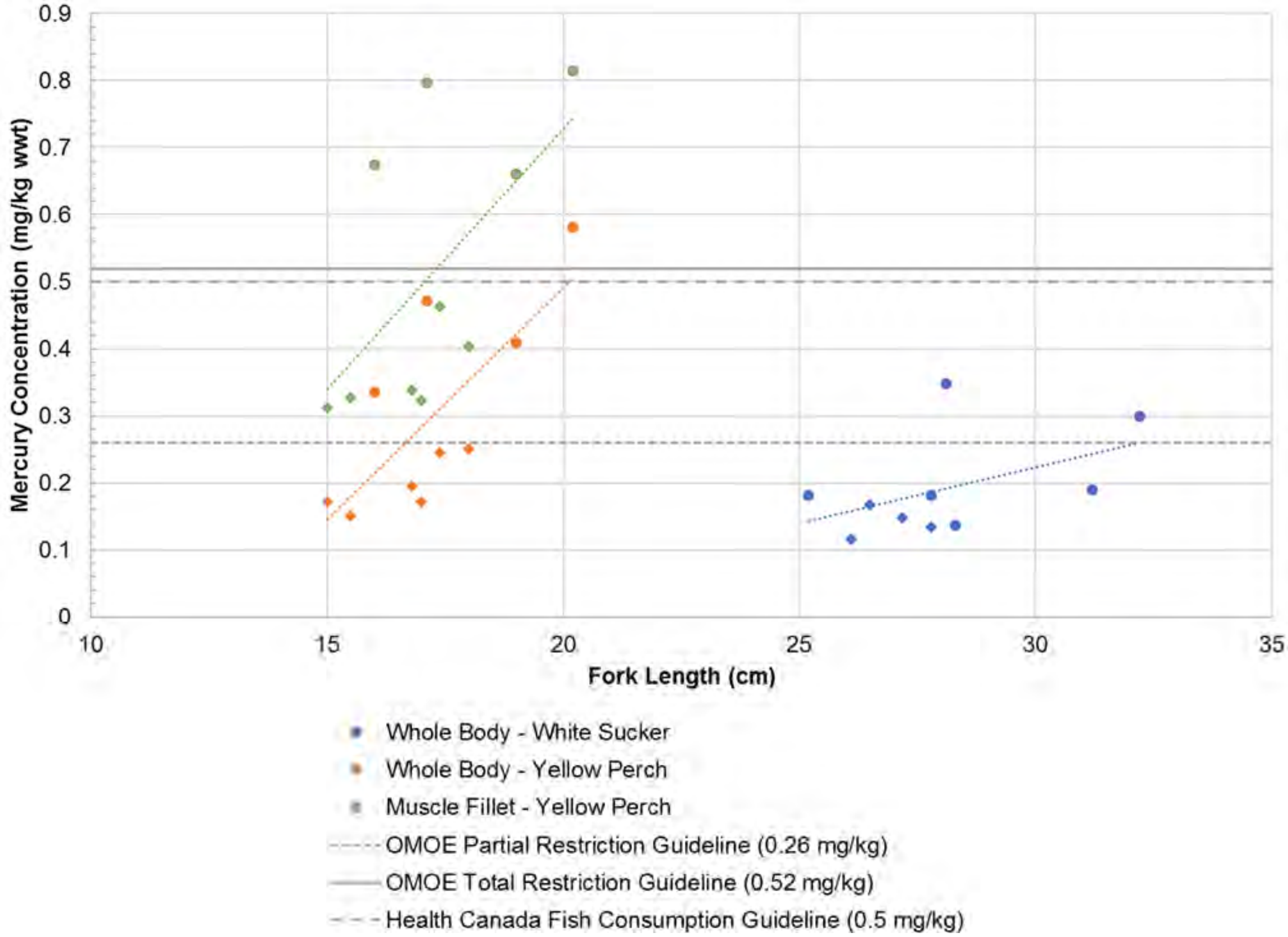


Figure 3.1 Yellow Perch and White Sucker Whole-Body Mercury Concentration in Relation to Fork Length (Circles represent nearfield, diamonds represent farfield)

3.4 BENTHIC INVERTEBRATE COMMUNITY ASSESSMENT

Five samples from each of the nearfield and farfield locations were sampled in Scraggy Lake. Benthic invertebrate sampling was not conducted in Long Lake or Alma Lake, as they had not been confirmed as suitable reference lakes for the Phase 1 EEM.

3.4.1 Community Structure

In total, over 13 different species from 12 families were identified from the samples (Appendix D). Diptera (e.g., Chironomidae, Chaoboridae and Ceratopogonidae) was the predominant major benthic invertebrate taxon (Figure 3.2). The other category was made up of all other taxa (i.e., Ephemeroptera, Trichoptera, Megaloptera, Odonata, Trombidiformes, Veneroida, Oligochaeta), which made up 9% of the benthic invertebrate community at the nearfield location on Scraggy Lake and 19% of the benthic invertebrate community at the farfield location, as shown in Figure 3.2. As these taxa each made up less than 5% of the community composition they were not presented in Figure 3.2.

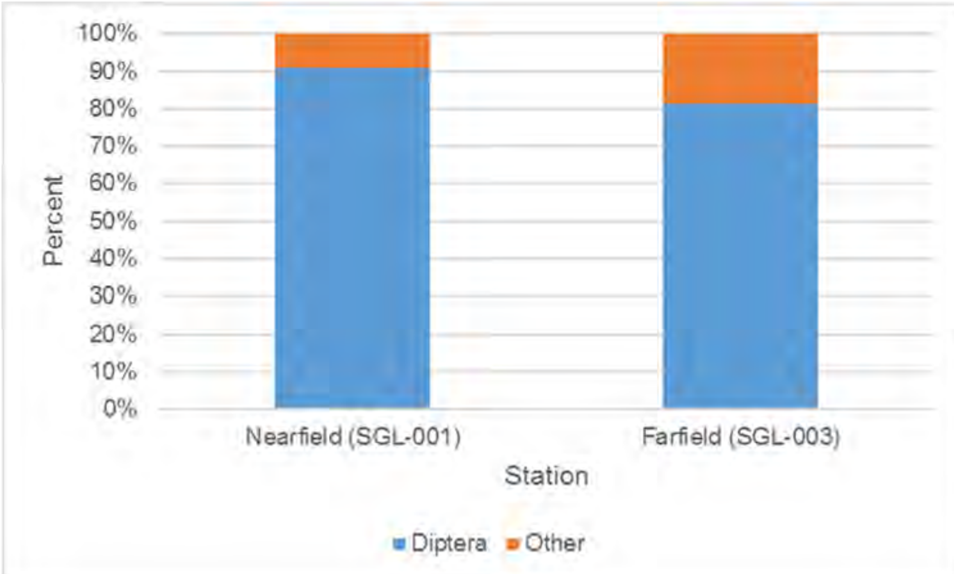


Figure 3.2 Taxonomic Composition of Benthic Invertebrate Community by Location

3.4.2 Benthic Invertebrate Community Endpoints

The summary statistics for the effect endpoints required by the Technical Guidance (EC 2012) are shown in Table 3.5 and include density (i.e., abundance), taxa richness (at family level), Simpson's Evenness Index, as well as Simpson's Diversity Index and biomass per sample. The benthic invertebrate community raw and indices values are presented in Appendix D.

Table 3.5 Benthic Invertebrate Community Summary Statistics for Abundance, Taxa Richness, Simpson's Diversity Index and Simpson's Evenness Index

Parameter	Nearfield (SGL-001)	Farfield (SGL-003)	Parameter	Nearfield (SGL-001)	Farfield (SGL-003)
N of Cases	5	5	**N of Cases**	5	5
Density (# individuals per m^2)			**Simpson's Evenness Index**		
Minimum	863	379	Minimum	0.31	0.23
Maximum	1582	732	Maximum	0.45	0.44
Median	1176	667	Median	0.34	0.36
Arithmetic Mean	1239	591	Arithmetic Mean	0.36	0.338
Standard Error of Arithmetic Mean	127	70	Standard Error of Arithmetic Mean	0.02	0.044
Standard Deviation	283	157	Standard Deviation	0.05	0.099
Taxa Richness			**Simpson's Diversity Index**		
Minimum	6	6	**Minimum**	0.51	0.37
Maximum	8	9	**Maximum**	0.63	0.75
Median	7	7	**Median**	0.61	0.54
Arithmetic Mean	6.8	7.4	**Arithmetic Mean**	0.58	0.56
Standard Error of Arithmetic Mean	0.4	0.7	**Standard Error of Arithmetic Mean**	0.03	0.06
Standard Deviation	0.8	1.5	**Standard Deviation**	0.06	0.14
Biomass					
Minimum	0.11	0.03			
Maximum	0.17	0.24			
Median	0.14	0.12			
Arithmetic Mean	0.14	0.14			
Standard Error of Arithmetic Mean	0.01	0.04			
Standard Deviation	0.03	0.09			

The density of organisms in the benthic invertebrate community was higher at the nearfield (median = 1176 individuals per m^2) than the farfield sampling location (median = 667 individuals per m^2) (Figure 3.3).

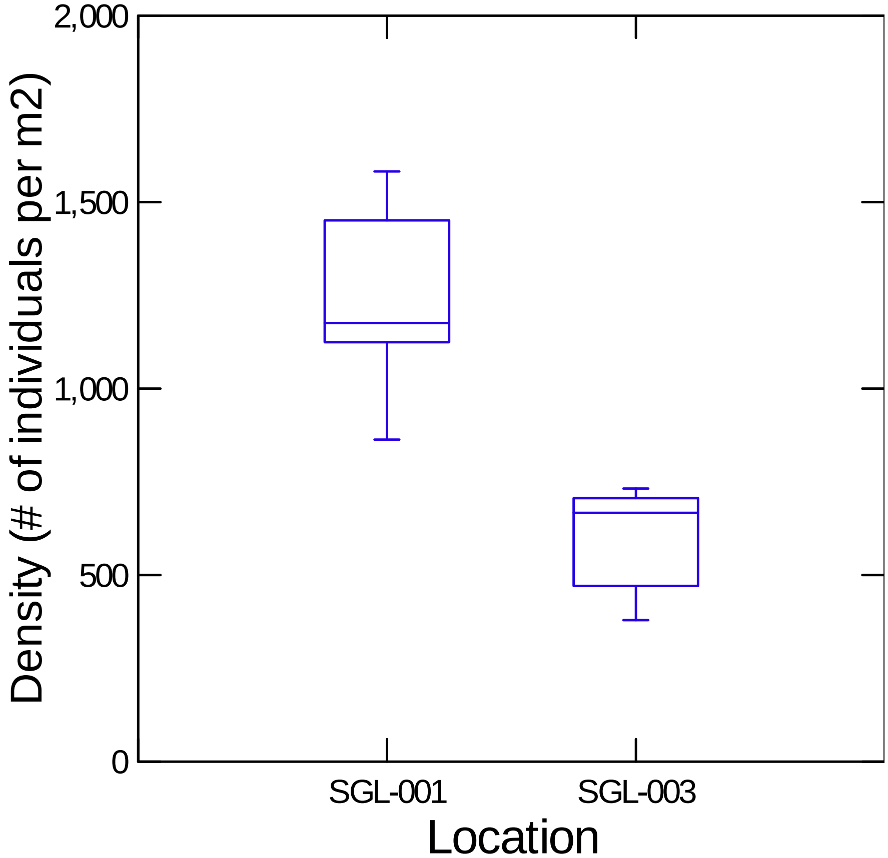


Figure 3.3 Box Plot of Benthic Invertebrate Community: Density (# of individuals per m^2).

Notes: The centre line is the median. Ends of the box indicate the lower and upper quartiles. Ends of the whiskers indicate the quartile ± 1.5 x interquartile spread. Asterisks indicate values falling within the quartile ± 3 x interquartile spread. Open circles indicate values falling outside the quartile ± 3 x interquartile spread.

Taxa richness was equivalent in the nearfield (median = 7 taxa) compared to the farfield sampling location (median = 7 taxa) (Figure 3.4).

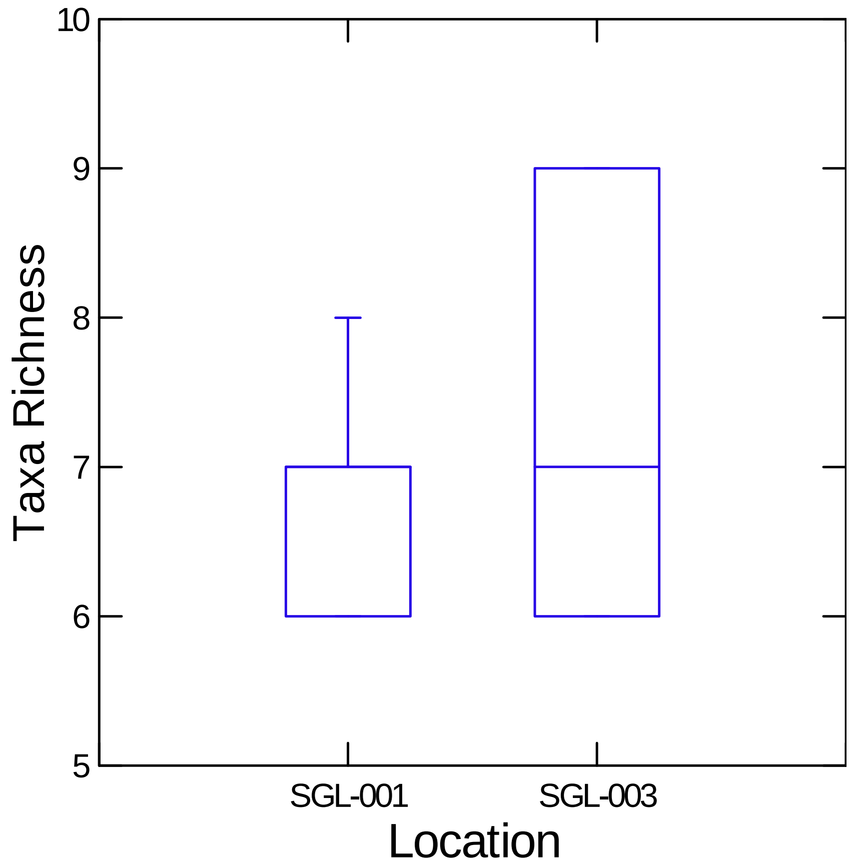


Figure 3.4 Box Plot of Benthic Invertebrate Community: Taxa Richness

Notes: The centre line is the median. Ends of the box indicate the lower and upper quartiles. Ends of the whiskers indicate the quartile ± 1.5 x interquartile spread. Asterisks indicate values falling within the quartile ± 3 x interquartile spread. Open circles indicate values falling outside the quartile ± 3 x interquartile spread.

Simpson's Evenness Index was similar at the farfield sampling location (median = 0.34) than the nearfield sampling location (median = 0.36) (Figure 3.5).

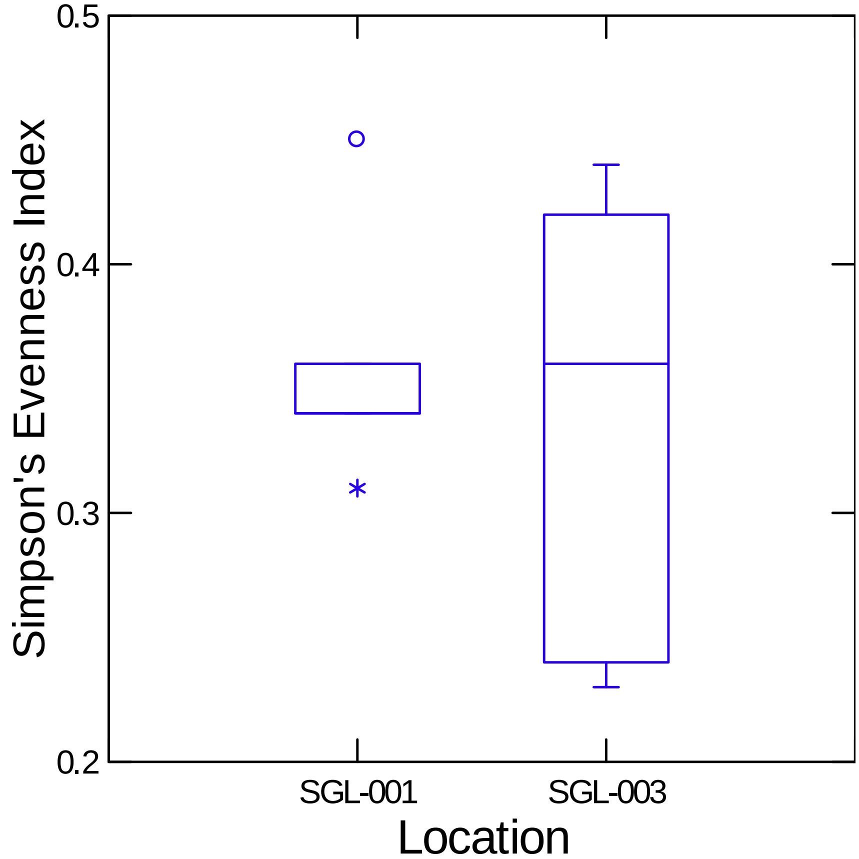


Figure 3.5 Box Plot of Benthic Invertebrate Community: Simpson's Evenness Index

Notes: The centre line is the median. Ends of the box indicate the lower and upper quartiles. Ends of the whiskers indicate the quartile ± 1.5 x interquartile spread. Asterisks indicate values falling within the quartile ± 3 x interquartile spread. Open circles indicate values falling outside the quartile ± 3 x interquartile spread.

Simpson's Diversity Index was similar at the farfield sampling location (median = 0.54) than the nearfield sampling location (median = 0.61) (Figure 3.6).

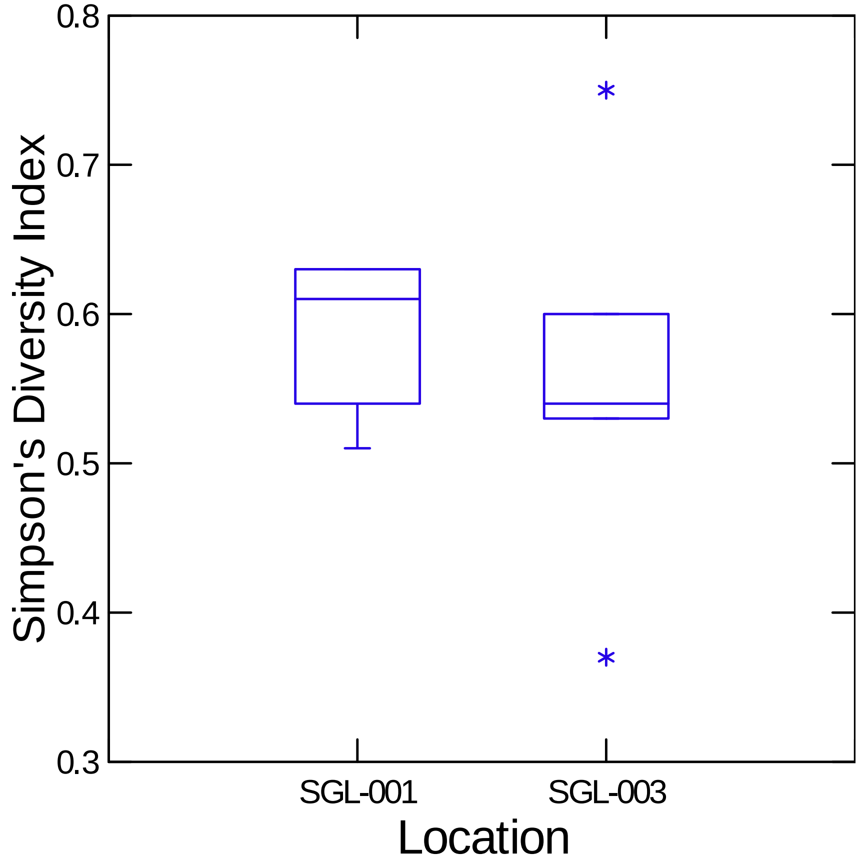


Figure 3.6 Benthic Invertebrate Community: Simpson's Diversity Index

Notes: The centre line is the median. Ends of the box indicate the lower and upper quartiles. Ends of the whiskers indicate the quartile ± 1.5 x interquartile spread. Asterisks indicate values falling within the quartile ± 3 x interquartile spread. Open circles indicate values falling outside the quartile ± 3 x interquartile spread.

The wetted biomass of organisms in the benthic invertebrate community was similar between the nearfield (median = 0.14 g) relative to the farfield sampling location (median = 0.12 g), however it was more variable at SGL-003 (Figure 3.7). The wet biomass of organisms did not reflect the trends observed in abundance inferring that the biomass in the nearfield was made up of greater numbers of lighter organisms compared to the farfield which had lower numbers of heavier organisms, as evidenced by the higher proportion of Diptera (Figure 3.2).

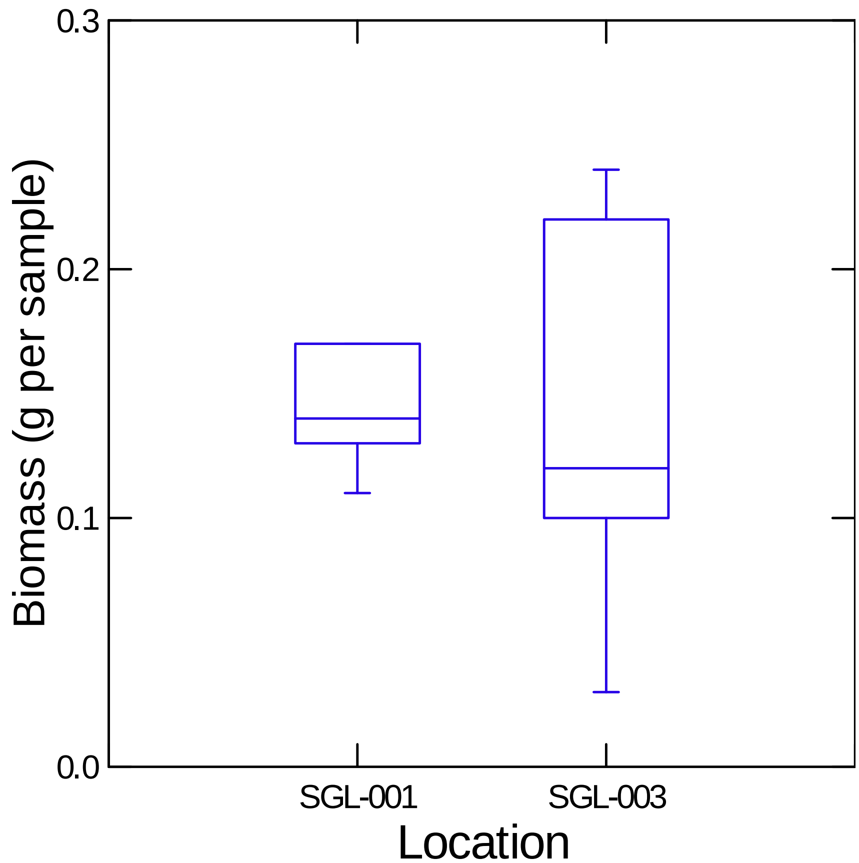


Figure 3.7 Benthic Invertebrate Community: Wet Biomass (g per sample)

Notes: The centre line is the median. Ends of the box indicate the lower and upper quartiles. Ends of the whiskers indicate the quartile ± 1.5 x interquartile spread. Asterisks indicate values falling within the quartile ± 3 x interquartile spread. Open circles indicate values falling outside the quartile ± 3 x interquartile spread.

Overall, the EEM endpoints determined for the benthic invertebrate community in Scraggy Lake were similar between the nearfield and farfield locations, with the exception of density which was higher in the nearfield than farfield. Based on the data collected it appears these locations offer similar habitat and are suitable for use in the future EEM program under MDMER.

3.5 WATER AND SEDIMENT QUALITY ASSESSMENT

In addition to baseline water and sediment quality information collected in 2017 and in anticipation that the mine will start discharging treated mine effluent to Scraggy Lake in the later part of 2018, a second year of water and sediment quality data were collected to further support interpretation of the results of baseline fish and benthic invertebrate community surveys.

3.5.1 Surface Water

In-situ surface water was collected from Scraggy Lake (nearfield and farfield), Long Lake (Reference #1) and Alma Lake (Reference #2). Surface water samples were collected on July 1-6, 2018 from Scraggy Lake, Long Lake and Alma Lake collected and were submitted for laboratory analyses within 24 hours of collection. Alma Lake was added in 2018 in order to investigate it as a potential second reference area having similar characteristics than the other two lakes. Additional information on surface water can be found in Appendix E.

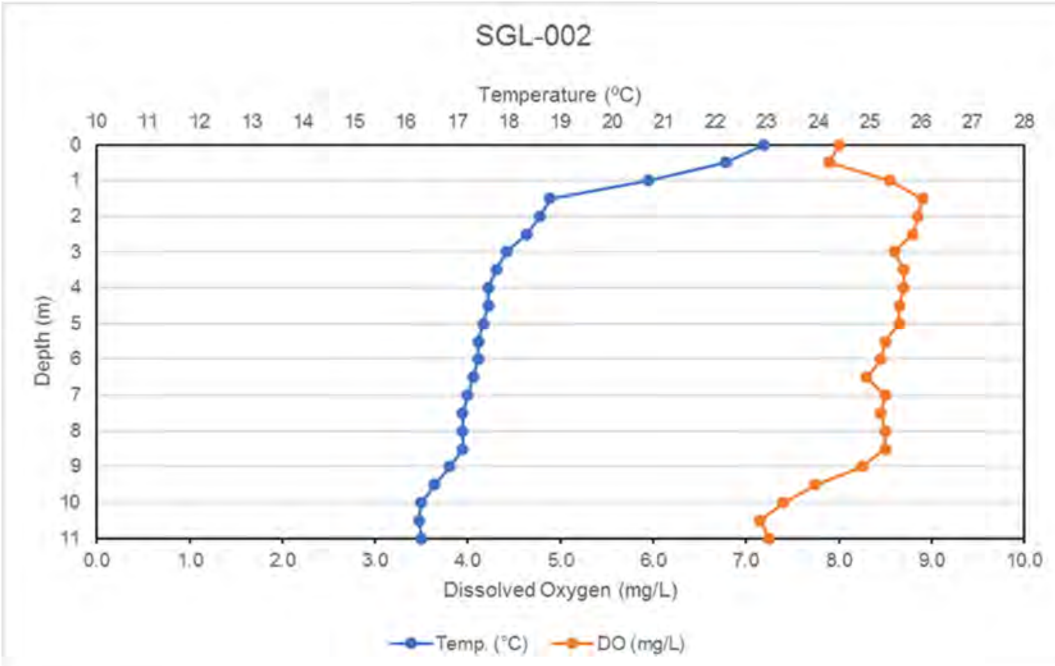
3.5.1.1 Scraggy Lake

A thermocline was not apparent but beginning to form in the deeper basins in Scraggy Lake in July 2018 (Appendix E; Figures E.1 to E.5). SGL-001, SGL-003 and SGL-008 are shallow basins (< 4.5 m water depth) which appear to not have sufficient depth for the formation of a thermocline. While SGL-002 and SGL-004 have deeper basins (<14 m water depth), no thermocline was present at either of these locations, however a thermocline was developing at SGL-004. Water temperature throughout the water column ranged between 11-23°C with warmer temperatures found near surface. The warmest surface temperature was noted at SGL-002 with 23°C (Figure 3.8), while the coldest bottom temperatures were noted at SGL-004 (~ 11°C).

Dissolved oxygen concentrations for Scraggy Lake were generally above 7.0 mg/L with the highest concentrations observed near surface suggesting well oxygenized waters (Figure 3.8). The lowest dissolved oxygen levels were observed in the deeper sections of the lake, especially at SGL-004 where levels dropped to < 2.8 mg/L. These lower levels at depth are likely a result of anoxic conditions which are often found near the bottom of lakes.

Conductivity levels for Scraggy Lake varied between 26-38 µs/cm with higher conductivity levels found near SGL-001 and SGL-002 varying from 32-38 µs/cm (Appendix E; Table E1 to E.5). The values for pH were found to be acidic and similar between the near-field and far-field locations with pH ranging between 5.0 and 5.6, and are consistent with the results obtained in 2017 (Stantec 2018b) and other lakes in this part of Nova Scotia. The in situ pH was below the recommended guideline CWQG PAL of 6.5.

Secchi disk measurements varied from 1.70 metres at SGL-002 to 2.65 metres at SGL-004.



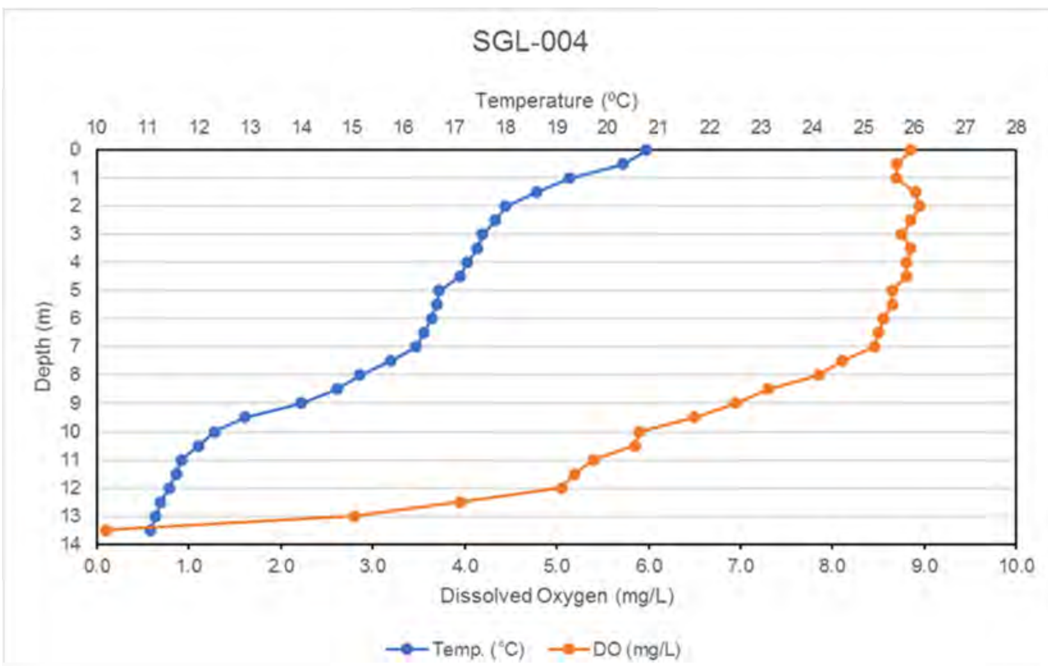


Figure 3.8 Dissolved Oxygen and Temperature Profiles for SGL-002 and SGL-004, July 2018, Scraggy Lake, NS

Analytical results for Scraggy Lake were compared to the CWQG PAL guidelines. Tables with the analytical results are included in Appendix E; Table E.6.

In general, the surface water quality in the study area are soft, containing low concentrations of dissolved minerals (i.e., hardness) and having low pH. The pH values from the laboratory were different than in the field (e.g., *in-situ* pH at SGL-003 of 5.1 and laboratory pH of 6.85). This is understandable given that the pH of very soft waters is prone to drift during holding time prior to analysis at the laboratory. As a result, field measured pH values are considered to be more reliable than the laboratory measured values. Alkalinity values were non-detectable, hardness ranged from 3.70 to 6.90 mg/L (as $CaCO_3$), and conductivity ranged from 25 to 66 µS/cm; all of these low values indicate soft water conditions in Scraggy Lake. The other major cations contributing to hardness (e.g., calcium, magnesium, sodium, potassium) were also found to be at low concentration. Total organic carbon ranged from 5.2 to 8.0 mg/L. The major ions in surface water samples reflect the generally thin soils and high resistance of underlying bedrock to weathering.

Nutrient concentrations in surface water in Scraggy Lake were generally low, which is not surprising given the relatively undeveloped nature of Scraggy Lake and surrounding land. Total phosphorus and ortho-phosphate values were non-detectable. Total ammonia, a source of nitrogen, was non-detectable, and nitrate + nitrite was detected at low levels in three out of ten samples. Reactive silica concentrations were non-detectable with the exception of one sample SGL-004-BT 0.8 mg/L). Chlorophyll a ranged from 0.56 to 2.37 µg/L indicating low to moderately low primary productivity (< 2 µg/L = low, < 5µg/L = moderate) (Mackie 2001). The water clarity and low nutrient concentrations of Scraggy Lake indicate an oligo-mesotrophic lake status (Mackie 2001). Nutrient concentrations were generally within the range of values observed in 2017, which the exception of chlorophyll a, which was slightly higher (2.84 µg/L) and total phosphorus which was detected in 2018 (maximum value = 350 µg/L) and not detected in 2017

Surface turbidity readings were generally low, varying between 0.84 NTU at SGL-003-SR and 1.2 NTU at SGL-008-SR with the exception of SGL-002-SR where 93 NTU was observed. This result may be erroneous since it significantly differs from other results collected at surface locations. Turbidity levels near bottom tend to be similar to surface with peak turbidity noted to be 1.6 NTU at SGL-003-BT. Turbidity concentrations were generally within the range of values observed in 2017, with the exception of SLG-002-SR which may be erroneous.

Water quality results for many parameters in Scraggy Lake were generally found to be below the reportable detection limit (RDL) (e.g., arsenic, chromium, molybdenum, nickel, selenium, zinc). All parameters were within the CWQG PAL guidelines, with the exceptions noted below.

The following exceedances of CWQG PAL guidelines were noted for Scraggy Lake and reflect baseline conditions:

- The laboratory-analyzed pH ranged from 6.04 to 6.85 and was below the recommended guideline of 6.5 for nine of the ten samples (Figure 3.9);
- Total aluminum concentrations ranged between 120-160 µg/L and exceeded the guideline (5 to 100 µg/L) at all sampling locations (Figure 3.10); and
- Total copper was detected in one of ten samples and exceeded the guideline (2 µg/L) at SGL-004-SR (3.7 µg/L) (Figure 3.11).

In comparison to trace metal and pH concentrations collected at Scraggy Lake in 2017:

- The laboratory analyzed pH was within the ranges observed in 2017 (5.8 to 6.7), with the exception of one sample which was slightly higher (SGL-003-SR – 6.85),
- Total aluminum concentrations were within the range observed in 2017 (97 to 320 µg/L),
- One sample of total copper (SGL-004-SR - 3.7 µg/L) exceeded the concentrations observed in 2017 (not detected).
- Arsenic was within the ranges observed in 2017 (<1 and 13 µg/L)
- Iron was within the ranges observed in 2017 (120 to 6000 µg/L)
- Lead was within the ranges observed in 2017 (1 to 1.6 µg/L)

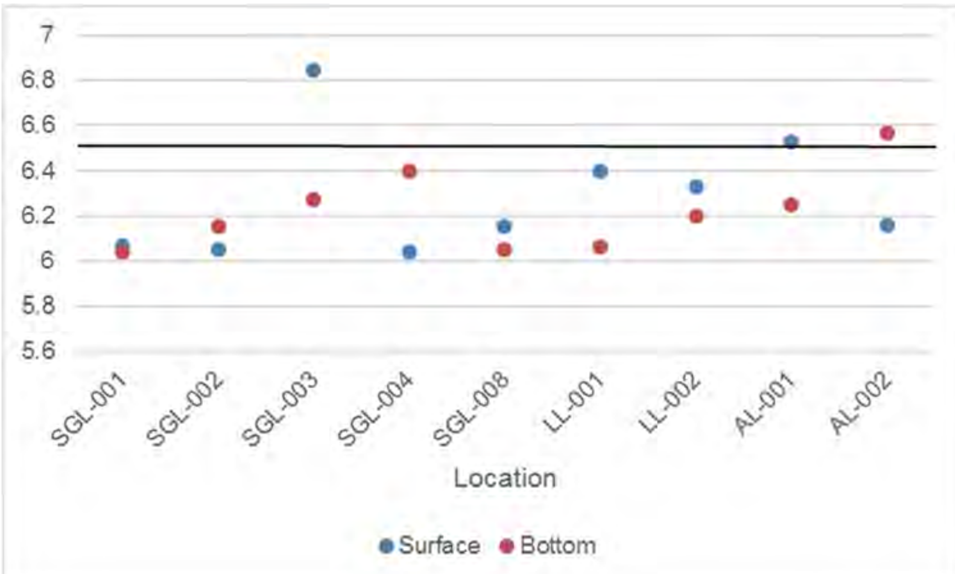


Figure 3.9 Plot of Individual Data Points for Surface Water pH in Scraggy Lake (SGL), Long Lake (LL) and Alma Lake (AL), NS. Black line indicates CWQG PAL for pH (6.5 to 9.0)

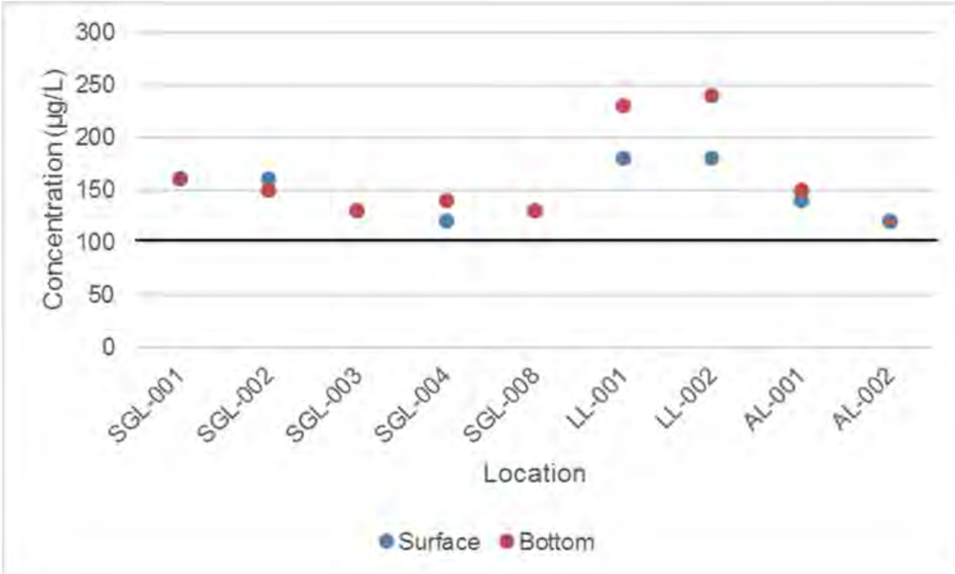


Figure 3.10 Plot of Individual Data Points for Total Aluminum in Surface Water in Scraggy Lake (SGL), Long Lake (LL) and Alma Lake (AL), NS. Black line indicates CWQG PAL for Aluminum (100 µg/L)

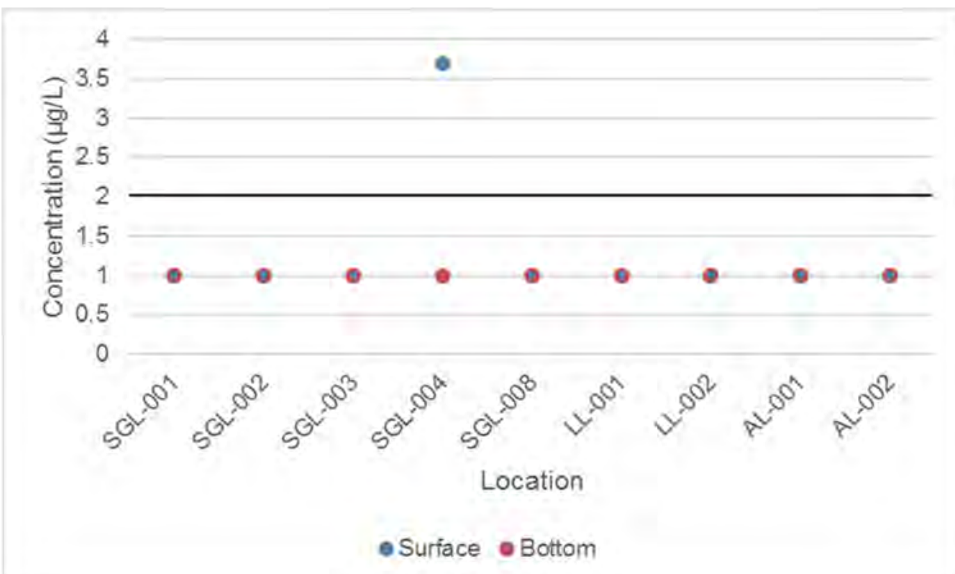


Figure 3.11 Plot of Individual Data Points for Total Copper in Surface Water in Scraggy Lake (SGL), Long Lake (LL) and Alma Lake (AL), NS. Black line indicates CWQG PAL for Copper (2 µg/L)

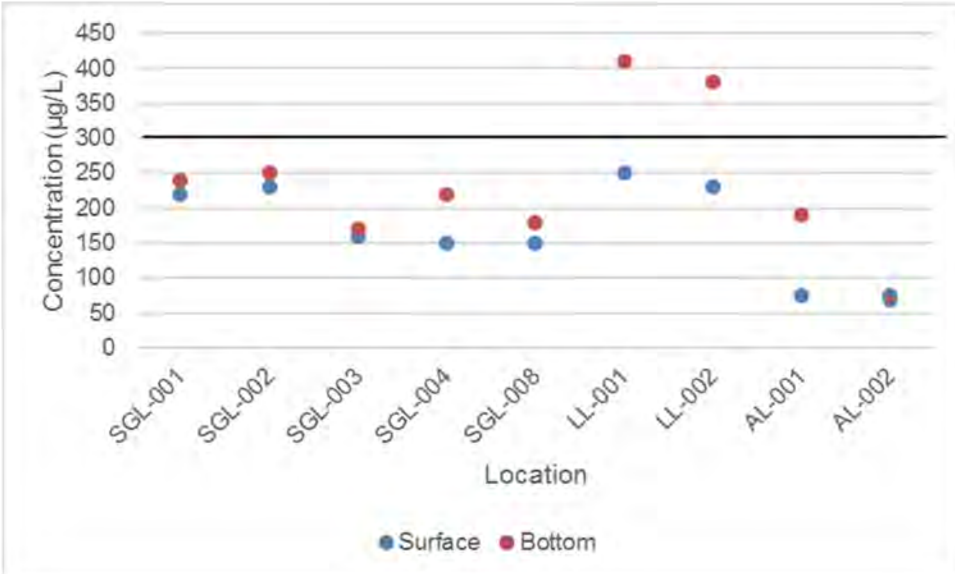


Figure 3.12 Plot of Individual Data Points for Total Iron in Surface Water in Scraggy Lake (SGL), Long Lake (LL) and Alma Lake (AL), NS. Black line indicates CWQG PAL for Iron (300 µg/L)

Total dissolved metals in surface water are provided in Appendix E. There were eight cases in Scraggy Lake when concentrations of dissolved parameters exceeded the concentrations of total parameters (e.g., barium, cadmium, calcium, magnesium, potassium, sodium, strontium and tin). The discrepancy between the results occurred as a result of analytical error associated with laboratory analysis of each parameter in the sample and were deemed acceptable (<20%).

3.5.1.2 Long Lake

In situ water quality parameters measured in the field were similar between both sampling locations (LL-001 and LL-002). Dissolved oxygen in Long Lake ranged from 5.6 to 8.5 mg/L and water temperature ranged from 25.9°C near surface to 17.8°C near bottom (Appendix E, Table E.7 to E.8). No thermal stratification (e.g., thermocline) was apparent in Long Lake likely because of its shallow depth (Appendix E; Figure E.6 and E.7). Conductivity levels were uniform throughout Long Lake ranging between 30.9 - 32.7 µs/cm. Secchi disk measurements at both sampling locations varied between 1.4 metres (LL-001) and 1.8 metres (LL-002).

Analytical results for Long Lake were compared to the CWQG PAL guidelines with the results summarized below. Tables with the analytical results are included in Appendix E; E.9.

Similar to Scraggy Lake, the surface water quality in Long Lake is very soft, containing low concentrations of dissolved minerals and having low pH. Alkalinity values were non-detectable, hardness ranged from 4.2 to 4.3 mg/L (as $CaCO_3$), and conductivity ranged from 29 to 35 µS/cm and were low. The other major cations contributing to hardness were also found to be low (e.g., calcium, magnesium, sodium, potassium. Total organic carbon ranged from 6.5 to 8.8 mg/L. Similar to Scraggy Lake, the major ion analyses reflect the generally thin soils and high resistance of underlying bedrock to weathering.

Water was typically clear, as indicated by low turbidity (1.5 - 3.1 NTU) measured in the laboratory, which is consistent with field measurements.

Nutrient concentrations in surface water were generally low, given the relatively undeveloped nature of Long Lake. Total phosphorus and ortho-phosphate values were non-detectable. Total ammonia, a source of nitrogen, was not detected, and nitrate + nitrite were detected at low levels in two of four samples. Reactive silica concentrations were also not detected (< 0.5 mg/L). Chlorophyll a ranged from 1.49 - 3.3 µg/L indicating moderate primary productivity (2 - 5 µg/L) (Mackie 2001). Nutrient concentrations in Long Lake in 2018 were generally similar to the results obtained in 2017, with the exception of total ammonia (0.27 mg/L in 2017) and chlorophyll a (2.84 µg/L in 2017) which were slightly higher.

Water quality results for many parameters in Long Lake were generally found to be below the RDL (e.g. arsenic, molybdenum, nickel, selenium, zinc). All total metal parameters were within the CWQG PAL guidelines, with the following exceptions:

- The laboratory analyzed pH ranged from 6.06 to 6.40. The pH was below the CWQG PAL guideline of 6.5 for all of the samples (Figure 3.9);
- Total aluminum concentrations ranged between 180-240 µg/L. Total aluminum exceeded the CWQG PAL guideline (100 µg/L) at all the sampling locations (Figure 3.10); and
- Total iron concentrations ranged between 250 to 410 µg/L. Total iron exceeded the CWQG PAL guideline of 300 µg/L at two of four sampling locations (Figure 3.12).

In comparison to trace metal and pH concentrations collected at Long Lake in 2017:

- Laboratory analyzed pH samples were within the ranges observed in 2017, with the exception of one sample which was slightly lower (6.06)
- Total aluminum concentrations in 2018 were above the concentrations observed in 2017
- Total iron concentrations collected in 2018 were less than the concentrations observed in 2017

Total dissolved metals in surface water are provided in Appendix E. There were seven cases in Long Lake when concentrations of dissolved parameters exceeded the concentrations of total parameters (e.g., arsenic, barium, cadmium, potassium, and strontium). The discrepancy between the results occurred as a result of analytical error associated with laboratory analysis of each parameter in the sample and were deemed acceptable (<20%).

3.5.1.3 Alma Lake

In situ water quality parameters measured in the field were similar between both sampling locations (AL-001 and AL-002). Dissolved oxygen in Long Lake ranged from 0.2 - 7.8 mg/L and water temperature ranged from 24.4°C near surface to 14.3°C near bottom (Appendix E, Tables E.10 and 11). Thermal stratification (e.g., thermocline) was apparent in Alma Lake at AL-001 as a result of its deep depth (Appendix E; Figure E.8 and E.9). Conductivity levels were uniform throughout Long Lake ranging between 23.7 - 26.2 µs/cm. Secchi disk measurements ranged between 3.3 and 3.5 metres.

Analytical results for Long Lake were compared to the CWQG PAL guidelines with the results summarized below. Tables with the analytical results are included in Appendix E; Table E.12.

Similar to Scraggy Lake, the surface water quality in Alma Lake is very soft, containing low concentrations of dissolved minerals and having low pH. Alkalinity values were non-detectable, hardness ranged from 3.1 to 3.3 mg/L (as $CaCO_3$), and conductivity ranged from 23 to 26 µS/cm and were low. The other major cations contributing to hardness were also found to be low (e.g., calcium, magnesium, sodium, potassium). Total organic carbon ranged from 4.1 to 4.7 mg/L. Similar to Scraggy Lake, the major ion analyses reflect the generally thin soils and high resistance of underlying bedrock to weathering.

Water was typically clear, as indicated by low turbidity (0.38-1.2 NTU) measured in the laboratory, which is consistent with field measurements.

Nutrient concentrations in surface water were generally low, given the relatively undeveloped nature of Alma Lake. Total phosphorus and ortho-phosphate values were non-detectable. Total ammonia, a source of nitrogen, was detected at one sampling location (AL-001-BT), and nitrate + nitrite were only detected at that same location. Reactive silica concentrations ranged from 0.87 to 1.5 mg/L. Chlorophyll *a* concentration was 0.65 µg/L in all samples, indicating low primary productivity (< 2 µg/L) (Mackie 2001).

Water quality results for many parameters in Alma Lake were generally found to be below the RDL (e.g. arsenic, copper, molybdenum, nickel, selenium, zinc). All total metal parameters were within the CWQG PAL guidelines, with the following exceptions:

- The laboratory analyzed pH ranged from 6.16 to 6.57. The pH was below the CWQG PAL guideline of 6.5 for two of the four the samples (Figure 3.9); and
- Total aluminum concentrations ranged between 120-150 µg/L. Total aluminum exceeded the CWQG PAL guideline (100 µg/L) at all the sampling locations (Figure 3.10).

Total dissolved metals in surface water are provided in Appendix E. There were 42 cases when concentrations of dissolved parameters exceeded the concentrations of total parameters (e.g., barium, cadmium, calcium, magnesium, potassium, sodium, and strontium). The discrepancy between the results occurred as a result of analytical error associated with laboratory analysis of each parameter in the sample and were deemed acceptable (<20%).

Overall, water quality in Scraggy Lake was similar to Long Lake and Alma Lake. Water in all three lakes was soft, containing n low concentrations of dissolved minerals (i.e., low hardness) and had low pH. Water was generally clear and with low nutrient levels. Trace metal concentrations of key parameters and general chemistry was similar. In terms of water quality Long Lake and Alma Lake are suitable reference lakes for Scraggy Lake.

3.5.2 Sediment

3.5.2.1 Analytical Results

Concentrations of metals were compared to the CSQG for the protection of aquatic life probable effects level (PEL) above which effects are considered probable to occur (CCME 2018). The results are compiled in Appendix E; Tables E.13 to E.15. No exceedances of the PEL were identified for cadmium, chromium, copper, lead, mercury and zinc. Arsenic was above the CSQG PEL guidelines in the nearfield location

(SGL-001) in Scraggy Lake and in Long Lake (LL-002) (Figure 3.13). Concentrations of arsenic in sediment from Scraggy Lake were higher in 2018 than 2017 (non-detect to 3.7 mg/kg).

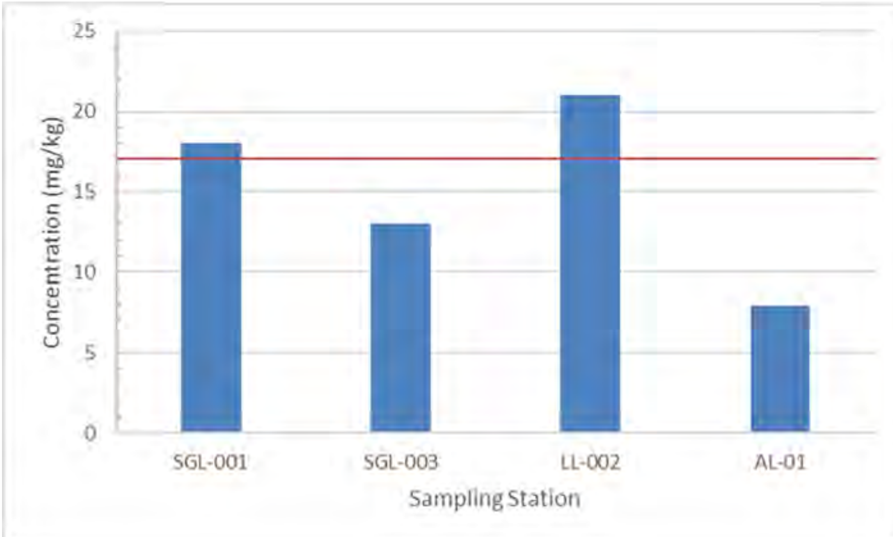


Figure 3.13 Acid Extractable Arsenic in Sediment Samples Collected in July 2018 in Scraggy Lake (SGL), Long Lake (LL) and Alma Lake (AL), NS.

Note: Red line indicates CSQG PEL for Arsenic.

Grain size distribution in sampled locations was similar between Scraggy Lake farfield (SGL-003), Long Lake (LL-002) and Alma Lake (AL-001) with the predominant grain size classes being silt and clay (Figure 3.14) (Appendix E; Table E.16) The Scraggy Lake nearfield (SGL-001) had a higher composition of sand than the other sampling locations (35% compared to 3 to 10%), which could influence the BIC composition.

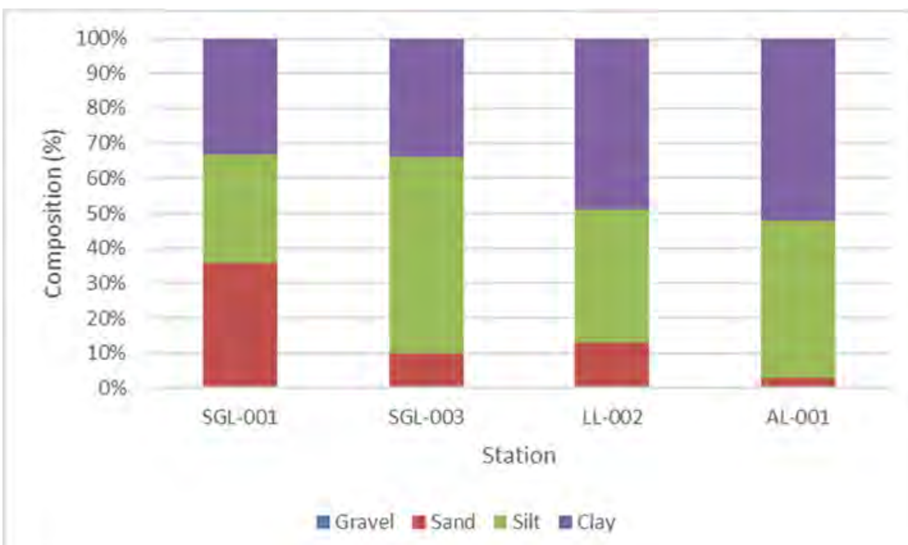


Figure 3.14 Particle Size Distribution in Sediment Samples in July 2018 in Scraggy Lake (SGL), Long Lake (LL) and Alma Lake (AL), NS.

3.6 QUALITY ASSURANCE AND QUALITY CONTROL

Overall, field duplicate (SGL-020) results agreed closely with the corresponding parent sample (SGL- 003-BT) and confirmed the representativeness of sampling procedures (Appendix E, Table E.17). For water, relative percent differences (RPD) from the mean for individual parameters were below 20%, with the exception of three parameters (i.e.,turbidity, strong acid dissociated cyanide and dissolved cadmium). Higher RPDs were typically observed when analyte concentrations were very low (i.e., close to their respective laboratory detection limit (e.g., dissolved cadmium and strong acid dissociated cyanide)). In general, field and trip blank results also showed non-detect confirming that no outside contamination affected the results.

Overall, field duplicate (SGL-020) results for sediment agreed closely with the parent sample (AL-001) and confirmed the representativeness of sampling procedures (Appendix E, Table E.6). For sediment the relative percent differences (RPD) from the mean for individual parameters were below 20% indicating the sampling methodology was consistent and acceptable and did not introduce outside contamination.

The laboratory that analyzed water and sediment samples (Maxxam Analytic, Bedford, NS) has a rigorous internal QA/QC program that includes use of chain-of-custody forms, sampling tracking and holding conditions, standard operating procedures for analysis and reporting, incorporation of laboratory duplicates and blanks, use of well-maintained equipment and qualified staff. Maxxam Analytics is accredited and certified by the Canadian Association of Laboratory Accreditation Inc. for environmental analyses. QA/QC results are provided with the laboratory certificates in Appendix C and indicate that results are acceptable.

Ten percent (1 of 10) of samples submitted for benthic invertebrate analysis were re-sorted. These re-sorts showed that 92% of the benthic invertebrates were recovered in the original sort (Appendix D). These recovery rates were deemed to be acceptable based on Technical Guidance (EC 2012).

3.7 HISTORICAL MINING LOCATIONS

A review of historical mining locations in the local area for Touquoy Mine was conducted to identify sites where historical mining should be taken into consideration in terms of influence on fish, BIC, water and sediment quality. It is important to take this into account when selecting suitable sampling locations (exposure and reference) for the future EEM program for the Touquoy Mine.

There are three major sub-watersheds that make up the Tangiers Watershed in which the Touquoy Mine is located: Salmon River Watershed, Fish River – Lake Charlotte Watershed, and Tangiers River sub-watershed. No currently active mines, aside from the Touquoy Mine, were identified within the Tangier Major watershed area and there was no documentation of historical mining activity identified within the Salmon River Watershed (Figure 3.15) (Hennick and Poole 2017).

Within the Fish River – Lake Charlotte sub-watershed there were seven areas of active and historical mining activity identified (Figure 3.15A) (Hennick and Poole 2017). These areas include the following.

- Currently active Touquoy Gold Mine developed by Atlantic Gold Corporation.

- Historical Moose River Mines: Moose River downstream of Long Lake at the old Moose River Gold Mines and the G&K Gold Co. Stamp Mill which includes the former Touquoy, Colonial Mining Company and McGregor Stamp Mills. It includes activity downstream of Shea Lake for gold and tungsten (i.e., shafts or open cuts). The Moose River Mine is described in more detail below.
- Scheelite Mines was worked for tungsten from 1908 to 1918.
- Historical Caribou Gold Mine which produced gold between 1869 and 1968 (Art Gallery of Nova Scotia 2013). It included a stamp mill, headframe shaft house and rail lines (Figure 3.17B).
- Historical Gold Lake Mine which had minor production of gold in the late 1800s; this is currently being explored by Osprey Gold Development Ltd. (Osprey Gold Development Ltd 2018).
- Historical Lake Charlotte Mine for tungsten and its nearby tributaries were mined for arsenic
- Single mine shaft at the outlet of Scraggy Lake for gold.

The historical Moose River Gold Mine included up to fifteen shafts and eight pits during operation and the area contained a number of stamp mills (Conestoga-Rovers & Associates 2007). The old Moose River Gold Mines and the G&K Gold Co. Stamp Mill which are located within the Touquoy Gold Project property limit near the proposed open pit (Stantec 2018c). The Reynolds Stamp Mill could not be located as part of Stantec searches (2018c) and likely contains historical tailings. These areas were actively mined for gold and tungsten in the 1930s and early 1980s. These stamp mills contain elevated levels of arsenic and mercury in soils (Stantec 2018c). Concentrations of aluminum, arsenic, cadmium, and iron detected in the surface water sample collected from Moose River were within the range or slightly elevated in comparison with background surface water data (Stantec 2018c).

Within the Tangiers River sub-watershed there were two areas of historical mining activity identified (Figure 3.15B). These areas include:

- Former Mooseland Gold Mine (Mooseland Gold Mining Co) operated near Moose Lake, Sluice Lake and Otter Ponds which was developed for gold from 1863 to 1934. It included a stamp mill and shaft house (Art Gallery of Nova Scotia 2013). Currently being explored by NS Gold Corp (Art Gallery of Nova Scotia 2013).
- Tangier Gold District (Tiger Lake, Copper Lake and Bullrush Lake area) which was developed for gold. The Tangier Gold District was the first underground gold mine in Nova Scotia it operated from 1862 to 1919, 1986 to 1989, and 1996 to 1997 (Art Gallery of Nova Scotia 2013). Acadian Mining Corp. has an approved Environmental Assessment for the Tangier Project. Further drilling to assess resource estimates are planned (Art Gallery of Nova Scotia 2013).

Areas containing elevated gold concentrations tend to have elevated concentrations of arsenic due to the presence of arsenopyrite that is common in the geology of the area. For the purposes of this report it is assumed that the areas of historical mining activity have elevated concentrations of gold and arsenic, as well as the potential for other trace metals.

Any lakes with current or past historical mining development should not be considered as a reference lake for EEM as any results obtained could be influenced by past mining activities. Locations with historical mining activity such as exploration only or downstream of historical mining activities may be considered suitable depending on the distance and activities in those locations. Based on the distribution of historical and current mining activity, Long Lake appears to be a suitable reference lake for Scraggy Lake as it is located upstream of historical and current mining activity.

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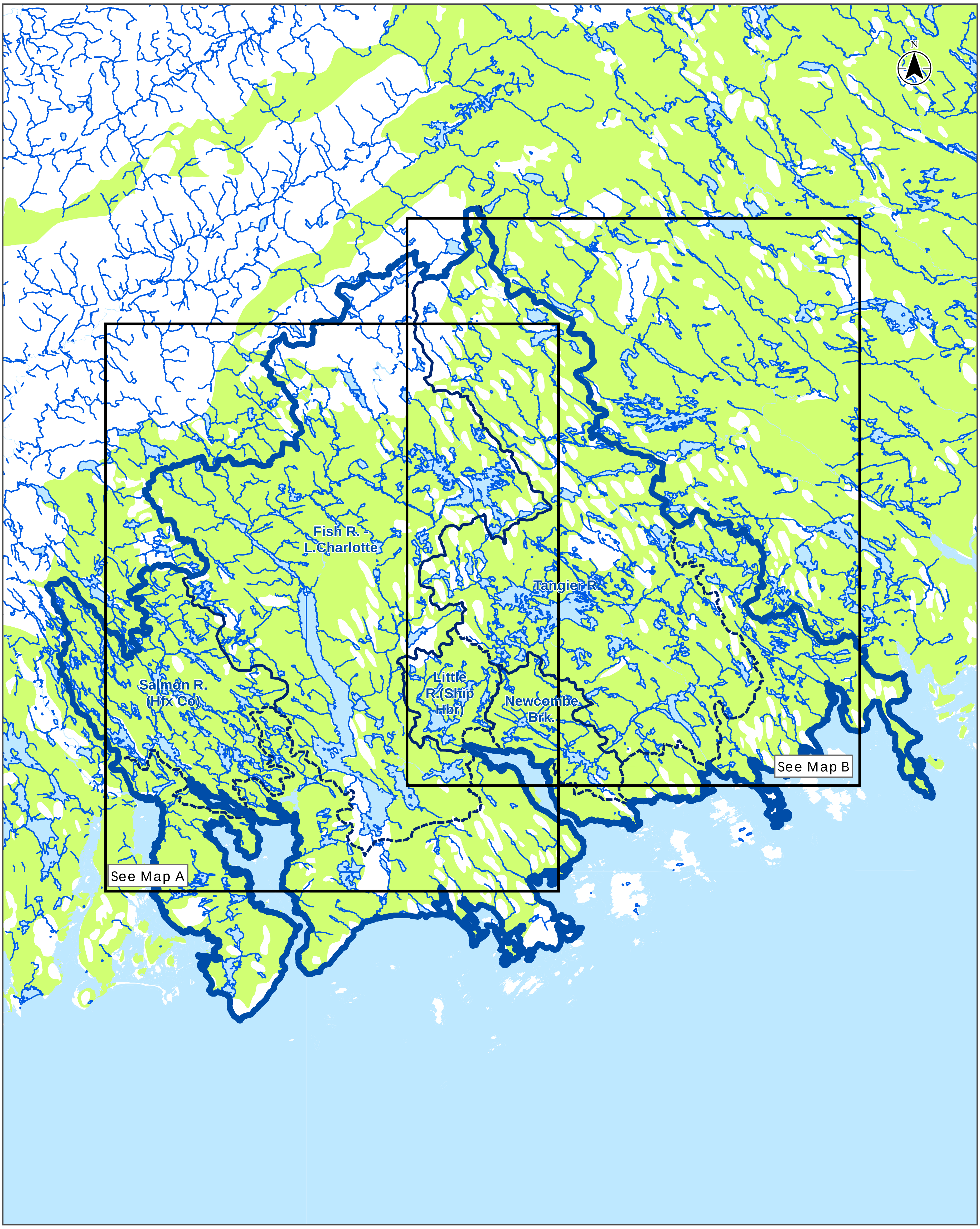
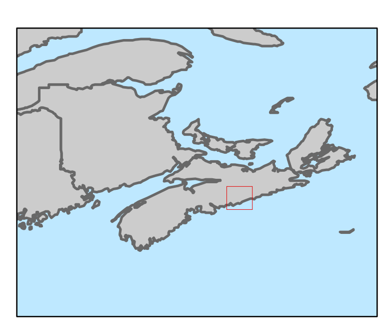


Taniger Watershed
Sub-Watershed
Watercourse
Waterbody
Surficial Geology - Stony Till Plain (2-20m)

0 2 4 6 8
kilometres

121619250

NAD 1983 CSRS UTM Zone 20N



Active and Historical Mines with the Tangiers Major Watershed

Stantec

Figure 3.15

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Sources: Base Data - Natural Earth; Thematic Data - ERBC
Service Layer Credits:

Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.

Please use the Map Document Properties/Description for the Special Notes.

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Historic Mine Site - Commodity

- ARSENIC
- GOLD
- TUNGSTEN
- Touquoy Mine

- Tangier Watershed
- Sub-Watershed
- Watercourse
- Waterbody
- Surficial Geology - Stony Till Plain (2-20m)

Active and Historical Mines with in the Fish River-Lake Charlotte Sub-Watershed

Stantec

Figure 13.5A

PROJECT NAME - AS FOUND ON HEADER OF DOCUMENT

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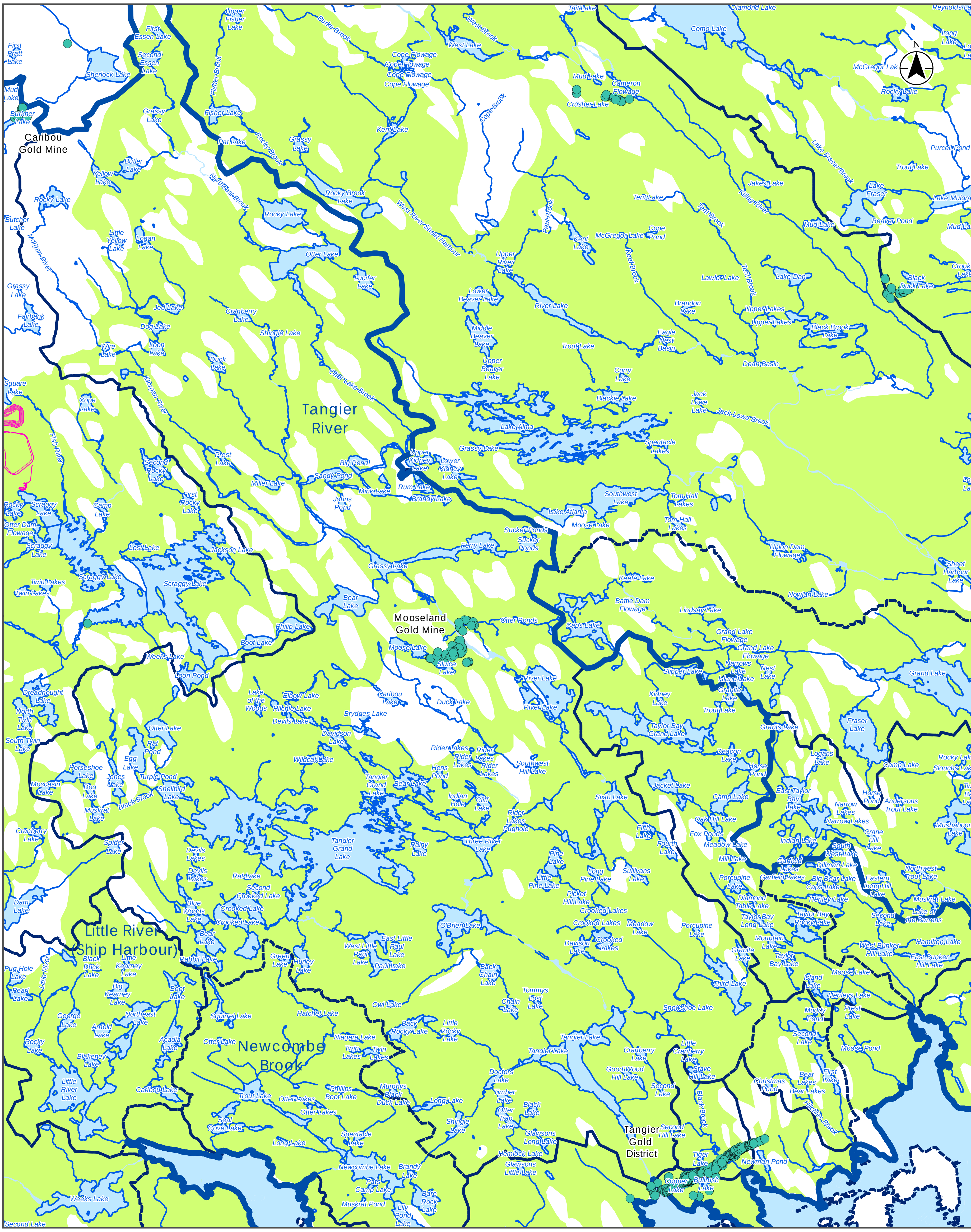

Historic Mine Site - Commodity

- GOLD
- Touquoy Mine

- Tangier Watershed
- Sub-Watershed
- Watercourse
- Waterbody
- Surficial Geology - Stony Till Plain (2-20m)

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NAD 1983 CSRS UTM Zone 20N

Active and Historical Mines with the Tangier River Sub-Watershed.

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Figure 3.15B

4.0 SUMMARY

In 2018, a baseline EEM program was conducted to supplement the baseline EEM information gathered in 2017. The purpose of these baseline studies was to gather information on existing conditions in the exposure area (Scraggy Lake) prior to effluent discharge from the Touquoy Mine. This information lays the groundwork for design of the future EEM program required under MDMER and provides context for interpretation of future EEM results and for use in a future human health and ecological risk assessment (HHERA) on metals in fish tissues, should that be required.

The baseline EEM studies suggest that a multiple control-impact design would be suitable for Phase 1 EEM. The "control" would be reference lakes unaffected by current mining activities to reflect background conditions; the "impact" would be Scraggy Lake. Two exposure locations in Scraggy Lake were investigated: nearfield at < 250m downstream from the effluent discharge point and farfield, approximately~ 4.5 km downstream of the effluent discharge point and near the outlet of the lake. Two potential reference lakes were investigated: Long Lake and Alma Lake. A desktop study was also undertaken to identify areas of historical mining locations in the local area for Touquoy Mine so that these areas can be avoided when selecting reference lakes.

Baseline work conducted in 2017 focused on Scraggy Lake to determine suitable locations and sampling parameters for the receiving water prior to effluent discharge from Touquoy Mine. Preliminary baseline work was conducted in Long Lake in 2017.

The 2018 supplemental baseline program design included the following components:

- Fish habitat survey – Alma Lake;
- Fish community study – Long Lake, Alma Lake;
- Fish tissue study – Scraggy Lake;
- BIC survey – Scraggy Lake;
- Supporting environmental variables (water and sediment quality) - Scraggy Lake, Long Lake and Alma Lake; and
- Historical mining locations in the local area for Touquoy Mine

The fish habitat in Alma Lake was similar to that observed in Long Lake and Scraggy Lake in 2017. All the lakes have rocky shorelines with sparse areas of aquatic vegetation and most of the habitat within the lakes is generally shallow (< 3m).

A fish community survey was undertaken in Long Lake and Alma Lake to determine the abundance and suitability of the sentinel species selected in Scraggy Lake (i.e., white sucker and yellow perch). The fish community survey indicated that there are similar fish species (i.e., a least six different species) within Long Lake, Alma Lake and Scraggy Lake. Long Lake possessed both the desired sentinel species, yellow perch and white sucker; however, Alma Lake only possessed white sucker. As Alma Lake only possesses one of the desired sentinel species it is not considered the best option for a reference lake for EEM.

A supplemental fish tissue study in Scraggy Lake was undertaken in 2018 with lower detection limits for trace metals to support a future HHERA study, if and as required. The study examined whole-body metals

for white sucker and muscle fillet and whole-body metals for yellow perch was undertaken. With the lower detection limits, there was an increased number of detections for trace metals in tissue compared to 2017.

For mercury concentration in fish tissue, four of ten muscle tissue samples and one of ten whole-body samples from yellow perch exceeded the Health Canada fish consumption guideline for human consumption of 0.5 mg/kg in the nearfield of Scraggy Lake. None of the whole-body white sucker samples exceeded the Health Canada fish consumption guideline for human consumption for mercury of 0.5 mg/kg. For yellow perch mercury concentration in muscle tissue samples and whole-body samples there were some exceedances of the OMOE muscle fillet total restriction guideline of 0.52 mg/kg for women of childbearing age and children under 15, and the OMOE partial restriction guideline for human consumption (0.26 mg/kg) (OMOE 2013). For white sucker whole-body samples the majority of samples were below the muscle fillet partial restriction guideline for human consumption (0.26 mg/kg) (OMOE 2013). Whole-body and muscle tissue samples from yellow perch and whole-body white sucker from Scraggy Lake showed an increasing trend in mercury concentration with fish length.

A BIC study was conducted to assess baseline conditions in Scraggy Lake in depositional areas of the nearfield and farfield locations prior to effluent discharge. The BIC in the nearfield and farfield were similar, with Diptera being the predominant taxon. For the endpoints assessed, taxa richness, Simpson's Evenness Index, Simpson's Diversity Index and biomass were similar between nearfield and farfield locations. The density of organisms was higher at the nearfield than the farfield sampling location. The locations and sampling methods used in 2018 are suitable for use in Phase 1 EEM. Future sampling should confirm the similarity of BICs in reference lakes as it is an existing data gap.

Surface water samples were collected to provide additional baseline conditions in Scraggy Lake prior to effluent discharge and determine similarities or differences to reference lakes. In all lakes, surface water was soft, contained low concentrations of dissolved minerals (i.e., hardness), had low pH and was nutrient poor. Total aluminum concentrations were elevated in all lakes relative to the CWQG FAL guidelines are is likely representative of the regional geology.

Sediment samples were collected to provide additional baseline conditions in Scraggy Lake, Long Lake and Alma Lake. There were no exceedances of the CSQG PEL guidelines for cadmium, chromium, copper, lead, mercury and zinc in any of the lakes sampled; arsenic exceeded the CSQG PEL guideline at the nearfield location (SGL-001; 18 mg/kg) in Scraggy Lake and at the reference location in Long Lake (LL-002; 21 mg/kg). Arsenic levels in sediment are reflective of background conditions in the area.

The historical mining study indicated that there are eight locations in the vicinity of Touquoy Mine that should be considered to avoid in the final selection of reference lakes. In addition to biological considerations, Long Lake appears to be a suitable reference lake for Scraggy Lake as the historical mining activity is located downstream.

Overall, the supplemental baseline study in 2018 provided additional baseline information for the benthic invertebrate community, water and sediment quality, and trace metals in fish tissues in Scraggy Lake prior to effluent discharge from the Mine. The biological information collected at the nearfield and farfield locations described above supports the use of these sites during the Phase 1 EEM. The supplemental baseline aquatic surveys also confirmed the suitability of Long Lake as a reference lake. Alma Lake has

similar fish habitat characteristics, water and sediment quality to Scraggy Lake. Given that only one of the sentinel fish species is present (i.e., white sucker) and relatively common throughout Nova Scotia, it is suggested that another reference lake (i.e., in lieu of Alma Lake) should be considered for Phase 1 EEM that contains both white sucker and yellow perch. The results of this program will be used to support development of the EEM study design and provide context for interpretation of results arising from future EEM programs under MDMER.

5.0 CLOSURE STATEMENT

This document entitled Touquoy Mine: 2018 Supplemental Baseline Aquatic Environment Technical Report was prepared by Stantec Consulting Ltd. ("Stantec") for the account of Atlantic Mining NS Corporation (the "Client"). Any reliance on this document by any third party without the consent of Stantec and the Client is strictly prohibited. The material in it reflects Stantec's professional judgment considering the scope, schedule and other limitations stated in the document and in the contract between Stantec and the Client. The opinions in the document are based on conditions and information existing at the time the document was published and do not consider any subsequent changes. In preparing the document, Stantec did not verify information supplied to it by others. Any use which a third party makes of this document is the responsibility of such third party. Such third party agrees that Stantec shall not be responsible for costs or damages of any kind, if any, suffered by it or any other third party because of decisions made or actions taken based on this document.

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APPENDIX A

Fish Habitat Photos

Alma Lake, NS

Photo 1 Boat Access

Photo 2 Representative Rocky Shoreline Habitat

Photo 3 Shoreline with Emergent Aquatic Vegetation

Photo 4 Rocky Shoreline Habitat Mixed with Aquatic Vegetation

Alma Lake, NS

Photo 5 Sediment at AL-001 – 11.5 m

Photo 6 Sediment at AL-002

APPENDIX B

Fish Survey Raw Data

Table B.1 Fish Capture Data for Scraggy, Alma and Long Lake, NS

Waterbody Nam	Field Staff	Area	Station Number	Method	Number in Set	Mesh Size	Type	Length (m)	Set Date	Set Time	Lift Date	Lift Time	Minimum Depth (m)	Maximum Depth (m)
Scraggy Lake	JR DL	Nearfield	SGL-001-GN02	Gill net	1		monofilament	30.5	1-Jul-18	14:36	2-Jul-18	11:21	1	1.7
Scraggy Lake	JR DL	Nearfield	SGL-001-GN01	Gill net	1	1.5	monofilament	30.5	1-Jul-18	16:30	2-Jul-18	10:30	1.2	1.3
Scraggy Lake	JR DL	Nearfield	SGL-001-GN03	Gill net	1	1.5	monofilament	30.5	3-Jul-18	13:00	3-Jul-18	15:45	1.5	2.8
Scraggy Lake	JR DL	Farfield	SGL-003-GN02	Gill net	1	2.5	monofilament	30.5	3-Jul-18	12:30	3-Jul-18	16:30	2.1	2.3
Scraggy Lake	JR DL	Farfield	SGL-003-GN01	Gill net	1	1.5	monofilament	30.5	1-Jul-18	17:06	2-Jul-18	13:15	1.7	2.3
Alma Lake	JR DL	-	AL-GN01	Gill net	1	1.5	monofilament	30.5	5-Jul-18	17:13	6-Jul-18	9:45	1.5	3
Alma Lake	JR DL	-	AL-GN02	Gill net	1	2.5	monofilament	30.5	5-Jul-18	17:24	6-Jul-18	10:15	1.7	4
Alma Lake	JR DL	-	AL-MT01	Minnow Trap	3	-	-		5-Jul-18	16:15	6-Jul-18	12:25	1.2	-
Alma Lake	JR DL	-	AL-MT03	Minnow Trap	3	-	-		5-Jul-18	14:26	6-Jul-18	12:20	1.7	2.2
Alma Lake	JR DL	-	AL-MT02	Minnow Trap	3	-	-		5-Jul-18	14:57	6-Jul-18	10:30	1	-
Long Lake	JR DL	-	LL-GN01	Gill net	1	2.5	monofilament	30.5	4-Jul-18	15:50	5-Jul-18	10:30	1	1.7
Long Lake	JR DL	-	LL-GN02	Gill net	1	1.5	monofilament	30.5	4-Jul-18	16:06	5-Jul-18	10:45	1.3	1.9
Long Lake	JR DL	-	LL-MT01	Minnow Trap	3	-	-		4-Jul-18	15:30	5-Jul-18	13:45	-	-
Long Lake	JR DL	-	LL-MT02	Minnow Trap	3	-	-		4-Jul-18	15:40	5-Jul-18	13:41	0.8	1
Long Lake	JR DL	-	LL-MT03	Minnow Trap	3	-	-		4-Jul-18	16:00	5-Jul-18	13:52	-	-

Table B.2 Raw Fish Data from Scraggy, Alma and Long Lake, NS

Area	Specimen ID	Date	Species	Station Number	Lift	Fork length (cm)	Sex M/F/I	Comments	Count
Scraggy Lake	-	2-Jul-18	alewife	SGL-001-GN02	1	25	Female	ripe and running	1
Scraggy Lake	-	2-Jul-18	alewife	SGL-001-GN02	1	26.5	Female		1
Scraggy Lake	-	2-Jul-18	alewife	SGL-001-GN02	1	26.5	Female		1
Scraggy Lake	-	2-Jul-18	alewife	SGL-001-GN02	1	25.3	Female	ripe	1
Scraggy Lake	-	2-Jul-18	alewife	SGL-001-GN02	1	25.6	Female		1
Scraggy Lake	-	2-Jul-18	alewife	SGL-001-GN02	1	25	Male		1
Scraggy Lake	-	2-Jul-18	alewife	SGL-001-GN02	1	25.5	Male		1
Scraggy Lake	-	2-Jul-18	alewife	SGL-001-GN02	1	25	Male		1
Scraggy Lake	-	2-Jul-18	alewife	SGL-001-GN02	1	25.5	Male		1
Scraggy Lake	-	2-Jul-18	alewife	SGL-001-GN02	1	25.3	Male		1
Scraggy Lake	-	2-Jul-18	alewife	SGL-001-GN02	1	25.3	Male		1
Scraggy Lake	-	2-Jul-18	alewife	SGL-001-GN02	1	27	Male		1
Scraggy Lake	-	2-Jul-18	alewife	SGL-001-GN02	1	24.5	Male		1
Scraggy Lake	-	2-Jul-18	alewife	SGL-001-GN02	1	25.5	Unknown		1
Scraggy Lake	-	2-Jul-18	alewife	SGL-001-GN02	1	26	Unknown	spent	1
Scraggy Lake	-	2-Jul-18	alewife	SGL-001-GN02	1	27.2	Unknown		1
Scraggy Lake	-	2-Jul-18	alewife	SGL-001-GN01	1				1
Scraggy Lake	-	2-Jul-18	alewife	SGL-001-GN02	1				3
Scraggy Lake	-	2-Jul-18	American eel	SGL-001-GN02	1	73	Female		1
Alma Lake	-	6-Jul-18	American eel	AL-MT03	1				1
Alma Lake	-	6-Jul-18	American eel	AL-MT03	1	38			1
Alma Lake	-	6-Jul-18	American eel	AL-MT03	1	40			1
Long Lake	-	5-Jul-18	American eel	LL-MT03	1	40		approximate length	1
Alma Lake	-	6-Jul-18	banded killifish	AL-MT01	1				25
Alma Lake	-	6-Jul-18	banded killifish	AL-MT02	1				55
Alma Lake	-	6-Jul-18	banded killifish	AL-MT02	1				9
Alma Lake	-	6-Jul-18	banded killifish	AL-MT03	1				9
Alma Lake	-	6-Jul-18	banded killifish	AL-MT03	1				5
Long Lake	-	5-Jul-18	banded killifish	LL-MT01	1				1
Long Lake	-	5-Jul-18	banded killifish	LL-MT02	1				29
Alma Lake	-	6-Jul-18	brown bullhead	AL-GN01	1				24
Alma Lake	-	6-Jul-18	brown bullhead	AL-GN02	1				
Long Lake	-	5-Jul-18	brown bullhead	LL-GN01	1	20.5			1
Long Lake	-	5-Jul-18	brown bullhead	LL-GN02	1				21

Table B.2 Raw Fish Data from Scraggy, Alma and Long Lake, NS

Area	Specimen ID	Date	Species	Station Number	Lift	Fork length (cm)	Sex M/F/I	Comments	Count
Long Lake	-	5-Jul-18	brown bullhead	LL-GN02	1	15.8			1
Long Lake	-	5-Jul-18	brown bullhead	LL-GN02	1	19.6			1
Long Lake	-	5-Jul-18	brown bullhead	LL-GN02	1	13.8			1
Long Lake	-	5-Jul-18	brown bullhead	LL-GN02	1	12.5			1
Long Lake	-	5-Jul-18	brown bullhead	LL-GN02	1	17.4			1
Long Lake	-	5-Jul-18	brown bullhead	LL-GN02	1	12.5			1
Long Lake	-	5-Jul-18	brown bullhead	LL-GN02	1	16.2			1
Long Lake	-	5-Jul-18	brown bullhead	LL-GN02	1	14.6			1
Long Lake	-	5-Jul-18	brown bullhead	LL-GN02	1	15.9			1
Long Lake	-	5-Jul-18	brown bullhead	LL-GN02	1	16.7			1
Scraggy Lake	-	2-Jul-18	brown bullhead	SGL-001-GN01	1				7
Scraggy Lake	-	2-Jul-18	brown bullhead	SGL-001-GN01	1	17.8			1
Scraggy Lake	-	2-Jul-18	brown bullhead	SGL-003-GN01	1				8
Alma Lake	-	6-Jul-18	brook trout	AL-GN01	1	15.9			1
Alma Lake	-	6-Jul-18	brook trout	AL-GN02	1	34.4			1
Alma Lake	-	6-Jul-18	brook trout	AL-GN02	1	27.6			1
Long Lake	-	5-Jul-18	brook trout	LL-GN01	1	26.4		black spot	1
Scraggy Lake	-	2-Jul-18	brook trout	SGL-001-GN01	1				1
Scraggy Lake	-	2-Jul-18	brook trout	SGL-003-GN01	1				2
Alma Lake	-	6-Jul-18	golden shiner	AL-MT01	1				34
Alma Lake	-	6-Jul-18	golden shiner	AL-MT01	1				3
Alma Lake	-	6-Jul-18	golden shiner	AL-MT02	1				2
Long Lake	-	5-Jul-18	golden shiner	LL-MT03	1				12
Scraggy Lake	-	2-Jul-18	golden shiner	SGL-001-GN01	1				3
Scraggy Lake	-	2-Jul-18	golden shiner	SGL-001-GN01	1	13.8			1
Scraggy Lake	-	3-Jul-18	golden shiner	SGL-001-GN03	1	12.8			1
Scraggy Lake	-	2-Jul-18	golden shiner	SGL-003-GN01	1	13.6			1
Long Lake	-	5-Jul-18	lake chub	LL-MT02	1				1
Long Lake	-	5-Jul-18	ninespine stickleback	LL-MT01	1				1
Alma Lake	GL-001-WHSC-(	2-Jul-18	white sucker	SGL-001-GN02	1	25.8			1
Scraggy Lake	GL-001-WHSC-(	2-Jul-18	white sucker	SGL-001-GN02	1	31.2			1
Scraggy Lake	GL-001-WHSC-(	2-Jul-18	white sucker	SGL-001-GN02	1	32.2			1
Scraggy Lake	GL-001-WHSC-(	2-Jul-18	white sucker	SGL-001-GN02	1	28.0			1
Scraggy Lake	GL-001-WHSC-(	2-Jul-18	white sucker	SGL-001-GN02	1	28.1			1

Table B.2 Raw Fish Data from Scraggy, Alma and Long Lake, NS

Area	Specimen ID	Date	Species	Station Number	Lift	Fork length (cm)	Sex M/F/I	Comments	Count
Scraggy Lake	GL-001-WHSC-(	2-Jul-18	white sucker	SGL-001-GN02	1	27.8			1
Scraggy Lake	GL-001-WHSC-(	2-Jul-18	white sucker	SGL-001-GN02	1	26.4			1
Scraggy Lake	GL-001-WHSC-(	2-Jul-18	white sucker	SGL-001-GN02	1	26.1			1
Scraggy Lake	GL-001-WHSC-(	2-Jul-18	white sucker	SGL-001-GN01	1	25.2			1
Scraggy Lake	GL-001-WHSC-1	2-Jul-18	white sucker	SGL-001-GN01	1	26			1
Scraggy Lake	GL-001-YLPR-0	2-Jul-18	yellow perch	SGL-001-GN02	1	20.2			1
Scraggy Lake	GL-001-YLPR-0	2-Jul-18	yellow perch	SGL-001-GN02	1	17.1			1
Scraggy Lake	GL-001-YLPR-0	2-Jul-18	yellow perch	SGL-001-GN02	1	19			1
Scraggy Lake	GL-001-YLPR-0	2-Jul-18	yellow perch	SGL-001-GN02	1	16			1
Scraggy Lake	GL-001-YLPR-1	3-Jul-18	yellow perch	SGL-001-GN03	1	16	Female		1
Scraggy Lake	GL-003-WHSC-1	2-Jul-18	white sucker	SGL-003-GN01	1	28.3			1
Scraggy Lake	GL-003-WHSC-1	2-Jul-18	white sucker	SGL-003-GN01	1	26.1			1
Scraggy Lake	GL-003-WHSC-1	2-Jul-18	white sucker	SGL-003-GN01	1	26.5			1
Scraggy Lake	GL-003-WHSC-1	2-Jul-18	white sucker	SGL-003-GN01	1	27.2			1
Scraggy Lake	GL-003-WHSC-1	2-Jul-18	white sucker	SGL-003-GN01	1	27.8			1
Scraggy Lake	GL-003-YLPR-0	2-Jul-18	yellow perch	SGL-003-GN01	1	16.8			1
Scraggy Lake	GL-003-YLPR-0	2-Jul-18	yellow perch	SGL-003-GN01	1	18			1
Scraggy Lake	GL-003-YLPR-0	2-Jul-18	yellow perch	SGL-003-GN01	1	17.4			1
Scraggy Lake	GL-003-YLPR-0	2-Jul-18	yellow perch	SGL-003-GN01	1	17	Female		1
Scraggy Lake	GL-003-YLPR-0	2-Jul-18	yellow perch	SGL-003-GN01	1	15.5	Female		1
Scraggy Lake	GL-003-YLPR-1	2-Jul-18	yellow perch	SGL-003-GN01	1	16	Female		1
Scraggy Lake	GL-003-YLPR-1	2-Jul-18	yellow perch	SGL-003-GN01	1	15	Female		1
Long Lake	-	5-Jul-18	white perch	LL-GN01	1			mostly consumed	1
Long Lake	-	5-Jul-18	white perch	LL-GN01	1	22.8			1
Long Lake	-	5-Jul-18	white perch	LL-GN01	1	22.8			1
Long Lake	-	5-Jul-18	white perch	LL-GN01	1	25.4			1
Long Lake	-	5-Jul-18	white perch	LL-GN01	1	26.4			1
Long Lake	-	5-Jul-18	white perch	LL-GN01	1	25.8			1
Long Lake	-	5-Jul-18	white perch	LL-GN01	1	10.2			1
Long Lake	-	5-Jul-18	white perch	LL-GN01	1	20.5			1
Long Lake	-	5-Jul-18	white perch	LL-GN02	1			mostly consumed	17
Long Lake	-	5-Jul-18	white perch	LL-GN02	1	13.4			1
Long Lake	-	5-Jul-18	white perch	LL-GN02	1	13.5			1
Long Lake	-	5-Jul-18	white perch	LL-GN02	1	14.2			1

Table B.2 Raw Fish Data from Scraggy, Alma and Long Lake, NS

Area	Specimen ID	Date	Species	Station Number	Lift	Fork length (cm)	Sex M/F/I	Comments	Count
Long Lake	-	5-Jul-18	white perch	LL-GN02	1	12.9			1
Long Lake	-	5-Jul-18	white perch	LL-GN02	1	14.5			1
Long Lake	-	5-Jul-18	white perch	LL-GN02	1	11.4			1
Long Lake	-	5-Jul-18	white perch	LL-GN02	1	10.5			1
Long Lake	-	5-Jul-18	white perch	LL-MT03	1				1
Scraggy Lake	-	2-Jul-18	white sucker	SGL-001-GN02	1	28.7	Female		1
Scraggy Lake	-	2-Jul-18	white sucker	SGL-001-GN02	1	28.5	Female		1
Alma Lake	-	6-Jul-18	white sucker	AL-GN01	1			partially consumed	4
Alma Lake	-	6-Jul-18	white sucker	AL-GN01	1	16.3			1
Alma Lake	-	6-Jul-18	white sucker	AL-GN01	1	18.5			1
Alma Lake	-	6-Jul-18	white sucker	AL-GN01	1	18.7			1
Alma Lake	-	6-Jul-18	white sucker	AL-GN01	1	20.4			1
Alma Lake	-	6-Jul-18	white sucker	AL-GN01	1	16.5			1
Alma Lake	-	6-Jul-18	white sucker	AL-GN01	1	30.3			1
Alma Lake	-	6-Jul-18	white sucker	AL-GN01	1	15.9			1
Alma Lake	-	6-Jul-18	white sucker	AL-GN01	1	15.1			1
Alma Lake	-	6-Jul-18	white sucker	AL-GN01	1	16.9			1
Alma Lake	-	6-Jul-18	white sucker	AL-GN01	1	17.6			1
Alma Lake	-	6-Jul-18	white sucker	AL-GN01	1	18			1
Alma Lake	-	6-Jul-18	white sucker	AL-GN01	1	18.4			1
Alma Lake	-	6-Jul-18	white sucker	AL-GN01	1	23			1
Alma Lake	-	6-Jul-18	white sucker	AL-GN01	1	15.7			1
Alma Lake	-	6-Jul-18	white sucker	AL-GN01	1	16.3			1
Alma Lake	-	6-Jul-18	white sucker	AL-GN01	1	19.7			1
Alma Lake	-	6-Jul-18	white sucker	AL-GN02	1				1
Alma Lake	-	6-Jul-18	white sucker	AL-GN02	1	32			1
Alma Lake	-	6-Jul-18	white sucker	AL-GN02	1	24.8			1
Alma Lake	-	6-Jul-18	white sucker	AL-GN02	1	28.6			1
Alma Lake	-	6-Jul-18	white sucker	AL-GN02	1	28			1
Alma Lake	-	6-Jul-18	white sucker	AL-GN02	1	27.7			1
Alma Lake	-	6-Jul-18	white sucker	AL-GN02	1	30.2			1
Alma Lake	-	6-Jul-18	white sucker	AL-GN02	1	38.2			1
Alma Lake	-	6-Jul-18	white sucker	AL-GN02	1	28.5			1
Alma Lake	-	6-Jul-18	white sucker	AL-GN02	1	30			1

Table B.2 Raw Fish Data from Scraggy, Alma and Long Lake, NS

Area	Specimen ID	Date	Species	Station Number	Lift	Fork length (cm)	Sex M/F/I	Comments	Count
Alma Lake	-	6-Jul-18	white sucker	AL-GN02	1	29.1			1
Alma Lake	-	6-Jul-18	white sucker	AL-GN02	1	25.9			1
Alma Lake	-	6-Jul-18	white sucker	AL-GN02	1	28.6			1
Long Lake	-	5-Jul-18	white sucker	LL-GN01	1			mostly consumed	2
Long Lake	-	5-Jul-18	white sucker	LL-GN01	1	28.2			1
Long Lake	-	5-Jul-18	white sucker	LL-GN01	1	26.3			1
Long Lake	-	5-Jul-18	white sucker	LL-GN02	1			mostly consumed	2
Long Lake	-	5-Jul-18	white sucker	LL-GN02	1				1
Long Lake	-	5-Jul-18	white sucker	LL-GN02	1	22			1
Scraggy Lake	-	2-Jul-18	white sucker	SGL-001-GN01	1				1
Scraggy Lake	-	2-Jul-18	white sucker	SGL-001-GN01	1				3
Scraggy Lake	-	2-Jul-18	white sucker	SGL-001-GN01	1	16.5		tail mangled	1
Scraggy Lake	-	2-Jul-18	white sucker	SGL-001-GN01	1	16.2			1
Scraggy Lake	-	2-Jul-18	white sucker	SGL-001-GN01	1	17			1
Scraggy Lake	-	2-Jul-18	white sucker	SGL-001-GN01	1	15.9			1
Scraggy Lake	-	2-Jul-18	white sucker	SGL-001-GN01	1	16.8			1
Scraggy Lake	-	2-Jul-18	white sucker	SGL-001-GN01	1	15.7			1
Scraggy Lake	-	2-Jul-18	white sucker	SGL-001-GN01	1	19.2			1
Scraggy Lake	-	2-Jul-18	white sucker	SGL-001-GN01	1	17.1			1
Scraggy Lake	-	2-Jul-18	white sucker	SGL-001-GN01	1	16.6			1
Scraggy Lake	-	2-Jul-18	white sucker	SGL-001-GN01	1	17.2			1
Scraggy Lake	-	2-Jul-18	white sucker	SGL-001-GN01	1	23.8			1
Scraggy Lake	-	2-Jul-18	white sucker	SGL-001-GN02	1				1
Scraggy Lake	-	3-Jul-18	white sucker	SGL-001-GN03	1	16.2			1
Scraggy Lake	-	2-Jul-18	white sucker	SGL-003-GN01	1				2
Scraggy Lake	-	2-Jul-18	white sucker	SGL-003-GN01	1	16.1			1
Scraggy Lake	-	2-Jul-18	white sucker	SGL-003-GN01	1	16.4			1
Scraggy Lake	-	2-Jul-18	white sucker	SGL-003-GN01	1	16.3			1
Scraggy Lake	-	3-Jul-18	white sucker	SGL-003-GN02	1	28.5			1
Long Lake	-	5-Jul-18	yellow perch	LL-MT03	1	9.7			1
Long Lake	-	5-Jul-18	yellow perch	LL-MT03	1	9.8			1
Long Lake	-	5-Jul-18	yellow perch	LL-MT03	1	10.1			1
Long Lake	-	5-Jul-18	yellow perch	LL-MT03	1	10			1
Long Lake	-	5-Jul-18	yellow perch	LL-MT03	1	9.9		black spot	1

Table B.2 Raw Fish Data from Scraggy, Alma and Long Lake, NS

Area	Specimen ID	Date	Species	Station Number	Lift	Fork length (cm)	Sex M/F/I	Comments	Count
Long Lake	-	5-Jul-18	yellow perch	LL-MT03	1	11.5			1
Long Lake	-	5-Jul-18	yellow perch	LL-MT03	1	9.9			1
Scraggy Lake	-	2-Jul-18	yellow perch	SGL-001-GN01	1				2
Scraggy Lake	-	2-Jul-18	yellow perch	SGL-001-GN01	1	14.5			1
Scraggy Lake	-	2-Jul-18	yellow perch	SGL-001-GN01	1	15			1
Scraggy Lake	-	2-Jul-18	yellow perch	SGL-001-GN01	1	14.5			1
Scraggy Lake	-	2-Jul-18	yellow perch	SGL-001-GN01	1	13.6			1
Scraggy Lake	-	3-Jul-18	yellow perch	SGL-001-GN03	1				1
Scraggy Lake	-	2-Jul-18	yellow perch	SGL-003-GN01	1				1
Scraggy Lake	-	2-Jul-18	yellow perch	SGL-003-GN01	1	10.4			1
Scraggy Lake	-	2-Jul-18	yellow perch	SGL-003-GN01	1	14.1			1
Scraggy Lake	-	2-Jul-18	yellow perch	SGL-003-GN01	1	14.6			1
Scraggy Lake	-	2-Jul-18	yellow perch	SGL-003-GN01	1	15			1
Scraggy Lake	-	2-Jul-18	yellow perch	SGL-003-GN01	1	14.5			1
Scraggy Lake	-	2-Jul-18	yellow perch	SGL-003-GN01	1	15.3			1
Scraggy Lake	-	2-Jul-18	yellow perch	SGL-003-GN01	1	14			1
Scraggy Lake	-	2-Jul-18	yellow perch	SGL-003-GN01	1	15.4			1
Scraggy Lake	-	2-Jul-18	yellow perch	SGL-003-GN01	1	14			1
Scraggy Lake	-	2-Jul-18	yellow perch	SGL-003-GN01	1	15.1			1
Scraggy Lake	-	2-Jul-18	yellow perch	SGL-003-GN01	1	14.6			1
Scraggy Lake	-	3-Jul-18	white sucker	SGL-003-GN02	1		Female		15
Scraggy Lake	-	3-Jul-18	white sucker	SGL-003-GN02	1		Male		11
Scraggy Lake	-	3-Jul-18	white sucker	SGL-003-GN02	1		Unknown		1

APPENDIX C

Fish Tissue Data

Table C.1 Summary of Crude Fat, Moisture and Selected Trace Metal Parameters of Concern for Whole Body White Sucker and Muscle Fillet and Whole Body Yellow Perch Tissue Samples

Sample ID	Area	Fork Length (cm)	Sample Weight [a] (g)	Parameter and Detection Limit (below)											
				Crude Fat (%)	Moisture (%)	Aluminum (%)	Arsenic (%)	Cadmium (%)	Copper (%)	Iron (%)	Lead (%)	Mercury (%)	Nickel (%)	Selenium (%)	Zinc (%)
				0.5	**1**	**0.2**	**0.005**	**0.002**	**0.01**	**1**	**0.002**	**0.002**	**0.01**	**0.01**	**0.04**
SGL-001-WHSC-02	Nearfield	31.2	347.14	2.4	77	33.7	0.167	0.0284	0.472	98.6	0.226	0.19	0.045	0.959	15.3
SGL-001-WHSC-03	Nearfield	32.2	431.33	<0.50	81	8.72	0.0826	0.048	0.659	39.9	0.108	0.3	0.023	0.671	21.2
SGL-001-WHSC-05	Nearfield	28.1	305.54	1.4	80	6.6	0.145	0.0611	0.627	28.5	0.313	0.348	0.019	0.69	24.2
SGL-001-WHSC-06	Nearfield	27.8	248.57	0.9	79	15.1	0.187	0.0567	0.589	47.4	0.458	0.182	0.026	0.657	26.9
SGL-001-WHSC-09	Nearfield	25.2	192.51	2.6	77	1.71	0.0896	0.036	0.918	13.5	0.151	0.182	0.01	0.603	21.8
SGL-003-WHSC-11	Farfield	28.3	251.3	0.6	83	9.67	0.0963	0.0495	1.02	34.5	0.237	0.137	0.027	0.979	13.8
SGL-003-WHSC-12	Farfield	26.1	190.04	0.9	82	3.22	0.0734	0.0392	1.23	19.4	0.28	0.115	0.022	0.691	21
SGL-003-WHSC-13	Farfield	26.5	209.76	1.1	79	15.5	0.103	0.0746	0.653	48.6	0.191	0.167	0.025	1.04	24
SGL-003-WHSC-14	Farfield	27.2	222.03	0.5	80	28.2	0.121	0.0355	0.991	80.2	0.222	0.147	0.049	1.37	16.9
SGL-003-WHSC-15	Farfield	27.8	285.17	1	82	25.3	0.13	0.0499	1.4	87.6	0.241	0.134	0.065	0.892	18.5
SGL-001-YLPR-01A/B	Nearfield	20.2	20.23	<0.50	N/A	0.21	0.0701	0.0026	0.211	1.5	0.0118	0.815	<0.010	1.19	3.79
SGL-001-YLPR-02A/B	Nearfield	17.1	22.97	<0.50	N/A	<0.20	0.0387	<0.0020	0.197	1.9	0.0037	0.796	<0.010	0.757	3.5
SGL-001-YLPR-03A/B	Nearfield	19	25.29	<0.50	N/A	<0.20	0.0443	<0.0020	0.172	1.7	0.0025	0.661	<0.010	0.569	4.17
SGL-001-YLPR-12A/B	Nearfield	16	18.33	<0.50	N/A	<0.20	0.048	<0.0020	0.284	2.9	0.0071	0.674	<0.010	0.689	3.99
SGL-003-YLPR-05A/B	Farfield	16.8	23.07	<0.50	N/A	<0.20	0.034	<0.0020	0.214	2.1	0.0032	0.338	<0.010	1.33	3.69
SGL-003-YLPR-06A/B	Farfield	18	21.89	<0.50	N/A	<0.20	0.0339	<0.0020	0.193	1.6	0.0028	0.403	<0.010	1.13	3.7
SGL-003-YLPR-07A/B	Farfield	17.4	21.30	<0.50	N/A	<0.20	0.0525	<0.0020	0.215	2.1	0.0046	0.463	<0.010	1.51	3.53
SGL-003-YLPR-08A/B	Farfield	17	21.81	<0.50	N/A	0.22	0.0283	<0.0020	0.216	1.9	0.0046	0.322	<0.010	1.31	3.64
SGL-003-YLPR-09A/B	Farfield	15.5	18.31	0.5	N/A	<0.20	0.0233	<0.0020	0.258	2.4	0.0046	0.326	<0.010	1.06	4.46
SGL-003-YLPR-11A/B	Farfield	15	19.67	<0.50	N/A	0.2	0.0394	<0.0020	0.257	2.6	0.0086	0.311	<0.010	1.39	4.43
SGL-001-YLPR-01C	Nearfield	20.2	76.64	4	73	3.96	0.0729	0.0262	0.93	20.5	0.345	0.519	0.015	1.03	30.4
SGL-001-YLPR-02C	Nearfield	17.1	37.83	2	73	2.26	0.0424	0.0359	0.393	25.4	0.222	0.386	0.011	0.725	27.7
SGL-001-YLPR-03C	Nearfield	19	45.63	1.5	75	1.94	0.0356	0.0235	0.904	16.1	0.155	0.343	0.021	0.554	25.5
SGL-001-YLPR-12C	Nearfield	16	26	1.5	N/A	19.3	0.159	0.0489	0.543	67.8	0.291	0.246	0.053	0.721	44.4
SGL-003-YLPR-05C	Farfield	16.8	31.55	2.2	74	6.35	0.0629	0.0429	0.584	37.8	0.254	0.156	0.025	1.17	37.4
SGL-003-YLPR-06C	Farfield	18	44.94	2.8	74	1.35	0.0411	0.0306	2.59	17.4	0.15	0.21	0.021	1	23.2
SGL-003-YLPR-07C	Farfield	17.4	36.52	1.3	73	128	0.186	0.06	0.532	324	0.411	0.187	0.18	1.18	36.1
SGL-003-YLPR-08C	Farfield	17	35.35	2.3	76	10.4	0.0679	0.0333	2.93	39.3	0.233	0.131	0.052	1.16	32.9
SGL-003-YLPR-09C	Farfield	15.5	23.46	1	N/A	13.4	0.0788	0.0367	0.752	44.7	0.233	0.103	0.035	0.89	36.6
SGL-003-YLPR-11C	Farfield	15	22.04	3.3	N/A	21.2	0.088	0.0428	1.12	77.9	0.329	0.134	0.06	1.16	33.7

Note: [a] Sample weights for yellow perch muscle fillets are the combined weight of muscle fillet tissue submitted for trace metal analysis and crude fat and moisture. WHSC = white sucker and YLPR = yellow perch.

Table C.2 Calculated Whole Body Crude Fat and Trace Metal Concentrations of Yellow Perch

Location	Sample	Crude Fat (%)	Total Aluminum (mg/kg)	Total Arsenic (mg/kg)	Total Cadmium (mg/kg)	Total Copper (mg/kg)	Total Iron (mg/kg)	Total Lead (mg/kg)	Total Mercury (mg/kg)	Total Nickel (mg/kg)	Selenium (mg/kg)	Total Zinc (mg/kg)
Nearfield	SGL-001-YLPR-01	3.2	3.2	0.0723	0.0213	0.78	16.5	0.2754	0.5808	0.0129	1.06	24.8
Nearfield	SGL-001-YLPR-02	1.6	1.8	0.0416	0.0286	0.35	20.5	0.1764	0.4716	0.0097	0.73	22.6
Nearfield	SGL-001-YLPR-03	1.2	1.6	0.0374	0.0188	0.75	13.1	0.1232	0.4094	0.0177	0.56	21.0
Nearfield	SGL-001-YLPR-12	1.2	15.3	0.1358	0.0389	0.49	54.2	0.2317	0.3354	0.0430	0.71	36.0
Farfield	SGL-003-YLPR-05	1.8	5.0	0.0569	0.0341	0.51	30.3	0.2016	0.1940	0.0208	1.20	30.4
Farfield	SGL-003-YLPR-06	2.3	1.1	0.0396	0.0244	2.09	14.1	0.1193	0.2503	0.0177	1.03	19.1
Farfield	SGL-003-YLPR-07	1.1	101.3	0.1581	0.0477	0.47	256.8	0.3261	0.2446	0.1435	1.25	29.3
Farfield	SGL-003-YLPR-08	1.9	8.3	0.0596	0.0266	2.36	31.5	0.1853	0.1709	0.0422	1.19	26.8
Farfield	SGL-003-YLPR-09	0.9	10.6	0.0672	0.0292	0.65	35.9	0.1853	0.1496	0.0287	0.93	29.9
Farfield	SGL-003-YLPR-11	2.7	16.8	0.0779	0.0341	0.94	62.2	0.2621	0.1710	0.0485	1.21	27.6

Note: YLPR = yellow perch

APPENDIX D

Benthic Invertebrate Community

Table D.1 Benthic Invertebrate Community Indices Endpoints by Sample

Station	Replicate	Sample ID	Taxa Richness	Density (# individuals per m2)	Simpson's Diversity Index	Simpson's Evenness Index	Biomass
SGL-001	1	SGL-001-1	6	1451	0.51	0.34	0.11
SGL-001	2	SGL-001-2	7	1582	0.54	0.31	0.13
SGL-001	3	SGL-001-3	6	1124	0.63	0.45	0.14
SGL-001	4	SGL-001-4	8	863	0.63	0.34	0.17
SGL-001	5	SGL-001-5	7	1176	0.61	0.36	0.17
SGL-003	1	SGL-003-1	6	379	0.54	0.36	0.10
SGL-003	2	SGL-003-2	6	471	0.60	0.42	0.24
SGL-003	3	SGL-003-3	9	667	0.53	0.24	0.22
SGL-003	4	SGL-003-4	7	732	0.37	0.23	0.03
SGL-003	5	SGL-003-5	9	706	0.75	0.44	0.12

BENTHIC INVERTEBRATE SPECIES COMPOSITION IN FRESHWATER PETIT PONAR SAMPLES—SCRAGGY LAKE, NOVA SCOTIA

STANTEC #121619250 | LAB NUMBER: L2018-43

September 2018

Report to:

Stantec, Fredericton, New Brunswick

Prepared by:

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BENTHIC INVERTEBRATE SPECIES COMPOSITION IN FRESHWATER KICK NET SAMPLES —SCRAGGY LAKE, NOVA SCOTIA— (STANTEC #121619250)

for

Stantec, Fredericton, New Brunswick

September 2018

INTRODUCTION

Stantec personnel collected ten petit ponar samples from two sample sites (SGL-001; Nearfield and SGL-003; Farfield) each having five stations within, from Scraggy Lake, Nova Scotia, on July 3 - 4, 2018 (Stantec Project # 121619250). Samples were collected using a petit ponar at each station (3 reps per station were pooled for a total of one station); preserved in 95% denatured ethyl alcohol; and subsequently shipped to Envirosphere Consultants Limited, Windsor, Nova Scotia, for sorting, identification and enumeration of benthic invertebrates. Samples were received on July 30, 2018. The results of the analysis are presented in this report.

METHODS

SIEVING OF WHOLE SEDIMENTS

The sediment samples were provided preserved (95% ethyl alcohol) in plastic 1L jars. Prior to sorting, samples were rinsed on an 0.5 mm sieve to remove preservative. All samples were processed at 100%.

SORTING AND IDENTIFICATION

Samples were examined at 6 - 6.4x magnification on a stereomicroscope, with a final brief check at 16x and all organisms were removed. Removal efficiency for lab personnel is checked periodically by resorting 10% of samples and is typically 90 % or better (see Attachment 1). Organisms were subsequently stored in labeled vials in 70% ethyl alcohol. Wet weight biomass (grams per sample) was estimated by weighing animals to the nearest milligram at the time of sorting, after blotting to remove surface water.

Organisms were identified to an appropriate taxonomic level, typically to genus, using conventional literature for the groups involved (see Attachment 2). Organisms were identified by Heather Levy (B.Sc. Hons.) and verified by Valerie Kendall (M.Env.Sc.) of Envirosphere Consultants Ltd. Abundance of each taxonomic group, number of taxonomic groups, and wet weight biomass were estimated from the data.

A reference collection containing voucher specimens of the taxa identified was prepared; animals are stored in 20 mL vials in 70% ethyl alcohol.

RESULTS AND DISCUSSION

Sample descriptions for samples, as received, are presented in Table 1. Identifications, abundance, taxon richness, and biomass measures are presented in Table 2. Abundance, taxon richness and biomass are expressed on a per sample basis.

Samples contained freshwater animals with most major organism groups represented, although Diptera (particularly midgefly larvae, Chironomidae, Ceratopogonidae and Chaoboridae), and Ephemeroptera (mayfly) were most numerous and most commonly occurring. Minor numbers of other groups such as Trichoptera (caddisfly), Megaloptera (alderfly), aquatic oligochaetes (worms), Odonata (dragonfly), Mollusca (bivalves), and Hydrachnidia (water mites) also occurred. Communities had a low/moderate diversity of organisms (taxon richness of 6 – 9 taxa per sample); low abundances (29 – 121 individuals per sample); and low biomasses (0.03 to 0.20 g per sample (Table 2).

Limiting Conditions

The quality of the results presented in this report are dependent both on our analysis, and on the quality of samples as provided to Envirosphere Consultants Limited by the client. The analyses are based on practices normally accepted in the analysis of marine and freshwater benthic invertebrate samples, and with suitable controls for quality assurance. No other warranty is made.

Table 1. Characteristics of samples, Stantec Project #121619250, Scraggy Lake, Nova Scotia, July 3-4, 2018.	
Sample	Sediment Description
SGL-001-01	Organic matter (detritus and woody debris) with sand and fines.
SGL-001-02	Sand with fines (silt) and organic debris (woody material) present.
SGL-001-03	Organic debris (leaf & woody matter) as well as sand and fines.
SGL-001-04	Sand, fines, and organics (detritus & woody debris) were present in sample.
SGL-001-05	Sand with organic matter (detritus & woody debris) was present in sample.
SGL-003-01	Organic matter (including woody debris) as well as sand and fines present.
SGL-003-02	Fines (silt) to sand with organics (woody and detritus).
SGL-003-03	Sand, as well as silt, and organic debris (detritus & woody material).
SGL-003-04	Sand with fines as well as organic debris (detritus and woody material).
SGL-003-05	Fines to sand with organic matter (plant and woody debris) noted.
Grain size classes: cobble = 6.4 cm and larger; pebble/ gravel = 4 mm to 6.4 cm; sand = 0.063 mm to 2 mm; silt = 0.004 mm to 0.063 mm; clay = <0.004 mm.	

Table 2. Abundance of benthic organisms in sediments from Stantec Project #121619250, Scraggy Lake, Nova Scotia, July 3 – 4, 2018.

Date Sampled				July 3-4, 2018									
				Nearfield and Farfield locations with stations (3 reps per station)									
				SGL-001 (Nearfield)					SGL-003 (Farfield)				
Phylum & Class	*Order*	*Family*	*Genus & Species*	1	2	3	4	5	1	2	3	4	5
Arthropoda Insecta													
	Diptera												
		Ceratopogonidae		11	11	9	6	6	4	3	7	3	8
		Chaoboridae											
			Chaoborus	21	18	25	16	23	1	2	4	4	6
		Chironomidae*		74	79	45	36	51	19	21	34	44	24
	Unidentified pupae							1					
	Ephemeroptera												
		Caenidae											
			Caenis									1	
		Ephemeridae											
			Hexagenia	3	8	3	2	3		8	1	1	5
	Trichoptera												
		Leptoceridae											
			Oecetis								1		4
		Dipseudopsidae											
			Phylocentropus				2		3		1	1	1
	Unidentified pupae			1									
	Megaloptera												
		Sialidae											
			Sialis				1	3	1	1	1		2
	Odonata												
		Macromiidae											
			Macromia								1		
Arthropoda Arachnida													

Table 2. Abundance of benthic organisms in sediments from Stantec Project #121619250, Scraggy Lake, Nova Scotia, July 3 – 4, 2018.

Date Sampled				July 3-4, 2018									
				Nearfield and Farfield locations with stations (3 reps per station)									
				SGL-001 (Nearfield)					SGL-003 (Farfield)				
Phylum & Class	*Order*	*Family*	*Genus & Species*	1	2	3	4	5	1	2	3	4	5
	Trombidiformes												
		Hydrachnidiae											
			species A	1									
			species B		1								
Mollusca Bivalvia													
	Veneroida												
		Pisidiidae		1	2	3	1	3		1	1	2	2
Annelida Clitellata													
	Aquatic Worms (Oligochaeta)												
					2	1	2	1	1				2
SUMMARY													
Abundance #/sample				112	121	86	66	91	29	36	51	56	54
Taxa Richness				7	7	6	8	8	6	6	9	7	9
Biomass (grams)				0.108	0.134	0.142	0.173	0.165	0.096	0.242	0.215	0.028	0.119
Excluded and Non-aquatic Taxa (not included in analyses)													
	Copepoda				1	1		1	11	2	8	11	6
	Cladocera			2		5		10	88	34	38	119	88
	Nematode			2						5		6	1

*Chironomid larvae and pupae stages are combined.

Envirosphere Consultants Limited
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ATTACHMENT 1 – SORTING EFFICIENCY

Envirosphere CONSULTANTS LIMITED

Sorting Efficiency Report

Client Name/Address: Stantec

Sample Information: L2018-43 Atlantic Gold EEM Baseline

Sorted by: Jesse MacDonald

Date: Sept. 22, 2018

Checked by: Heather Levy

Date Checked: Sept 26, 2018

Approved by: HL

Date: Sept. 26, 2018

SAMPLE NUMBER	STATED NUMBER OF ORGANISMS (A)	NUMBER OF ADDITIONAL ORGANISMS FOUND (B)	SORTING EFFICIENCY (%) (A/(A+B)) X 100	SORTED BY (Initials)
1. SGL-003-05	149	13	92.0 %	JM
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				

Comments:

M:\myfiles\ENVIROSPHERE Benthic Lab\QA_QC forms\Sorting Efficiency Report Form\Sorting Efficiency Report Form.docx

ATTACHMENT 2 – TAXONOMIC LITERATURE

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APPENDIX E

Water and Sediment Quality Data

Table E.1 2018 In-Situ Water Quality Data at SGL-001 in Scraggy Lake, NS

Site: SGL-001 (Scraggy Lake)
UTM: 20 T 506488 4979667
Date: 1/7/2018
Time: 15:43
Sampler: JR/DL
Weather: sunny/overcase, slight breeze

	Down	Up	Comments : Water samples SGL-001SR/BT
Secchi (m):	1.7	1.8	
Max Depth (m):		4.3	

Depth (m)	DO (mg/L)	DO (%)	SpCond. (μs/cm)	Temp. (°C)	pH
0.0	8.6	101	36.0	23.3	5.6
0.5	8.4	97	36.3	22.2	
1.0	8.6	97	35.4	21.0	
1.5	8.4	94	35.0	20.6	
2.0	8.5	92	41.1	18.9	
2.5	8.5	90	38.1	18.0	
3.0	8.4	89	36.1	17.7	
3.5	8.5	90	35.9	17.6	
4.0	8.2	86	36.3	17.5	
4.5	**Bottom**				
4.0	8.1	95	36.0	23.2	5.6
3.5	8.0	92	35.3	22.1	
3.0	8.2	91	35.6	20.9	
2.5	8.4	95	35.6	20.8	
2.0	8.2	92	35.3	20.3	
1.5	8.1	87	44.3	18.6	
1.0	8.2	88	37.9	17.9	
0.5	8.2	86	36.4	17.6	
0.0	8.3	88	36.4	17.5	

Table E.2 2018 In-Situ Water Quality Data at SGL-002 in Scraggy Lake, NS

Site: SGL-002 (Scraggy Lake)
UTM: 20 T 508101 4978053
Date: 1/7/2018
Time: 14:42
Sampler: JR/DL
Weather: sunny with clouds, light breeze

	Down	Up	**Comments:** Water sample SGL-002SR/BT
Secchi (m):	1.57	1.7	
Max Depth (m):		11.2	

Depth (m)	DO (mg/L)	DO (%)	SpCond. (µs/cm)	Temp. (°C)	pH
0.0	8.2	96	33.1	23.1	5.3
0.5	8.1	94	33.1	22.2	
1.0	8.7	97	32.8	20.4	
1.5	9.0	97	32.4	18.8	
2.0	9.0	97	32.1	18.6	
2.5	8.9	95	32.0	18.4	
3.0	8.7	92	32.9	18.0	
3.5	8.7	93	32.4	17.8	
4.0	8.8	93	32.4	17.6	
4.5	8.8	93.0	32.6	17.6	
5.0	8.7	91	32.7	17.5	
5.5	8.6	90	32.6	17.4	
6.0	8.5	87	32.8	17.4	
6.5	8.3	87	32.7	17.3	
7.0	8.7	92	32.6	17.2	
7.5	8.5	89	32.6	17.1	
8.0	8.6	90	32.6	17.1	
8.5	8.7	91	32.7	17.1	
9.0	8.5	88	32.9	16.9	
9.5	8.0	83	33.1	16.6	
10.0	7.7	79	33.4	16.3	
10.5	6.8	70	33.5	16.0	
11.0	6.5	66	33.4	15.8	
11.0	6.1	62	33.5	15.8	
10.5	6.5	66	33.5	16.0	
10.0	7.1	72	33.5	16.3	
9.5	7.5	77	33.4	16.5	
9.0	8	83	33.1	16.8	
8.5	8.3	87	33	17.1	
8.0	8.4	87	33	17.1	
7.5	8.4	87	33.1	17.1	
7.0	8.3	87	33.1	17.2	
6.5	8.3	87	33.1	17.3	
6.0	8.4	89	33.2	17.4	
5.5	8.4	89	33.2	17.4	
5.0	8.6	91	33.3	17.5	
4.5	8.5	89	33.3	17.6	
4.0	8.6	91	33.1	17.6	
3.5	8.7	92	33.2	17.7	
3.0	8.5	9	33.3	17.9	
2.5	8.7	94	32.8	18.3	
2.0	8.7	94	32.9	18.6	
1.5	8.8	95	32.8	18.8	
1.0	8.4	95	33.1	21	
0.5	7.7	89	33.3	22.2	
0.0	7.8	92	33.2	22.8	5

Table E.3 2018 In-Situ Water Quality Data at SGL-003 in Scraggy Lake, NS

Site: SGL-003 (Scraggy Lake)

UTM: 20 T 509227 4976867
Date: 2-Jul-18
Time: 14:20
Sampler: JR/DL
Weather: overcast/sunny/light breeze

	Down	Up
Secchi (m):	2.10	1.9
Max Depth (m):		3.7

Comments: Secchi measured July 3, 2018; Water samples SLG-003-SR/BT**. SLG-020 (dup)**

Depth (m)	DO (mg/L)	DO (%)	SpCond. (µs/cm)	Temp. (°C)	pH
0.0	8.9	102	27.3	21.9	5.2
0.5	8.9	101	27.3	21.7	
1.0	8.9	101	27.3	21.3	
1.5	8.7	98	27.3	21.1	
2.0	8.9	98	27.9	19.6	
2.5	9.0	96	27.8	18.5	
3.0	9.0	95	27.3	18.1	
3.5	8.9	94	27.3	17.9	5.4
3.5	8.5	89	27.4	18.0	5.3
3.0	8.9	95	27.5	18.0	
2.5	8.4	91	27.9	19.0	
2.0	8.7	95	28.2	19.5	
1.5	8.6	97	27.5	21.0	
1.0	8.7	98	27.6	21.2	
0.5	8.4	97	27.6	21.7	
0.0	8.8	101	27.5	21.9	5.1

Table E.4 2018 In-Situ Water Quality Data at SGL-004 in Scraggy Lake, NS

Site: SGL-004 (Scraggy Lake)
UTM: **20 T 511138 4975670**
Date: **1-Jul-18**
Time: **14:05**
Sampler: **JR/DL**
Weather: sunny with clouds, light breeze

	Down	Up
Secchi (m):	2.46	2.65
Max Depth (m):		14.1

Comments: Water samples SLG-004-SR/BT.

Depth (m)	DO (mg/L)	DO (%)	SpCond. (µs/cm)	Temp. (°C)	pH
0.0	8.7	99	26.8	20.8	5.3
0.5	8.5	96	26.8	20.6	
1.0	8.6	95	26.7	19.3	
1.5	8.8	95	26.9	18.3	
2.0	8.8	94	26.9	17.9	
2.5	8.8	94	26.9	17.8	
3.0	8.6	91	27.0	17.5	
3.5	8.8	93	26.9	17.4	
4.0	8.6	90	27.0	17.2	
4.5	8.6	89.0	26.9	17.0	
5.0	8.5	88	27.0	16.7	
5.5	8.5	88	27.1	16.6	
6.0	8.4	86	27.1	16.5	
6.5	8.3	86	27.2	16.4	
7.0	8.2	84	27.2	16.2	
7.5	7.9	80	27.3	15.7	
8.0	7.8	79	27.5	15.1	
8.5	7.1	71	27.7	14.5	
9.0	6.6	65	27.9	13.9	
9.5	6.2	60	28.2	12.8	
10.0	5.9	56	28.5	12.2	
10.5	6.2	58	28.5	12.0	
11.0	5.3	49	28.6	11.6	
11.5	5.1	47	28.7	11.5	
12.0	4.9	46	28.7	11.4	
12.5	2.8	27	28.9	11.1	
13.0	0.6	6	27.9	11.0	
13.5	0.1	1	29.0	11.0	
14.0	0.1	1	29.9	11.0	
14.0	0.1	1	29.0	11.1	
13.5	0.1	1	28.5	11.1	
13.0	5.0	45	28.4	11.3	
12.5	5.1	47	28.3	11.4	
12.0	5.2	48	28.2	11.4	
11.5	5.3	49	28.2	11.6	
11.0	5.5	51	28.3	11.7	
10.5	5.5	52	28.1	12.0	5.1
10.0	5.9	56	28.1	12.4	
9.5	6.8	65	28.1	13.0	
9.0	7.3	71	27.5	14.1	
8.5	7.5	74	27.1	14.9	
8.0	7.9	80	26.9	15.2	
7.5	8.3	84	26.9	15.8	

Table E.4 2018 In-Situ Water Quality Data at SGL-004 in Scraggy Lake, NS

Site: SGL-004 (Scraggy Lake)
UTM: **20 T 511138 4975670**
Date: **1-Jul-18**
Time: **14:05**
Sampler: **JR/DL**
Weather: sunny with clouds, light breeze

	Down	Up
Secchi (m):	2.46	2.65
Max Depth (m):		14.1

Comments: Water samples SLG-004-SR/BT**.**

Depth (m)	DO (mg/L)	DO (%)	SpCond. (µs/cm)	Temp. (°C)	pH
7.0	8.7	89	26.5	16.3	
6.5	8.7	89	26.5	16.4	
6.0	8.7	90	26.5	16.6	
5.5	8.8	91	26.3	16.7	
5.0	8.8	91	26.4	16.7	
4.5	9.0	94	26.3	17.2	
4.0	9.0	94	26.3	17.3	
3.5	8.9	94	26.2	17.5	
3.0	8.9	94	26.1	17.6	
2.5	8.9	94	26.2	17.8	
2.0	9.1	96	26.4	18.1	
1.5	9.0	97	26.4	18.9	
1.0	8.8	97	26.4	19.2	
0.5	8.9	97	26.7	20.0	
0.0	9.0	101	26.1	20.7	

Table E.5 2018 In-Situ Water Quality Data at SGL-008 in Scraggy Lake, NS

Site: SGL-008 (Scraggy Lake)
UTM: **20 T 510110 4977505**
Date: **2-Jul-18**
Time: **13:15**
Sampler: **JR/DL**
Weather: overcast/sunny/light breeze

	Down	Up
Secchi (m):	1.7	1.8
Max Depth (m):		5.1

Comments: Reading at 5.0 m may have been in substrate based on low DO, Water samples collected were SGL-008SR/BT

Depth (m)	DO (mg/L)	DO (%)	SpCond. (µs/cm)	Temp. (°C)	pH
0.0	8.3	95	26.5	21.9	5.4
0.5	8.2	94	26.5	21.9	
1.0	8.3	95	26.5	21.8	
1.5	8.0	92	26.4	21.8	
2.0	8.3	94	26.5	21.6	
2.5	8.1	88	26.7	19.4	
3.0	8.2	87	26.6	18.5	
3.5	8.2	88	26.6	18.2	
4.0	8.0	85	26.7	18.0	
4.5	8.0	85.0	26.6	17.6	
5.0	0.6	6	26.8	17.4	5.5
5.0	0.1	1	26.8	17.3	5.5
4.5	7.7	81	27	17.6	
4.0	8	84	26.9	18	
3.5	7.9	84	27	18.1	
3.0	8	85	26.9	18.4	
2.5	7.9	86	26.9	19.1	
2.0	7.8	89	26.6	21.7	
1.5	7.9	90	26.7	21.8	
1.0	8	91	26.8	21.8	
0.5	8	92	26.8	21.9	
0.0	8.1	93	26.7	21.9	5.3

Table E6 General Chemistry and Trace Metal Concentrations of Surface Water for Scraggy Lake in July 2018

Sampling Date				2018/07/01 15:45	2018/07/01 16:00	2018/07/01 14:45	2018/07/01 15:00	2018/07/02 14:20	2018/07/02 14:30	2018/07/01 13:15	2018/07/01 13:30	2010/07/02 15:15	2010/07/02 15:15	2018/07/02 14:30	Decriptive Statistics						
	UNITS	RDL	CCME-FAL	SGL-001-SR	SGL-001-BT	SGL-002-SR	SGL-002-BT	SGL-003-SR	SGL-003-BT	SGL-004-SR	SGL-004-BT	SGL-008-SR	SGL-008-BT	SGL-020	Min.	Max.	Mean	Std Deviation	Std Error	Count	CCME FAL Exceedances
Calculated Parameters																					
Anion Sum	me/L	N/A	-	0.24	0.25	0.22	0.22	0.12	0.13	0.14	0.14	0.15	0.15	0.13	0.12	0.25	0.17	0.05	0.01	11	NA
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	1	-	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.50	0.50	0.50	0.00	0.00	11	NA
Calculated TDS	mg/L	1	-	16	16	14	14	8	9	9	10	9	9	9	8.00	16.00	11.18	3.12	0.94	11	NA
Carb. Alkalinity (calc. as CaCO3)	mg/L	1	-	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.50	0.50	0.50	0.00	0.00	11	NA
Cation Sum	me/L	N/A	-	0.29	0.29	0.25	0.24	0.2	0.2	0.19	0.19	0.19	0.19	0.2	0.19	0.29	0.22	0.04	0.01	11	NA
Hardness (CaCO3)	mg/L	1	-	6.9	6.8	5.7	5.5	4	4.1	3.8	3.8	3.8	3.7	4	3.70	6.90	4.74	1.25	0.38	11	NA
Ion Balance (% Difference)	%	N/A	-	9.43	7.41	6.38	4.35	25	21.2	15.2	15.2	11.8	11.8	21.2	4.35	25.00	13.54	6.71	2.02	11	NA
Langelier Index (@ 20C)	N/A	N/A	-	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC							NA
Langelier Index (@ 4C)	N/A	N/A	-	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC							NA
Nitrate (N)	mg/L	0.05	-	0.025	0.067	0.025	0.025	0.025	0.025	0.053	0.057	0.025	0.025	0.025	0.03	0.07	0.03	0.02	0.00	11	NA
Saturation pH (@ 20C)	N/A	N/A	-	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC							NA
Saturation pH (@ 4C)	N/A	N/A	-	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC							NA
Inorganics																					NA
Total Alkalinity (Total as CaCO3)	mg/L	5	-	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.50	2.50	2.50	0.00	0.00	11	NA
Dissolved Chloride (Cl-)	mg/L	1	-	5.2	5.3	5.1	5.3	4.2	4.5	4.7	4.9	5.4	5.3	4.6	4.20	5.40	4.95	0.40	0.12	11	NA
Colour	TCU	5	-	48	49	66	50	34	33	30	29	31	30	34	29.00	66.00	39.45	12.00	3.62	11	NA
Nitrate + Nitrite (N)	mg/L	0.05	2.9	0.025	0.067	0.025	0.025	0.025	0.025	0.053	0.057	0.025	0.025	0.025	0.03	0.07	0.03	0.02	0.00	11	0
Nitrite (N)	mg/L	0.01	0.06	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.01	0.01	0.01	0.00	0.00	11	0
Nitrogen (Ammonia Nitrogen)	mg/L	0.05	4[c]	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.03	0.03	0.03	0.00	0.00	11	0
Total Organic Carbon (C)	mg/L	0.5	-	6.7	7.1	8	7	5.6	5.7	5.2	5.2	5.4	5.5	4.9	4.90	8.00	6.03	1.00	0.30	11	NA
Orthophosphate (P)	mg/L	0.01	-	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.01	0.01	0.01	0.00	0.00	11	NA
pH	pH	N/A	6.5-9.0	6.07	6.04	6.05	6.15	6.85	6.27	6.04	6.4	6.15	6.05	6.22	6.04	6.85	6.21	0.24	0.07	11	9
Reactive Silica (SiO2)	mg/L	0.5	-	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.8	0.25	0.25	0.25	0.25	0.80	0.30	0.17	0.05	11	NA
Dissolved Sulphate (SO4)	mg/L	2	-	4.8	4.8	3.5	3.2	1	1	1	1	1	1	1	1.00	4.80	2.12	1.62	0.49	11	NA
Turbidity	NTU	0.1	-	1.2	1.2	93	1.2	0.84	1.6	0.94	1.3	1.2	1.1	1.1	0.84	93.00	9.52	27.69	8.35	11	NA
Conductivity	uS/cm	1	-	34	34	31	31	66	26	25	27	25	25	25	25.00	66.00	31.73	11.93	3.60	11	NA
Strong Acid Dissoc. Cyanide (CN)	mg/L	0.001	0.005	0.0029	0.0032	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0015	0.00	0.00	0.00	0.00	0.00	11	NA
Metals (dissolved)																					NA
Dissolved Aluminum (Al)	ug/L	5	-	140	130	150	130	120	130	110	120	120	110	110	110.00	150.00	124.55	12.93	3.90	11	NA
Dissolved Antimony (Sb)	ug/L	1	-	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.50	0.50	0.50	0.00	0.00	11	NA
Dissolved Arsenic (As)	ug/L	1	-	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.50	0.50	0.50	0.00	0.00	11	NA
Dissolved Barium (Ba)	ug/L	1	-	4.3	3.9	3.8	3.9	3.4	3.8	3.6	3.9	3.6	3.5	3.2	3.20	4.30	3.72	0.30	0.09	11	NA
Dissolved Beryllium (Be)	ug/L	1	-	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.50	0.50	0.50	0.00	0.00	11	NA
Dissolved Bismuth (Bi)	ug/L	2	-	1	1	1	1	1	1	1	1	1	1	1	1.00	1.00	1.00	0.00	0.00	11	NA
Dissolved Boron (B)	ug/L	50	-	25	25	25	25	25	25	25	25	25	25	25	25.00	25.00	25.00	0.00	0.00	11	NA
Dissolved Cadmium (Cd)	ug/L	0.01	-	0.013	0.013	0.013	0.015	0.014	0.013	0.017	0.019	0.012	0.014	0.017	0.01	0.02	0.01	0.00	0.00	11	NA
Dissolved Calcium (Ca)	ug/L	100	-	1800	1800	1500	1400	900	920	830	840	850	820	910	820.00	1800.00	1142.73	399.98	120.60	11	NA
Dissolved Chromium (Cr)	ug/L	1	-	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.50	0.50	0.50	0.00	0.00	11	NA
Dissolved Cobalt (Co)	ug/L	0.4	-	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.20	0.20	0.20	0.00	0.00	11	NA
Dissolved Copper (Cu)	ug/L	2	-	1	1	1	1	1	1	1	1	1	1	1	1.00	1.00	1.00	0.00	0.00	11	NA
Dissolved Iron (Fe)	ug/L	50	-	160	180	180	170	120	120	100	140	110	120	110	100.00	180.00	137.27	30.03	9.05	11	NA
Dissolved Lead (Pb)	ug/L	0.5	-	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.00	0.00	11	NA
Dissolved Magnesium (Mg)	ug/L	100	-	580	570	520	510	420	430	410	420	400	410	430	400.00	580.00	463.64	67.86	20.46	11	NA
Dissolved Manganese (Mn)	ug/L	2	-	43	44	42	48	40	42	43	61	40	42	41	40.00	61.00	44.18	6.00	1.81	11	NA
Dissolved Molybdenum (Mo)	ug/L	2	-	1	1	1	1	1	1	1	1	1	1	1	1.00	1.00	1.00	0.00	0.00	11	NA
Dissolved Nickel (Ni)	ug/L	2	-	1	1	1	1	1	1	1	1	1	1	1	1.00	1.00	1.00	0.00	0.00	11	NA
Dissolved Phosphorus (P)	ug/L	100	-	50	50	50	50	50	50	50	50	50	50	50	50.00	50.00	50.00	0.00	0.00	11	NA
Dissolved Potassium (K)	ug/L	100	-	340	330	250	260	230	210	190	220	210	210	220	190.00	340.00	242.73	49.62	14.96	11	NA
Dissolved Selenium (Se)	ug/L	1	-	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.50	0.50	0.50	0.00	0.00	11	NA
Dissolved Silver (Ag)	ug/L	0.1	-	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.00	0.00	11	NA
Dissolved Sodium (Na)	ug/L	100	-	3200	3200	2900	2700	2500	2500	2400	2400	2400	2400	2500	2400.00	3200.00	2645.45	314.21	94.74	11	NA
Dissolved Strontium (Sr)	ug/L	2	-	8.4	7.7	6.6	6.6	5.5	5.5	5.2	6	5.2	5.6	5.8	5.20	8.40	6.19	1.05	0.32	11	NA
Dissolved Thallium (Tl)	ug/L	0.1	-	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.00	0.00	11	NA
Dissolved Tin (Sn)	ug/L	2	-	1	1	1	1	1	2.4	1	1	1	1	2.5	1.00	2.50	1.26	0.59	0.18	11	NA
Dissolved Titanium (Ti)	ug/L	2	-	1	1	1	1	1	1	1	1	1	1	1	1.00	1.00	1.00	0.00	0.00	11	NA
Dissolved Uranium (U)	ug/L	0.1	-	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.00	0.00	11	NA
Dissolved Vanadium (V)	ug/L	2	-	1	1	1	1	1	1	1	1	1	1	1	1.00	1.00	1.00	0.00	0.00	11	NA
Dissolved Zinc (Zn)	ug/L	5	-	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.50	2.50	2.50	0.00	0.00	11	NA
Metals																					
Total Aluminum (Al)	ug/L	5	5-100[a]	160	160	160	150	130	130	120	140	130	130	140	120.00	160.00	140.91	14.46	4.36	11	11

Table E6 General Chemistry and Trace Metal Concentrations of Surface Water for Scraggy Lake in July 2018

Sampling Date				2018/07/01 15:45	2018/07/01 16:00	2018/07/01 14:45	2018/07/01 15:00	2018/07/02 14:20	2018/07/02 14:30	2018/07/01 13:15	2018/07/01 13:30	2010/07/02 15:15	2010/07/02 15:15	2018/07/02 14:30	Decriptive Statistics						
	UNITS	RDL	CCME-FAL	SGL-001-SR	SGL-001-BT	SGL-002-SR	SGL-002-BT	SGL-003-SR	SGL-003-BT	SGL-004-SR	SGL-004-BT	SGL-008-SR	SGL-008-BT	SGL-020	Min.	Max.	Mean	Std Deviation	Std Error	Count	CCME FAL Exceedances
Total Antimony (Sb)	ug/L	1	-	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.50	0.50	0.50	0.00	0.00	11	NA
Total Arsenic (As)	ug/L	1	5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.50	0.50	0.50	0.00	0.00	11	0
Total Barium (Ba)	ug/L	1	-	3.7	3.9	3.7	3.6	3.2	3.3	3.4	3.7	3.4	3.3	3.5	3.20	3.90	3.52	0.22	0.07	11	NA
Total Beryllium (Be)	ug/L	1	-	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.50	0.50	0.50	0.00	0.00	11	NA
Total Bismuth (Bi)	ug/L	2	-	1	1	1	1	1	1	1	1	1	1	1	1.00	1.00	1.00	0.00	0.00	11	NA
Total Boron (B)	ug/L	50	1500	25	25	25	25	25	25	25	25	25	25	25	25.00	25.00	25.00	0.00	0.00	11	0
Total Cadmium (Cd)	ug/L	0.01	0.09	0.015	0.014	0.016	0.024	0.012	0.011	0.016	0.019	0.016	0.013	0.011	0.01	0.02	0.02	0.00	0.00	11	0
Total Calcium (Ca)	ug/L	100	-	1800	1700	1500	1400	850	860	780	810	840	790	920	780.00	1800.00	1113.64	400.08	120.63	11	NA
Total Chromium (Cr)	ug/L	1	-	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.50	0.50	0.50	0.00	0.00	11	NA
Total Cobalt (Co)	ug/L	0.4	-	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.20	0.20	0.20	0.00	0.00	11	NA
Total Copper (Cu)	ug/L	2	2[b]	1	1	1	1	1	1	3.7	1	1	1	1	1.00	3.70	1.25	0.81	0.25	11	1
Total Iron (Fe)	ug/L	50	300	220	240	230	250	160	170	150	220	150	180	170	150.00	250.00	194.55	37.78	11.39	11	0
Total Lead (Pb)	ug/L	0.5	1[b]	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.00	0.00	11	0
Total Magnesium (Mg)	ug/L	100	-	550	560	500	500	410	420	400	430	410	410	430	400.00	560.00	456.36	59.71	18.00	11	NA
Total Manganese (Mn)	ug/L	2	-	42	46	43	52	41	44	43	64	43	45	42	41.00	64.00	45.91	6.70	2.02	11	NA
Total Molybdenum (Mo)	ug/L	2	73	1	1	1	1	1	1	1	1	1	1	1	1.00	1.00	1.00	0.00	0.00	11	0
Total Nickel (Ni)	ug/L	2	25[b]	1	1	1	1	1	1	1	1	1	1	1	1.00	1.00	1.00	0.00	0.00	11	0
Total Phosphorus (P)	ug/L	100	-	50	50	50	50	50	50	50	50	50	50	50	50.00	50.00	50.00	0.00	0.00	11	NA
Total Potassium (K)	ug/L	100	-	300	310	250	250	220	180	190	200	250	210	190	180.00	310.00	231.82	44.23	13.34	11	NA
Total Selenium (Se)	ug/L	1	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.50	0.50	0.50	0.00	0.00	11	0
Total Silver (Ag)	ug/L	0.1	0.25	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.00	0.00	11	0
Total Sodium (Na)	ug/L	100	-	2900	2900	2700	2700	2300	2400	2300	2400	2400	2400	2500	2300.00	2900.00	2536.36	224.82	67.79	11	NA
Total Strontium (Sr)	ug/L	2	-	8.5	8.2	7.5	7.5	5.7	6	5.6	5.9	6.2	5.8	5.7	5.60	8.50	6.60	1.10	0.33	11	NA
Total Thallium (Tl)	ug/L	0.1	-	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.00	0.00	11	NA
Total Tin (Sn)	ug/L	2	-	1	1	1	1	1	2.1	1	1	1	1	1	1.00	2.10	1.10	0.33	0.10	11	NA
Total Titanium (Ti)	ug/L	2	-	1	1	2.5	2.4	1	1	1	1	1	1	1	1.00	2.50	1.26	0.59	0.18	11	NA
Total Uranium (U)	ug/L	0.1	15	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.00	0.00	11	0
Total Vanadium (V)	ug/L	2	-	1	1	1	1	1	1	1	1	1	1	1	1.00	1.00	1.00	0.00	0.00	11	NA
Total Zinc (Zn)	ug/L	5	7	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.50	2.50	2.50	0.00	0.00	11	0
Total Mercury (Hg)	ug/L	0.013	0.026	0.0065	0.0065	0.0065	0.0065	0.0065	0.0065	0.0065	0.0065	0.0065	0.0065	0.0065	0.01	0.01	0.01	0.00	0.00	11	0
Chlorophyll a - Acidification Techniqu	ug/L	-	-	1.13	0.48	1.16	0.37	1.55	1.14	0.81	0.25	0.8	1.32	-	0.25	1.55	0.90	0.43	0.14	10	NA
Chlorophyll a - Welschmeyer Techni	ug/L	-	-	1.76	0.92	1.95	1.07	2.37	1.92	1.24	0.56	1.41	1.98	-	0.56	2.37	1.52	0.57	0.18	10	NA

Note: a CWQG PAL (Freshwater) varies with pH; b CWQG PAL varies with hardness; c value which were below the detection limit are presented as half of the detection limit and used in calculations

Table E.7 2018 In-Situ Water Quality Data at LL-001 in Long Lake, NS

Site: LL-001 (Long Lake)
UTM: 20 T 502423 4983670
Date: 7/5/2018
Time: 12:10
Sampler: JR/DL
Weather: sunny

	Down	Up
Secchi (m):	1.40	1.50
Max Depth (m):		3.4

Comments: Water samples collected LL-001SR/BT

Depth (m)	DO (mg/L)	DO (%)	SpCond. (µs/cm)	Temp. (°C)	pH
0.0	8.3	103	31.3	25.9	5.4
0.5	8.1	98	31.4	25.2	
1.0	8.3	99	31.2	23.9	
1.5	8.3	98	31.2	23.7	
2.0	9.8	91	31.3	23.1	
2.5	8.0	89	31.1	20.8	
3.0	6.6	71	31.9	18.8	5.3
3.0	6.7	72	72.0	18.7	5.4
2.5	7.8	87	30.9	20.5	
2.0	7.7	90	31.2	23.0	
1.5	7.5	92.0	31.3	23.7	
1.0	7.9	95	31.4	23.9	
0.5	7.8	96	31.6	25.3	
0.0	8.1	101	31.4	25.8	5.5

Table E.8 2018 In-Situ Water Quality Data at LL-002 in Long Lake, NS

Site: LL-002 (Long Lake)
UTM: 20 T 503189 4982461
Date: 7/5/2018
Time: 12:45
Sampler: JR/DL
Weather: Sunny, some clouds with moderate wind

	Down	Up	Comments: Water samples taken are LL-002SR/BT
Secchi (m):	1.55	1.80	
Max Depth (m):		3.7	

Depth (m)	DO (mg/L)	DO (%)	SpCond. (µs/cm)	Temp. (°C)	pH
0.0	8.5	103	31.8	25.4	5.3
0.5	8.3	102	31.8	25.3	
1.0	8.2	100	31.6	25.3	
1.5	8.1	98	31.8	24.4	
2.0	8.0	95	31.8	23.7	
2.5	8.5	96	32.5	21.0	
3.0	7.6	81	32.6	18.4	
3.5	5.6	59	32.5	17.8	5.3
3.5	5.6	64	32.7	17.9	5.4
3.0	6.0	79	32.5	18.4	
2.5	7.3	89.0	32.1	20.5	
2.0	7.9	93	31.8	23.8	
1.5	7.9	96	31.9	24.1	
1.0	8.0	98	31.6	25.2	
0.5	8.0	98	31.8	25.3	
0.0	8.2	101	31.7	25.3	5.5

Table E9 General Chemistry and Trace Metal Concentrations of Surface Water for Long Lake in July 2018

Sampling Date				2018/07/04 15:00	2018/07/05 12:00	2018/07/05 12:50	2018/07/05 13:00	Descriptive Statistics						
	UNITS	RDL	CCME-FAL	LL-001-SR	LL-001-BT	LL-002-SR	LL-002-BT	Min.	Max.	Mean	Std Deviation	Std Error	Count	CCME FAL Exceedances
Calculated Parameters														
Anion Sum	me/L	N/A	-	0.17	0.16	0.18	0.17	0.16	0.18	0.17	0.01	0.004	4	NA
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	1	-	0.5	0.5	0.5	0.5	0.50	0.50	0.50	0.00	0.000	4	NA
Calculated TDS	mg/L	1	-	11	12	12	11	11.00	12.00	11.50	0.58	0.289	4	NA
Carb. Alkalinity (calc. as CaCO3)	mg/L	1	-	0.5	0.5	0.5	0.5	0.50	0.50	0.50	0.00	0.000	4	NA
Cation Sum	me/L	N/A	-	0.25	0.27	0.25	0.25	0.25	0.27	0.26	0.01	0.005	4	NA
Hardness (CaCO3)	mg/L	1	-	4.2	4.3	4.3	4.2	4.20	4.30	4.25	0.06	0.029	4	NA
Ion Balance (% Difference)	%	N/A	-	19.1	25.6	16.3	19.1	16.30	25.60	20.03	3.94	1.972	4	NA
Langelier Index (@ 20C)	N/A	N/A	-	NC	NC	NC	NC							NA
Langelier Index (@ 4C)	N/A	N/A	-	NC	NC	NC	NC							NA
Nitrate (N)	mg/L	0.05	-	0.025	0.091	0.097	0.025	0.03	0.10	0.06	0.04	0.020	4	NA
Saturation pH (@ 20C)	N/A	N/A	-	NC	NC	NC	NC							NA
Saturation pH (@ 4C)	N/A	N/A	-	NC	NC	NC	NC							NA
Inorganics														NA
Total Alkalinity (Total as CaCO3)	mg/L	5	-	2.5	2.5	2.5	2.5	2.50	2.50	2.50	0.00	0.000	4	NA
Dissolved Chloride (Cl-)	mg/L	1	-	6.1	5.5	6	5.9	5.50	6.10	5.88	0.26	0.131	4	NA
Colour	TCU	5	-	47	59	45	47	45.00	59.00	49.50	6.40	3.202	4	NA
Nitrate + Nitrite (N)	mg/L	0.05	2.9	0.025	0.091	0.097	0.025	0.03	0.10	0.06	0.04	0.020	4	0
Nitrite (N)	mg/L	0.01	0.06	0.005	0.005	0.005	0.005	0.01	0.01	0.01	0.00	0.000	4	0
Nitrogen (Ammonia Nitrogen)	mg/L	0.05	4[c]	0.025	0.27	0.025	0.025	0.03	0.27	0.09	0.12	0.061	4	0
Total Organic Carbon (C)	mg/L	0.5	-	7.1	8.8	6.9	6.6	6.60	8.80	7.35	0.99	0.494	4	NA
Orthophosphate (P)	mg/L	0.01	-	0.005	0.005	0.005	0.005	0.01	0.01	0.01	0.00	0.000	4	NA
pH	pH	N/A	6.5-9.0	6.4	6.06	6.33	6.2	6.06	6.40	6.25	0.15	0.075	4	4
Reactive Silica (SiO2)	mg/L	0.5	-	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.00	0.000	4	NA
Dissolved Sulphate (SO4)	mg/L	2	-	1	1	1	1	1.00	1.00	1.00	0.00	0.000	4	NA
Turbidity	NTU	0.1	-	1.5	2.4	1.5	3.1	1.50	3.10	2.13	0.78	0.388	4	NA
Conductivity	uS/cm	1	-	29	30	31	35	29.00	35.00	31.25	2.63	1.315	4	NA
Strong Acid Dissoc. Cyanide (CN)	mg/L	0.001	0.005	0.001	N/A	0.0005	N/A	0.00	0.00	0.00	0.00	0.000	2	NA
Metals (dissolved)														NA
Dissolved Aluminum (Al)	ug/L	5	-	150	160	150	130	130.00	160.00	147.50	12.58	6.292	4	NA
Dissolved Antimony (Sb)	ug/L	1	-	0.5	0.5	0.5	0.5	0.50	0.50	0.50	0.00	0.000	4	NA
Dissolved Arsenic (As)	ug/L	1	-	1.1	0.5	0.5	0.5	0.50	1.10	0.65	0.30	0.150	4	NA
Dissolved Barium (Ba)	ug/L	1	-	5.1	5.5	5.4	5.4	5.10	5.50	5.35	0.17	0.087	4	NA
Dissolved Beryllium (Be)	ug/L	1	-	0.5	0.5	0.5	0.5	0.50	0.50	0.50	0.00	0.000	4	NA
Dissolved Bismuth (Bi)	ug/L	2	-	1	1	1	1	1.00	1.00	1.00	0.00	0.000	4	NA
Dissolved Boron (B)	ug/L	50	-	25	25	25	25	25.00	25.00	25.00	0.00	0.000	4	NA
Dissolved Cadmium (Cd)	ug/L	0.01	-	0.015	0.018	0.012	0.017	0.01	0.02	0.02	0.00	0.001	4	NA
Dissolved Calcium (Ca)	ug/L	100	-	990	1000	1000	1000	990.00	1000.00	997.50	5.00	2.500	4	NA
Dissolved Chromium (Cr)	ug/L	1	-	0.5	0.5	0.5	0.5	0.50	0.50	0.50	0.00	0.000	4	NA
Dissolved Cobalt (Co)	ug/L	0.4	-	0.2	0.2	0.2	0.2	0.20	0.20	0.20	0.00	0.000	4	NA
Dissolved Copper (Cu)	ug/L	2	-	1	1	1	1	1.00	1.00	1.00	0.00	0.000	4	NA
Dissolved Iron (Fe)	ug/L	50	-	140	240	140	180	140.00	240.00	175.00	47.26	23.629	4	NA
Dissolved Lead (Pb)	ug/L	0.5	-	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.00	0.000	4	NA
Dissolved Magnesium (Mg)	ug/L	100	-	430	420	430	420	420.00	430.00	425.00	5.77	2.887	4	NA
Dissolved Manganese (Mn)	ug/L	2	-	57	82	56	83	56.00	83.00	69.50	15.02	7.511	4	NA
Dissolved Molybdenum (Mo)	ug/L	2	-	1	1	1	1	1.00	1.00	1.00	0.00	0.000	4	NA
Dissolved Nickel (Ni)	ug/L	2	-	1	1	1	1	1.00	1.00	1.00	0.00	0.000	4	NA
Dissolved Phosphorus (P)	ug/L	100	-	50	50	50	50	50.00	50.00	50.00	0.00	0.000	4	NA
Dissolved Potassium (K)	ug/L	100	-	190	190	200	200	190.00	200.00	195.00	5.77	2.887	4	NA
Dissolved Selenium (Se)	ug/L	1	-	0.5	0.5	0.5	0.5	0.50	0.50	0.50	0.00	0.000	4	NA

Table E9 General Chemistry and Trace Metal Concentrations of Surface Water for Long Lake in July 2018

Sampling Date				2018/07/04 15:00	2018/07/05 12:00	2018/07/05 12:50	2018/07/05 13:00	Descriptive Statistics						
	UNITS	RDL	CCME-FAL	LL-001-SR	LL-001-BT	LL-002-SR	LL-002-BT	Min.	Max.	Mean	Std Deviation	Std Error	Count	CCME FAL Exceedances
Dissolved Silver (Ag)	ug/L	0.1	-	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.00	0.000	4	NA
Dissolved Sodium (Na)	ug/L	100	-	3500	3400	3600	3600	3400.00	3600.00	3525.00	95.74	47.871	4	NA
Dissolved Strontium (Sr)	ug/L	2	-	4.9	4.5	4.9	4.6	4.50	4.90	4.73	0.21	0.103	4	NA
Dissolved Thallium (Tl)	ug/L	0.1	-	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.00	0.000	4	NA
Dissolved Tin (Sn)	ug/L	2	-	1	1	1	1	1.00	1.00	1.00	0.00	0.000	4	NA
Dissolved Titanium (Ti)	ug/L	2	-	1	1	1	1	1.00	1.00	1.00	0.00	0.000	4	NA
Dissolved Uranium (U)	ug/L	0.1	-	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.00	0.000	4	NA
Dissolved Vanadium (V)	ug/L	2	-	1	1	1	1	1.00	1.00	1.00	0.00	0.000	4	NA
Dissolved Zinc (Zn)	ug/L	5	-	2.5	2.5	2.5	2.5	2.50	2.50	2.50	0.00	0.000	4	NA
Metals														
Total Aluminum (Al)	ug/L	5	5-100[a]	180	230	180	240	180.00	240.00	207.50	32.02	16.008	4	4
Total Antimony (Sb)	ug/L	1	-	0.5	0.5	0.5	0.5	0.50	0.50	0.50	0.00	0.000	4	NA
Total Arsenic (As)	ug/L	1	5	0.5	0.5	0.5	0.5	0.50	0.50	0.50	0.00	0.000	4	0
Total Barium (Ba)	ug/L	1	-	5.7	6	5.3	5.8	5.30	6.00	5.70	0.29	0.147	4	NA
Total Beryllium (Be)	ug/L	1	-	0.5	0.5	0.5	0.5	0.50	0.50	0.50	0.00	0.000	4	NA
Total Bismuth (Bi)	ug/L	2	-	1	1	1	1	1.00	1.00	1.00	0.00	0.000	4	NA
Total Boron (B)	ug/L	50	1500	25	25	25	25	25.00	25.00	25.00	0.00	0.000	4	0
Total Cadmium (Cd)	ug/L	0.01	0.09	0.015	0.017	0.019	0.015	0.02	0.02	0.02	0.00	0.001	4	0
Total Calcium (Ca)	ug/L	100	-	1000	1000	1000	1000	1000.00	1000.00	1000.00	0.00	0.000	4	NA
Total Chromium (Cr)	ug/L	1	-	1.1	0.5	0.5	0.5	0.50	1.10	0.65	0.30	0.150	4	NA
Total Cobalt (Co)	ug/L	0.4	-	0.2	0.2	0.2	0.2	0.20	0.20	0.20	0.00	0.000	4	NA
Total Copper (Cu)	ug/L	2	2[b]	1	1	1	1	1.00	1.00	1.00	0.00	0.000	4	0
Total Iron (Fe)	ug/L	50	300	250	410	230	380	230.00	410.00	317.50	90.69	45.346	4	2
Total Lead (Pb)	ug/L	0.5	1[b]	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.00	0.000	4	0
Total Magnesium (Mg)	ug/L	100	-	450	450	440	440	440.00	450.00	445.00	5.77	2.887	4	NA
Total Manganese (Mn)	ug/L	2	-	61	88	59	90	59.00	90.00	74.50	16.78	8.391	4	NA
Total Molybdenum (Mo)	ug/L	2	73	1	1	1	1	1.00	1.00	1.00	0.00	0.000	4	0
Total Nickel (Ni)	ug/L	2	25[b]	1	1	1	1	1.00	1.00	1.00	0.00	0.000	4	0
Total Phosphorus (P)	ug/L	100	-	50	50	50	50	50.00	50.00	50.00	0.00	0.000	4	NA
Total Potassium (K)	ug/L	100	-	190	180	230	200	180.00	230.00	200.00	21.60	10.801	4	NA
Total Selenium (Se)	ug/L	1	1	0.5	0.5	0.5	0.5	0.50	0.50	0.50	0.00	0.000	4	0
Total Silver (Ag)	ug/L	0.1	0.25	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.00	0.000	4	0
Total Sodium (Na)	ug/L	100	-	3700	3600	3700	3700	3600.00	3700.00	3675.00	50.00	25.000	4	NA
Total Strontium (Sr)	ug/L	2	-	4.8	5.5	4.8	5.3	4.80	5.50	5.10	0.36	0.178	4	NA
Total Thallium (Tl)	ug/L	0.1	-	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.00	0.000	4	NA
Total Tin (Sn)	ug/L	2	-	1	1	1	1	1.00	1.00	1.00	0.00	0.000	4	NA
Total Titanium (Ti)	ug/L	2	-	6	3.6	2	3.9	2.00	6.00	3.88	1.64	0.822	4	NA
Total Uranium (U)	ug/L	0.1	15	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.00	0.000	4	0
Total Vanadium (V)	ug/L	2	-	1	1	1	1	1.00	1.00	1.00	0.00	0.000	4	NA
Total Zinc (Zn)	ug/L	5	7	2.5	2.5	2.5	2.5	2.50	2.50	2.50	0.00	0.000	4	0
Total Mercury (Hg)	ug/L	0.013	0.026	0.0065	0.0065	0.0065	0.0065	0.01	0.01	0.01	0.00	0.000	4	0
Chlorophyll a - Acidification Techniqu	ug/L	-	-	3.25	4.08	1.82	3.02	1.82	4.08	3.0425	0.93353718	0.46676859	4	NA
Chlorophyll a - Welschmeyer Techniq	ug/L	-	-	2.63	2.6	1.49	3.3	1.49	3.3	2.505	0.749866655	0.374933327	4	NA

Note: a CWQG PAL (Freshwater) varies with pH; b CWQG PAL varies with hardness; c value which were below the detection limit are presented as half of the detection limit and used in calculations

Table E.10 2018 In-Situ Water Quality Data at AL-001 in Alma Lake, NS

Site: AL-001 (Alma Lake)
UTM: 20 T 521865 4981314
Date: 7/6/2018
Time: 11:27
Sampler: JR/DL
Weather: Windy, overcast

	Down	Up	Comments: Water samples AL-001SR/BT collected
Secchi (m):	3.30	3.5	
Max Depth:		11.5	

Depth (m)	DO (mg/L)	DO (%)	SpCond. (µs/cm)	Temp. (°C)	pH
0.0	7.8	93	23.7	23.7	5.6
0.5	7.6	91	24.2	23.7	
1.0	7.8	92	24.2	23.7	
1.5	7.4	89	24.2	23.6	
2.0	7.7	91	24.1	23.6	
2.5	7.7	85	24.0	23.6	
3.0	7.6	86	24.0	23.5	
3.5	7.6	84	25.1	21.0	
4.0	7.8	80	24.0	19.1	
4.5	7.8	84.0	24.3	18.5	
5.0	7.5	80	24.2	18.1	
5.5	7.5	80	24.3	17.9	
6.0	7.4	79	24.5	17.8	
6.5	7.4	79	24.5	17.6	
7.0	7.2	76	24.6	17.4	
7.5	7.3	77	24.7	17.1	
8.0	7.2	75	24.7	16.8	
8.5	6.9	71	25.1	16.2	
9.0	6.5	67	25.2	15.9	
9.5	5.6	56	25.6	15.3	
10.0	5.3	52	25.7	15.0	5.4
10.5	4.7	46	25.8	14.6	
11.0	0.2	2	26.0	14.3	
11.0	0.2	2	26.2	14.4	
10.5	4.5	45	26.1	14.5	
10.0	4.9	49	25.8	14.3	5.4
9.5	5.7	58	25.5	15.4	
9.0	6.3	64	25.3	15.8	
8.5	6.7	69	25.3	16.2	
8.0	7.1	74	25	16.8	
7.5	7.2	75	25.1	17.1	
7.0	7.1	75	25.1	17.3	
6.5	7.2	76	25	17.6	
6.0	7.2	77	25	17.7	
5.5	7.3	78	24.8	17.9	
5.0	7.5	81	24.7	18.2	
4.5	7.5	81	24.7	18.4	
4.0	7.6	83	24.6	19.2	
3.5	7.3	87	24.4	22.4	
3.0	7.6	90	24.1	23.6	
2.5	7.6	91	24.2	23.6	
2.0	7.6	91	24.1	23.6	
1.5	7.5	90	24.3	23.6	
1.0	7.6	91	24.3	23.6	
0.5	7.6	91	24.2	23.6	
0.0	7.7	91	24.2	23.7	5.6

Table E.11 2018 In-Situ Water Quality Data at AL-002 in Alma Lake, NS

Site: AL-002 (Alma Lake)
UTM: 20 T 522825 4981543
Date: 7/6/2018
Time: 12:50
Sampler: JR/DL
Weather: Windy, overcast

	Down	Up	**Comments:** Water samples collected (AL-002SR/BT)
Secchi (m):	-	-	
Max Depth (m):		3.4	

Depth (m)	DO (mg/L)	DO (%)	SpCond. (µs/cm)	Temp. (°C)	pH
0.0	7.6	92	23.8	24.4	5.7
0.5	7.5	91	24.1	24.4	
1.0	7.5	90	24.1	24.3	
1.5	7.6	92	24.0	24.3	
2.0	7.5	91	24.1	24.2	
2.5	7.3	88	24.2	24.0	
3.0	7.4	89	24.2	23.9	5.8
3.1	7.3	88	24.2	23.9	5.6
2.5	7.4	90	24.4	24.0	
2.0	7.5	90	24.3	24.3	
1.5	7.3	88.0	24.4	24.3	
1.0	7.5	90	24.3	24.4	
0.5	7.4	89	24.3	24.4	
0.0	7.4	90	24.3	24.4	5.7

Table E12 General Chemistry and Trace Metal Concentrations of Surface Water for Alma Lake in July 2018

Sampling Date				2018/07/05 16:45	2018/07/06 11:30	2018/07/05 17:45	2018/07/06 12:45	Descriptive Statistics						
	UNITS	RDL	CCME-FAL	AL-001-SR	AL-001-BT	AL-002-SR	AL-002-BT	Min.	Max.	Mean	Std Deviation	Std Error	Count	CCME FAL Exceedances
Calculated Parameters														
Anion Sum	me/L	N/A	-	0.13	0.15	0.13	0.13	0.13	0.15	0.14	0.01	0.005	4	NA
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	1	-	0.5	0.5	0.5	0.5	0.50	0.50	0.50	0.00	0.000	4	NA
Calculated TDS	mg/L	1	-	9	11	9	10	9.00	11.00	9.75	0.96	0.479	4	NA
Carb. Alkalinity (calc. as CaCO3)	mg/L	1	-	0.5	0.5	0.5	0.5	0.50	0.50	0.50	0.00	0.000	4	NA
Cation Sum	me/L	N/A	-	0.18	0.19	0.18	0.19	0.18	0.19	0.19	0.01	0.003	4	NA
Hardness (CaCO3)	mg/L	1	-	3.1	3.2	3.1	3.3	3.10	3.30	3.18	0.10	0.048	4	NA
Ion Balance (% Difference)	%	N/A	-	16.1	11.8	16.1	18.8	11.80	18.80	15.70	2.89	1.447	4	NA
Langelier Index (@ 20C)	N/A	N/A	-	NC	NC	NC	NC							NA
Langelier Index (@ 4C)	N/A	N/A	-	NC	NC	NC	NC							NA
Nitrate (N)	mg/L	0.05	-	0.025	0.083	0.025	0.025	0.03	0.08	0.04	0.03	0.015	4	NA
Saturation pH (@ 20C)	N/A	N/A	-	NC	NC	NC	NC							NA
Saturation pH (@ 4C)	N/A	N/A	-	NC	NC	NC	NC							NA
Inorganics														NA
Total Alkalinity (Total as CaCO3)	mg/L	5	-	2.5	2.5	2.5	2.5	2.50	2.50	2.50	0.00	0.000	4	NA
Dissolved Chloride (Cl-)	mg/L	1	-	4.7	5.1	4.5	4.6	4.50	5.10	4.73	0.26	0.131	4	NA
Colour	TCU	5	-	22	23	20	21	20.00	23.00	21.50	1.29	0.645	4	NA
Nitrate + Nitrite (N)	mg/L	0.05	2.9	0.025	0.083	0.025	0.025	0.03	0.08	0.04	0.03	0.015	4	0
Nitrite (N)	mg/L	0.01	0.06	0.005	0.005	0.005	0.005	0.01	0.01	0.01	0.00	0.000	4	0
Nitrogen (Ammonia Nitrogen)	mg/L	0.05	4[c]	0.025	0.061	0.025	0.025	0.03	0.06	0.03	0.02	0.009	4	0
Total Organic Carbon (C)	mg/L	0.5	-	4.1	4.7	4.2	4.4	4.10	4.70	4.35	0.26	0.132	4	NA
Orthophosphate (P)	mg/L	0.01	-	0.005	0.005	0.005	0.005	0.01	0.01	0.01	0.00	0.000	4	NA
pH	pH	N/A	6.5-9.0	6.53	6.25	6.16	6.57	6.16	6.57	6.38	0.20	0.102	4	2
Reactive Silica (SiO2)	mg/L	0.5	-	0.95	1.5	0.87	0.93	0.87	1.50	1.06	0.29	0.147	4	NA
Dissolved Sulphate (SO4)	mg/L	2	-	1	1	1	1	1.00	1.00	1.00	0.00	0.000	4	NA
Turbidity	NTU	0.1	-	0.42	1.2	0.38	0.44	0.38	1.20	0.61	0.39	0.197	4	NA
Conductivity	uS/cm	1	-	24	24	23	26	23.00	26.00	24.25	1.26	0.629	4	NA
Strong Acid Dissoc. Cyanide (CN)	mg/L	0.001	0.005	0.0012	0.0035	0.0005	0.0005	0.00	0.00	0.00	0.00	0.001	4	NA
Metals (dissolved)														NA
Dissolved Aluminum (Al)	ug/L	5	-	110	120	110	110	110.00	120.00	112.50	5.00	2.500	4	NA
Dissolved Antimony (Sb)	ug/L	1	-	0.5	0.5	0.5	0.5	0.50	0.50	0.50	0.00	0.000	4	NA
Dissolved Arsenic (As)	ug/L	1	-	0.5	0.5	0.5	0.5	0.50	0.50	0.50	0.00	0.000	4	NA
Dissolved Barium (Ba)	ug/L	1	-	3.9	4.2	4.1	3.9	3.90	4.20	4.03	0.15	0.075	4	NA
Dissolved Beryllium (Be)	ug/L	1	-	0.5	0.5	0.5	0.5	0.50	0.50	0.50	0.00	0.000	4	NA
Dissolved Bismuth (Bi)	ug/L	2	-	1	1	1	1	1.00	1.00	1.00	0.00	0.000	4	NA
Dissolved Boron (B)	ug/L	50	-	25	25	25	25	25.00	25.00	25.00	0.00	0.000	4	NA
Dissolved Cadmium (Cd)	ug/L	0.01	-	0.017	0.018	0.015	0.016	0.02	0.02	0.02	0.00	0.001	4	NA
Dissolved Calcium (Ca)	ug/L	100	-	600	620	610	640	600.00	640.00	617.50	17.08	8.539	4	NA
Dissolved Chromium (Cr)	ug/L	1	-	0.5	0.5	0.5	0.5	0.50	0.50	0.50	0.00	0.000	4	NA
Dissolved Cobalt (Co)	ug/L	0.4	-	0.2	0.2	0.2	0.2	0.20	0.20	0.20	0.00	0.000	4	NA
Dissolved Copper (Cu)	ug/L	2	-	1	1	1	1	1.00	1.00	1.00	0.00	0.000	4	NA
Dissolved Iron (Fe)	ug/L	50	-	25	100	25	25	25.00	100.00	43.75	37.50	18.750	4	NA
Dissolved Lead (Pb)	ug/L	0.5	-	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.00	0.000	4	NA
Dissolved Magnesium (Mg)	ug/L	100	-	380	410	380	410	380.00	410.00	395.00	17.32	8.660	4	NA
Dissolved Manganese (Mn)	ug/L	2	-	61	95	62	67	61.00	95.00	71.25	16.05	8.025	4	NA
Dissolved Molybdenum (Mo)	ug/L	2	-	1	1	1	1	1.00	1.00	1.00	0.00	0.000	4	NA
Dissolved Nickel (Ni)	ug/L	2	-	1	1	1	1	1.00	1.00	1.00	0.00	0.000	4	NA
Dissolved Phosphorus (P)	ug/L	100	-	50	50	50	50	50.00	50.00	50.00	0.00	0.000	4	NA
Dissolved Potassium (K)	ug/L	100	-	240	250	230	230	230.00	250.00	237.50	9.57	4.787	4	NA
Dissolved Selenium (Se)	ug/L	1	-	0.5	0.5	0.5	0.5	0.50	0.50	0.50	0.00	0.000	4	NA

Table E12 General Chemistry and Trace Metal Concentrations of Surface Water for Alma Lake in July 2018

Sampling Date				2018/07/05 16:45	2018/07/06 11:30	2018/07/05 17:45	2018/07/06 12:45	Descriptive Statistics						
	UNITS	RDL	CCME-FAL	AL-001-SR	AL-001-BT	AL-002-SR	AL-002-BT	Min.	Max.	Mean	Std Deviation	Std Error	Count	CCME FAL Exceedances
Dissolved Silver (Ag)	ug/L	0.1	-	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.00	0.000	4	NA
Dissolved Sodium (Na)	ug/L	100	-	2500	2600	2500	2700	2500.00	2700.00	2575.00	95.74	47.871	4	NA
Dissolved Strontium (Sr)	ug/L	2	-	6.1	6.1	6.5	6.4	6.10	6.50	6.28	0.21	0.103	4	NA
Dissolved Thallium (Tl)	ug/L	0.1	-	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.00	0.000	4	NA
Dissolved Tin (Sn)	ug/L	2	-	1	1	1	1	1.00	1.00	1.00	0.00	0.000	4	NA
Dissolved Titanium (Ti)	ug/L	2	-	1	1	1	1	1.00	1.00	1.00	0.00	0.000	4	NA
Dissolved Uranium (U)	ug/L	0.1	-	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.00	0.000	4	NA
Dissolved Vanadium (V)	ug/L	2	-	1	1	1	1	1.00	1.00	1.00	0.00	0.000	4	NA
Dissolved Zinc (Zn)	ug/L	5	-	2.5	2.5	2.5	2.5	2.50	2.50	2.50	0.00	0.000	4	NA
Metals														
Total Aluminum (Al)	ug/L	5	5-100[a]	140	150	120	120	120.00	150.00	132.50	15.00	7.500	4	4
Total Antimony (Sb)	ug/L	1	-	0.5	0.5	0.5	0.5	0.50	0.50	0.50	0.00	0.000	4	NA
Total Arsenic (As)	ug/L	1	5	0.5	0.5	0.5	0.5	0.50	0.50	0.50	0.00	0.000	4	0
Total Barium (Ba)	ug/L	1	-	4	4.3	4	3.9	3.90	4.30	4.05	0.17	0.087	4	NA
Total Beryllium (Be)	ug/L	1	-	0.5	0.5	0.5	0.5	0.50	0.50	0.50	0.00	0.000	4	NA
Total Bismuth (Bi)	ug/L	2	-	1	1	1	1	1.00	1.00	1.00	0.00	0.000	4	NA
Total Boron (B)	ug/L	50	1500	25	25	25	25	25.00	25.00	25.00	0.00	0.000	4	0
Total Cadmium (Cd)	ug/L	0.01	0.09	0.018	0.02	0.014	0.017	0.01	0.02	0.02	0.00	0.001	4	0
Total Calcium (Ca)	ug/L	100	-	610	590	590	610	590.00	610.00	600.00	11.55	5.774	4	NA
Total Chromium (Cr)	ug/L	1	-	0.5	0.5	0.5	0.5	0.50	0.50	0.50	0.00	0.000	4	NA
Total Cobalt (Co)	ug/L	0.4	-	0.2	0.2	0.2	0.2	0.20	0.20	0.20	0.00	0.000	4	NA
Total Copper (Cu)	ug/L	2	2[b]	1	1	1	1	1.00	1.00	1.00	0.00	0.000	4	0
Total Iron (Fe)	ug/L	50	300	75	190	76	69	69.00	190.00	102.50	58.42	29.208	4	0
Total Lead (Pb)	ug/L	0.5	1[b]	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.00	0.000	4	0
Total Magnesium (Mg)	ug/L	100	-	470	390	400	410	390.00	470.00	417.50	35.94	17.970	4	NA
Total Manganese (Mn)	ug/L	2	-	65	95	65	69	65.00	95.00	73.50	14.46	7.228	4	NA
Total Molybdenum (Mo)	ug/L	2	73	1	1	1	1	1.00	1.00	1.00	0.00	0.000	4	0
Total Nickel (Ni)	ug/L	2	25[b]	1	1	1	1	1.00	1.00	1.00	0.00	0.000	4	0
Total Phosphorus (P)	ug/L	100	-	50	50	50	50	50.00	50.00	50.00	0.00	0.000	4	NA
Total Potassium (K)	ug/L	100	-	260	250	220	230	220.00	260.00	240.00	18.26	9.129	4	NA
Total Selenium (Se)	ug/L	1	1	0.5	0.5	0.5	0.5	0.50	0.50	0.50	0.00	0.000	4	0
Total Silver (Ag)	ug/L	0.1	0.25	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.00	0.000	4	0
Total Sodium (Na)	ug/L	100	-	2500	2500	2700	2700	2500.00	2700.00	2600.00	115.47	57.735	4	NA
Total Strontium (Sr)	ug/L	2	-	6.4	5.6	6.4	6.5	5.60	6.50	6.23	0.42	0.210	4	NA
Total Thallium (Tl)	ug/L	0.1	-	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.00	0.000	4	NA
Total Tin (Sn)	ug/L	2	-	1	1	1	1	1.00	1.00	1.00	0.00	0.000	4	NA
Total Titanium (Ti)	ug/L	2	-	1	2.4	1	1	1.00	2.40	1.35	0.70	0.350	4	NA
Total Uranium (U)	ug/L	0.1	15	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.00	0.000	4	0
Total Vanadium (V)	ug/L	2		1	1	1	1	1.00	1.00	1.00	0.00	0.000	4	NA
Total Zinc (Zn)	ug/L	5	7	2.5	2.5	2.5	2.5	2.50	2.50	2.50	0.00	0.000	4	0
Total Mercury (Hg)	ug/L	0.013	0.026	0.0065	0.0065	0.0065	0.0065	0.01	0.01	0.01	0.00	0.000	4	0
Chlorophyll a - Acidification Techniqu	ug/L	-	-	0.8	-	0.81	-	0.80	0.81	0.81	0.01	0.005	2	NA
Chlorophyll a - Welschmeyer Techniq	ug/L	-	-	0.65	-	0.65	-	0.65	0.65	0.65	0.00	0.000	2	NA

Note: a CWQG PAL (Freshwater) varies with pH; b CWQG PAL varies with hardness; c value which were below the detection limit are presented as half of the detection limit and used in calculations

Table E13 Trace Metal Concentrations of Sediment for Scraggy Lake - July 2018

Sampling Date				2018/07/03 11:00	2018/07/04 15:00	2018/07/06 12:00
	UNITS	RDL	CCME-PEL	SGL-001	SGL-003	SGL 020
Metals						
Acid Extractable Aluminum (Al)	mg/kg	10		11000	15000	21000
Acid Extractable Antimony (Sb)	mg/kg	2		ND	ND	ND
Acid Extractable Arsenic (As)	mg/kg	2	17	**18**	13	8
Acid Extractable Barium (Ba)	mg/kg	5		33	31	53
Acid Extractable Beryllium (Be)	mg/kg	2		ND	ND	ND
Acid Extractable Bismuth (Bi)	mg/kg	2		ND	ND	ND
Acid Extractable Boron (B)	mg/kg	50		ND	ND	ND
Acid Extractable Cadmium (Cd)	mg/kg	0.3	3.5	ND	ND	0.81
Acid Extractable Chromium (Cr)	mg/kg	2	90	14	17	18
Acid Extractable Cobalt (Co)	mg/kg	1		7.5	7.6	6.1
Acid Extractable Copper (Cu)	mg/kg	2	197	9.7	10	14
Acid Extractable Iron (Fe)	mg/kg	50		15000	20000	16000
Acid Extractable Lead (Pb)	mg/kg	0.5	91.3	35	40	63
Acid Extractable Lithium (Li)	mg/kg	2		9.9	12	14
Acid Extractable Manganese (Mn)	mg/kg	2		400	510	250
Acid Extractable Mercury (Hg)	mg/kg	0.1	0.486	0.45	0.27	0.39
Acid Extractable Molybdenum (Mo)	mg/kg	2		ND	ND	ND
Acid Extractable Nickel (Ni)	mg/kg	2		13	15	13
Acid Extractable Rubidium (Rb)	mg/kg	2		5.3	5.2	6.3
Acid Extractable Selenium (Se)	mg/kg	1		1.5	1.7	2.7
Acid Extractable Silver (Ag)	mg/kg	0.5		ND	ND	ND
Acid Extractable Strontium (Sr)	mg/kg	5		11	9.4	16
Acid Extractable Thallium (Tl)	mg/kg	0.1		ND	ND	0.19
Acid Extractable Tin (Sn)	mg/kg	2		ND	ND	3.7
Acid Extractable Uranium (U)	mg/kg	0.1		0.65	0.75	2.1
Acid Extractable Vanadium (V)	mg/kg	2		15	19	30
Acid Extractable Zinc (Zn)	mg/kg	5	315	46	54	73
Inorganics						
Organic Carbon (TOC)	g/kg	0.2		89	78	160

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
N/A = Not Applicable
ND = Non Detect

Table E14 Trace Metal Concentrations of Sediment for Long Lake - July 2018

Sampling Date				2018/07/05 13:11
	UNITS	RDL	CCME-PEL	LL-002
Metals				
Acid Extractable Aluminum (Al)	mg/kg	10		24000
Acid Extractable Antimony (Sb)	mg/kg	2		ND
Acid Extractable Arsenic (As)	mg/kg	2	17	**21**
Acid Extractable Barium (Ba)	mg/kg	5		93
Acid Extractable Beryllium (Be)	mg/kg	2		ND
Acid Extractable Bismuth (Bi)	mg/kg	2		ND
Acid Extractable Boron (B)	mg/kg	50		ND
Acid Extractable Cadmium (Cd)	mg/kg	0.3	3.5	0.47
Acid Extractable Chromium (Cr)	mg/kg	2	90	23
Acid Extractable Cobalt (Co)	mg/kg	1		26
Acid Extractable Copper (Cu)	mg/kg	2	197	20
Acid Extractable Iron (Fe)	mg/kg	50		40000
Acid Extractable Lead (Pb)	mg/kg	0.5	91.3	45
Acid Extractable Lithium (Li)	mg/kg	2		26
Acid Extractable Manganese (Mn)	mg/kg	2		920
Acid Extractable Mercury (Hg)	mg/kg	0.1	0.486	0.36
Acid Extractable Molybdenum (Mo)	mg/kg	2		3.3
Acid Extractable Nickel (Ni)	mg/kg	2		37
Acid Extractable Rubidium (Rb)	mg/kg	2		11
Acid Extractable Selenium (Se)	mg/kg	1		1.8
Acid Extractable Silver (Ag)	mg/kg	0.5		ND
Acid Extractable Strontium (Sr)	mg/kg	5		12
Acid Extractable Thallium (Tl)	mg/kg	0.1		0.16
Acid Extractable Tin (Sn)	mg/kg	2		ND
Acid Extractable Uranium (U)	mg/kg	0.1		1.5
Acid Extractable Vanadium (V)	mg/kg	2		24
Acid Extractable Zinc (Zn)	mg/kg	5	315	140
Inorganics				
Organic Carbon (TOC)	g/kg	0.2		110

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
N/A = Not Applicable
ND = Non Detect

Table E15 Trace Metal Concentrations of Sediment for Alma Lake - July 2018

Sampling Date				**2018/07/06 12:00**
	UNITS	**RDL**	**CCME-PEL**	**AL-001**
Metals				
Acid Extractable Aluminum (Al)	mg/kg	10		20000
Acid Extractable Antimony (Sb)	mg/kg	2		ND
Acid Extractable Arsenic (As)	mg/kg	2	17	7.9
Acid Extractable Barium (Ba)	mg/kg	5		54
Acid Extractable Beryllium (Be)	mg/kg	2		ND
Acid Extractable Bismuth (Bi)	mg/kg	2		ND
Acid Extractable Boron (B)	mg/kg	50		ND
Acid Extractable Cadmium (Cd)	mg/kg	0.3	3.5	0.81
Acid Extractable Chromium (Cr)	mg/kg	2	90	18
Acid Extractable Cobalt (Co)	mg/kg	1		6.1
Acid Extractable Copper (Cu)	mg/kg	2	197	14
Acid Extractable Iron (Fe)	mg/kg	50		15000
Acid Extractable Lead (Pb)	mg/kg	0.5	91.3	62
Acid Extractable Lithium (Li)	mg/kg	2		14
Acid Extractable Manganese (Mn)	mg/kg	2		240
Acid Extractable Mercury (Hg)	mg/kg	0.1	0.486	0.37
Acid Extractable Molybdenum (Mo)	mg/kg	2		ND
Acid Extractable Nickel (Ni)	mg/kg	2		12
Acid Extractable Rubidium (Rb)	mg/kg	2		6.2
Acid Extractable Selenium (Se)	mg/kg	1		2.7
Acid Extractable Silver (Ag)	mg/kg	0.5		ND
Acid Extractable Strontium (Sr)	mg/kg	5		15
Acid Extractable Thallium (Tl)	mg/kg	0.1		0.23
Acid Extractable Tin (Sn)	mg/kg	2		3.4
Acid Extractable Uranium (U)	mg/kg	0.1		2.1
Acid Extractable Vanadium (V)	mg/kg	2		29
Acid Extractable Zinc (Zn)	mg/kg	5	315	72
Inorganics				
Organic Carbon (TOC)	g/kg	0.2		160

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
N/A = Not Applicable
ND = Non Detect

Table E16 Particle Size Distributions of Sediment for Scraggy Lake, Long Lake and Alma Lake - July 2018

Sampling Date			**2018/07/03 11:00**	**2018/07/04 15:00**	**2018/07/05 13:11**	**2018/07/06 12:00**	**2018/07/06 12:00**
	UNITS	**RDL**	**SGL-001**	**SGL-003**	**LL-002**	**AL-001**	**SGL 020**
Inorganics							
Organic Carbon (TOC)	g/kg	0.2	89	78	110	160	160
< -1 Phi (2 mm)	%	0.1	99	100	100	100	100
< 0 Phi (1 mm)	%	0.1	99 (1)	100	100	100 (2)	100 (1)
< +1 Phi (0.5 mm)	%	0.1	99	100	98	100	100
< +2 Phi (0.25 mm)	%	0.1	97	99	94	99	99
< +3 Phi (0.12 mm)	%	0.1	84	97	90	98	99
< +4 Phi (0.062 mm)	%	0.1	64	90	87	97	97
< +5 Phi (0.031 mm)	%	0.1	60	80	83	93	91
< +6 Phi (0.016 mm)	%	0.1	52	61	70	81	81
< +7 Phi (0.0078 mm)	%	0.1	39	40	55	60	58
< +8 Phi (0.0039 mm)	%	0.1	33	34	49	52	50
< +9 Phi (0.0020 mm)	%	0.1	28	25	39	41	40
Gravel	%	0.1	0.58	<0.10	<0.10	<0.10	<0.10
Sand	%	0.1	35	9.9	13	3.1	2.6
Silt	%	0.1	31	56	38	45	48
Clay	%	0.1	33	34	49	52	50

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
N/A = Not Applicable
(1) PSA sample observation comment: Fraction contained fibers
(2) Duplicate %RPD violation not applicable. Absolute % Difference within 10%.

Results relate only to the items tested.

Table E17 Relative Percent Difference of Parent and Field Duplicate Surface Water Samples Taken for Quality Assurance and Quality Control

	UNITS	RDL	SGL-003-BT	SGL-020 (Dupl. for SGL-003-BT)	Relative Percent Difference (%)
Anion Sum	me/L	N/A	0.13	0.13	0%
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	1	ND	ND	N/A
Calculated TDS	mg/L	1	9	9	0%
Carb. Alkalinity (calc. as CaCO3)	mg/L	1	ND	ND	N/A
Cation Sum	me/L	N/A	0.2	0.2	0%
Hardness (CaCO3)	mg/L	1	4.1	4	2%
Ion Balance (% Difference)	%	N/A	21.2	21.2	0%
Langelier Index (@ 20C)	N/A	N/A	NC	NC	N/A
Langelier Index (@ 4C)	N/A	N/A	NC	NC	N/A
Nitrate (N)	mg/L	0.05	ND	ND	N/A
Saturation pH (@ 20C)	N/A	N/A	NC	NC	N/A
Saturation pH (@ 4C)	N/A	N/A	NC	NC	N/A
Total Alkalinity (Total as CaCO3)	mg/L	5	ND	ND	N/A
Dissolved Chloride (Cl-)	mg/L	1	4.5	4.6	2%
Colour	TCU	5	33	34	3%
Nitrate + Nitrite (N)	mg/L	0.05	ND	ND	N/A
Nitrite (N)	mg/L	0.01	ND	ND	N/A
Nitrogen (Ammonia Nitrogen)	mg/L	0.05	ND	ND	N/A
Total Organic Carbon (C)	mg/L	0.5	5.7	4.9	15%
Orthophosphate (P)	mg/L	0.01	0.005	0.005	0%
pH	pH	N/A	6.27	6.22	1%
Reactive Silica (SiO2)	mg/L	0.5	ND	ND	N/A
Dissolved Sulphate (SO4)	mg/L	2	ND	ND	N/A
Turbidity	NTU	0.1	1.6	1.1	37%
Conductivity	uS/cm	1	26	25	4%
Strong Acid Dissoc. Cyanide (CN)	mg/L	0.001	0.0005	0.0015	100%
Dissolved Aluminum (Al)	ug/L	5	130	110	17%
Dissolved Antimony (Sb)	ug/L	1	ND	ND	N/A
Dissolved Arsenic (As)	ug/L	1	ND	ND	N/A
Dissolved Barium (Ba)	ug/L	1	3.8	3.2	17%
Dissolved Beryllium (Be)	ug/L	1	ND	ND	N/A
Dissolved Bismuth (Bi)	ug/L	2	ND	ND	N/A
Dissolved Boron (B)	ug/L	50	ND	ND	N/A
Dissolved Cadmium (Cd)	ug/L	0.01	0.013	0.017	27%
Dissolved Calcium (Ca)	ug/L	100	920	910	1%
Dissolved Chromium (Cr)	ug/L	1	ND	ND	N/A
Dissolved Cobalt (Co)	ug/L	0.4	ND	ND	N/A
Dissolved Copper (Cu)	ug/L	2	ND	ND	N/A
Dissolved Iron (Fe)	ug/L	50	120	110	9%
Dissolved Lead (Pb)	ug/L	0.5	ND	ND	N/A
Dissolved Magnesium (Mg)	ug/L	100	430	430	0%
Dissolved Manganese (Mn)	ug/L	2	42	41	2%
Dissolved Molybdenum (Mo)	ug/L	2	ND	ND	N/A
Dissolved Nickel (Ni)	ug/L	2	ND	ND	N/A
Dissolved Phosphorus (P)	ug/L	100	ND	ND	N/A
Dissolved Potassium (K)	ug/L	100	210	220	5%
Dissolved Selenium (Se)	ug/L	1	ND	ND	N/A

Table E17 Relative Percent Difference of Parent and Field Duplicate Surface Water Samples Taken for Quality Assurance and Quality Control

	UNITS	RDL	SGL-003-BT	SGL-020 (Dupl. for SGL-003-BT)	Relative Percent Difference (%)
Dissolved Silver (Ag)	ug/L	0.1	ND	ND	N/A
Dissolved Sodium (Na)	ug/L	100	2500	2500	0%
Dissolved Strontium (Sr)	ug/L	2	5.5	5.8	5%
Dissolved Thallium (Tl)	ug/L	0.1	ND	ND	N/A
Dissolved Tin (Sn)	ug/L	2	2.4	2.5	4%
Dissolved Titanium (Ti)	ug/L	2	1	1	0%
Dissolved Uranium (U)	ug/L	0.1	ND	ND	N/A
Dissolved Vanadium (V)	ug/L	2	ND	ND	N/A
Dissolved Zinc (Zn)	ug/L	5	ND	ND	N/A
Total Aluminum (Al)	ug/L	5	130	140	7%
Total Antimony (Sb)	ug/L	1	ND	ND	N/A
Total Arsenic (As)	ug/L	1	ND	ND	N/A
Total Barium (Ba)	ug/L	1	3.3	3.5	6%
Total Beryllium (Be)	ug/L	1	ND	ND	N/A
Total Bismuth (Bi)	ug/L	2	ND	ND	N/A
Total Boron (B)	ug/L	50	ND	ND	N/A
Total Cadmium (Cd)	ug/L	0.01	0.011	0.011	0%
Total Calcium (Ca)	ug/L	100	860	920	7%
Total Chromium (Cr)	ug/L	1	ND	ND	N/A
Total Cobalt (Co)	ug/L	0.4	ND	ND	N/A
Total Copper (Cu)	ug/L	2	ND	ND	N/A
Total Iron (Fe)	ug/L	50	170	170	0%
Total Lead (Pb)	ug/L	0.5	ND	ND	N/A
Total Magnesium (Mg)	ug/L	100	420	430	2%
Total Manganese (Mn)	ug/L	2	44	42	5%
Total Molybdenum (Mo)	ug/L	2	ND	ND	N/A
Total Nickel (Ni)	ug/L	2	ND	ND	N/A
Total Phosphorus (P)	ug/L	100	ND	ND	N/A
Total Potassium (K)	ug/L	100	180	190	5%
Total Selenium (Se)	ug/L	1	ND	ND	N/A
Total Silver (Ag)	ug/L	0.1	ND	ND	N/A
Total Sodium (Na)	ug/L	100	2400	2500	4%
Total Strontium (Sr)	ug/L	2	6	5.7	5%
Total Thallium (Tl)	ug/L	0.1	0.05	0.05	0%
Total Tin (Sn)	ug/L	2	2.1	ND	N/A
Total Titanium (Ti)	ug/L	2	ND	ND	N/A
Total Uranium (U)	ug/L	0.1	ND	ND	N/A
Total Vanadium (V)	ug/L	2	ND	ND	N/A
Total Zinc (Zn)	ug/L	5	ND	ND	N/A
Total Mercury (Hg)	ug/L	0.013	ND	ND	N/A

Table E18 Trace Metal Concentrations of Sediment for Scraggy Lake - July 2018

Sampling Date					**2018/07/06 12:00**
	UNITS	**RDL**	**CCME-PEL**	**AL-001**	**SGL-020**
Metals					
Acid Extractable Aluminum (Al)	mg/kg	10		20000	21000
Acid Extractable Antimony (Sb)	mg/kg	2		ND	ND
Acid Extractable Arsenic (As)	mg/kg	2	17	7.9	8
Acid Extractable Barium (Ba)	mg/kg	5		54	53
Acid Extractable Beryllium (Be)	mg/kg	2		ND	ND
Acid Extractable Bismuth (Bi)	mg/kg	2		ND	ND
Acid Extractable Boron (B)	mg/kg	50		ND	ND
Acid Extractable Cadmium (Cd)	mg/kg	0.3	3.5	0.81	0.81
Acid Extractable Chromium (Cr)	mg/kg	2	90	18	18
Acid Extractable Cobalt (Co)	mg/kg	1		6.1	6.1
Acid Extractable Copper (Cu)	mg/kg	2	197	14	14
Acid Extractable Iron (Fe)	mg/kg	50		15000	16000
Acid Extractable Lead (Pb)	mg/kg	0.5	91.3	62	63
Acid Extractable Lithium (Li)	mg/kg	2		14	14
Acid Extractable Manganese (Mn)	mg/kg	2		240	250
Acid Extractable Mercury (Hg)	mg/kg	0.1	0.486	0.37	0.39
Acid Extractable Molybdenum (Mo)	mg/kg	2		ND	ND
Acid Extractable Nickel (Ni)	mg/kg	2		12	13
Acid Extractable Rubidium (Rb)	mg/kg	2		6.2	6.3
Acid Extractable Selenium (Se)	mg/kg	1		2.7	2.7
Acid Extractable Silver (Ag)	mg/kg	0.5		ND	ND
Acid Extractable Strontium (Sr)	mg/kg	5		15	16
Acid Extractable Thallium (Tl)	mg/kg	0.1		0.23	0.19
Acid Extractable Tin (Sn)	mg/kg	2		3.4	3.7
Acid Extractable Uranium (U)	mg/kg	0.1		2.1	2.1
Acid Extractable Vanadium (V)	mg/kg	2		29	30
Acid Extractable Zinc (Zn)	mg/kg	5	315	72	73
Inorganics					
Organic Carbon (TOC)	g/kg	0.2		160	160

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
N/A = Not Applicable
ND = Non Detect

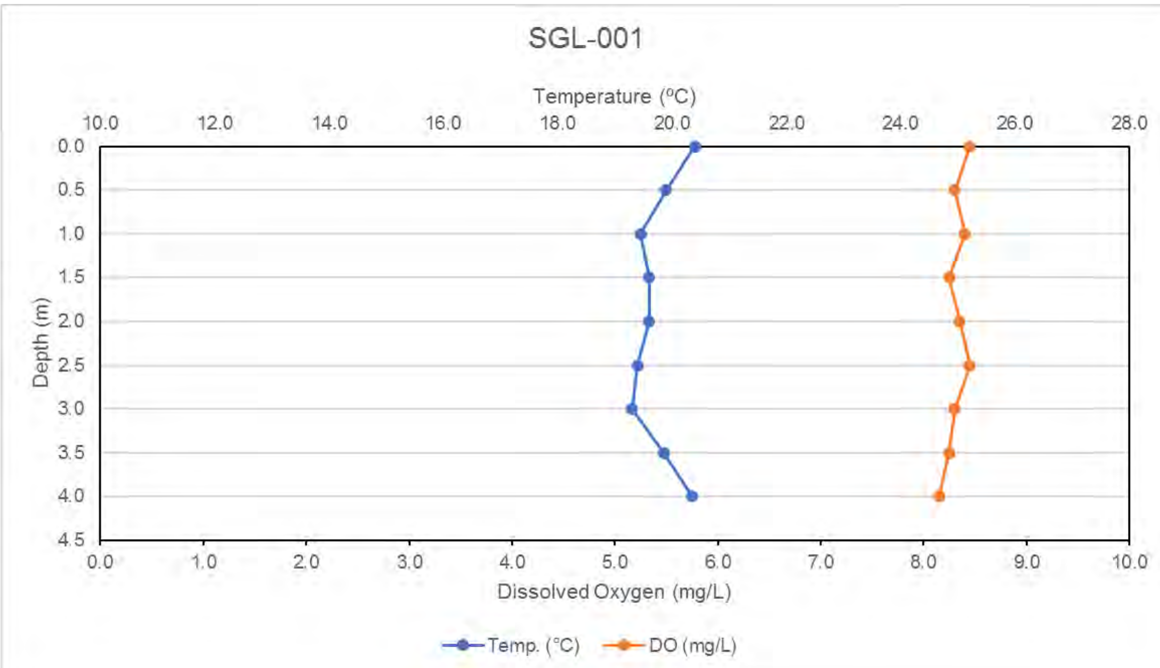

Figure E.1 Water Temperature and Dissolved Oxygen Profiles for SGL-001 on Scraggy Lake, NS.

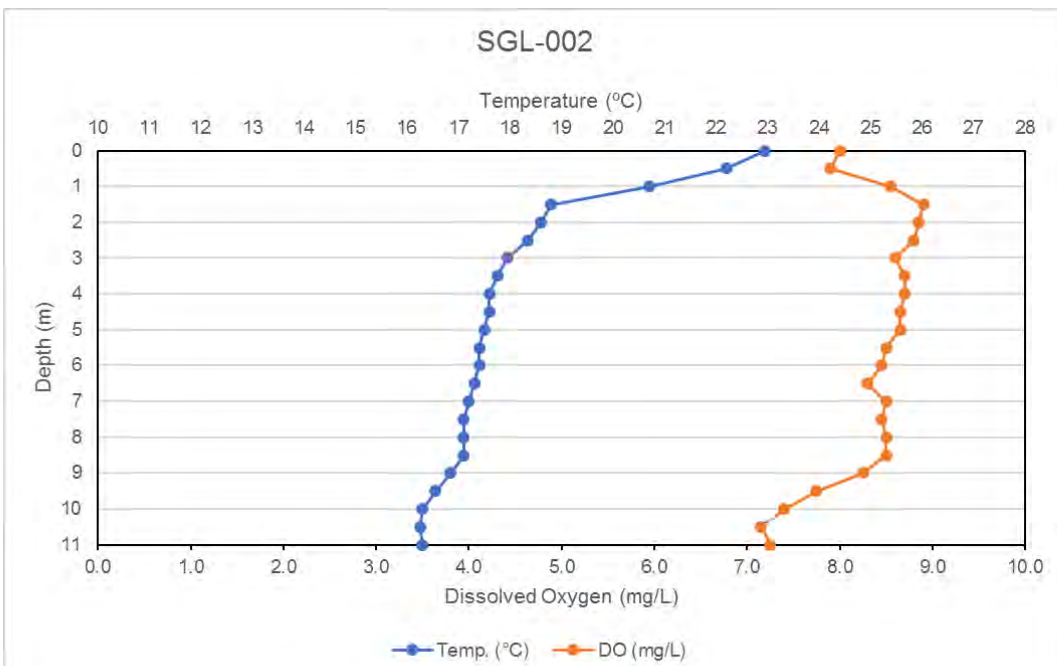

Figure E.2 Water Temperature and Dissolved Oxygen Profiles for SGL-002 on Scraggy Lake, NS.

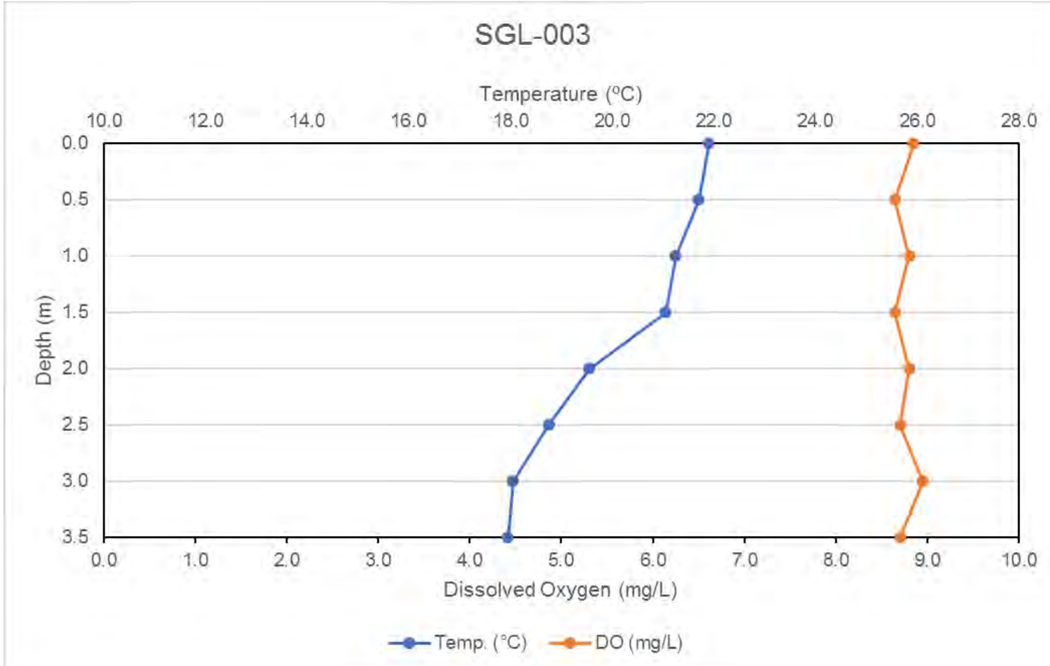

Figure E.3 Water Temperature and Dissolved Oxygen Profiles for SGL-003 on Scraggy Lake, NS.

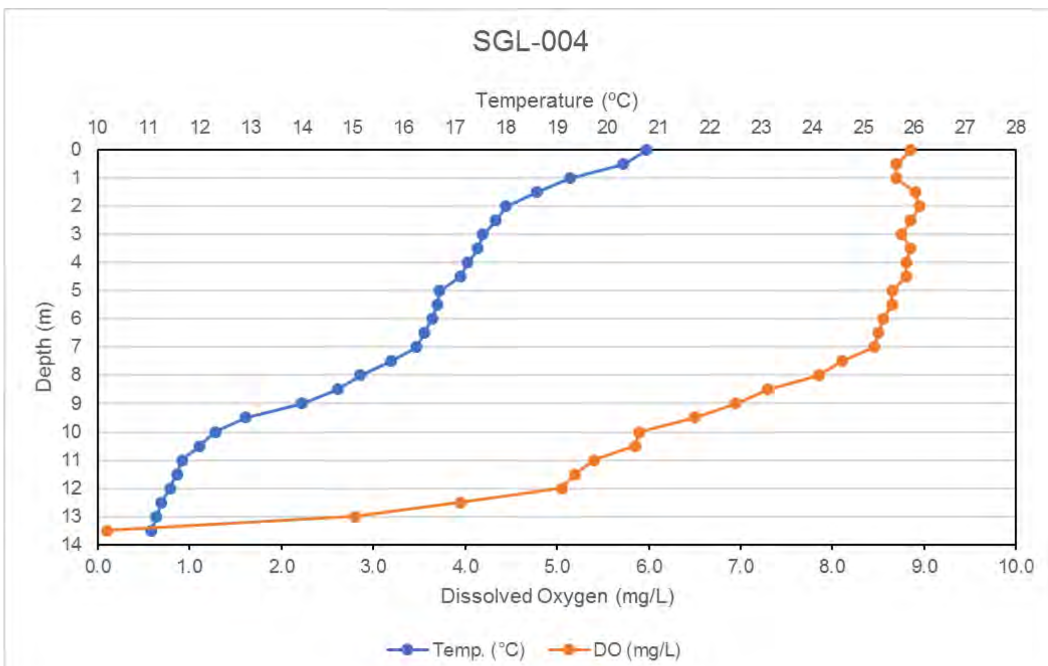

Figure E.4 Water Temperature and Dissolved Oxygen Profiles for SGL-004 on Scraggy Lake, NS.

Figure E.5 Water Temperature and Dissolved Oxygen Profiles for SGL-008 on Scraggy Lake, NS.

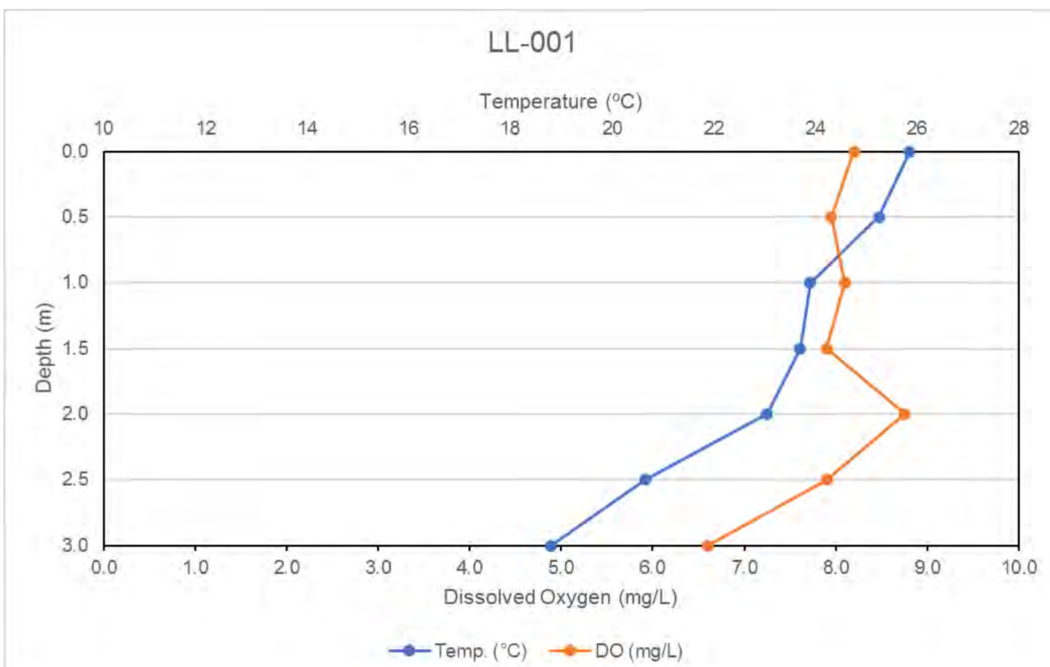

Figure E.6 Water Temperature and Dissolved Oxygen Profiles for LL-001 on Long Lake, NS.

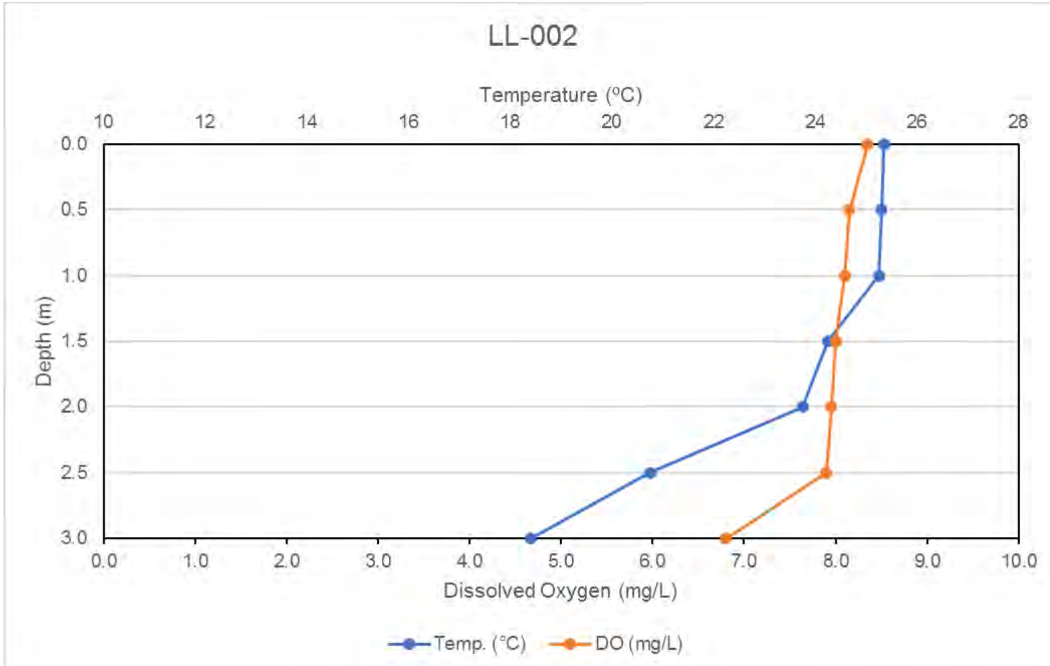

Figure E.7 Water Temperature and Dissolved Oxygen Profiles for LL-002 on Long Lake, NS.

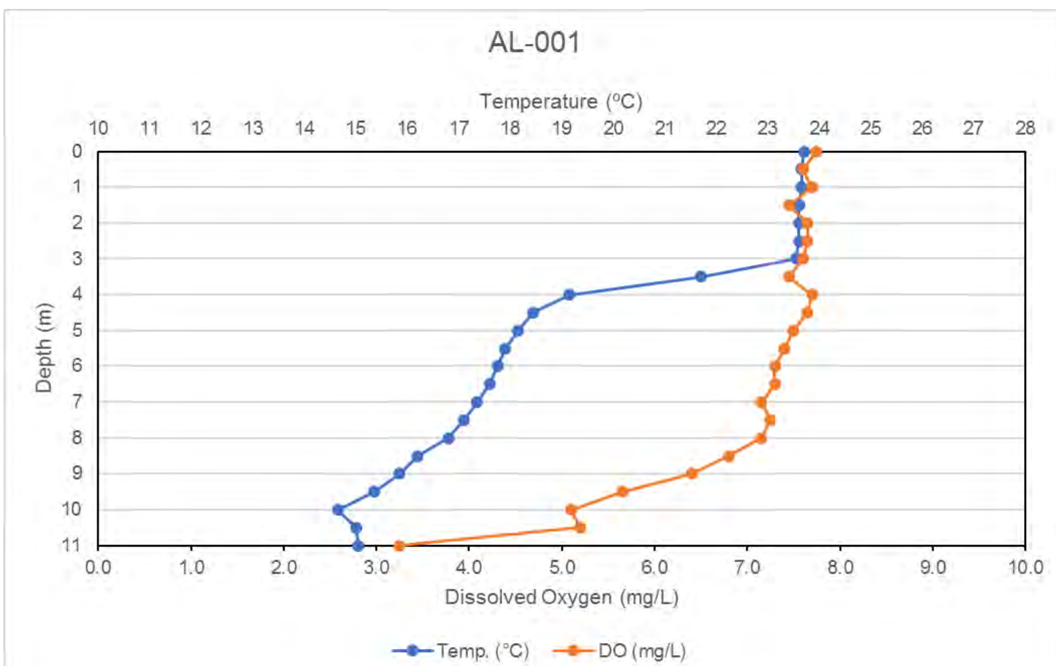

Figure E.8 Water Temperature and Dissolved Oxygen Profiles for AL-001 on Alma Lake, NS.

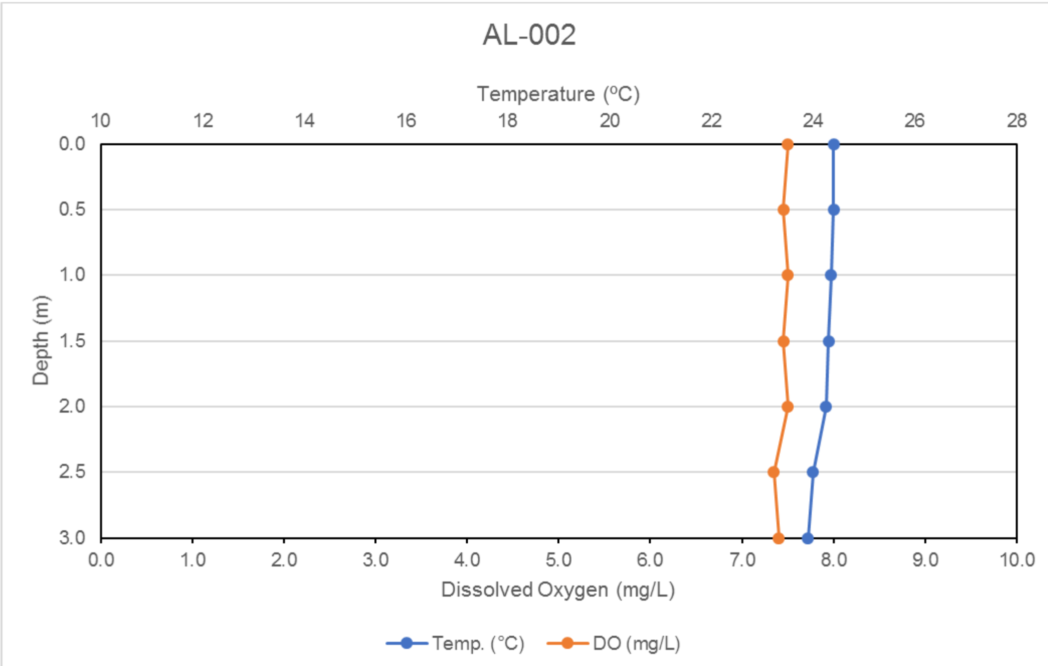

Figure E.9 Water Temperature and Dissolved Oxygen Profiles for AL-002 on Alma Lake, NS.