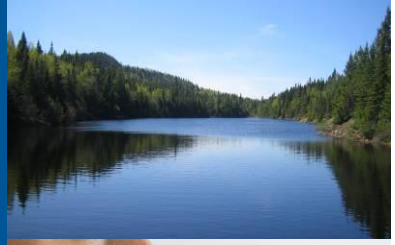




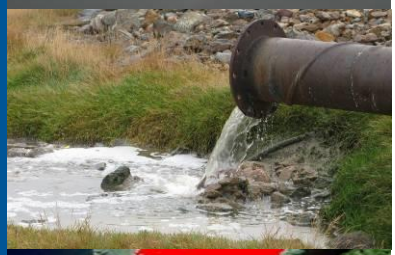


Real Time Water Quality Report

Tata Steel Minerals Canada

Elross Lake/Joan Brook Network

Deployment Period
2022-07-25 to 2022-09-20

Government of Newfoundland & Labrador
Department of Environment & Climate Change
Water Resources Management Division
St. John's, NL, A1B 4J6 Canada

Prepared by:

Department of Environment & Climate Change
Water Resources Management Division

General

- The Water Resources Management Division (WRMD), in partnership with Tata Steel Minerals Canada Limited (TSMC) and Environment and Climate Change Canada (ECCC), maintains two real-time water quality and water quantity stations in close proximity to the Elross Lake Iron Ore Mine in western Labrador, near Schefferville, QC.
- The official name of each station is ELROSS CREEK BELOW PINETTE LAKE INFLOW and JOAN BROOK BELOW OUTLET OF JOAN LAKE, hereafter referred to as the *Elross Creek Station* and the *Joan Brook Station,* respectively.
- A third station, previously known as GOODREAM CREEK 2KM NORTHWEST OF TIMMINS 6, was removed in 2018 for relocation further downstream near Triangle Lake. In 2022, the station was still awaiting relocation by TSMC.
- Station sites were selected to monitor all surface water outflows from the Elross Lake and the DSO4 Project 2B mining sites. The Elross Creek Station is situated downstream of the Timmins 1 pit, and downstream of Pinette Lake. The original Goodream Creek Station served to monitor potential impacts from groundwater flowing from Timmins 6 pit into the surface water of Goodream Creek. The new Goodream Station will monitor impacts from the development of the Howse deposit. The Joan Brook station is downstream of the five pits (Kivivic 1, 2, 3N, 4 and 5) which are included in the DSO4 Project 2B mining operation.
- The Water Resources Management Division will inform Tata Steel Minerals Canada Limited of any significant water quality events by email notification and by monthly deployment reports.
- This monthly deployment report presents water quality and water quantity data recorded at the Elross Creek and Joan Brook stations from July 25th to September 20th, 2022, which was the second deployment period for the 2022 field season. The equipment at Elross Creek was not switched on September 20th, but this date was chosen to standardize the reporting period.
- Due to site access limitations due to the Covid-19 pandemic, instruments were shipped to TSMC via charter flight and installed at the stations by TSMC staff. Limited shipping options prevented collection of proper QA/QC grab samples.

Quality Assurance / Quality Control

- Water quality instrument performance is tested at the beginning and end of its deployment period. The process is outlined in Appendix A.
- Instruments are assigned a performance ranking (i.e., poor, marginal, fair, good or excellent) for each water quality parameter measured.

- Table 1 shows the performance rankings of three water quality parameters (i.e., pH, specific conductivity and turbidity) measured by instruments deployed at the water monitoring stations and grab samples.

- With the exception of water quantity data (stage height), all data used in the preparation of the graphs and subsequent discussion below adhere to this stringent QA/QC protocol. The stage data is raw data that is transmitted via satellite and published on our web page. It has not been corrected for backwater effect. The Water Survey of Canada is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.

Table 1: Water quality instrument performance during deployment compared to grab samples

	Elross Creek		**Joan Brook**	
Stage of deployment	Beginning	End (not removed)	Beginning	End
Deployment Date	2022-07-25	2022-09-20	2022-07-25	2022-09-20
Grab Sample Date	2022-07-25	NA	2022-07-25	2022-09-20
pH	Good	NA	Excellent	Excellent
Specific Conductivity	Excellent	NA	Excellent	Excellent
Turbidity	Excellent	NA	Excellent	Excellent

- Sensor performance rankings were not obtained for the majority of parameters as a full QA/QC instrument was not available and grab samples were not always taken during deployment and removal. Grab sample results were included in Table 1 compared to in-situ results at the same time the grab sample was collected to provide more information on the condition of the field sensors.

Deployment Notes

- Water quality monitoring for this deployment period started on July 25th, 2022, at Elross Creek. The Joan Brook instrument was switched July 14th, but for the purposes of this report we use July 25th to facilitate data comparisons for the same timeframe.
- Elross Creek station experienced significant transmission and power loss, resulting in data gaps. Where possible, data was supplemented using internally logged data from the real-time instrumentation. However, when logged data was used, stage data was still unavailable.

Data Interpretation

- Data records were interpreted for each station during the deployment period for the following six parameters:

  (i.) Stage (m)
  (ii.) Temperature (°C)
  (iii.) pH
  (iv.) Specific conductivity (µS/cm)
  (v.) Dissolved oxygen (mg/l)
  (vi.) Turbidity (NTU)

Stage

- The stage data is raw data that is transmitted via satellite and published on our web page. It has not been corrected for backwater effect. The Water Survey of Canada is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.
- Due to data transmission issues at Elross Creek, stage data was unavailable for the majority of the deployment until late September. Logged data was used for the water quality parameters.
- For the available data at Elross Creek, stage ranged from 1.11 m to 1.18 m (Figure 1). At Joan Brook, stage ranged from 1.55m to 1.67m (Figure 2). Joan Brook showed an increasing trend for stage, fed by numerous precipitation events during the deployment period (Appendix B). Elross Creek did not have enough recorded data to comment on trends.

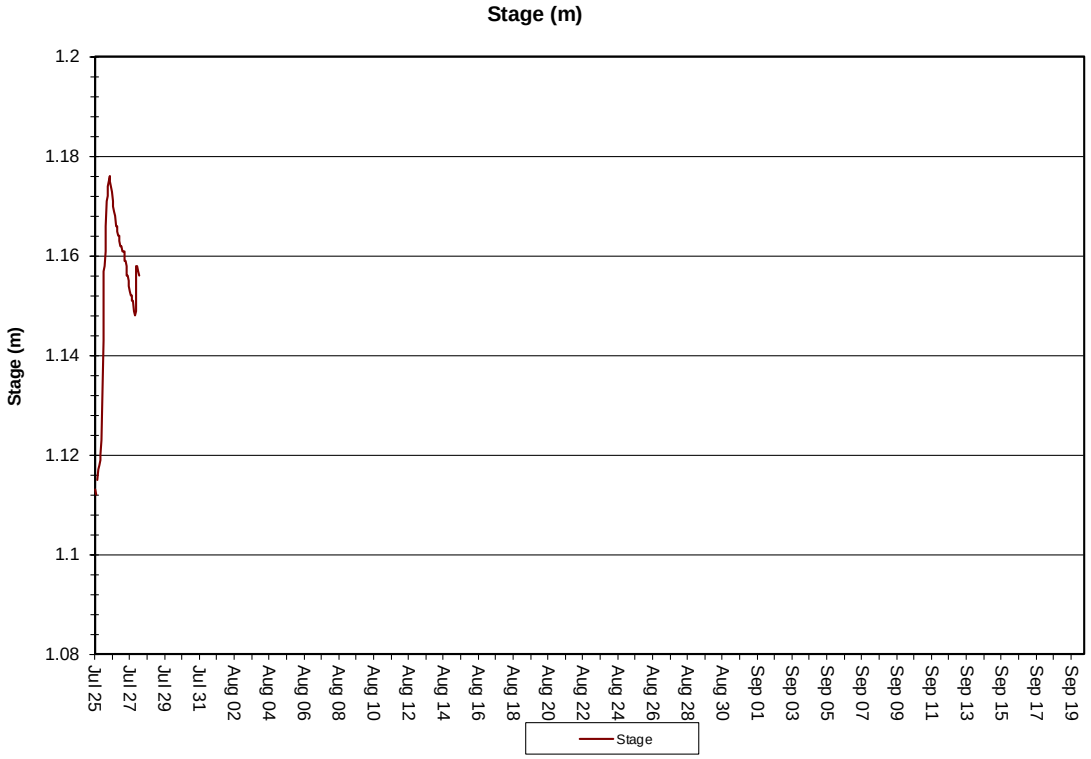

Figure 1: Stage at Elross Creek

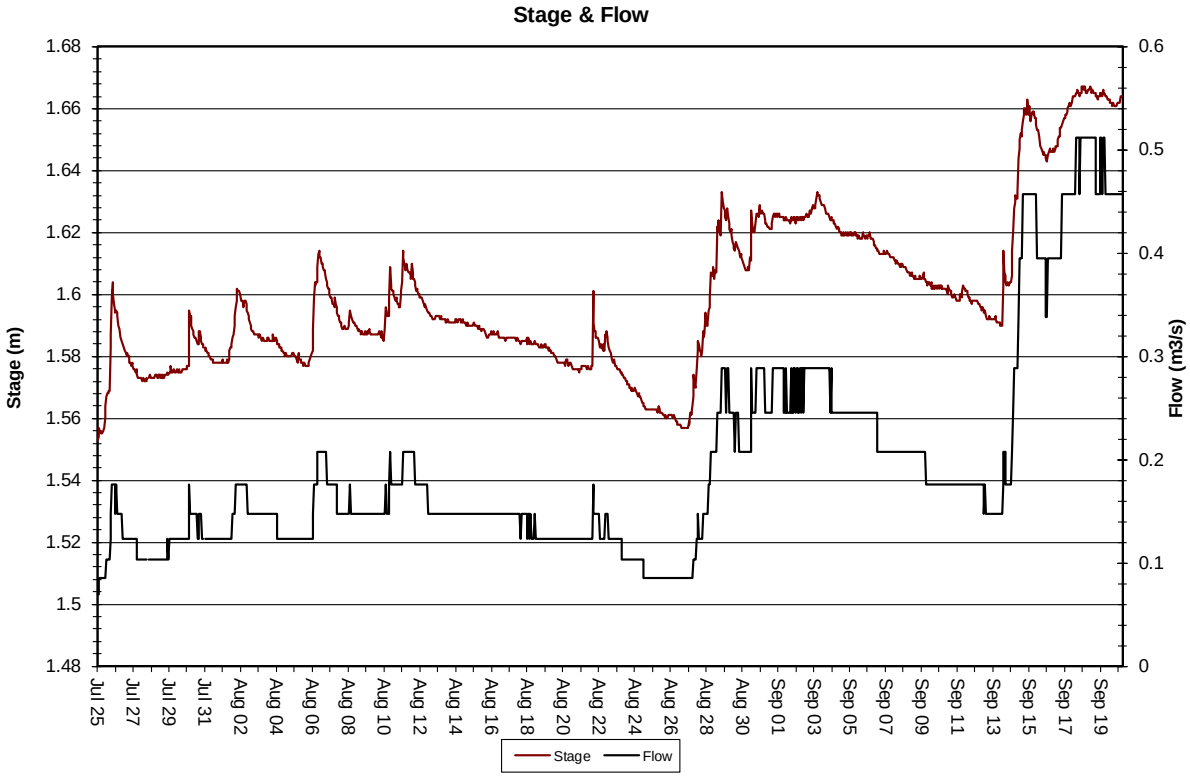

Figure 2: Stage & Flow at Joan Brook

Temperature

- The stage data is raw data that is transmitted via satellite and published on our web page. It has not been corrected for backwater effect. The Water Survey of Canada is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.
- During the deployment period covered by this report, water temperature ranged from 5.88˚C to 16.77˚C at Elross Creek and from 3.50˚C to 15.80˚C at Joan Brook (Figures 3-4).
- Both stations display noticeable diurnal variations, typical of shallow water streams and ponds that are highly influenced by diurnal variations in ambient air temperatures.
- Both station's temperature values showed an increasing trend over the first half of deployment followed by decreases into the second half of deployment. This is to be expected as temperatures rose into August before decreasing again as September approached in a seasonal pattern.

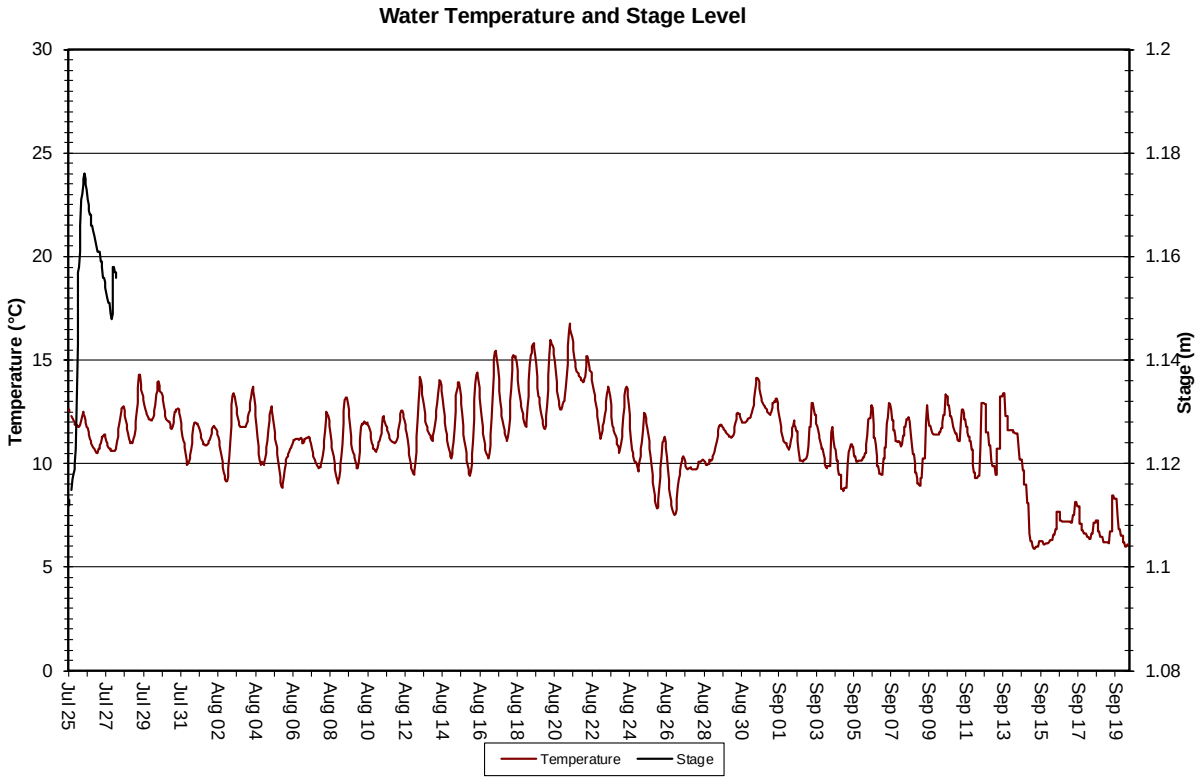

Figure 3: Water Temperature & Stage at Elross Creek

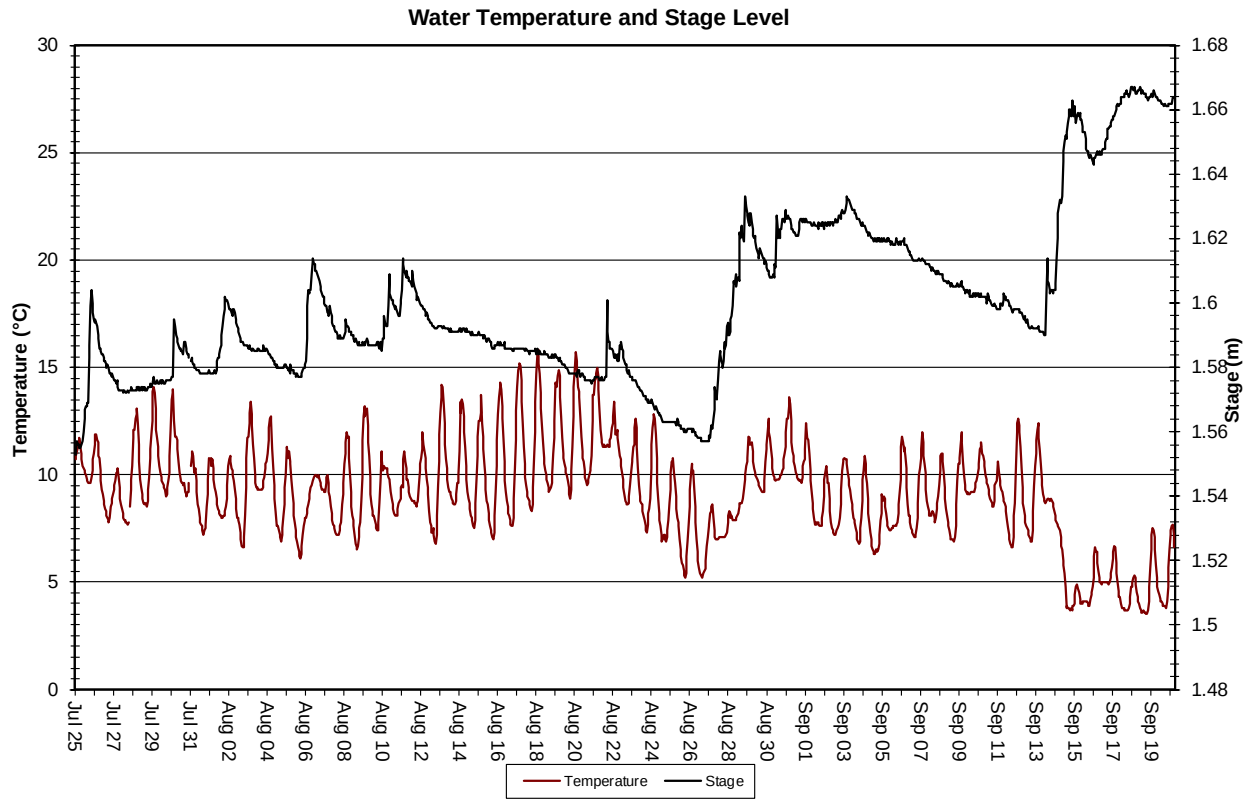

Figure 4: Water Temperature & Stage at Joan Brook

pH

- The stage data is raw data that is transmitted via satellite and published on our web page. It has not been corrected for backwater effect. The Water Survey of Canada is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.
- During the deployment period, pH values ranged from 6.25 units to 6.91 units at Elross Creek and from 6.64 units to 6.97 units at Joan Brook (Figures 5-6).
- pH tends to show a diurnal trend which is related to the diurnal temperature trend. This diurnal trend is visible at both stations.
- pH appears to be relatively stable at both Elross Creek and Joan Brook, with Elross Creek recording temporary declines of pH during periods of high precipitation. This influence is not noticeable at Joan Brook.
- The majority of pH values at Elross Creek are within the guidelines set for the protection of aquatic life (i.e., 6.5 – 9.0 units), as defined by the Canadian Council of Ministers of the Environment (CCME) (2007). Values dip below the guidelines briefly during periods of high precipitation. At Joan Brook, all values remained within the guidelines. It should be noted that acidic waters are quite common in Canada, particularly in boreal and northern ecoregions, and pH is often naturally below the 6.5 unit guideline.

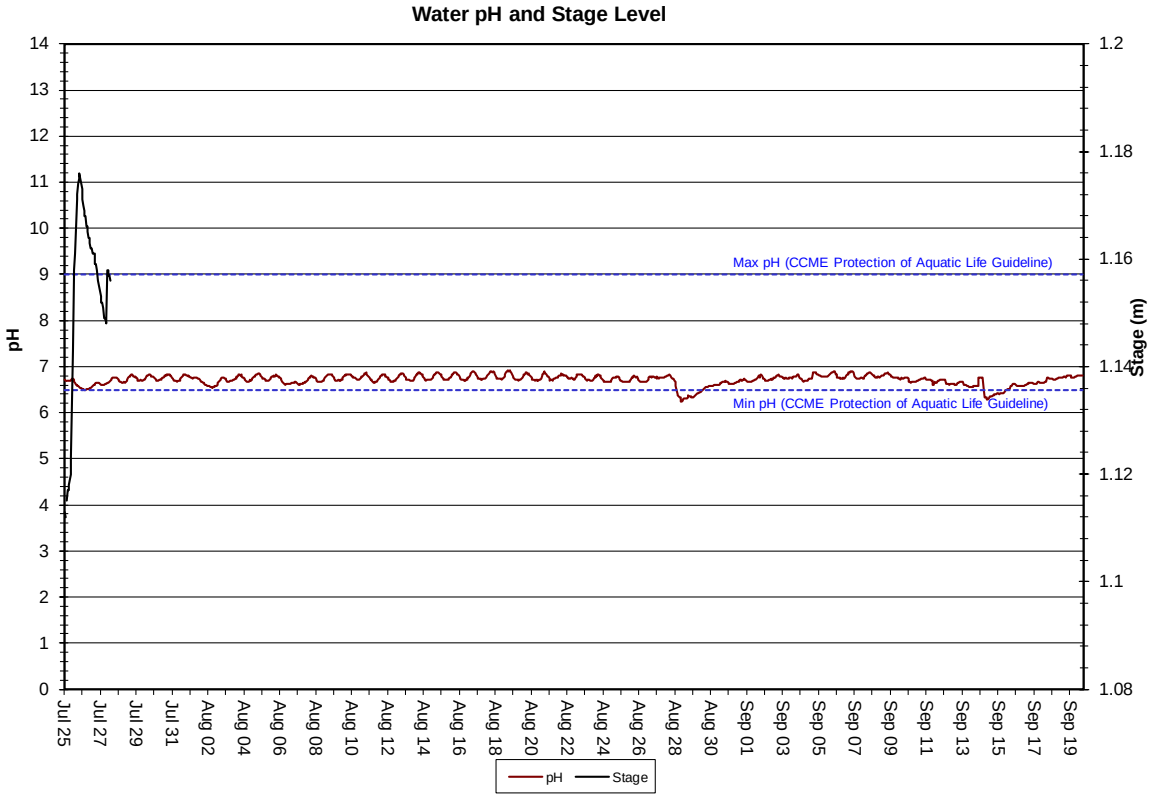

Figure 5: pH & Stage at Elross Creek

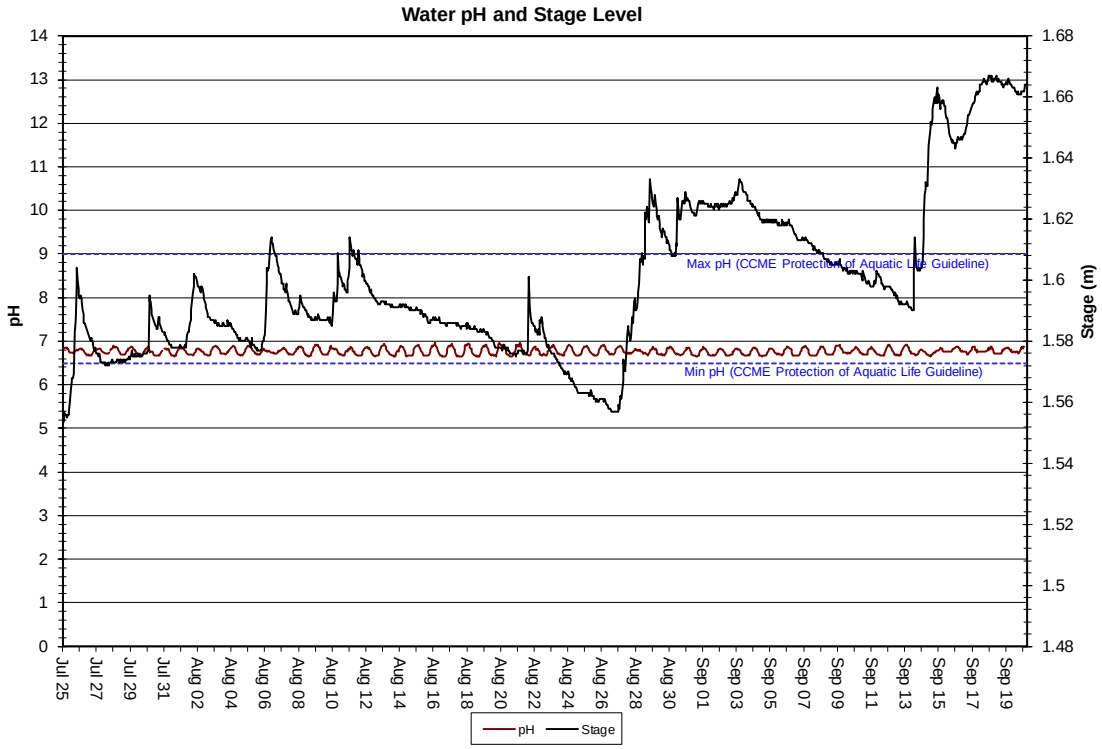

Figure 6: pH & Stage at Joan Brook

Specific Conductivity

- The stage data is raw data that is transmitted via satellite and published on our web page. It has not been corrected for backwater effect. The Water Survey of Canada is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.
- During the deployment period, specific conductivity ranged from 14 µs/cm to 24 µs/cm at Elross Creek and from 7.2 µs/cm to 9.6 µs/cm at Joan Brook (Figures 7-8). Both stations demonstrated an overall increasing trend but with heavy influence from precipitation causing short term decreases.
- Both stations exhibit the natural relationship between conductivity and stage values: as stage levels go up and more water is added to the system, conductivity decreases due to dilution and vice versa.

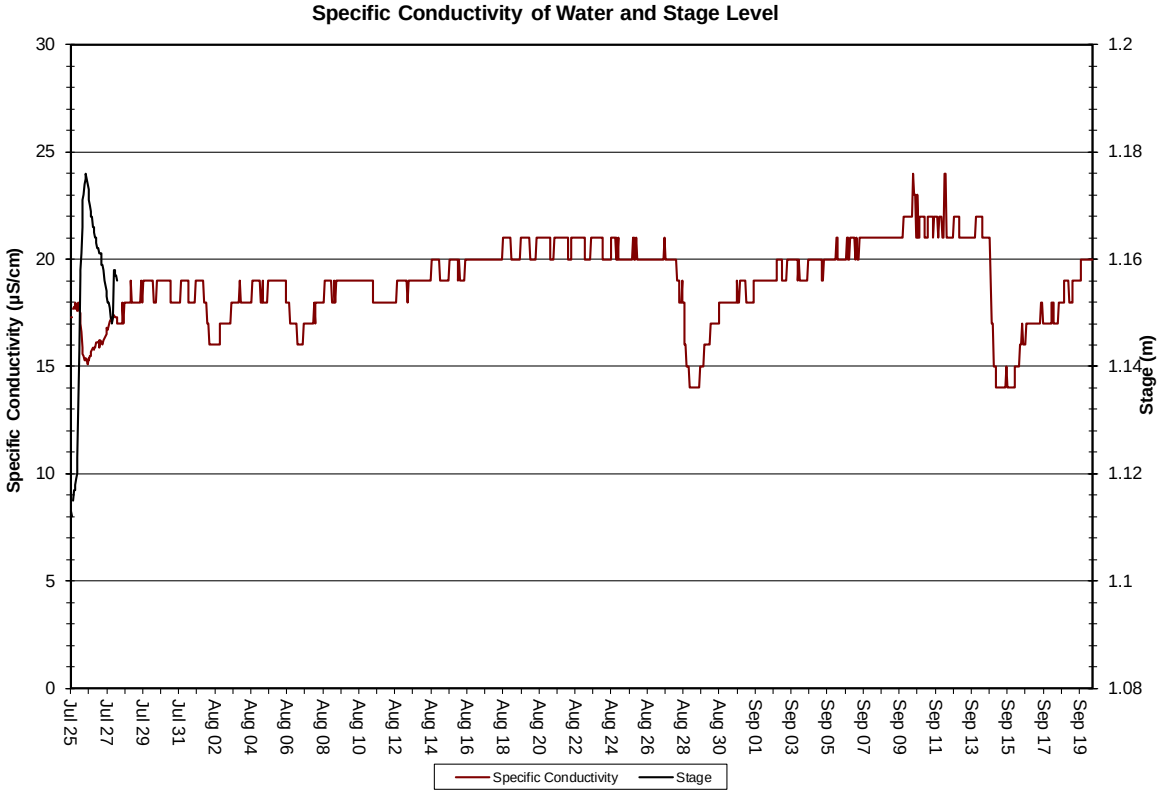

Figure 7: Specific Conductivity & Stage at Elross Creek

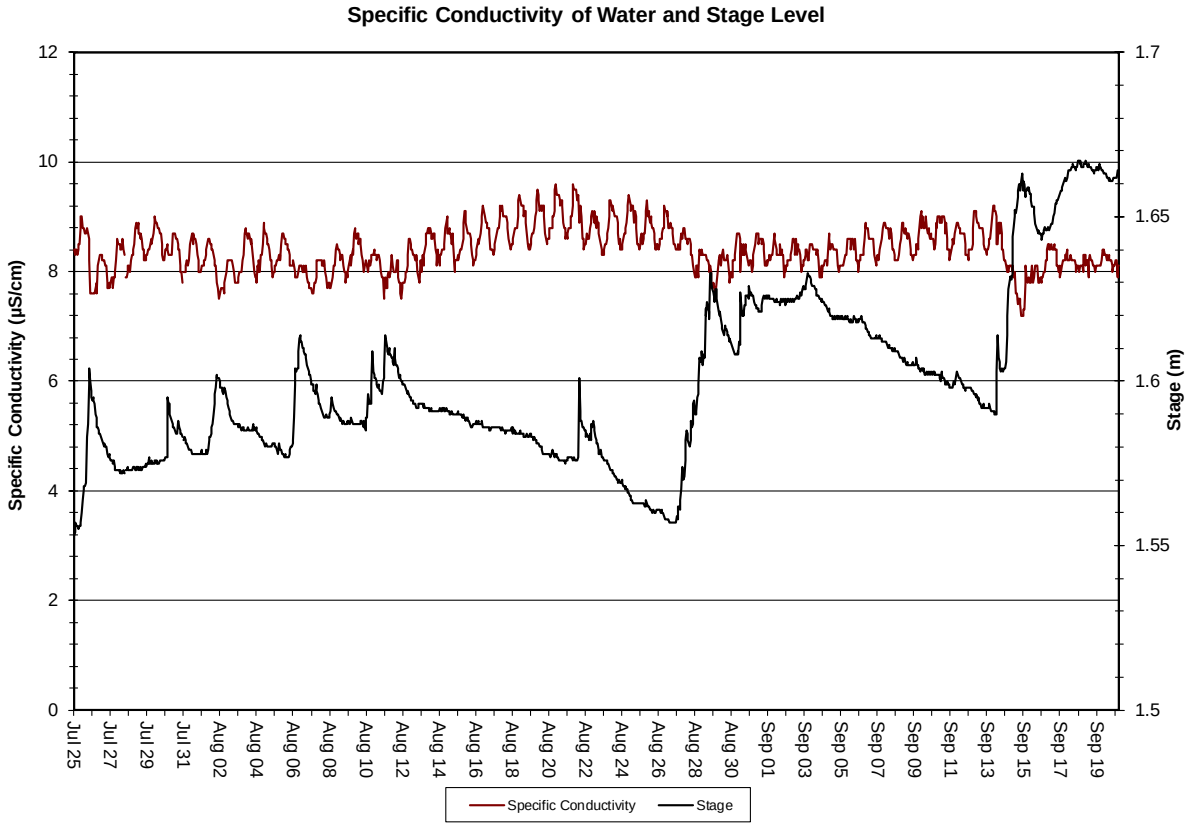

Figure 8: Specific Conductivity & Stage at Joan Brook

Dissolved Oxygen

- During the deployment period, dissolved oxygen (DO) values ranged from 8.59 mg/l (84.5% saturation) to 11.30 mg/l (99.8% saturation) at Elross Creek and from 9.34 mg/l (87.6% saturation) to 12.07 mg/l (95.4% saturation) at Joan Brook (Figures 9-10).
- DO exhibited at both stations was relatively stable for the first half of deployment before gradually increasing during the second portion as water temperatures cooled into September. This is a natural relationship as cooler water can hold more dissolved oxygen.
- The DO values at Elross Creek and Joan Brook remained above the minimum guidelines set for other life stages (6.5 mg/l) throughout deployment but occasionally dipped below the guideline for early life stages (9.5 mg/l) during periods of the warmest temperatures, as determined by the Canadian Council of Ministers of the Environment (2007).

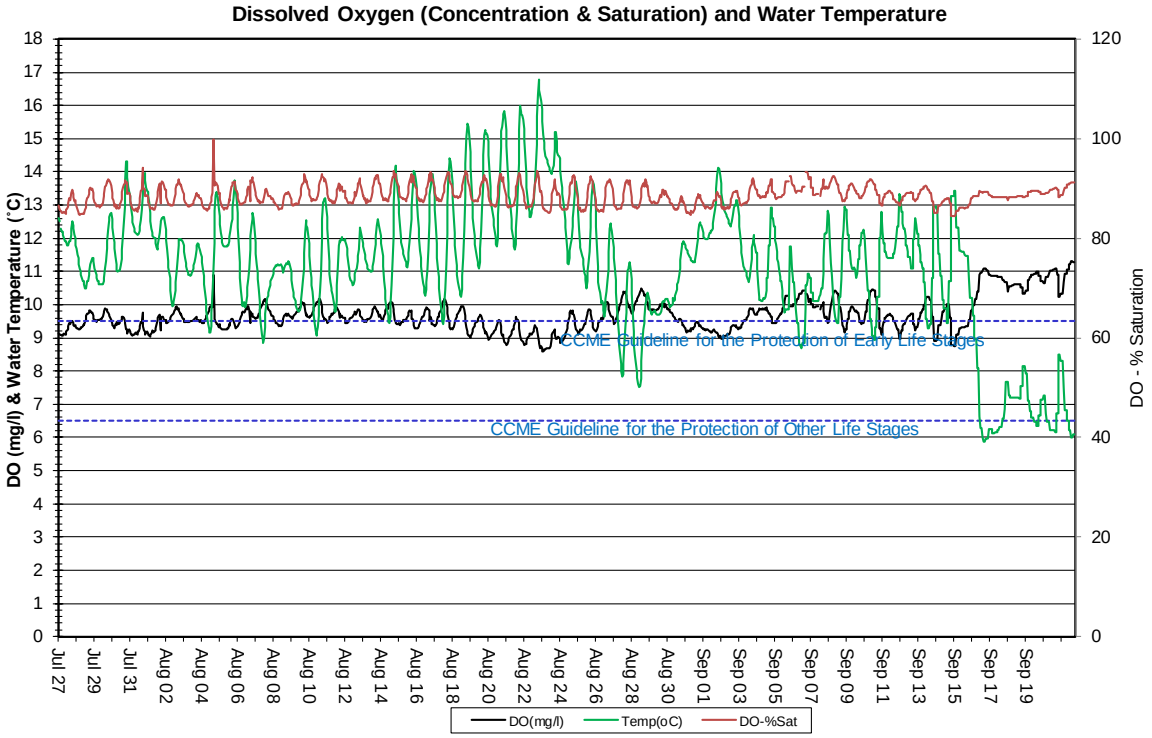

Figure 9: Dissolved Oxygen & Water Temperature at Elross Creek

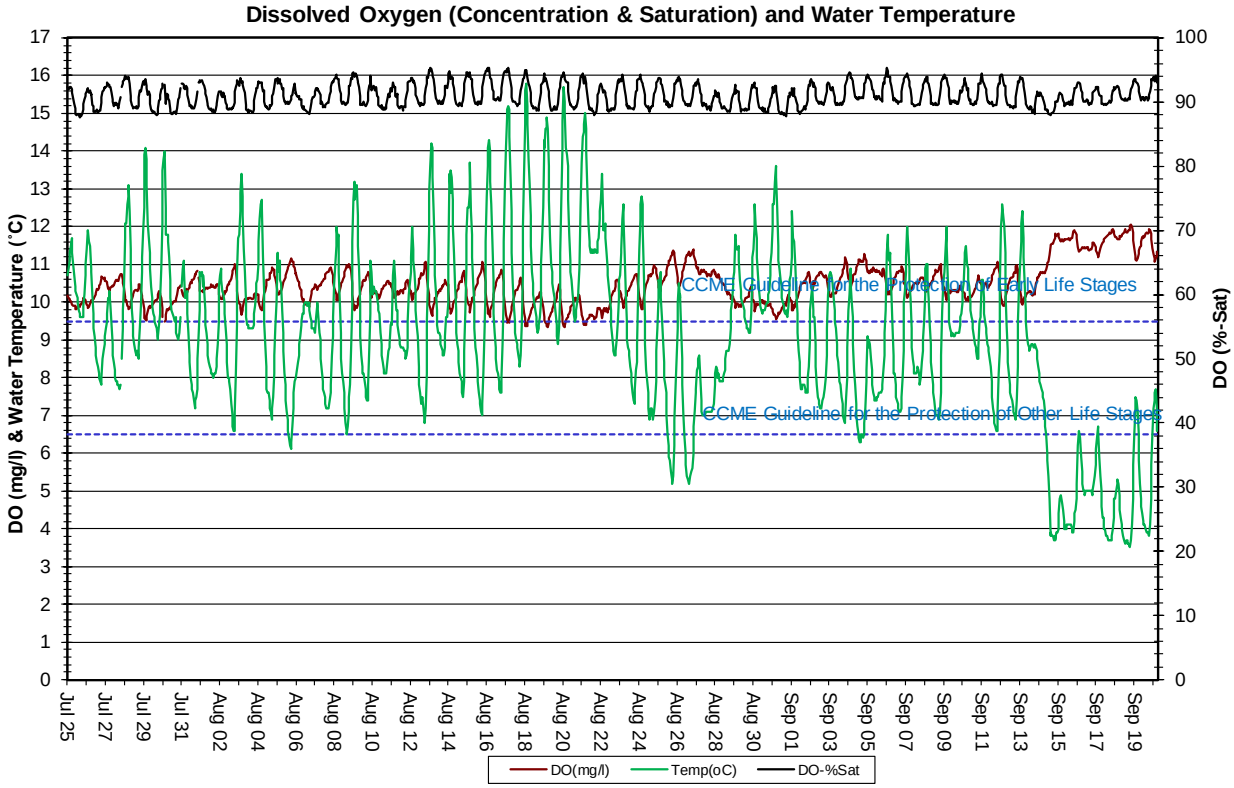

Figure 10: Dissolved Oxygen & Water Temperature at Joan Brook

Turbidity

- The stage data is raw data that is transmitted via satellite and published on our web page. It has not been corrected for backwater effect. The Water Survey of Canada is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.
- During the deployment period, turbidity values ranged from 1.1 NTU to 2909 NTU at Elross Creek and from 0.0 NTU to 527 NTU at Joan Brook (Figures 11-12). The turbidity sensors at Elross Creek had power issues September 5th onwards, so there is no data for this portion of the deployment.
- Elross Creek was slightly turbid throughout the deployment (median 2.5 NTU) while Joan Brook recorded minimal turbidity throughout the deployment (median 0.0 NTU). At both stations, turbidity values were elevated during increased stage events as the result of precipitation (Appendix B).

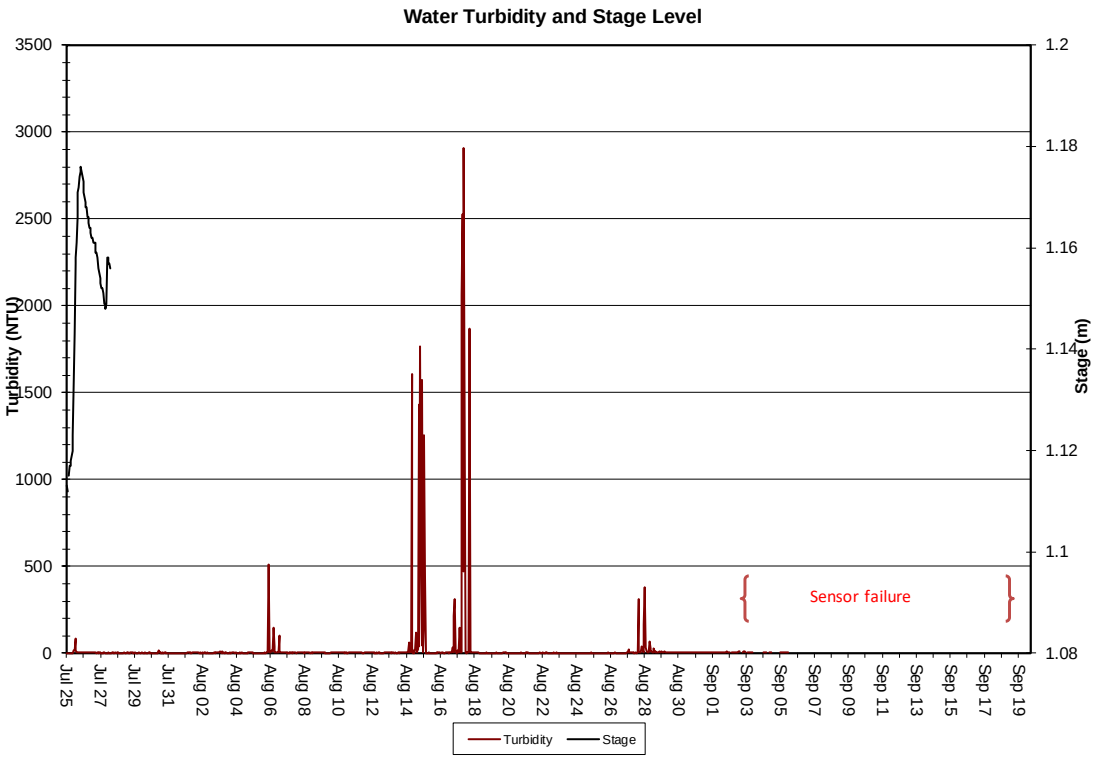

Figure 11: Turbidity & Stage at Elross Creek

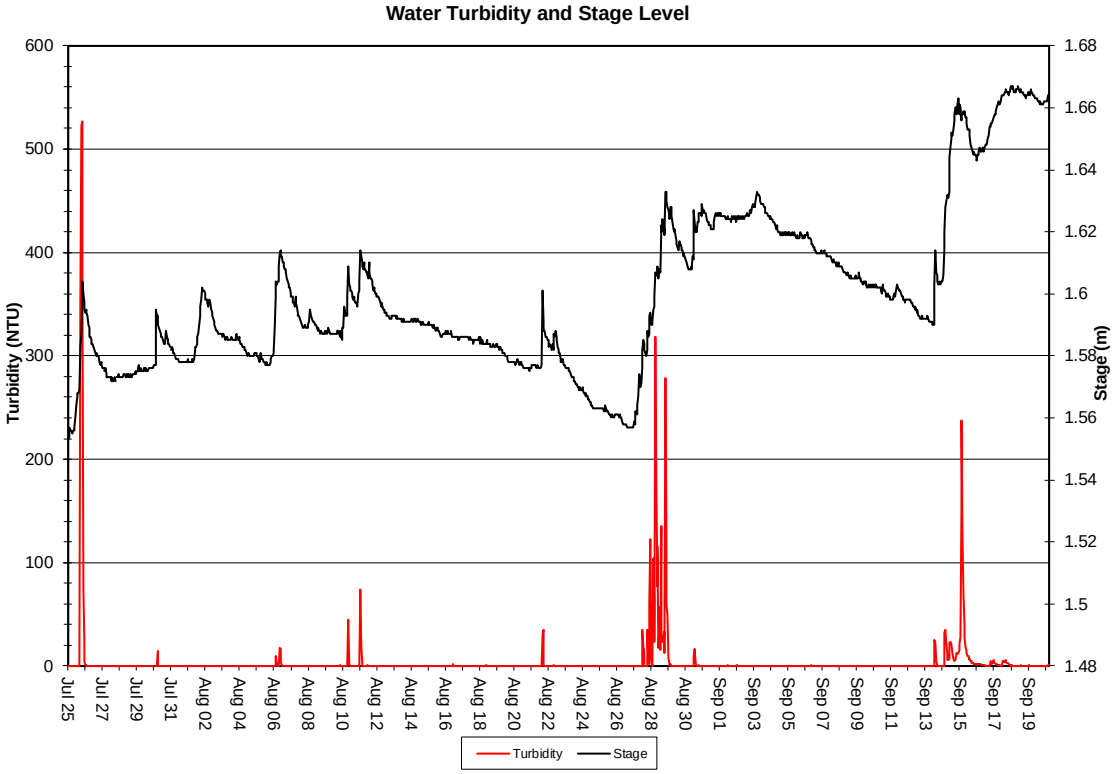

Figure 12: Turbidity & Stage at Joan Brook

Conclusions

- This deployment report presents water quality and water quantity data recorded at the Elross Creek and Joan Brook real time monitoring stations from July 25th to September 20th, 2022.
- Field instruments for both stations performed well over the deployment period despite major transmission and power loss at Elross Creek. Logged water quality data was used to supplement the data.
- Variations in water quality/quantity values recorded at each station are summarized below:
    - Joan Brook showed an increasing trend for stage, fed by numerous precipitation events during the deployment period (Appendix B). Elross Creek did not have enough recorded data to comment on trends.
    - At both stations, temperature showed an increasing trend over the first portion of deployment as temperatures rose into summer, followed by temperature declines for the second portion of deployment as Fall approached into September.
    - pH values ranged from 6.25 units to 6.91 units at Elross Creek and from 6.64 units to 6.97 units at Joan Brook. pH at Elross Creek dropped slightly below the guidelines during periods of high precipitation, while pH at Joan Brook remained within the guidelines throughout deployment.
    - Specific conductivity ranged from 14 µs/cm to 24 µs/cm at Elross Creek and from 7.2 µs/cm to 9.6 µs/cm at Joan Brook. Both stations showed an overall increasing trend and both were influenced by large increases in stage levels.
    - Dissolved oxygen (DO) values ranged from 8.59 mg/l (84.5% saturation) to 11.30 mg/l (99.8% saturation) at Elross Creek and from 9.34 mg/l (87.6% saturation) to 12.07 mg/l (95.4% saturation) at Joan Brook. Both stations were influenced by seasonal water temperatures, dipping below guidelines during warmest periods, before increasing into fall as cooler temperatures prevailed.
    - Turbidity values ranged from 1.1 NTU to 2909 NTU at Elross Creek in the available data and from 0.0 NTU to 527 NTU at Joan Brook. Stage level increases frequently caused spikes in turbidity.

References

Canadian Council of Ministers of the Environment. 2007. Canadian water quality guidelines for the protection of aquatic life: Summary table. Updated December, 2007. In: Canadian environmental quality guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg.

APPENDIX A
Quality Assurance / Quality Control Procedures

As part of the Quality Assurance / Quality Control (QA/QC) protocol, the performance of a station's water quality instrument (i.e., Field Sonde) is rated at the beginning and end of its deployment period. The procedure is based on the approach used by the United States Geological Survey (Wagner *et al.* 2006)[1].

At the beginning of the deployment period, a fully cleaned and calibrated QA/QC water quality instrument (i.e., QA/QC Sonde) is placed *in-situ* with the fully cleaned and calibrated Field Sonde. After Sonde readings have stabilized, which may take up to five minutes in some cases, water quality parameters, as measured by both Sondes, are recorded to a field sheet. Field Sonde performance for all parameters is rated based on differences recorded by the Field Sonde and QA/QC Sonde. If the readings from both Sondes are in close agreement, the QA/QC Sonde can be removed from the water. If the readings are not in close agreement, there will be attempts to reconcile the problem on site (e.g., removing air bubbles from sensors, etc.). If no fix is made, the Field Sonde may be removed for recalibration.

At the end of the deployment period, a fully cleaned and calibrated QA/QC Sonde is once again deployed *in-situ* with the Field Sonde, which has already been deployment for 30-40 days. After Sonde readings have stabilized, water quality parameters, as measured by both Sondes, are recorded to a field sheet. Field Sonde performance for all parameters is rated based on differences recorded by the Field Sonde and QA/QC Sonde.

Performance ratings are based on differences listed in the table below.

	Rating				
Parameter	**Excellent**	**Good**	**Fair**	**Marginal**	**Poor**
Temperature (°C)	≤ ±0.2	> ±0.2 to 0.5	> ±0.5 to 0.8	> ±0.8 to 1	> ±1
pH (unit)	≤ ±0.2	> ±0.2 to 0.5	> ±0.5 to 0.8	> ±0.8 to 1	> ±1

[1] Wagner, R.J., Boulger, R.W., Jr., Oblinger, C.J., and Smith, B.A., 2006, Guidelines and standard procedures for continuous water-quality monitors—Station operation, record computation, and data reporting: U.S. Geological Survey Techniques and Methods 1–D3, 51 p. + 8 attachments; accessed April 10, 2006, at *http://pubs.water.usgs.gov/tm1d3*

Sp. Conductance (µS/cm)	≤ ±3	> ±3 to 10	> ±10 to 15	> ±15 to 20	> ±20
Sp. Conductance > 35 µS/cm (%)	≤ ±3	> ±3 to 10	> ±10 to 15	> ±15 to 20	> ±20
Dissolved Oxygen (mg/l) (% Sat)	≤ ±0.3	> ±0.3 to 0.5	> ±0.5 to 0.8	> ±0.8 to 1	> ±1
Turbidity <40 NTU (NTU)	≤ ±2	> ±2 to 5	> ±5 to 8	> ±8 to 10	> ±10
Turbidity > 40 NTU (%)	≤ ±5	> ±5 to 10	> ±10 to 15	> ±15 to 20	> ±20

APPENDIX B
Environment Canada Weather Data – Schefferville