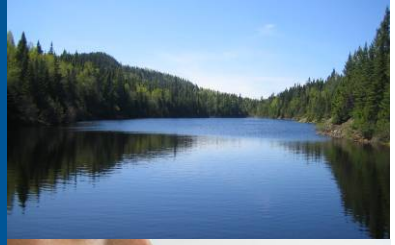




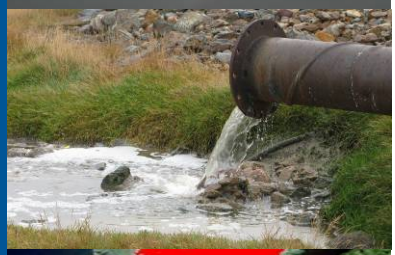


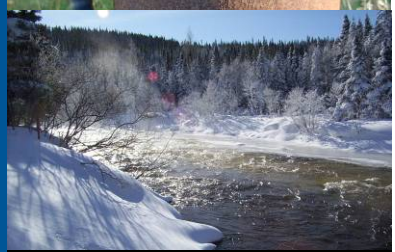

Real Time Water Quality Report

Tata Steel Minerals Canada

Elross Lake Network

Deployment Period
2014-08-13 to 2014-09-10

Government of Newfoundland & Labrador
Department of Environment and Conservation
Water Resources Management Division
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General

- The Water Resources Management Division, in partnership with Tata Steel Minerals Canada Limited and Environment Canada, maintain 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 GOODREAM CREEK 2KM NORTHWEST OF TIMMINS 6, hereafter referred to as the *Elross Creek Station* and the *Goodream Creek Station*, respectively.
- Station sites were selected to monitor all surface water outflows from the Elross Lake mining site. The Elross Creek Station is situated downstream of the Timmins 1 pit, and downstream of Pinette Lake. The Goodream Creek Station will serve to monitor potential impacts from groundwater flowing from Timmins 6 pit into the surface water of Goodream Creek.
- 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 from August 13, 2014 to September 10, 2014. **Unfortunately due to low flow conditions it was impossible to deploy a Hydrolab Sonde at Goodream Creek during this deployment period.**
- This was the third deployment of a total of four deployments during the 2014 field season.

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 rating (i.e., poor, marginal, fair, good or excellent) for each water quality parameter measured.
- Table 1 shows the performance ratings of five water quality parameters (i.e., temperature, pH, specific conductivity, dissolved oxygen and turbidity) measured by instruments deployed at the water monitoring station.

Table 1: Water quality instrument performance at the beginning and end of deployment

	Elross Creek	
Stage of deployment	**Beginning**	**End**
Date	2014-08-13	2014-09-10
Temperature	Good	Excellent
pH	Excellent	Fair
Specific Conductivity	Excellent	Excellent
Dissolved Oxygen	Excellent	NA
Turbidity	Excellent	Excellent

The performances of all sensors were rated good to excellent at the beginning of the deployment period and fair to excellent at removal (Table 1). It should be noted that at removal the oxygen sensor on the QA/QC instrument failed and therefore it was impossible to make a comparison with the field instrument.

Deployment Notes

- Water quality monitoring for this deployment period season started at Elross Creek on August 13, 2014, at 1:00 am ADT and continues without any significant operational issues until September 10, 2014 when the instruments was removed for calibration and maintenance.

Data Interpretation

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

  (i.) Stage (m)
  (ii.) Temperature (^{o}C)
  (iii.) pH
  (iv.) Specific conductivity (□S/cm)
  (v.) Dissolved oxygen (mg/l)
  (vi.) Turbidity (NTU)

Stage

- Stage height values ranged from 1.02 m to 1.06 m at Elross Creek from August 13, 2014 to September 10, 2014 (Figure 1). Stage height is directly related to the volume of flow in a stream as defined by a rating curve which is unique for every site.
- For Elross Creek there are a number of significant spikes in stage height with the most pronounced shown inside a red oval. This spike peaks on August 27 which most likely coincides with a significant rainfall event however unfortunately the precipitation data is unavailable for several days during this period (Climate data located in Appendix B) so this cannot be confirmed.

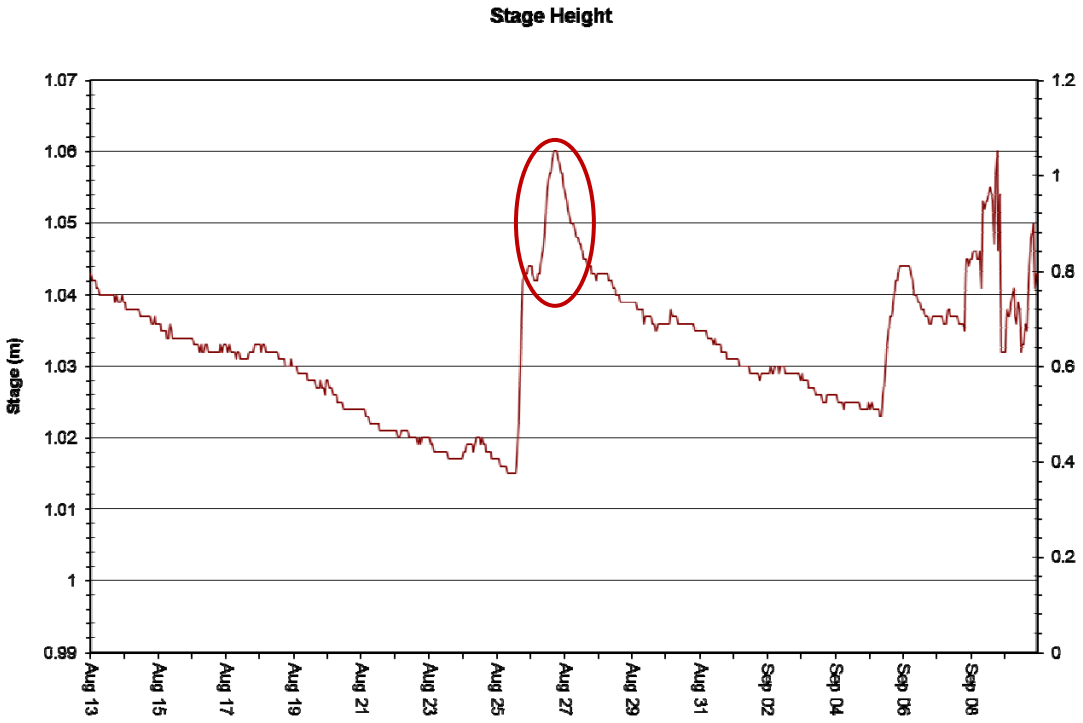

Figure 1: Stage Height (m) at Elross Creek – August 13, 2014 to September 10, 2014

Temperature

- Water temperature ranged from 6.90˚C to 16.30˚C at Elross Creek from August 13, 2014 to September 10, 2014 (Figure 2).
- There is a gentle declining trend in temperature for this deployment period which is consistent with cooling air temperature trends towards the end of summer.
- Water temperatures at Elross Creek display noticeable diurnal variations, typical of shallow water streams and ponds that are highly influenced by diurnal variations in ambient air temperatures.

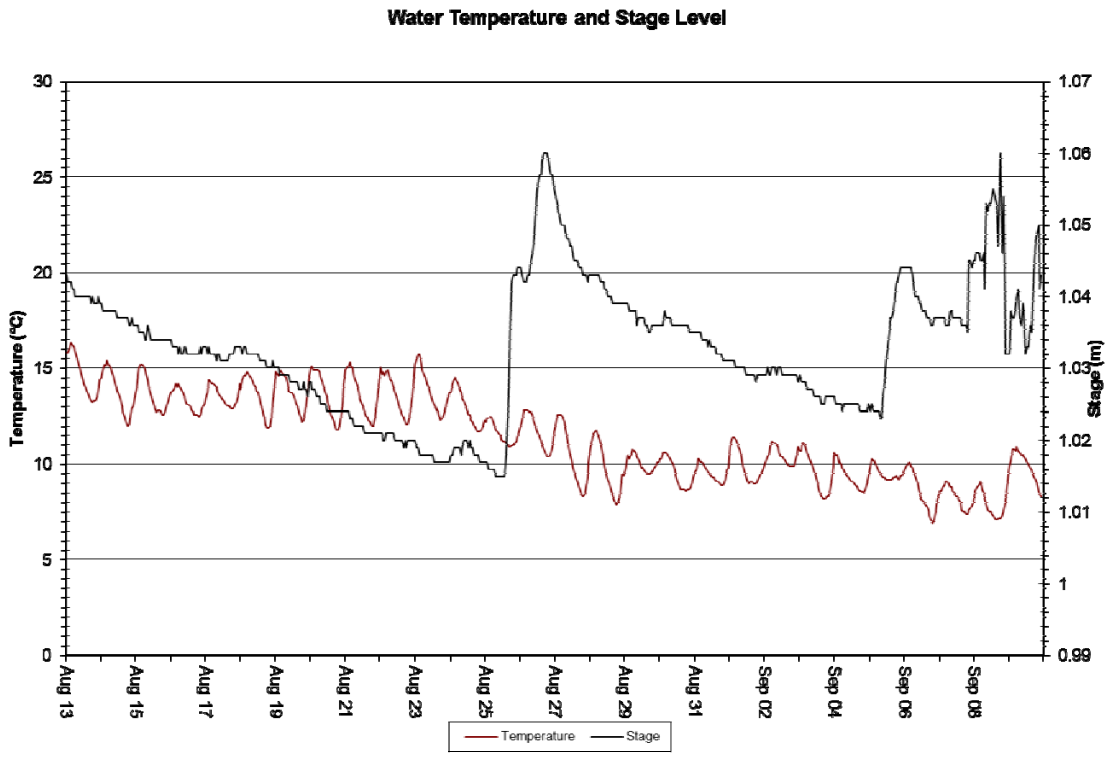

Figure 2: Temperature (°C) - Elross Creek – August 13, 2014 to September 10, 2014

pH

- pH values ranged from 5.50 units to 6.19 units at Elross Creek from August 13, 2014 to September 10, 2014 (Figure 3).
- pH tends to show a diurnal trend which is related to the diurnal temperature trend. This diurnal trend is quite weak during this deployment period but is still discernible for the Elross Creek data.
- At Elross Creek pH remained relatively stable throughout the deployment period and barely affected by significant changes in stream flow.
- With a mean value of 5.84, pH values recorded at Elross Creek were below the minimum pH guideline set for the protection of aquatic life (i.e., 6.5 units), as defined by the Canadian Council of Ministers of the Environment (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 this 6.5 unit guideline.

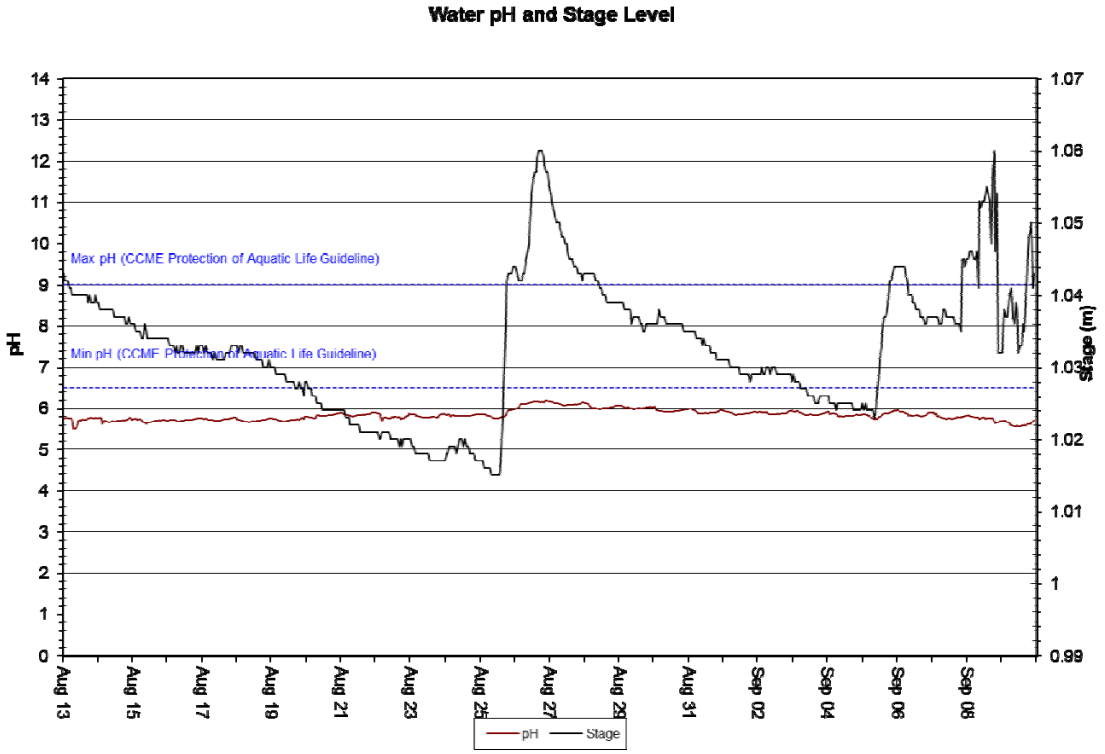

Figure 3: pH at Elross Creek – August 13, 2014 to September 10, 2014

Specific Conductivity

- Specific Conductivity ranged from 6.1 µs/cm to 9.5 µs/cm at Elross Creek from August 13, 2014 to September 10, 2014 (Figure 4).
- At Elross Creek there are noticeable diurnal fluctuations in specific conductivity which are related to the diurnal temperature fluctuations. Apart from these diurnal fluctuations there is no distinct trend over the deployment period.
- It is difficult to determine the cause of a sharp spike in Specific Conductivity between August 19 and 20 as it does not appear to be related to an increase in flow. It should be noted that it does correspond with a significant spike in turbidity. The spikes in specific conductivity and turbidity are both very short term with a single elevated data point for each parameter.

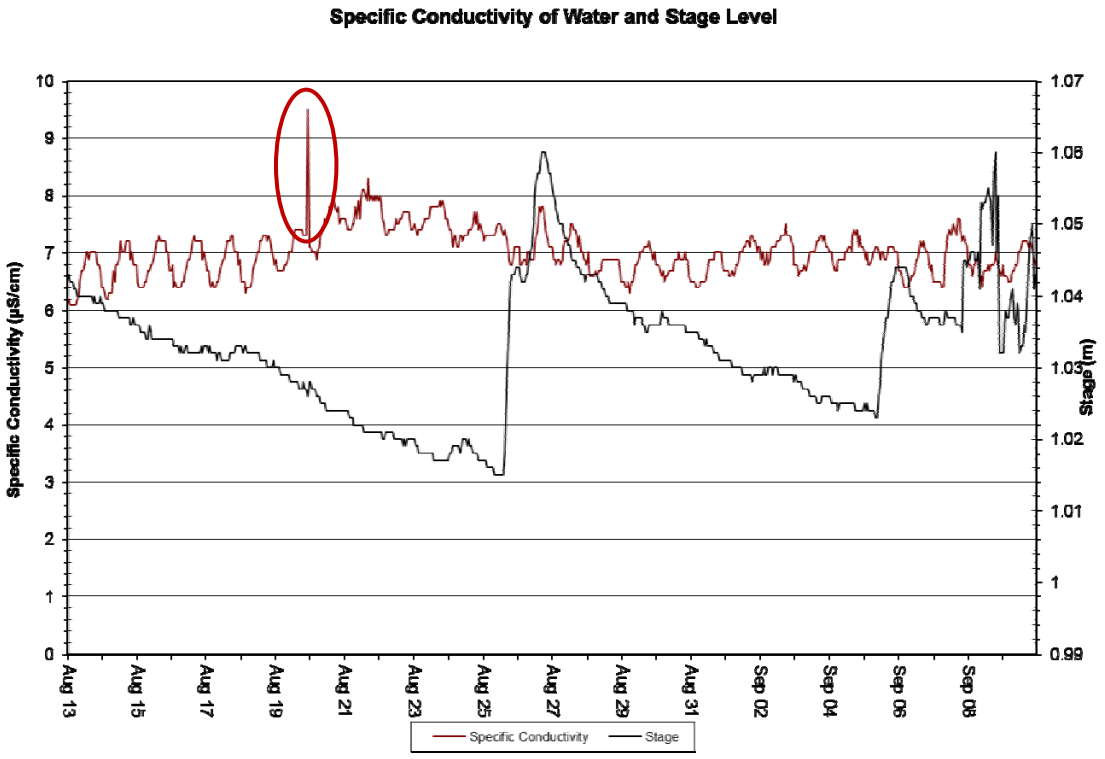

Figure 4: Specific conductivity (us/cm) - Elross Creek – August 13, 2014 to September 10, 2014

Dissolved Oxygen

- Dissolved Oxygen (DO) values ranged from 6.87 mg/l (69.5% saturation) to 9.74 mg/l (89.4% saturation) at Elross Creek from August 13, 2014 to September 10, 2014 (Figure 5).
- Dissolved oxygen remains relatively stable over the deployment period for Elross Creek.
- There is a diurnal trend for DO (mg/l & % saturation) which is clearly visible and is related to the diurnal temperature trends.
- The DO values at Elross Creek were above the cold water minimum guideline set for aquatic life during other life stages (6.5 mg/l), as determined by the Canadian Council of Ministers of the Environment (2007).

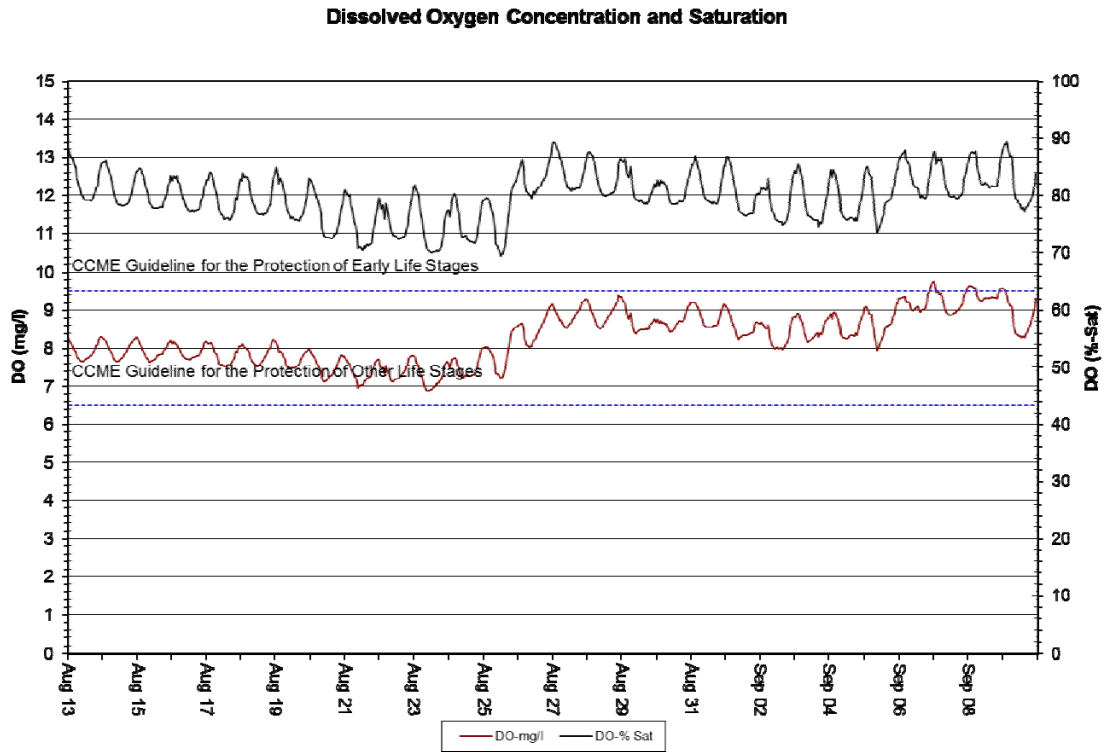

Figure 5: DO (mg/l & % saturation) at Elross Creek – August 13, 2014 to September 10, 2014

Turbidity

- Turbidity values ranged from 0.1 NTU to 63.5 NTU at Elross Creek from August 13, 2014 to September 10, 2014 (Figures 6).
- Spikes in turbidity at Elross Creek most often correspond with increases in flow related to precipitation events.

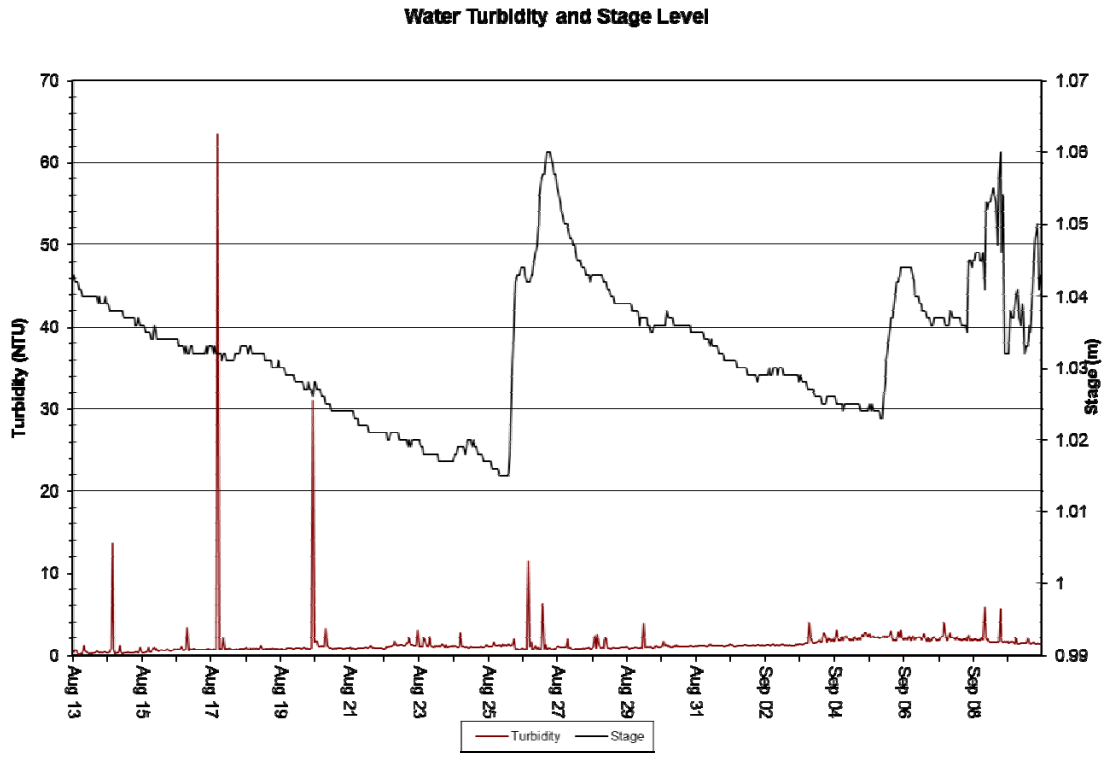

Figure 6: Turbidity (NTU) at Elross Creek – August 13, 2014 to September 10, 2014

Conclusion

- This monthly deployment report, presents water quality and water quantity data recorded at the Elross Creek from August 13, 2014 to September 10, 2014. **Unfortunately due to low flow conditions it was impossible to deploy a Hydrolab Sonde at Goodream Creek during this deployment period.**
- The performances of all sensors were rated good to excellent at the beginning of the deployment period and fair to excellent at removal. It should be noted that at removal the oxygen sensor on the QA/QC instrument failed and therefore it was impossible to make a comparison with the field instrument.

- Variations in water quality/quantity values recorded at each station are summarized below:
    - For Elross Creek there are a number of significant spikes in stage height. This spike peaks on August 27 which most likely coincides with a significant rainfall event however unfortunately the precipitation data is unavailable for several days during this period so this cannot be confirmed.
    - There is a gentle declining trend in temperature for this deployment period which is consistent with cooling air temperature trends towards the end of summer.
    - Water temperatures at Elross Creek display noticeable diurnal variations, typical of shallow water streams and ponds that are highly influenced by diurnal variations in ambient air temperatures.
    - pH tends to show a diurnal trend which is related to the diurnal temperature trend. This diurnal trend is quite weak during this deployment period but is still discernible for the Elross Creek data.
    - At Elross Creek pH remained relatively stable throughout the deployment period and barely affected by significant changes in stream flow.
    - With a mean value of 5.84, pH values recorded at Elross Creek were below the minimum pH guideline set for the protection of aquatic life (i.e., 6.5 units), as defined by the Canadian Council of Ministers of the Environment (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 this 6.5 unit guideline.
    - At Elross Creek there are noticeable diurnal fluctuations in specific conductivity which are related to the diurnal temperature fluctuations. Apart from these diurnal fluctuations there is no distinct trend over the deployment period.
    - It is difficult to determine the cause of a sharp spike in Specific Conductivity between August 19 and 20 as it does not appear to be related to an increase in flow. It should be noted that it does correspond with a significant spike in turbidity. The spikes in specific conductivity and turbidity are both very short term with a single elevated data point for each parameter.
    - Dissolved oxygen remains relatively stable over the deployment period for Elross Creek.
    - There is a diurnal trend for DO (mg/l & % saturation) which is clearly visible and is related to the diurnal temperature trends.

- The DO values at Elross Creek were above the cold water minimum guideline set for aquatic life during other life stages (6.5 mg/l), as determined by the Canadian Council of Ministers of the Environment (2007).
- Spikes in turbidity at Elross Creek most often correspond with increases in flow related to precipitation events.
- The field instrument for Elross Creek station performed quite well over the deployment period with no significant maintenance issues.

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. (Website: http://ceqg-rcqe.ccme.ca/download/en/222/)

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 (^{o}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*

APENDIX B

Environment Canada Weather Data – Schefferville (August 13, 2014 to September 10, 2014)

Date	Max Temp (°C)	Min Temp (°C)	Mean Temp (°C)	Heat Deg Days (°C)	Cool Deg Days (°C)	Total Rain Flag	Total Snow Flag	Total Precip (mm)
8/13/2014	25	14.6	19.8	0	1.8	M	M	0
8/14/2014	22.1	13	17.6	0.4	0	M	M	0
8/15/2014	22.1	11.7	16.9	1.1	0	M	M	0
8/16/2014	19.1	12.4	15.8	2.2	0	M	M	2.1
8/17/2014	19	12.2	15.6	2.4	0	M	M	4.6
8/18/2014	19.2	10.6	14.9	3.1	0	M	M	0.3
8/19/2014	22.3	9	15.7	2.3	0	M	M	0
8/20/2014	23.3	10.3	16.8	1.2	0	M	M	
8/21/2014	23.6	9.2	16.4	1.6	0	M	M	0
8/22/2014	25.5	12.2	18.9	0	0.9	M	M	0
8/23/2014	27.3	10.6	19	0	1	M	M	0
8/24/2014	21.5	8.7	15.1	2.9	0	M	M	0.3
8/25/2014	11.7	6.6	9.2	8.8	0	M	M	
8/26/2014		8				M	M	
8/27/2014						M	M	
8/28/2014	14.5	0.5	7.5	10.5	0	M	M	0
8/29/2014	17.6	4	10.8	7.2	0	M	M	0
8/30/2014	16.1	5.2	10.7	7.3	0	M	M	2.6
8/31/2014	12	6.1	9.1	8.9	0	M	M	0
9/1/2014	16.9	6.3	11.6	6.4	0	M	M	0
9/2/2014	18.7	8	13.4	4.6	0	M	M	2.3
9/3/2014	13.8	6.5	10.2	7.8	0	M	M	0
9/4/2014	13.9	5.6	9.8	8.2	0	M	M	0.3
9/5/2014	12.4	4.8	8.6	9.4	0	M	M	10.6
9/6/2014	12.7	2.3	7.5	10.5	0	M	M	1.9
9/7/2014	10.5	3.8	7.2	10.8	0	M	M	
9/8/2014	11	3.6	7.3	10.7	0	M	M	1
9/9/2014		3.6				M	M	
9/10/2014	7.7	1.5	4.6	13.4	0	M	M	