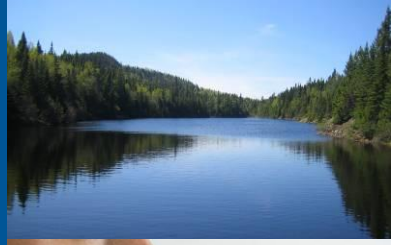




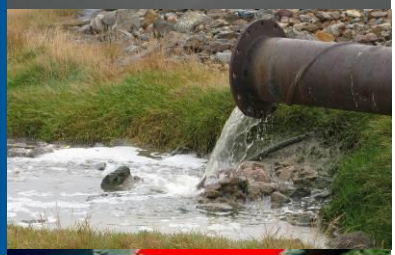


Real Time Water Quality Report

Tata Steel Minerals Canada

Elross Lake/Joan Brook Network

Deployment Period
2022-06-20 to 2022-07-25

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 June 20th to July 25th, 2022, which was the first deployment period for the 2022 field season. The equipment at Joan Brook was not switched on July 25th, 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	Beginning	End
Deployment Date	2022-06-21	2022-07-25	2022-06-20	2022-07-25
Grab Sample Date	2022-06-28	2022-07-25	2022-06-28	2022-07-25
pH	Excellent	Good	Good	Excellent
Specific Conductivity	Excellent	Excellent	Excellent	Excellent
Turbidity	Excellent	Excellent	NA- failure	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 June 20th, 2022, at Joan Brook and June 21st, 2022 at Elross Creek.
- Both stations experienced sporadic 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. Turbidity data was unavailable for June 21-July 14 at Joan Brook due to sensor issues.

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.
- During the deployment period, stage values ranged from 1.09 m to 1.19 m at Elross Creek, and from 1.55m to 1.62m at Joan Brook (Figures 1-2). Both showed a downward trend in stage which is normal as spring meltwaters begin to decrease into summer.
- Due to data transmission issues and issues with power supply, there are several data gaps for stage and all other parameters during this deployment.

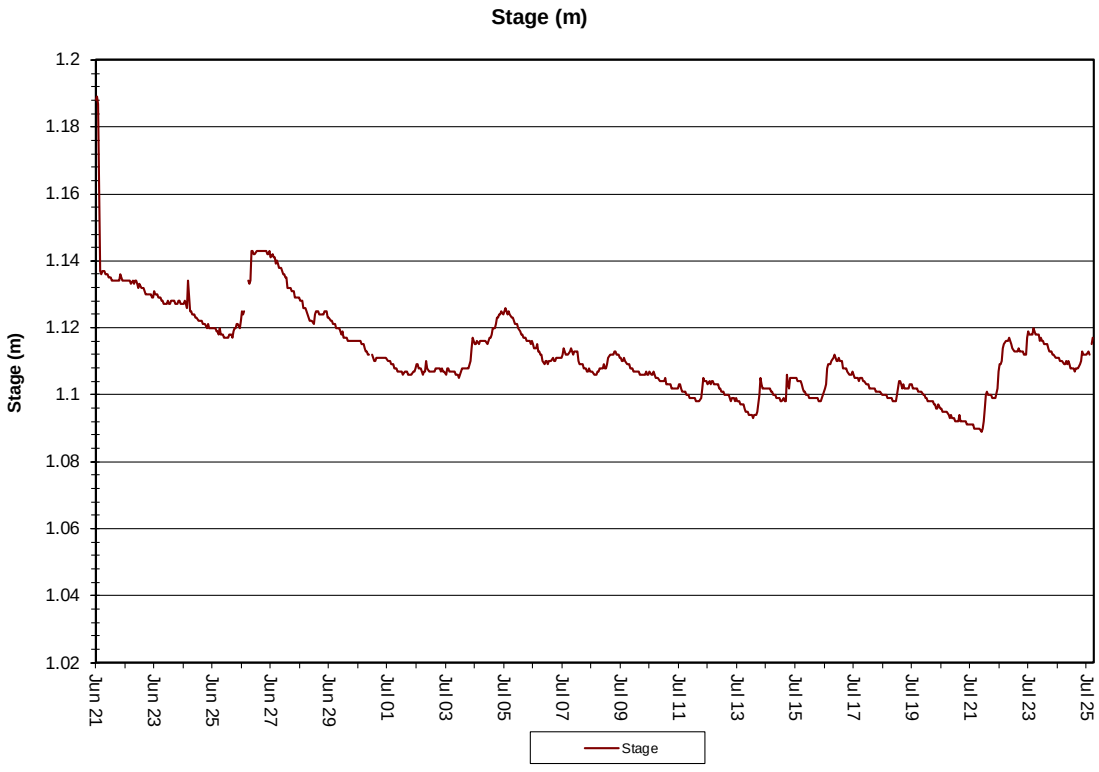

Figure 1: Stage at Elross Creek

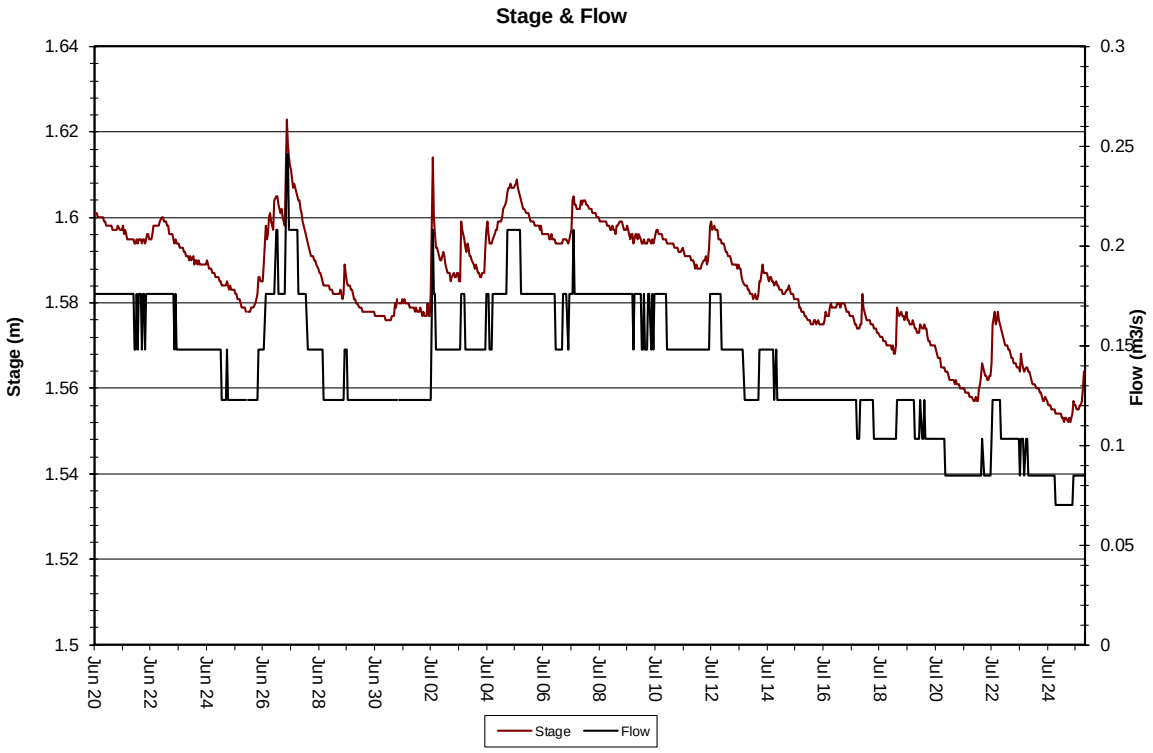

Figure 2: Stage & Flow at Joan Brook

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 6.60˚C to 14.20˚C at Elross Creek and from 4.20˚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 deployment which is typical of the transition from spring into summer.

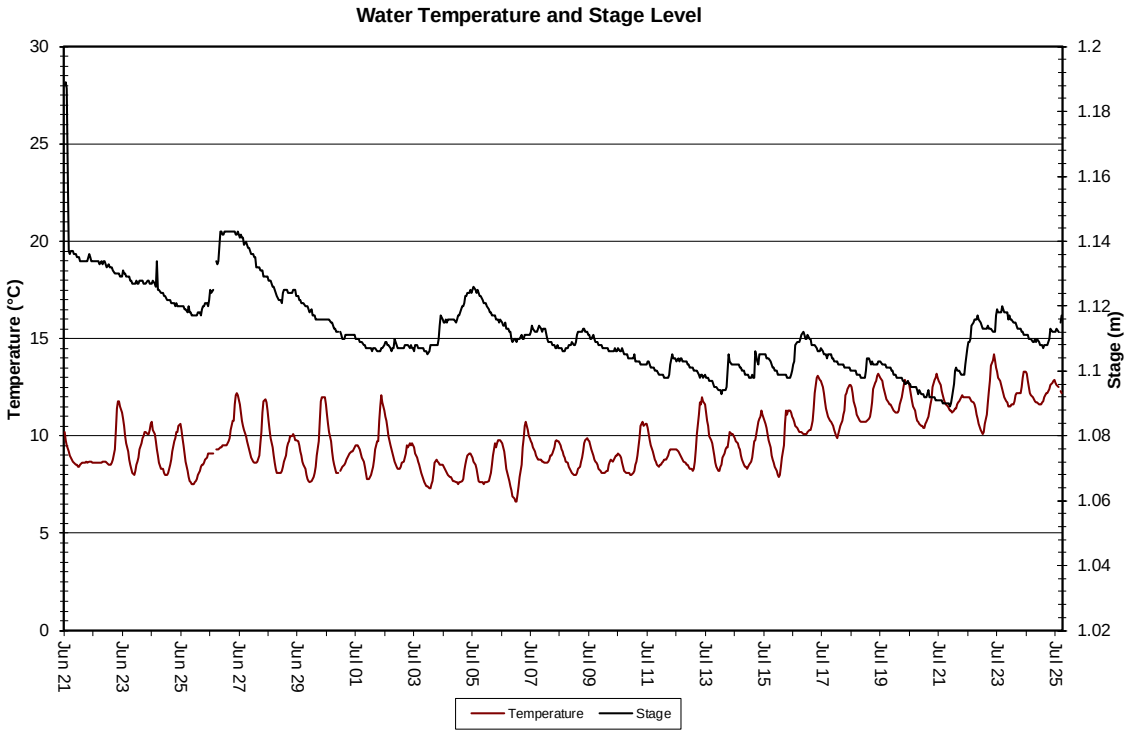

Figure 3: Water Temperature & Stage at Elross Creek

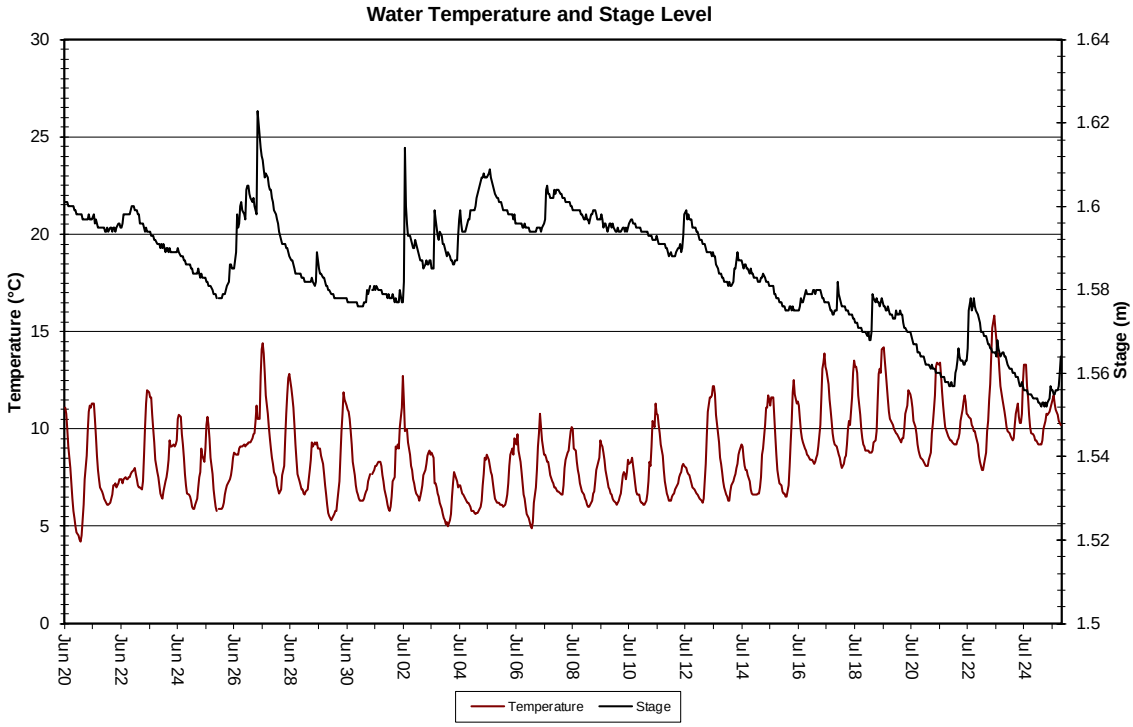

Figure 4: Water Temperature & Stage at Joan Brook

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 6.61 units to 6.86 units at Elross Creek and from 6.64 units to 7.01 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 stations during this deployment period. The slight drop in pH at Joan Brook on July 14th is due to the instrument being switched out at this time.
- With a minimum values of 6.61 and 6.64 units, all pH values at both stations 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). It should be noted that acidic waters are quite common in Canada, particularly in boreal and northern ecoregions, and pH is often naturally near or below the 6.5 unit guideline.

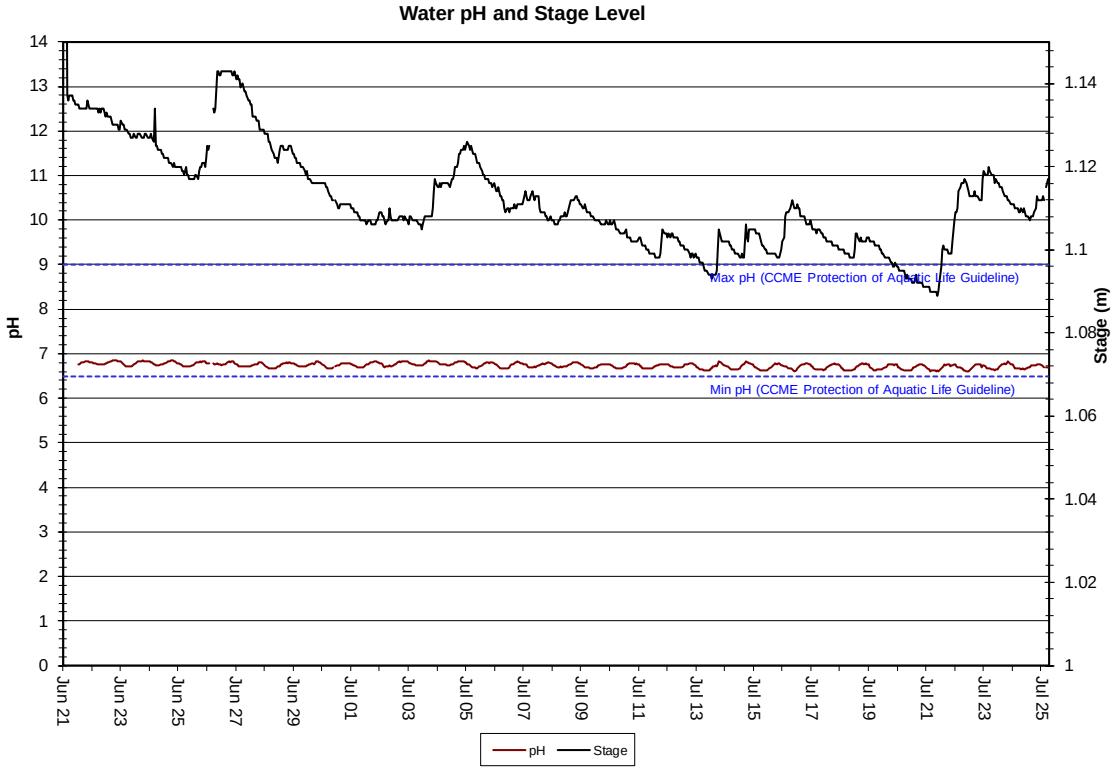

Figure 5: pH & Stage at Elross Creek

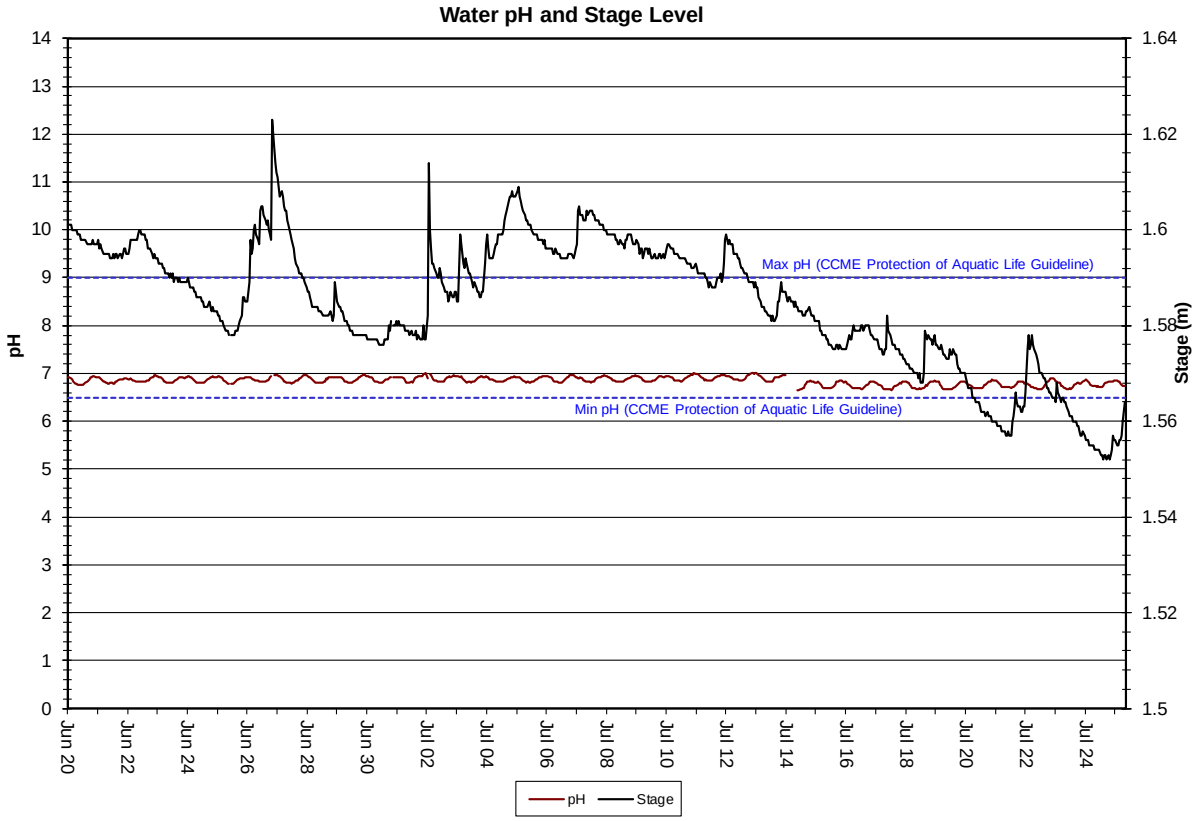

Figure 6: pH & Stage at Joan Brook

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 14.8 µs/cm to 17.6 µs/cm at Elross Creek and from 6.8 µs/cm to 9.1 µs/cm at Joan Brook (Figures 7-8). Elross Creek was relatively stable while Joan Brook demonstrated an overall increasing trend.
- 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.
- Two large increases in stage caused associated drops in conductance at Elross Creek and Joan Brook on June 25th and July 5th (Figure 7 & 8).

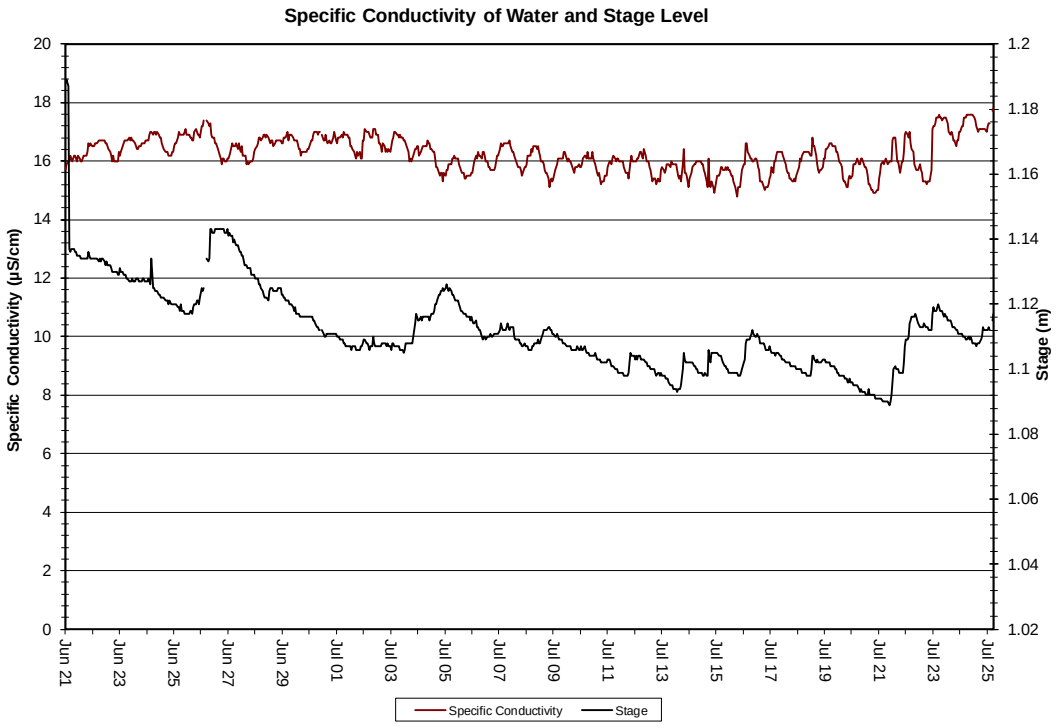

Figure 7: Specific Conductivity & Stage at Elross Creek

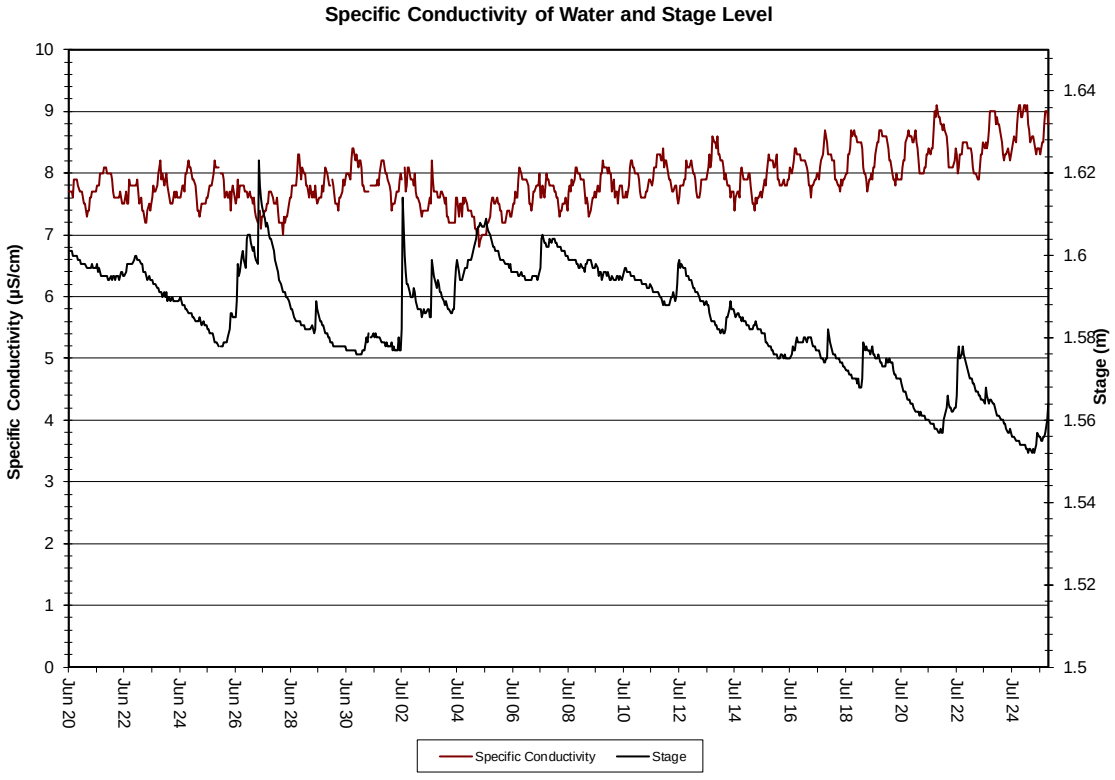

Figure 8: Specific Conductivity & Stage at Joan Brook

Dissolved Oxygen

- During the deployment period, dissolved oxygen (DO) values ranged from 8.92 mg/l (83.3% saturation) to 10.77 mg/l (93.6% saturation) at Elross Creek and from 9.20 mg/l (86.9% saturation) to 11.82 mg/l (94.6% saturation) at Joan Brook (Figures 9-10).
- DO exhibited a slight decreasing trend at both stations during the deployment period as water temperatures warmed into summer. This is a natural relationship as warmer water can hold less 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) and early life stages (9.5 mg/l), as determined by the Canadian Council of Ministers of the Environment (2007), with the exception of the warmest period at Elross Creek, July 19th to 25th.

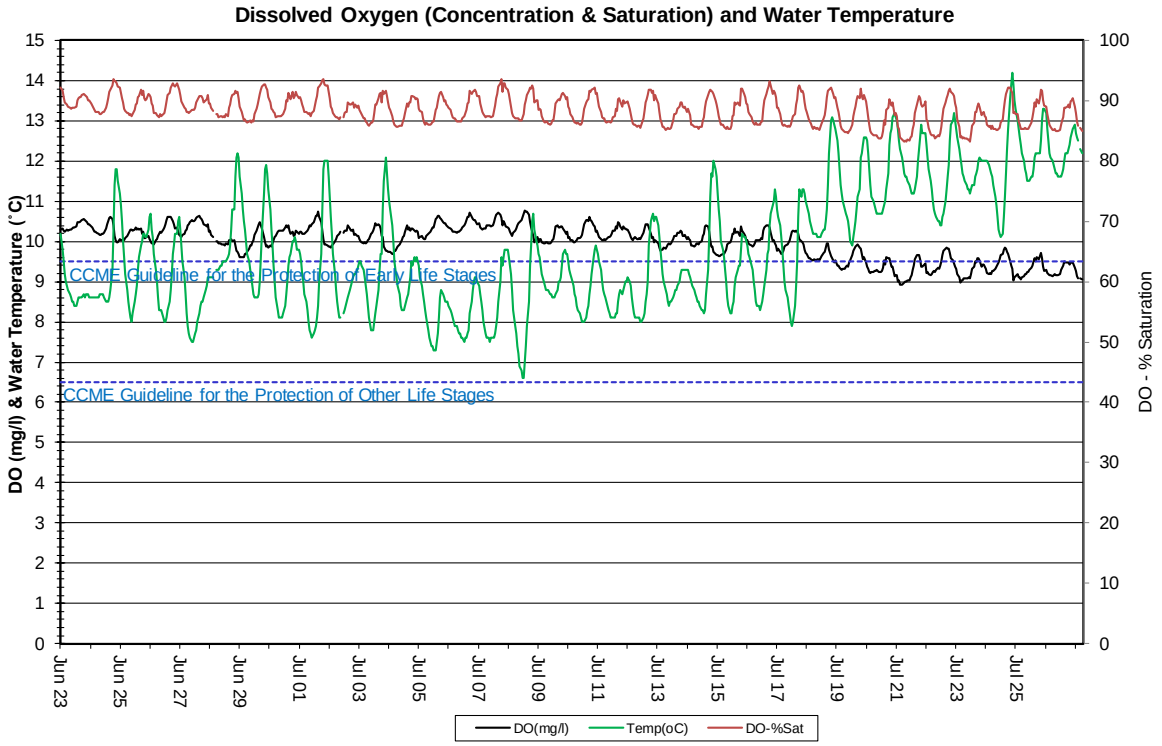

Figure 9: Dissolved Oxygen & Water Temperature at Elross Creek

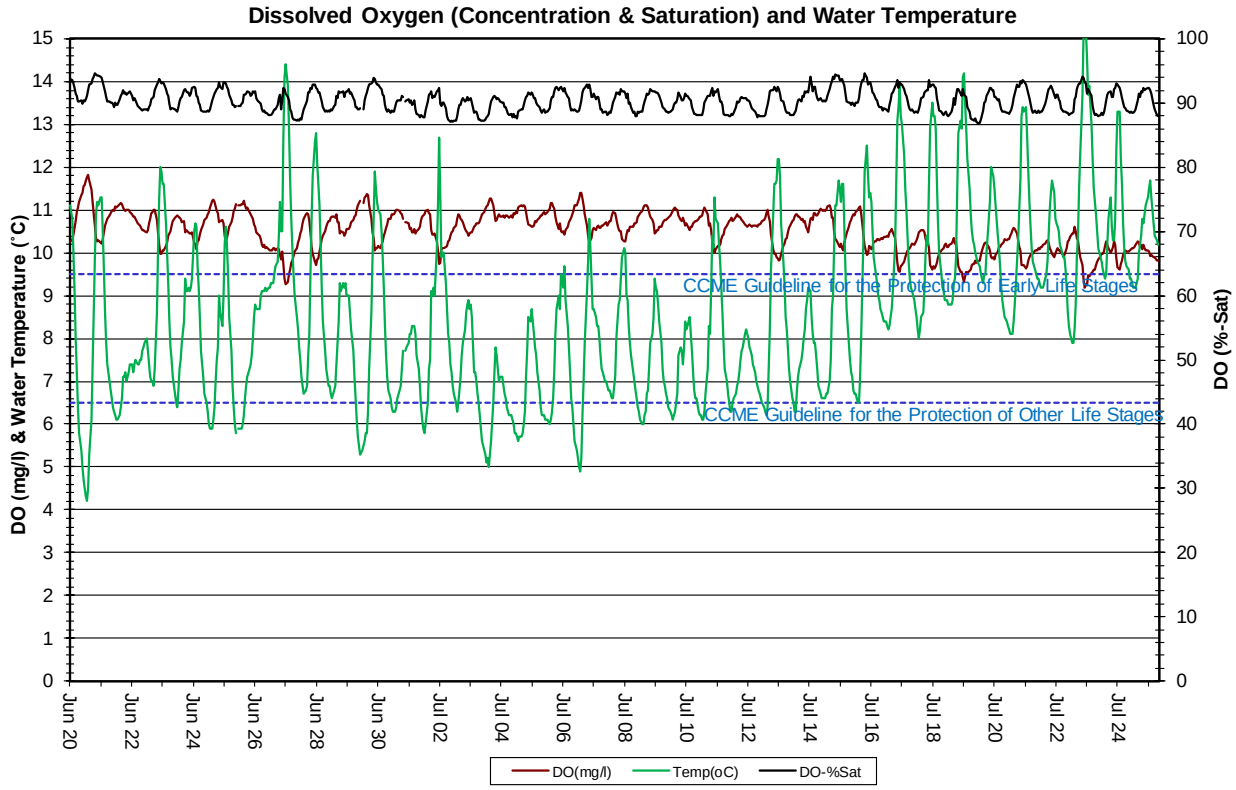

Figure 10: Dissolved Oxygen & Water Temperature at Joan Brook

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 0.2 NTU to 5.9 NTU at Elross Creek and from 0.0 NTU to 58.3 NTU at Joan Brook (Figures 11-12). Turbidity was unavailable for the majority of the deployment at Joan Brook due to sensor failure.
- Both stations reported low median turbidity – median of 1.5 NTU at Elross Creek and median of 1.0 NTU at Joan Brook. Elross showed a decreasing trend while trends at Joan Brook could not be assessed due to lack of data for the deployment period.

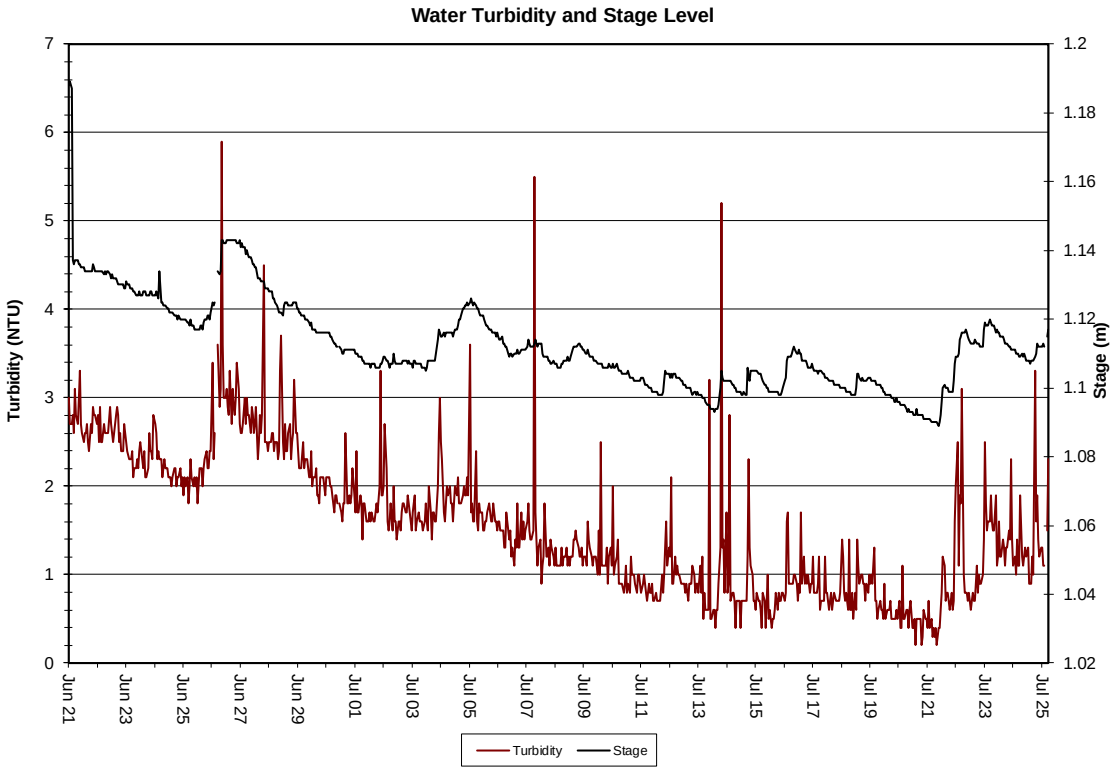

Figure 11: Turbidity & Stage at Elross Creek

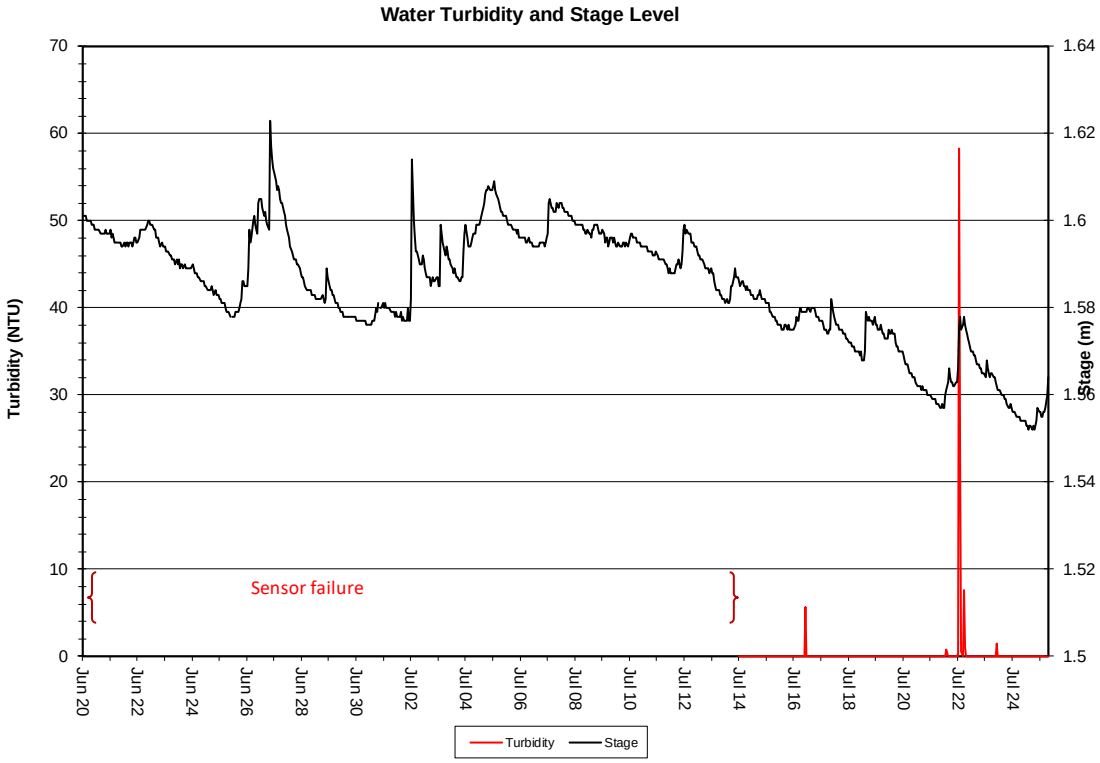

Figure 12: Turbidity & Stage at Joan Brook

Conclusions

- This deployment report presents water quality and water quantity data recorded at the Elross Creek and Joan Brook real time monitoring stations from June 20th to July 25th, 2022.
- Field instruments for both stations performed well over the deployment with only a few transmission issues. The turbidity sensor originally installed at Joan Brook was found to be faulty and was replaced with a new instrument on July 14th.
- Variations in water quality/quantity values recorded at each station are summarized below:
    - At both stations, stage was typical for spring into summer as the last of the spring melt passes through the system, decreasing the overall stage level. Significant rainfall events can cause spikes that are relatively short lived.
    - At both stations, temperature showed an increasing trend over the deployment which is typical of the transition from late spring to early summer.
    - pH values ranged from 6.61 units to 6.86 units at Elross Creek and from 6.64 units to 7.01 units at Joan Brook. pH at both stations was within the recommended guidelines throughout the deployment.
    - Specific conductivity ranged from 14.8 µs/cm to 17.6 µs/cm at Elross Creek and from 6.8 µs/cm to 9.1 µs/cm at Joan Brook. Elross Creek was relatively stable wile Joan Brook demonstrated an overall increasing trend. Both stations were influenced by large increases in stage levels.
    - Dissolved oxygen (DO) values ranged from 8.92 mg/l (83.3% saturation) to 10.77 mg/l (93.6% saturation) at Elross Creek and from 9.20 mg/l (86.9% saturation) to 11.82 mg/l (94.6% saturation) at Joan Brook. Both stations were influenced by increasing seasonal water temperatures, displaying a decreasing trend as summer temperatures warmed.
    - Turbidity values ranged from 0.2 NTU to 5.9 NTU at Elross Creek and from 0.0 NTU to 58.3 NTU at Joan Brook. At both locations, stage level increases caused spikes in turbidity. Only partial data is available from Joan Brook due to a sensor issue from deployment until July 14th.

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.

[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*

	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

APPENDIX B
Environment Canada Weather Data – Schefferville