Real-Time Water Quality Deployment Report

Flora Creek below TLH

August 31 to
October 12, 2016

Newfoundland Labrador

Government of Newfoundland & Labrador
Department of Environment and Climate Change
Water Resources Management Division

Contents

General

- The Water Resources Management Division, in partnership with Cliffs Natural Resources – 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 August 31, 2016, a real-time water quality monitoring instrument was deployed at the station Flora Creek below TLH. The instrument was deployed for a period of 42 days. The instrument was removed on October 12th, 2016. This was the last deployment period of the 2016 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

	Rank				
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

- 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 August 31 and October 12, 2016 is summarized in Table 2.

Table 2: Comparison rankings for Flora Creek below TLH station August 31 – October 12, 2016.

Station	Date	Action	Comparison Ranking				
			Temperature	pH	Conductivity	Dissolved Oxygen	Turbidity
Flora Creek below TLH	Aug 31, 2016	Deployment	Excellent	Excellent	Good	Excellent	Excellent
	Oct 12, 2016	Removal	N/A	N/A	N/A	N/A	N/A

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

- QA/QC rankings could not be obtained for the removal, due to an issue with the QA/QC instrument.

Data Interpretation

- The following graphs and discussion illustrate water quality-related events from August 31 to October 12, 2016 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 5.25 to 16.94°C during this deployment period (Figure 1).
- Water temperature decreased throughout the deployment period, corresponding with decreasing ambient air temperature of the fall season (Figure 2).

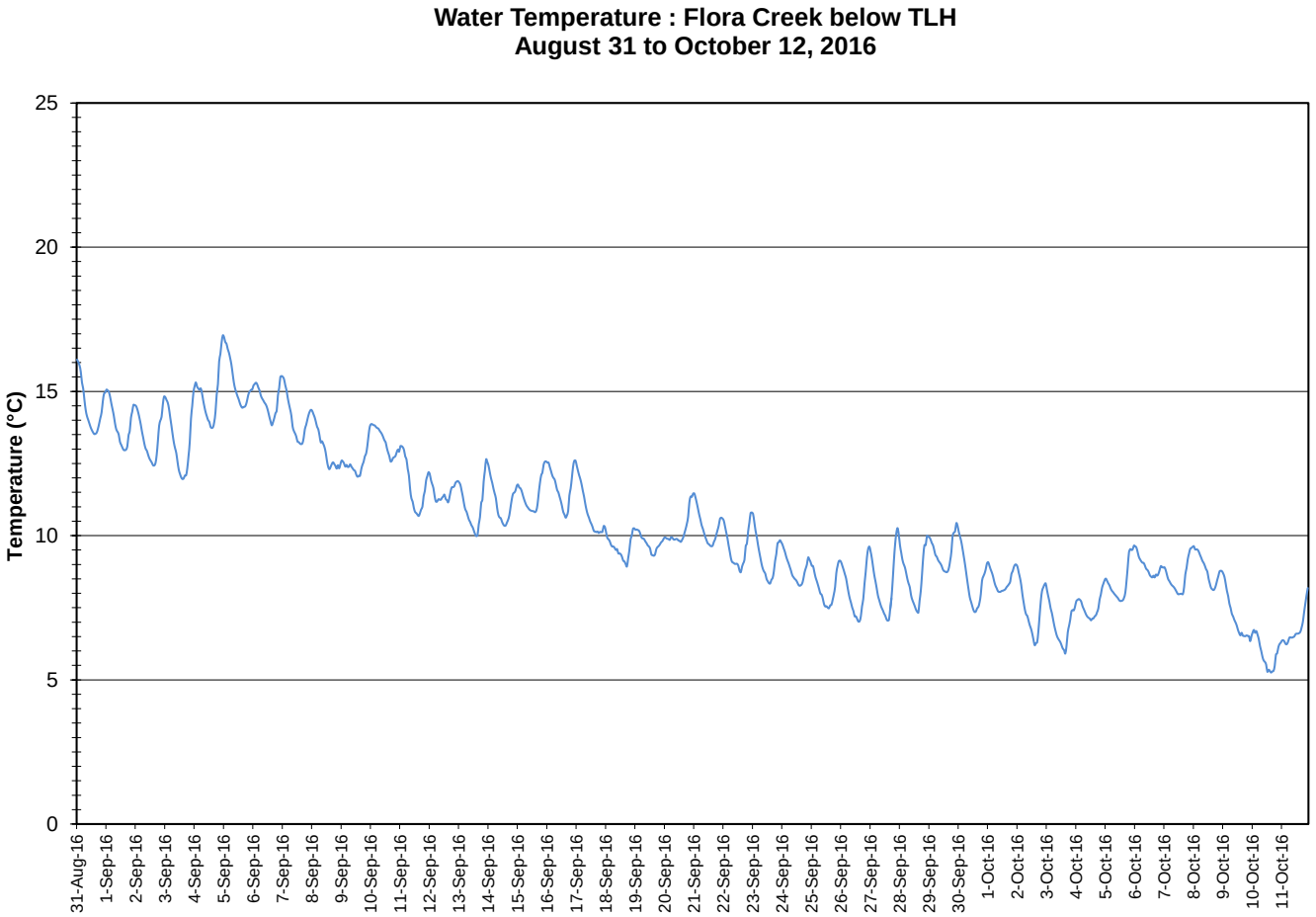

Figure 1: Water temperature - Flora Creek below TLH

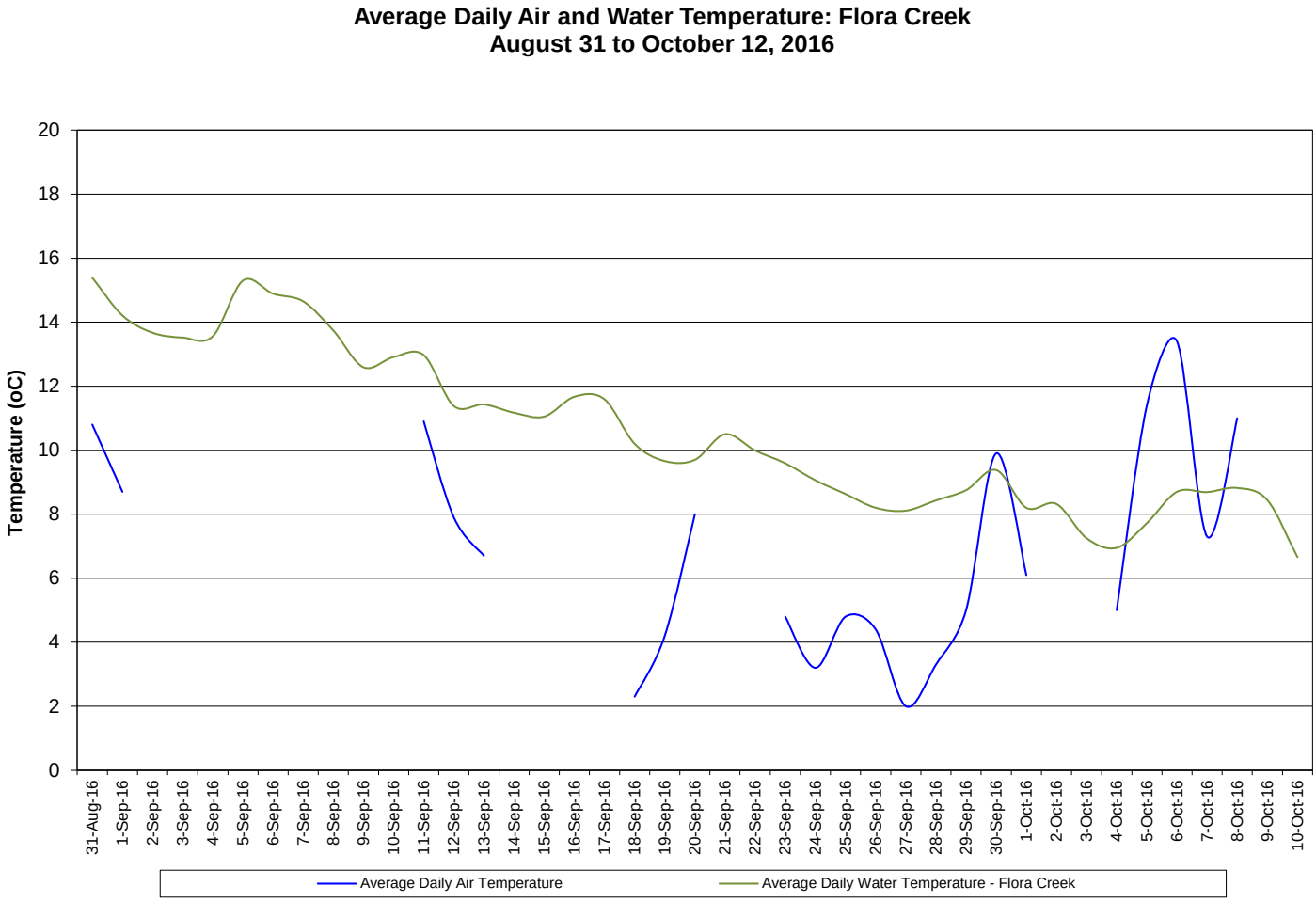

Figure 2: Average daily air and water temperatures - Flora Creek below TLH (weather data collected at Wabush Airport)

- pH ranged between 7.58 and 8.00 pH units throughout the deployment period, with a median value of 7.79 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.
- 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.
- There is a slight depression in pH on the 11th of September; this is due to an increase in stage during a heavy rainfall event. This is identified on the graph in red.
- 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.

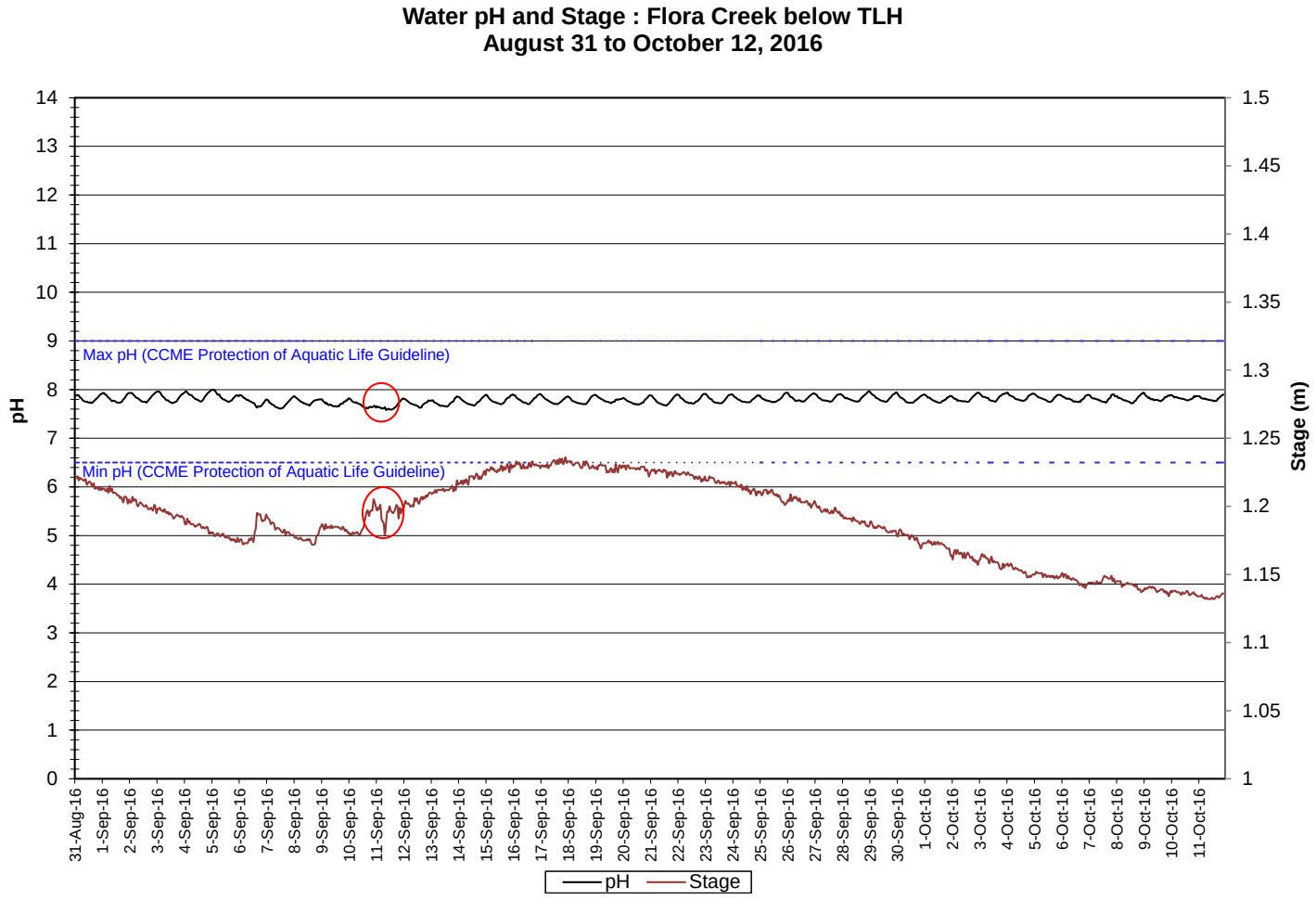

Figure 3: pH - Flora Creek below TLH

- Specific conductivity ranged from 68.9 to 72.8 µs/cm (Figure 4).
- Specific conductivity increased slightly over the course of this deployment period. Stage is stable throughout this deployment period.
- There were two small noticeable decreases in conductivity during this deployment period; they are identified on the graph in red. These instances correlate with significant rainfall events at the time. This occurs when an increased amount of water is introduced to the system and the amount of solids is diluted.
- 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.

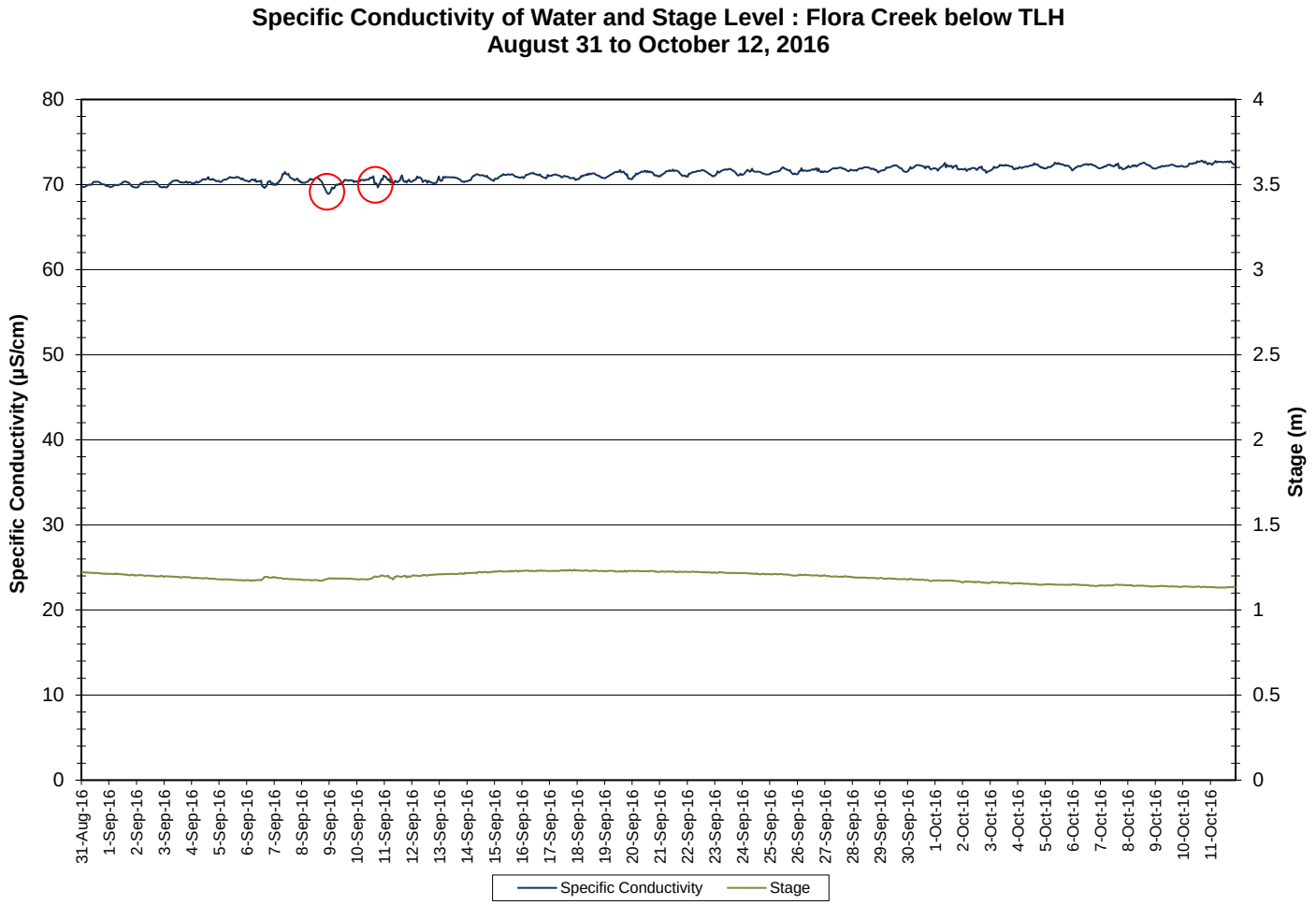

Figure 4: Specific conductivity and stage level - Flora Creek below TLH

- The saturation of dissolved oxygen ranged from 87.4 to 101.4% and a range of 9.25 to 11.69 mg/l was found in the concentration of dissolved oxygen with a median value of 10.51 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. Most values were above 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 this deployment period, this can be expected as the air temperature is decreasing during this time.

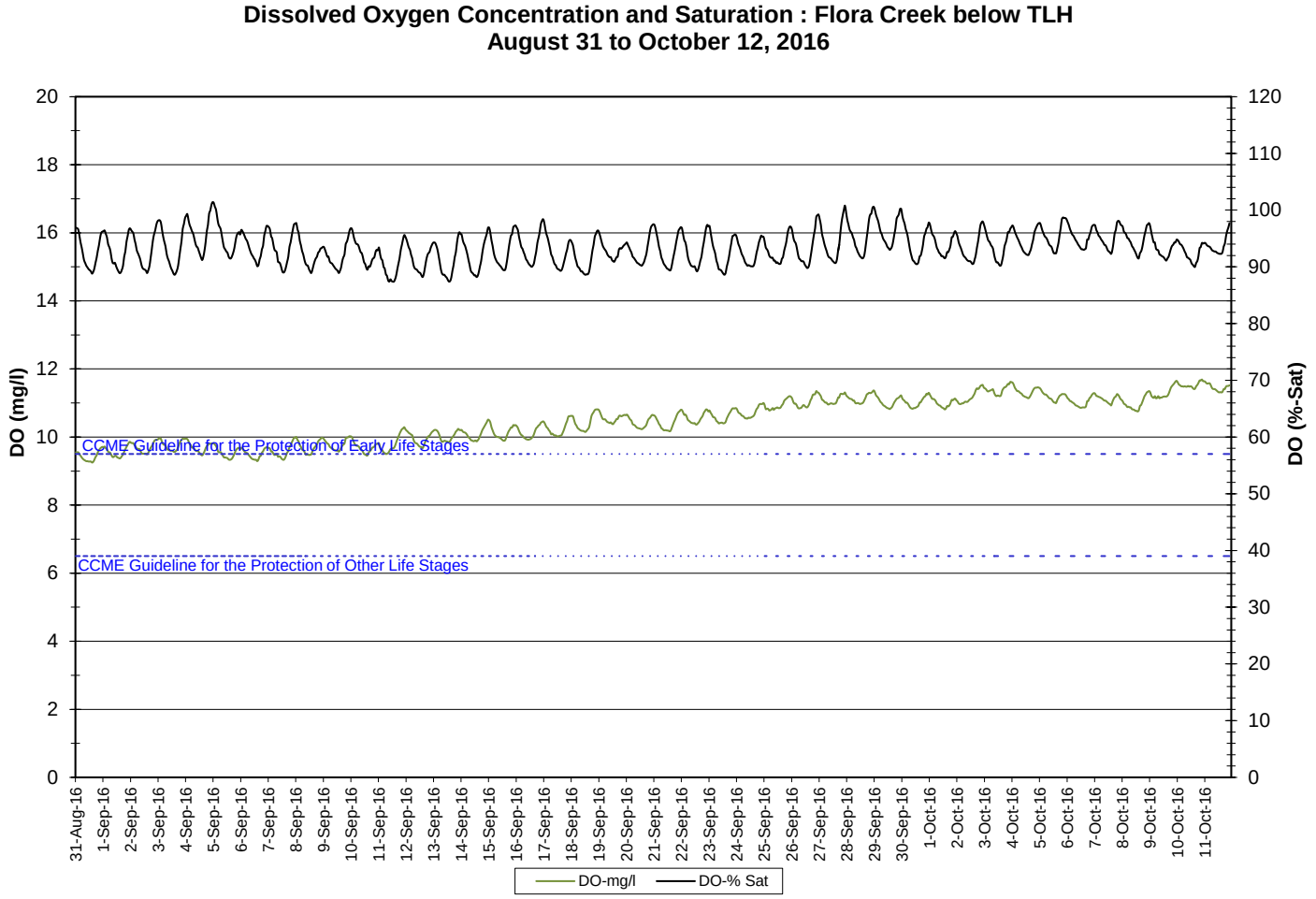

Figure 5: Dissolved oxygen and percent saturation - Flora Creek below TLH

- Turbidity values range from 6.2 NTU to 28.0 NTU (Figure 6). There were a few turbidity spikes during this deployment period; those that can be attributed to precipitation at the time are identified on the graph in red.
- This site has very turbid water at times. However, turbidity levels for this deployment period are significantly less than the previous 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.

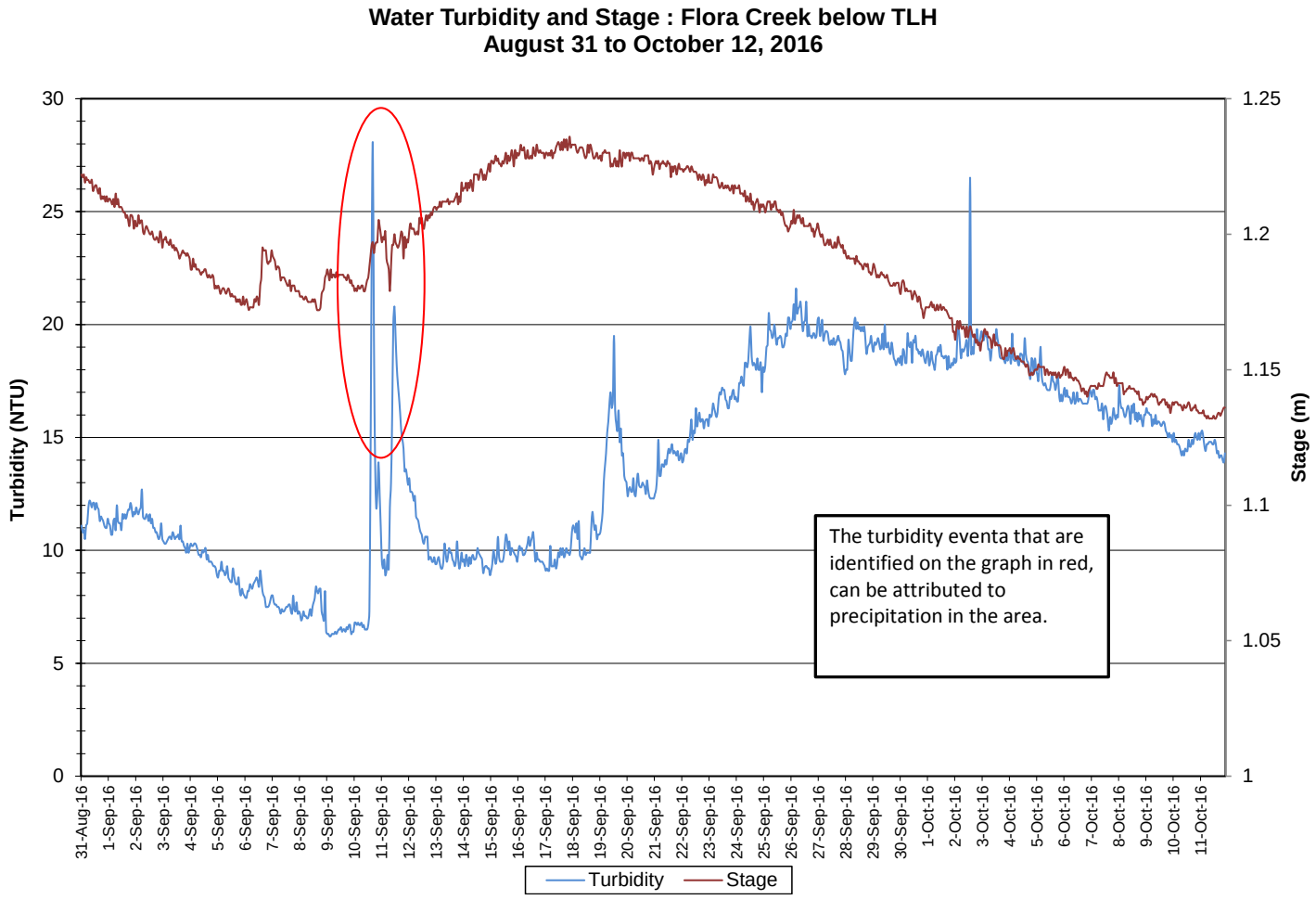

Figure 6: Turbidity - Flora Creek below TLH

- Precipitation and stage during the deployment period is graphed below (Figure 7). Stage was relatively stable during the deployment period. Precipitation levels varied.
- 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.

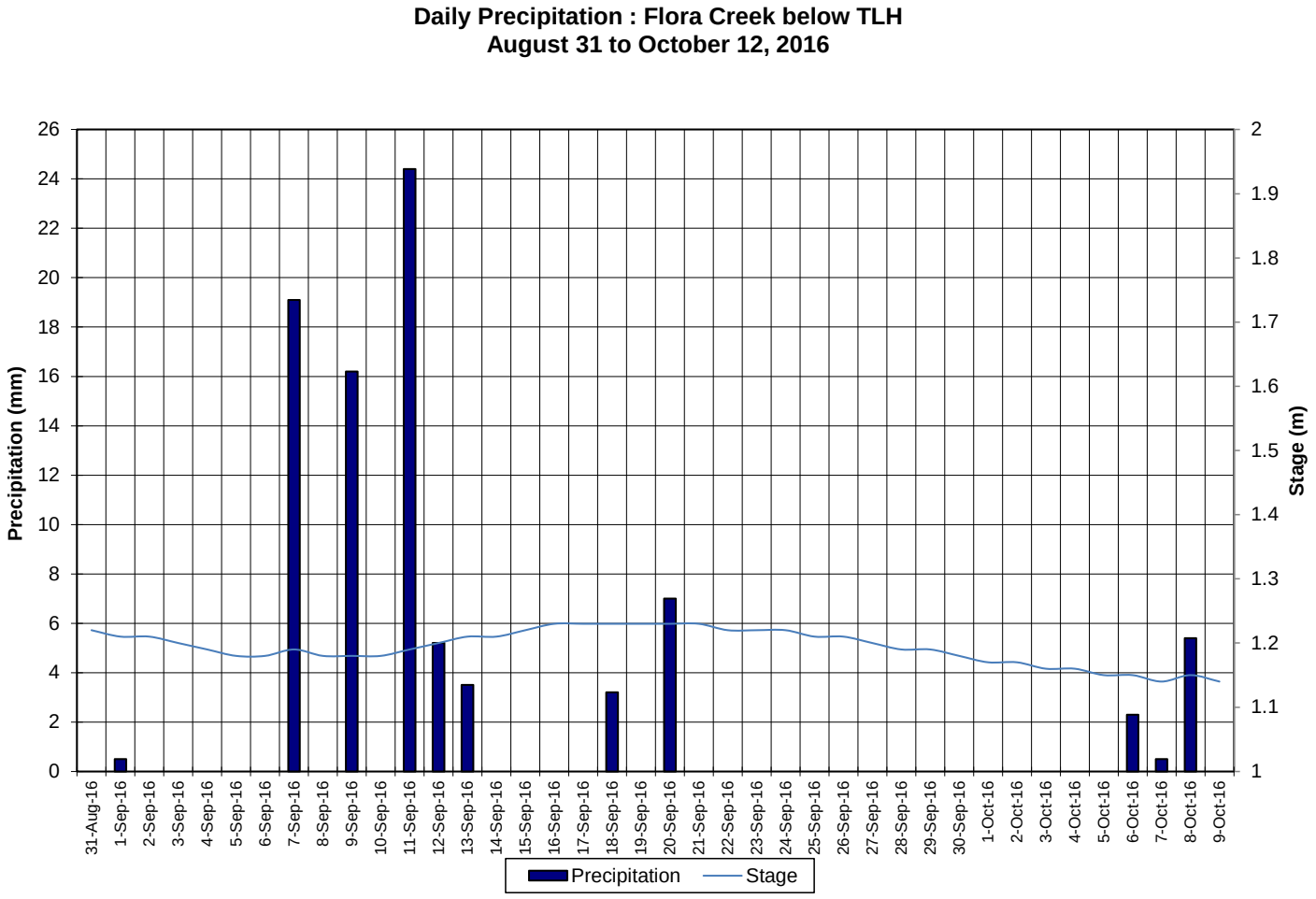

Figure 7: Precipitation and Stage – Flora Creek below TLH

Conclusions

- An instrument at the water quality monitoring station on the Flora Creek below TLH station was deployed on August 31 and removed on October 12, 2016 for the winter season.
- In most cases, weather related events or increases/decreases in water level could be used to explain the fluctuations. Most 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. Water temperature corresponded with air temperature. The temperature typically ranged between 5.25 and 16.94^{o}C.
- pH values were all within the recommended CCME Guidelines for the Protection of Aquatic Life. pH ranged between 7.58 and 8.00.
- Specific conductivity ranged from 68.9 to 72.8 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 and most values were above the CCME Guideline for the Protection of Aquatic Life for Cold Water Biota at Early Life Stages of 9.5 mg/l. DO decreased during this deployment period.
- Turbidity values fluctuated over the course of this deployment period but have decreased since the last deployment. There were a couple of spikes, some occurring after precipitation events.
- Stage was stable throughout this 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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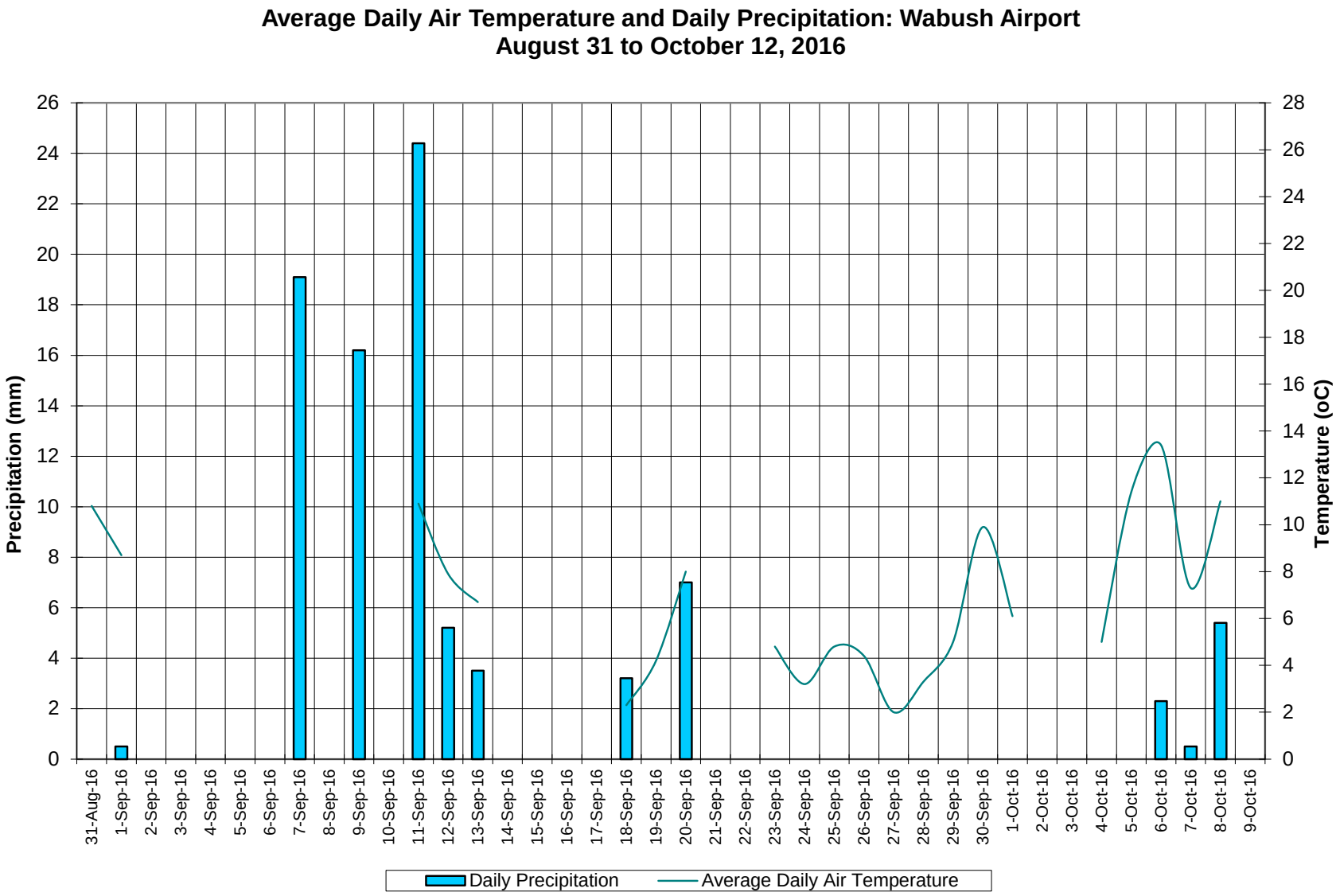
Appendix 1


Average Daily Air Temperature and Daily Precipitation: Wabush Airport
August 31 to October 12, 2016
Precipitation (mm)
Temperature (oC)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
31-Aug-16
1-Sep-16
2-Sep-16
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5-Oct-16
6-Oct-16
7-Oct-16
8-Oct-16
9-Oct-16
Daily Precipitation
Average Daily Air Temperature