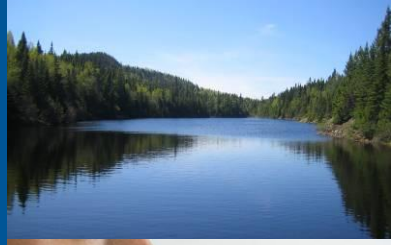




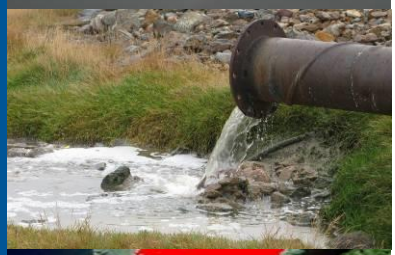


Real Time Water Quality Report

Tata Steel Minerals Canada

Elross Lake/Joan Brook Network

Deployment Period
2022-09-20 to 2022-10-18

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 September 20th to October 18th, 2022, which was the third and final deployment period for the 2022 field season.
- 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	Beginning	End
Deployment Date	2022-09-20	2022-10-17	2022-09-20	2022-10-18
Grab Sample Date	NA* sonde not switched	2022-10-17	2022-09-20	2022-10-18
pH	NA	Excellent	Excellent	Excellent
Specific Conductivity	NA	Excellent	Excellent	Good
Turbidity	NA	Excellent	Excellent	NA

- 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 September 20th, 2022, at Joan Brook and July 25th at Elross Creek. The equipment at Elross Creek was not switched on September 20th, but this date was chosen to standardize the reporting period for comparisons.
- Elross Creek continued to experience major transmission loss until October 5th. Water quality data was supplemented using internally logged data from the real-time instrumentation. However, when logged data was used, stage data was still unavailable. Joan Brook experienced minor transmission losses throughout the deployment.

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.
- Stage data is only available for the second portion of the deployment period at Elross Creek due to transmission issues. During the deployment period, stage values ranged from 1.138 m to 1.19 m at Elross Creek, and from 1.479 m to 1.666 m at Joan Brook (Figures 1-2). The large drop in stage at Joan Brook on October 5th is due to an adjustment of equipment by WSC. Both stations showed a downward trend in stage during the second portion of deployment with an increase at the end due to precipitation (Appendix B).
- Due to data transmission issues and issues with power supply, there are minor data gaps for stage and all other parameters during this deployment period.

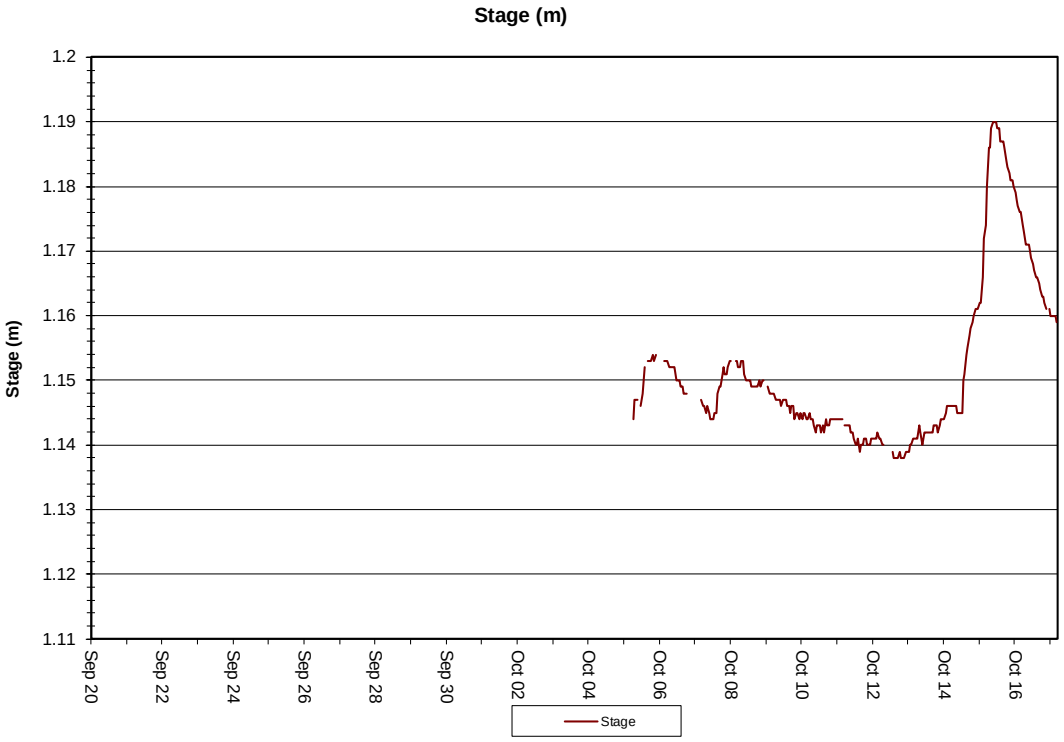

Figure 1: Stage at Elross Creek

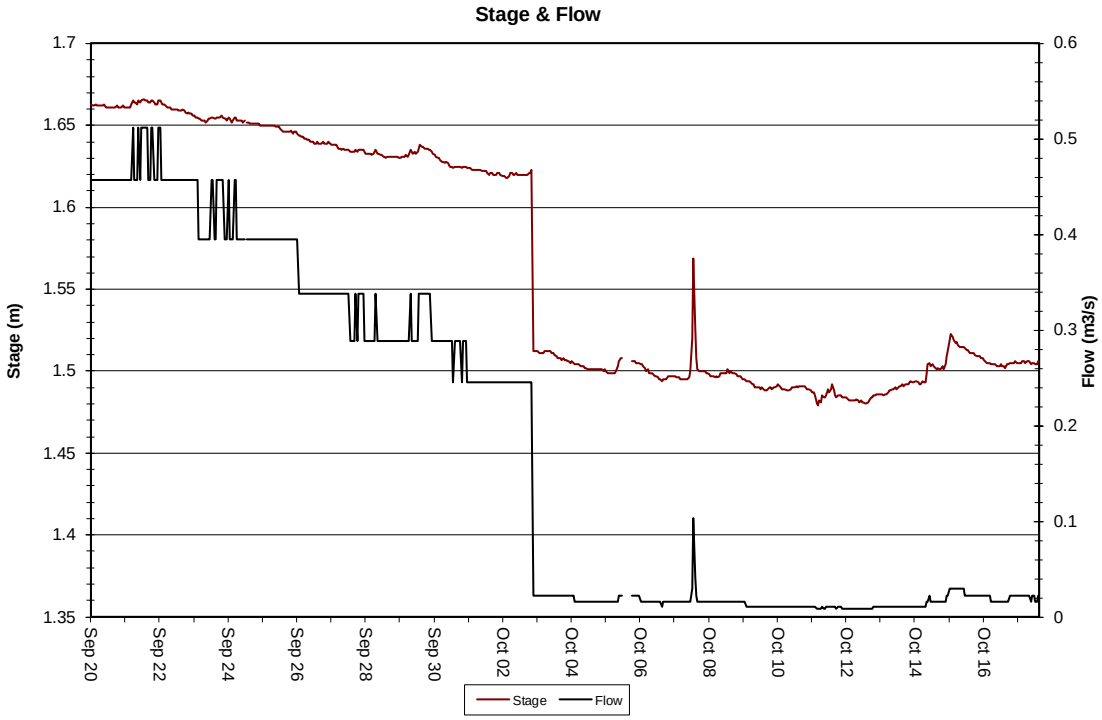

Figure 2: Stage & Flow at Joan Brook

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 1.50˚C to 8.82˚C at Elross Creek and from 0.03˚C to 7.30˚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 a decreasing trend over the deployment which is typical of the transition from early to late Fall.

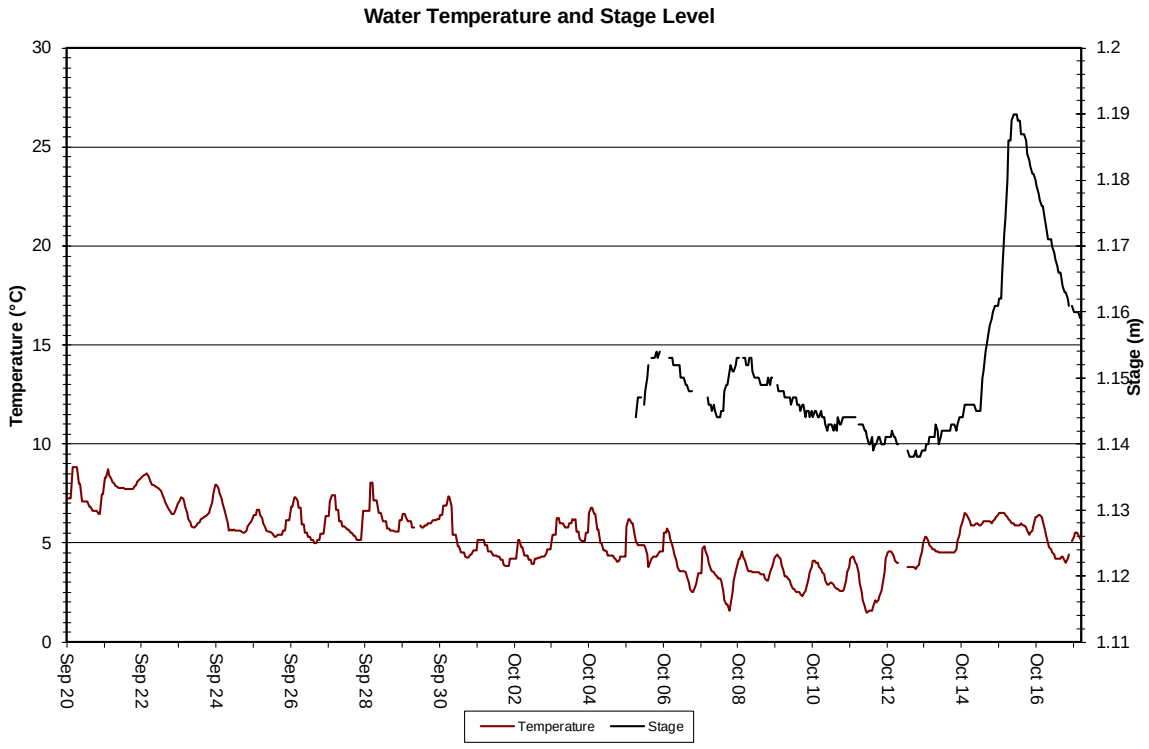

Figure 3: Water Temperature & Stage at Elross Creek

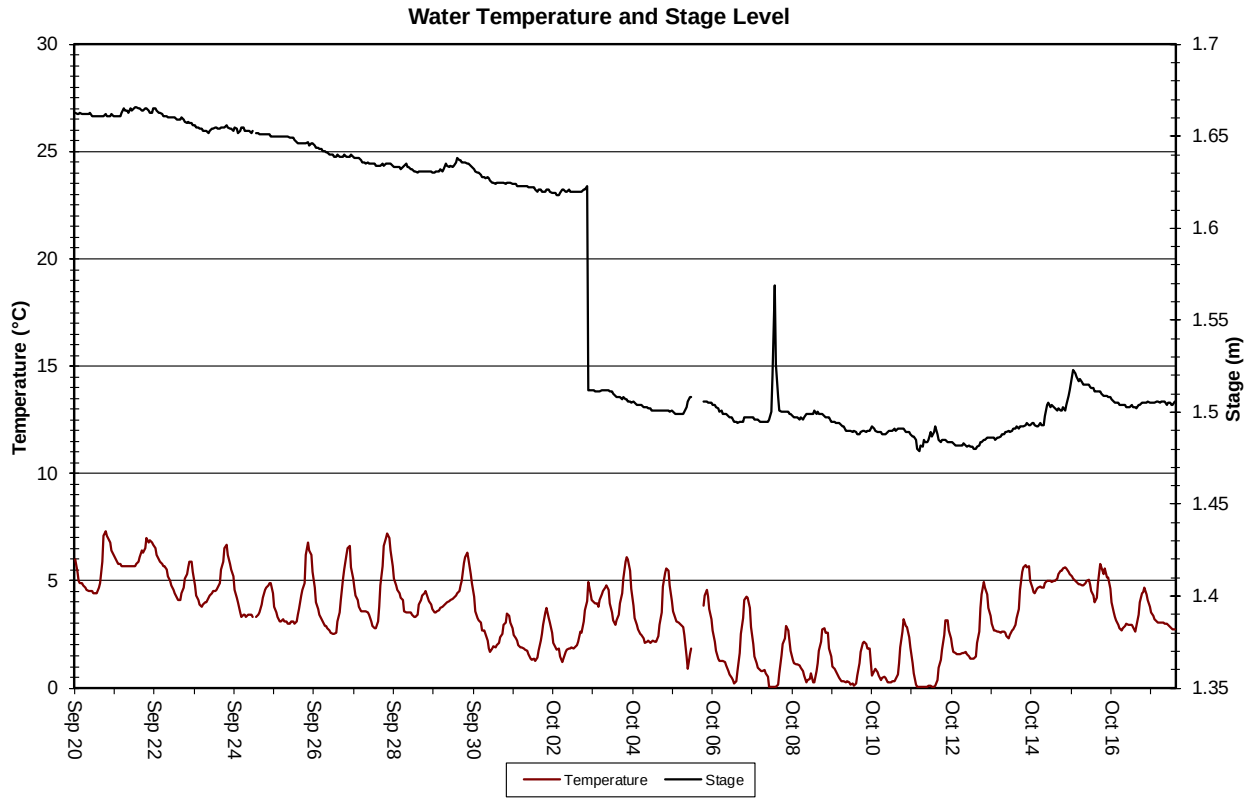

Figure 4: Water Temperature & Stage at Joan Brook

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 6.73 units to 7.03 units at Elross Creek and from 6.62 units to 7.04 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, though less pronounced at Elross Creek.
- pH appears to be relatively stable at both stations during this deployment period, but did record a noticeable decrease at Elross Creek following a significant precipitation event and associated stage increase on October 15th.
- All pH values at both stations were 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). 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.

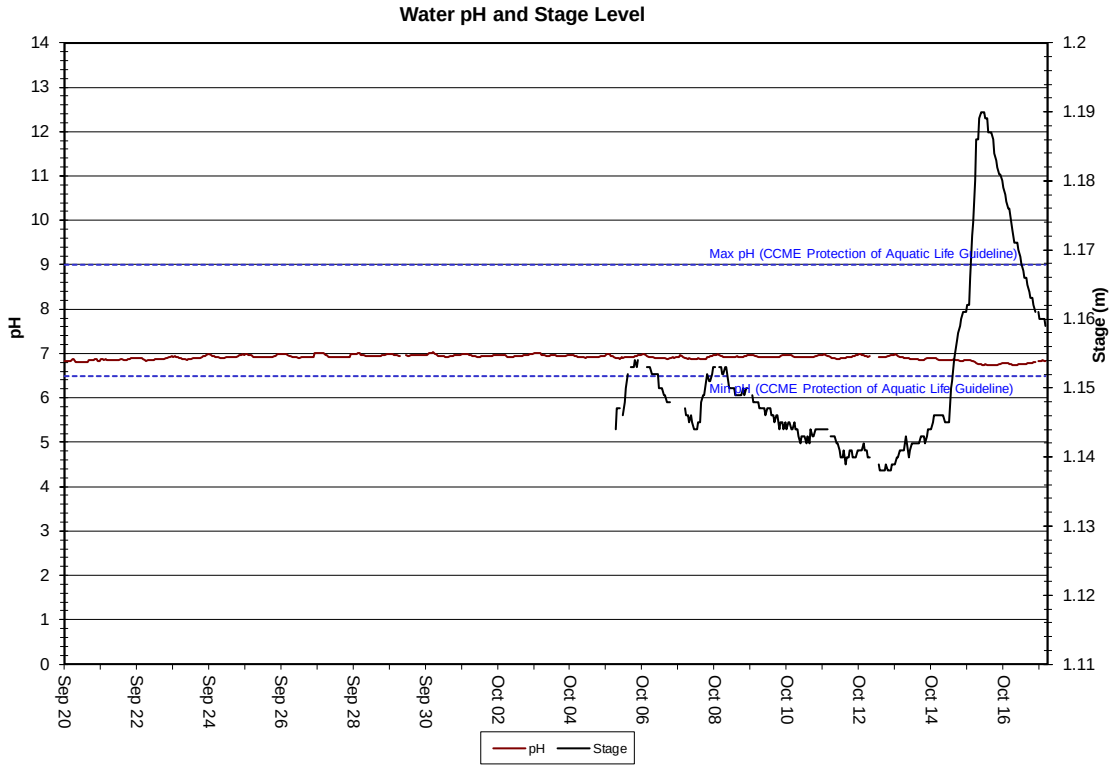

Figure 5: pH & Stage at Elross Creek

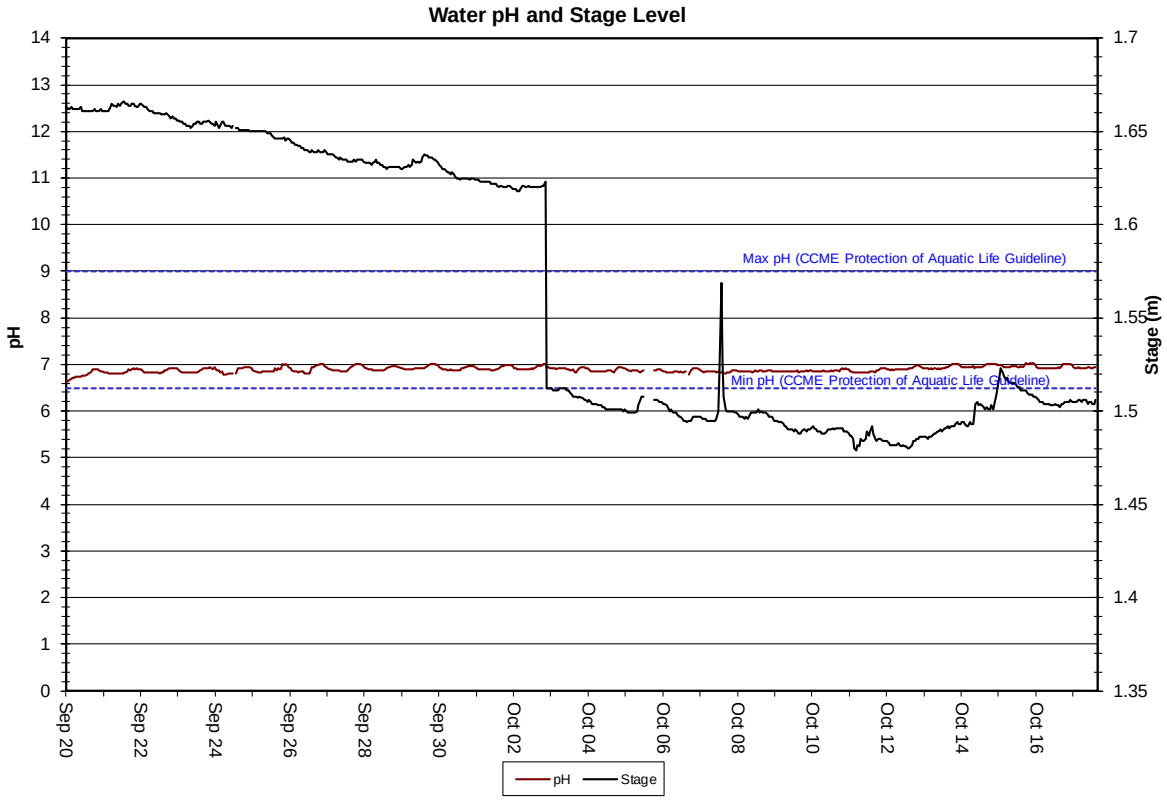

Figure 6: pH & Stage at Joan Brook

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 19.2 µs/cm to 25.6 µs/cm at Elross Creek and from 7.4 µs/cm to 8.3 µs/cm at Joan Brook (Figures 7-8). Both stations demonstrated an overall increasing trend until a large precipitation event near the end of the deployment caused a noticeable drop in conductivity, particularly at Elross Creek (Figure 7).
- 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.

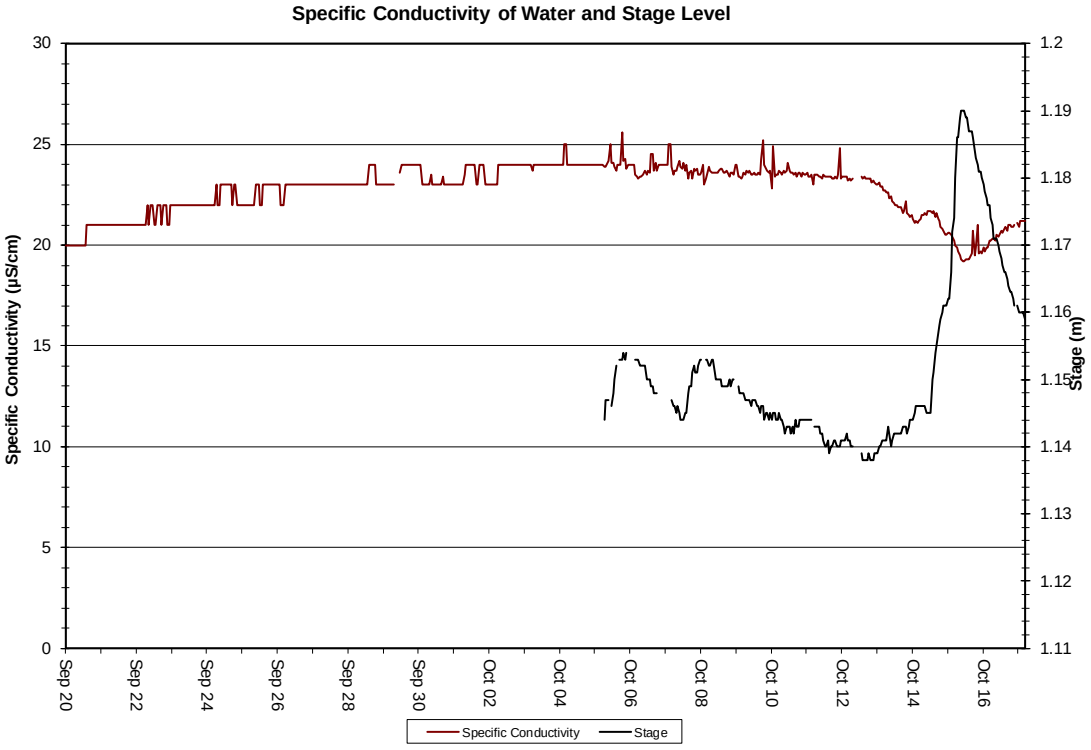

Figure 7: Specific Conductivity & Stage at Elross Creek

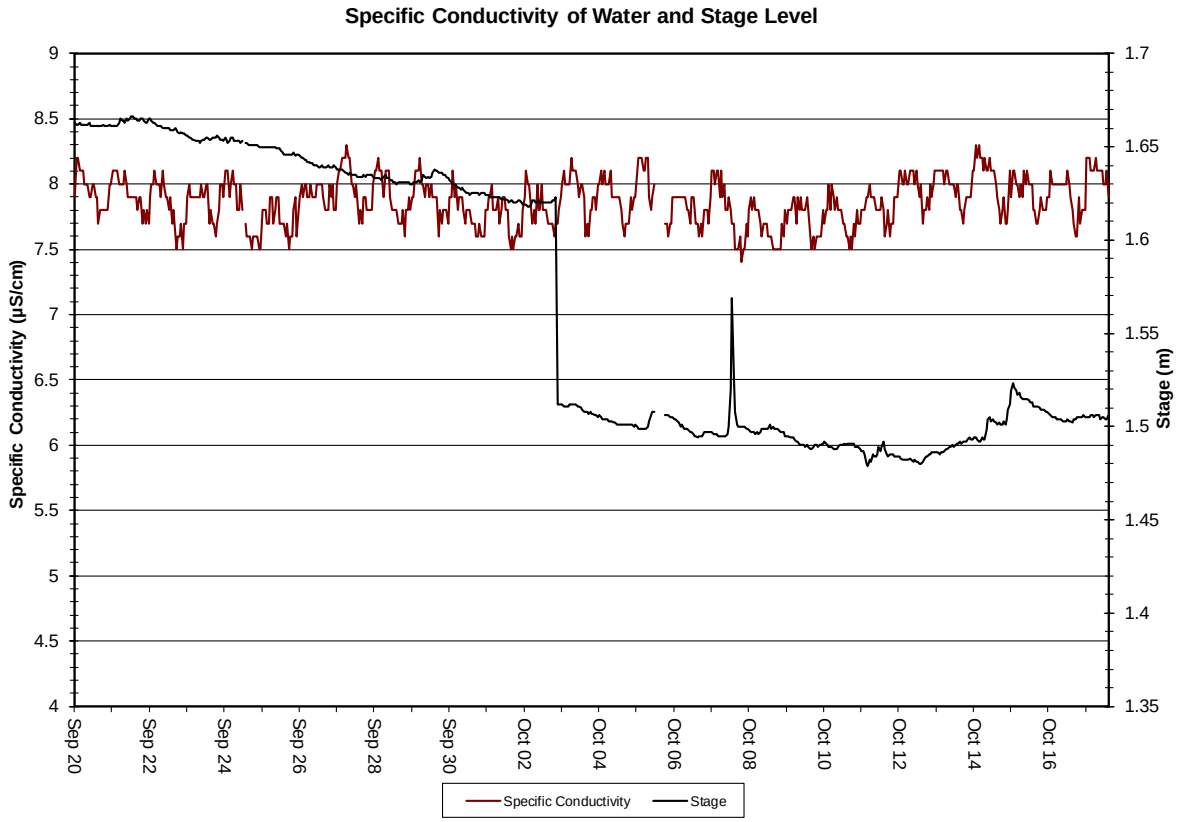

Figure 8: Specific Conductivity & Stage at Joan Brook

Dissolved Oxygen

- During the deployment period, dissolved oxygen (DO) values ranged from 10.2 mg/l (88.2% saturation) to 12.52 mg/l (92.8% saturation) at Elross Creek and from 10.81 mg/l (85.9% saturation) to 12.93 mg/l (92.7% saturation) at Joan Brook (Figures 9-10).
- DO exhibited a slight increasing trend at both stations during the deployment period as water temperatures cooled from early to late Fall. This is a natural relationship as cooler water can hold more dissolved oxygen. There was a slight decrease in DO near the end of the deployment at both stations as warmer water temperatures were observed at this time.
- The DO values at Elross Creek and Joan Brook remained above the minimum guidelines set for other life stages (6.5 mg/l) and early life stages (9.5 mg/l), as determined by the Canadian Council of Ministers of the Environment (2007).

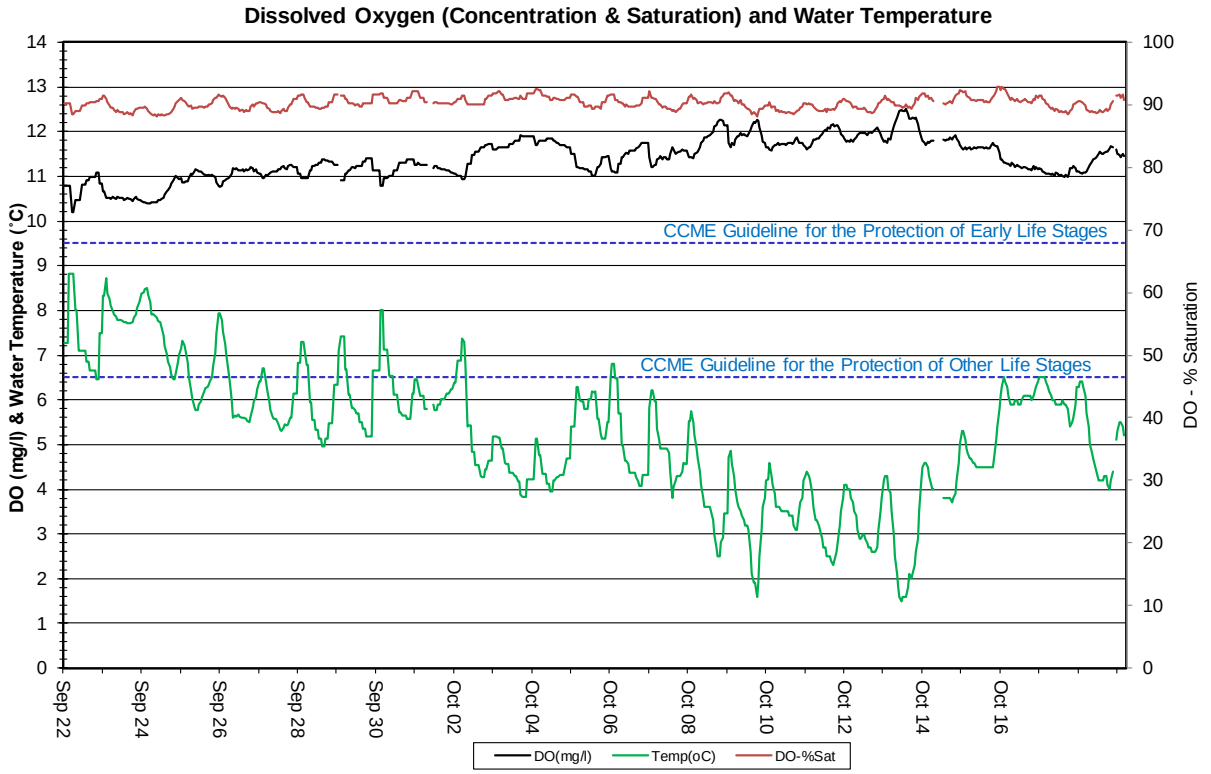

Figure 9: Dissolved Oxygen & Water Temperature at Elross Creek

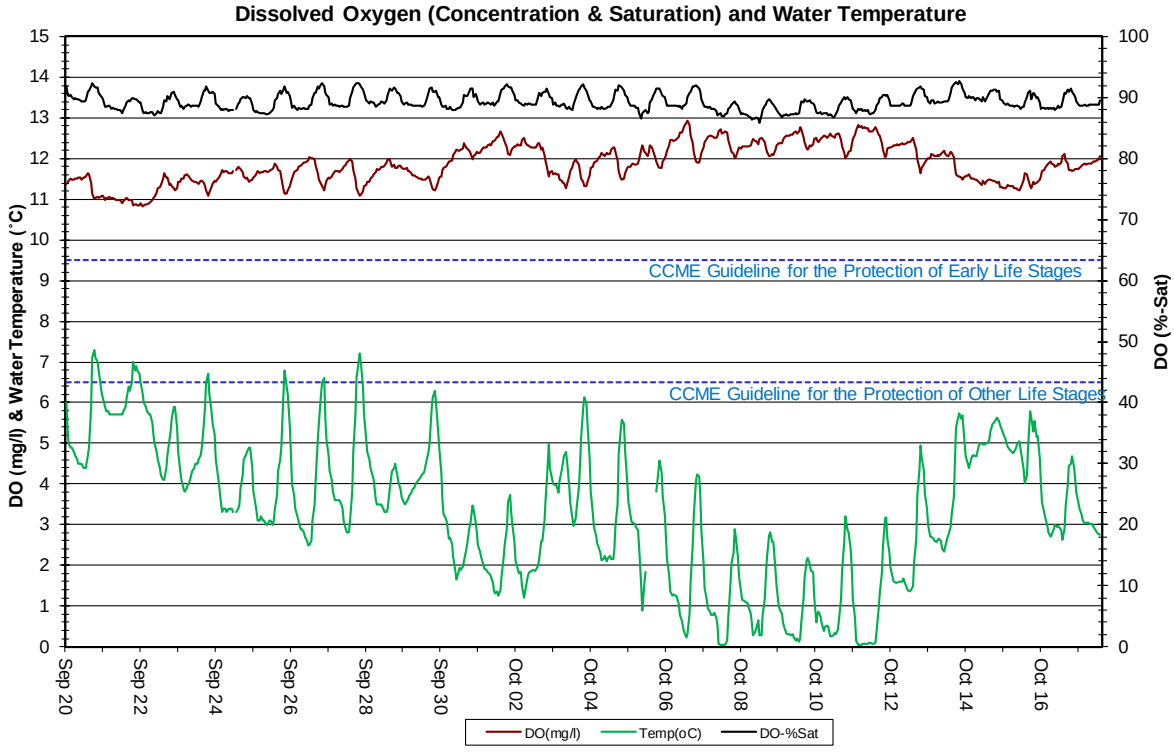

Figure 10: Dissolved Oxygen & Water Temperature at Joan Brook

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 2.2 NTU to 61.1 NTU at Elross Creek and from 0 NTU to 233.3 NTU at Joan Brook (Figures 11-12).
- Elross Creek was turbid throughout the portion of deployment with recorded data (median 4.5 NTU) while Joan Brook recorded minimal turbidity throughout the deployment (median 0.0 NTU). At both stations, turbidity values were frequently elevated during increased stage events.

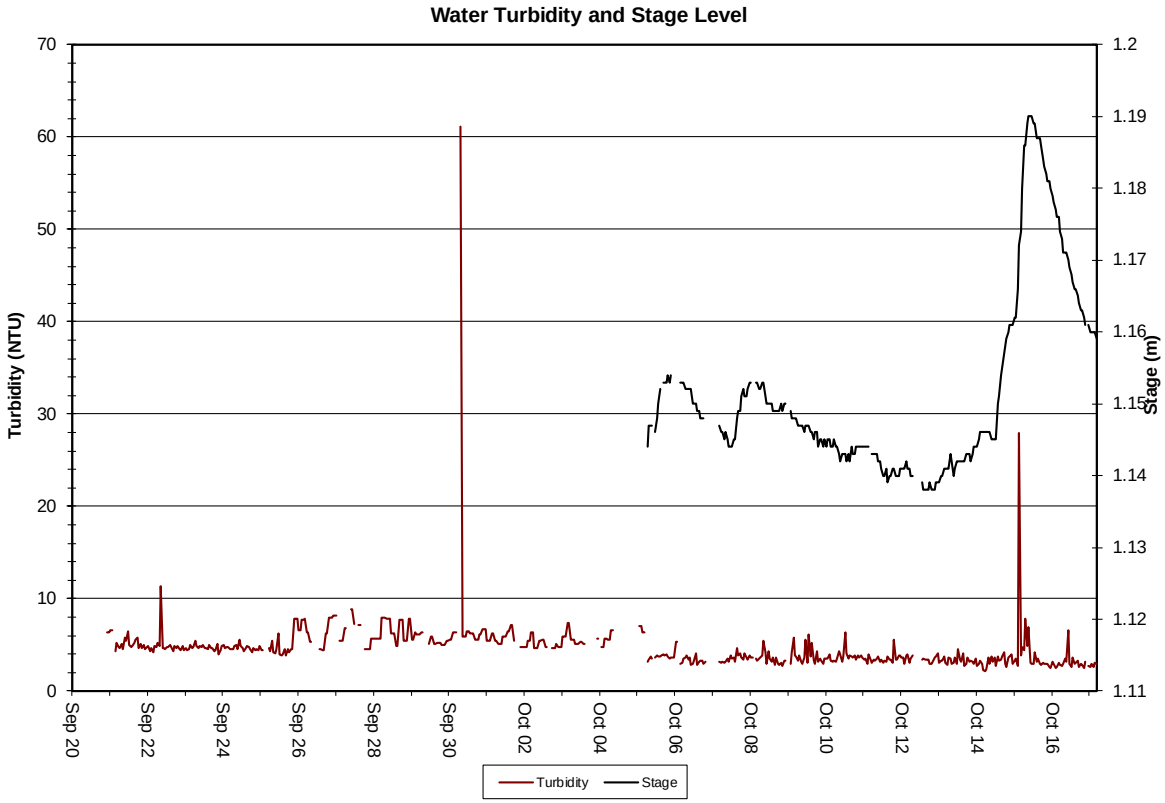

Figure 11: Turbidity & Stage at Elross Creek

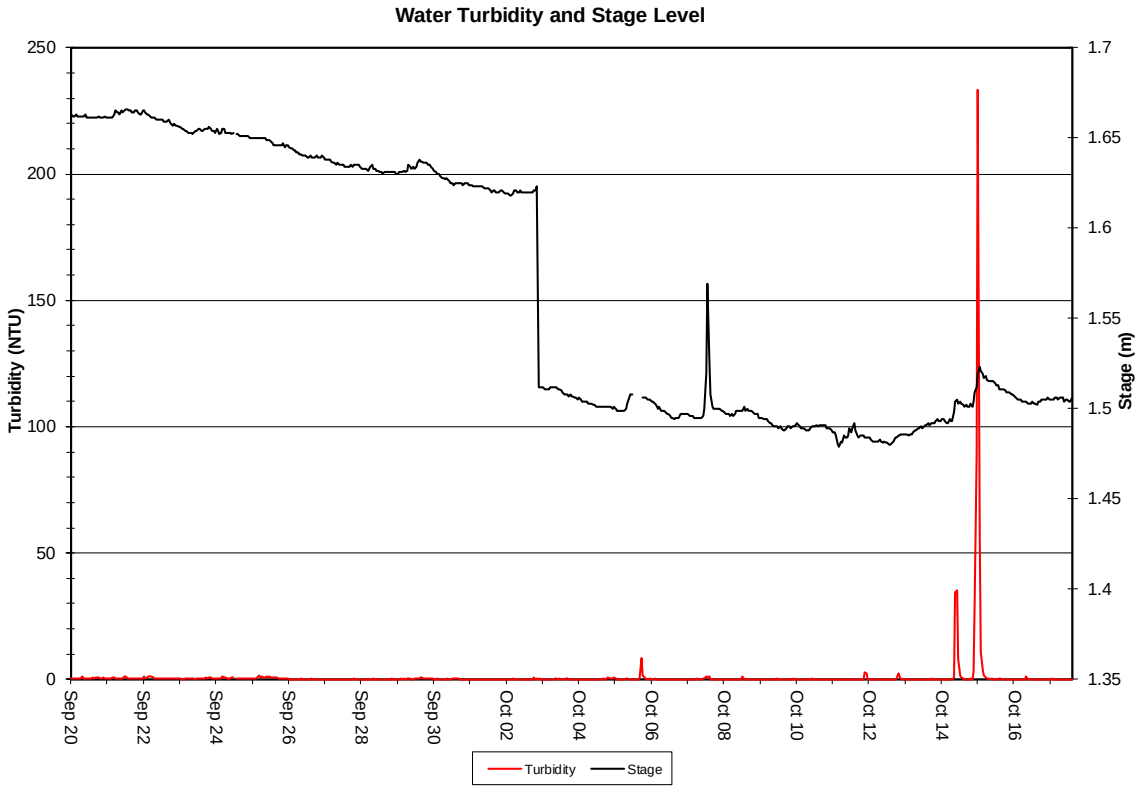

Figure 12: Turbidity & Stage at Joan Brook

Conclusions

- This deployment report presents water quality and water quantity data recorded at the Elross Creek and Joan Brook real time monitoring stations from September 20th to October 18th, 2022.
- Field instruments for both stations performed well over the deployment period despite major transmission issues at Elross Creek.
- Variations in water quality/quantity values recorded at each station are summarized below:
    - At both stations, stage showed a general decreasing trend but was influenced by precipitation events. At Elross Creek, stage data was only available for the second portion of deployment due to major transmission issues with the station.
    - At both stations, temperature showed a decreasing trend over the deployment which is typical of the transition from early to late Fall. Both stations also recorded a slight increase in temperature near the end of the deployment related to weather conditions during this period.

- pH values ranged from 6.73 units to 7.03 units at Elross Creek and from 6.62 units to 7.04 units at Joan Brook. pH at both stations remained within the recommended guidelines throughout deployment.
- Specific conductivity ranged from 19.2 µs/cm to 25.6 µs/cm at Elross Creek and from 7.4 µs/cm to 8.3 µs/cm at Joan Brook. Both stations showed an overall increasing trend and both were influenced by large increases in stage levels near the end of deployment, showing decreases at this time.
- Dissolved oxygen (DO) values ranged from 10.2 mg/l (88.2% saturation) to 12.52 mg/l (92.8% saturation) at Elross Creek and from 10.81 mg/l (85.9% saturation) to 12.93 mg/l (92.7% saturation) at Joan Brook. Both stations were influenced by decreasing seasonal water temperatures, displaying an increasing trend as the seasons progressed from early to late Fall.
- Turbidity values ranged from 2.2 NTU to 61.1 NTU at Elross Creek and from 0.0 NTU to 233.3 NTU at Joan Brook. Elross Creek recorded a low level of turbidity throughout the deployment period (median of 4.5 NTU). At both locations, 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
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

[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*

APPENDIX B
Environment Canada Weather Data – Schefferville (Sept.-Oct. 2022)