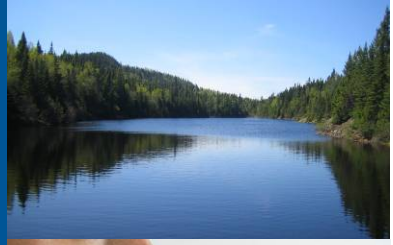




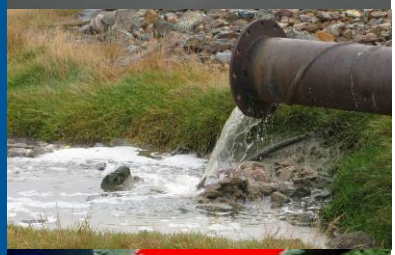


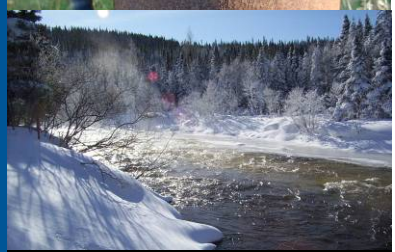

# Real Time Water Quality Report

# Tata Steel Minerals Canada

## Elross Lake/Joan Brook Network

### Deployment Period
### 2019-07-17 to 2019-08-21

Newfoundland Labrador

Government of Newfoundland & Labrador
Department of Municipal Affairs & Environment
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## General

- The Water Resources Management Division, in partnership with Tata Steel Minerals Canada Limited and Environment and Climate Change Canada, maintains three 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, GOODREAM CREEK 2KM NORTHWEST OF TIMMINS 6, and JOAN BROOK BELOW OUTLET OF JOAN LAKE, hereafter referred to as the *Elross Creek Station*, the *Goodream Creek Station*, and the *Joan Brook Station,* respectively.
- **Please note that the Goodream Creek Station has been temporarily shut down to allow for moving the station to a new location further downstream near Triangle Lake. It is hoped that this move will be completed early in the 2020 field season and that the station will be fully operational at the new location before the end of the 2020 field season.**
- 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 17th, 2019 to August 21st, 2019, which was the second deployment period for the 2019 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 stations.

- **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 at the beginning and end of deployment**

| | Elross Creek | | Joan Brook | |
|---|---|---|---|---|
| Stage of deployment | Beginning | End | Beginning | End |
| Date | 2019-7-17 | 2019-8-20 | 2019-7-17 | 2019-8-21 |
| Temperature | Excellent | Excellent | Good | Excellent |
| pH | Excellent | Good | Good | Good |
| Specific Conductivity | Excellent | Excellent | Excellent | Excellent |
| Dissolved Oxygen | Good | Excellent | Excellent | Excellent |
| Turbidity | Poor | Good | Good | Excellent |

- The performance of all sensors at both stations was within acceptable limits during this deployment period with the exception of Turbidity at Elross Creek, which had a Poor performance at the time of deployment (Table 1). The Poor performance of Turbidity at Elross may have been related to relatively high turbidity readings which were highly variable. In addition, the fact that the field instrument has a nylon mesh covering the sensor guard means that some parameters take quite a while to stabilize after deployment and therefore don't compare well with the QA/QC sonde.

**Deployment Notes**

- Water quality monitoring for this deployment period started on July 17$^{th}$, 2019, at Elross Creek and Joan Brook. Continuous real-time monitoring continued at Elross Creek until August 20$^{th}$, 2019 and at Joan Brook until August 21$^{st}$, 2019. Both stations ran for the full deployment period with no significant operational 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 covered by this report, stage values ranged from 1.13 m to 1.24 m at Elross Creek and from 1.57 m to 1.65 m at Joan Brook (Figures 1 & 2). Stage is directly related to the volume of flow in a stream, as defined by a rating curve which is unique for every site.

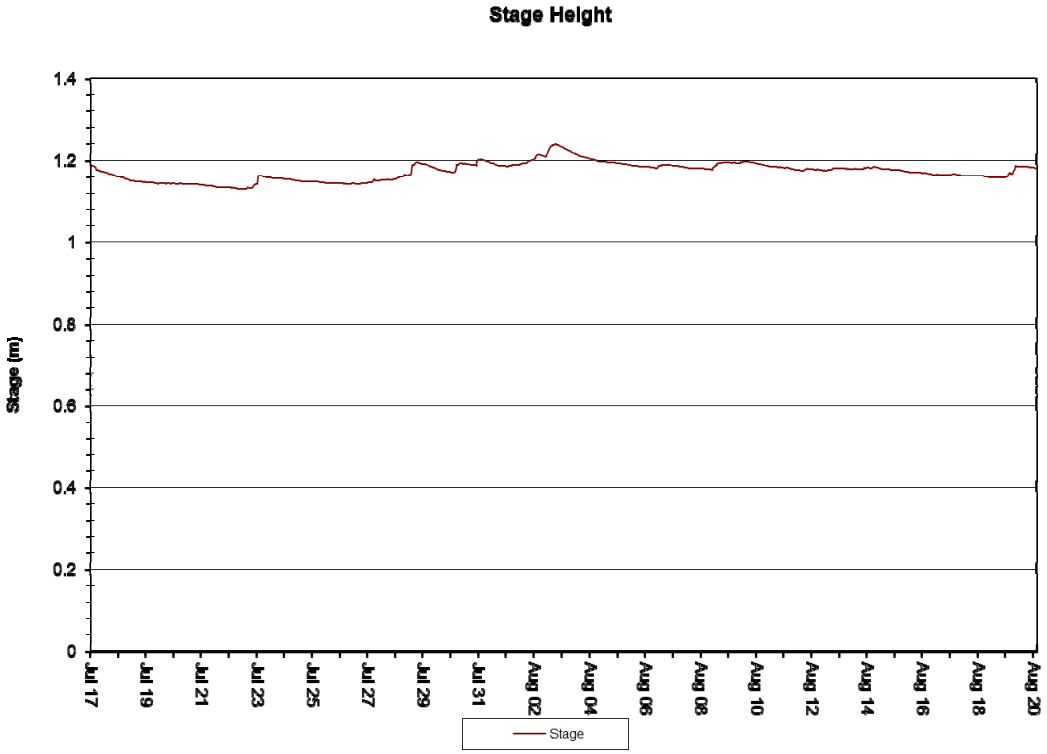


**Figure 1: Stage (m) at Elross Creek – July 17, 2019 to August 20, 2019**

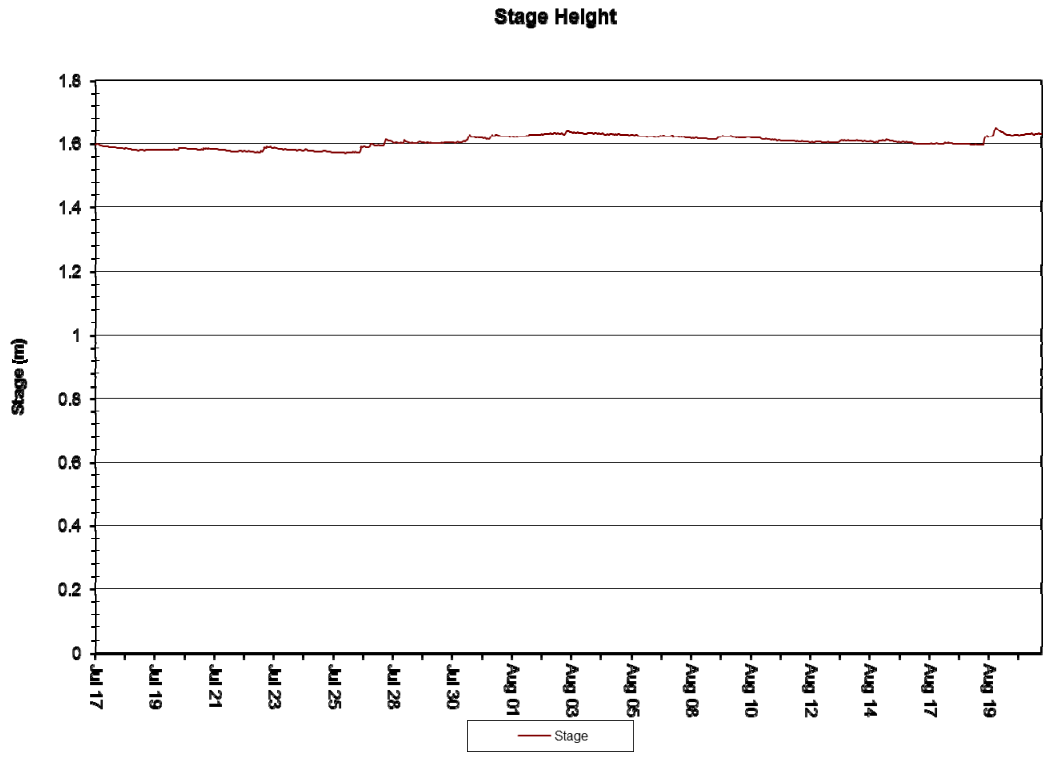


**Figure 2: Stage (m) at Joan Brook – July 17, 2019 to August 21, 2019**

## 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 9.20˚C to 16.00˚C at Elross Creek, and from 6.90 ˚C to 14.80 ˚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.
- At both Elross Creek and Joan Brook temperature was relatively stable throughout the deployment period.

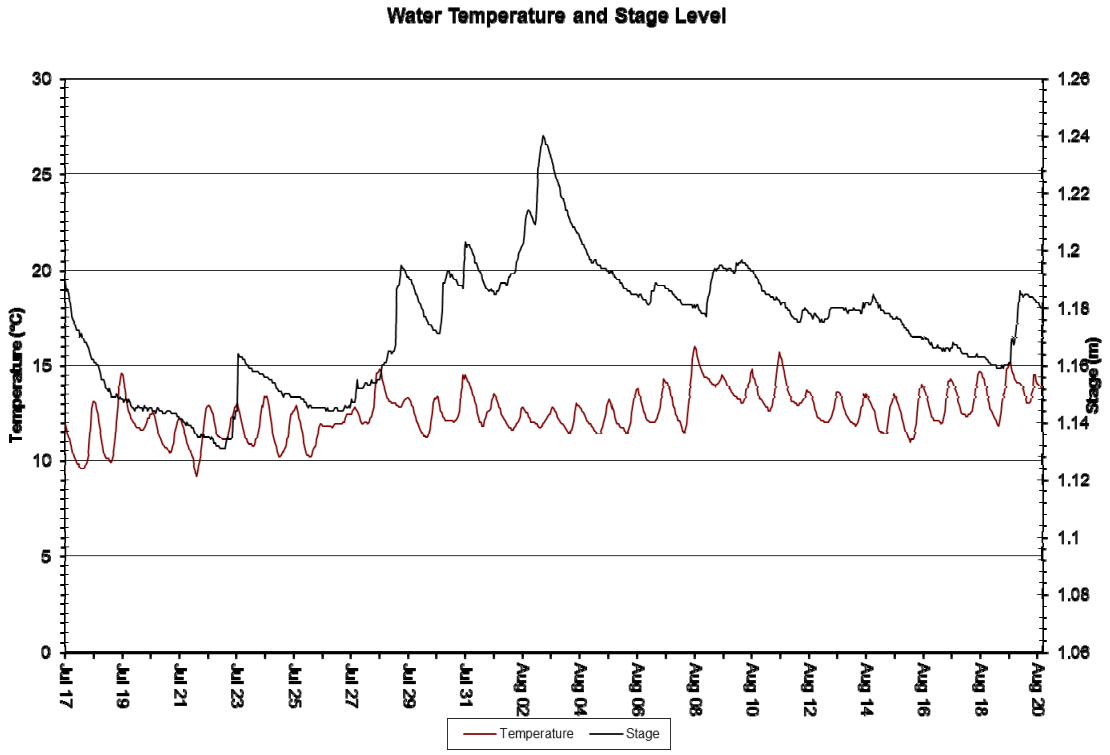


**Figure 3: Temperature (°C) - Elross Creek – July 17, 2019 to August 20, 2019**

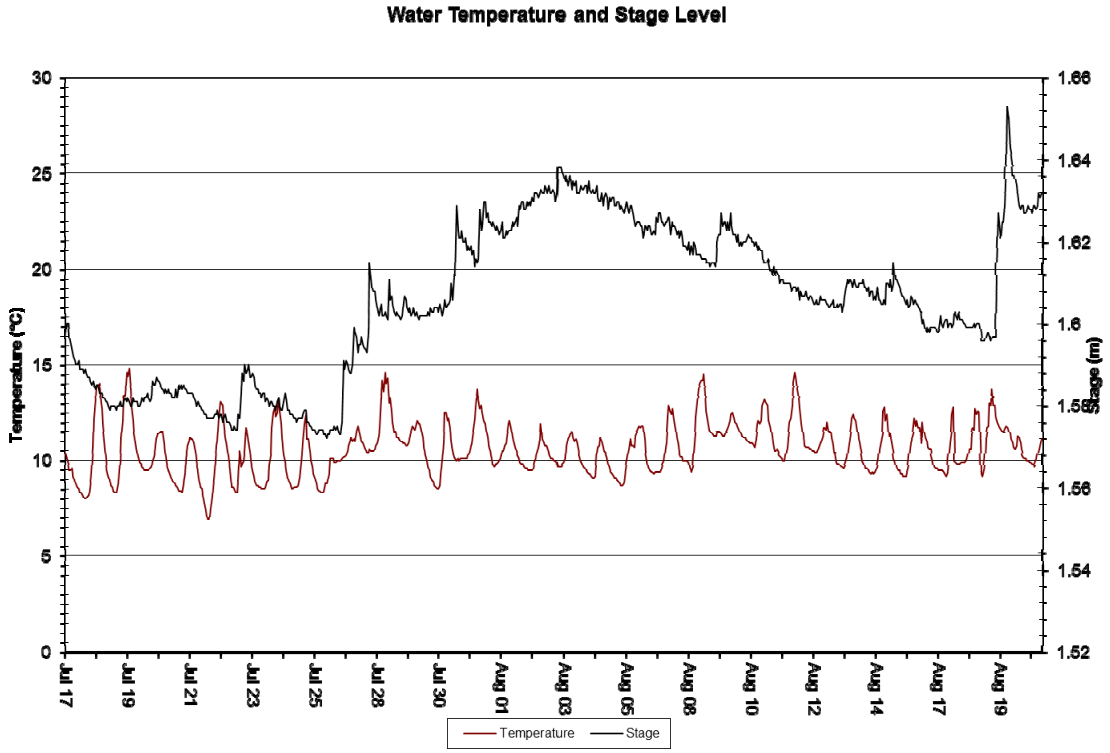


**Figure 4: Temperature (°C) – Joan Brook – July 17, 2019 to August 21, 2019**

**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 covered by this report, pH values ranged from 6.34 units to 6.82 units at Elross Creek, and from 6.32 units to 6.64 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.
- With a median value of 6.65 units, almost all pH values at Elross Creek are just above the minimum guideline set for the protection of aquatic life (i.e., 6.5 units), as defined by the Canadian Council of Ministers of the Environment (CCME) (2007). At Joan Brook the median pH value is 6.49 units with most values at, or very close to, the minimum guideline range. 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.

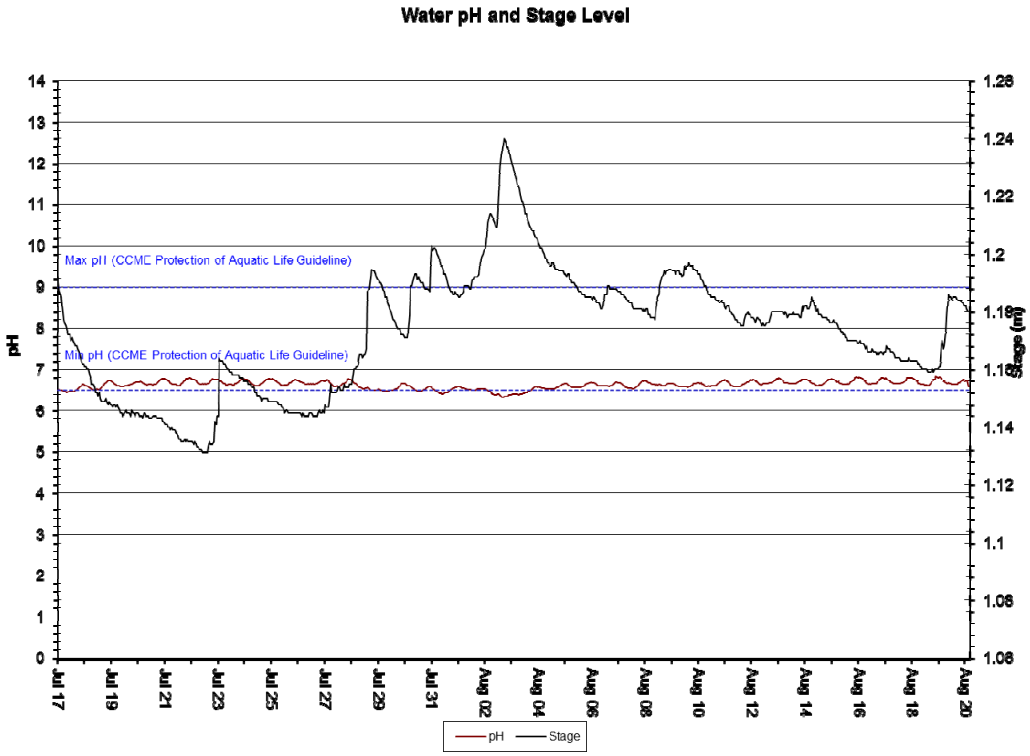


**Figure 5: pH at Elross Creek – July 17, 2019 to August 20, 2019**

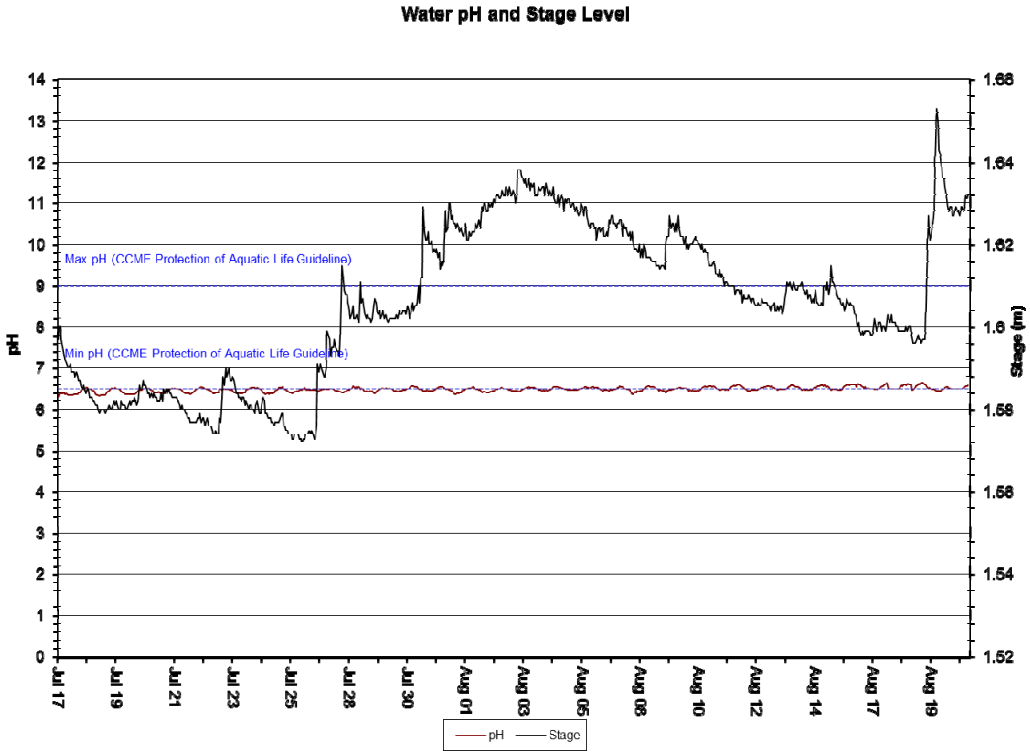


**Figure 6: pH at Joan Brook – July 17, 2019 to August 21, 2019**

## 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 covered by this report, specific conductivity ranged from 12.7 µs/cm to 19.4 µs/cm at Elross Creek, and from 5.9 µs/cm to 8.1 µs/cm at Joan Brook (Figures 7 & 8).
- Specific conductivity normally shows clear diurnal trends which are related to the diurnal temperature trend.

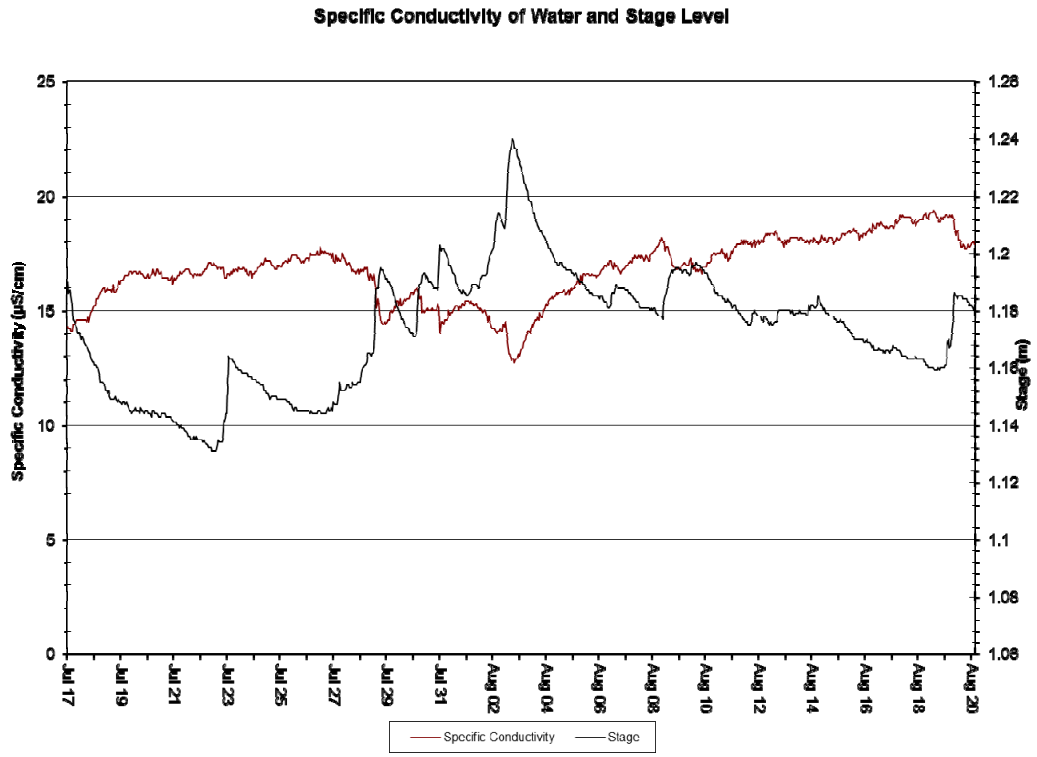


**Figure 7: Specific Conductivity at Elross Creek – July 17, 2019 to August 20, 2019**

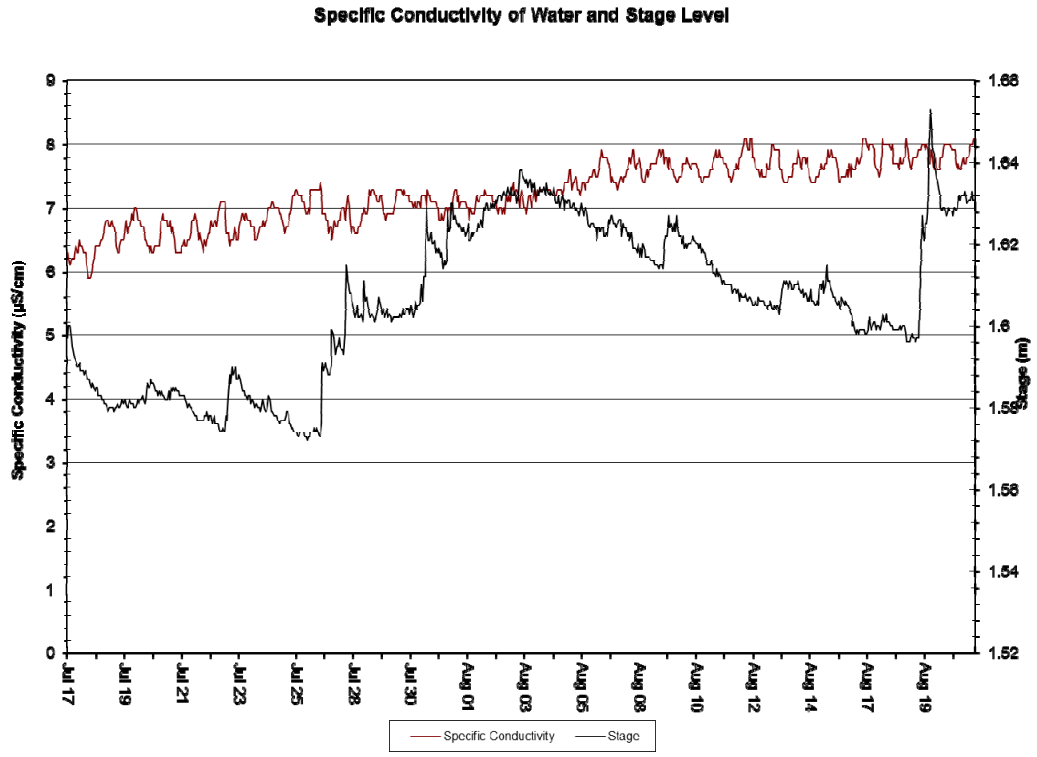


**Figure 8: Specific Conductivity at Joan Brook – July 17, 2019 to August 21, 2019**

## Dissolved Oxygen

- During the deployment period covered by this report, dissolved oxygen (DO) values ranged from 8.86 mg/l (92.5% saturation) to 10.07 mg/l (99.8% saturation) at Elross Creek, and from 9.11 mg/l (87.2% saturation) to 10.85 mg/l (102.0% saturation) at Joan Brook (Figures 9 & 10).
- DO was relatively stable over the deployment period for both stations.
- At both stations there are obvious diurnal trends in DO which are related to diurnal temperature trends.
- The DO values at Elross Creek and Joan Brook are above the minimum guidelines set for other life stages (6.5 mg/l) and near or above the minimum guideline set for cold-water biota during early life stages (9.5 mg/l), as determined by the Canadian Council of Ministers of the Environment (2007).

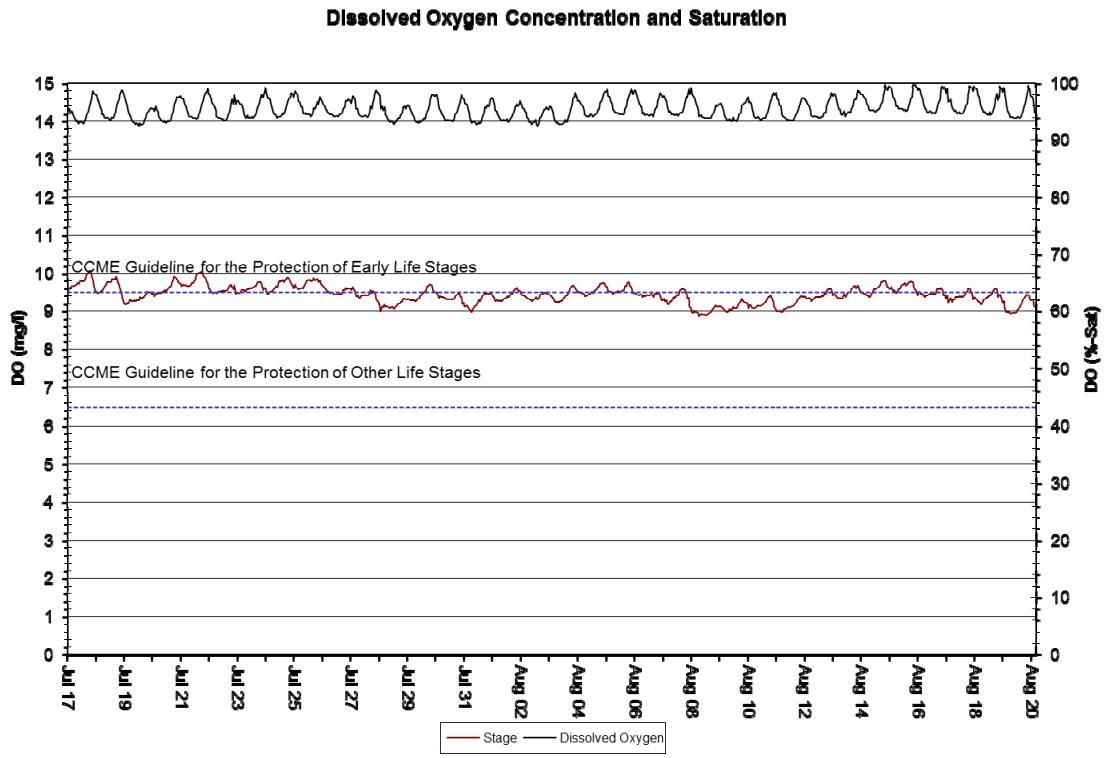


**Figure 9: DO (mg/l & % Sat.) at Elross Creek – July 17, 2019 to August 20, 2019**

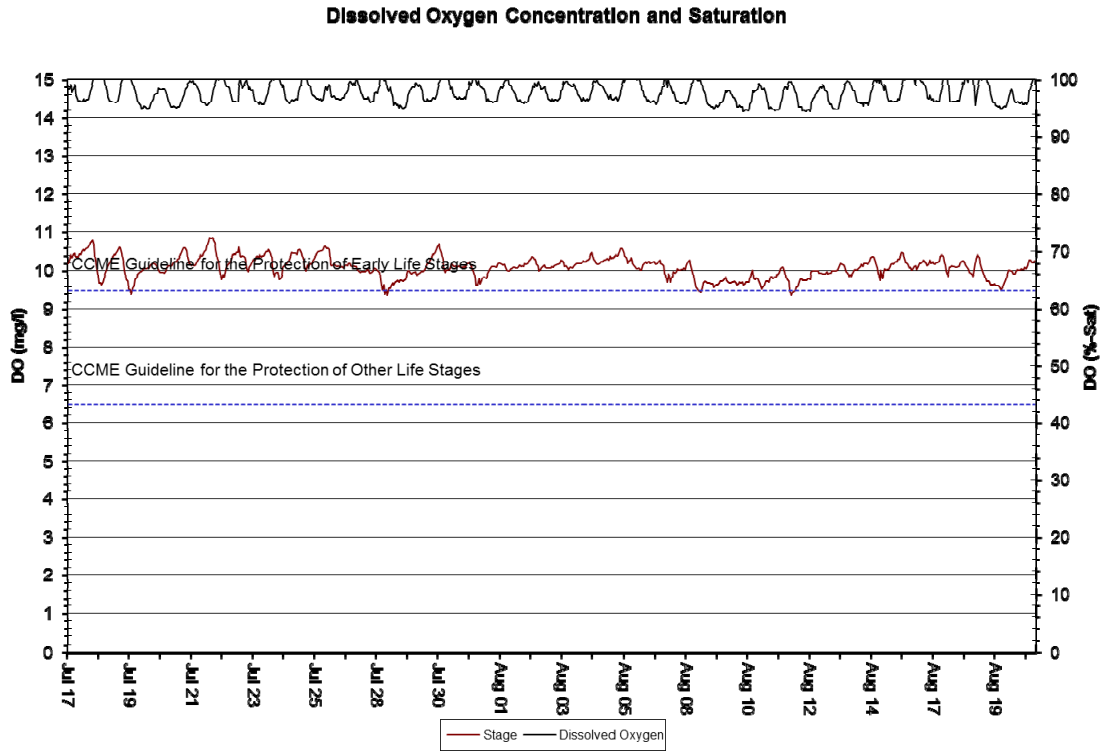


**Figure 10: DO (mg/l & % Sat.) at Joan Brook – July 17, 2019 to August 21, 2019**

## 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 covered by this report, turbidity values ranged from 13.7 NTU to 1569.0 NTU at Elross Creek, and from 0.0 NTU to 807.0 NTU at Joan Brook (Figures 11 & 12).
- At both stations there are significant spikes in turbidity(see inside red ovals) which correspond directly with sharp increases in Stage Height related to significant precipitation events.

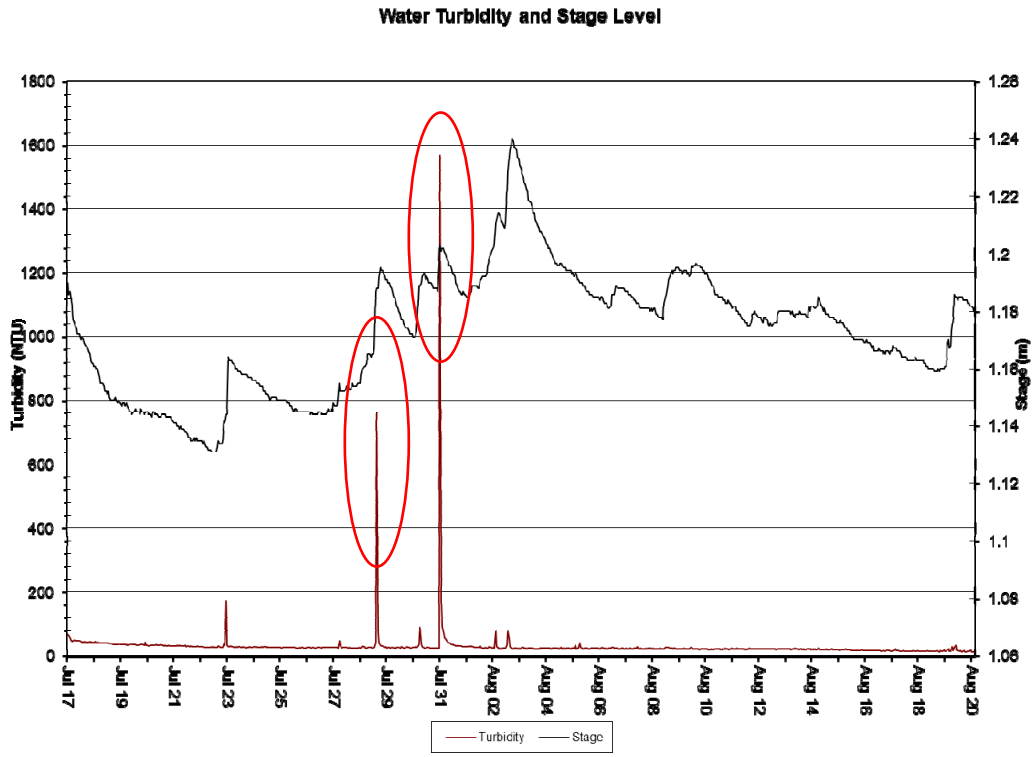


**Figure 11: Turbidity (NTU) at Elross Creek – July 17, 2019 to August 20, 2019**

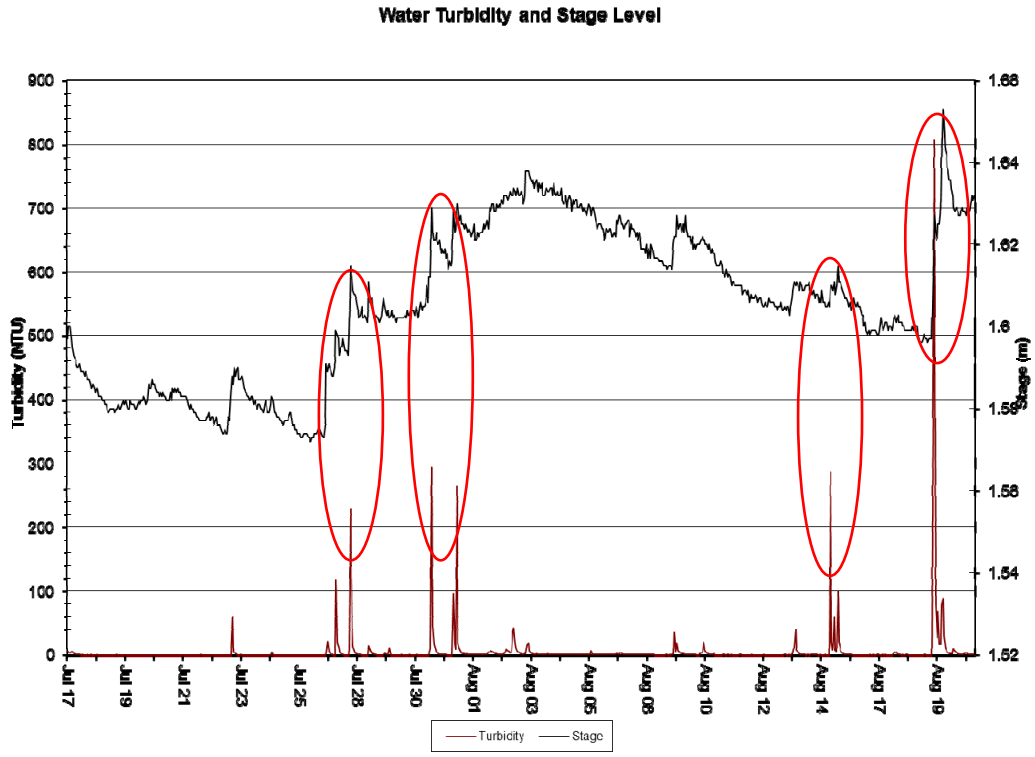


**Figure 12: Turbidity (NTU) at Joan Brook – July 17, 2019 to August 21, 2019**

## Conclusions

- This monthly deployment report presents water quality and water quantity data recorded at the Elross Creek and Joan Brook stations from July 17th, 2019 to August 21st, 2019.
- Field instruments for both stations performed well over the deployment period with only minor operational issues.
- Variations in water quality/quantity values recorded at each station are summarized below:
    - For both stations the stage height was typical for the mid-summer season when hydrological conditions are affected by significant rainfall events which cause spikes that are relatively short lived.
    - For both stations temperature was relatively stable, which is typical of the mid-summer season in this northerly location.
    - During the deployment period covered by this report, pH values ranged from 6.34 units to 6.82 units at Elross Creek, and from 6.32 units to 6.64 units at Joan Brook.
    - During the deployment period covered by this report, specific conductivity ranged from 12.7 µs/cm to 19.4 µs/cm at Elross Creek, and from 5.9 µs/cm to 8.1 µs/cm at Joan Brook.
    - During the deployment period covered by this report, dissolved oxygen (DO) values ranged from 8.86 mg/l (92.5% saturation) to 10.07 mg/l (99.8% saturation) at Elross Creek, and from 9.11 mg/l (87.2% saturation) to 10.85 mg/l (102.0% saturation) at Joan Brook.
    - During the deployment period covered by this report, turbidity values ranged from 13.7 NTU to 1569.0 NTU at Elross Creek, and from 0.0 NTU to 807.0 NTU at Joan Brook.

## 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*

# APENDIX B

## Environment Canada Weather Data – Schefferville (July 17, 2019 to August 21, 2019)

| Date/Time | Max Temp (°C) | Min Temp (°C) | Mean Temp (°C) | Heat Deg Days (°C) | Cool Deg Days (°C) | Total Precip (mm) |
|---|---|---|---|---|---|---|
| 7/17/2019 | 16.6 | 7.5 | 12.1 | 5.9 | 0 | 7.8 |
| 7/18/2019 | 19.4 | 8.6 | 14 | 4 | 0 | |
| 7/19/2019 | 22.5 | 8.4 | 15.5 | 2.5 | 0 | 1.7 |
| 7/20/2019 | 16.6 | 10.1 | 13.4 | 4.6 | 0 | 2.6 |
| 7/21/2019 | 14 | 7.7 | 10.9 | 7.1 | 0 | 0.4 |
| 7/22/2019 | 16 | 6.9 | 11.5 | 6.5 | 0 | 0.2 |
| 7/23/2019 | 15.6 | 9.2 | 12.4 | 5.6 | 0 | 8 |
| 7/24/2019 | 16.9 | 9 | 13 | 5 | 0 | 1 |
| 7/25/2019 | 17.3 | 9.7 | 13.5 | 4.5 | 0 | 0.6 |
| 7/26/2019 | 19.7 | 10.1 | 14.9 | 3.1 | 0 | 1.5 |
| 7/27/2019 | 17.5 | 14.5 | 16 | 2 | 0 | 4 |
| 7/28/2019 | 23.8 | 14.1 | 19 | 0 | 1 | 7.8 |
| 7/29/2019 | 16.4 | 8.3 | 12.4 | 5.6 | 0 | 2.3 |
| 7/30/2019 | 16.5 | 7.8 | 12.2 | 5.8 | 0 | 11 |
| 7/31/2019 | 17 | 10.8 | 13.9 | 4.1 | 0 | |
| 8/1/2019 | 16.4 | 9 | 12.7 | 5.3 | 0 | 1.4 |
| 8/2/2019 | 14.8 | 8.7 | 11.8 | 6.2 | 0 | 6.3 |
| 8/3/2019 | 13.1 | 9.8 | 11.5 | 6.5 | 0 | 8.7 |
| 8/4/2019 | 13.8 | 9.2 | 11.5 | 6.5 | 0 | 0.2 |
| 8/5/2019 | 14.9 | 8.7 | 11.8 | 6.2 | 0 | 0.4 |
| 8/6/2019 | 15.1 | 8.8 | 12 | 6 | 0 | 1.9 |
| 8/7/2019 | 19.6 | 11.4 | 15.5 | 2.5 | 0 | 7.8 |
| 8/8/2019 | 23.4 | 10.7 | 17.1 | 0.9 | 0 | 3 |
| 8/9/2019 | 16.4 | 13.6 | 15 | 3 | 0 | 13.9 |
| 8/10/2019 | 19.7 | 10.7 | 15.2 | 2.8 | 0 | 0.2 |
| 8/11/2019 | 20.3 | 9.5 | 14.9 | 3.1 | 0 | 0 |
| 8/12/2019 | 14.5 | 10.6 | 12.6 | 5.4 | 0 | 2.5 |
| 8/13/2019 | 14.2 | 9.2 | 11.7 | 6.3 | 0 | 8.8 |
| 8/14/2019 | 15.1 | 8.4 | 11.8 | 6.2 | 0 | 4.9 |
| 8/15/2019 | 17.4 | 8.3 | 12.9 | 5.1 | 0 | 0 |
| 8/16/2019 | 20.4 | 11.3 | 15.9 | 2.1 | 0 | |
| 8/17/2019 | 21.3 | 13.4 | 17.4 | 0.6 | 0 | 0 |
| 8/18/2019 | 21.7 | 11.2 | 16.5 | 1.5 | 0 | 0 |
| 8/19/2019 | 24.1 | 12.7 | 18.4 | 0 | 0.4 | 8.7 |
| 8/20/2019 | 17 | 10.5 | 13.8 | 4.2 | 0 | 1.6 |
| 8/21/2019 | 14.2 | 6.1 | 10.2 | 7.8 | 0 | 8 |