# APPENDIX F

## Response to DFO Request 20-HMAR-00531Moose River Request for Studies Halifax County, Nova Scotia

Stantec Consulting Ltd.
102-40 Highfield Park Drive, Dartmouth, NS  B3A 0A3

November 1, 2021
File: 121619250.3001.104.2

Attention: Melissa Nicholson, P.Eng.
Atlantic Mining NS Inc.
409 Billybell Way, Mooseland
Middle Musquodoboit, NS B0N 1X0

Dear Ms. Nicholson,

**Reference: Response to DFO Request 20-HMAR-00531 – Moose River Request for Studies Halifax County, Nova Scotia**

Stantec Consulting Ltd. (Stantec) has prepared the following information on behalf of Atlantic Mining NS Inc (AMNS) in response to Requests 1-4 of the Fisheries and Oceans Canada (DFO) Ministerial Request Pursuant to Subsections 34.3 (1) and 37 (1) of the *Fisheries Act*. This Ministerial Request was issued by DFO on June 16, 2021, under DFO file number 20-HMAR-00531.

This response should be read in conjunction with the following material prepared by Stantec in response the previous requests for information from Fisheries and Oceans Canada (DFO):

- Response to July 22, 2020 Request for Additional Information on Industrial Approval Amendment Application (Reference 20-HMAR-00251); issued by Stantec September 3, 2020.
- Response to October 9, 2020 Information Request (Reference 20-HMAR-00531), three submissions issued by Stantec on March 9, March 24 and March 30, 2021.
- Response to June 16, 2021 Ministerial Request- Moose River Request for Studies (Reference 20-HMAR-00531); issued by Stantec on July 30, 2021.

The 2021 hydrometric monitoring program was adjusted in response to the DFO ministerial request 20-HMAR-00531, and included the installation of additional monitoring stations and weekly monitoring during the low flow period from July to September 2021. Further detail on these activities is provided below. The monitoring program and corresponding data analysis was completed in conformance to the best practices defined in this document and resulted in the desired range of statistical accuracy. Results of the 2021 monitoring program were consistent with past years monitoring programs (i.e., 2019 and 2020); expected baseflow reductions to Moose River amount to no more than 4.5% of stream flow estimate at SW-2 based on upstream flow measurements.

A detailed interpretation of the 2021 monitoring data is summarized in appended report, in reference to the interpretation and conclusions in past years.

## RESPONSES TO QUESTIONS

The response/conformance to DFO Ministerial Requests 1-4 are summarized in Table 1. A response to Request 5 was provided on July 30, 2021.  A detailed report is provided in Attachment A.

**Table 1 Response to DFO Ministerial Request 20-HMAR-00531**

| DFO Ministerial Request | Response |
|---|---|
| 1. Install two new monitoring stations **prior to July 1st, 2021,** consisting of staff gauges and automated data loggers measuring water surface elevations and flow velocities located at: | Two monitoring stations were installed instrumented with staff gauges and data loggers, details below. |
| a. A location no further than 250 meters downstream of the Mooseland Rd. bridge (44°50' 16'19"N, 62 56'43.00"W) | Monitoring station HM-3 was installed on June 29, 2021 approximately 30 meters downstream of the Mooseland Rd. bridge. |
| b. A location no further than 100 meters upstream or 100 meters downstream of the location immediately adjacent to the open pit well OPM-2A/B (44°58'58.29"N, 62 56'50.64"W) | Monitoring station HM-4 was installed on June 29, 2021 at a location adjacent to the open pit monitoring well OPM-2A/B. |
| 2. Implement a flow monitoring program between July 1 and September 30, 2021 on Moose River utilizing the data collected from the five surface water monitoring stations, referred to in 2a. including the three existing surface water monitoring stations Keizer et al (2020), following the *Discharge measurement by the velocity-area method* in Cassie (2018).<br>Monitoring Stations required: | Flow monitoring was performed weekly on Moose River between July 1 and September 30, 2021 at five locations.<br>Flow monitoring was conducted by Nicole Bell, E.I.T., Hydrologist (Stantec) and Ryan Gardiner, Environmental Consultant (McCallum Environmental Ltd.) and field reviewed by Stantec Senior Hydrologist Rachel Jones, P.Eng. Flow cross sections were measured as panels, as per the velocity-area method. |
| a. SW-11; as described in Keizer et al (2020) | Installed 25 April, 2018, an additional station (SW-11B) was monitored beginning July 8, 2021 to assess flow accuracy at SW-11. This additional station was not required by DFO. |
| b. HM-1; as described in Keizer et al (2020) | Installed 17 August, 2018 |
| c. SW-2; as described in Keizer et al (2020) | Installed 25 April, 2018 |
| d. Referenced in 1a; | Installed 29 June, 2021 |
| e. Referenced in 1b; | Installed 29 June, 2021 |
| Each monitoring stations must have: | |
| f. Staff gauge and automated data logger installed and calibrated correctly and sited in an appropriate location to collect information required in sections 3 and 4 of this request; | Staff gauge and automated data loggers were installed at each station.<br>The Levelogger was installed to measure the water depth above the sensor. Data loggers were calibrated at the time of station installation; the logger was installed in a vertical stilling well and anchored 0.95 m below the top of staff gauge. The water depth at the time of installation was visually recorded and directly compared with the recorded depth above the sensor measured by the Levelogger. As part of the calibration process, this manual water depth was used to correct logger data due to sensor drift.<br>As the Levelogger measures total pressure, barometric compensation of the logger data was performed and the pressure converted to water depth over the sensor.<br>Triangulated benchmarks were set up adjacent to each station to verify that the staff gauge and Levelogger do not move laterally or vertically. |

**Table 1 Response to DFO Ministerial Request 20-HMAR-00531**

| DFO Ministerial Request | Response |
|---|---|
| g. Benchmark elevations measured accurately with sufficient frequency to establish the surface water elevation; | Benchmark surveys were conducted weekly to achieve consistency in field practices and to achieve a high level of confidence in the monitoring data. No shifts or movement in monitoring equipment were detected between surveys throughout the monitoring period. In addition no visual or climate based observations indicated a possible shift throughout the monitoring period; therefore these surveys were only required at the time of installation and decommissioning.<br>Redundant measurements of water level, top of staff gauge height and/or benchmark and collected to achieve an accuracy of 8 mm or less. Field work was conducted consistently by trained field staff to reduce measurement error; such as, surveyed benchmark points are noted from “the top of nail head” at the highest point of top of nail head, staff gauge readings are taken from a consistent vantage point etc.<br>Water depth over the sensor was converted to water elevation based on the benchmark survey tied into geodetic datum. |
| 3. Develop a flow monitoring program analysis to include the following: | |
| a. Develop a rating curve (stage-discharge) of flow in Moose River at each monitoring stations listed in 2 a. for the period of July 1, 2021 to September 30, 2021 to demonstrate the relationship between the water level (i.e., stage) on the staff gauge and discharge. | Stage-Discharge relationships for each station are included in the Station Summaries in the detailed report provided in Attachment A. |
| b. Rating curves should have an $R^2$ value ≥0.95. | An $R^2$ ≥0.95 was achieved at each station. |
| c. Accepted stream gauging standards such as ISO 748, shall be used in developing the rating curve at all monitoring stations. | Rating curves were developed in accordance with ISO 748 and WMO No. 1044 Manual on Stream Gauging (2010):<br>1. Cross-section set up: benchmark staking on each bank which formed the consistent boundary conditions of each in-situ flow measurement<br>2. Each flow survey consisted of 20 panel measurements.<br>3. Flow measurements were taken using the midsection method.<br>4. Velocity measurements were taken at 60% depth.<br>5. Cross-section widths were measured from left bank to right bank, and right bank to left bank to confirm. |
| d. Benchmark elevations should be measured at each station to establish the water surface elevation | Benchmark elevations were surveyed to Canadian Geodetic Vertical Datum 2013 to establish water surface elevation. |
| e. A minimum of one measurement of depth and flow should be made per week at each monitoring station for the period of July 1, 2021 to September 30, 2021. Depth and flow measurements should be taken at an appropriate section control point (e.g., free of aquatic vegetation, stable riffle where flow is confined). | Flow cross sections were monitored weekly at established locations. These locations were sited to achieve the highest quality measurements possible and using the 2019 Water Survey of Canada (WSC) Hydrometric Field Manual (Moore 2019) while maintaining with the bounds or criteria of the station. |

## Table 1 Response to DFO Ministerial Request 20-HMAR-00531

| DFO Ministerial Request | Response |
|---|---|
| f. Flow measurement equipment (e.g., flow meter, water level sensor) which is sufficiently sensitive to measure flows in the range of 0.002 cubic meters per second shall be used to determine flows. The capability of flow measurement instrumentation shall be documented in all required reporting for establishment of the rating curve. | The following flow meter and water level sensors were used to measure flows weekly:<br>The OTT MF pro electromagnetic flow meter was used to collect flow measurements. The OTT MF pro has a reported sensor velocity measurement range of 0.000 to 6.090 m/s (0 to 20 ft/s). The reported velocity accuracy for the OTT MF pro is +-2% of reading +-0.015 m/s (+-0.05 ft/s); 0 to 3.04 m/s (0 to 10 ft/s); +- 4% of reading from 3.04 to 4.87 m/s (10 to 16 ft/s). This flow meter is sufficient in measuring flows in the range of 0.002 $m^3$/s. This flow meter has also been consistently used in the measurement of flows for this Project.<br>Solinst Levelogger 5 water level loggers were the water level sensors used to measure stage (m) throughout the period of analysis. A Levelogger was installed in the stilling well at each hydrometric station and recorded hourly water levels (m). The Levelogger has an accuracy of +- 0.05% Full Scale (5 m) which is sufficiently sensitive for this project (Solinst 2021). |
| g. Measurements of water levels made by the water level sensors shall be within the range of accuracy specified by the manufacturer. | Water level measurements made by the water level sensor ranged between 0.277 and 1.26 m which is well within the range of accuracy specified by the manufacturer. The accuracy of the Solinst Levelogger M5 was noted in comment 3f. |
| h. A detailed description of the flow measurement equipment used including manufacturer and model. | The following flow measurement equipment was used:<br>• Flow meter: OTT MF pro Flow Meter manufactured by OTT HydroMet<br>• Solinst Levelogger M5 installed in 3 in. diameter slotted PVC well casing.<br>– Direct Read cable attached to logger and cable was anchored to the hydrometric station to ensure the logger remained static.<br>– Leveloggers were downloaded weekly using the Solinst Model 3002 DataGrabber 5. Downloaded directly to iPhone using Bluetooth communications and Solinst App.<br>• Solinst Barologger was installed adjacent to the tailings management area groundwater monitoring well TMW-1A. The barologger measured barometric pressure which was subtracted from the Levelogger readings to obtain a net water level at each hydrometric station |
| i. GPS coordinates of the location of each monitoring station. | GPS coordinates of for the monitoring stations are below:<br>SW-11: 20T 504126 E, 4982555 N<br>SW-11B: 20T 504140 E 4982526 N<br>HM-1: 20T 503924 E, 4981232 N<br>SW-2: 20T 504306 E, 4980726 N<br>HM-3: 20T 504288 E, 4981604 N<br>HM-4: 20T 504158 E, 4981032 N |

**Table 1 Response to DFO Ministerial Request 20-HMAR-00531**

| DFO Ministerial Request | Response |
|---|---|
| j. All channel cross-section measurements, water velocity and depth measurements, and the benchmark elevations used to determine the water surface elevation at each monitoring station as shown in Table 1 of Cassie (2018) | Stations summaries of the hydrometric monitoring program for the 2021 monitoring period are included for each site in the detailed report provided in Attachment A.<br>Weekly flow monitoring and associated cross section and benchmark surveys are also presented in the detailed report provided in Attachment A. |
| k. All daily water level elevation measurements made by the water level sensors with date/time. | Hydrographs of the daily water level elevation over time are provided in the detailed report provided in Attachment A.<br>Daily water level elevations made by the water level sensors can be found in the Excel workbook titled *MooseRiverDailyWaterlevels.xlsm.* |
| 4. Provide Fishery Officer MacMullin by email at Steven.MacMullin@DFO-MPO.gc.ca or by phone at 1-902-307-0859 a detailed report based on the flow monitoring program described in sections 2 and 3 of this request by **November 1, 2021.** | A detailed report is provided in Attachment A. |
| 5. Provide Fishery Officer MacMullin by email at Steven.MacMullin@DFO-MPO.gc.ca or by phone at 1-902-307-0859 the following existing and historic information by August 1st 2021:<br>a. A detailed description of the equipment and methodology used to monitor dewatering rates of the open pit at the Touquoy mine;<br>b. All data collected to date associated with dewatering of the open pit at the Touquoy mine including the date and time of each measurement<br>c. All data associated with all discharge and stage measurements taken at the SW-11, HM-1, and SW-2 monitoring stations to date, including: channel cross-section measurements, water velocity and depth measurements, and the benchmark elevations used to determine the water surface elevation;<br>i. The equation(s) used to calculate values in the column "SW-2_daily_estimated" in MS Excel spreadsheet "Attachments_1+2" provided to Fisheries and Oceans Canada on March 25, 2021 along with a sample calculation;<br>d. A detailed explanation for the large variability on daily water level data collected by the water level sensors;<br>e. An examination of the flow-time series for HM-1 during the June through September period in 2019 and 2020 to explain the lack of variability in discharge in response to precipitation events; and | Response provided under separate cover on July 30, 2021. |

Reference: Response to DFO Request 20-HMAR-00531 – Moose River Request for Studies Halifax County, Nova Scotia

**Table 1 Response to DFO Ministerial Request 20-HMAR-00531**

| DFO Ministerial Request | Response |
|---|---|
| f. Examinations and explanations for the low $R^2$ values associated with the rating curves developed for each monitoring station. | |

## CLOSURE

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Regards,

**Stantec Consulting Ltd.**

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Attachment: Attachment A Results of 2021 Flow Monitoring and Data File MooseRiverDailyWaterLevels.xlsm
Attachment B Detailed Report on 2021 Moose River Hydrometric Data

## REFERENCES

Caissie, D. 2018. Discharge Measurement by the Velocity-Area Method. Fisheries and Oceans Canada. September 2018.

Fisheries and Oceans Canada (DFO). 2014. "A Science-Based Framework for Assessing the Response of Fisheries Productivity to State of Species or Habitats." Science Advisory Report 2013/067. Canadian Science Advisory Secretariat Science Advisory Report. Ottawa: Fisheries and Oceans Canada. http://www.dfo-mpo.gc.ca/csas-sccs/Publications/SAR-AS/2013/2013_067-eng.html.

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# ATTACHMENT A

**Detailed Report on 2021 Moose River Hydrometric Data**
**MooseRiverDailyWaterLevels.xlsm (Provided Electronically)**

# Detailed Report on 2021 Moose River Hydrometric Data

Response to Part 4 of DFO Request 20-HMAR-00531 – Moose River Request for Studies Halifax County, Nova Scotia, June 16, 2020

November 1, 2021

Prepared for:

Atlantic Mining NS Inc
409 Billybell Way, Mooseland
Middle Musquodoboit, NS B0N 1X0

Prepared by:

Stantec Consulting Ltd.
102-40 Highfield Park Drive,
Dartmouth, NS B3A 0A3

File: 121619250

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# 1.0 2021 HYDROMETRIC MONITORING PROGRAM

The 2021 hydrometric monitoring on Moose River and Long Lake tributary has been conducted to assess effects of operation of the mine, as required under the existing Industrial Approval and in response to DFO Ministerial Request 20-HMAR-00531. This report should be read in conjunction with the following material prepared by Stantec in response the previous requests for information from Fisheries and Oceans Canada (DFO):

- Response to July 22, 2020 Request for Additional Information on Industrial Approval Amendment Application (Reference 20-HMAR-00251); issued by Stantec September 3, 2020.
- Response to October 9, 2020 Information Request (Reference 20-HMAR-00531), three submissions issued by Stantec on March 9, March 24 and March 30, 2021.
- Response to June 16, 2021 Ministerial Request- Moose River Request for Studies (Reference 20-HMAR-00531); issued by Stantec on July 30, 2021, and November 1, 2021.

This memo describes Stantec's analysis of the 2021 hydrometric monitoring program and our interpretation of the effects of pit dewatering on water levels in Moose River in proximity to the pit. As supported in more detail in the sections below, flow reductions to Moose River were observed, however, based on metered pit dewatering rates, these reductions cannot wholly be attributed to pit dewatering as the reductions are up to an order of magnitude higher than pit dewatering rates. Predicted reductions in baseflow amount to less than 4.5% in relation to the Touquoy pit dewatering and do not exceed ecological flow metrics outlined in the "Framework for Assessing the Ecological Flow Requirements to Support Fisheries in Canada" (DFO 2013[1]).

## 1.1 MONITORING LOCATIONS

Figure 1.1, illustrates the Touquoy surface water monitoring network, including the five hydrometric monitoring stations on Moose River and the Long Lake tributary to Moose River.

The five hydrometric monitoring stations include three existing stations (SW-11, SW-2, and HM-1) and two new stations (HM-3 and HM-4) installed in 2021 as directed by the June 16, 2021, Fisheries and Oceans (DFO) Ministerial Request. Monitoring station HM-3 was installed on June 29, 2021, approximately 30 meters downstream of the Mooseland Rd. bridge and monitoring station HM-4 was installed on June 29, 2021, at a location adjacent to the open pit monitoring well OPM-2A/B. An additional station (SW-11B) was installed approximately 60 m downstream of SW-11 on July 8, 2021, to assess flow accuracy of the monitoring location as a result of the grassy vegetation present at SW-11.

These locations were sited using the 2019 Water Survey of Canada (WSC) Hydrometric Field Manual (Moore 2019[2]) to achieve the highest quality measurements possible while also meeting the criteria of the

[1] Framework for Assessing the Ecological Flow Requirements to Support Fisheries in Canada" (DFO 2013).

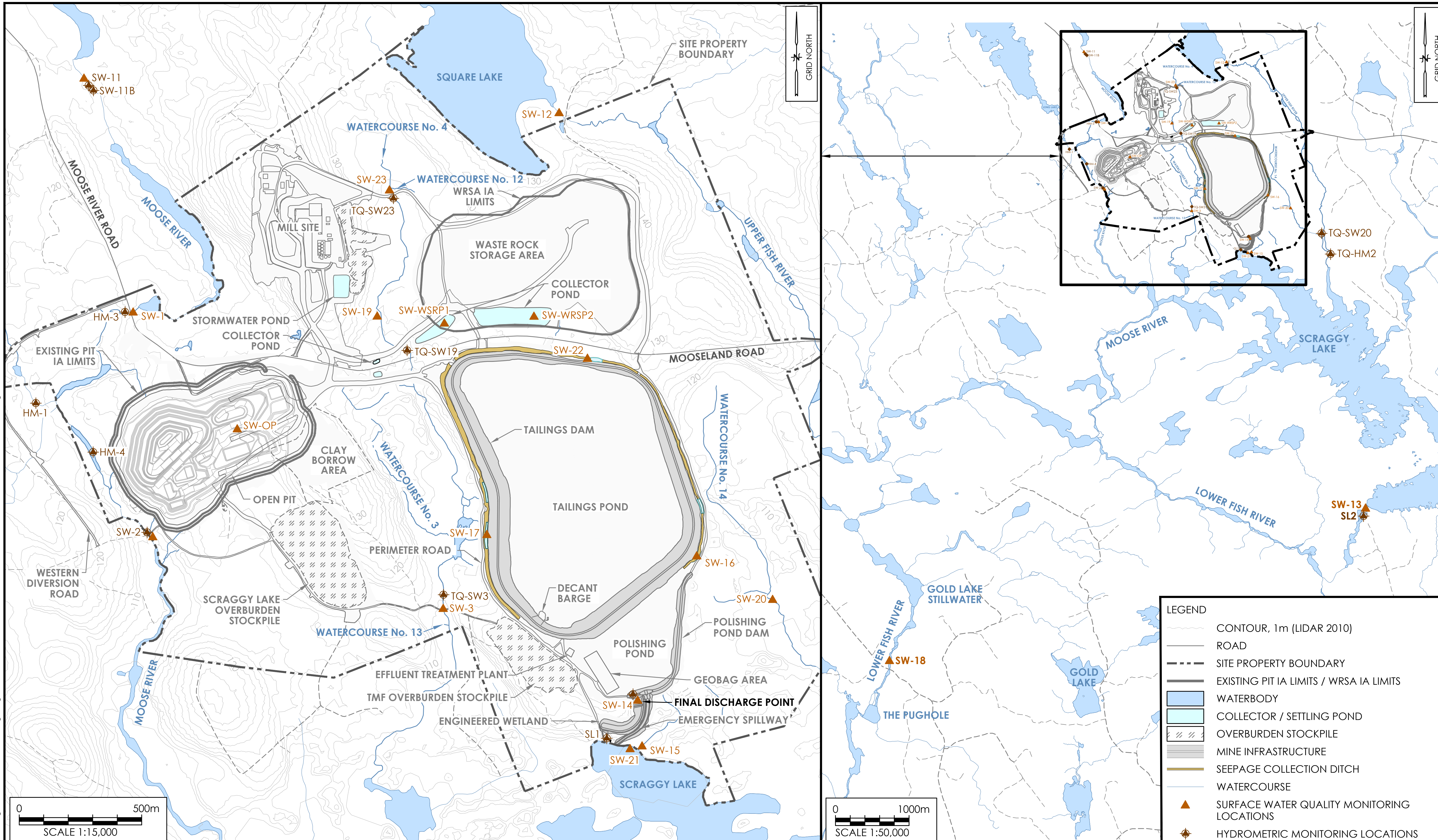
[2] Moore, S. 2019. Hydrometric Field Manual – Measurement of Stage. Water Survey of Canada, Environment and Climate Change Canada. Version 2. 2019. https://publications.gc.ca/collections/collection_2021/eccc/en37/En37-274-2019-eng.pdf

stations dictated by the Ministerial Request. Staff gauge and automated data loggers were installed at each station. Site location and monitoring details are summarized in Table 1.1.

**Table 1.1 Details of Hydrometric Monitoring Locations – Moose River**

| Station | CGVD2013 Zone 20T Coordinates | Date of Installation | Watercourse | Location | Monitoring Requirement | Monitoring Rationale |
|---|---|---|---|---|---|---|
| SW-11 | 504126 E 4982555 N | April 25 2018 | Moose River | Most upstream station | Condition 7(g)(ii) of the Industrial Approval | Background monitoring June 1 to September 30 |
| SW-11B | 504140 E 4982526 N | July 14, 2021 | Moose River | Approximately 60 m downstream of SW-11 on Moose River | None | Assess flow accuracy of Background Station SW-11 |
| HM-3 | 504288 E, 4981604 N | June 29, 2021 | Moose River | Upstream of Pit | DFO Ministerial Request HMAR-00531 | Assess project effects |
| HM-1 | 503924 E, 4981232 N | August 17, 2018 | Long Lake Tributary to Moose River | Near confluence with Moose River | None | Distinguish tributary inflows to better define changes in flow |
| HM-4* | 504158 E, 4981032 N | June 29, 2021 | Moose River | Upstream of Pit, 20 m upstream of old wooden weir in river | DFO Ministerial Request HMAR-00531 | Assess project effects |
| SW-2 | 504306 E, 4980726 N | April 25 2018 | Moose River | Downstream of Pit, 15 m upstream of the Western Diversion Rd bridge crossing | Condition 7(g)(ii) of the Industrial Approval | Assess project effects June 1 to September 30 |

* Moose River reach identified in the ministerial request is not optimal hydrometric station location as flow accuracy may be reduced due to the presence of Wetland 22 and/or wooden bridge structure, see Section 4.3 for further discussion.




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

**Reference:**
1. PROVINCIAL BASE DATA REPRODUCED AND DISTRIBUTED WITH THE PERMISSION OF SERVICE NOVA SCOTIA & MUNICIPAL RELATIONS (SNSMR, 2006) AS PER THE TERMS OF USE OUTLINED IN THE UNRESTRICTED DATA USE LICENSE AGREEMENT FOR GEOGRAPHIC DATA.
2. EXISTING TOPOGRAPHY SHOWN IS BASED ON LIDAR DATA PROVIDED BY CONESTOGA-ROVERS & ASSOCIATES (2010).

# SURFACE WATER MONITORING LOCATIONS (QUALITY/QUANTITY)

TOUQUOY HYDROMETRIC MONITORING PROJECT
HALIFAX COUNTY, NOVA SCOTIA

**Client:** ATLANTIC MINING NS INC.

| | |
|---|---|
| Job No.: | 121619250 |
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## 1.2 HYDROMETRIC MONITORING PROGRAM METHODOLOGY

Hydrometric monitoring was conducted by Nicole Bell, E.I.T., Hydrologist (Stantec) and Ryan Gardiner, Environmental Consultant (McCallum Environmental Ltd.) and field reviewed by Stantec Senior Hydrologist Rachel Jones, P.Eng.

The formal standard operating procedure (SOP) for hydrometric flow monitoring is described in the 2017 Moose River Stage-Discharge Curve Report (Atlantis 2017[3]) and is reported to be in accordance with *ISO 748:2007E Hydrometry – Measurements of liquid flow in open channels using current meters or floats (ISO 2007)*[4]. The hydrometric monitoring program included the following for each station:

- Install a staff gauge and automated data logger. Logger secured in a vertical stilling well, and well anchored in-place with angle iron.
- Weekly download of dataloggers via direct read cable or Bluetooth connection. Barometric compensation performed on logger data and convert from pressure to water depth.
- Weekly benchmark surveys to identify any shift in hydrometric monitoring equipment (stilling well, sensor, or staff gauge) since the last survey. Triangulated benchmarks were set up adjacent to each station and surveyed to CGVD2013 datum. Redundant measurements were collected to achieve an accuracy of 8mm or less.
- Measure flow cross sections at a minimum of 20 panels and 60% depth, as per the velocity-area method[5]. A single panel discharge should target approximately 10% of total discharge. Two cross sections were collected to quantify the measurement accuracy.
- Flow cross sections were marked to improve consistency
- Record weekly staff gauge readings.
- Manually measure water depth above sensor to correct the data logger water level to observed due to sensor drift.
- Survey cross section from bank to bank at each flow measurement location.
- Take photos weekly to document field observations (from upstream, downstream, left bank, right bank and substrate).
- Weekly review to identify potential impacts to Moose River by the Project.
- Develop a stage discharge curve based on the relationship of water elevation and flow
- Calculate a hydrograph of flow overtime derived from the rating curve and measured water level record

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[3] Atlantis Watershed Consultants. 2017. 2017 Moose River Stage-Discharge Curve Report. Prepared for Atlantic Mining NS Corp. October 31, 2017.
[4] International Organization for Standardization (ISO). 2007. ISO 748:2007 Hydrometry – Measurement of liquid flow in open channels using current-meters or floats. October 2007.
[5] Caissie, D. 2018. Discharge Measurement by the Velocity-Area Method. Fisheries and Oceans Canada. September 2018.

- Flow measurement was conducted using the OTT MF pro electromagnetic flow meter was used to collect flow measurements. The OTT MF pro6 has a reported sensor velocity measurement range of 0.000 to 6.090 m/s (0 to 20 ft/s). The reported velocity accuracy for the OTT MF pro is +-2% of reading +-0.015 m/s (+-0.05 ft/s); 0 to 3.04 m/s (0 to 10 ft/s); +- 4% of reading from 3.04 to 4.87 m/s (10 to 16 ft/s). This flow meter is sufficient in measuring flows in the range of 0.002 m3/s. This flow meter has also been consistently used in the measurement of flows for this Project.

Solinst Levelogger 5[7] water level loggers were the water level sensors used to measure stage (m) throughout the period of analysis. A Levelogger was installed in the stilling well at each hydrometric station and recorded hourly water levels (m). The Levelogger has an accuracy of +- 0.05% Full Scale (5 m) which is sufficiently sensitive for this project (Solinst 2021).

Stage discharge curves were developed in accordance with ISO 748 and WMO No. 1044 *Manual on Stream Gauging* (2010). A power fit was applied to a minimum of 14 flow measurements, plotted against water elevation. The correlation coefficient Root Mean Squared ($R^2$) of ≥ 0.95 was achieved at each station. The stage-discharge curve depends on the hydraulic characteristics of the watercourse and will vary over time. Subtle changes to the watercourse may include growth of aquatic vegetation in the summer, the frequent shifting of a sand-bed stream bottom or significant changes due to flood events or nearby construction. These changes might require a minor or temporary adjustment to streamflow records or could require a complete reevaluation of the stage-discharge curve, as was completed in 2021 as more than 10 flow measurements were available in a single field season. A review of the applicability of flow measurement data from year to year will be conducted, as part of the annual surface water and groundwater monitoring report.

The data collected as part of the 2021 hydrometric monitoring program on Moose River is summarized in the station summaries in Appendix A.

## 1.3 CHARACTERIZATION OF MONITORING STATIONS

Site analysis and characterization was performed by Stantec Hydrologist Nicole Bell, E.I.T., and Senior Water Resources Engineer, Rachel Jones, P.Eng. on July 8, 2021. Table 1.1 summarizes the details of hydrometric stations, along Moose River, listed from upstream to downstream. A visual characterization of the watercourse, floodplain, and substrate is summarized in the station summaries in Appendix A.

Table 1.2 provides a characterization of the monitoring stations. Moose River is located west of the existing Touquoy pit and drains to Lower Fish River. Long Lake tributary confluences with Moose River upstream of the Touquoy pit, between hydrometric stations HM-3 and HM-4. Station HM-4 is a low-gradient wide reach with a contiguous wetland (Wetland 22) and a remnant wooden structure 20 m downstream. The majority of Moose River catchment area is forested with waterbodies and wetlands. A

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[6] OTT HydroMet (OTT). 2018. OTT MF pro – Water Flow Meter Basic User Manual. Edition 7. September 2018. https://www.ott.com/download/ott-mf-pro-basic-user-manual-international-version-non-eu-1/

[7] Solinst Canada Ltd. (Solinst). 2021. Levelogger 5 Water Level Dataloggers. Solinst Levelogger 5. Accessed October 16, 2021. https://www.solinst.com/products/dataloggers-and-telemetry/3001-levelogger-series/levelogger/datasheet/

portion of the Touquoy project footprint reduces the predevelopment watershed of Moose River. Moose River is generally a meandering low-gradient watercourse with defined banks. Further detailed hydrometric station summaries can be found in Appendix A.

### Table 1.2 2021 Moose River Hydrometric Station Field Observations

| Station | Catchment Area (km$^2$) | Range of Average of 2021 Field Visits | | | Substrate | Floodplain |
|---|---|---|---|---|---|---|
| | | Wetted Width (m) | Depth (m) | Velocity (m/s) | | |
| SW-11 | 25.08 | 7.1-9.2 | 0.104-0.355 | 0.065-0.467 | Fines, gravel, cobbles and few boulders, grassy vegetation | Grasses, shrubs, and low-cut banks |
| SW-11B | 25.75 | 4.4-9.4 | 0.164-0.331 | 0.074-0.456 | Fines, gravel, cobbles and few boulders near the channel edges | Mixed wood floodplain with low cut banks on both sides of the channel |
| HM-3 | 26.78 | 7.1 -7.9 | 0.278-0.486 | 0.026-0.416 | Exposed bedrock, boulders, cobbles, and gravel | High rock cuts, tall grass, medium shrubs |
| HM-1 | 12.02 | 3.0-4.8 | 0.100-0.194 | 0.112-0.431 | Gravel and cobbles | Tall grasses, mosses, ferns, and hardwood species; the banks were low-cut |
| HM-4* | 38.82 | 13.3-14.3 | 0.451-0.726 | 0.014-0.170 | Soft organic, with some boulders | Contiguous wetland (Wetland 22) features such as hydrophytic vegetation |
| SW-2 | 39.03 | 7.5-9.4 | 0.557-0.743 | 0.022-0.099 | Fine material and few cobbles. During low flows, boulders are exposed on either side of the cross section. | Wide, low-cut banks, boulders, and grasses which transition into a mixed wood forest |

* Moose River reach identified in the ministerial request is not optimal hydrometric station location as flow accuracy may be reduced due to the presence of Wetland 22 and/or wooden bridge structure, see Section 4.3 for further discussion.

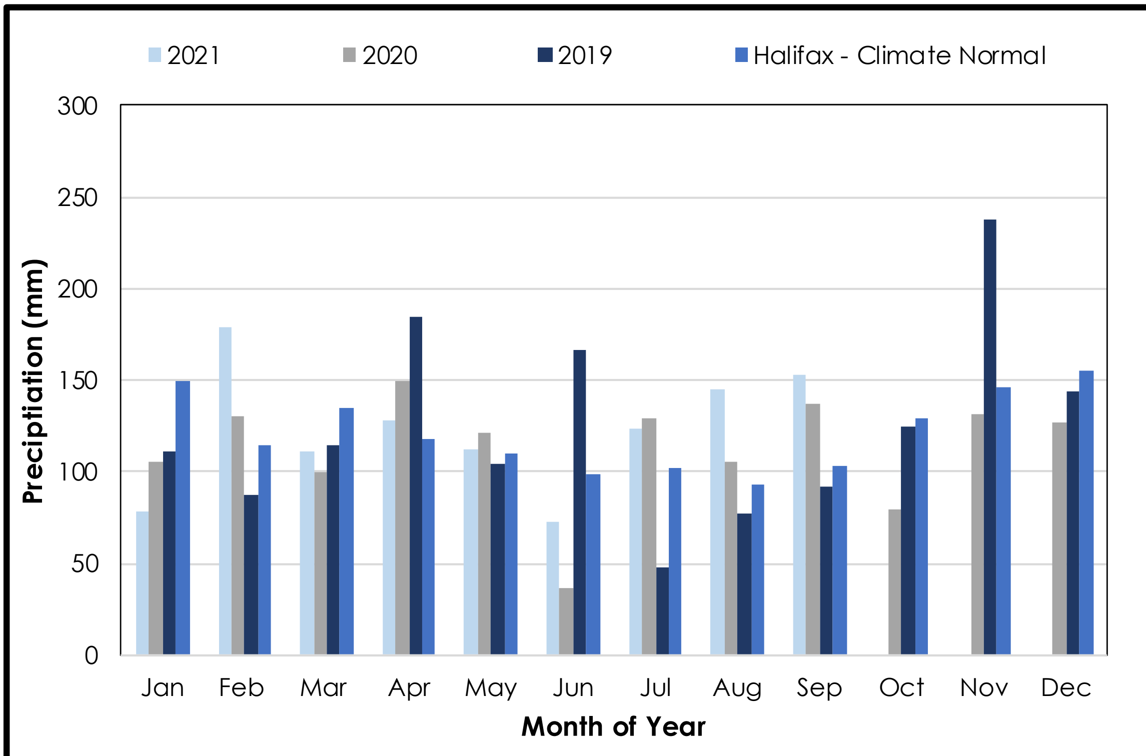
# 2.0 CLIMATE & STREAMFLOW

Consistent with routine water balance monitoring efforts onsite, climate is represented by the active Halifax International Airport climate station (Station ID 8202251)[8]. Climate normal conditions were assumed as the 1981 - 2010 climate record. In addition, climate data is represented by the on-site meteorological station, when data is available.

## 2.1 TOTAL PRECIPITATION

Figure 2.1 presents the total precipitation for 2021, 2020, and 2019. As of the end of September 2021, the total precipitation is higher than the past two years and climate normal.

[8] Environment Canada. 2015a. Climate, Canadian Climate Normals, 1981-2010 Canadian Climate Normals & Averages. Halifax Airport Nova Scotia. Website: http://climate.weather.gc.ca/climate_normals/index_e.html. Reviewed on January 6, 2016.




| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **2021** | 78.0 | 178.9 | 111.0 | 127.7 | 111.7 | 72.4 | 123.5 | 145.1 | 152.8 | | | |
| **2020** | 105.4 | 130.8 | 99.6 | 149.3 | 121.7 | 37.0 | 129.0 | 105.8 | 137.0 | 79.5 | 131.0 | 127.0 |
| **2019** | 111.2 | 87.2 | 114.6 | 185.1 | 104.8 | 166.6 | 48.1 | 77.1 | 91.8 | 124.5 | 238.0 | 144.0 |
| **Climate Normal** | 149.2 | 114.4 | 134.5 | 118 | 109.7 | 98.3 | 102.2 | 92.7 | 103.6 | 128.7 | 146 | 155 |
| Note: Cells highlighted blue are from on-site meterological station | | | | | | | | | | | | |

**Figure 2.1 Total Precipitation Data at the Site**

## 2.2 STREAMFLOW

The mean annual flow is based on a regional regression analysis conducted as part of the Environmental Assessment Registration Document[9] (EARD). Mean monthly flows at SW-2 are summarized in Table 2.1. Mean annual discharge in Moose River at SW-2 is estimated to be 99,969 $m^3$/day or 1.15 $m^3$/s.

**Table 2.1 Mean Monthly Flow in Moose River at Station SW-2**

| Parameter | Moose River Mean Monthly Flow ($m^3$/day) |
|---|---|
| January | 106,991 |
| February | 107,043 |
| March | 141,131 |
| April | 192,363 |
| May | 111,895 |
| June | 58,462 |
| July | 34,251 |
| August | 32,935 |
| September | 38,845 |
| October | 81,451 |
| November | 146,375 |
| December | 147,884 |
| **Mean Annual Flow** | **99,969** |
| **Catchment area ($km^2$)** | **39.03** |

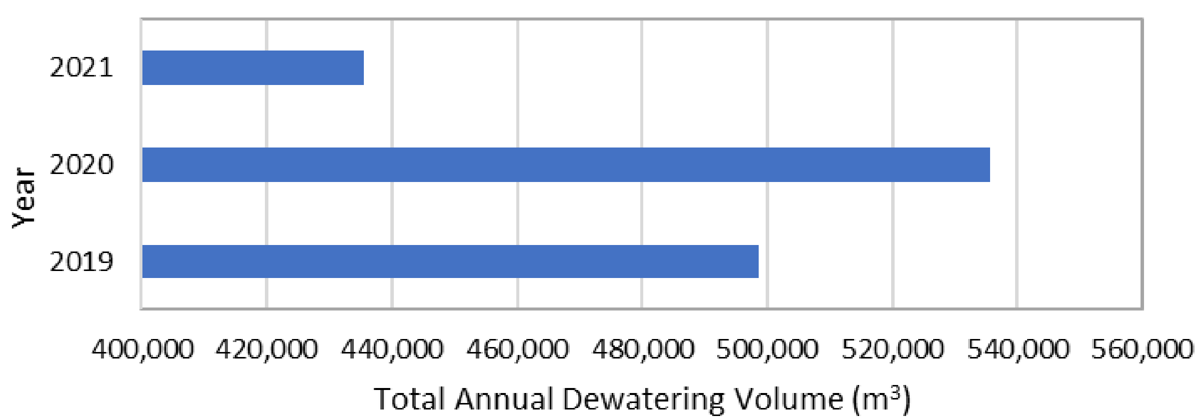
# 3.0 METHODOLOGY TO ASSESS POTENTIAL EFFECTS

Potential effects of the Project considered metered pit dewatering, predicted losses of baseflow from supporting groundwater modelling (Stantec 2021)[10], and the ecological flow metrics outlined in the "Framework for Assessing the Ecological Flow Requirements to Support Fisheries in Canada" (DFO 2013[11]). Observed Touquoy Pit dewatering rates were used as the upper bound of potential losses in flow to Moose River as a result of pit dewatering activity associated with the project. As the dewatering volumes are predominately from direct precipitation to the pit and pumped runoff from the Scraggy Stockpile area, the remainder of seepage inflows that have the potential to be taken from Moose River are smaller than the pump dewatering rates.

[9] Stantec. 2021. Environmental Assessment Registration Document for the Touquoy in-pit Disposal Project.
[10] Stantec. 2021. Groundwater Flow and Solute Transport Modelling to Evaluate Disposal of tailings in Touquoy Open Pit. Dated February 8,2021
[11] Framework for Assessing the Ecological Flow Requirements to Support Fisheries in Canada" (DFO 2013).

## 3.1 PIT DEWATERING

The existing Touquoy pit is routinely dewatered as water accumulates at the bottom of the pit from direct precipitation and seepage inflows. An inline totalizing flow meter is used to monitor the volume of water pumped from the Touquoy open pit. The recorded volumes were converted to average daily flow rates by taking the difference between total volume readings each day. For days where no readings were recorded, the volumes were interpolated for the days between readings based on the available data. Monthly pit dewatering rates are presented on Figure 3.1 and the daily values are presented with streamflows in the results and interpretation sections.




| Year | Average Monthly Pit Dewatering Rates (m³/d) up to the end of September 2021 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
| 2019 | 1708 | 1164 | 1465 | 2592 | 900 | 1183 | 252 | 346 | 643 | 1451 | 2635 | 2457 |
| 2020 | 1261 | 1148 | 2397 | 2754 | 1373 | 422 | 902 | 366 | 1270 | 1296 | 1902 | 2117 |
| 2021 | 1795* | 2566 | 2295 | 1451 | 1368 | 763 | 632 | 1552 | 1628 | NA | NA | NA |

Note: * indicates average calculated using less than a complete month of data due to problems with flow meter/frozen pipeline. The rates of pumped flow from Scraggy stockpile was removed from pit dewatering flows, based on the metered data for the 2021 monitoring period.

**Figure 3.1 Metered Pit Dewatering Flow**

Annual pit dewatering volumes as of the end of September 2021 are projected to be in the range of past years. Average monthly pit dewatering rates in 2021 have been within the observed range in 2019 and 2020, between 643 m$^3$/d and 1,561 m$^3$/d.

## 3.2 ECOLOGICAL FLOW REQUIREMENTS

Consistent to 2020 and 2019 hydrometric monitoring review, potential for environmental effects of the project were assessed based on the two criteria outlined in the “Framework for Assessing the Ecological Flow Requirements to Support Fisheries in Canada” (DFO 2013) are summarized in the Table 3.1. These criteria were used in our review as a guide to trigger the potential for an environmental effect.

Alterations in flow in excess of these criteria may result in potential effects to fish and fish habitat, including decreases in wetted perimeter and physical area of fish habitat available, and the creation of barriers to fish passage and changes to water temperature during periods of low flow.

**Table 3.1 Ecological Flow Metrics**

| Criterion No. | Ecological Flow Criteria | Reduction Threshold |
|---|---|---|
| 1 | *Cumulative flow alterations <10% in amplitude of the actual (instantaneous) flow in the river relative to a “natural flow regime” have a low probability of detectable impacts to ecosystems that support commercial, recreational or Aboriginal fisheries. Such projects can be assessed with “desktop” methodologies.*[12] | 0.0057 $m^3/s$ of mean annual baseflow &<br>0.0035 $m^3/s$ of mean summer baseflow from pre-development conditions |
| 2 | *Cumulative flow alterations that result in instantaneous flows < 30% of the mean annual discharge (MAD) have a heightened risk of impacts to fisheries.* | 30% of MAD = 0.345 $m^3/s$. |
| Source 1: Mean annual discharge at SW-2 is estimated to be 1.15 $m^3/s$. Therefore, to meet the first ecological flow criterion, alterations to mean annual baseflow in Moose River related to mining operations should not decrease by ≥0.0057 $m^3/s$, and summer baseflow by ≥0.0035 $m^3/s$ from pre-development conditions, as described in the response to 20-MAR-00531-02 (Stantec 2021[13]), based on the extent of the August 2019 pit shell. | | |
| Source 2: Mean annual discharge at SW-2 is estimated to be 1.15 $m^3/s$. Therefore, to meet the second ecological flow criterion, alterations to instantaneous flows related to mining operations should not result in flows less than 30% of mean annual discharge, equivalent to below 0.345 $m^3/s$ at SW-2. | | |

[12] Framework for Assessing the Ecological Flow Requirements to Support Fisheries in Canada” (DFO 2013).
[13] Stantec Consulting Ltd. (Stantec). 2021. Response to DFO Request 20-HMAR-00531 – Moose River Request for Studies Halifax County, Nova Scotia. March 24, 2021. Issued to Atlantic Mining NS Inc.

# 4.0 RESULTS & INTERPRETATION

The results and interpretation of the 2021 flow monitoring program are provided in the sections below. The results were reviewed weekly to identify effects of the Project, in particular pit dewatering.

## 4.1 AVERAGE DAILY FLOW

Figure 4.1 presents the observed average daily flow in $m^3/s$ over the monitoring period between June 1 and the end of September 2021 on the primary x-axis and the Halifax Stanfield International Airport climate station (Environment and Climate Change Canada 2021) on the secondary x-axis. The flow is presented to 2.0 $m^3/s$, associated with the applicability of the associated rating curves. As observed in Figure 4.1 and discussed in Section 4.2, the flow response to precipitation events at the Long Lake tributary to Moose River HM-1 is attenuated compared to the response in the Moose River main branch. For the most part, flow show increase with progression downstream in Moose River due to an increase in catchment area. Generally, flows at SW-2 observed in 2021 were slightly higher than flows observed in 2019 and 2020 and had a similar response to precipitation events.

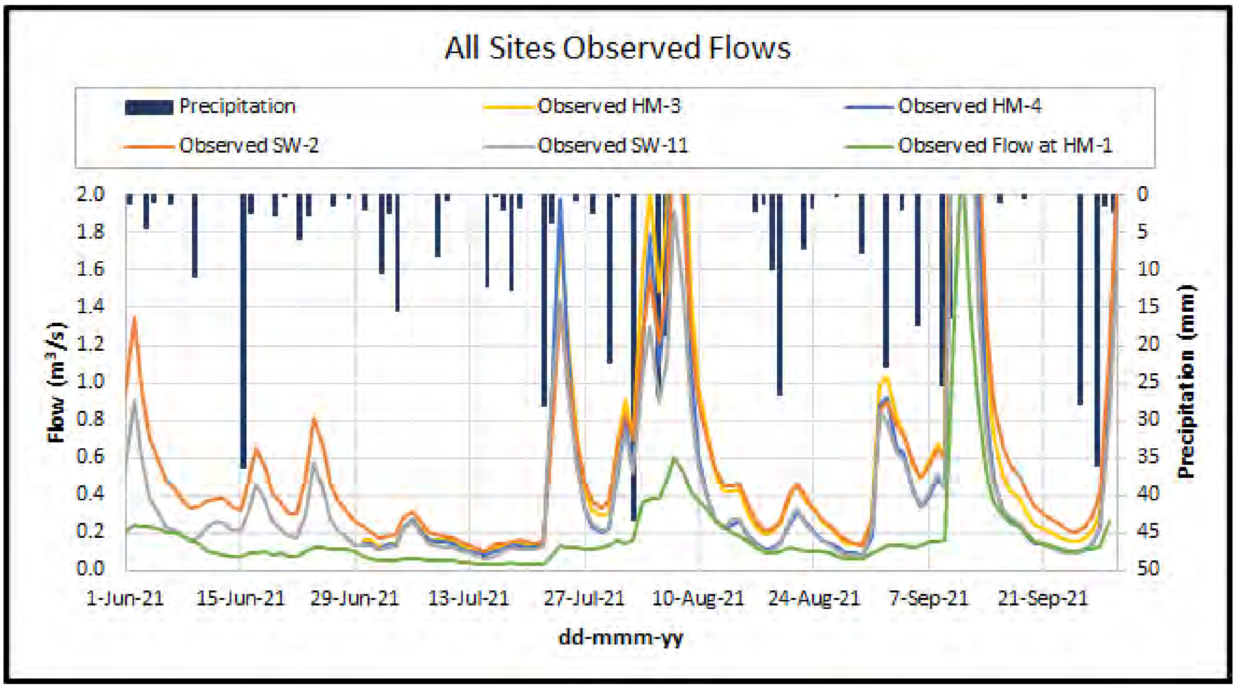



**Figure 4.1 Average Daily Flow and Total Precipitation Over Time for All Stations**

## 4.2 ATTENUATED FLOWS AT HM-1 HYDROMETRIC STATION

Figure 4.2 presents the flow-times series at HM-1 hydrometric station for the monitoring period in 2021 between June 1 and the end of September. As observed in 2019 and 2020 data (Stantec July 2021[14]), the results show a delay in the discharge response at HM-1 following large precipitation events, due to a delay in transit time of precipitation through the watershed (lag-time). HM-1 has a large headwater lake, Long Lake, which acts as a reservoir that can store runoff from precipitation events and release it more gradually than observed in the main channel of Moose River. Storage in Long Lake builds up from precipitation events in mid-June to mid-July, as flow in the tributary does not respond to these events. Rises in discharge rates are observed beginning mid-July to mid-August and again in mid-September.

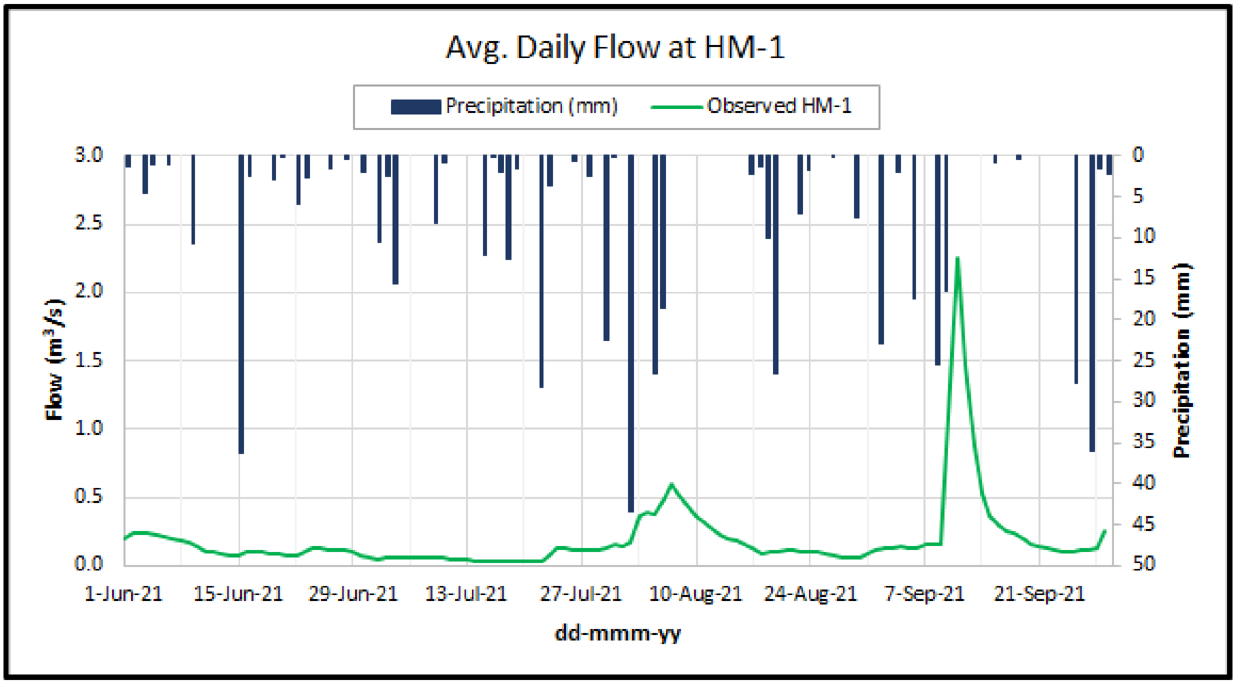



**Figure 4.2 Average Daily Flow and Total Precipitation Over Time at HM-1**

[14] Stantec Consulting Ltd. (Stantec). 2021. Response to DFO Request 20-HMAR-00531 – Moose River Request for Studies Halifax County, Nova Scotia. July 30, 2021. Issued to Atlantic Mining NS Inc.

## 4.3 ASSESSMENT OF FLOW LOSSES

The observed flows at stations HM-3, HM-4, and SW-2 were compared to the calculated flows at the associated stations based on area pro-rating (also referred to as regional extrapolation) flow measurements at SW-11 and HM-1, as these stations are outside of the drawdown cone of depression of the pit developed in groundwater modeling. Calculated flows are prorated based on catchment area (A, $km^2$) from SW-11, for example:

Calculated Flow $Q_{HM-3} = Q_{SW-11} * (A_{HM-3} / A_{SW-11})$

When calculating flow downstream of the Long Lake tributary at HM-1 calculated flows sum the tributary flow and main branch, for example:

Calculated Flow $Q_{HM-4} = Q_{HM-1} + Q_{SW-11} * (A_{HM-4} / (A_{SW-11} + A_{HM-1})$

Flow hydrographs overtime are depicted in Figures 4.3 to Figure 4.5, for flows up to 2.0 $m^3/s$; corresponding to the maximum flows measured during the in-situ flow monitoring events and the resultant applicability of the stage discharge curve. There are periods when these observed streamflows were lower than the calculated (prorated) streamflows, indicating a potential loss to Moose River, particularly in mid-September observed at HM-3, HM-4 and SW-2. Potential losses to Moose River were calculated from the difference of calculated (prorated) from observed as shown in Figure 4.6.

### 4.3.1 Ecological Flow Criterion 1

The reduction threshold for Ecological Flow Criterion 1 is 0.0057 $m^3/s$ of mean annual baseflow and/or 0.0035 $m^3/s$ of mean summer baseflow from pre-development conditions (Table 3.1) and is based on cumulative flow alterations <10% in amplitude of the actual (instantaneous) flow in the river relative to a "natural flow regime".

There are periods for which calculated potential losses amount to more than 10% of the instantaneous stream flow (Criterion 1). Consistent to what was observed in past years, particularly in September and October 2019; these losses greater than 10% occur throughout the low flow period as shown in Figure 4.7, and Table 4.1.

As illustrated in Figure 4.6 and 4.7, generally, the volume of water removed from the pit is up to an order of magnitude less than the corresponding calculated potential streamflow reduction in Moose River. Based on this assessment, streamflow reductions in Moose River would normally occur without the consideration of pit dewatering. As noted earlier, water that is removed from the pit is contributed from direct precipitation to the pit and groundwater seepage. Given that the metered pit dewatering rates are lower than the streamflow reductions, the streamflow reductions in Moose River cannot be wholly attributed to pit dewatering. The upper bound of the proportion of potential calculated losses which could result from dewatering of the open pit on days with more than 10% decrease in instantaneous stream flows, averaged over the monitoring period between Jun 1 and Sep 30, 2021 is summarized in Table 4.1. In 2021, pit dewatering can only account for up to 15% of the total potential losses in stream flow on days where a more than 10% decrease in instantaneous stream flow was observed.

The project effect of pit dewatering does not exceed Criterion 1, calculated potential flow losses that exceeds Criterion 1 would occur if no pit dewatering occurred. The evaluation of the flow assessment to Criterion 1 is summarized in Table 4.1.

**Table 4.1 Evaluation of the Flow Assessment to Criterion 1**

| Station | Ecological Flow Criterion 1 Exceeded | | Project Effect Exceeding Criterion 1 | |
|---|---|---|---|---|
| HM-3 | Yes | Single occurrence on Jul 24,2021 of potential calculated losses >10%<br>Upper bound of proportion of total decrease in instantaneous streamflow attributed to Pit is 15% | No | The modelled project-related reduction in baseflow of 4.5% in relation to the Touquoy pit does not exceed Criterion 1.<br>In addition, the pit dewatering rates (negating the fact that dewatering rates are also attributed to direct precipitation) are lower than observed flow reductions and therefore flow reductions can only be partially attributable to pit dewatering. |
| HM-4 | Yes | Intermittently throughout 2021 monitoring period<br>Upper bound of proportion of total decrease in instantaneous streamflow attributed to Pit is 15% | No | |
| SW-2 | Yes | Occurrences on Jul 24, Aug 3, Aug 7, Sep 1, 2021 of potential calculated losses >10%<br>Upper bound of proportion of total decrease in instantaneous streamflow attributed to Pit is 9% | No | |

## 4.3.2 Ecological Flow Criterion 2

The reduction threshold for Ecological Flow Criterion 1 is 0.345 $m^3$/s (Table 4.1) and is based on cumulative flow alterations that result in instantaneous flows < 30% of the mean annual discharge (MAD).

As noted in Figure 4.6, a calculated potential loss to Moose River at HM-4 exceeding Criterion 2 was observed for approximately three days (September 13, 14, 15, 2021) of the 122-day monitoring period. The cumulative calculated potential flow loss over the three days amounts to 1.183 $m^3$/s, as presented in Figure 4.8, showing the losses to Moose River at a higher resolution scale. This loss in flow resulted in a temporary reduction of water depth of 0.389 m, occurred during a dry period without rain for several days, and was not observed downstream at SW-2 nor upstream at HM-3. An explanation for the temporary potential loss at HM-4 is that flow in Moose River is expanding into the adjacent wetland (Wetland 22) as “interflow” and coming back into the stream around the bend. This is likely occurring more predominately during low flow periods. This inaccessible portion of the river flow that may be stored in Wetland 22 would not be captured in flow monitoring and therefore the lower portion of the stage discharge curve may be biased low. In addition, there is an inundated remnant wooden plank structure located 30 m downstream of the station that likely results in some backwater during lower flows and may influence the stage discharge relationship at this station. At the lowest observed water level during the 2021 monitoring program, the water level in the river was cresting the top of the remnant wooden plank structure.

The upper bound of the proportion of potential calculated losses of pit dewatering flows, averaged over the monitoring period between Jun 1 and Sep 30, 2021 is summarized in Table 4.1. In 2021, pit dewatering can only account for up to 0.05% of the potential losses at HM-4. Observed pit dewatering average rates over the monitoring period amounts to less than 1% of the flow loses to Moose River at both HM-4 or SW-2.

The project effect of pit dewatering does not exceed Criterion 2. The evaluation of the flow assessment to Criterion 1 is summarized in Table 4.2

**Table 4.2 Evaluation of the Flow Assessment to Criterion 2**

| Station | Ecological Flow Criterion 2 Exceeded | | Project Effect Exceeding Criterion 2 | |
|---|---|---|---|---|
| HM-3 | No | No exceedances | No | The modelled project-related reduction in baseflow of 4.5% in relation to the Touquoy pit does not exceed Criterion 2. In addition, the pit dewatering rates (negating the fact that dewatering rates are also attributed to direct precipitation) is lower than observed flow reductions and cannot be wholly attributable to pit dewatering. |
| HM-4 | Yes | Occurrences on September 13, 14, and 15, 2021<br>Upper bound of proportion of loss attributed to Pit of 0.05% | No | |
| SW-2 | No | No exceedances | No | |

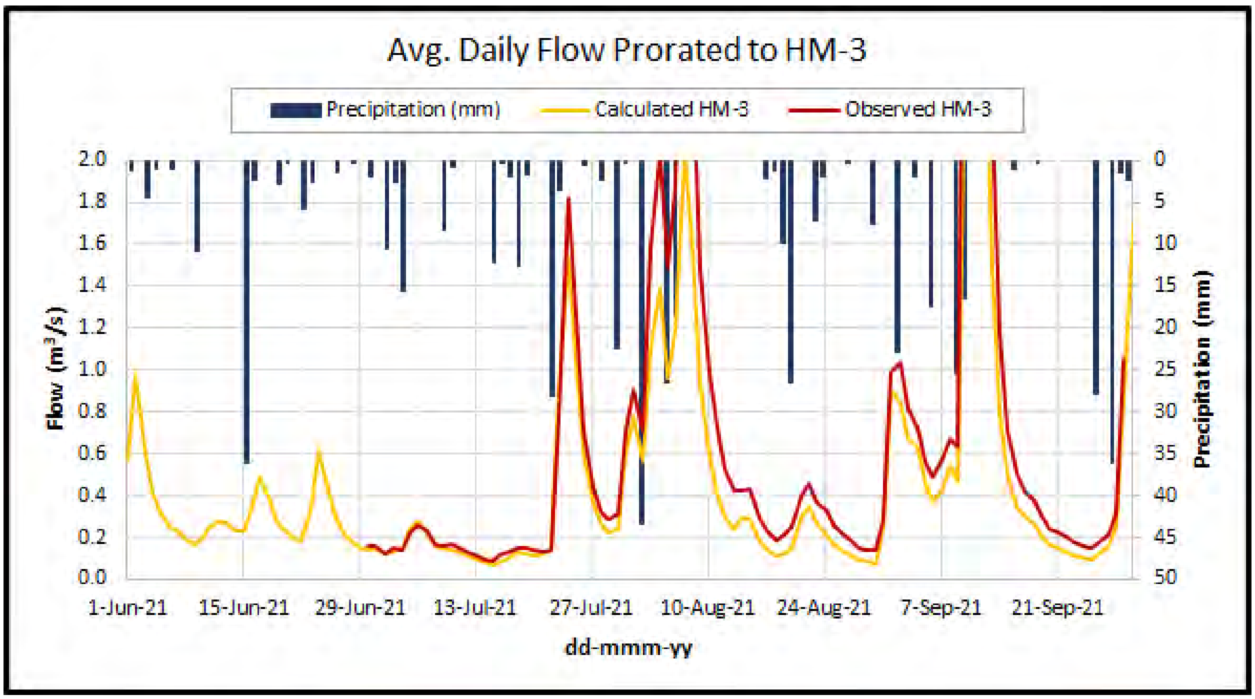



**Figure 4.3 Average Daily Flow and Total Precipitation Over Time at HM-3 (Calculated Vs. Observed)**

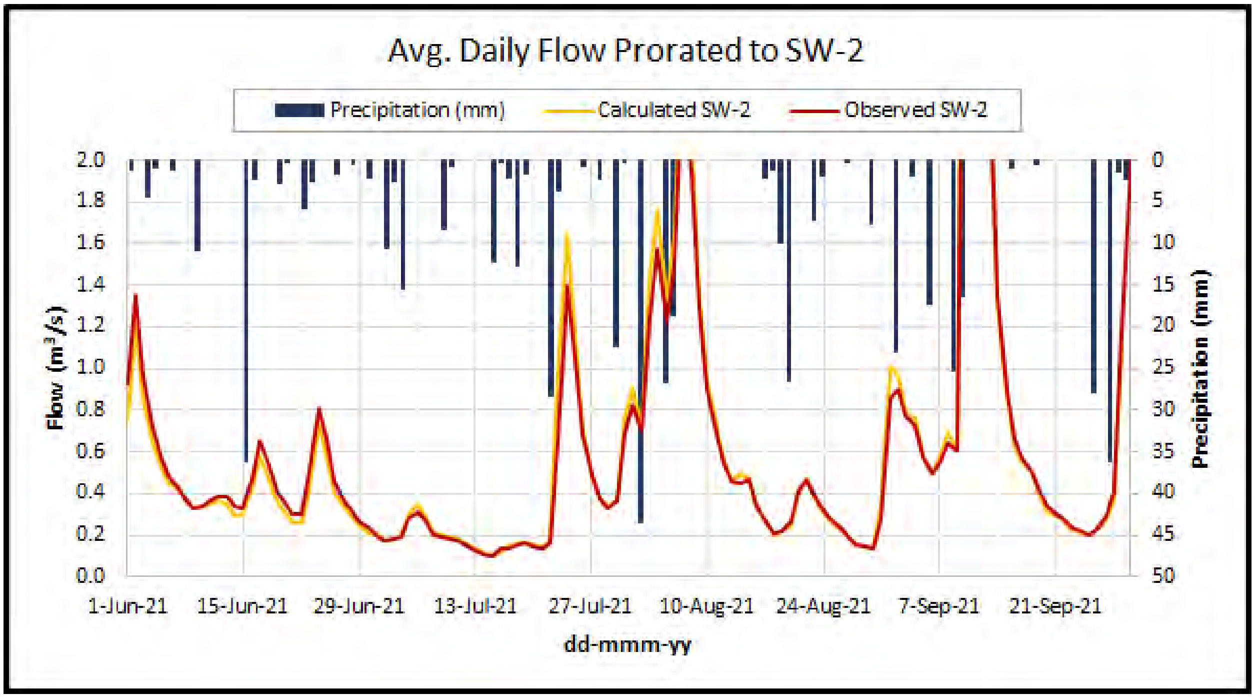



**Figure 4.4 Average Daily Flow at Total Precipitation Over Time at SW-2**

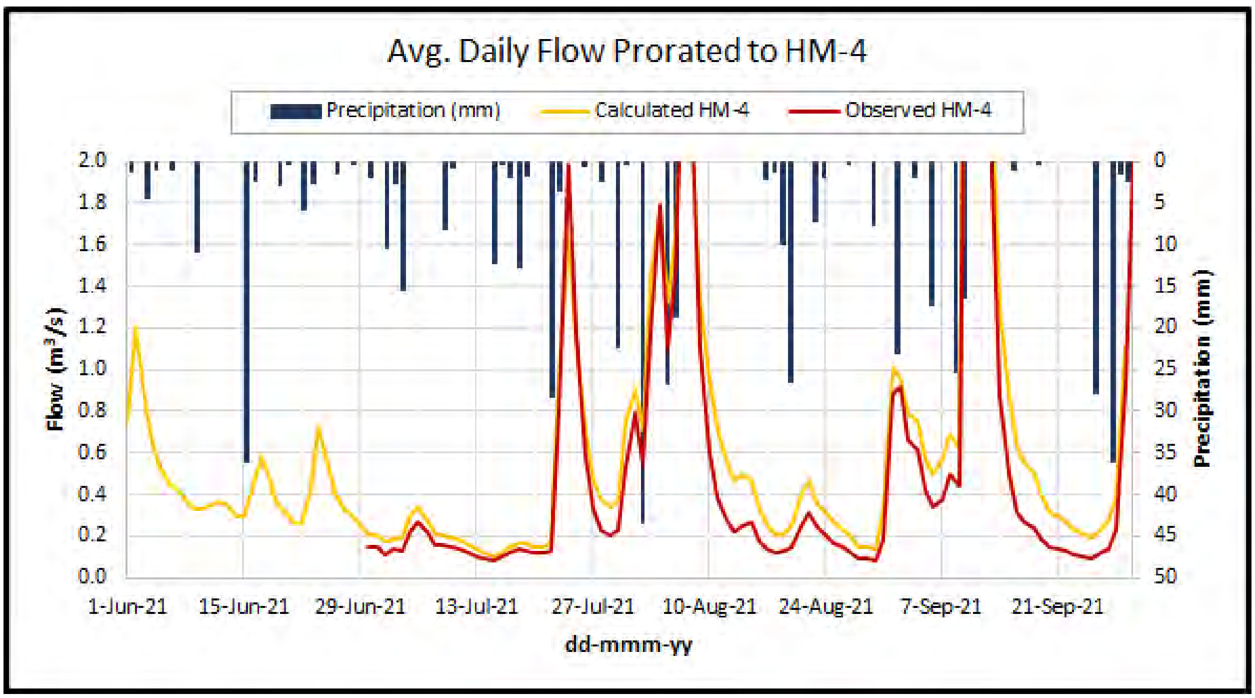



**Figure 4.5 Average Daily Flow at Total Precipitation Over Time at HM-4**

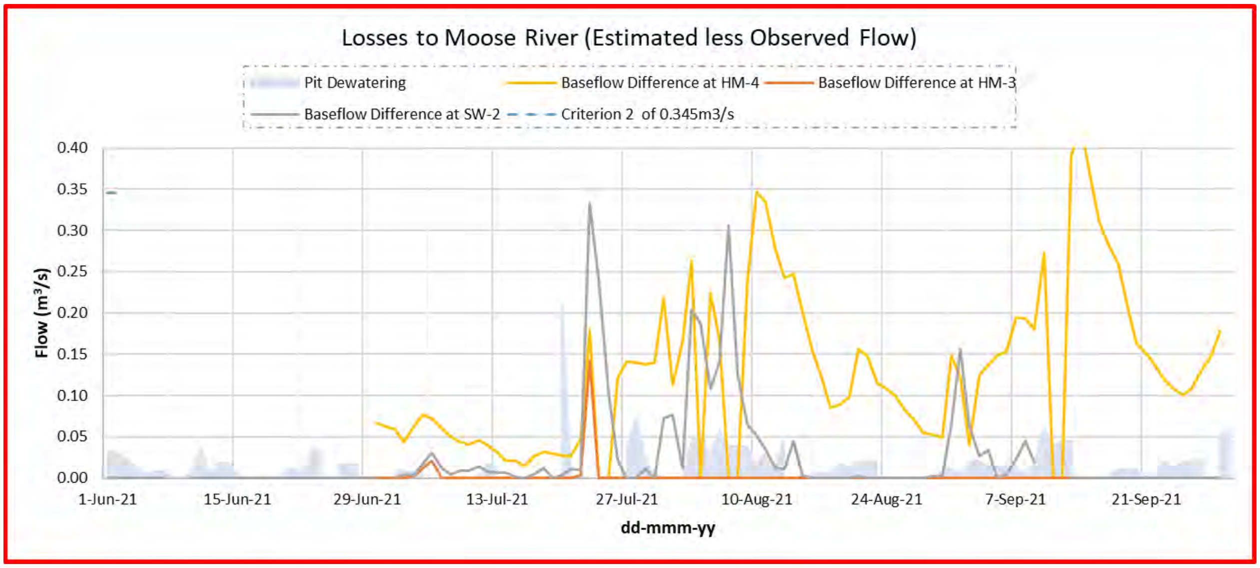



**Figure 4.6 Calculated Potential Flow Losses to Moose River**

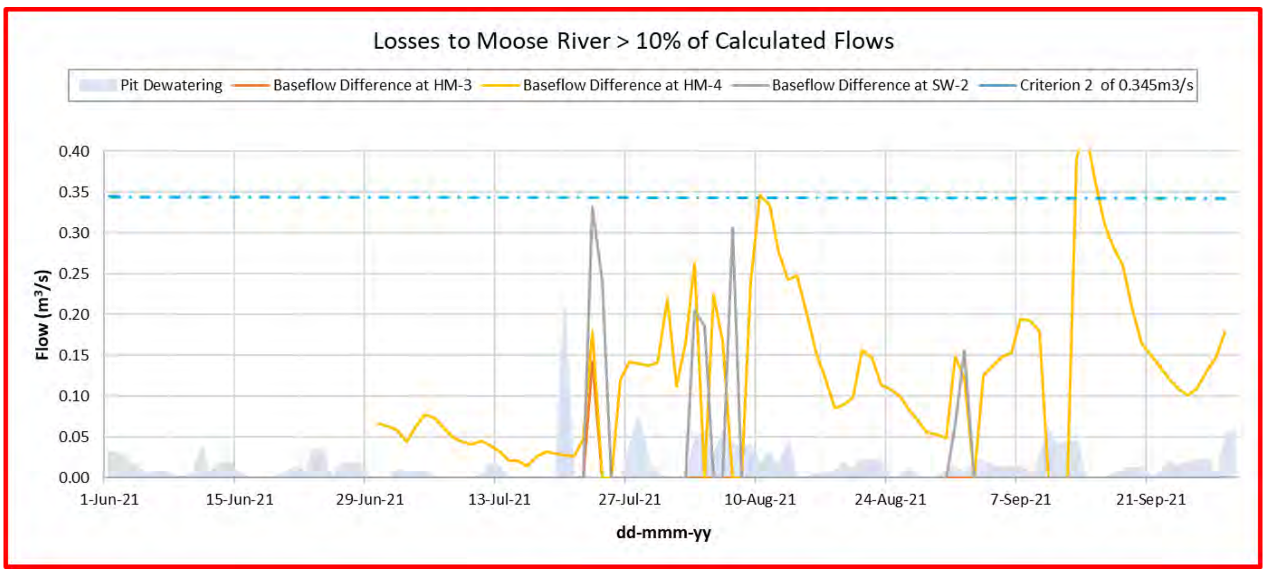



**Figure 4.7 Calculated Potential Flow Losses Greater than 10%**

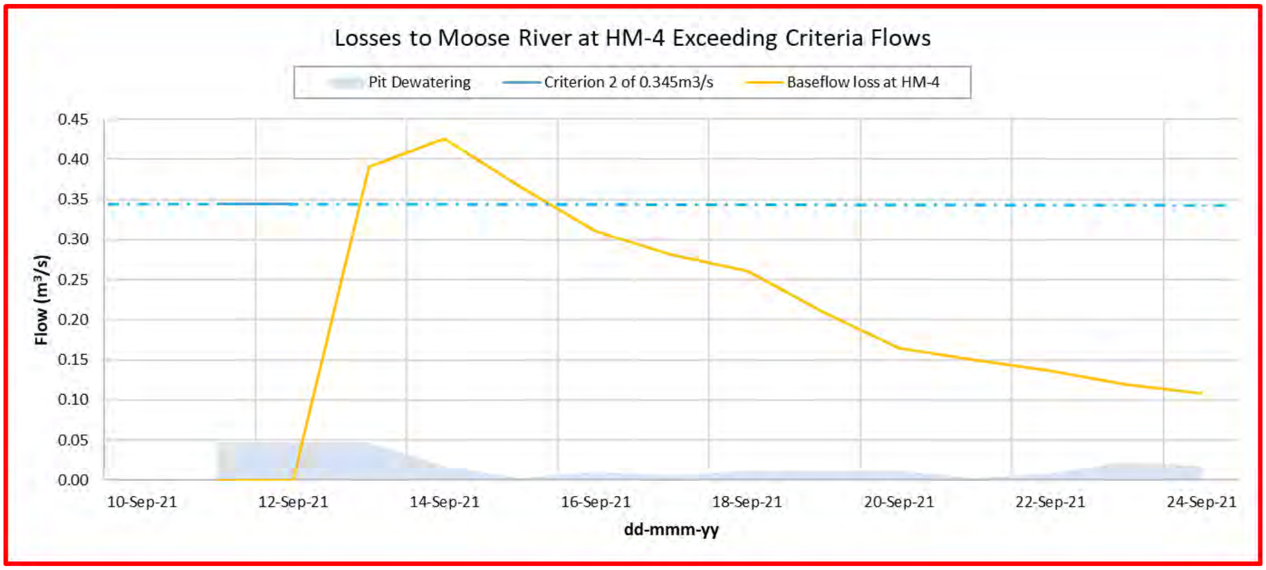



**Figure 4.8 Calculated Potential Flow Losses at HM-4 Exceeding Criterion 2**

# 5.0 INTEPRETATION OF FLOW ASSESSMENT

As described in in the Stantec response to October 9, 2020, Information Request (Reference 20-HMAR-00531 dated March 24, 2021, these modelled baseflow reductions amount to no more than 4.5% of streamflow estimated at SW-2 based on upstream flow in Moose River in 2019, 2020 and 2021. The modelled project-related reduction in baseflow of 4.5% in relation to the Touquoy pit does not exceed either of the two ecological flow criteria and is below a 10% alteration in magnitude of instantaneous flow in Moose River, including during low flow periods in the summer months.

In addition, pit dewatering is not attributed to the calculated potential losses to Moose River as a whole. The metered pit dewatering rates, which also include direct precipitation to the pit are up to an order of magnitude lower than the calculated potential losses to Moose River. The remaining portion of the calculated potential flow losses to Moose River may be attributed to a combination of factors that are not related to Touquoy Mine Site operation, including:

- Evapotranspiration losses, as indicated in correspondence from NRCan (2020)[15] that flow observed in rivers during the warm summer months is subject to heavy evapotranspiration losses (20-50% of the flow)

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[15] Natural Resources Canada (NRCan). 2020. Letter from Shelley Ball titled “Additional expert advice on scope of work for the Touquoy Groundwater Model”, dated December 22, 2020.

- Interflow losses through adjacent hydrophytic vegetation (i.e., Wetland 22) at HM-4; thus, streamflow monitoring data at this monitoring location may not be representing all the flow in Moose River at this location.
- The presence of a remnant wooden structure with the potential to influence the rating curve more pronouncedly in lower flows
- The flow response from precipitation events at HM-1 Long Lake tributary varying from the response in Moose River; thus, showing a delay in discharge from rainfall events
- Natural characteristics of the river and watershed

Although quality control and accuracy of the 2021 hydrometric monitoring program was high, there are limitations in the data collection and methodology that cannot be avoided, including the following:

- limitation of instrument accuracy in the water level and flow monitoring data, compensation, and correction
- inherent method error associated with any aerial pro-rating upstream hydrometric stations to downstream stations adjacent to the pit. Natural variation in the watercourse over time, subtle changes to the watercourse as a result of a mobile bed layer

As this loss was not observed in pit dewatering flow rates or downstream at SW-2, it is perceived as and wetland material and/or measurement error. Substantive residual effects to fish habitat as a result of the open pit are not anticipated, and no mitigation measures are proposed.

As demonstrated with presentation of daily pit dewatering data, instantaneous flow rates are predicted to be reduced below Criterion 2, the 30% of MAD threshold of 0.345 m3/s due to project related effects in relation to the Touquoy pit. Hydrometric data review indicated that Criterion 2 was exceeded on HM-4 for three days in September 2021, however, making the assumption that all pit dewatering volume is taken from Moose River (i.e., negating the fact that some water is from direct precipitation to the pit) this criterion would be exceeded even with eliminating the pit dewatering activity. The flow reduction is an order of magnitude higher than the dewatering rate pumped from the pit. Therefore, the estimated flows losses are not exclusively sourced to the pit. Estimated flow losses are thought to be a combination of factors described above plus the potential of interflow through the adjacent low-lying wetland floodplain and the presence of the remnant wooden structure 20 m downstream.

Consistent with the findings of previous analysis outlined in correspondence provided in March 2021, substantive residual effects to fish habitat as a result of the open pit are not anticipated.

# 6.0 SUMMARY & NEXT STEPS

The 2021 Moose River hydrometric monitoring program on Moose River and Long Lake assessed the effects of operation of the mine on flows in Moose River, as required under the existing Industrial Approval and in response to DFO Ministerial Request 20-HMAR-00531. The program was conducted in accordance with the ISO standards referenced in the industrial approval and achieved a measurement accuracy within internal SOPs, and WMO guidelines. The program is limited to instrument accuracy and natural variability. No improvements to the 2021 hydrometric program are recommended.

Potential losses to Moose River were calculated using the 2021 monitoring data. Metered pit dewatering rates are up to an order of magnitude lower then calculated potential losses to Moose River and therefore cannot account wholly for the potential losses in Moose River. Predicted reductions in baseflow attributed to pit dewatering amounted to less than 4.5% and do not exceed ecological flow Criteria 1 and 2 (see Section 3.1).

The findings of the present study are summarized below:

- The 2021 monitoring results at SW-2 provide a similar pattern to previous years in 2019 and 2020.
- The additional two new flow monitoring stations at HM-3 and HM-4 facilitated a more detailed comparison of flows from upstream to downstream.
- The reach upstream and downstream of monitoring station HM-4 may not be optimal for hydrometric monitoring due to the presence of a wetland (Wetland 22) that may affect the accuracy of the stage discharge curve, as streamflow monitoring data at this monitoring location may not be representing all the flow in Moose River at this location.
- Potential flow losses in Moose River were calculated at hydrometric monitoring stations HM-3, HM-4 and SW-2.
- Potential calculated flow losses in Moose River were consistent to what was observed in past years; with intermittent losses amounting to more than 10% of the instantaneous stream flow (Criterion 1).
- For the June 1 to September 30, 2021 monitoring period the average flow reductions exceeded observed pit dewatering rates (i.e. amounting to less than 1% of the average total loss to Moose River) and therefore the reductions observed in Moose River can only be partially attributed to the pit operation (i.e., as an upper bound of 15% or less of total decease in stream flow). The remainder of losses may be attributed to a combination of factors such as natural characteristics of the river and inherent limitations of accuracy of hydrometric monitoring and comparison of losses.
- The calculated baseflow reduction of no more than 4.5% of Moose River flow at SW-2 in 2019, 2020, and 2021 is below Criterion 1, which is a 10% alteration in magnitude of instantaneous flow in Moose River.
- No instantaneous flow rates are predicted to be reduced below Criterion 2, which is a reduction of 30% of MAD threshold, or 0.345 $m^3/s$ in Moose River at SW-2. A potential loss to Moose River at HM-4 was calculated for three days that exceeds Criterion 2, however, this magnitude of potential loss is not attributed to pit dewatering because this exceedance would have occurred naturally, without any contribution from pit dewatering. The potential flow loss due to pit dewatering is an order of magnitude lower than the calculated potential flow loss.
- Substantive residual effects to fish habitat as a result of pit dewatering are not anticipated.

# 7.0 CLOSURE

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# APPENDIX A

## Station Summaries

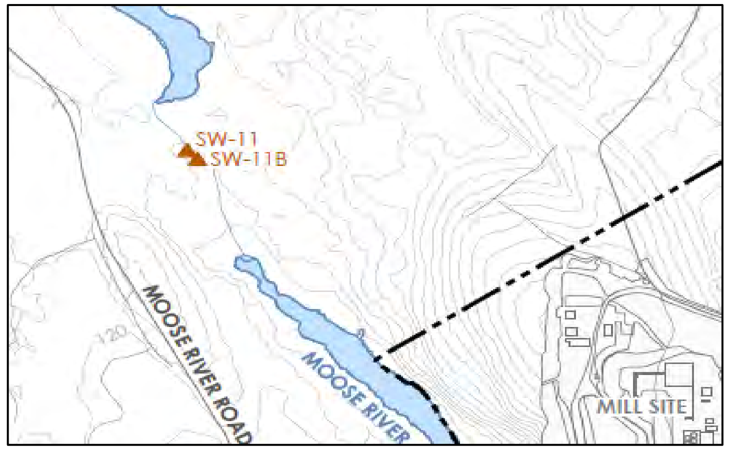
Stantec

## Hydrometric Station Summary

| | | | |
|---|---|---|---|
| **Hydrometric Station ID** | SW-11 | **Flow Meter** | OTT MF pro |
| **Location** | Northernmost station on Moose River | **Fixed Point Average** | 40 seconds |
| **Installation Date** | 25-Apr-18 | **Data Collected at site** | Water temperature, water level, atm. pressure |
| **Coordinates** | 20T 504126E, 4982555N | **Main channel** | Grassy vegetation, not clear |
| **Access** | Moose River Road | **Channel Bottom** | cobbles, gravel, grassy vegetation throughout |
| **Drainage Area** | 25.08 $km^2$ | **Flood Plain** | Tall grass, shrubs |
| **Period of Record** | August 2017-present | **Comments** | Extremely vegetated site. Recommendations made to relocate this site downstream aprprox. 60 m. (SW-11B) |

**Water Level**

Date: 28-Jul-21

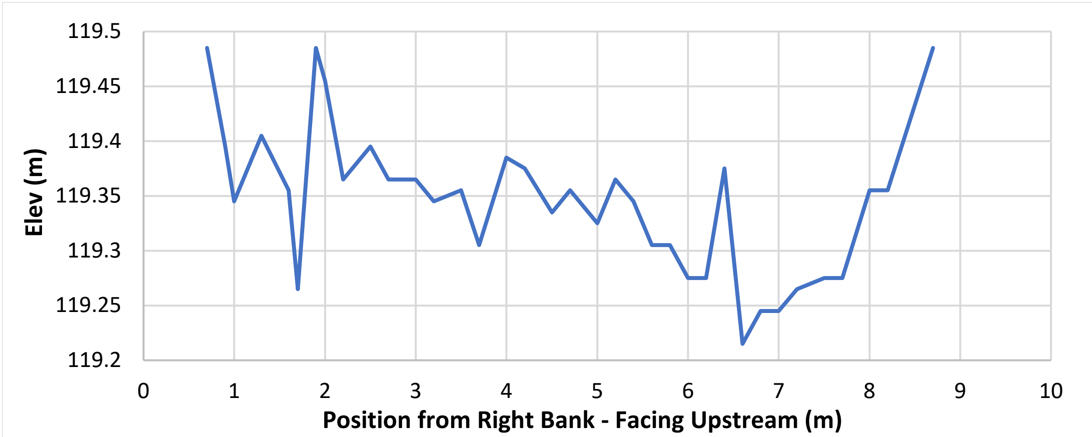

Map: SW-11, Upstream site on MR

SW-11 Facing Upstream, July 14, 2021

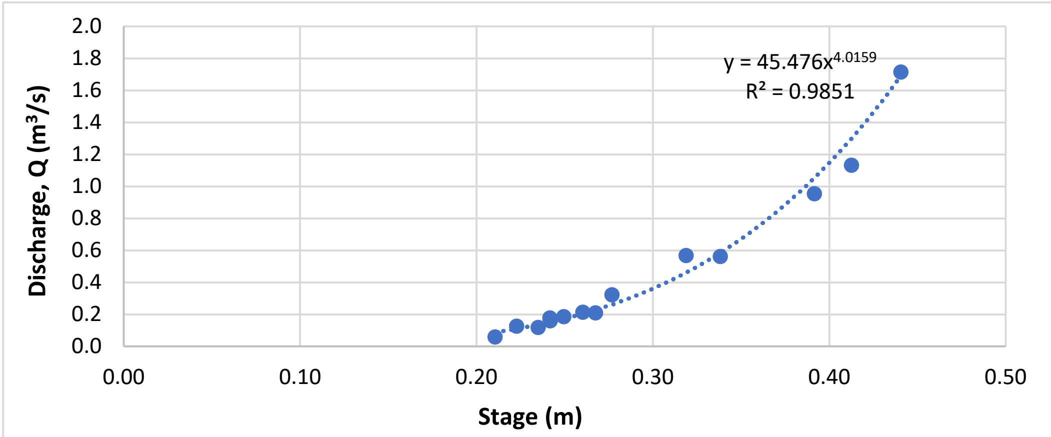
Downstream at SW-11, July 14, 2021

| dd/mm/yy h:mm | Water Elev. (m) | Q ($m^3/s$) | Accuracy % |
|---|---|---|---|
| 6/29/2021 | 0.22278 | 0.126 | |
| 7/8/2021 3:50 | 0.242 | 0.160 | 6.4 |
| 7/14/2021 15:00 | 0.211 | 0.060 | 6.5 |
| 7/21/2021 14:05 | 0.235 | 0.117 | 3.6 |
| 7/28/2021 17:05 | 0.267 | 0.208 | 49.7 |
| 8/3/2021 14:05 | 0.413 | 1.133 | 0.6 |
| 8/13/2021 14:00 | 0.277 | 0.323 | 5.6 |
| 8/17/2021 13:55 | 0.250 | 0.185 | 0.4 |
| 8/25/2021 13:55 | 0.260 | 0.214 | 6.8 |
| 9/1/2021 13:45 | 0.392 | 0.953 | 5.4 |
| 9/8/2021 13:35 | 0.338 | 0.562 | 2.7 |
| 9/15/2021 14:25 | 0.319 | 0.569 | 14.2 |
| 9/22/2021 12:40 | 0.242 | 0.178 | 11.4 |
| 9/30/2021 11:35 | 0.441 | 1.713 | 9.4 |

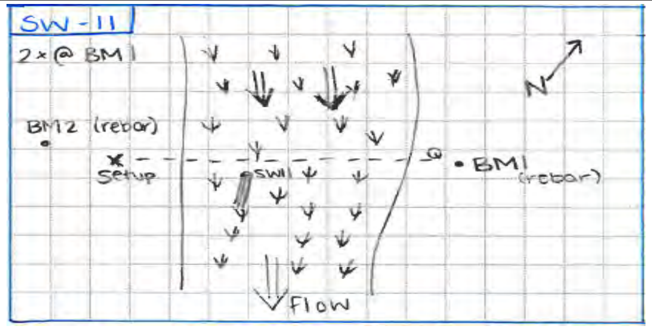
### Cross Section July 8, 2021




### Stage-Discharge Curve

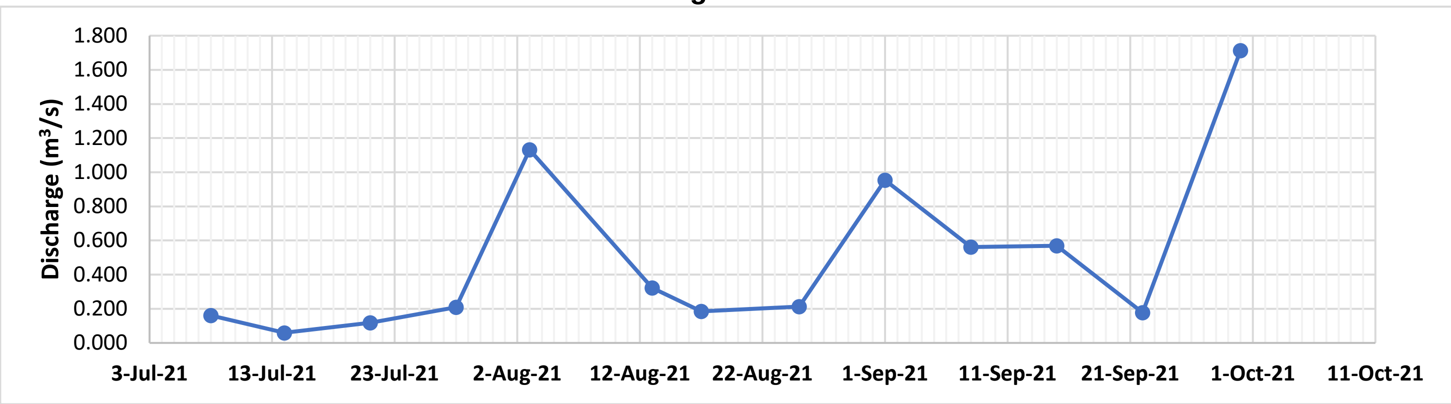



### Benchmark Elevation Surveys

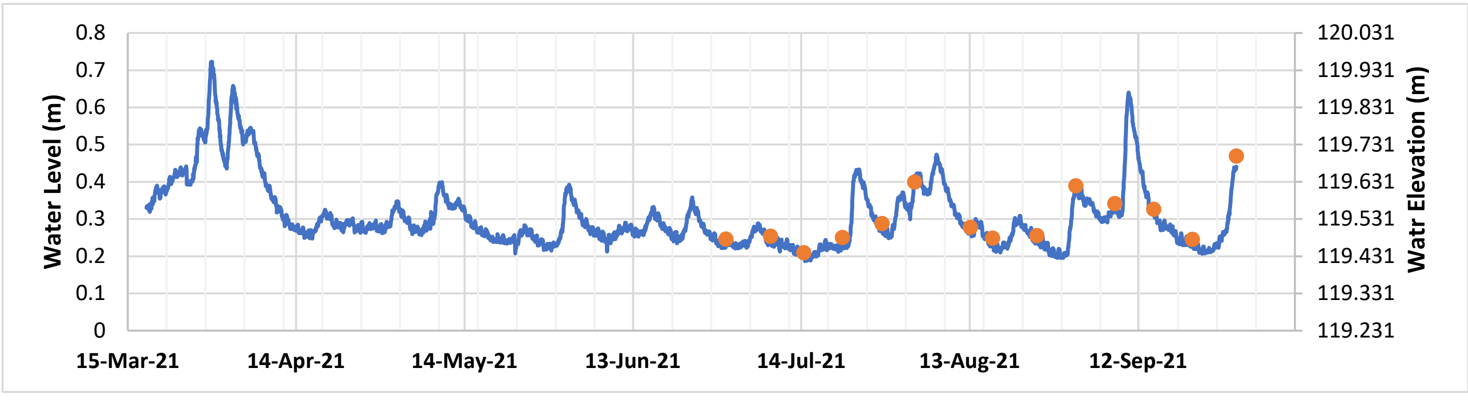



| Staff Gauge | BM-1 | BM-2 | Date |
|---|---|---|---|
| 120.231 | 120.262 | 120.194 | 6-Aug-21 |

### Discharge over Time




### Water Level over Time



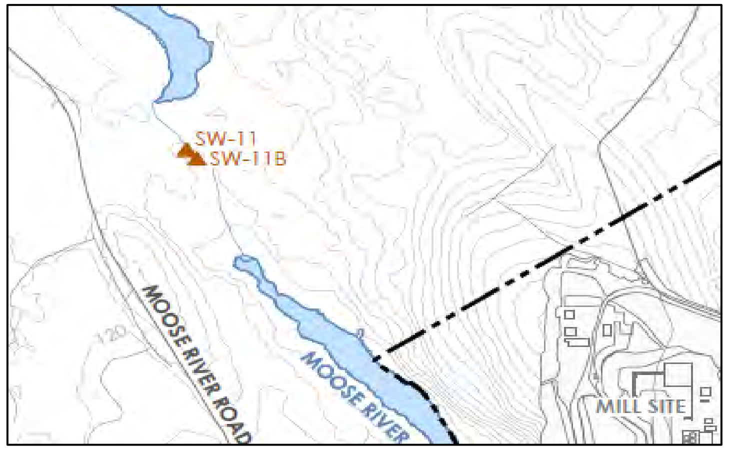
Stantec

## Hydrometric Station Summary

| | | | |
|---|---|---|---|
| **Hydrometric Station ID** | SW-11B | **Flow meter used** | OTT MF pro |
| **Location** | 60 m downstream of SW-11 on Moose River | **Fixed Point Average** | 40 seconds |
| **Installation Date** | 8-Jul-21 | **Data Collected at site** | Flow measurement, depths, and velocities |
| **Coordinates** | 20T 504146E 4982519N | **Main channel** | Clean and winding |
| **Access** | Moose River Road | **Channel Bottom** | Gravel, cobble substrate with boulders near banks |
| **Drainage Area** | 25.78 $km^2$ | **Flood Plain** | Tall grass |
| **Period of Record** | July 2021-present | **Comments** | Located 60 m downstream of SW-11. At this location, Moose River narrows, and flows SE. |

**Water Level**

Date: 21-Jul-21

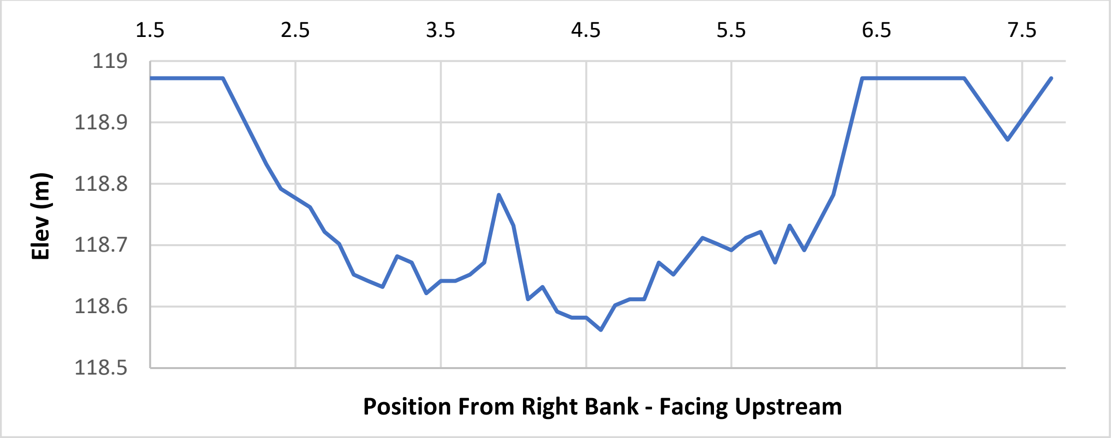

Map: SW11B - New upstream station

SW11B Facing Upstream - July 21, 2021

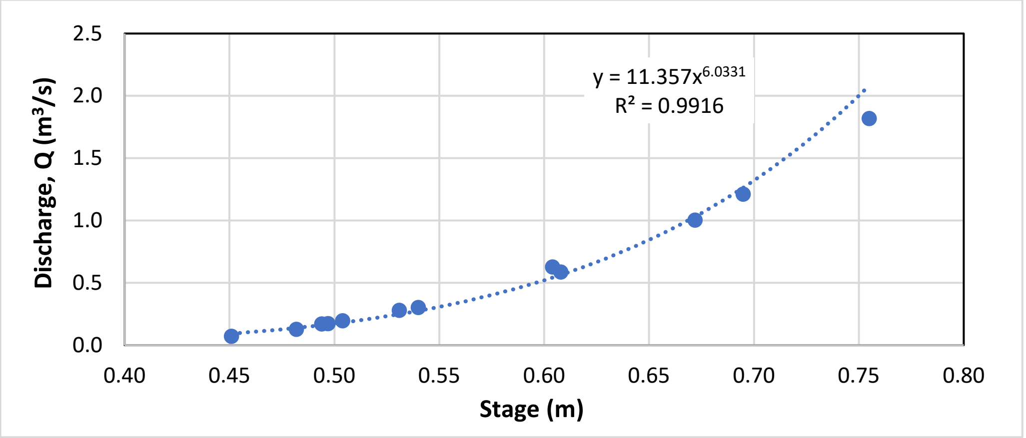
Downstream at SW11B - July 21, 2021

| Date | Stage (m) | Q ($m^3/s$) | Accuracy % |
|---|---|---|---|
| 30-Jun-21 | --- | | |
| 8-Jul-21 | --- | | |
| 14-Jul-21 | 0.451 | 0.072 | 0.5 |
| 21-Jul-21 | 0.482 | 0.128 | 3.5 |
| 28-Jul-21 | 0.540 | 0.303 | 1.3 |
| 3-Aug-21 | 0.695 | 1.210 | 1.1 |
| 13-Aug-21 | 0.531 | 0.279 | 8.2 |
| 17-Aug-21 | 0.494 | 0.169 | 8.6 |
| 25-Aug-21 | 0.504 | 0.197 | 6.8 |
| 1-Sep-21 | 0.672 | 1.003 | 3.5 |
| 8-Sep-21 | 0.604 | 0.627 | 1.2 |
| 15-Sep-21 | 0.608 | 0.587 | 1.6 |
| 22-Sep-21 | 0.497 | 0.173 | 5.0 |
| 30-Sep-21 | 0.755 | 1.818 | 5.6 |

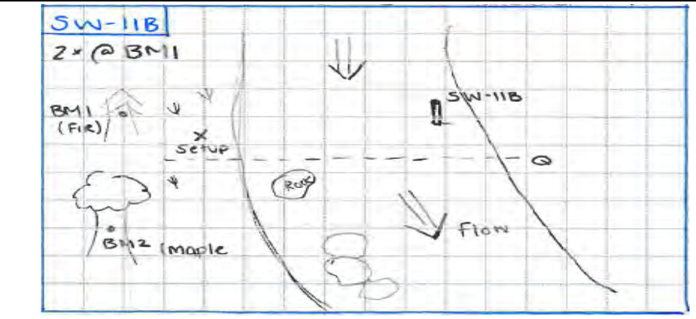
**Cross Section: July 8, 2021**




**Stage-Discharge Curve**

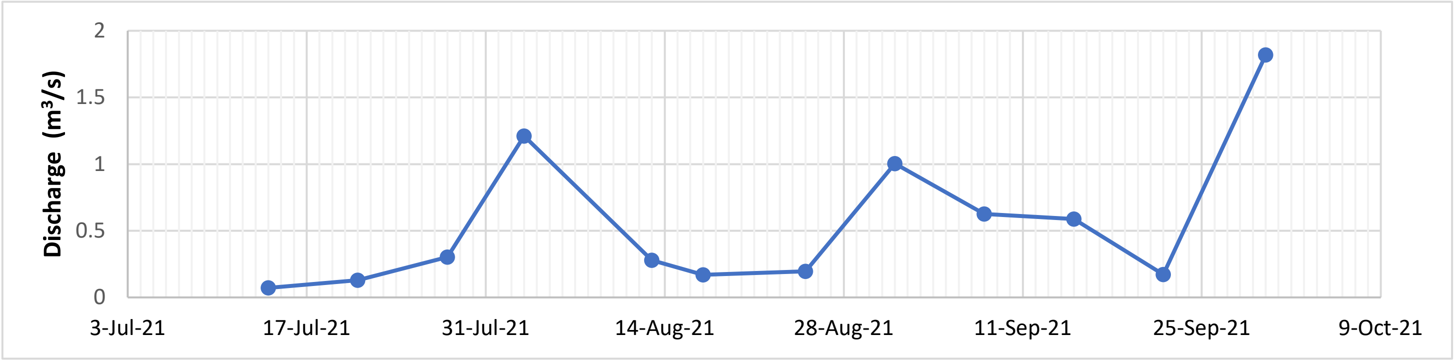



**Benchmark Elevation Surveys**

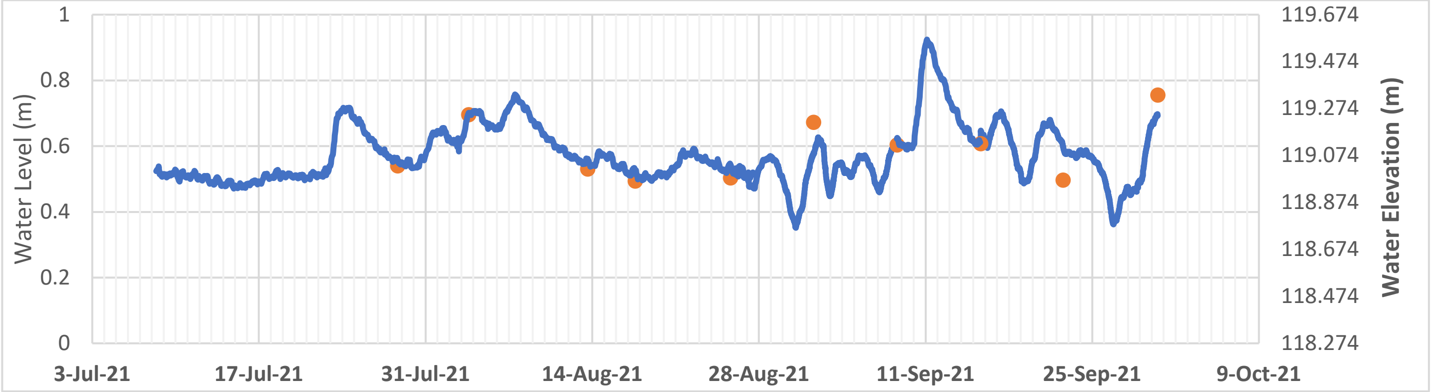



| Staff Gauge | BM-1 | BM-2 | Date |
|---|---|---|---|
| 119.521 | 119.633 | 120.167 | 6-Aug-21 |

**Discharge over Time**




**Water Level over Time**



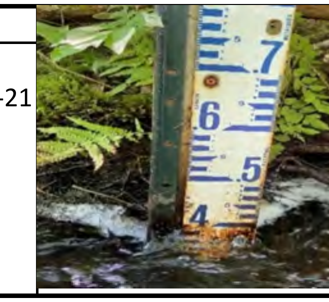
Stantec

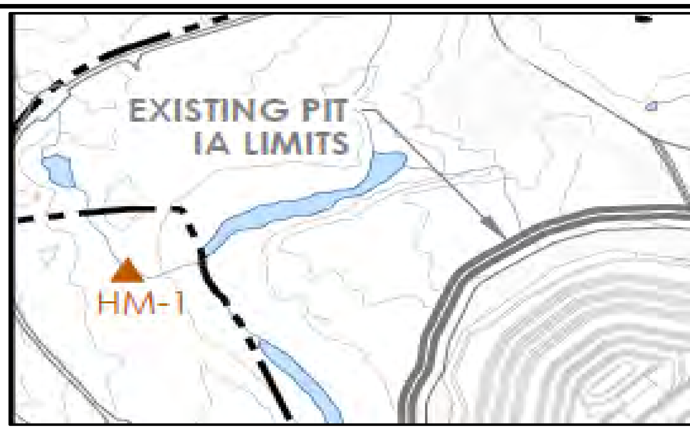
## Hydrometric Station Summary

| | | | |
|---|---|---|---|
| **Hydrometric Station ID** | HM-1 | **Flow Meter** | OTT MF pro |
| **Location** | Tributary to Moose River | **Fixed Point Average** | 40 seconds |
| **Installation Date** | 17-Aug-18 | **Data Collected at site** | Flow measurement, depths, and velocities |
| **Coordinates** | 20T 4981235E 503925N | **Main channel** | Clear |
| **Access** | Western Diversion Road | **Channel Bottom** | Gravel and cobbles |
| **Drainage Area** | 12.02 $km^2$ | **Flood Plain** | Tall grass, ferns, trees |
| **Period of Record** | August 2018-present | **Comments** | Narrow, shallow reach. Flows from a large lake (Long Lake) |

**Water Level**

Date: 26-Aug-21



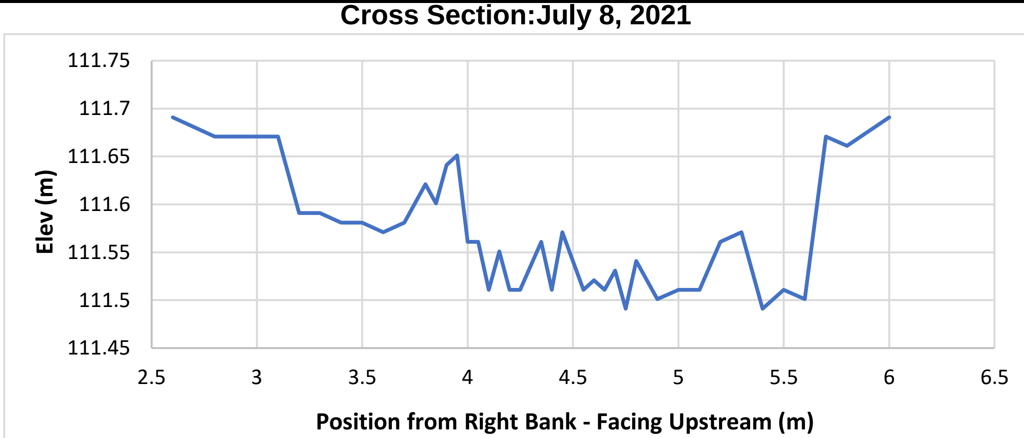

**Map: HM-1, Tributary to Moose River**

**Upstream photo: July 14, 2021**

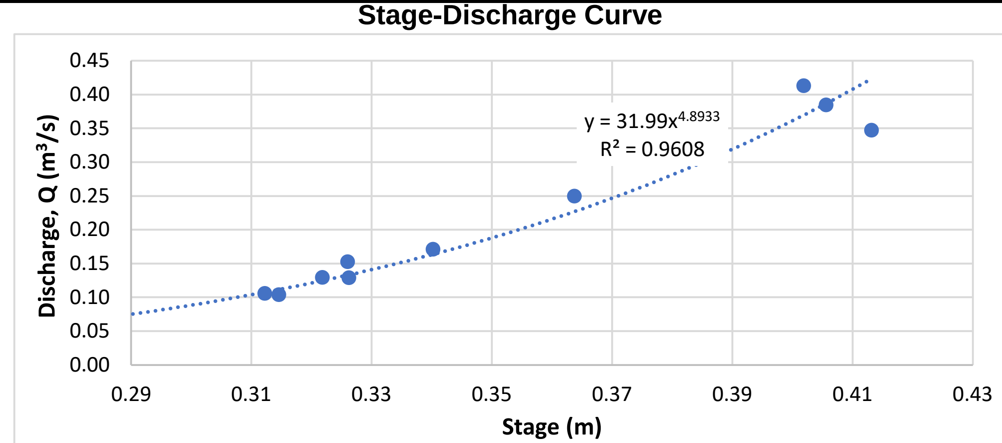
**Downstream photo: July 14, 2021**

| Date | Stage (m) | Q ($m^3/s$) | Accuracy % |
|---|---|---|---|
| 30-Jun-21 | 0.279 | 0.059 | |
| 8-Jul-21 | 0.284 | 0.064 | 8.9 |
| 14-Jul-21 | 0.254 | 0.036 | 3.1 |
| 21-Jul-21 | 0.240 | 0.033 | 12.6 |
| 28-Jul-21 | 0.315 | 0.104 | 27.8 |
| 3-Aug-21 | 0.413 | 0.347 | 3.5 |
| 13-Aug-21 | 0.364 | 0.250 | 1.3 |
| 17-Aug-21 | 0.326 | 0.129 | 12.5 |
| 25-Aug-21 | 0.312 | 0.106 | 9.8 |
| 1-Sep-21 | 0.322 | 0.129 | 3.5 |
| 8-Sep-21 | 0.340 | 0.171 | 8.5 |
| 15-Sep-21 | 0.406 | 0.384 | 3.4 |
| 22-Sep-21 | 0.326 | 0.153 | 1.4 |
| 30-Sep-21 | 0.402 | 0.413 | 2.6 |

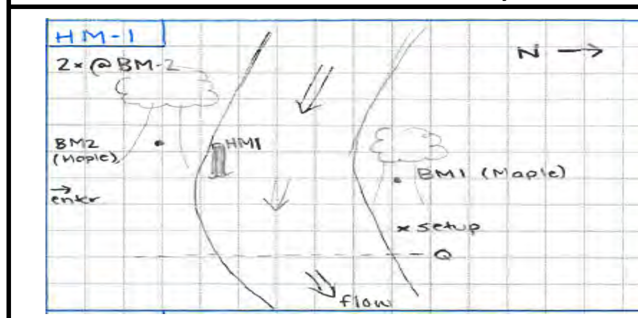
**Cross Section:July 8, 2021**




**Stage-Discharge Curve**

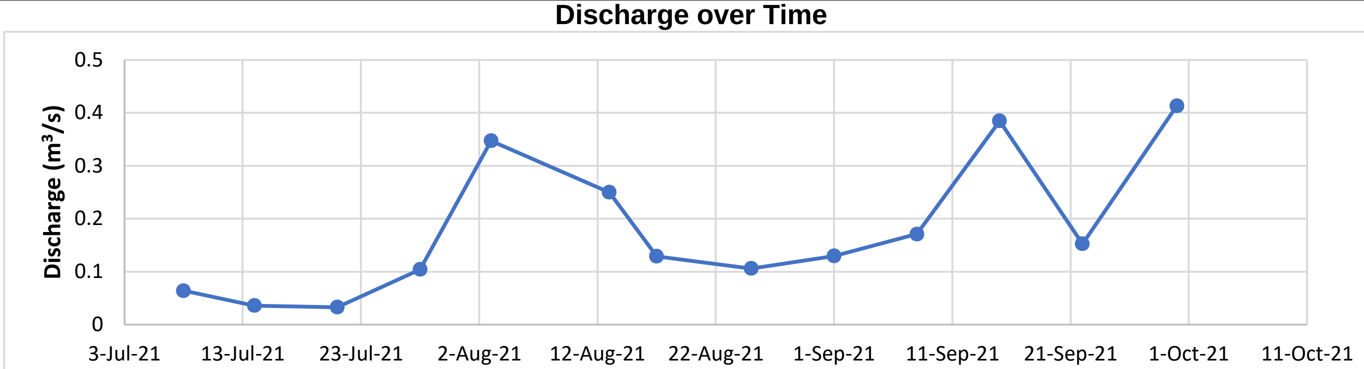



**Benchmark Elevation Surveys**

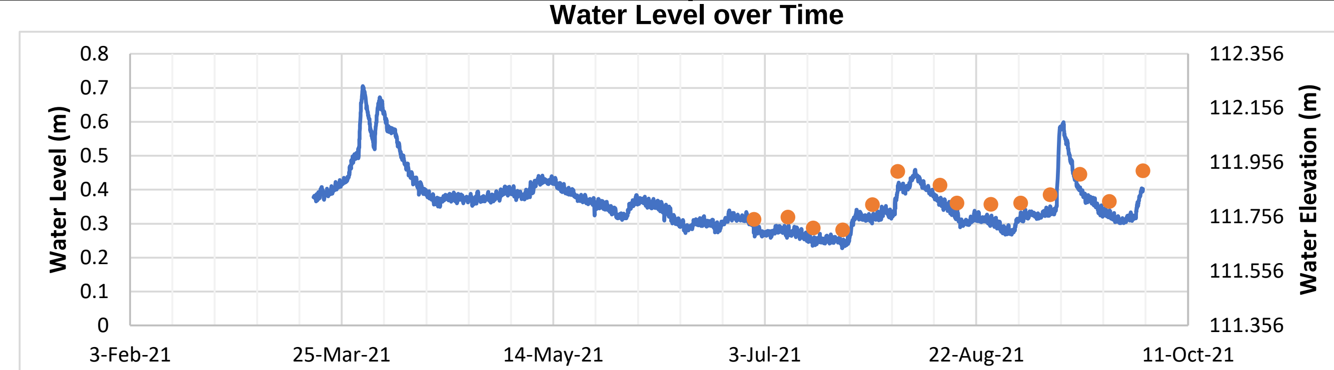



| Staff Gauge | BM-1 | BM-2 | Date |
|---|---|---|---|
| 112.356 | 112.558 | 112.456 | 6-Aug-21 |

**Discharge over Time**




**Water Level over Time**



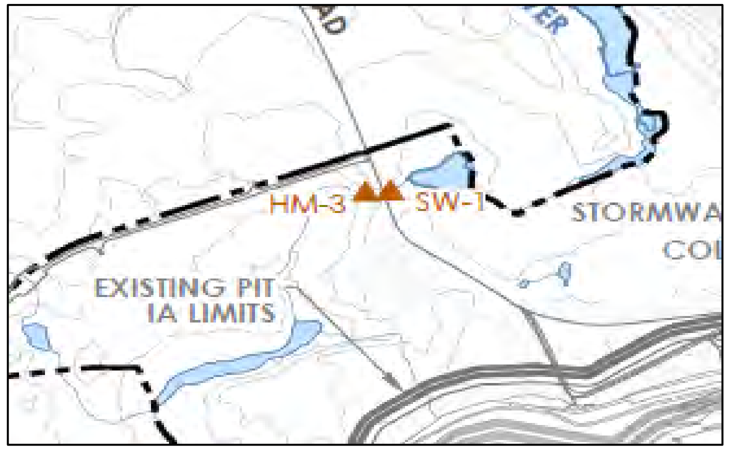
Stantec

## Hydrometric Station Summary

| | | | |
|---|---|---|---|
| **Hydrometric Station ID** | HM-3 | **Flow Meter** | OTT MF pro |
| **Location** | Moose River at Moose River Road Bridge X-ing | **Fixed Point Average** | 40 seconds |
| **Installation Date** | 29-Jun-21 | **Data Collected at site** | Flow measurement, depths, and velocities |
| **Coordinates** | 20T 4981604E 504292N | **Main channel** | Rocky, cut |
| **Access** | Moose River Road | **Channel Bottom** | Gravel, cobbles and boulders |
| **Drainage Area** | 26.78 $km^2$ | **Flood Plain** | High rock cuts, tall grass, medium shrubs. |
| **Period of Record** | 2021 to present | **Comments** | Waterfall (drop of 1 m) under bridge approx. 30 m upstream |

**Water Level**

Date: 28-Jul-21

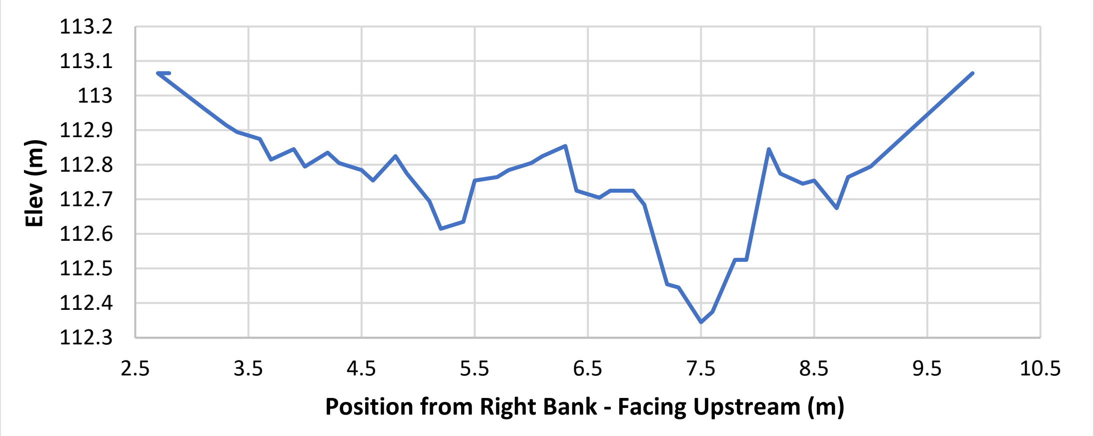

**Map: HM3 under bridge crossing MR Rd.**

**Upstream photo: July 21, 2021**

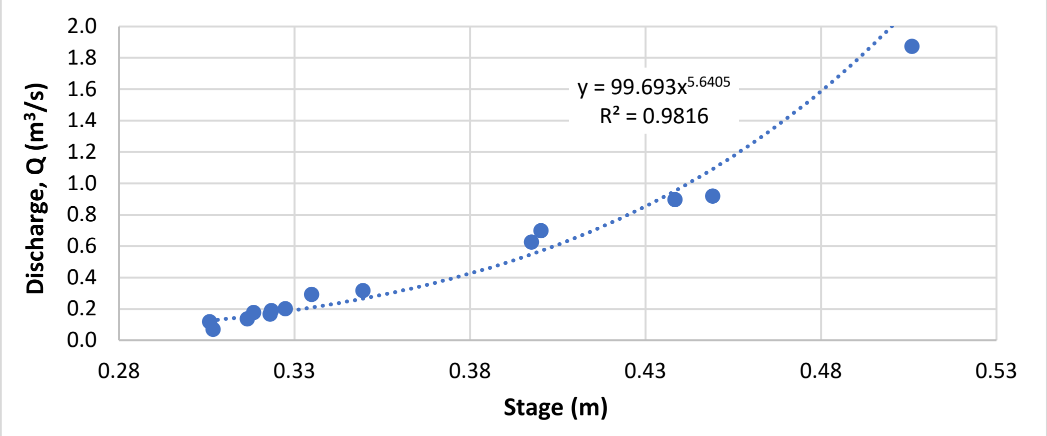
**Downstream photo: July 21,2021**

| Date | Water level (m) | Q($m^3/s$) | Accuracy % |
|---|---|---|---|
| 30-Jun-21 | 0.317 | 0.137 | --- |
| 8-Jul-21 | 0.323 | 0.188 | 10.8 |
| 14-Jul-21 | 0.307 | 0.069 | 9.1 |
| 21-Jul-21 | 0.306 | 0.118 | 10.0 |
| 28-Jul-21 | 0.349 | 0.317 | 2.1 |
| 3-Aug-21 | 0.449 | 0.920 | 4.8 |
| 13-Aug-21 | 0.335 | 0.291 | 5.1 |
| 17-Aug-21 | 0.323 | 0.167 | 8.7 |
| 25-Aug-21 | 0.327 | 0.201 | 8.6 |
| 1-Sep-21 | 0.438 | 0.897 | 8.8 |
| 8-Sep-21 | 0.397 | 0.625 | 1.1 |
| 15-Sep-21 | 0.400 | 0.698 | 5.4 |
| 22-Sep-21 | 0.318 | 0.176 | 15.4 |
| 30-Sep-21 | 0.506 | 1.874 | 8.4 |

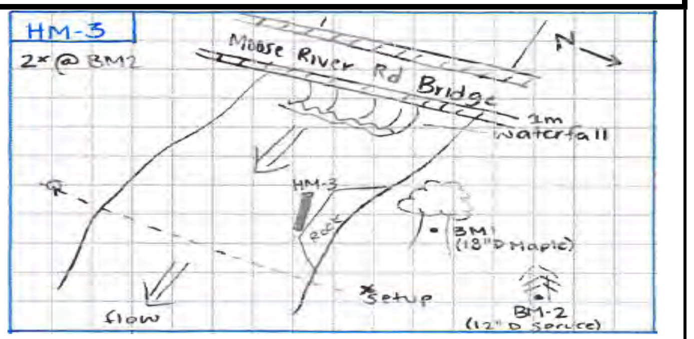
**Cross Section: July 8, 2021**




**Stage-Discharge Curve**

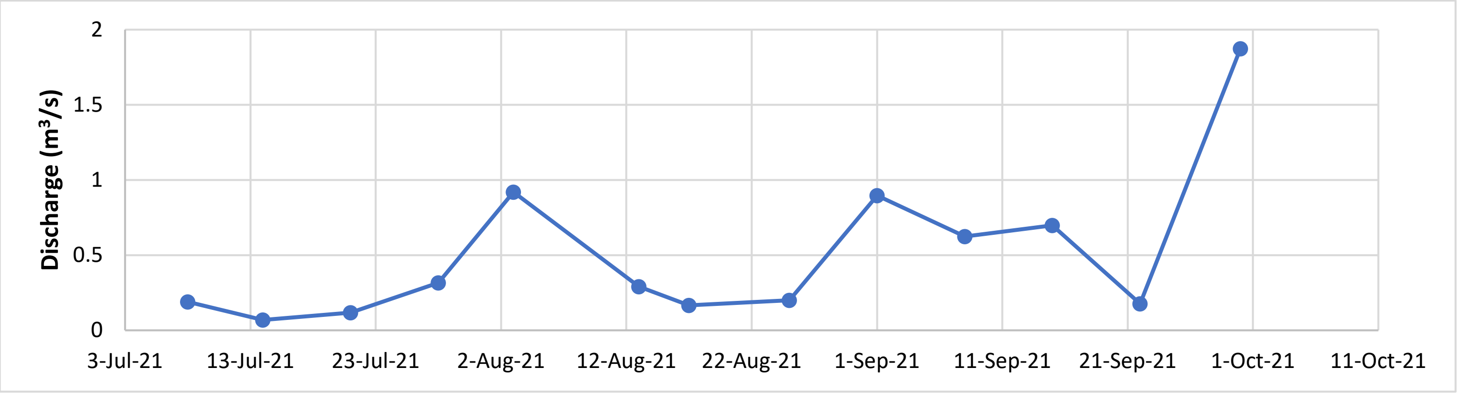



**Benchmark Elevation Surveys**

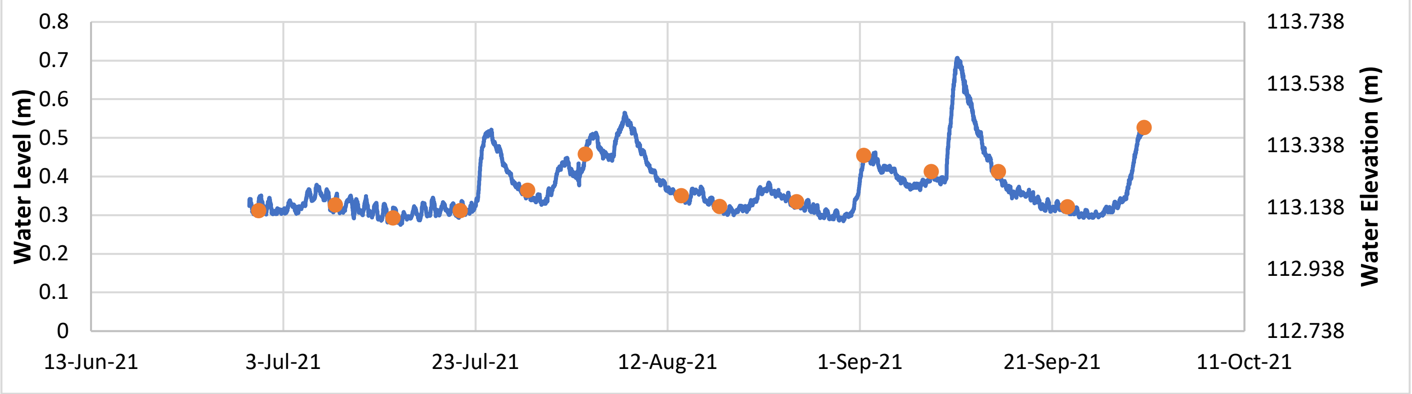



| Staff Gauge | BM-1 | BM-2 | Date |
|---|---|---|---|
| 113.738 | 114.45 | 114.772 | 6-Aug-21 |

**Discharge over Time**




**Water Level over Time**



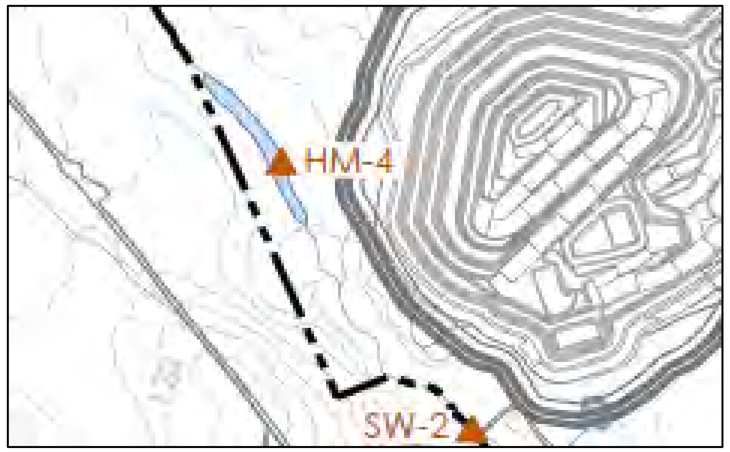
Stantec

## Hydrometric Station Summary

| | | | |
|---|---|---|---|
| **Hydrometric Station ID** | HM-4 | **Flow Meter** | OTT MF pro |
| **Location** | Moose River, adjacent to open pit well OPM-2A/B | **Fixed Point Average** | 40 seconds |
| **Installation Date** | 29-Jun-21 | **Data Collected at site** | Flow measurement, depths, and velocities |
| **Coordinates** | 20T 4981021E 504156N | **Main channel** | Clean |
| **Access** | Western Diversion Rd. | **Channel Bottom** | Soft, organic bottom, with some boulders |
| **Drainage Area** | 38.82 $km^2$ | **Flood Plain** | Tall grass, shrubs |
| **Period of Record** | 2021 to present | **Comments** | Almost no slope, trouble to tell which way water is flowing. Wide channel. |

**Water Level**

Date: 28-Jul-21

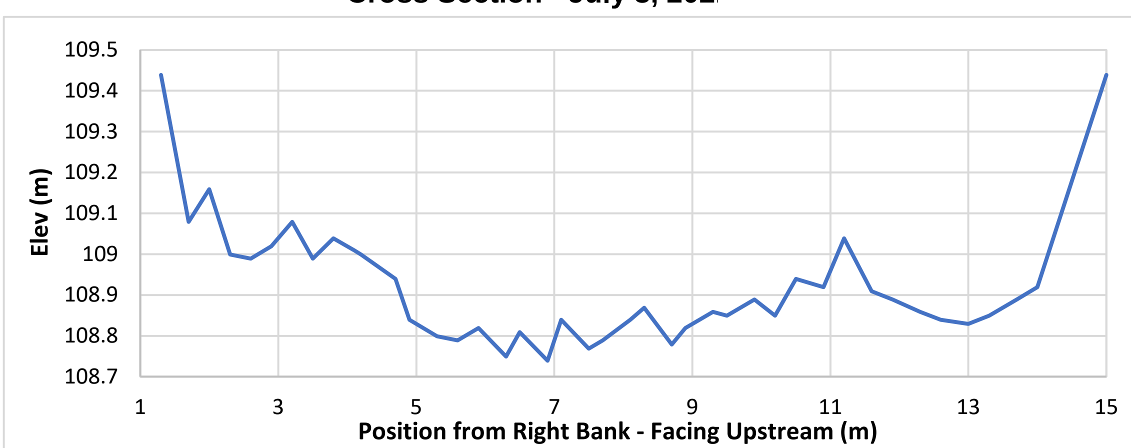

**Map: HM-4, adjacent to OPM-2A/B**

**Upstream photo**

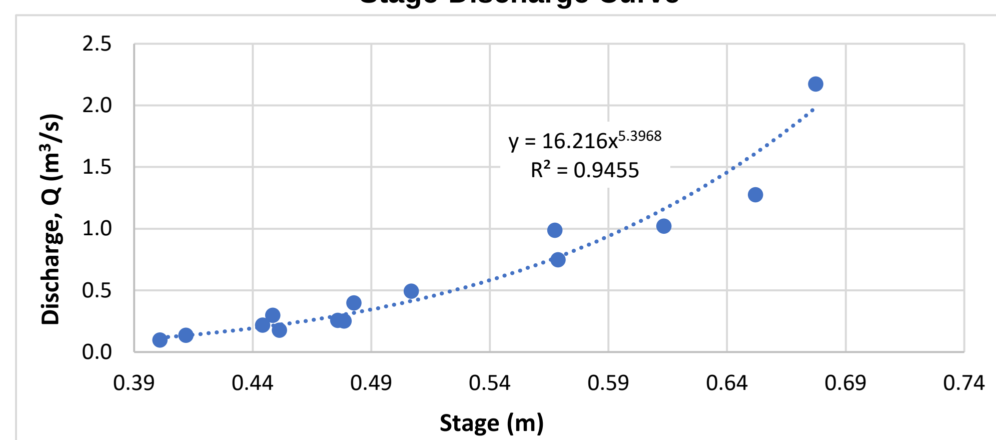
**Downstream photo**

| Date | Stage (m) | Q ($m^3/s$) | Accuracy % |
|---|---|---|---|
| 30-Jun-21 | 0.444 | 0.217 | |
| 8-Jul-21 | 0.451 | 0.177 | 6.8 |
| 14-Jul-21 | 0.401 | 0.097 | 13.4 |
| 21-Jul-21 | 0.412 | 0.134 | 3.5 |
| 28-Jul-21 | 0.483 | 0.397 | 10.4 |
| 3-Aug-21 | 0.652 | 1.276 | 4.5 |
| 13-Aug-21 | 0.507 | 0.492 | 2.4 |
| 17-Aug-21 | 0.476 | 0.256 | 11.5 |
| 25-Aug-21 | 0.479 | 0.251 | 10.0 |
| 1-Sep-21 | 0.613 | 1.020 | 6.8 |
| 8-Sep-21 | 0.569 | 0.747 | 1.1 |
| 15-Sep-21 | 0.567 | 0.988 | 4.1 |
| 22-Sep-21 | 0.448 | 0.297 | 3.9 |
| 30-Sep-21 | 0.677 | 2.174 | 2.7 |

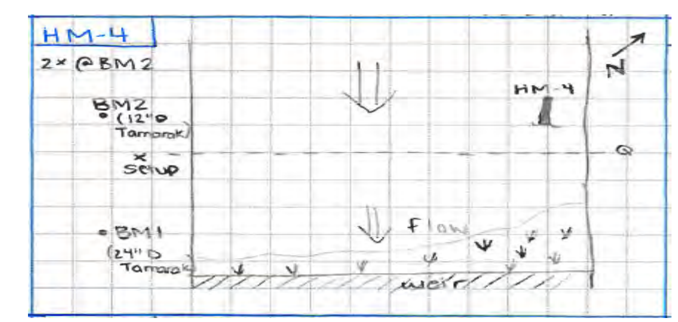
**Cross Section - July 8, 202**




**Stage-Discharge Curve**

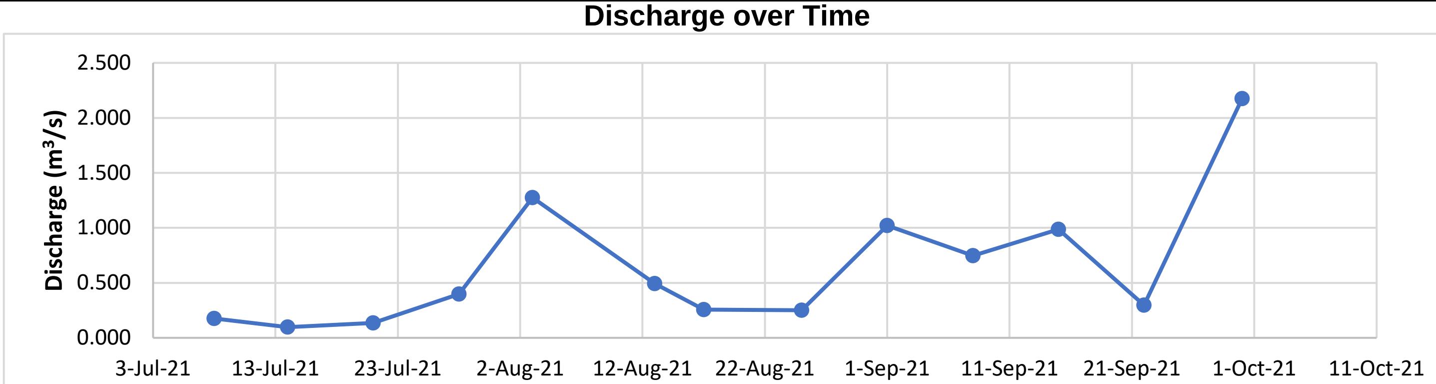



**Benchmark Elevation Surveys**

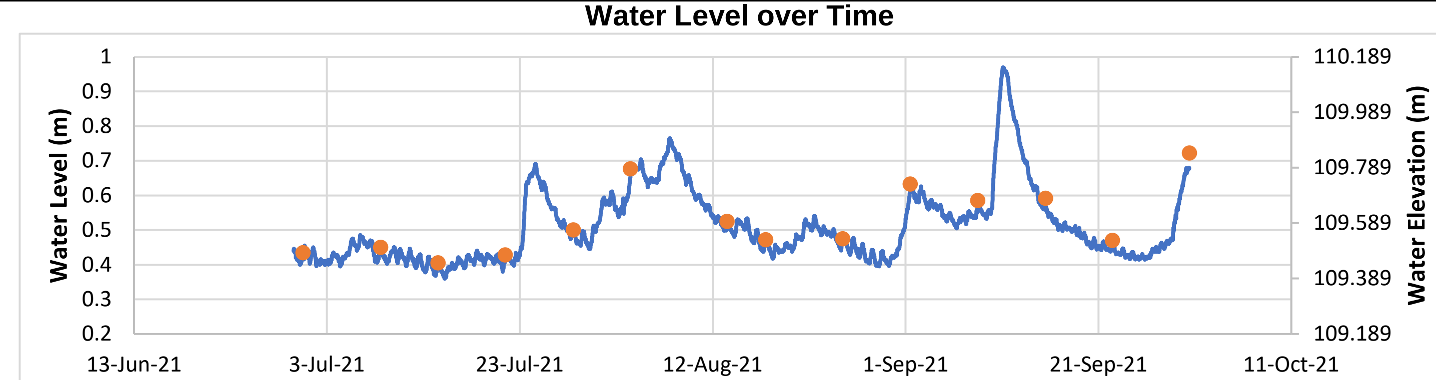



| Staff Gauge | BM-1 | BM-2 | Date |
|---|---|---|---|
| 109.989 | 110.748 | 111.106 | 6-Aug-21 |

**Discharge over Time**




**Water Level over Time**



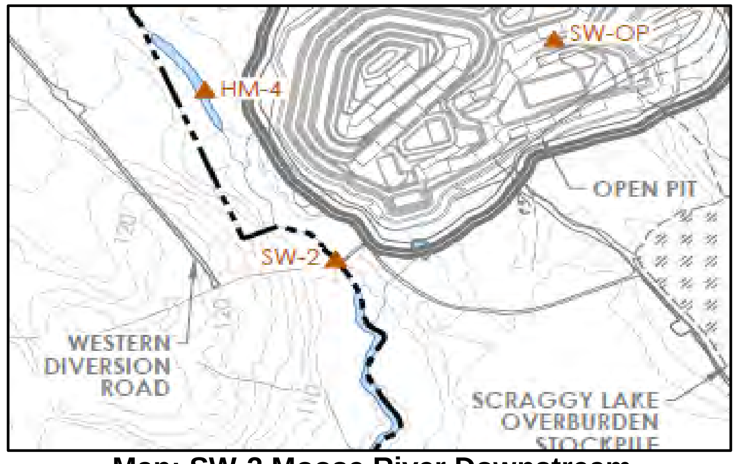
Stantec

## Hydrometric Station Summary

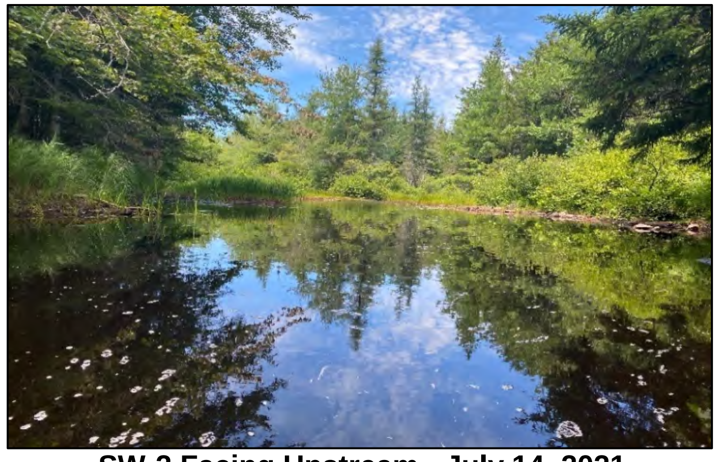
| | | | |
|---|---|---|---|
| **Hydrometric Station ID** | SW-2 | **Flow Meter** | OTT MF pro |
| **Location** | Moose River Downstream | **Fixed Point Average** | 40 seconds |
| **Installation Date** | 25-Apr-2018 | **Data Collected at site** | Water Temperature, Water Level, Atm. Pressure |
| **Coordinates** | 20T 504306E, 4980726N | **Main channel** | Clear and straight |
| **Access** | Western Diversion Road, near bridge | **Channel Bottom** | Soft material, gravel, and few cobbles |
| **Drainage Area** | 39.03 $km^2$ | **Flood Plain** | Tall grass, trees |
| **Period of Record** | July 2017-present | **Comments** | |

**Water Level**

Date: 28-Jul-21


Map: SW-2 Moose River Downstream

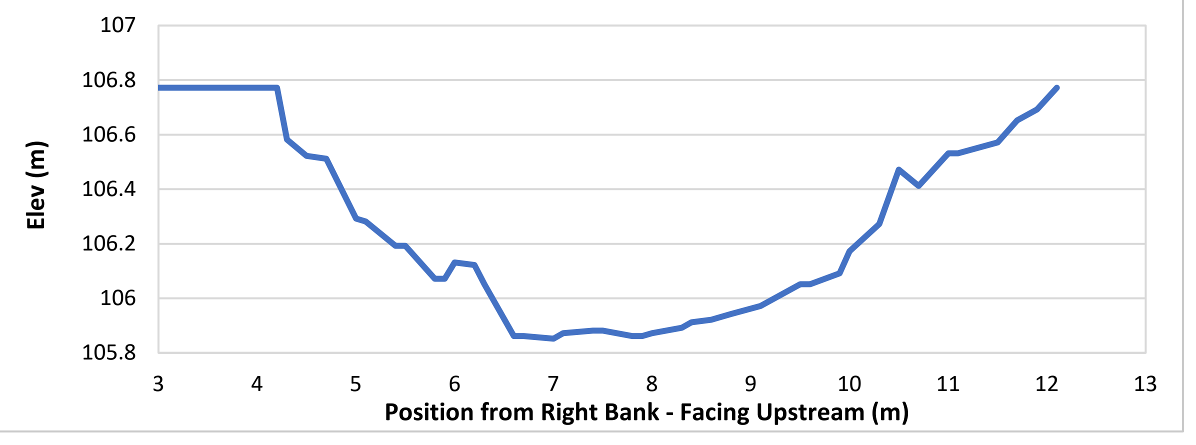


SW-2 Facing Upstream - July 14, 2021

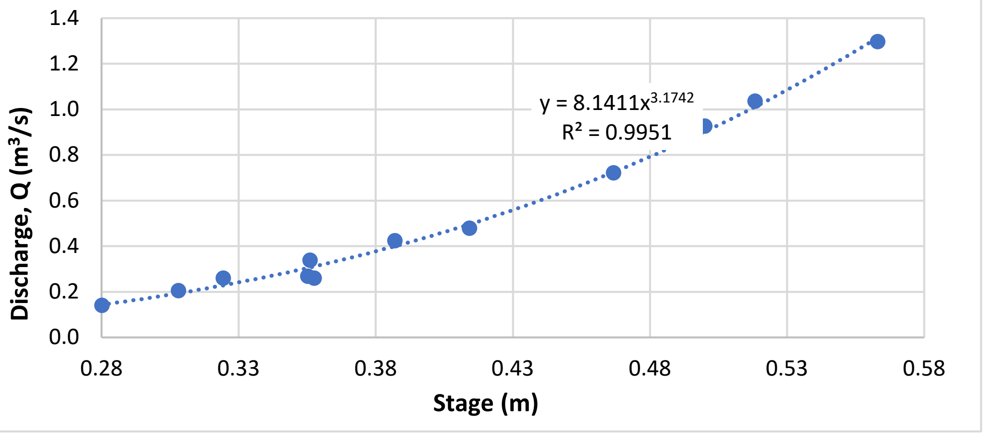
Downstream at SW-2 - July 14, 2021

| Date | Stage (m) | Q ($m^3$/s) | Accuracy % |
|---|---|---|---|
| 30-Jun-21 | 0.324 | 0.260 | |
| 8-Jul-21 | 0.308 | 0.206 | 6.2 |
| 14-Jul-21 | 0.265 | 0.118 | 12.2 |
| 21-Jul-21 | 0.280 | 0.140 | 5.3 |
| 28-Jul-21 | 0.387 | 0.424 | 6.2 |
| 3-Aug-21 | 0.563 | 1.297 | 4.4 |
| 13-Aug-21 | 0.414 | 0.479 | 3.0 |
| 17-Aug-21 | 0.358 | 0.260 | 11.1 |
| 25-Aug-21 | 0.355 | 0.268 | 9.5 |
| 1-Sep-21 | 0.518 | 1.036 | 1.3 |
| 8-Sep-21 | 0.467 | 0.722 | 5.6 |
| 15-Sep-21 | 0.500 | 0.927 | 3.9 |
| 22-Sep-21 | 0.356 | 0.338 | 8.8 |
| 30-Sep-21 | 0.656 | - too deep to collect | |

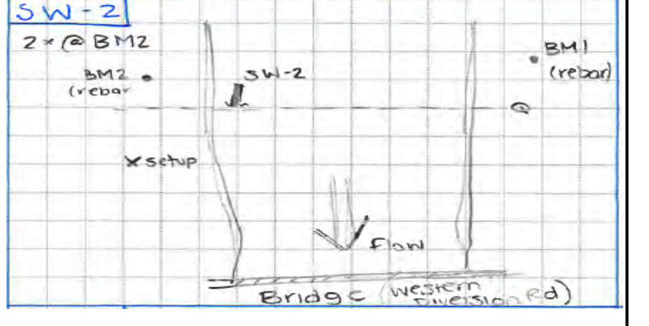
**Cross Section: July 8, 2021**




**Stage-Discharge Curve**

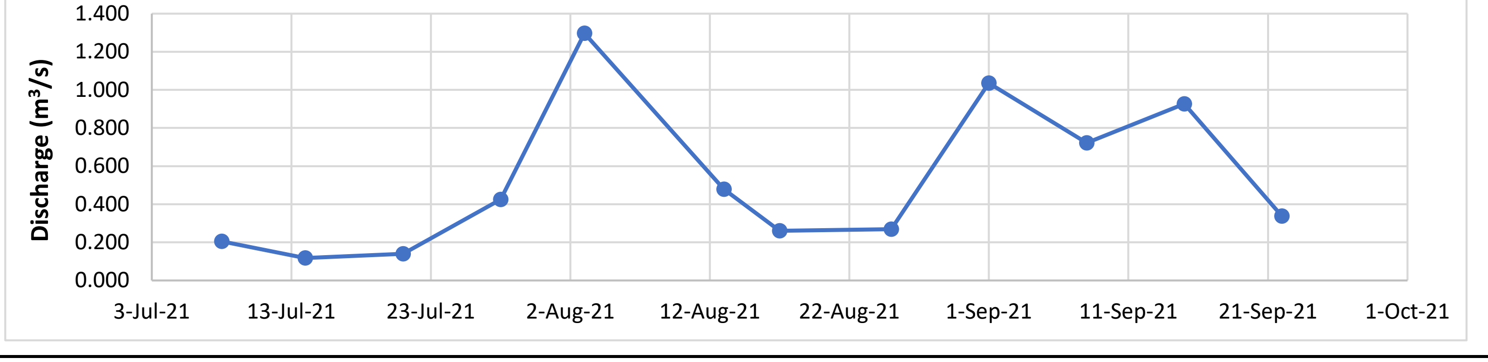



**Benchmark Elevation Surveys**

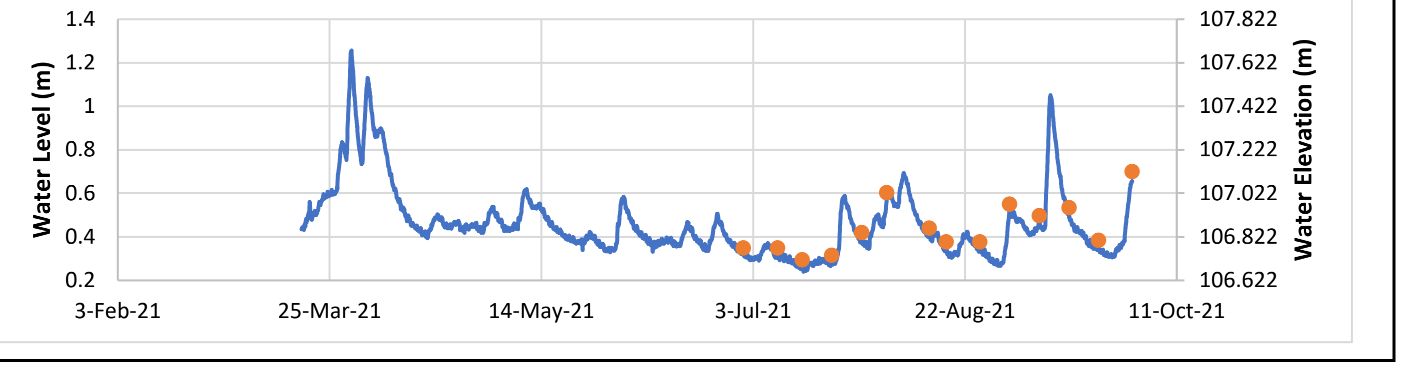



| Staff Gauge | BM-1 | BM-2 | Date |
|---|---|---|---|
| 107.422 | 108.027 | 107.603 | 6-Aug-21 |

**Discharge over Time**




**Water Level over Time**



# APPENDIX G

## Flora, Fauna, and Aquatic Survey Data Summary

## FLORA AND FAUNA SURVEY DATA (IR 9); FISH SURVEY DATA (IR 13)

*Provide all flora and fauna survey data referenced in the EARD with corresponding analysis.*

*Provide all fish surveys and relevant data that has been completed at or near the Touquoy site*

Please refer to Tables 1 and 2, which summarize the sources of flora, fauna, and aquatic survey data referenced in the 2021 EARD. Flora and fauna survey data results and analyses (e.g., species lists) from the 2007 EARD submission and the 2007 Focus Report were summarized, when relevant to the assessment, in the 2021 submission. Additional information such as survey methodology, as is available from the 2007 EARD and Focus Report (completed by Conestoga Rovers and Associates (CRA), is provided in the tables below. Figure 5.1 of the 2007 EARD submission shows the transects and survey types at that time and is attached.

Survey methodology for the surveys completed in 2020 and 2021 to support existing conditions section 9.4.2 of the EARD were not presented in the 2021 EARD submission and therefore, are brought forward in this IR response. For results of the 2020 and 2021 surveys, except for 2021 rare plant survey, please refer to the 2021 EARD submission.

Additional surveys were completed in 2021 to support this IR response. These surveys are described in Section 4.1 (terrestrial) and Section Sections 7.2 and 7.3 (aquatic) of the main Addendum document.

**Table 1 Summary of Flora Fauna Surveys and Data Source References**

| Survey Type | Surveyor(s) | Year | Methods | Document Source | Data Source Page Number | Comments |
|---|---|---|---|---|---|---|
| Lichen Surveys | Lichen experts: Tom Neily and Dr. David Richardson, and a Conestoga Rovers & Associates (CRA) ecologist. | 2004, 2005 and 2007 | Meandering targeted searches targeting predictive boreal felt lichen habitat polygons and suitable rare lichen habitat (i.e. mature forested wetlands and uplands). | Touquoy Gold Project EARD (2007) | Table 9.3, Page 137 | Location of lichen survey tracks in 2007 presented in the 2007 EARD, are shown below (Figure X).<br>A table of all lichens observed is found in Table 9.3 of the 2007 EARD.<br>Raw spatial data not available. |
| | | | | Touquoy Gold Project Modifications – EARD (2021) | Table 9.3, Page 9.6 | Table of species observed provided in the 2021 EARD in Table 9.3. |
| | Terrestrial Ecologist: John Galop (MEL) | 2020 and 2021 | Meandering targeted searches targeting predictive boreal felt lichen habitat polygons and suitable rare lichen habitat (i.e. mature forested wetlands and uplands). | Touquoy Gold Project Modifications – EARD (2021) | Table 9.11, Page 9.43<br>Figure 9.4 | Summary of rare lichen species observed during these surveys is provided in the 2021 EARD document. |
| Bird Surveys | Unknown. CRA ecologist or contractor | June 2005 | 5-minute breeding bird Point Counts – 11 locations | Touquoy Gold Project EARD (2007) | Table 9.5, Page 145; Figure 5.1 | Survey locations shown in Figure 5.1 of the 2007 EARD. |
| | | | | 2007 Focus Report | Appendix I | |
| Vascular Flora Surveys | Unknown. CRA ecologist or contractor | August 2004, May and July 2005 | Meandering foot transects targeting suitable rare plant habitat | Touquoy Gold Project EARD (2007) | Sections 9.1.2, Pages:131-134; Figure 5.1 | Meandering foot transects shown in Figure 5.1 of the 2007 EARD. |
| | Terrestrial Ecologist: John Galop (MEL) | September 2021 | Meandering foot transects Meandering foot transects targeting suitable rare plant habitat | In support of this IR response document. | Herein (Sections 4.1.1 to 4.1.4) | Vascular plant surveys took place in September 2021 to support the initial general plant list that was generated out of season in 2020 and 2021. |
| Vegetation Community Assessments | Unknown. CRA ecologist or contractor | 2004, 2005 and 2006 | Vegetation communities were identified at a broad scale using the NSL&F forestry layer derived from photo interpretation. | Touquoy Gold Project EARD (2007) | Pages: 129-131 | No transects of this survey type present as specific vegetation community assessments did not occur. Habitat data at a broad scale was collected during other biophysical surveys and tracks are shown in Figure 5.1 of the 2007 EARD submission. |
| | Terrestrial Ecologist: John Galop (MEL) | Fall of 2020 and winter of 2021 | Methods involved meandering transects during the 2020 and 2021 and was concurrent with the lichen surveys.<br>See section 4.1.1 in this IR response for the methodology used. | Touquoy Gold Project Modifications – EARD (2021) | Pages: 9.31-9.32.<br>Figure 9.3 | Figure of the approximate locations of the communities are found on page 9.31. Although an in-season survey took place after the submission of the 2021 EARD, the results shown in this figure are still relevant. |
| Herpetile Surveys | Herptile specialist John Gilhen and CRA ecologists | 2004, 2005 and 2007 | Detail methods were not described in this document; however, transects are shown on Figure 5.1 | Touquoy Gold Project EARD (2007) | Pages: 149-150; Figure 5.1 | No specific dates (i.e. dates of the month); however, surveys occurred concurrently with rare plants and wetland surveys in August 2004, May and July 2005. |
| Herpetile Surveys | Terrestrial Ecologist: John Galop (MEL) | September 2021 | Portions of watercourse 4 within Wetland 15 were assessed for potential snapping turtle overwintering habitat. | In support of this IR. | N/A | Deep pools (>2 m) were observed with mucky substrate which could provide habitat for snapping turtles. |

**Table 2 Summary of Aquatic Survey and Data Source References**

| Survey Type | Surveyor(s) | Year | Methods | Document Source | Data Source Page Number | Comments |
|---|---|---|---|---|---|---|
| **Aquatic Habitat Surveys** | CRA | June 2005, September 2005, 2006 | Habitat examination using standard DFO parameters such as channel width, water depth, substrate type and cover. | Touquoy Gold Project EARD (2007) | Section 7.1.2 | Data report not available |
| **Aquatic Fish Surveys** | CRA | 2005 or 2006? | Electrofishing conducted as spot checks to determine species present. | Touquoy Gold Project EARD (2007) | Section 7.1.2 | Data report not available; limited data would be available from a DFO Permit Report. |
| **Aquatic Invertebrate sampling** | CRA | Spring and Fall 2005 | No details available other than locations (Figure 5.1). | Touquoy Gold Project EARD (2007) | Section 7.1.2 | Stations upstream and downstream from the proposed 2005 study area (Figure 5.1; attached). Data report not available |
| **Aquatic Surface Water Quality** | CRA | Sep 2004- Jan 2007 | Baseline surface water samples were collected at seven sampling locations throughout the Project and surrounding area on a monthly basis between September 2004 and January 2007 (Figure 5.1). An eighth station was added in July 2006. | Touquoy Gold Project EARD (2007) | Table 7.1 (min/max values). Appendix F. | See Figure 5.1 (attached) for survey locations |
| **Aquatic Sediment Sampling** | CRA | Jan-07 | Single surficial grab samples collected from 10 locations (Figure 5.1). Analyses included baseline concentrations of metals, percent moisture, and grain size analysis. | Touquoy Gold Project EARD (2007) | Table 7.2 | See Figure 5.1 (attached) for survey locations |
| **Aquatic Fish Resource Sampling – Scraggy Lake** | CRA | Aug and Sep 2007 | Four sets of gill nets were set in Scraggy Lake, and one in Square Lake. One transect through the entire length of Scraggy Lake using a fish finder. | 2007 Focus Report | Section 3.2.1 Pages 62-63, Figure 3.2-2 (survey locations). | |
| **Aquatic Fish Survey (Body Burden Testing)– Scraggy Lake** | CRA | Sep-07 | Muscle tissue from six of the white suckers and the single yellow perch collected from Scraggy Lake were submitted to Maxxam Analytical Inc. for mercury analysis of muscle tissue. | 2007 Focus Report | Section 3.2.3 pages 65-66; Table 3.2-1 (Mercury in Fish Muscle Tissues (mg/kg) From Scraggy Lake – September 07) | |
| **Aquatic Sediment Sampling – Scraggy lake** | CRA | Sep-07 | A surficial sediment sample was collected near each location (n=4) of the gillnets in Scraggy Lake for laboratory analysis | 2007 Focus Report | Section 3.2.4; Table 3.2-2 (Summary Concentrations of Heavy Metals in Surficial Sediments of Scraggy Lake; Appendix J (Raw Data) | |
| **Aquatic Fish Habitat Survey – Moose River** | Stantec | Jul-20 | Collection of habitat information at six georeferenced transect locations along a 650m segment of Moose River and photos were taken. Detailed depth profile obtained at 2 areas of interest. In situ water quality data collected at two transect locations. | Touquoy Gold Project Modifications – EARD (2021), SD 15 | Raw field data in Attachment C | SD 15 (Fish Habitat Assessment Survey in Moose River in the Vicinity of the Proposed Pit Expansion) |
| **Aquatic Fish Habitat Survey – Moose River** | Stantec | Nov-20 | Collection of habitat information at three reaches of Moose River extending 650 m. In situ water quality data collected at seven locations in two (upper and lower) reaches. | Touquoy Gold Project Modifications – EARD (2021), SD 16 | Attachment B: Photos of fish habitat sampling units; Appendix C: Raw fish habitat and water quality data | SD 16 (Fish Habitat Assessment in Moose River in the Vicinity of the Existing Open Pit) |

**Table 2 Summary of Aquatic Survey and Data Source References**

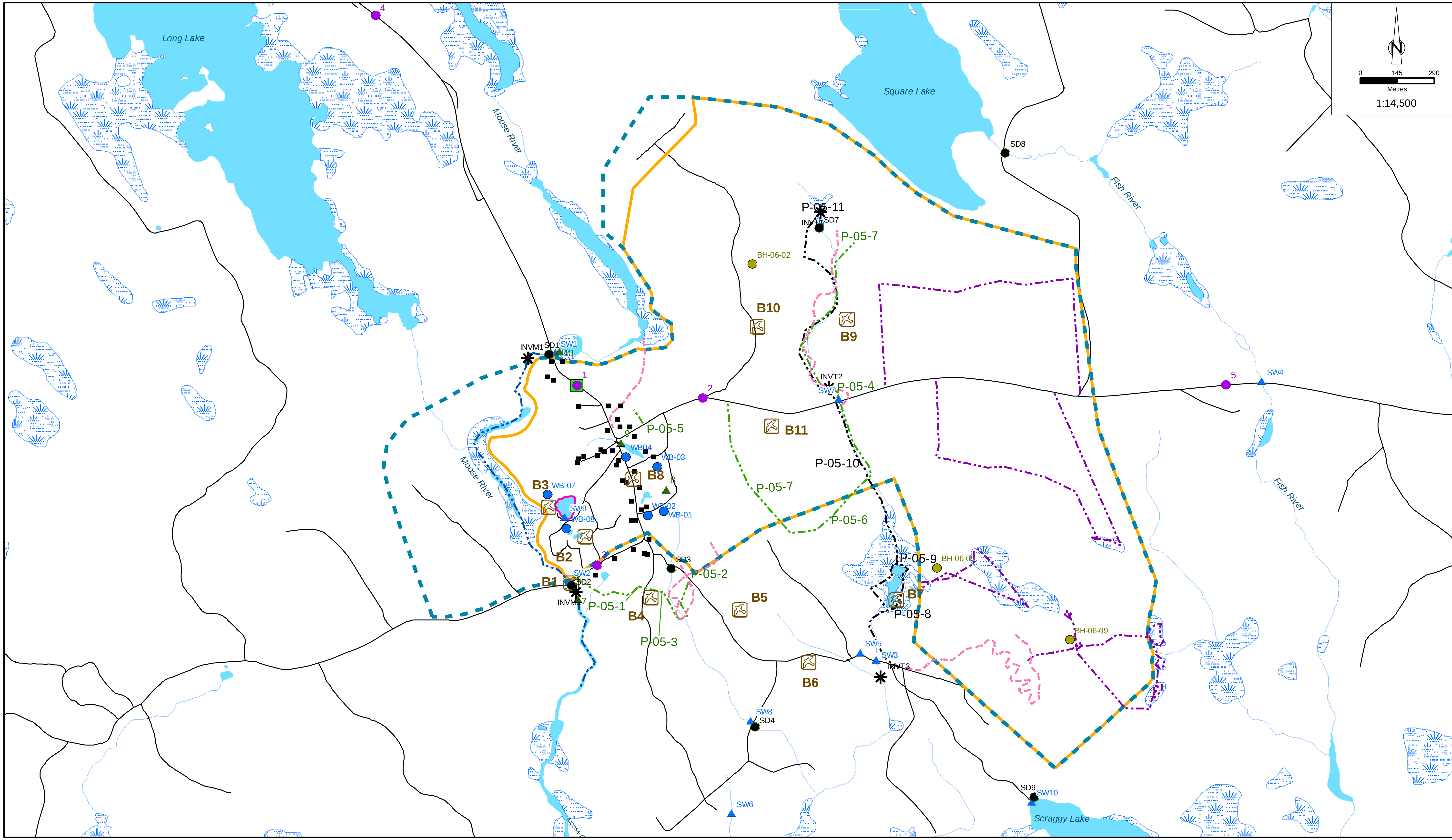
| Survey Type | Surveyor(s) | Year | Methods | Document Source | Data Source Page Number | Comments |
|---|---|---|---|---|---|---|
| **Fish Habitat Survey** | Stantec | Aug and Oct 2017 | Reconnaissance: limited bathymetry survey for Long Lake; Baseline Survey: substrate type, aquatic vegetation, and water depth, photos taken | Touquoy Gold Project Modifications – EARD (2021), SD 10 | Appendix A: Fish Habitat Photos; | SD 10 (2017 Baseline Aquatic Environmental Technical Report) |
| **Adult Fish Survey- Scraggy Lake and Long Lake** | Stantec | Aug and Oct 2017 | Reconnaissance: Minnow traps set in the near-field area of Scraggy Lake and near boat launch of Long Lake; Baseline Survey: Gill nets set overnight to catch yellow perch and white sucker at near-field and far-field locations in Scraggy Lake. Fyke nets and minnow traps were also used. | Touquoy Gold Project Modifications – EARD (2021), SD 10 | Appendix B: Fish Survey Raw Data; Appendix C: Fish Tissue Data | SD 10 (2017 Baseline Aquatic Environmental Technical Report) |
| **Benthic Invertebrate Community (BIC) Assessment** | Stantec | Aug and Oct 2017 | Five samples were collected for BIC assessment within the littoral areas of the nearfield and farfield locations of Scraggy lake in October 2017. Benthic invertebrates were identified to the lowest practical level by a qualified taxonomist at Envirosphere Consultants Limited. | Touquoy Gold Project Modifications – EARD (2021), SD 10 | Appendix D: Benthic Invertebrate Community Raw Data | SD 10 (2017 Baseline Aquatic Environmental Technical Report) |
| **Water and Sediment Quality Assessment** | Stantec | Aug and Oct 2017 | Sampling from near-field, mid-field and far-field sampling locations in Scraggy Lake and two in Long Lake. One additional sample added during fall sampling between 2 main basins of Scraggy Lake. No sediment sampling in Long lake. Near surface and near bottom water samples taken. In situ temperature, DO and cond. profiles taken at 0.5 m intervals. Composite sediment samples taken from three locations in Scraggy Lake. | Touquoy Gold Project Modifications – EARD (2021), SD 10 | Appendix E: Water and Sediment Quality Data | SD 10 (2017 Baseline Aquatic Environmental Technical Report) |
| Aquatic Environment | Stantec | 2018 | The baseline program was conducted to establish existing conditions in the future aquatic receiving environment for effluent in Scraggy Lake. It was designed to mirror the requirements for EEM under MMER to support interpretation of future EEM results when Mine becomes subject to MMER. The Metal Mining Technical Guidance for Environmental Effects Monitoring (Technical Guidance; Environment Canada 2012) was used to inform for design and methods. | Touquoy Mine: 2017 Baseline Aquatic Environment Technical Report. Prepared for Atlantic Mining NS Inc. Originally issued April 30, 2018, updated February 12, 2020. | Entire document | SD 10 (2017 Baseline Aquatic Environmental Technical Report) |

**Table 2 Summary of Aquatic Survey and Data Source References**

| Survey Type | Surveyor(s) | Year | Methods | Document Source | Data Source Page Number | Comments |
|---|---|---|---|---|---|---|
| Aquatic Environment | Stantec | 2019 | Wetlands 6 and 15 were surveyed on July 31 and August 1, 2019. At each wetland, an ecologist with wetland and plant expertise looked for evidence of adverse effects associated with silt discharge into the wetlands including silt deposits, plant mortality and plant morbidity. Baseline information (pre-mine construction) on the two wetlands was provided in advance by AMNS.<br><br>To characterize the existing conditions for fish and fish habitat in support of the WC4 assessment, field data were collected in 2019 and existing information was reviewed. | Assessment of Wetlands 6 and 15 and Watercourse 4, Touquoy Mine, Nova Scotia. Prepared for Atlantic Mining NS Inc. | Entire document | SD 14 (Assessments of Wetlands 6 and 15 and Watercourse 4). |
| Aquatic Environment | Stantec | 2019 | 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. | Touquoy Mine: 2018 Supplemental Baseline Aquatic Environment Technical Report. Prepared for Atlantic Mining NS Inc. Originally issued June 24, 2019, updated February 12, 2020. | Entire document | SD 11 (2018 Supplemental Baseline Aquatic Environmental Technical Report). |
| Fish Habitat Survey | Stantec | 2020 | Methodology included collection of the following habitat information: channel width, channel depth, bank height, substrate composition, gradient, bank cover, bank slope, stream cover, habitat type (e.g., pool, riffle, run), vegetation. Habitat information was collected at six georeferenced transect locations and photos were taken . | Fish Habitat Assessment Survey in Moose River in the Vicinity of the Proposed Pit Expansion. Prepared for Jim Millard, AMNS. August 31, 2020. | Entire document | SD 15 (Fish Habitat Assessment Survey in Moose River in the Vicinity of the Proposed Pit Expansion) |
| Fish Habitat Survey | Stantec | 2020 | Fish habitat surveys were conducted in the upper and lower section of Moose River on November 2 to 4, 2020. Fish habitat information was collected on a habitat type scale and included: habitat type (riffle, run, pool), substrate composition, bank stability, riparian vegetation, overhead and instream cover, wetted and channel width, depth and gradient. | Fish Habitat Assessment Survey in Moose River in the Vicinity of the Proposed Pit Expansion. Prepared for Jim Millard, AMNS. December 11, 2020. | Entire document | SD 16 (Fish Habitat Assessment in Moose River in the Vicinity of the Existing Open Pit) |

**Table 2 Summary of Aquatic Survey and Data Source References**

| Survey Type | Surveyor(s) | Year | Methods | Document Source | Data Source Page Number | Comments |
|---|---|---|---|---|---|---|
| Aquatic Environment | Stantec | 2021 | A review of existing information, drone aerial imagery, and in-field assessments of open bog wetland and shallow water plant communities were used to assess the recovery of Wetland 6 following siltation events. | Monitoring of the Effects of Sediment Deposition in Wetlands 6 and 15, Touquoy Mine, Nova Scotia: Year 1 (2020). Prepared for Atlantic Mining NS Inc. March 29, 2021. | Entire document | SD 09 (Monitoring of the Effects of Sediment Deposition in Wetlands 6 and 15, Year 1 [2020]). |
| Aquatic Environment | Stantec | 2021 | Fish habitat information was collected on a habitat type scale and included: habitat type (riffle, run, pool), substrate composition, bank stability, riparian vegetation, overhead and instream cover, wetted and channel width and depth. | Stantec (Stantec Consulting Ltd.). 2021. Touquoy Gold Modifications: 2021 Aquatic Surveys, Summary of Fish and Fish Habitat Surveys to Support the Touquoy Gold Modification. Prepared for Atlantic Mining NS Inc., December 12, 2021. (not in EA but info supported it) | Entire document | Appended to the Main Addendum Document (Appendix I) |
| Aquatic Environment | Stantec | 2021 | Gill nets, fyke nets and minnow traps were used to capture fish for the fish population survey. Gill net mesh sizes ranged from 25.4 mm to 76.2 mm and nets were 30.5 m in length and 1.82 m in height. Location and effort for all gear types was recorded. | Touquoy Mine – Phase 1 EEM Interpretive Report. Prepared for Atlantic Mining NS Inc., July 8, 2021. (not cited in EA but info supported it). | Entire document | Under review with Environment Canada. |




- Building
- Invertebrate Sample 06&09/05
- Soil Samples
- Air Monitoring Stations
- Sediment Sample
- Groundwater Sample
- Historic Surface Water Sample
- Surface Water Sample
- Noise Sample
- 2006 Breeding Bird Survey 06/06
- 2007 Lichen Survey Transect
- 2006 Groundwater Upwelling Survey Transect
- 2006 Plant, Mammal & Herptile Survey Transect
- 2005 Plant SurveyTransect 05/05
- 2005 Plant SurveyTransect 07/05
- Existing Pit Extent
- Road
- Rivers and Streams
- Project Site Boundary
- Study Site Boundary
- Wetlands
- Lake

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Data projected to UTM (Zone 20T) NAD83

Figure 5.1

SAMPLING AND SURVEY LOCATIONS

Touquoy Gold Project, DDV Gold Ltd.

*Halifax County, Nova Scotia*