

Real-Time Water Quality Deployment Report

Flora Creek below TLH

September 12 to
October 17, 2018



Government of Newfoundland & Labrador
Department of Municipal Affairs and
Environment
Water Resources Management Division

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General

- The Water Resources Management Division, in partnership with Tacora Resources Inc. – Wabush Mines, maintains one real-time water quality and water quantity station at Flora Creek.
- This station is situated downstream of the former Wabush Mines tailings disposal area, in Flora Lake.
- Water Resources Management Division staff monitor the real-time web pages regularly.
- On September 12, 2018, a real-time water quality monitoring instrument was deployed at the station Flora Creek below TLH. The instrument was deployed for a period of 35 days. This was the final deployment for the 2018 season.

Quality Assurance and Quality Control

- As part of the Quality Assurance and Quality Control protocol (QA/QC), an assessment of the reliability of data recorded by an instrument is made at the beginning and end of the deployment period. The procedure is based on the approach used by the United States Geological Survey.
 - At deployment and removal, a QA/QC Sonde is temporarily deployed along side the Field Sonde. Values for temperature, pH, conductivity, dissolved oxygen and turbidity are compared between the two instruments. Based on the degree of difference between parameters recorded by the Field Sonde and QA/QC Sonde at deployment and at removal, a qualitative statement is made on the data quality (Table 1).

Table 1: Ranking classifications for deployment and removal

Parameter	Rank				
	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

- It should be noted that the temperature sensor on any sonde is the most important. All other parameters can be broken down into three groups: temperature dependant, temperature compensated and temperature independent. Because the temperature sensor is not isolated from the rest of the sonde the entire sonde must be at the same temperature before the sensor will stabilize. The values may take some time to climb to the appropriate reading; if a reading is taken too soon it may not accurately portray the water body.

- Deployment and removal comparison rankings for the station on Flora Creek deployed between September 12 and October 17, 2018 is summarized in Table 2.

Table 2: Comparison rankings for Flora Creek below TLH station September 12 – October 17, 2018.

Station	Date	Action	Comparison Ranking				
			Temperature	pH	Conductivity	Dissolved Oxygen	Turbidity
Flora Creek below TLH	Sept 12, 2018	Deployment	Good	Excellent	Excellent	Fair	Fair
	Oct 17, 2018	Removal	Excellent	Excellent	Excellent	Fair	Marginal

- At deployment, temperature, pH and conductivity ranked either ‘good’ or ‘excellent’. Dissolved oxygen ranked ‘fair’. The field instrument read a value of 10.71 mg/l, while the QA/QC instrument read a value of 10.18 mg/l. Turbidity ranked ‘fair’. The field instrument read a value 15.0 NTU, while the QA/QC instrument read a value of 21.4 NTU.
- At removal, temperature, pH and conductivity ranked ‘excellent’. Dissolved oxygen ranked ‘fair’. The field instrument read a value of 13.36 mg/l, while the QA/QC instrument read a value of 12.61 mg/l. Turbidity ranked ‘marginal’. The field instrument read a value of 4.6 NTU, while the QA/QC instrument read a value of 12.8 NTU. However, when compared to the QA/QC grab sample that was collected, turbidity on the field instrument would rank ‘good’ as the QA/QC sample value was 4.3 NTU.

There are few circumstances which may cause less than ideal QA/QC rankings to be obtained. These include: the placement of the QA/QC sonde in relation to the field sonde, the amount of time each sonde was given to stabilize before readings were recorded; and deteriorating performance of one of the sensors.

Data Interpretation

- The following graphs and discussion illustrate water quality related events from July 26 to September 11 at the station Flora Creek below TLH.
- With the exception of water quantity data (stage), all data used in the preparation of the graphs and subsequent discussion adhere to this stringent QA/QC protocol. Water Survey of Canada is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.

Flora Creek below TLH

- Water temperature ranged from 1.41 to 15.68°C during this deployment period (Figure 1).
- Water temperature generally decreased throughout the deployment period, which corresponds with decreasing ambient air temperature (Figure 2).

**Water Temperature : Flora Creek below TLH
September 12 to October 17, 2018**

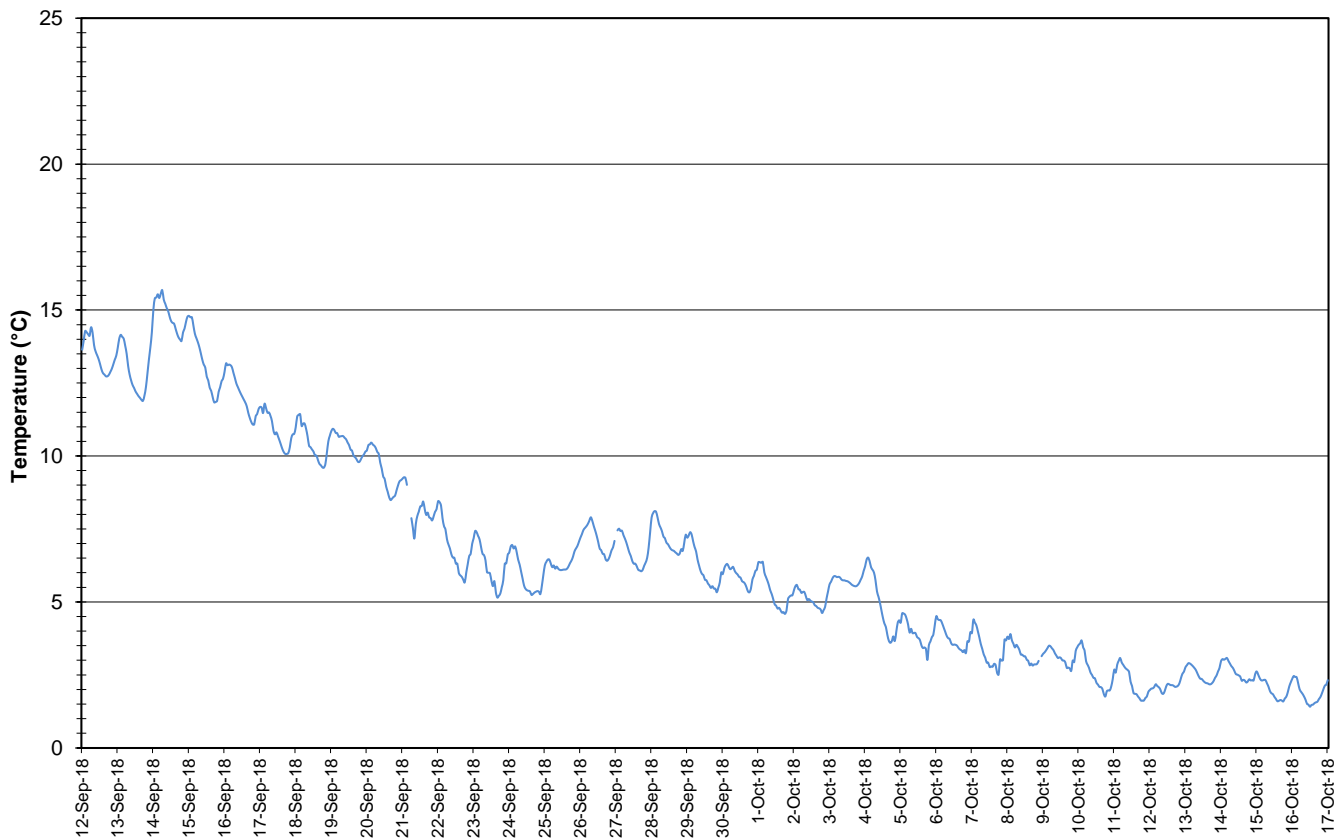


Figure 1: Water temperature - Flora Creek below TLH

**Average Daily Air and Water Temperature: Flora Creek
September 12 to October 17, 2018**

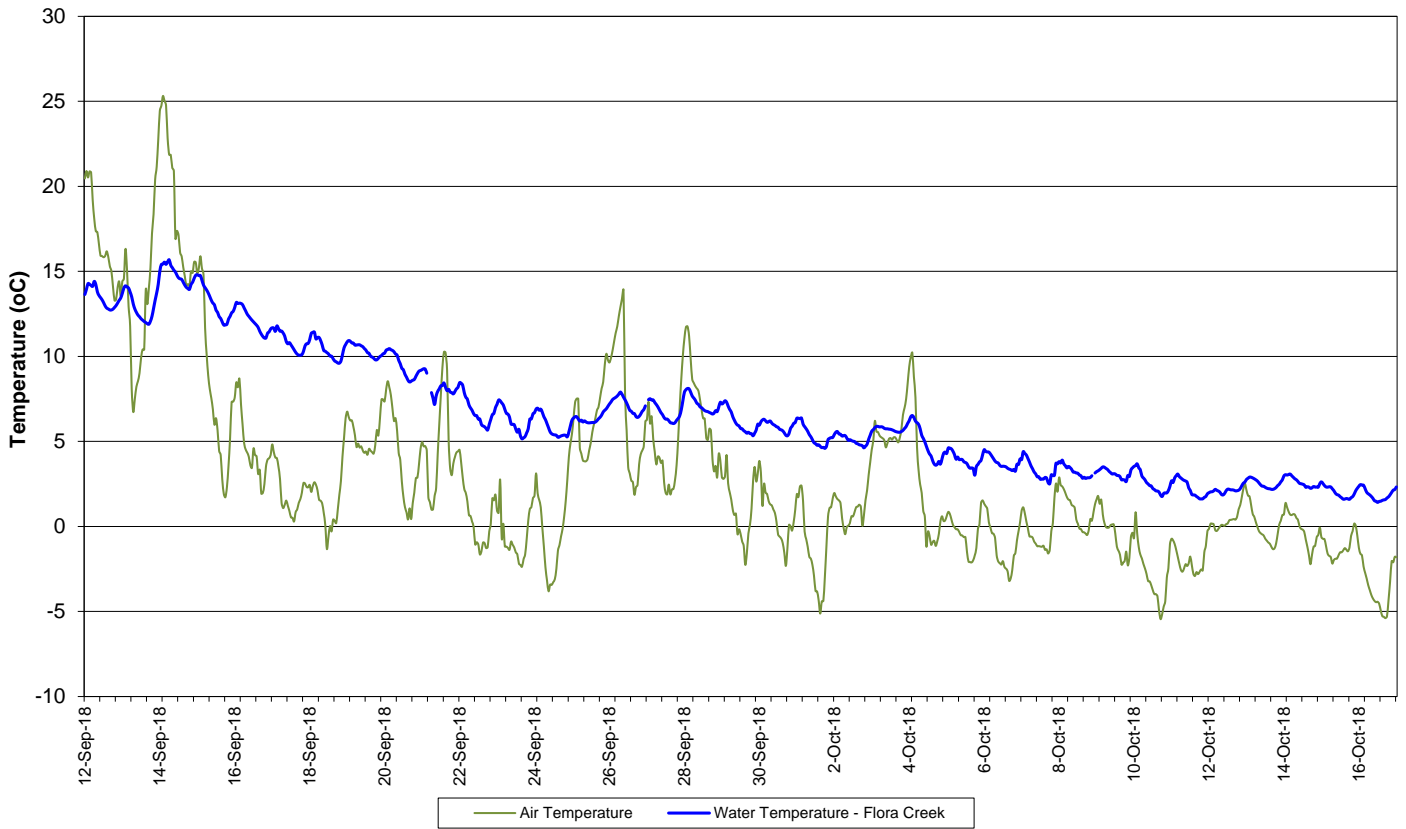


Figure 2: Average daily air and water temperatures - Flora Creek below TLH

(Weather data collected from climate station on TLH between Churchill Falls and Labrador City, ~95km away)

Flora Creek below TLH, Newfoundland and Labrador

- pH ranged between 7.53 and 7.77 pH units throughout the deployment period, with a median value of 7.60 units (Figure 3).
- All values during the deployment are within the CCME Guidelines for the Protection of Aquatic Life (between 6.5 and 9 pH units). pH fluctuates slightly during the day and night.

**Water pH : Flora Creek below TLH
September 12 to October 17, 2018**

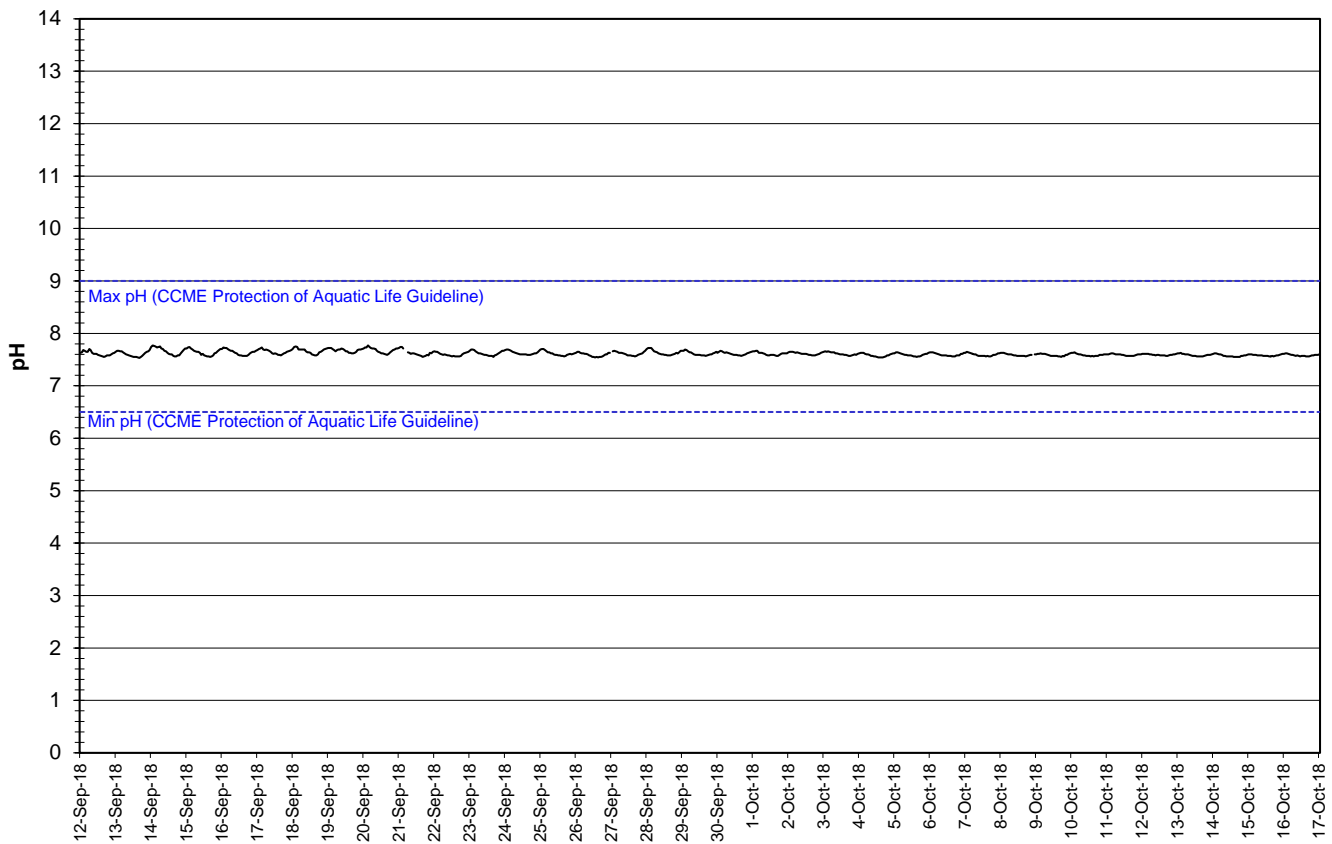


Figure 3: pH - Flora Creek below TLH

- Specific conductivity ranged from 62.3 to 66.9 $\mu\text{S}/\text{cm}$ (Figure 4).
- Specific conductivity increased slightly over the course of this deployment period.
- There are some noticeable decreases in conductivity corresponding with rainfall events and identified on the graph below. This is to be expected after rainfall as the increase in the amount of water in the creek, dilutes the solids that are present, decreasing the conductivity.
- With the exception of water quantity data (stage), all data used in the preparation of the graphs and subsequent discussion adhere to this stringent QA/QC protocol. Water Survey of Canada is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.

**Specific Conductivity of Water and Stage Level : Flora Creek below TLH
September 12 to October 17, 2018**

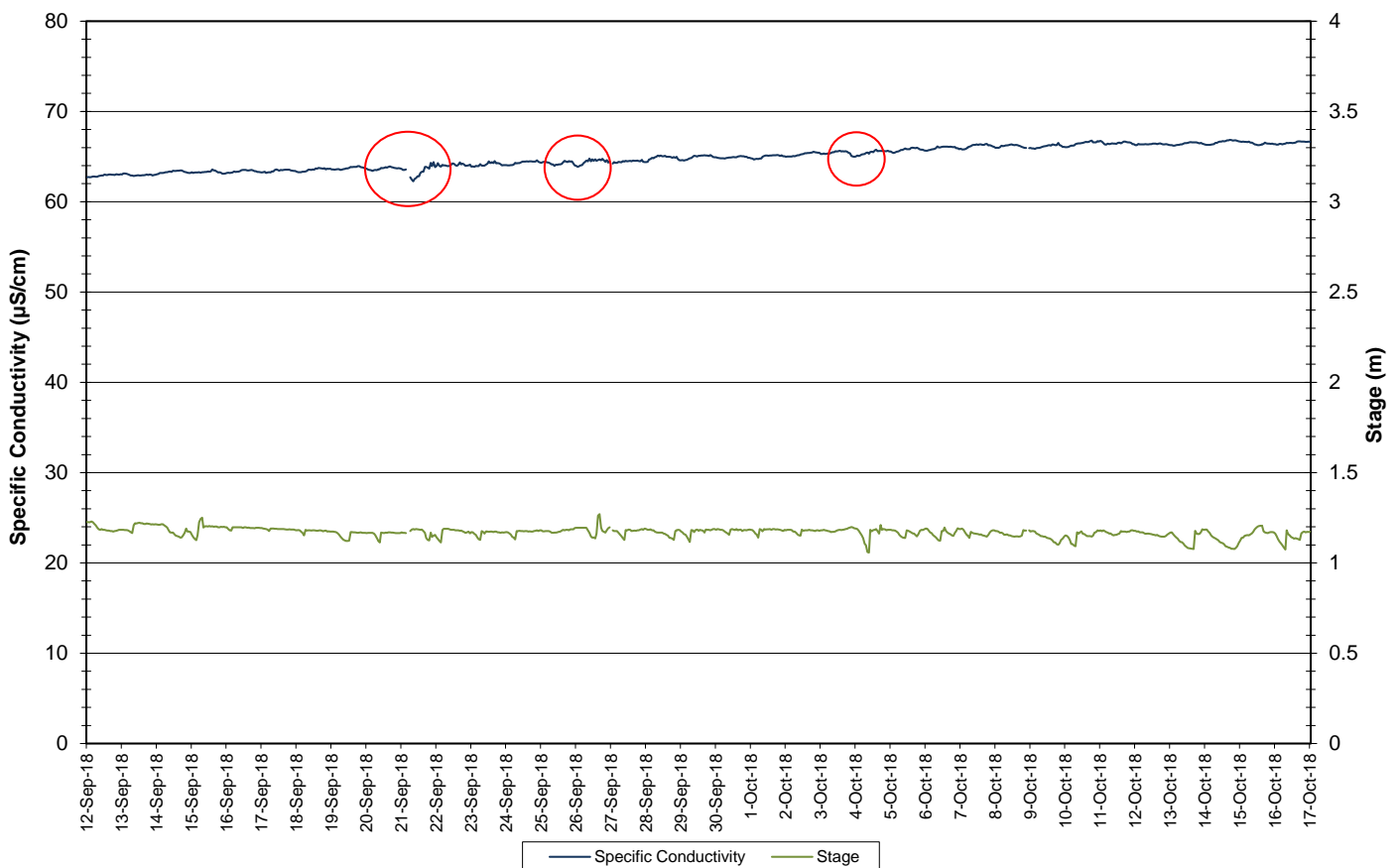


Figure 4: Specific conductivity and stage level - Flora Creek below TLH

- The saturation of dissolved oxygen ranged from 92.8 to 106.0% and a range of 10.11 to 13.55 mg/l was found for the concentration of dissolved oxygen with a median value of 12.21 mg/l (Figure 5).
- All values were above the minimum CCME Guideline for the Protection of Other Life Stage Cold Water Biota of 6.5 mg/l and the minimum CCME Guideline for the Protection of Early Life Stage Cold Water Biota value of 9.5 mg/l. The guidelines are indicated in blue on Figure 5.
- Dissolved oxygen content fluctuates diurnally, displaying the inverse relationship to water temperature. Overall, DO increases during this deployment period due to a decrease in water temperature at this time.

**Dissolved Oxygen Concentration and Saturation : Flora Creek below TLH
September 12 to October 17, 2018**

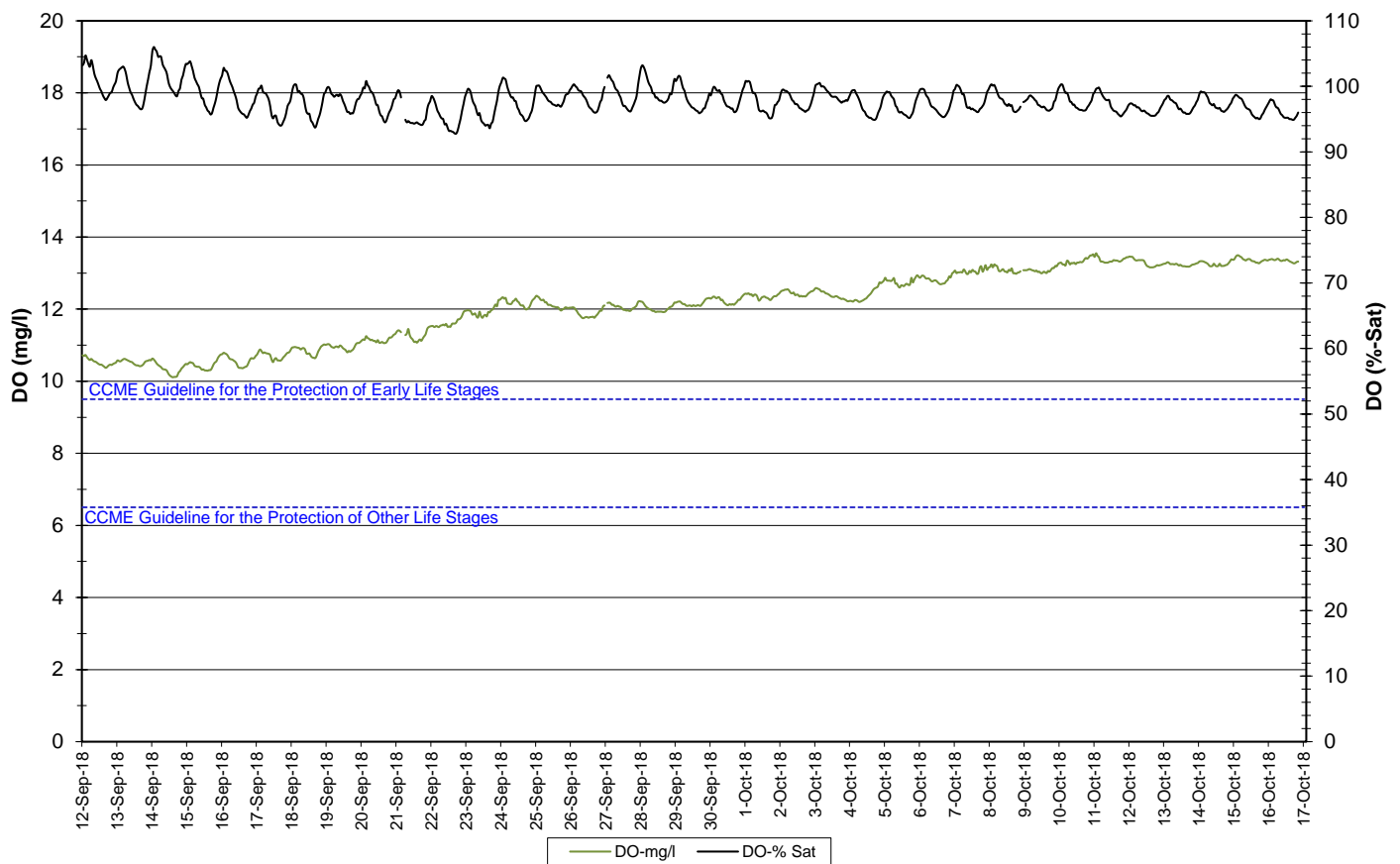


Figure 5: Dissolved oxygen and percent saturation - Flora Creek below TLH

- Turbidity values range from 3.8 NTU to 42.7 NTU. Turbidity fluctuates during this deployment period with a few significant events. These events correspond with high precipitation, they are identified on the graph in red (Figure 6).
- This site has very turbid water at times.

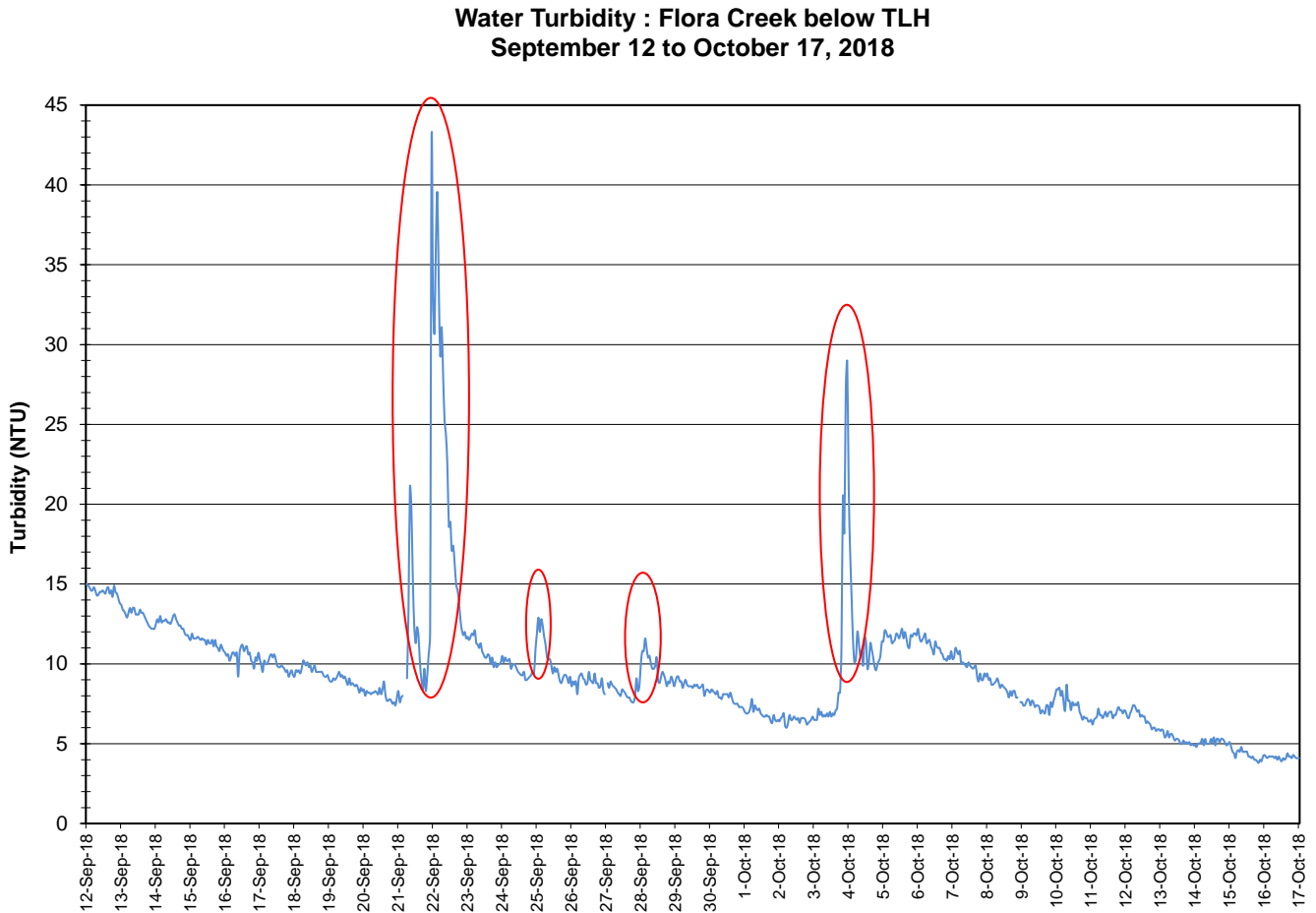


Figure 6: Turbidity - Flora Creek below TLH

- Precipitation and stage during the deployment period are graphed below (Figure 7). Stage decreased slightly during the first half of August before increasing, then decreasing again in September.
- With the exception of water quantity data (stage), all data used in the preparation of the graphs and subsequent discussion below adhere to this stringent QA/QC protocol. Water Survey of Canada is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.

**Daily Precipitation : Flora Creek below TLH
September 12 to October 17, 2018**

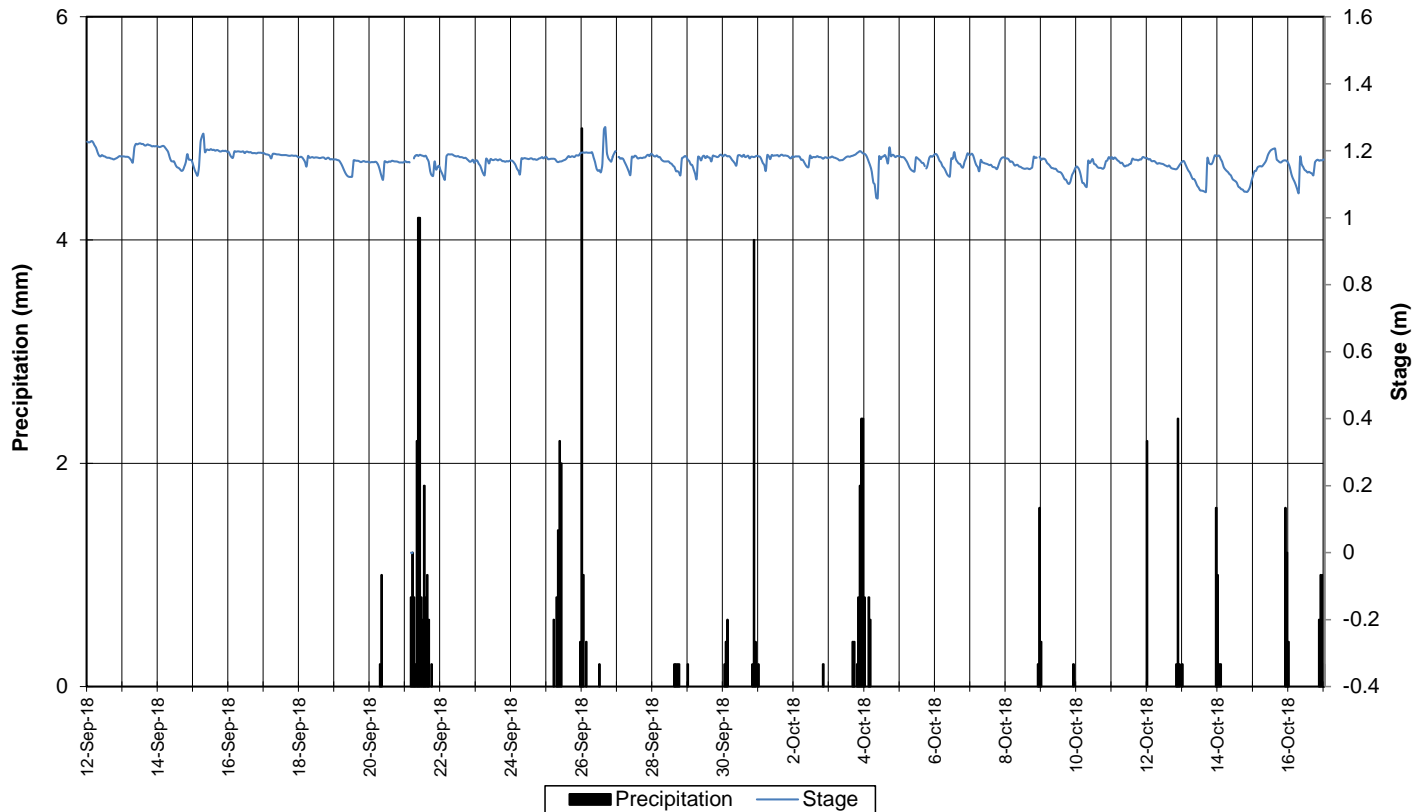


Figure 7: Precipitation and Stage – Flora Creek below TLH

Conclusions

- An instrument was deployed at the Flora Creek below TLH water quality monitoring station on September 12 and removed on October 17, 2018. This was the final deployment for the 2018 field season. The instrument was removed for the winter season and will be re-deployed in the spring of 2019, when conditions permit.
- In most cases, weather related events or increases/decreases in water level explain parameter fluctuations. All values recorded were within ranges as suggested by the CCME Guidelines for the Protection of Aquatic Life for pH and dissolved oxygen.
- Water temperature decreased during the deployment period, ranging between 1.41 and 15.68°C.
- pH values were all within the recommended CCME Guidelines for the Protection of Aquatic Life. pH ranged between 7.53 and 7.77.
- Specific conductivity ranged from 62.3 to 66.9 µs/cm.
- Dissolved oxygen values were above the minimum CCME Guideline for the Protection of Aquatic Life for Cold Water Biota at Other Life Stages of 6.5 mg/l and the CCME Guideline for the Protection of Aquatic Life for Cold Water Biota at Early Life Stages of 9.5 mg/l.
- Turbidity values generally decreased over the deployment period, with increases noticed during precipitation events.
- Stage was relatively stable during the deployment period with slight fluctuations.
- With the exception of water quantity data (stage), all data used in the preparation of the graphs and subsequent discussion adhere to this stringent QA/QC protocol. Water Survey of Canada is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.

Appendix 1

**Average Daily Air Temperature and Daily Precipitation:
TLH between Churchill Falls and Labrador City Climate Station
September 12 to October 17, 2018**

