

Real-Time Water Quality Deployment Report

Flora Creek below TLH

July 26 to
September 11, 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 monitors the real-time web pages regularly.
- On June 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 91 days. This is double the time it is usually deployed; this was due to logistical issues. For the purpose of this report, data from July 26th to September 11th will be used for reporting.

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.

Flora Creek below TLH, Newfoundland and Labrador

- Deployment and removal comparison rankings for the station on Flora Creek deployed between June 12 and September 11, 2018 are summarized in Table 2.

Table 2: Comparison rankings for Flora Creek below TLH station June 12 – September 11, 2018.

Station	Date	Action	Comparison Ranking				
			Temperature	pH	Conductivity	Dissolved Oxygen	Turbidity
Flora Creek below TLH	June 12, 2018	Deployment	Excellent	Good	Excellent	Excellent	Excellent
	Sept 11, 2018	Removal	Excellent	Good	Excellent	Excellent	Excellent

- At deployment and removal, all parameters ranked either 'excellent' or 'good'.

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 10.23 to 23.44°C during this deployment period (Figure 1).
- Water temperature generally decreased throughout the deployment period, which corresponds with decreasing ambient air temperature (Figure 2). It is important to note that weather data was collected from a climate station approximately 95 kilometers away.

**Water Temperature : Flora Creek below TLH
July 26 to September 11, 2018**

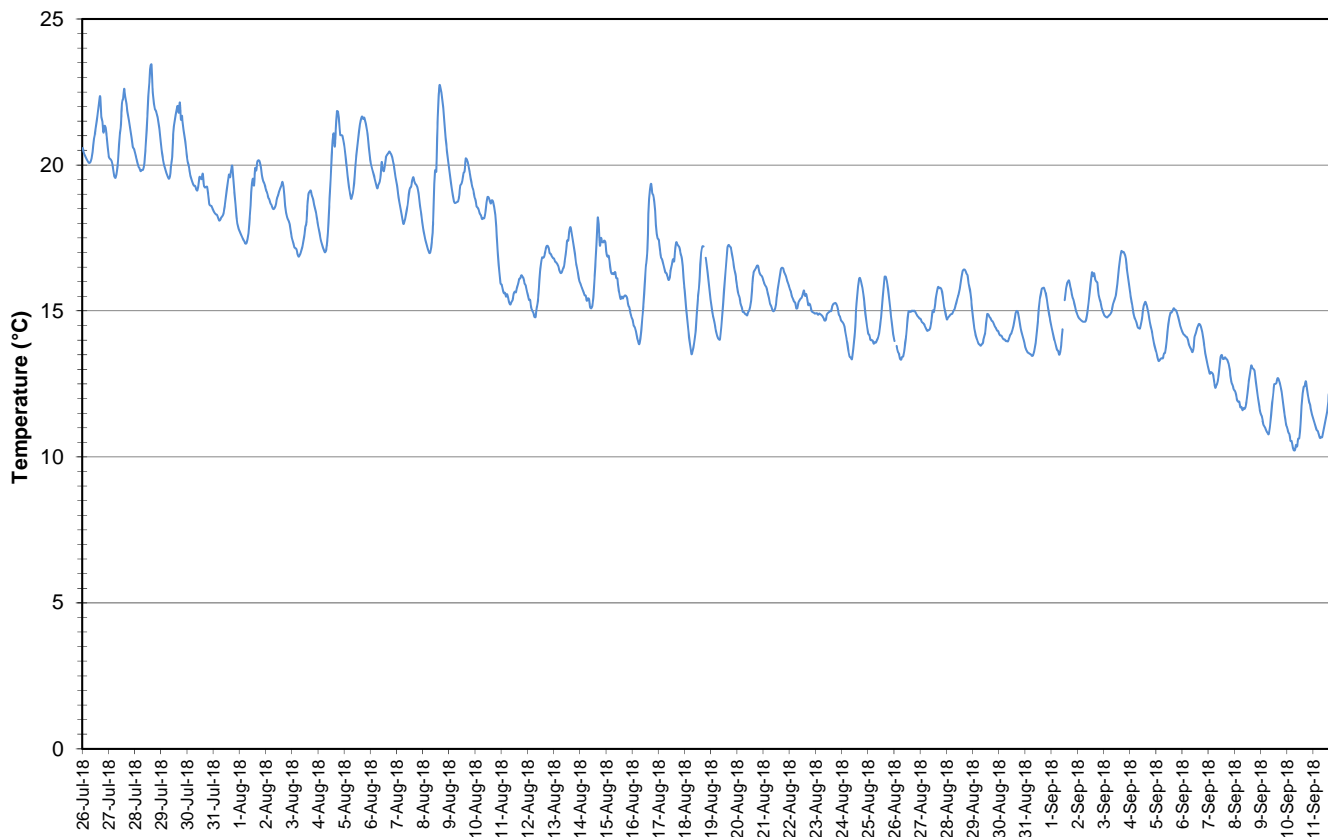


Figure 1: Water temperature - Flora Creek below TLH

**Average Daily Air and Water Temperature: Flora Creek
July 26 to September 11, 2018**

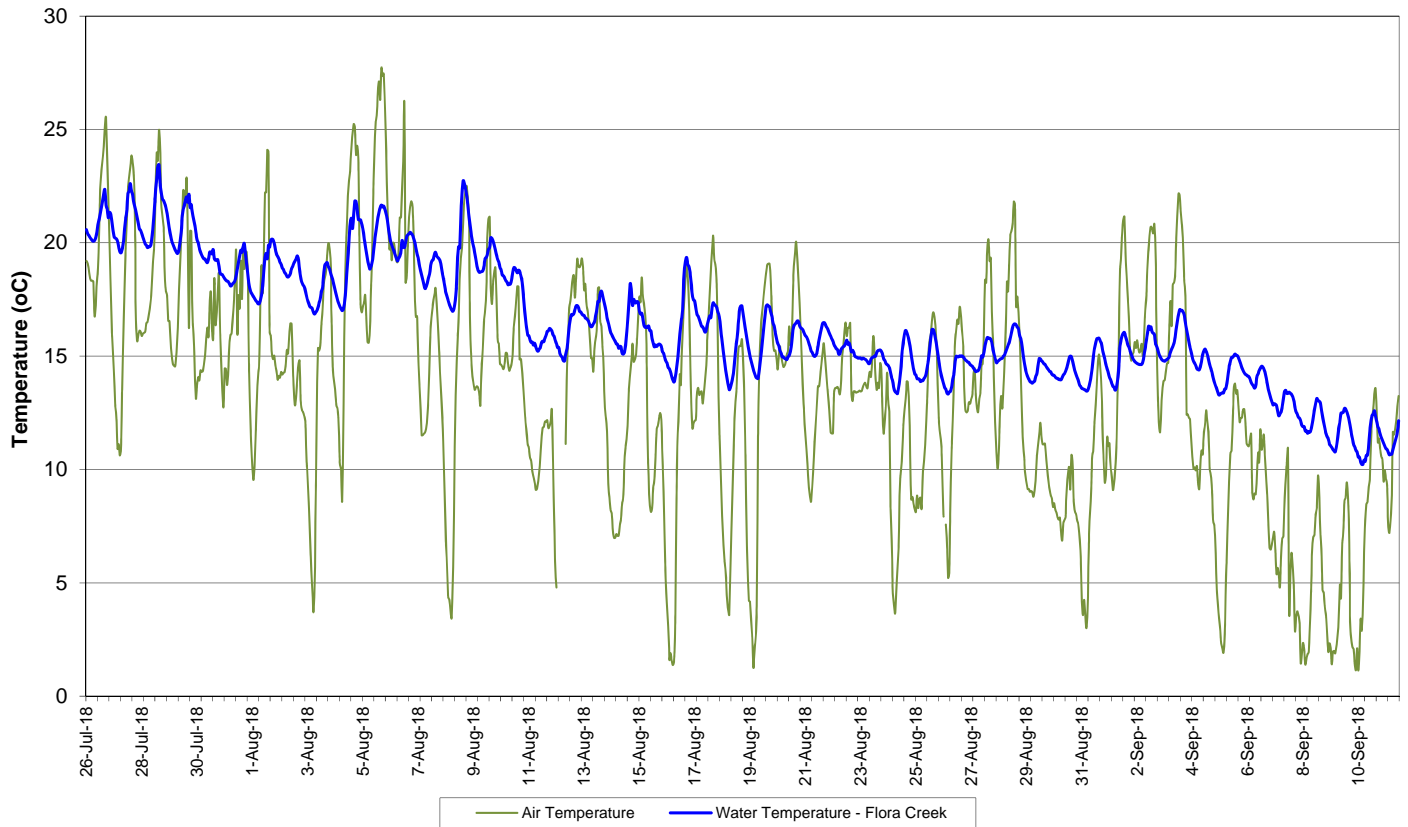


Figure 2: Average daily air and water temperatures - Flora Creek below TLH

(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 7.47 and 8.03 pH units throughout the deployment period, with a median value of 7.73 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
July 26 to September 11, 2018**

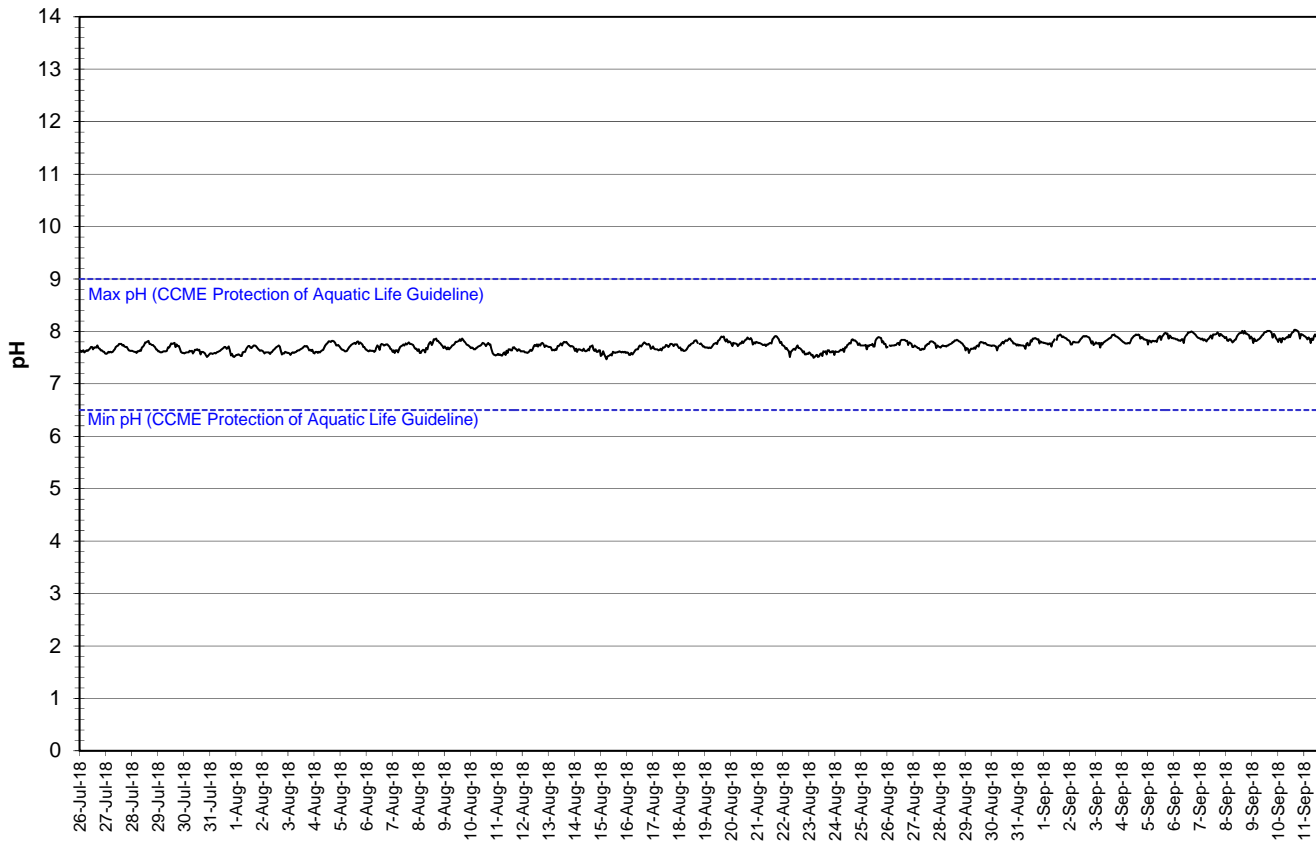


Figure 3: pH - Flora Creek below TLH

- Specific conductivity ranged from 60.0 to 63.8 $\mu\text{S}/\text{cm}$ (Figure 4).
- Specific conductivity increased slightly during the end of August and beginning of September. Slight decreases in conductivity are identified on the graph in red. This occurs after precipitation events when solids are diluted. Thus, 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
July 26 to September 11, 2018**

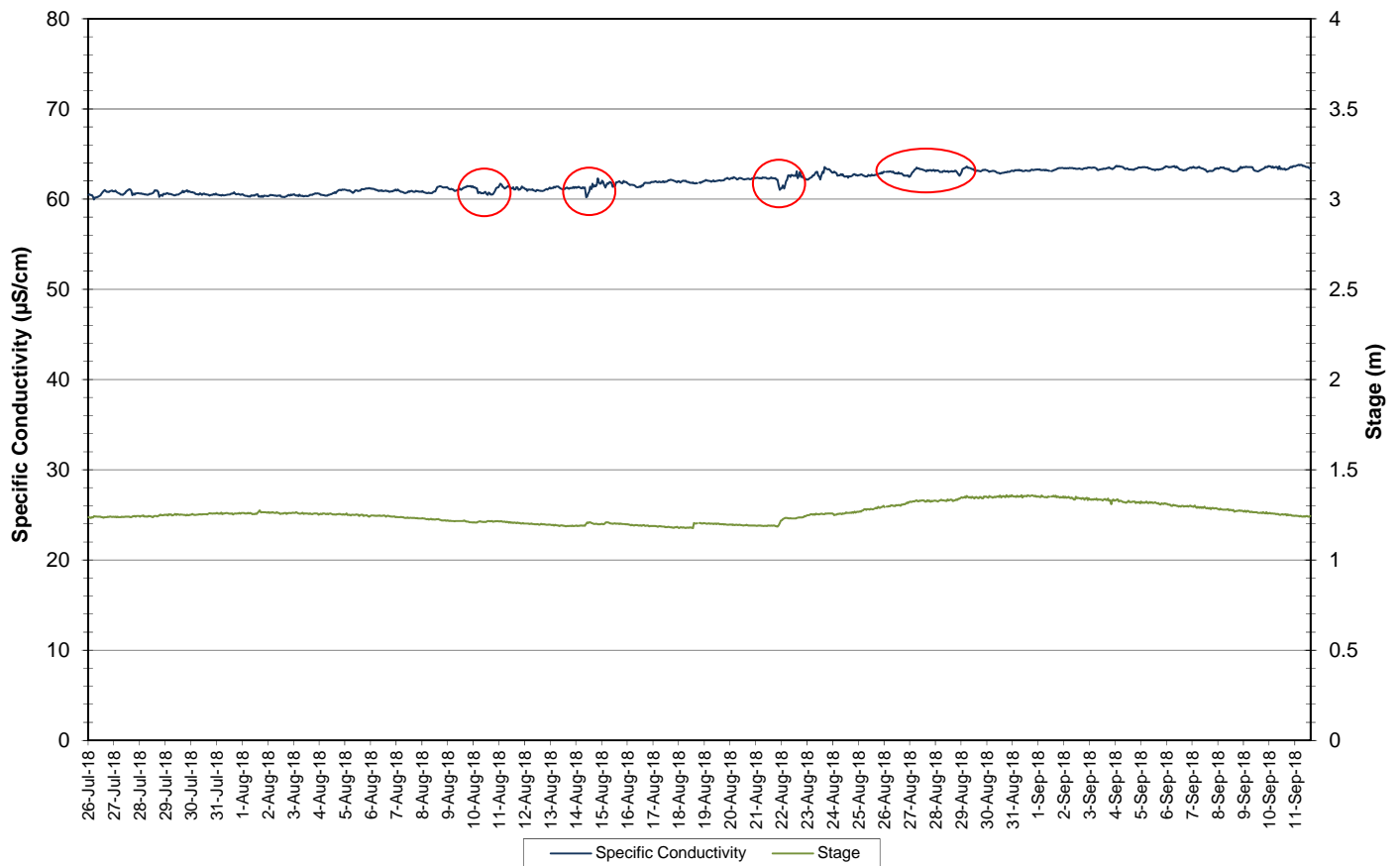


Figure 4: Specific conductivity and stage level - Flora Creek below TLH

- The saturation of dissolved oxygen ranged from 87.1 to 99.8%. The concentration of dissolved oxygen ranged from 8.33 to 10.44 mg/l with a median value of 9.10 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. The majority of values were below 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. DO increases during the later portion of the deployment period; due to a decrease in water temperature at this time.

Dissolved Oxygen Concentration and Saturation : Flora Creek below TLH
July 26 to September 11, 2018

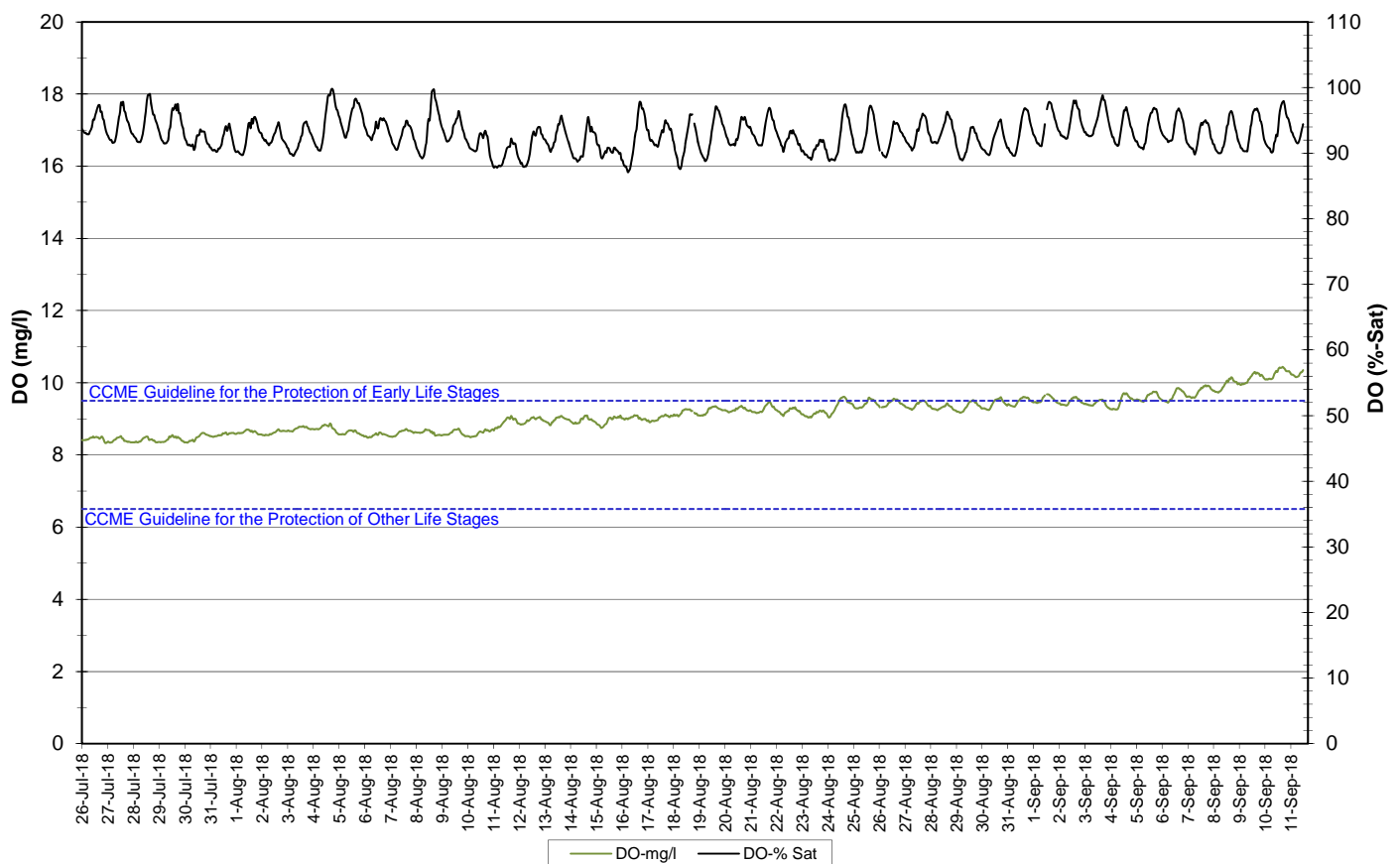


Figure 5: Dissolved oxygen and percent saturation - Flora Creek below TLH

- Turbidity values range from 13.9 NTU to 63.4 NTU, the highest readings being recorded at the beginning of the deployment period. Turbidity gradually decreases over the course of the deployment period with a slight increase during the later portion (Figure 6). Some turbidity spikes can be attributed to precipitation events in the area; they are identified on the graph in red.
- This site has very turbid water at times.

**Water Turbidity : Flora Creek below TLH
July 26 to September 11, 2018**



Figure 6: Turbidity - Flora Creek below TLH

- Precipitation and stage during the deployment period is graphed below (Figure 7). Stage decreased slightly during the first half of August. It then increased before decreasing during the middle of 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
July 26 to September 11, 2018**

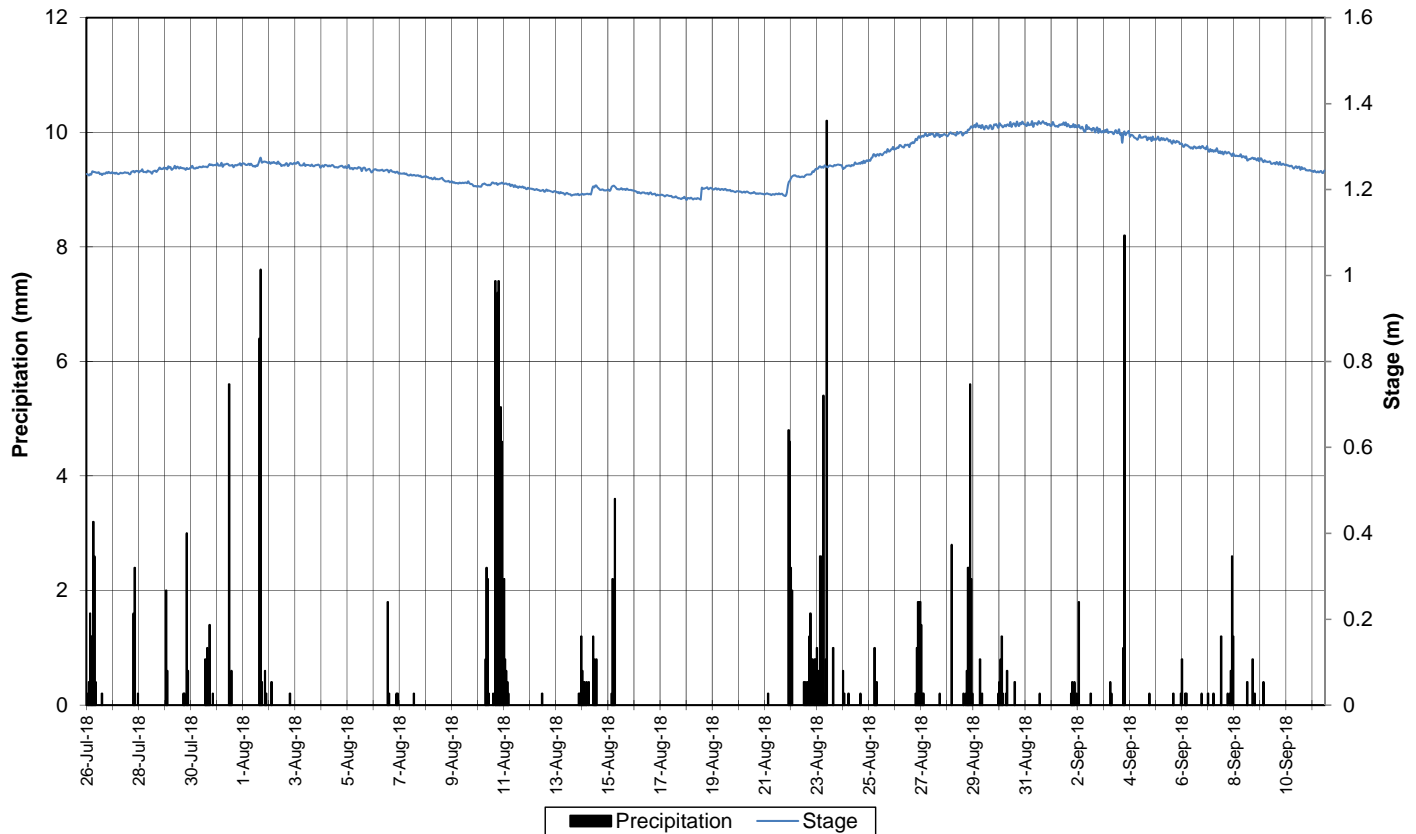


Figure 7: Precipitation and Stage – Flora Creek below TLH

Conclusions

- An instrument at the water quality monitoring station on Flora Creek below the TLH was deployed on June 12 and removed on September 11, 2018. Data from July 26 to September 11, 2018 was analyzed in this report.
- In most cases, weather related events or increases/decreases in water level could be used to explain the fluctuations. The majority of values recorded were within ranges as suggested by the CCME Guidelines for the Protection of Aquatic Life for pH and dissolved oxygen.
- The water temperature ranged between 10.23 and 23.44° showing a decreasing trend throughout the deployment period.
- pH ranged between 7.47 and 8.03 and all values were within the recommended CCME Guidelines for the Protection of Aquatic Life.
- Specific conductivity was stable throughout deployment, ranging from 60.0 to 63.8 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. The majority of values were below the CCME Guideline for the Protection of Aquatic Life for Cold Water Biota at Early Life Stages of 9.5 mg/l.
- Turbidity values decreased steadily over the deployment period.
- Stage increased slightly during the later portion of the deployment period.
- 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.

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Appendix 1

**Average Daily Air Temperature and Daily Precipitation:
TLH between Churchill Falls and Labrador City Climate Station
July 26 to September 11, 2018**

