Stantec

RESPONSE TO MINISTERIAL INFORMATION REQUEST NO. 8

Addendum to the Touquoy Gold Project Modifications – Environmental Assessment Registration

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Co-branded

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1.0 INTRODUCTION

Ministerial IR No. 8 asks, "*In consultation with the Inspection and Compliance Division and Water Resources Branch at ECC, clarify or provide information related to water quality and quantity analysis inconsistencies*".

Meetings were held with the Inspection and Compliance Division and Water Resources Branch at NSECC on September 14, 2021 and October 21, 2021 to seek input on the inconsistencies these reviewers felt should be addressed directly in the IR Responses. The questions below have been formulated from the Comment Index attached to the decision letter on the Touquoy Gold Mine Site Modifications Environmental Assessment; the responses clarify inconsistencies and provide information related to water quality and quantity analysis presented in the EARD.

2.0 GROUP A - WATER QUALITY CRITERIA AND GUIDELINES

Provide additional information on the use of water quality criteria and guidelines. In particular, address the following questions.

2.1 A.1 - WATER QUALITY CRITERIA

Clarify the applicability of various water quality criteria and how these are being used to determine significance of effects on surface water quality.

The Touquoy Gold Project is subject to provincial and federal water quality guidelines. Provincially, the mine is currently subject to Approval No. 2012-084244-11 (the IA, version effective December 16, 2021) issued originally under the Nova Scotia Environment Act, S.N.S. 1994-95, c.1 s.1 on July 19, 2018. Please refer to Attachment 1 for discussion of how the revised IA has been considered in this Addendum. Federally, the mine became subject to the MDMER when the mine exceeded an effluent discharge rate of 50 m^3/d, based on effluent deposited from the single FDP at SW-14 in July 2018. Based on the IA, surface water quality monitoring has been conducted during construction, and will be conducted for one-year post-operation for water quality parameters specified in the MDMER.

In accordance with Condition15(c)(ii) of the IA, surface water analytical results must conform to the MDMER and any other separate liquid effluent discharge limit NS ECC may choose to establish. In addition, Condition 7(d)(iii)(a) requires that that Approval Holder report surface water monitoring results in a watercourse downstream of site activities and compare against the surface water criteria identified in Column C of Table 6 in Appendix K of the IA ("Column C"). Condition 7(d)(iii)(b) further stipulates that any parameter which is shown to have natural background exceedances that also exceeds the criteria in Column C, the Approval holder will ensure that a statistical trend analysis is completed to assess the existence of an increasing trend as a result of site activities. Where confirmed, this shall indicate an exceedance of criteria.

As part of water quality modelling for the EARD, water quality predictions were developed downstream of the final discharge points. Model predictions during operation were compared against the MDMER limits (MDMER Sched. 4 Table 2 (Existing Mine) MAMMC) and IA Water Quality Criteria. Model predictions during active closure were compared against the project baseline (further description of baseline provided in Response E.2) concentrations, CCME FAL, and MDMER limits. Model predictions were also compared to the site-specific water quality objective (SSWQO) for arsenic (Intrinsik 2019, EARD Attachment SD 22). The value developed is 0.030 mg/L (30µg/L) and concentrations predicted in the receiving environment of Moose River are below this value. Water treatment was applied as mitigation until, at minimum, water quality at the discharge point met MDMER limits, and water quality downstream in the receiving environment met CCME FAL and/or baseline concentrations or the SSWQO for arsenic downstream of the final discharge point. The environmental effects were assessed after mitigation was applied.

Significance criteria, as required in environmental assessment, are provided in the EARD (Section 6.3 – Groundwater; Section 7.3 – Surface Water).

2.2 A.2 - WATER QUALITY OBJECTIVES

Clarify proposed water quality objectives for the project. Where the water quality objective is not derived from a Nova Scotia guideline, provide justification for the use of a surrogate guideline and how it will be determined if adverse effects are occurring.

Arsenic and sulphate are two identified parameters that reference guideline values not derived from a Nova Scotia guideline. The Health Canada drinking water aesthetic objective and BC Guideline for Sulphate are provided as reference only to offer context to sulphate concentrations in surface water. These are not proposed as surrogate guidelines. A site-specific water quality objective was developed for arsenic concentrations in Moose River. AMNS is currently developing a site-specific limit for sulphate suitable for the protection of aquatic life, based on the Terms and Conditions of Variance for # 2012-084244-08.

The approach and developed SSWQO for arsenic in Moose River was completed by Intrinsik Corp. and first submitted in Appendix G4 of the 2019 Revised Environmental Impact Statement for the Beaver Dam Mine Project (Intrinsik 2019, EARD Attachment SD 21). Using the CCME protocol for development of water quality guidelines (CCME 2003), a species sensitivity distribution (SSD) approach was used to develop the site-specific water quality objective (SSWQO) for arsenic.

The SSD approach was comprised of identifying chronic toxicity data for species, analyzing the data using a regression approach and selecting the final chronic effects benchmark. The HC5 (i.e., the concentration that is hazardous to no more than 5% of a species in the community) was selected as the final chronic effects benchmark as per CCME (2007) guidance. The value developed is 0.030 mg/L (30µg/L). Arsenic will continue to be monitored in effluent discharges and at surface water monitoring locations at the site.

2.3 A.3 - MDMER INCONSISTENCIES

Clarify inconsistencies in MDMER requirements presented in Table 7.26 of the EARD and the current version of the MDMER.

The maximum authorized monthly mean concentrations (MAMMC) for effluent water quality for existing mines are based on those presented in Schedule 4 - Table 2 of the MDMER regulation effective June 1, 2021. Table 7.26 presents these effluent concentration limits in units of ug/L due to the low predicted concentrations of WRSA effluent better read as ug/L; however, in Schedule 4 - Table 2 they are presented in mg/L(i.e. 0.50 mg/L = 500 µg/L)

3.0 GROUP B – REGIONAL REGRESSION ANALYSIS

Provide more information on the regional regression analysis undertaken, justifying the approach taken and specifically addressing the following questions.

3.1 B.1 - CRITERIA FOR STATIONS

What criteria were used to determine which stations would be used in this analysis? How were these stations assessed for appropriateness for this exercise?

The regional hydrology assessment presented in Section 7.4.4.1 of the EARD is based on 10 flow gauging stations proximal to the mine site presented in Table 7.4. A regional regression approach was taken to estimate local site hydrology because site watersheds range from small subwatersheds such as Watercourse #4 and the Fish River headwaters of 1.8 km2 – 5.2 km^2 to 40 km^2 – 48 km^2 for the Fish River and Moose River watersheds. The regional regression used gauged flow stations in the region around the mine site with watersheds ranging from 10.1 km^2 – 650 km^2. Several factors are considered in determining the appropriateness of regional gauging stations including:

- distance from site to confirm that the gauging watershed is subject to a similar climatic regime as the site (the maximum station distance was approximately 200 km)
- being in the same or similar physiographic region with comparable watershed, soil conditions and vegetation cover
- having a period of record of at least 10 years with most stations having records of 25 years or longer
- being no more than 1 order of magnitude from the largest watershed of interest (this was the case for 9 of the 10 gauged stations; Musquodoboit River at Crawford Falls was retained being > 1 order of magnitude larger because it is the closest gauged station to the project site and has a very long period of record)

Ultimately the strength of regional hydrology correlation is demonstrated by a high coefficient of determination in the regression equation. The R2 for the regional relationship between drainage area and mean annual flow was very high at 0.9956 as presented in Table 7.4 of the EARD. Similarly high R2 values are observed for peak flows ranging from the 1:2 – 1:100 year return period events and mean monthly flows.

Please refer to response B.3 below for further assessment of hydrologic homogeneity in the regional dataset selected.

3.2 B.2 - REGRESSION METHODS

What are the limitations and level of confidence in using this method in the calculation of flows on a different timescale (e.g., monthly vs annual flows) and for watersheds several orders of magnitude lower than those used in the regional regression analysis?

The method used in the regional hydrology assessment is referred to as regional extrapolation but is also referred to as regionalization (NERSC 1975; Tasker 1982; Nathan and McMahan 1990; Environment Canada 1976; BC Land and Water 2005), areal reduction (NSE 2016) and Drainage Area Ratio Method (DARM) (Asquith et al. 2006). Regional regression of multiple stations is used when there is no single station nearby or when the nearby station is not appropriate to apply to the target ungauged watersheds. The Lower Musquodoboit River at Crawford Falls station has a very long record but at 650 km^2 its watershed is too large to apply to all the target watersheds associated with the site as indicated in response C.1 above. Therefore, a multiple station approach incorporating a range of gauged watershed sizes allows the development of regression equations applicable to the small to moderate sizes associated with the Project site.

Regional regression and single station areal reduction flood frequency is at the centre of Environment Canada's (1976) "Hydrologic and Hydraulic Procedures for Flood Plain Delineation". Regional analysis typically employs a technique such as index flood method, multiple regression analysis, or determination of regional distribution parameters; multiple regression was used in this case. Regional regression was used in "Inland Flooding in Atlantic Canada" (Burrell 2011) for the Atlantic Climate Solutions Association, a non-profit organization formed to coordinate project management and planning for climate change adaptation initiatives in Nova Scotia, New Brunswick, Prince Edward Island, and Newfoundland and Labrador, and supported through the Regional Adaptation Collaborative, a joint undertaking between the Atlantic provinces. Regional regression was also completed for large-scale province-wide assessments in New Brunswick (Burrell and Anderson 1991) and Newfoundland and Labrador (AMEC Environment and Infrastructure 2014). Areal reduction or watershed pro-rating is acknowledged in the low flow assessment approach in NSECC's (2016) Guide to Surface Water Withdrawal Approvals.

The regional regression method is limited to gauged stations in areas of hydrologic homogeneity where, as described in 1.3, a) the landscape is subject to similar climate, and physiographic conditions. A further limitation is the use of unregulated watersheds to estimate unregulated watersheds. All the stations used in this assessment are on unregulated rivers.

The confidence of regional regression is high especially at timescales applied in this Project such as mean annual flow, mean monthly flow, peak flows and low flows from which environment flow or instream maintenance flows are derived. Confidence is high in this method when hydrologic homogeneity is confirmed. As indicated above, the regional regression method used in this Project does not apply relationships to watersheds “several orders of magnitude lower than those used in the regional regression analysis”. The regional regression is a relationship of stations ranging from 10.1 – 650 km^2 and applied to watersheds associated with the site ranging from 1.8 – 48 km^2. In this relationship the smaller gauged stations set the equation parameters used to apply to the small to moderate watersheds associated with the site. Therefore, except in the case of the Lower Musquodoboit at Crawford Falls explained above, the regression is applied to with a single order of magnitude.

<u>References</u>

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NSECC (Nova Scotia Environment and Climate Change). 2016. Guide to Surface Water Withdrawal Approvals.

Nathan, R.J. and McMahon, T.A., 1990. Identification of homogeneous regions for the purposes of regionalization. J. Hydrol., 121:217 238.

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Tasker, G.D., 1982. Simplified testing of hydrologic regression regions. J. Hydraul. Div., Proc. ASCE, 108(HY10): 128-1222.

3.3 B.3 - VALIDATION OF ESTIMATES

What validation of these estimations has taken place?

Validation for the regional hydrology dataset for the range of uses applied was conducted by confirming the hydrologic homogeneity of the group. Table 3.1 presents the results of a series of hydrologic factors and tests that were assessed to confirm hydrologic homogeneity. A station would not be eliminated because it did not fail a single test, but would be eliminated if it failed multiple tests demonstrating more heterogeneity than homogeneity. The results of hydrologic factors and tests include:

- Climate – The climate normal annual precipitation for Halifax Stanfield Airport of 1396.2 mm is used to characterize the Touquoy site. Assessment of longer term climate stations proximal to the gauging stations indicate that the climate normal annual precipitations range from 1232.2 to 1513.2 mm and thus within -15% to +8% of the climate normal annual precipitation at site.
- Soils – Nova Scotia soils mapping for the areas at each regional gauging station are characterized by dry, moist, and fresh medium to coarse textured soils which would be characterized as Hydrologic Soil Group B and C.
- Vegetation – The watersheds reporting to the regional gauging stations are rural in nature with forest cover in the range of 72 – 95% based on Nova Scotia forest mapping. Forest cover in the regional hydrology dataset area is characterized by a mixture of coniferous and mixedwood forests, with lesser amounts of deciduous forests.
- Site Proximity – Site proximity ranges from 27 km to 202 km. Site proximity is analogous to correlation with regional climate and physiography.
- Years of Record – Years of record ranged from 11 to 98 years. Generally, a station will only be included if it has at least 10 years of data.
- Period of Record- Period of record ranges from currently monitored to ending in 1979. Generally, a goal is to use regional stations whose period of record is within one climate normal period (i.e. 30 years). As such, 01DH003 is at the temporal boundary and 01EO003 is a decade older than the boundary.
- Regulation – None of the stations are on regulated systems
- Watershed <10x – A general principle in regional regression is to keep the areal proration to no more than one order of magnitude between the watershed area of the gauged site and that of the target site. As described in 1.3.a. above, 01EK001 is beyond 10x the size of the largest site watershed but was retained because it is the closest station to site and has a long period of record.
- Mean Annual Flow (MAF) – The MAF regression equation demonstrated high statistical significance with a coefficient of determination of R^2 = 0.9956.
- Mean Monthly Flow (MMF) – Similarly to MAF, the individual monthly regression equations also demonstrated high statistical significance with R^2 ranging from 0.9753 to 0.9965.
- Unit Flow – Unit flows are presented in Figure 2.1 below and range from 23.69 – 37.23 L/s/km^2 with 01EJ004 and 01EK001 presenting outside the linear trend of increasing hydraulic efficiency with increasing drainage area.
- Flow Duration Curve (FDC)- The FDCs for the regional dataset are presented below in Figure 2.2. All station FDCs follow a similar shape pattern with little FDC cross-over indicative of FDC variance.

- Index Flood Flow - In the flood indexing approach, the 95th confidence interval has been used to assess the homogeneity of the regional dataset using the Mean Annual Flood (recurrence interval of 2.33 years) as the Index Flood, the 10-year flood, and their ratios. The Index Flood test results are presented in Figure 2.3. The two stations (01DG003 and 01ED013) with the lowest homogeneity of flood flow relative to the regional dataset are shown in red on Figure 2.3. Station 01ED013 plots near the 95th percentile threshold of the Gumbel Distribution test; however, 01DG003 (Beaverbank near Kinsac) plots well outside the 95th confidence interval for the Gumbel Distribution test

In general, despite some variance among stations with respect to period of record, larger watershed area, unit flows, and index flooding, the regional hydrologic dataset of the ten stations presented in Table 3.1 and used in the EARD demonstrates more hydrologic homogeneity than heterogeneity and thus is considered acceptable for inclusion in the regional hydrology dataset grouping.

Table 3.1 Hydrologic Homogeneity Factors and Test Results

Station ID	**01DH003**	**01EJ004**	**01EE005**	**01EH006**	**01DP004**	**01DG003**	**01FA001**	**01ED013**	**01EO003**	**01EK001**
Station Name/ Parameter	**Fraser Brook Near Archibald**	**Little Sackville River at Middle Sackville**	**Moose Pit Brook at Tupper Lake**	**Canaan River at Outlet of Connaught Lake**	**Middle River of Pictou at Rocklin**	**Beaverbank River Near Kinsac**	**River Inhabitants at Glenora**	**Shelburne River at Pollard's Falls Bridge**	**East River St. Marys at Newtown**	**Musquodoboit River at Crawford Falls**
Climate Normal	1357.6	1513.2	1455.0	1359.1	1232.2	1396.2	1440.5	1486.2	1315.1	1396.2
Soils	Dry, fresh, and moist medium to coarse textured soils characterized by Hydrologic Soil Group B and C.									
Vegetation	Coniferous and mixed wood forests, with lesser amounts of deciduous forest. Forest cover ranges between 72-95% of watersheds.									
Site Proximity (km)	45	65	192	107	58	60	150	202	75	27
Years of Record	26	39	39	11	54	98	55	21	15	82
Period of Record	1965-1990	1980-2018	1981-2019	1986-1996	1965-2018	1921-2018	1965-2019	1999-2019	1965-1979	1915-1996
Regulation	No	No	No	No	No	No	No	No	No	No
Watershed < 10x	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Mean Annual Flow	$y = 1.0699x - 1.6413$ $R^2 = 0.9956$									
Mean Monthly Flow	$R^2 = 0.9753 – 0.9965$									
Unit flow	23.69 – 37.23 $L/s/km^2$									
Flow Duration Curve	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
Index Flood Flow	Pass	Pass	Pass	Pass	Pass	Outlier	Pass	Outlier	Pass	Pass

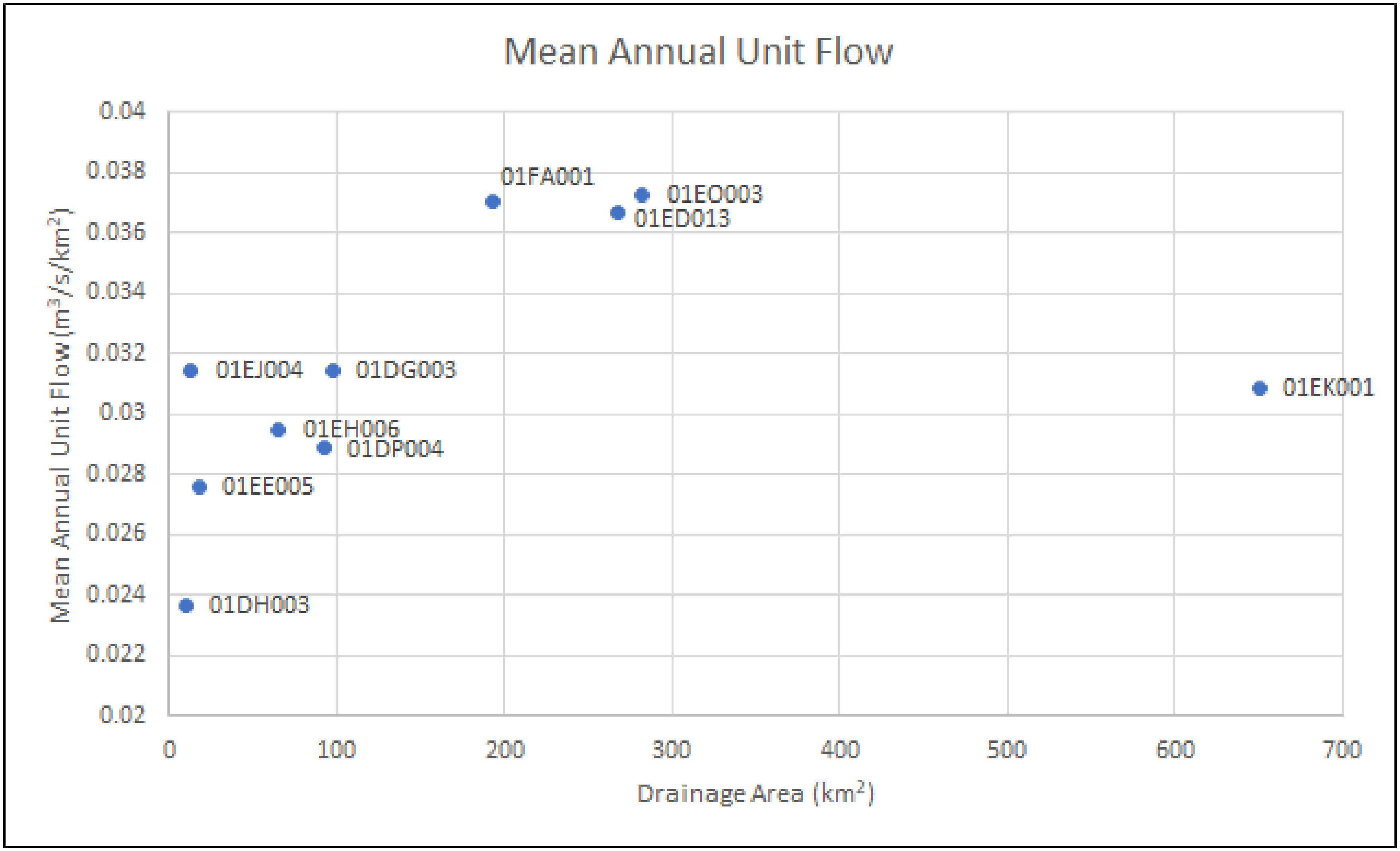

Figure 3.1 Mean Annual Unit Flows for Regional Dataset

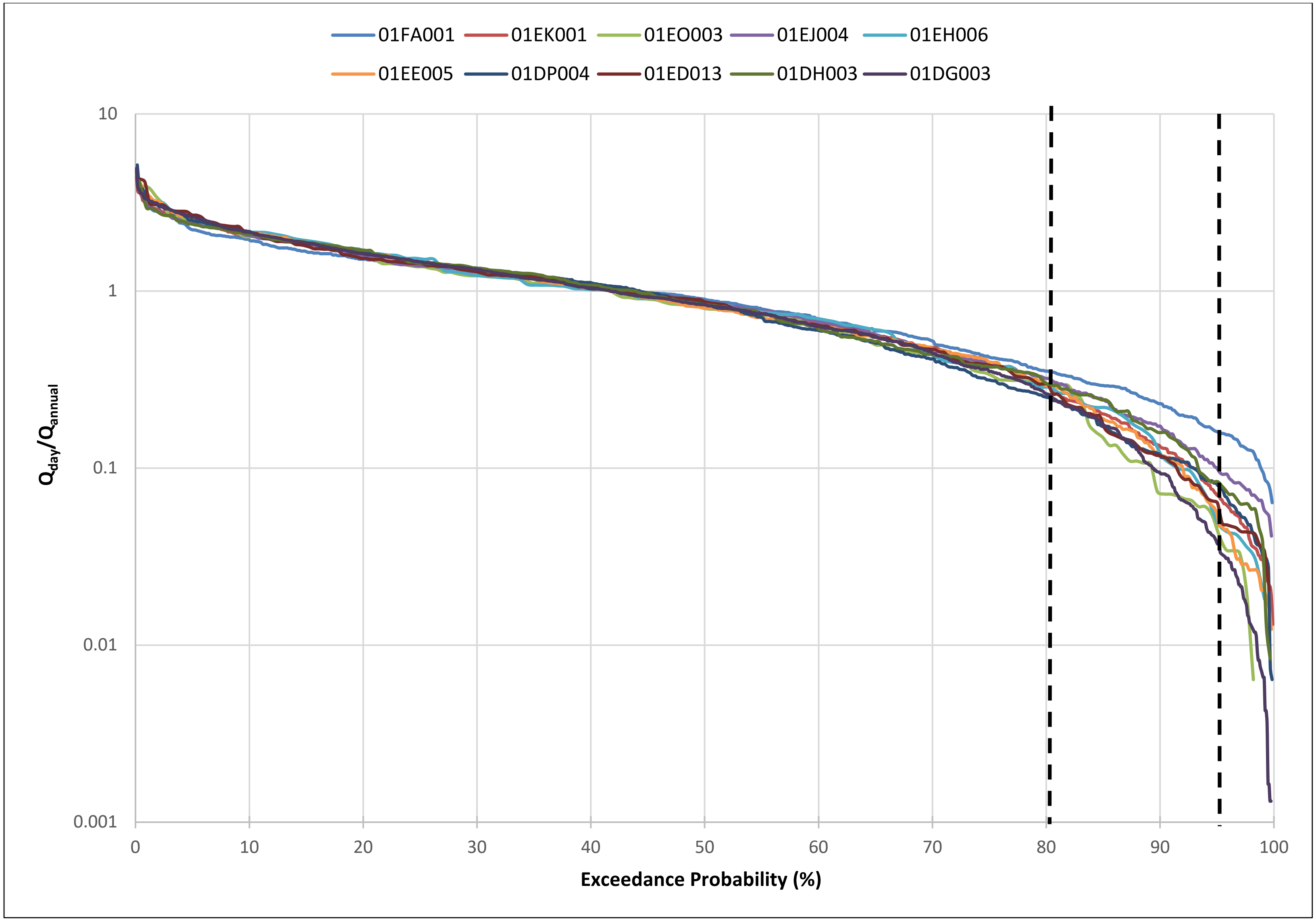

Figure 3.2 Regional Dataset Flow Duration Curves

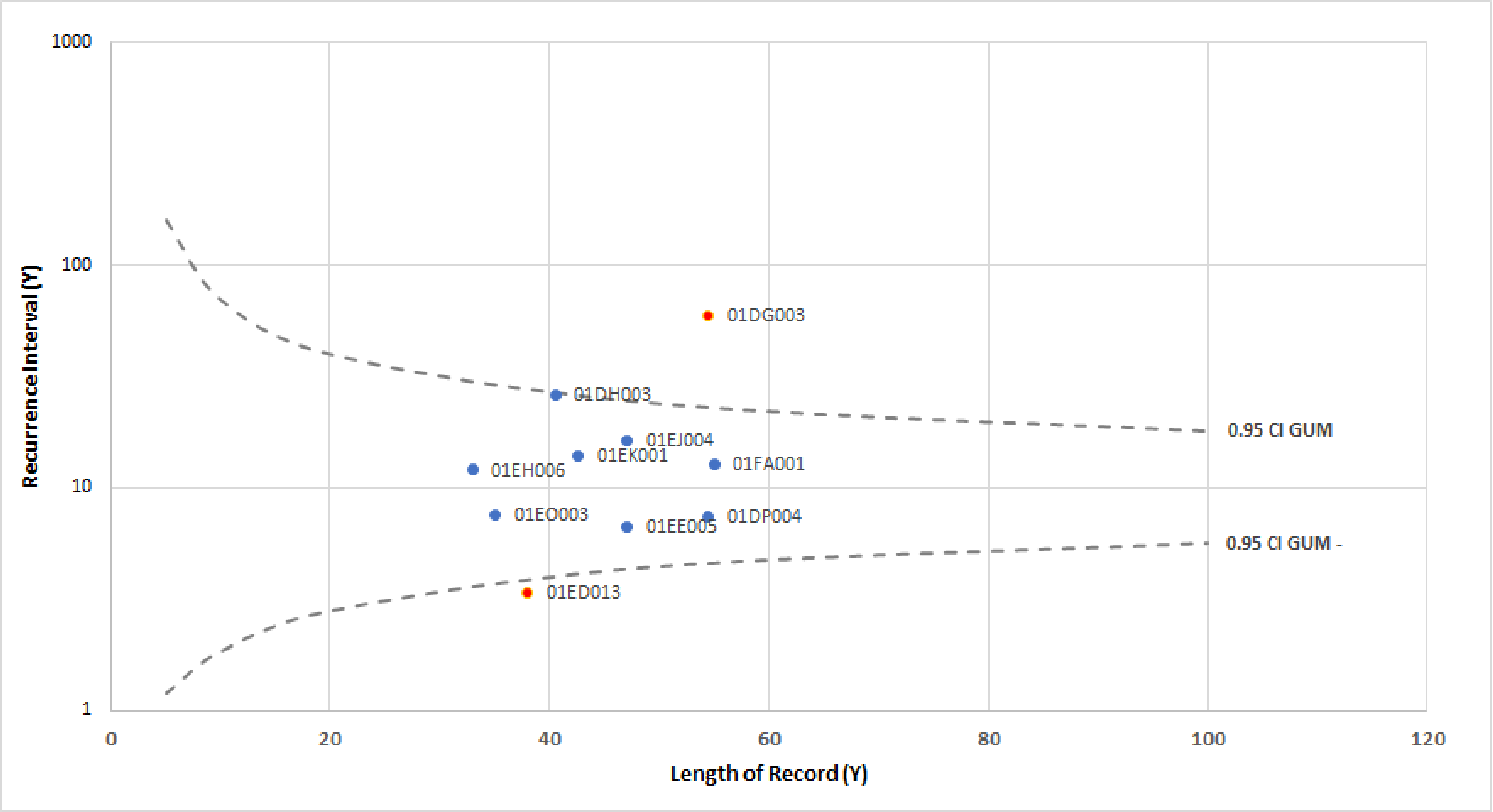

Figure 3.3 Index Flood Test

3.4 B.4 - CALCULATED AND MEASURED FLOWS

Explain the reason for differences observed between calculated flows and measured flows.

EARD Figure 7-5 presents the calculated and estimated (measured) flows at SW-2 on the Moose River adjacent to the Open Pit. The method used to calculate the flows at SW-2 were to take the flows estimated (measured) at SW-11 upstream of the mine site and estimated (measured) at HM-1 (Long Lake tributary) and then prorate these flows to the combined Moose River watershed at SW-2. The estimated flows at SW-2, SW-11 and HM-1 were based on the development of ratings curves for each station and then applying water level datalogger records to the station rating curve to estimate flows. The calculated flows based on upstream measured flows were assumed to be at gauging stations beyond the influence of the mine and Open Pit. Overlaying the calculated and estimated flows enables investigation of potential flow losses at SW-2 that may be associated with the Open Pit.

Further hydrotechnical field work was undertaken during the summer of 2021 to validate the gauging station rating curves and further investigate potential flow losses in the Moose River to the Open Pit. Figure 1.3.d-1 below presents the SW-2 calculated and observed (estimated/measured) hydrographs from June 1 – September 30 along with Halifax Stanfield International Airport precipitation hyetograph. Calculated and observed flows at SW-2 during summer 2021 monitoring tracked consistently with observed differences of less than 10% of calculated flows. Specific runoff peak occurrences on Jul 24, Aug 3, Aug 7, Sep 1, 2021 of potential calculated losses >10% for short durations. The investigation examined potential flow losses to the pit by examining daily pit dewatering records and determined that the upper bound of proportion of total decrease in instantaneous streamflow attributed to the Open Pit is 9%, meaning that no more that 9% of the calculated to observed flow difference could be attributed to pit inflow losses from the Moose River.

Apart from the interpreted small potential flow loss to the Open Pit, other potential sources of variance between calculated and observed flows include, but are not limited to:

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

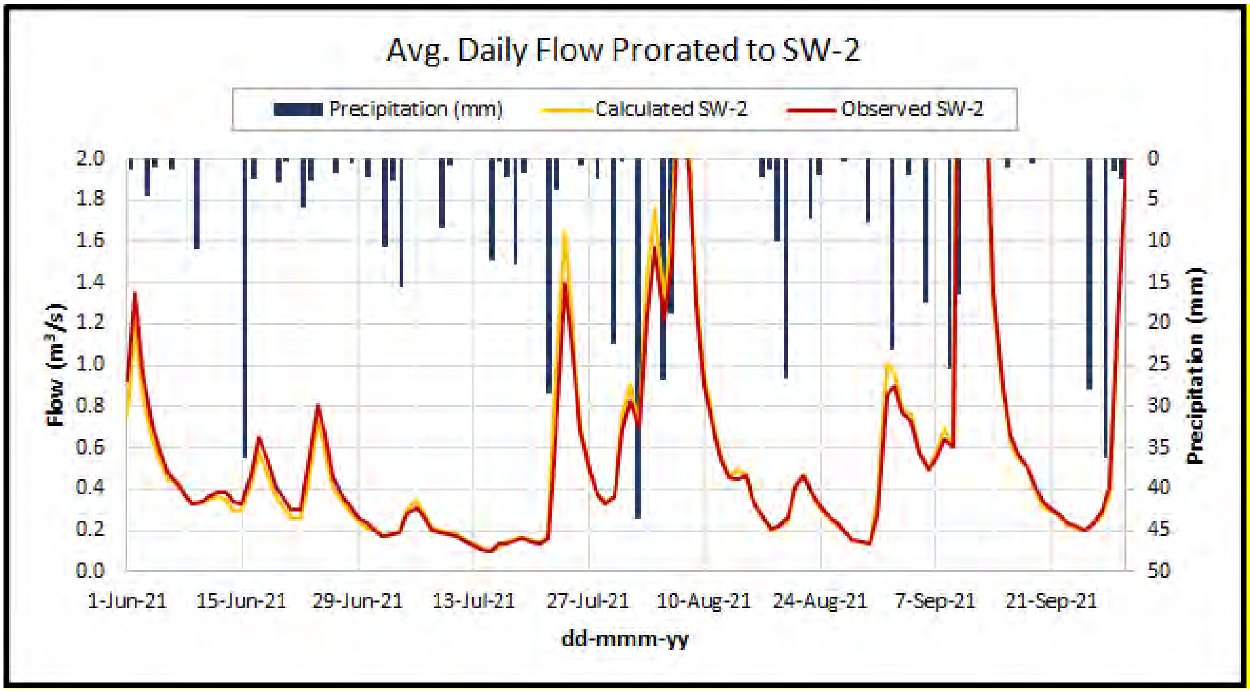

Figure 3.4 Summer 2021 Calculated and Observed (Estimated) flow Hydrograph at SW-2

<u>References</u>

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.

3.5 B.5 - SETTLING POND AND INSTANTENOUS FLOWS

Additional discussion of the proposed settling pond (New WRSA Pond) on instantaneous flows

As discussed in EARD Section 7.7.1, the WRSA and Clay Borrow Area expansions reduce the contributing catchment area of Watercourse #4 by 12.9 ha at an existing natural ground runoff coefficient of 0.67 equating to approximately 12,100 m^3/y based on climate normal conditions. Based on flow monitoring on-site at project components, the runoff coefficient for the WRSA is 0.43 and would require 20.4 ha of WRSA to match the annual volume of runoff expected to be displaced by the WRSA and Clay Borrow Area expansions and yield an estimate annual runoff of 12,198 m3/y.

The proposed new sedimentation pond for the WRSA would incorporate the WRSA expansion area draining currently to Watercourse #4 (5.1 ha) and would also add 14.6 ha of catchment area from the existing WRSA footprint to the new sedimentation pond drainage area catchment.

As a part of detailed engineering, Stantec intends to model the watershed of Watercourse #4 upstream of Mooseland Road using a hydrologic model such as HEC-HMS or PC-SWMM for a series of precipitation events ranging from a 10 mm, 25 mm, 2 year to 100 year return period to characterize existing conditions in a series of hydrographs. The model would be calibrated and validated with rainfall records from the on-site meteorological station and flow records collected at SW-19 upstream of Mooseland Road. Subsequently, the model would be modified with the WRSA expansion and new sedimentation pond and contributing drainage area catchment.

As the existing natural ground WRSA expansion is 5.1 ha, but the new sedimentation pond drainage area of 20.4 ha is compensating for total Watercourse #4 natural ground loss of 12.9 ha at the new FDP from the new sedimentation pond to Watercourse #4, the model is expected to demonstrate relative hydrograph matching at the model timestep. In fact, it is expected that an increase in peak flows would be observed because of the increased size of contributing area at the new FDP. However, as the new sedimentation pond will serve a flood and erosion control function and typically does so via peak shaving, it is expected that the attenuating effect of the new sedimentation pond will demonstrate pre- to post-condition relative hydrograph peak matching. We anticipate that the attenuating effect of the new sedimentation pond will result in baseflow extension or augmentation from the pond. In light of the relatively small headwater catchment upstream of the new Watercourse #4 FDP we understand that relative peak matching and baseflow augmentation would be considered positive hydrologic outcomes for the new sedimentation pond.

Through proposed hydrologic modeling during detailed engineering, which will be included in the Industrial Approval submission, AMNS intends to demonstrate the compatibility of the new sedimentation pond outflows at the new FDP in Watercourse #4 to contribute higher flows without inducing flooding or erosion and extend baseflows in this relatively intermittent section of Watercourse #4 headwaters.

Please refer to Section 3.5 for further estimates of instantaneous flow responses in Watercourse #4 and under conditions including the new WRSA sedimentation pond.

3.6 B.6 - FLOWS TO WATERCOURSE NO. 4

Inconsistencies noted in the approach for determining flows to watercourse No.4

As flow gauging on Watercourse #4 did not commence until Spring, 2021, the method used to present mean annual and mean monthly flow estimates for Watercourse #4 and its sub-catchments 1, 2 and 3 was to prorate the flows collected by the project on the Moose River during the 2017 – 2020 flow monitoring period. Understanding that the Moose River flow gauging was not part of the Regional Hydrology dataset, we acknowledge that the method used to present MAF and MMF on Watercourse #4 and its sub-catchments is inconsistent with the Regional Hydrology MAF and MMF regression analysis. Table 3.2 below presents the MAF and MMF for Watercourse #4 and its sub-catchments using the Regional Hydrology Database discussed in detail above in the response to Section 3.3. Due to the shorter duration of Moose River monitoring, the monitored MAF and MMF do not have the statistical strength and validity of the Regional Hydrology dataset and therefore use of these short-term local flows introduces potential error to Watercourse #4 estimates. The MAF and MMF estimates in Table 3.2 bring the statistical strength and verification undertaken in vetting and confirming the Regional Hydrology Dataset grouping and therefore are considered more accurate and consistent with other long term flow estimates based on the Regional Hydrology dataset.

Table 3.2 Watercourse #4 and Sub-catchment flows based on Regional Regression Relationships

Month	Watercourse #4 Catchment	Catchment 1- Mooseland Rd	Catchment 2 - SW-3	Catchment 3 - Otter Dam
	Mean Monthly Flow (L/s)			
January	41.22	12.44	8.36	15.94
February	40.50	12.61	8.55	16.05
March	66.79	21.67	14.91	27.37
April	80.54	25.03	16.98	31.89
May	45.70	14.08	9.52	17.97
June	25.83	8.18	5.58	10.38
July	16.38	5.33	3.67	6.73
August	13.03	3.97	2.67	5.08
September	19.42	6.43	4.45	8.08
October	38.20	12.35	8.49	15.61
November	64.57	20.44	13.95	25.94
December	61.92	19.24	13.05	24.51
MAF	42.84	13.48	9.18	17.13
Catchment area (km2)	1.808	0.613	0.428	0.767

4.0 GROUP C – WATER BALANCE MODEL

Provide additional details on the purpose, approach and assumptions associated with the water balance model. In particular, address the following questions.

4.1 C.1 - ASSUMPTIONS

Provide rationale for the assumption that runoff, evapotranspiration and infiltration are negligible in months with average monthly temperatures below 0°C. How was this assumption tested or validated?

The Touquoy Integrated Water and Tailings Management Plan presents an environmental water balance and the site wide water balance model. The environmental water balance was provided for context as it was used as a starting point in the Touquoy site wide water balance model to estimate the proportion of precipitation as runoff after evapotranspiration and infiltration losses (i.e. the runoff coefficient). As the site has been in operation since 2018, these initial runoff coefficients estimated in the environmental water balance have been updated through bi-monthly calibration to metered data in the site wide water balance model.

The environmental water balance was completed for the site based on the 1981-2010 climate normal conditions at the Middle Musquodoboit climate station. In this model, when temperatures are below zero it is assumed that precipitation was stored as snow thus no runoff. This is a common assumption in a water balance in an Atlantic climate. Rational for these assumptions are provided below:

- As much of the project catchment area is unforested/unvegetated, transpiration is only a small portion of evapotranspiration year-round and considered negligible for the site.
- Lake evaporation rates are reported at the Truro climate station as zero for these same winter months. The Truro climate station is used to represent pond evaporation in the water balance model.

Typically, the ground is frozen in the winter months limiting soil saturation or natural percolation into the ground.

4.2 C.2 - CALIBRATION

Provide details on how the water balance model was calibrated. In the calibration of the existing water balance, how well did the assumptions work and the model perform? Was the model also validated?

The Touquoy in-pit water balance model was based on the existing site water balance. Therefore, the accuracy of the water balance model is expected to be high relative to a typical model completed for an environmental assessment, as observed data at the site is available and the model input parameters have been calibrated.

The site water balance model is updated bi-annually, coincident with the annual bathymetry survey of the TMF and an interim capacity update. The site water balance already captures the WRSA, Open Pit and Clay Borrow Area, as they currently are collected and pumped to the TMF. The site includes an on-site meteorological station equipped with a precipitation gauge, and metered pumped flows. Pumped flows at the site are metered and ponds are monitored for water level. The combination of this data allows for calibration. Adjustment to calibrated runoff coefficients have not been required recently as the water balance closely matches observed operating conditions. As the water balance is updated on a weekly timestep, it is continually validated to identify if observed pumped volumes and pond level match simulated.

Sensitivity of water balance inputs is performed routinely for operation of the TMF and for the in-pit tailings deposition modelling to support planning and design. Water balance results are routinely presented for the 100-year wet and 100-year dry climate conditions. Additional sensitivity is run on the monthly distribution of the 100-year wet and dry-year, an increase in WRSA runoff coefficient as toe seepage is expected to increase with time as the pile is wetted, the month representing end of life of the TMF, and evaporative losses. In addition, the change in average deposited tailings density for in-pit tailings deposition has been conducted to support detailed design and identify risks in design.

The water balance presented as part of the EARD was simplified to provide an average over the period of the 30 plus years of simulation. During this time, the monthly climate fluctuations will become more balanced. As done currently, this model will routinely be updated to account for the existing conditions and to calibrate inputs to improve the match of simulated and observed model extractions.

4.3 C.3 - SUB-AQUEOUS DEPOSITION DESCRIPTION

Confirm or clarify how tailings would be deposited 'sub-aqueously' into the pit

As described in the Touquoy Integrated Water and Tailings Management plan appended to the EARD (Appendix A.1 of the EARD), the proposed tailings deposition strategy is described below:

- A TMF slurry line will be run from the mill, along the pit ramp and to a floating barge placed in the pit.
- The tailings will be deposited approximately 2 m below the water surface.
- A tremie line and barge will be moved around the pit to maintain water cover.
- A floating baffle curtain will be installed on the floating barge or in sections of the pit to enhance settling.

A model of the tailings deposition reclaim barge, discharge barge arrangement is currently being developed to plan the arrangement of the reclaim barge, discharge barge and bubblers for the initial months of operation. The model is being developed in alignment with the above noted strategy presented in the EARD and will be provided as part of the industrial approval documentation.

4.4 C.4 - SUB-AQUEOUS DEPOSITION AND WATER BALANCE

Does subaqueous deposition of tailings impact the results of the water balance?

The water balance assumed that the tailings would be deposited sub-aqueously. The assumed average deposited density of the tailings and the water volume retained in the consolidated tailings was based on subaqueous tailings deposition of the Touquoy tailings. A change to the tailings deposition strategy would result in a change to the water balance.

4.5 C.5 - SUB-AQUEOUS DEPOSITION AND WATER DEPTH

What is the minimum acceptable water depth for safe and sustainable subaqueous flow? Provide model results to indicate whether this depth will likely be achieved, or indicate if any monitoring activities have been planned to ensure satisfactory depth exists prior to tailings deposition.

As described in the Touquoy Integrated Water and Tailings Management Plan appended to the EARD, an objective of the water balance model was to account for the start-up water to support water reclaim water demand from the pit during operation. The volume and elevation of water in the Open Pit throughout operation is presented in Figure 4.4. and Figure 4.5 of the Plan.

To reduce the risk of shortages of process water and subsequent mill shutdowns, the target start-up water volume of 500,000 m3 or 43 m above the pit floor is carried forward in design. This water volume will be supplied from the following:

- Natural groundwater inflow and direct precipitation on the pit accumulating overtime
- Pre-filling of the Phase 1 pit prior to completion of mining
- The delay of reclaim from the pit, as reclaim will be actively drawn from the TMF pond until no longer feasible to pump
- Surplus water from the Open Pit and polishing pond
- Runoff from the Scraggy (i.e. overburden) stockpile, Clay Borrow Area, and WRSA

Effectively, this transition period when tailings slurry will be deposited in the Open Pit without reclaim from the pit will build the water cover reservoir over the deposited tailings.

The transition from depositing tailings into the TMF to the exhausted Touquoy pit is currently being designed and further modelling is being conducted so the design can manage risk for the Project.

4.6 C.6 - EVAPOTRANSPIRATION

Clarify and justify the evapotranspiration numbers. Have losses due to evaporation been included, and where (Table 4.11)?

Losses to evapotranspiration were accounted for in the site wide water balance model that was summarized in the Touquoy Integrated Water and Tailings Management Plan. Evapotranspiration losses were applied to the land, where applicable and evaporation losses were applied to the ponded areas. Both evapotranspiration and infiltration losses are accounted for in the site wide water balance model as a whole and as discussed above in comment 1.5a), and have been calculated based on observed data. The pumped runoff summarized in Table 4.1 and the process balance in Table 4.1 presents monthly volumes that already account for these losses. Only evaporation losses directly from the pit lake are presented in Table 4.1 of the Touquoy Integrated Water and Tailings Management Plan, as the water balance was developed to simulate the filling of the pit lake.

<u>Explanation of Table 5.1 of Appendix A.1 to the EARD</u>

Pumped inflows to the pit, which includes the runoff to open pit catchment, runoff from Scraggy stockpile, and runoff from the WRSA have been presented in Table 4.1, as net precipitation and already account for these evapotranspiration and infiltration losses. This includes the pumped inflows discussed above, the evaporation loss of the pit lake, and the pit groundwater inflow. The runoff from Scraggy Stockpile that is pumped to the pit during filling was not presented in the Touquoy Integrated Water and Tailings Management Plan and therefore has been included below.

Table 4.1 In the Touquoy Integrated Water and Tailings Management Plan presents the process flows

Month	Runoff to Open Pit	Evaporation from Pit Lake	Pit GW Inflow	Runoff from Scraggy Stockpile	Water Diverted from WRSA	Sum of Inflows to Pit During Pit Filling	Pit Overflow During Closure
January	20,822	0	24,817	9,293	3,359	58,291	38,871
February	26,383	0	22,589	11,733	4,289	64,994	32,383
March	33,094	0	24,749	13,170	10,841	81,854	35,537
April	145,991	0	23,881	16,391	18,689	204,953	75,409
May	45,168	-36,251	24,579	9,828	6,788	50,112	119,303
June	42,768	-41,130	23,730	9,255	6,345	40,967	19,223
July	44,482	-47,502	24,482	9,591	6,556	37,609	11,660
August	39,383	-38,751	24,450	8,516	5,901	39,498	7,322
September	47,439	-27,824	23,633	10,398	7,493	61,140	11,236
October	50,010	-16,251	24,385	11,059	8,182	77,386	29,397
November	58,624	0	23,558	13,105	9,991	105,278	43,816
December	27,662	0	24,298	6,184	4,740	62,884	67,829

Explanation of Table 4.11

Similarly, the monthly volumes reported in Table 4.11 of the Touquoy Integrated Water and Tailings Management Plan (Appendix A.1 of the EARD) incorporate the evapotranspiration and infiltration losses. The inflows to the pit are presented as net precipitation in Table 4.11 as “Sum of Inflows to Pit.” Losses due to evaporation and spillage were also accounted for the in the process balance. These losses are calculated as metered data is available throughout the mill circuit. These losses account for approximately 3% of tailings production (t). These monthly losses were not presented in the Open Pit Process Water Balance Touquoy Integrated Water and Tailings Management Plan. The monthly volumes of “Discharged with thickened tailings” accounts for these losses and have been calibrated to observed pumped discharge data.

4.7 C.7 - ENVIRONMENTAL WATER BALANCE DESCRIPTION

What is the purpose of the ‘Environmental Water Balance’ and how is it used to support recommendations and conclusions for the proposed works?

The Touquoy Integrated Water and Tailings Management Plan presents an environmental water balance and the site wide water balance model. The environmental water balance was provided for context as it was used as a starting point in the Touquoy site wide water balance model to estimate the proportion of precipitation as runoff after evapotranspiration and infiltration losses (i.e. the runoff coefficient). As the site has been in operation since 2018, these initial runoff coefficients estimated in the environmental water balance have been updated through bi-monthly calibration to metered data in the site wide water balance model. The site wide water balance model at Touquoy has been matching closely with the observed values. Therefore, the environmental water balance has been superseded by the site wide water balance model.

4.8 C.8 - WATER DISCHARGE FROM SPILLWAY

From the start of tailings deposition into the exhausted Open Pit, what year will water start discharging from the spillway?

As described in the Touquoy Integrated Water and Tailings Management Plan appended to the EARD (Appendix A.1), the Open Pit will fill to the spillway elevation of 108 m in 103 months (approximately year 2030 if commencement is 2022) from the commencement of in-pit tailings deposition. However, the pit water level will be maintained below the spillway elevation until water quality in the pit lake meets regulatory discharge criteria. This excess water will be pumped to a treatment plant and discharged through the spillway. Water quality was simulated to improve overtime and in Year 30 is expected to meet discharge quality, without considering any water quality improvements realized from batch treatment during filling

4.9 C.9 - RUNOFF COEFFICIENT

Explain why the runoff coefficient used in the WRSA analysis differs from previously submitted information. How were these values for runoff and evaporation chosen and validated?

The simulated runoff coming from the WRSA is calibrated bi-annually based on observed pump records of toe seepage/runoff to the WRSA ponds. The value of runoff and evaporation carried in the water balance model will be based on the latest available data.

In addition, seepage collected in the perimeter ditching around the waste rock pile is expected to increase overtime as the waste rock is wetted. Therefore, the runoff coming from the WRSA is increased overtime.

4.10 C.10 - INSTANTANEOUS FLOWS

What is the rationale/justification for not assessing changes to instantaneous flows resulting from proposed activities?

Context: The report goes on to say that "Returning flow from a 20.5 ha section of the WRSA drainage area would return approximately 12,198 m3 to the watercourse on an annual basis, thus achieving no net change in surface water quantity to Watercourse #4." (pg. 7.33). The previous page had outlined that this approach would "make up the anticipated instantaneous to annual flow volume loss…", but discussion related to the impacts of the proposed settling pond/treatment approach on instantaneous flows is not provided

Please refer to Section 3.5.

Notwithstanding that detailed design of the WRSA new sedimentation pond and the associated hydrologic and hydraulic modeling has not occurred, nor the stated objectives of instantaneous flow hydrograph matching, the following presents an empirically based estimate of anticipated instantaneous flow changes in Watercourse #4 at the new sedimentation pond FDP.

Local flow station SW-19 was established on Watercourse #4 upstream of Mooseland Road in sub-catchment 1. The hydrograph for the 2021 flow monitoring period at SW-19 is presented in Figure 1.5.j-1.The upstream catchment area of SW-19 is 61.3 ha. The WRSA expansion includes 5.1 ha of the existing Watercourse #4 drainage area and represents 8% of the SW-19 upstream catchment. Therefore, without flow supplementation, the SW-19 hydrograph would be reduced as indicated in Figure 1.5.j-1. To estimate and present the anticipated effect of the WRSA expansion new sedimentation pond on flows at SW-19 a short distance downstream from the proposed new FDP, hydrograph separation was conducted. The residual unaffected upstream catchment of SW-19 would produce flows as per the "without flow supplementation" hydrograph. To estimate runoff and seepage to the WRSA new sedimentation pond and then to the FDP, hydrograph simulation was conducted based on a total proposed WRSA contributing area of 20.4 ha and then the hydrograph was reduced to account for the reduction in runoff coefficient observed between natural ground (0.67) and the existing WRSA (0.43). Subsequently, to account for runoff and seepage lag and detention time in the pond the WRSA 20.4 ha contributing hydrograph was adjusted using a moving average which attenuates peaks and extends its baseflows. The results of the estimated resulting flows at SW-19 are presented in Figure 1.5. j-1 and will be confirmed by the modeling proposed in 1.3.e.

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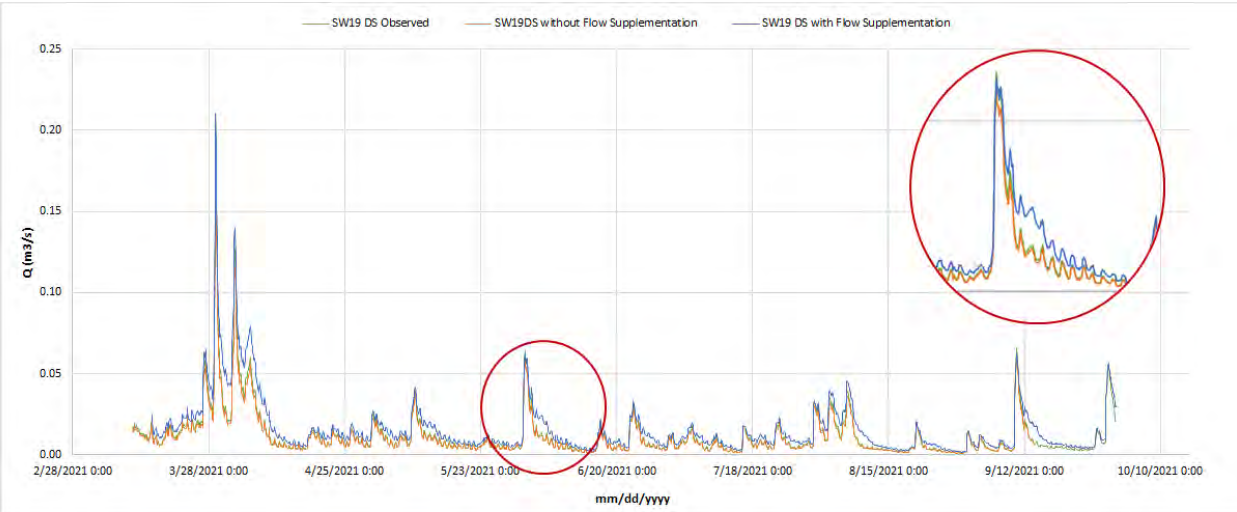

Figure 4.1 2021 SW-19 Hydrograph and Estimated Hydrographs with and without Flow Supplementation from the New WRSA Sedimentation Pond

4.11 C.11 - HYDROMETRY STANDARD

This standard relates to single measurements – what approach was taken for the installation and maintenance of the continuous monitoring stations?

As per the industrial approval for the operation Touquoy mine, AMNS is required to follow ISO 748:2007E Hydrometry – Measurements of liquid flow in open channels using current

t meters or floats. The AMNS Standard Operating Procedures for the collection of water level data using pressure transducers in surface water and groundwater stations is applied to the pressure transducer dataloggers installed at hydrometric stations as described below. Pressure transducers are installed in a stilling well secured in the bed of the watercourse using angle iron or rebar. The logger is hung from the top of the stilling well to sit at the bottom of the water column, secured to restrict movement. Direct read cables are installed at each hydrometric station or bluetooth enabled dataloggers to avoid removing the transducer from the water column during data downloads. The installed pressure transducers measure total pressure and are compensated with barometric pressure transducer data from loggers onsite.

Water levels above the sensor are manually measured at the time of logger installation and retrieval to apply corrections for barometric compensation. Manual staff gauge readings at the time of each flow measurement are collected for comparison to the automated level to detect measurement drift in pressure transducers and make required data corrections. Routine benchmark surveys are also conducted to detect movement of the stilling well, staff gauge and/or pressure transducer. The Leveloggers are downloaded at regular intervals to reduce the opportunity for a loss of data.

Water levels at the monitoring stations are referenced to CGVD2013 through a survey of the top of the staff gauge. Confirmatory surveys of the top of staff gauge elevation and stilling well are conducted routinely or after a heavy flow event to detect any movement in the station.

5.0 GROUP D - GROUNDWATER FLOW AND SOLUTE TRANSPORT MODEL

5.1 D.1 - EVAPOTRANSPIRATION

From a review of the results in Table 4.6, the evapotranspiration numbers require clarification and justification.

Evapotranspiration is also discussed above in Responses C.1 and C.6.

Table 4.6 of Appendix D.1 to the EARD presents model inputs for recharge and evapotranspiration (ET) rates. In addition to the ET rate reported in Table 4.6, MODFLOW also requires an ET extinction depth as input. The actual ET rate in a model cell decreases linearly from the specified rate for water levels at the ground surface or above to zero below the specified extinction depth. In addition to the specific ET rates in Table 4.6, the groundwater model uses an extinction depth of 0.5 m in both the annual and summer cases.

Table 5.1 Summary of Modeled Recharge and Evaporation Output

Parameter	Modeled Rate		Expected Range	
Annual	**m^3/d**	**mm/yr**	**mm/yr**	**mm/yr**
Modeled Recharge	51,564	323		
Modeled ET	8,309	52		
Net Model Recharge	43,255	271	136	408
Summer				
Modeled Recharge	20,044	126		
Modeled ET	5,955	37		
Net Model Recharge	14,089	89	123	368

The modeled recharge and ET should not be evaluated in isolation; rather, the net annual recharge (modeled recharge – modeled ET) from the model output should be compared with the expected range of the percentage of annual precipitation that recharges groundwater of 10% to 30%. Given the average annual precipitation of 1361.1 mm/yr from Section 2.2 in the groundwater model report, the expected range of annual net groundwater recharge is 135 mm/yr to 405 mm/yr as presented in Table 4.6. Net annual model recharge determined the model output table above (Table 5.1) is 271 mm/yr, or 20% of mean annual precipitation, which falls within the expected range.

Mean precipitation is 306.4 mm during the summer months (July – September) which equates to an annual rate of 1226 mm/yr. The net model recharge rate in the above Table 5.1 during this period is 89 mm/yr, or 7 % of precipitation rate during the summer months. A lower net recharge percentage during the summer months is expected due to higher actual evapotranspiration from phreatophyte growth in the summer and higher solar evaporation.

5.2 D.2 - MEAN ANNUAL FLOW MOOSE RIVER

Moose River stations are only monitored from May – October – is this the dataset that was used to support the 'annual' flow rates at SW-2?

Mean annual flow rates for Moose River are provided in Section 7.4.7.1, Table 7.9 of the EARD and are based on the regional regression for Moose River, outlined in the same section. Mean monthly flows from measured data at surface water monitoring locations on Moose River are given in Table 7.8 of the EARD for reference. These data are not used to calculate a mean annual flow as the measurement season is limited to the non-frozen months and a complete annual data set is not available for monitored locations.

5.3 D.3 - DATA RANGE

Why is only 2019 data used to support assessment of the model

An updated modelling report is provided in Appendix B.3: Groundwater Flow and Solute Transport Modelling to Evaluate Disposal of Tailings in Touquoy Open Pit.

5.4 D.4 - HYDRAULIC CONDUCTIVITY

What impact did assumptions of the hydraulic conductivity of the fault alignments presented on Figure 2.4 have on flow simulation results?

As pertains to Appendix D.1 of the EARD, a sensitivity analysis was run on the hydraulic conductivity of the faults and is presented in Section 5.4.2.1 of the EARD. The model was run with the hydraulic conductivity of the mapped faults raised by an order of magnitude higher and lowered by an order of magnitude from the base conductivity of the surrounding bedrock. The model report presents this sensitivity (Figure 5.10) in terms of relative seepage concentration. Since the transport model assumes a constant source concentration in the pit and no degradation along the flow path, the relative concentrations presented in Figure 5.10 can be used as a corollary to modelled seepage to the Moose River. Reducing the hydraulic conductivity of the faults has little effect on relative concentrations or seepage to the Moose River. Increasing the hydraulic conductivity of the faults by an order of magnitude results in increased seepage concentrations, and thus, increase seepage flow to the Moose River, of 2.7x after 50 years, 3.7x after 100, and 4.4 times after 500 years.

An update to the groundwater flow and solute transport model is provided in Appendix B.3 of the Main Addendum Report.

5.5 D.5 - GROUNDWATER MODELLING CONFIDENCE

Describe uncertainty present in the results presented and potential ranges of values that should be considered in the assessment of impacts from what is proposed?

As stated in Section 5.5 of the groundwater modeling report (Appendix D.1 to the EARD):

"The approach used in model simulations completed for this Project was to incorporate conservative assumptions for predicting effects that may result from the Project. This report presents the assumptions made in developing these conservative predictions and discusses the high-level confidence of these predictions.

The groundwater flow modelling was conducted using a model calibrated to water levels, and baseflow targets to establish baseline conditions. Predictions made using the model are based on several conservative assumptions to reduce the influence of uncertainty in the predictions. Therefore, the confidence in the predictions made using the model is considered high.

Uncertainty in predictive model results presented in the EARD is mainly due to the density of available data in areas of potential impacts from mining operations; specifically, the area between the pit and Moose River and the area around the WRSA. Based on the additional work carried out in this area and subsequent updates to the model (Section 2.1 and Appendix B.3 of the Main Addendum Report), the certainty associated with modelling predictions has been increased.

6.0 GROUP E – VARIOUS

6.1 E.1 - GROUNDWATER MONITORING POST CLOSURE

Describe the proposed groundwater monitoring plan for the post-closure phase including timelines for long-term monitoring.

The Reclamation Plan covers the post-closure phase and indicates timelines for long term monitoring. This plan is under review and will be updated to reflect the proposed modifications, if approved. As reflected in Section 5 of the Reclamation Plan (Attached to the EARD as SD 06), "Post-closure monitoring will initially be an extension of the current mine operation monitoring programs. These programs include monitoring physical and chemical parameters for air, surface water, groundwater, vegetation, and soils, as well as environmental effects monitoring, and are outlined in the Project IA. As part of developing a Final Plan leading up to closure, an adaptive post-closure monitoring plan will be prepared. This monitoring program would be informed by the monitoring results compiled over operations to focus on areas of concern identified during mining, and/or aspects of closure with high uncertainty/risk. The surface water and groundwater monitoring programs are planned to continue based on a similar scope as during operations, with reduced frequency from operational monitoring for the duration of active decommissioning and earthworks closure. Once these closure activities are completed, it is expected that surface water and groundwater conditions will stabilize, and monitoring can be reduced. This is expected to occur first for the Mill Site and Admin Area, followed by the WRSA and TMF and eventually the Open Pit due to the timelines associated with passive pit flooding (approx. 18 years). Monitoring of the pit lake during flooding is expected to be much reduced from the program during mining operations and will include an in-pit location to assess water chemistry and flooding rates. Specific compliance points will be proposed in a final Plan and based on industry standards (e.g. mixing zone length at Moose River).

6.2 E.2 - BASELINE DATA

Provide rationale for using 2017 water quality data to represent baseline conditions when development started in 2016.

Construction of the Touquoy Gold Project facilities began on June 1, 2016, however operation of the project facilities did not occur until the start of processing of ore in October 2017. The first dumping of waste rock occurred in early October, 2017 and the processing of ore and disposition of tailings began on October 11, 2017. The treatment facilities were commissioned in 2018 with effluent discharge beginning in July 2018. Baseline conditions were documented in the 2016 Surface Water and Groundwater (SW & GW) Monitoring Report, issued on April 30, 2017 as part of IA requirement, and reiterated in subsequent annual monitoring reports. This included 2016 monitoring data and Q1 of 2017 (January to March). This was extended in the 2017 SW & GW Monitoring Report to include information up to October 11, 2017 as data became available. This is confirmed in correspondence from NSE ICE Division indicating baseline data for the Pit, Plant and TMF can include all dates up to October 11, 2017 (email dated May 10, 2019, C.Hynes).

Construction activities occurring during the baseline monitoring period are expected to have been controlled through the implementation of erosion and sediment control measures and the construction of site stormwater controls. The baseline monitoring period ceased nine months before point-source discharges occurred from the mine site to sampled receiving water bodies. Background concentrations referred to in the EARD represent surface water quality at sampling locations upstream of mine infrastructure and include data points through 2018 to present day. References to baseline sampling extending through 2017 refer to baseline environmental effects monitoring.

6.3 E.3 - SILTATION EVENTS

It is noted that an assessment of effects of siltation concluded effects appeared to be minor and reversible if further siltation events are prevented". The basis of this conclusion is not offered within the body of the report and no reference is given for further details within Appendices or Supporting Documents. It is therefore uncertain that this conclusion is warranted, and that water management infrastructure is or can be relied on to eliminate siltation from project areas.

An assessment was undertaken in 2019 to assess the effects of siltation on the wetlands and watercourse downgradient from sediment release events at the Touquoy Mine. The report, "Assessment of Wetlands 6 and 15 and Watercourse 4, Touquoy Mine, Nova Scotia", dated December 19, 2019 was attached to the EARD as SD No. 14. Based on the observations made by Qualified Persons (i.e., aquatic and terrestrial biologists) during this assessment Stantec determined that the effects appeared to be minor and reversible.

Subsequent to the 2019 assessment, follow-up monitoring activities that have been approved by NS ECC are noted below:

- A Monitoring Plan was created for Wetland 6 and 15 dated June 11, 2020 a copy of which is attached (Attachment 2);
- This Monitoring Plan includes additional monitoring activities in 2020, 2022, and 2024 and was approved by NSECC and incorporated into the mine's permit conditions.
- Pursuant to this approved Monitoring Plan, Stantec conducted site work in August and October 2020 and submitted a report March 29, 2021, a copy of which is included with the Main Addendum Document as Appendix I. As a result of this investigation, Stantec recommended that a qualitative sampling of the interstitial water be undertaken in August 2021 for select samples in Wetlands 6 and 15. This work was completed in August of this year.
- Further follow up reports will be provided to NS ECC in 2022 and 2024.

Overall, the results from Year 1 monitoring of Watercourse #4 suggest that six of the seven swift-flowing habitats are returning to their pre-siltation substrate composition (Stantec 2021). Silt that was observed at sites appeared to be stable. In habitats where there is lower water velocity and gradient, such as HU24, may require more time to restore to pre-disturbance substrate composition given the lower velocities relative to other areas.

Within the still water areas of Wetland 6 within Watercourse #4 the aquatic plant community and sediment deposition results from 2020 suggest that sediment deposition may have had less influence on aquatic plant cover than water depth. The lower cover of aquatic vegetation at the northern end of the still water area where sediment deposition was highest may be attributed to the deeper water found in this area than to the amount of sediment deposited there. The first layer of sediment in all of the cores collected was a dark brown/organic floc indicating a recovery to natural sediment types (Stantec 2021).

Within Wetland 6 the comparison of the largely qualitative information collected in 2019 versus the quantitative information collected in 2020 suggests that the condition of the vegetation in the affected areas of the bog have not changed substantively between 2019 and 2020. Other factors such as dry growing seasons may also have resulted in mortality in sphagnum moss as silt was observed in reference and affected quadrats. In Wetland 15 the monitoring suggests that the effects of sediment deposition were highly localized and mainly limited to ground vegetation species and the relatively limited adverse effects on wetland vegetation are probably attributable to the patchy distribution of sediment deposits (Stantec 2021). Continued monitoring will assess the recovery of habitats within Wetland 6 and 15 and Watercourse #4.

In addition to the above monitoring activities, AMNS would like to note the following mitigation measures that have been completed in response to siltation events that occurred at the mine site:

- AMNS has made significant capital and operating investments (estimated 2.5 million between 2018 and 2021) to prevent and mitigate sediment release including several large-scale engineering projects to improve sediment and erosion control infrastructure at areas where reported events have occurred or where there was identified risk for occurrence.

- AMNS commissioned several independent engineering studies to determine how to correct the siltation issues which were originating from the mine haul road storm water runoff.
- The corrective work included the substantial redesign and reconstruction of the roadbed with the incorporation of filtration layers (including geotextiles) as well as alteration of surface grading to direct storm water from the road surface into collection ponds from which the water is pumped to the TMF.
- The redesign and reconstruction of the TMF Haul Road was completed as of Spring 2021, and despite several heavy precipitation events since there have been no unauthorized releases of substances or water that do not meet statutory or Industrial Approval limits at this location.

6.4 E.4 - SQUARE LAKE

The application states that seepage to Square Lake will be reduced however there are no proposed groundwater wells or surface water monitoring stations around Square Lake or in the areas that may receive water impacts resulting from the WRSA expansion.

As per Figure 6.17 in the EARD, steady-state particle tracks for the proposed expanded WRSA are predicted to migrate towards the southernmost reaching area of Square Lake. A seepage collection ditch is proposed to capture seepage from this area and convey to a seepage collection pond. Per Table 6.5 in the EARD, the seepage reduction to Square Lake is predicted to be low, in the order of 3 m3/d or 3,000 L/day. From a quantity perspective, two surface water flow monitoring stations have been established downstream of Square Lake on Fish River (TQ-SW20 and TQ-HM2). Seasonal measured flows at TQ-SW20 ranged from approximately 6 to 26 L/s during the 2021 monitoring season. A loss of groundwater seepage of 3,000 L/day to Square Lake is quantified as approximately 0.1 % to 0.6 % percent of the downstream flow in Fish River. From a quality perspective, surface water is currently monitored for quality at the outlet of Square Lake (SW-12) on a monthly basis (see Figure 7.4 in the EARD). If changes in quality occur within Square Lake, it is expected to be captured within routine monitoring at SW-12. Currently there are two nested sets of wells (WRW-1A/B and WRW-2A/B) which are located north of the western half and eastern half of the WRSA, respectively and between the WRSA and Square Lake. Groundwater flow at the Touquoy mine site is generally from N - NE to S - SW so these nested wells sets are upgradient of the WRSA and downgradient of Square Lake.

6.5 E.5 - WRW-1A/B

One addition well is proposed for the replacement of WRW-1A/B however the design details were not provided (single or nested, etc).

The replacement of WRW-1A/B will be in kind and in accordance with NSECC requirements. The shallower (A) well will be installed to a maximum depth of 6 m and the deeper (B) well to a maximum depth of 20 m. The wells will be nested.

6.6 E.6 - DRAINAGE DESIGN

The drainage design includes a buried culvert along the North section. What is the purpose of this culvert and how will it be maintained if it is buried? Will this culvert be there indefinitely?

The buried culvert in the WRSA perimeter ditching by-passes a local topographic high and maintains gravity drainage of toe seepage and runoff to the west water management pond. The rationale of design of this culvert versus a conventional open trench ditch is outlined below:

- To maintain stability of the waste rock pile; avoiding a 4m plus open trench excavation open at the toe of the pile
- To reduce the ditch footprint area thus not encroaching on the pile footprint or the 30 m buffer to Square Lake; circling around this topographic high would result in an encroachment

This culvert will be monitored and maintained in accordance with the existing operation, maintenance, and surveillance plan for the operating Touquoy site. A trash rack is incorporated into the design to reduce the potential for blockage of the culvert. Access to either end of the culver is available to allow inspection and clean out as needed.

The culvert is planned to remain in place until toe seepage meets water quality discharge criteria. This culvert will be incorporated into the WRSA closure plan.

6.7 E.7 - GROUNDWATER SEEPAGE

For groundwater seepage, the proponent finds (Appendix D.5, Table 6, p. 12) that "no parameters in the seepage are predicted to exceed the MDMER or WQOs." The large differences between the modelled surface water and groundwater quality findings are not explained in the text. This should be better explained in order to verify the groundwater quality predicted to seep into the Moose River.

Average concentrations referenced in Appendix D.5 of the EARD, Table 6 relate to groundwater seepage modeled from the pit and are considered in addition to baseline groundwater concentrations. Absolute concentrations in groundwater would be the sum of modeled seepage concentrations and baseline groundwater concentrations. Per Appendix D.1 of the EARD, Section 5.4.2, relative concentrations are multiplied by the source term concentrations provided by Lorax (2018) for the parameters of primary concern in the open pit to predict the concentrations to the receiving environment over time. These data are shown in Table 5.4 in Appendix D.1 of the EARD and refer to concentrations in groundwater seepage from the pit, similar to Appendix D.5, Table 6.

6.8 E.8 - DEVELOPMENT AREA

Table 7.6 outlines the changes to Watercourse No.4 and Fish River Headwater catchment areas as a result of development, correct? Does Existing Area (ha) refer to post-development area including areas proposed for development under this submission? It is unclear (pg. 7.13)

The existing area column presented in Section 7.4.6, Table 7.6 of the EARD, shows subcatchment area alterations from existing mine operations in the current state. Subcatchment area alterations resulting from the proposed modifications to the Approved Project are discussed in Section 7.7.1 of the EARD.

6.9 E.9 - SCRAGGY LAKE

"Residual effects associated with the in-pit tailings disposal will result in a low magnitude change in surface water quantity to Scraggy Lake during the operational phase but will be reversed after the operation when runoff is returned from previously diverted drainage areas, and excess water is no longer required to augment process water demand. This effect will be temporary as changes in surface water flows to Scraggy Lake will be restored during the mine closure and post-closure phase."

To clarify - 'temporary' in this case is a period of 9 years?

Per Section 7.7.1 of the EARD, flow will be returned to Scraggy Lake from the rehabilitated TMF and WRSA after operations have ceased. Flow return is contingent on closure design and will begin during the period when the Open Pit is filling with water and extend to post-closure. During current operations, flow is discharged to Scraggy Lake through the existing ETP discharge, offsetting the Scraggy Lake water withdrawal and flow loss from the existing drainage area diversion and contributing an additional 260,000 m3/year of flow to the lake after offset. When the ETP discharge is ceased, the anticipated flow loss to Scraggy Lake is primarily attributed to the drainage area diversion from the existing project (1,048,684 m^3/year), with the proposed project accounting for an additional 11,256 m^3/year (or 1.1%) of loss from diverted drainage area (Table 7.25 in the EARD). This change is considered temporary as drainage area will be returned to the Scraggy Lake watershed during the mine closure and post-closure phases, occurring over a 2 to 9 year period.

6.10 E.10 - WATER FLOW

"Maintain perimeter ditching to capture toe seepage from the TMF and waste rock storage area until water quality meets reclamation regulatory water quality requirements as described in the reclamation plan for Touquoy (Stantec 2017b)." (App. A, pg. 9)

To confirm, where does this water go in the proposed case? Open pit?

Toe seepage captured by the existing seepage collection ditches around the TMF is collected in sump ponds and pumped back into the TMF. This will continue for the duration of the Project.

Perimeter ditching for the expanded WRSA will be tied into the existing perimeter ditching to capture runoff and toe seepage. The ditch will gravity drain to a water management pond and once treated will drain to Watercourse #4. Drainage to the east will continue to be collected and managed in the existing water management ponds and flow that is currently pumped to the TMF will be redirected to the pit to accelerate pit filling.

6.11 E.11 - DILUTION RATIOS

"Table 7 presents the dilution ratios of the effluent with the receiver water assuming full mixing. The dilution ratios were calculated as a ratio of flow in the receiver to the effluent flow for the same month." (App D.5, pg 13)

- *Where did the values in Table 7 come from? If I understand this correctly, the 'Receiver Flow' is Moose River, and 'Effluent Flow' is discharge from the Open pit via spillway. If I do understand this correctly, why do these values differ from what has been reported as the average monthly effluent rates shown in Figure 4, or from the measured Moose River flows shown in Table 7.8 of the submission? The measured Moose River flow at SW-2 is significantly less than what is reported in Table 7 of the appendix (124 L/s vs. 450 L/s)*

Please comment on the validity of using the approach in Section 8 to determine inputs to support a 'worst-case' assessment of mixing, and not an approach using 7Q10 or other typical low flow metrics.

In reference to Appendix D.5 of the EARD, Table 7, 'Receiver Flow' refers to flow in Moose River and 'Effluent Flow' refers to flow from the proposed Open Pit spillway. Seepage refers to groundwater seepage flow from the Open Pit.

Section 7.4.7.1, Table 7.8 in the EARD refers to measured mean monthly flows for Moose River (see response 1.6 b) and are not used in the assessment based on shorter seasonal duration and period of record.

Per Appendix D.5 of the EARD, Section 8.0, low river flows correspond to low effluent flows and high river flows correspond to high effluent flows. This occurs because the Touquoy pit effluent and river flow are driven by the same meteorological factors. As a result, the dilution scenario in Moose River differs from a typical wastewater dilution scenario where effluent flow is constant and is not subject to seasonal climate or meteorological event changes. Regarding effluent flow to Moose River, the lowest dilution ratio occurs when the effluent flow rate is high in comparison to the receiving water body flow rate. During typical low flow months, both the effluent flow rate and receiving water flow rate are low, resulting in a higher dilution factor. Typical low flow metrics were not applied for this reason.

An update to the Assimilative Capacity study provided in Appendix D.5 of the EARD has been completed (Appendix D to the Main Addendum Report) to address the following discrepancies, as denoted by the reviewer:

- Effluent flow rates shown in Appendix D.5 of the EARD, Figure 4 refer to average monthly flow from the Open Pit spillway

- The Effluent Flow column in Table 7 should correspond to the total effluent flow rate to Moose River, including spillway flow and groundwater seepage. The Touquoy pit seepage rate to the river was simulated using a groundwater flow model (Stantec 2021a). Average daily seepage rate to Moose River was estimated at 259 m^3/day or 3.0 L/s. This has been updated to include a seepage rate of 3.0 L/s and changes to dilution ratios or CORMIX modeling results have been included in the updated report.
- Receiver flow rates shown in Appendix D.5 of the EARD, Table 7 refer to average monthly flow rates based on regional regression analysis outlined in Section 4.0 of Appendix D.5 of the EARD and specific to the appendix report. This regression includes data from an outlier station not referenced in the EARD and Section 4.0 has been updated to align with the regional regression used in the EARD, as this regression is more refined and based on a hydrologically homogeneous group as described in the response to 1.3 above.

6.12 E.12 - ERRATA

SD 21 appears to be a document related to the Beaver Dam mine and not this proposed activity – only reference I could find in the EA submission to it referred to it as the 2020 Wetland post Construction Monitoring Report?

Errata. P.9.49 makes an incorrect reference to SD 21; this should be SD 20.

ATTACHMENT A

Consideration of Approval No. 2012-084244-11 in the EARD

Industrial Approval No.2012-084244-11 was issued during the later stages of the EA review process, on December 16, 2021. This approval updates water quality criteria (Appendix K, Appendix L), and outlines new reporting, action, and response requirements. The Touquoy site is currently operating in accordance with IA No.2012-084244-11; however AMNS filed a Notice of Appeal to the revised Terms and Conditions of this Approval on January 17, 2022.

Table 1 summarizes the changes in water quality criteria between Version 8 and Version 11.

Table 1 Comparison of Water Quality Criteria between IA Approval 2012-084244-08 and 2012-084244-11

Parameter	Units	Column A		Column B		Column C	
		V8	V11	V8	V11	V8	V11
Nitrite (as N)	mg-N/L	1	0.06			60	0.06
Sulphate	mg/L	NG	Cond ref.	NG	500	NG	Cond ref.
Barium	µg/L			1,000	2,000		
Cadmium	µg/L			5	7		
Silver	µg/L	0.1	0.25	100	NG	0.1	0.25
Tin	µg/L	4,400	2,400	4.400	2.400		
Benzene	mg/L					0.37	2.1
Toluene	mg/L			0.06	0.004	0.012	0.77
Ethylbenzene	mg/L	0.09	0.0016	0.14	0.0016	0.09	0.32
Xylenes	mg/L	0.09	0.02	0.09	0.02		

With respect to the current EARD, we have considered the implications of the updated criteria with respect to the environmental assessment of surface water and groundwater quality. AMNS is committed to updating the Groundwater Contingency Response Plan based on the requirements of IA 2012-084244-11 once the Appeal is resolved.

Groundwater

With mitigation and environmental protection measures, the residual effect of a change in groundwater quality is predicted to be not significant, because the extent of changes in groundwater quality resulting from the WRSA expansion, or the in-pit disposal of tailings will not result in groundwater quality that exceeds the GCDWQ for consecutive period of 30 days or more at existing or future groundwater users located outside of the PDA, as defined in the EARD. A review of the impacts associated with decreased criteria concentrations for the parameters identified in Table 1 (above), suggests that there is no anticipated impact to the overall groundwater compliance at the site between the requirements of IA-V8 and IA-V11. Any exceedances of the specified criteria since 2016 have been transitory and short-lived; this is not expected to change due to the modifications. As a result, there is no change to determination of significance as defined in the EARD for the Groundwater VEC.

Surface Water

Exceedances of IA Water Quality thresholds are anticipated for select parameters, however baseline water quality is already exceeding these thresholds for these parameters or is limited to areas as described. Changes in surface water quality are expected to be contained within the boundaries of the LAA and to be dissipated within the mixing zones of each respective water body. Based on the above, with effects avoidance, mitigation and environmental protection measures, the residual effect of a change in surface water quality is predicted to be not significant. The water quality predictions for Scraggy Lake and Watercourse No.4 were reviewed against the revised criteria listed in IA 2012-084244-11. The predicted concentrations in Scraggy Lake are below the revised criteria. In the case of Watercourse No.4, the predicted concentrations for most parameters are below the revised criteria; the exceptions are: i) those parameters (aluminum, arsenic, and cadmium) with baseline concentrations greater than the IA 2012-084244-11 criteria, and ii) sulphate concentrations are predicted to be greater than the IA 2012-084244-11 criterion during the driest period of the year (assuming that the IA Water Quality Criterion is 429 mg/L for water with hardness that ranges from 181 to 250 mg/L). When applying the base case geochemical source terms, the sulphate concentrations in Watercourse No.4 are predicted to be as high as 450 mg/L and greater than the IA-11 criterion during July and part of August (12% of the year). When applying the upper case geochemical source terms, the sulphate concentrations in Watercourse No.4 are predicted to be as high as 501 mg/L and greater than the IA-11 criterion during July through September (25% of the year). The elevated sulphate concentrations in Watercourse No.4 have been observed as part of the operational water quality monitoring and this issue is being addressed through adaptive management and remediation as described in Section 3.1 of the Main Addendum Document.

The assimilative capacity predictions for Moose River were reviewed against the revised criteria listed in IA 2012-084244-11. Of the parameters which have been updated, four are currently non-detect (Silver, Benzene, Toluene, Ethylbenzene); and there are therefore no changes required to the assessment. The values for Nitrate and Sulphate have been reviewed, and there is no anticipated impact to the overall surface water compliance for Moose River.

As a result, there is no change to determination of significance as defined in the EARD for the Surface Water VEC.

ATTACHMENT B

Monitoring Plan for Wetland #5 and Wetland #15

Stantec

Memo

To:	Melissa Nicholson Atlantic Mining NS	From:	Jenny Reid, Michael Crowell Stantec Consulting Ltd.
File:	121619250 2000.900	Date:	June 11, 2020

Reference: Monitoring Plan for Wetland #6 and Wetland #15

BACKGROUND

Stantec Consulting Ltd. (Stantec) was commissioned by Atlantic Mining Nova Scotia Corp. (AMNS) in 2019 to conduct a study to assess conditions in Watercourse #4 and Wetlands #6 and #15 at the Touquoy Mine Site in Nova Scotia following release of silt from mine roads. The report (Stantec 2019) was submitted to Nova Scotia Environment (NSE) as a follow-up to inspection reports issued by NSE to AMNS. NSE issued comments on this report to AMNS, dated April 29, 2020, and included a request for a monitoring plan for Wetland #6 and Wetland #15.

This memo describes the monitoring plan for Wetland #6 and Wetland #15, developed by Michael Crowell M.Sc., a qualified terrestrial ecologist with 36 years of experience. The monitoring plan is based on recommendations in Stantec (2019) and is limited to monitoring of effects to Wetlands 6 and 15 as a result of siltation events documented in 2018 and 2019 as assessed by Stantec in 2019.

Based on the results of each monitoring event, the scope, methodology, and frequency of subsequent monitoring will be re-evaluated. Should additional effects (e.g. from additional siltation events) be reported or observed beyond those documented in Stantec 2019, the monitoring plan may be adjusted accordingly. A revised monitoring plan will be submitted to AMNS and NSE for approval prior to implementing any changes.

MONITORING PLAN OBJECTIVES AND OVERVIEW

The objective of the monitoring plan is to monitor and document the natural restoration of Wetland #6 and #15. The monitoring program will be conducted in Years 1, 3 and 5 (i.e., 2020, 2022, 2024) following the initial assessments conducted in 2019 (Year 0).

The wetland monitoring program will include site visits to the Touquoy Mine by an experienced wetland scientist between July and September of each year of monitoring. The site visit will include monitoring of plots to be established in Wetlands #6 and #15 in Year 1 to document conditions for subsequent comparison in Years 3 and 5. It will also include monitoring of aquatic plant communities and silt within the open water portion of Wetland #6.

A combination of field surveys and desktop analysis of drone imagery provided by AMNS will be used to assess and monitor the aquatic and wetland plant communities in Wetland #6. Drone imagery will be provided by AMNS in a geotiff file with imagery in high definition, RGB (red, green, blue).

A technical data report will be prepared for each monitoring year that summarizes the findings of wetland monitoring. Photos will be taken and georeferenced to document field observations.

The monitoring plan is specific to each wetland and is detailed below.

WETLAND 6

Ongoing wetland plant community monitoring is being conducted in Wetland #6 by McCallum Environmental Ltd. Four transects, each containing four quadrats have been established in the wetland and have been monitored since 2016. Detailed vegetation data are available for two of the transects. General observations are available for the other two transects. A review of the data collected at these sites as well as photographs of the monitoring plots indicates that these monitoring plots are not located in the open bog plant community where effects associated with sediment deposition were evident in 2019. As such, effective monitoring cannot be conducted using these monitoring plots. However, the existing data will be useful for determining if the sedimentation events have potentially affected other plant communities in Wetland #6.

For the proposed monitoring program in Wetland #6, eight 1 m X 1 m study quadrats will be placed at representative locations of sphagnum moss staining and bleaching to document recovery based on colonization by healthy plants over time. It is anticipated that the quadrats placed in areas affected by sediment deposition will be situated within the areas in Figure 1 that are identified as areas of sphagnum moss staining and bleaching. Plot locations will be selected during the site visit in 2020 so that they are placed in affected areas.

For spatial comparison within each monitoring year, eight 1 m X 1 m reference quadrats will also be established in similar habitat in an area of Wetland #6 unaffected by sediment deposition. These plot locations will also be selected during the site visit in 2020. If unaffected habitat is not present in Wetland #6, reference quadrats will be established in nearby wetlands that support similar open bog habitat. The corners of monitoring plots will be marked with wooden stakes and their locations will be marked visually using flagging tape and using GPS coordinates so that they can revisited for monitoring in Years 3 and 5.

The percent cover of each vascular plant species found in each study and reference quadrat will be estimated. Sphagnum cover will be further broken down into bleached and healthy classes. Sphagnum moss species are very difficult to identify, typically requiring microscopic examination of the plants for identification to species. As such, it is extremely difficult to efficiently and accurately collect abundance data by species. Instead, sphagnum moss cover will be estimated at the level of genus rather than species. The percent cover of sediment staining will also be estimated in each quadrat.

The reference quadrats will provide information regarding what the species composition of an unstressed bog plant community can be expected to be in this area in any given monitoring year. Monitoring of changes in species composition over time in the reference quadrats will provide information on the rate of vegetation change in unstressed bog plant communities. This can then be compared with the species composition and rates of vegetation change in the affected bog plant communities. This will be used to determine if there are large differences between affected and unaffected sites and if species composition is shifting to a state similar to the reference site as the vegetation in the areas affected by the 2019 sediment deposition begins to recover.

Monitoring surveys will be conducted in August, if possible, for consistency with Year 0 (2019) and because most species are sufficiently developed and in flower or fruit at this time to facilitate identification. The rate at which plants grow has slowed by August so timing of subsequent monitoring surveys is less critical. Surveys carried out in Years 3 and 5 will be conducted within one week of the Year 1 survey date.

Comparison of the data collected in the study plots where siltation was observed in 2019 to the reference sites will be used to determine over space and time if and how far plant species composition and mortality rates have been shifted by siltation and whether recovery of these communities is occurring. A qualitative comparison will be completed, no statistical analysis will be conducted.

In addition to the on-site quadrat analysis for vegetation cover, drone imagery taken by AMNS in Wetland #6 will be examined to determine if areas of sphagnum moss mortality and/or staining can be detected on the imagery. The drone imagery will be used to supplement in-field monitoring. This will be done by superimposing the drone imagery over locations where areas of sphagnum moss mortality and/or staining are known to occur. If a unique visual cue is associated with these locations, it should be possible to map the distribution of affected areas throughout the wetland. If successful, information from drone imagery can be used to monitor the recovery of areas of sphagnum mortality. If a visual cue cannot be detected, then this approach will not be pursued. In Year 1, potential areas of sphagnum mortality will be identified visually from the imagery by the wetland biologist. Any areas of mortality will be quantified (m^2) using GIS tools. The imagery collected in Years 3 and 5 will be overlaid with the imagery collected in Year 1 to document the recovery (i.e., locations and area) of sphagnum within Wetland #6.

In open water slow flowing habitats (habitat units 27 to 31; Stantec 2019) in Watercourse #4 which contained only fine substrates, species composition and distribution of aquatic plants in relation to water depth and silt/sediment thickness will be assessed to assist in determining if silt deposition has influenced aquatic plant cover and its recovery. In total five transects will be established (Figure 1). Two transects will be established parallel to the stream banks where the stream is narrow (habitat units 27 to 29; Stantec 2019) and three transects will be established perpendicular to the stream banks where the stream is wide (habitat units 30 to 31; Stantec 2019). At three locations along each transect the thickness of silt deposits will be assessed with a sediment corer; water depth will be collected, submergent aquatic plant species will be identified, and the cover of the plant community and the dominant plant species will be estimated within a 5 m x 5 m area. Stakes will be driven into the wetland on either side of Watercourse #4 at the locations where sediment cores, depth measurements and aquatic plant community descriptions will be taken. A rope will be strung between the two stakes to mark the locations where these data will be collected. This will allow more accurate year to year comparisons of these parameters. The field survey will be conducted in August, if possible, when the aquatic plant communities are fully developed. The field surveys will not be conducted immediately following heavy precipitation events so that visibility through the water column is not impeded by suspended sediment.

Within the open water portion of Watercourse #4 that flows through Wetland #6 (habitat units 27 to 31; Stantec 2019), the overall distribution of aquatic plant communities will be assessed using visual analysis of drone imagery taken by AMNS to document changes in aquatic plant coverage (i.e., m^2 of aquatic plant community coverage) over time.

In Year 1, the drone imagery will be analyzed and areas of suspected aquatic plant cover in the portion of the watercourse passing through Wetland #6 will be mapped using GIS tools. The georeferenced aquatic vegetation mapping will be loaded onto a data logger and the locations where suspected aquatic plant communities have and have not been recorded will be inspected by a botanist to determine if the drone imagery is able to be used to map the distribution of aquatic plants in the watercourse. This would provide a means of monitoring the areal extent of aquatic plant community development in Wetland #6. If this method is successful, the distribution of aquatic plant communities in Wetland 6 will be mapped using this approach in

Year 3 and Year 5. If the Year 1 data indicate that the drone imagery is not an effective or accurate means of mapping the distribution of aquatic plant communities, this monitoring approach will be discontinued.

It is recommended that the drone imagery be collected in mid to late July when aquatic vegetation cover is well developed and there is enough time to process the imagery before the site visit in August. The drone imagery should be taken under conditions of low wind so that waves on the water surface do not interfere with gaining good imagery of underlying aquatic plant communities. The imagery should not be collected soon after a heavy rain event because this could increase the turbidity of the water and mask the underlying aquatic plant communities.

WETLAND 15

Ongoing wetland plant community monitoring is being conducted in Wetland #15 by McCallum Environmental Ltd. Two transects, each containing four quadrats, have been established in the wetland and have been monitored since 2016. Detailed vegetation data are available for these transects. A review of the data collected at these sites indicates that one of these transects is situated in the northern tip of Wetland #15 where siltation was evident in 2019 (Stantec 2019), affecting 5 to 10% of the surface of the wetland affected in this area. There is a low probability that the four monitoring plots established by McCallum Environmetnal Ltd. in this area are situated in depressions where siltation occurred. Therefore, new monitoring plots will be selected for monitoring in areas of siltation observed in 2019 to monitor the effects of the sediment deposition event. Data collected annually by McCallum Environmental Ltd. will be incorporated into the monitoring report for Wetland #15 to assess possible effects of the 2019 sediment deposition event on plant communities that are found adjacent to areas where sediment was deposited in 2019.

The methodology for monitoring in Wetland #15 is different than in Wetland #6 as a result of differences in the structure of the two wetlands. The portion of Wetland #15 that was affected by the 2019 sediment deposition event is occupied by forested wetland, whereas the portion of Wetland #6 where adverse effects associated with sediment deposition was evident are either open bog or shallow water wetland. In Wetland #15, five nested 1 m X 1 m and 2 m X 2 m study quadrats will be placed at representative locations in the northern end of the wetland where silt deposits were observed in 2019 to document recovery based on colonization by healthy vegetation over time. Similarly, five nested 1 m X 1 m and 2 m X 2 m reference quadrats will be placed in portions of Wetland #15 that support similar plant communities and were not affected by siltation in 2019.

At each sampling site, a 1 m X 1 m quadrat will be nested inside a 2 m X 2 m quadrat. In the 1 m X 1 m quadrats, the percent cover of all plant species less than 2 m in height will be estimated along with the cover of exposed sediment, leaf litter, woody debris, and open water. In the 2 m X 2 m quadrats the cover of all plants taller than 2 m in height will be estimated. In addition, the diameter at breast height (DBH) of all trees and shrubs present in the 2 m X 2 m quadrat will be measured with a diameter tape. Each tree or shrub will be identified to species and will be classified as living or dead.

The monitoring site visit will be conducted in August, if possible, for consistency with Year 0 and to facilitate comparison across monitoring years. Surveys carried out in Years 3 and 5 will be conducted within one week of the Year 1 survey date, if possible.

Comparison of the data collected in the study plots where siltation was observed in 2019 to the reference sites will be used to determine over space and time if and how far plant species composition and mortality

Reference: Monitoring Plan for Wetland #6 and Wetland #15

rates have been shifted by siltation and whether recovery of these communities is occurring. The analysis will be qualitative with no statistical analyses being conducted.

CLOSURE

This document entitled Monitoring Plan for Wetland #6 and Wetland #15 was prepared by Stantec Consulting Ltd. ("Stantec") for the account of Atlantic Mining Nova Scotia Corp. (the "Client"). Any reliance on this document by any third party is strictly prohibited. The material in it reflects Stantec's professional judgment in light of the scope, schedule and other limitations stated in the document and in the contract between Stantec and the Client. The opinions in the document are based on conditions and information existing at the time the document was published and do not take in to account any subsequent changes. In preparing the document, Stantec did not verify information supplied to it by others. Any use which a third party makes of this document is the responsibility of such third party. Such third party agrees that Stantec shall not be responsible for costs or damages of any kind, if any, suffered by it or any other third party as a result of decisions made or actions taken based on this document

Stantec Consulting Ltd.

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Attachment: Figure 1

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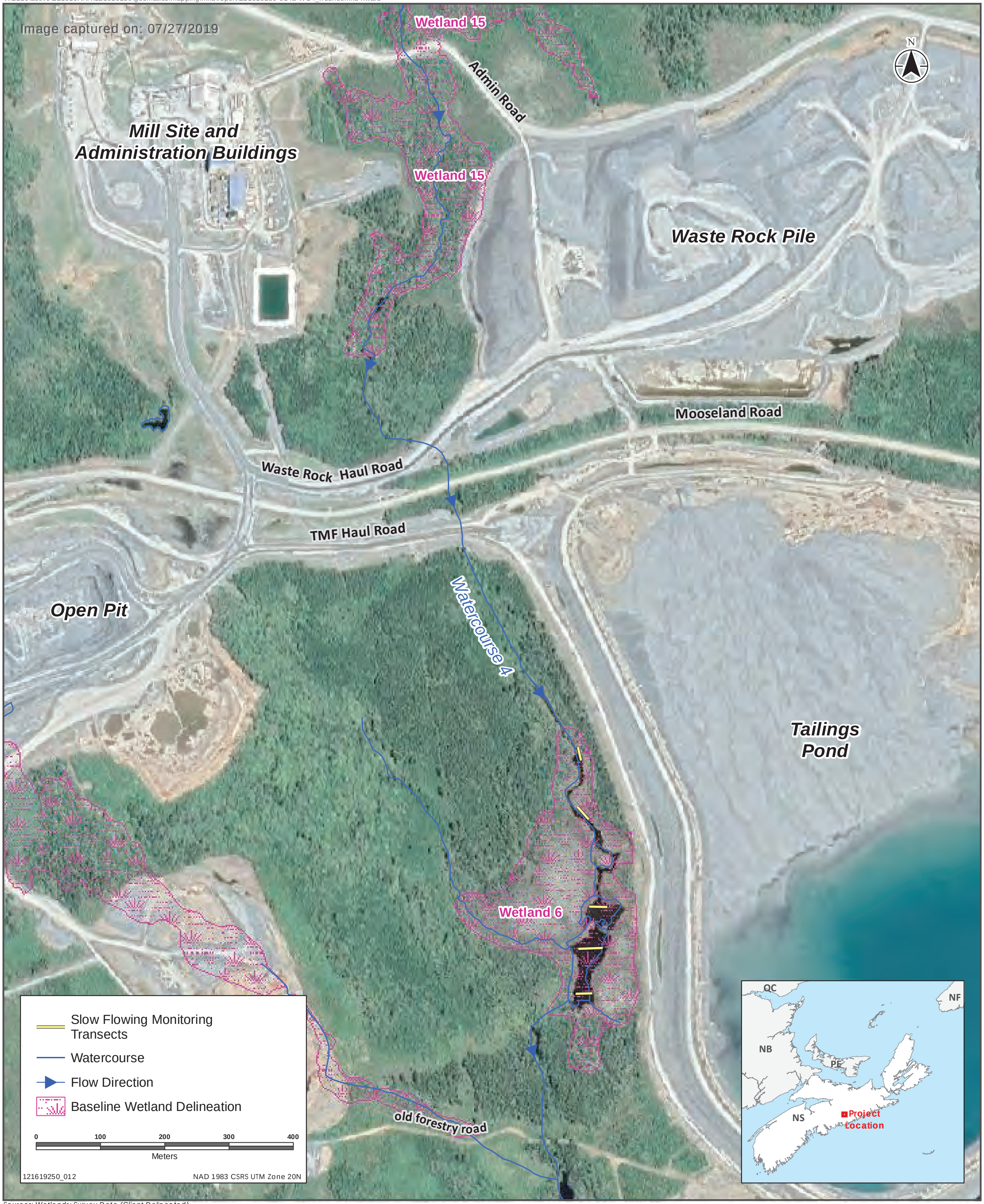

Sources: Wetlands: Survey Data (Client Delineated)

Service Layer Credits: Google Earth Image (July 27, 2019). Moose River Gold, NS. CNES/Airbus [Obtained October 9, 2019]

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

Monitoring Locations for Wetlands #6 and #15 Monitoring Plan, Touquoy Mine, NS

Stantec