Real-Time Water Quality Deployment Report

Flora Creek below TLH

September 13 to October 23, 2017

Newfoundland Labrador

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

Contents

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 September 13th, 2017, a clean and calibrated real-time water quality monitoring instrument was deployed at the station Flora Creek below TLH, for the final deployment of the season. The instrument was deployed for a period of 40 days; it was removed on October 23, 2017, for the winter season. An instrument will be redeployed in the spring, when conditions permit.

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 September 13 and October 23, 2017 is summarized in Table 2.

Table 2: Comparison rankings for Flora Creek below TLH station September 13 – October 23, 2017.

Station	Date	Action	Comparison Ranking				
			Temperature	pH	Conductivity	Dissolved Oxygen	Turbidity
Flora Creek below TLH	Sept 13, 2017	Deployment	Excellent	Excellent	Excellent	Marginal	Excellent
	Oct 23, 2017	Removal	Excellent	Poor	Good	Marginal	Fair

- At deployment, all parameters besides dissolved oxygen ranked 'excellent'. Dissolved oxygen ranked 'marginal', the field instrument read a value of 10.50 mg/l, while the QA/QC instrument read a value of 9.65 mg/l.

- At removal, temperature and conductivity ranked 'excellent' and 'good', respectively. pH ranked 'poor', the field instrument read a value of 7.71, and the QA/QC instrument read a value of 6.47. Dissolved Oxygen ranked 'marginal', the field instrument read a value of 13.53 mg/l, while the QA/QC instrument read a value of 12.61 mg/l. Turbidity ranked 'fair', the field instrument read a value of 49.1 NTU, while the QA/QC read a value of 43.1 NTU.

- These un-satisfactory rankings could be due to the placement of the QA/QC instrument in relation to the field sonde, as we were not able to fully immerse the QA/QC sonde.

Data Interpretation

- The following graphs and discussion illustrate water quality-related events from September 13 to October 23 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 1.80 to 12.76°C during this deployment period (Figure 1).
- Water temperature decreased during this deployment period. Corresponding with decreasing ambient air temperature of the fall season (Figure 2). It is important to note that weather data was collected at Goose Bay, due to missing weather data in Wabush.

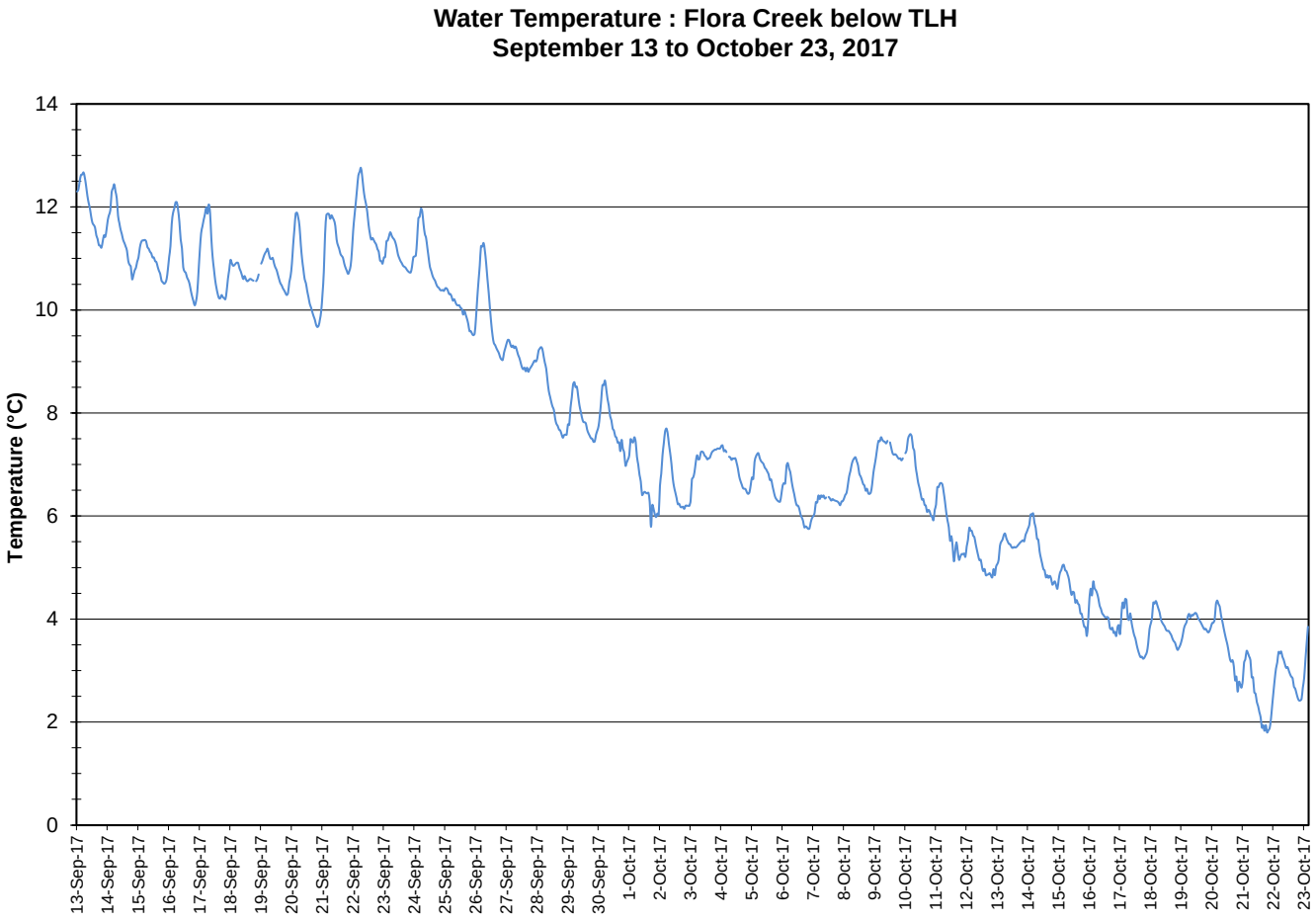

Figure 1: Water temperature - Flora Creek below TLH

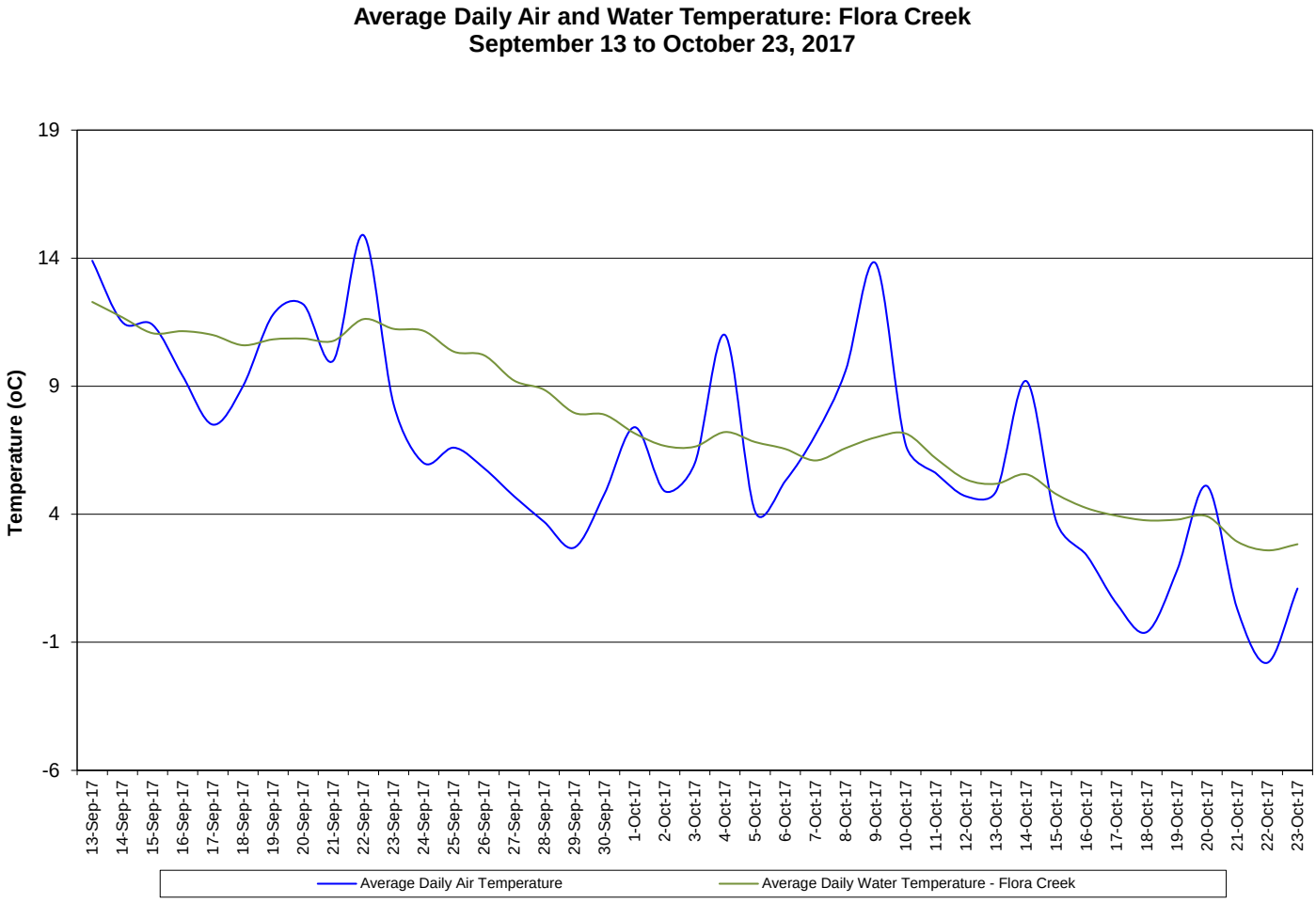

Figure 2: Average daily air and water temperatures - Flora Creek below TLH

(Weather data collected at Goose Bay, NL)

Flora Creek below TLH, Newfoundland and Labrador

- pH ranged between 7.52 and 7.71 pH units throughout the deployment period, with a median value of 7.65 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.

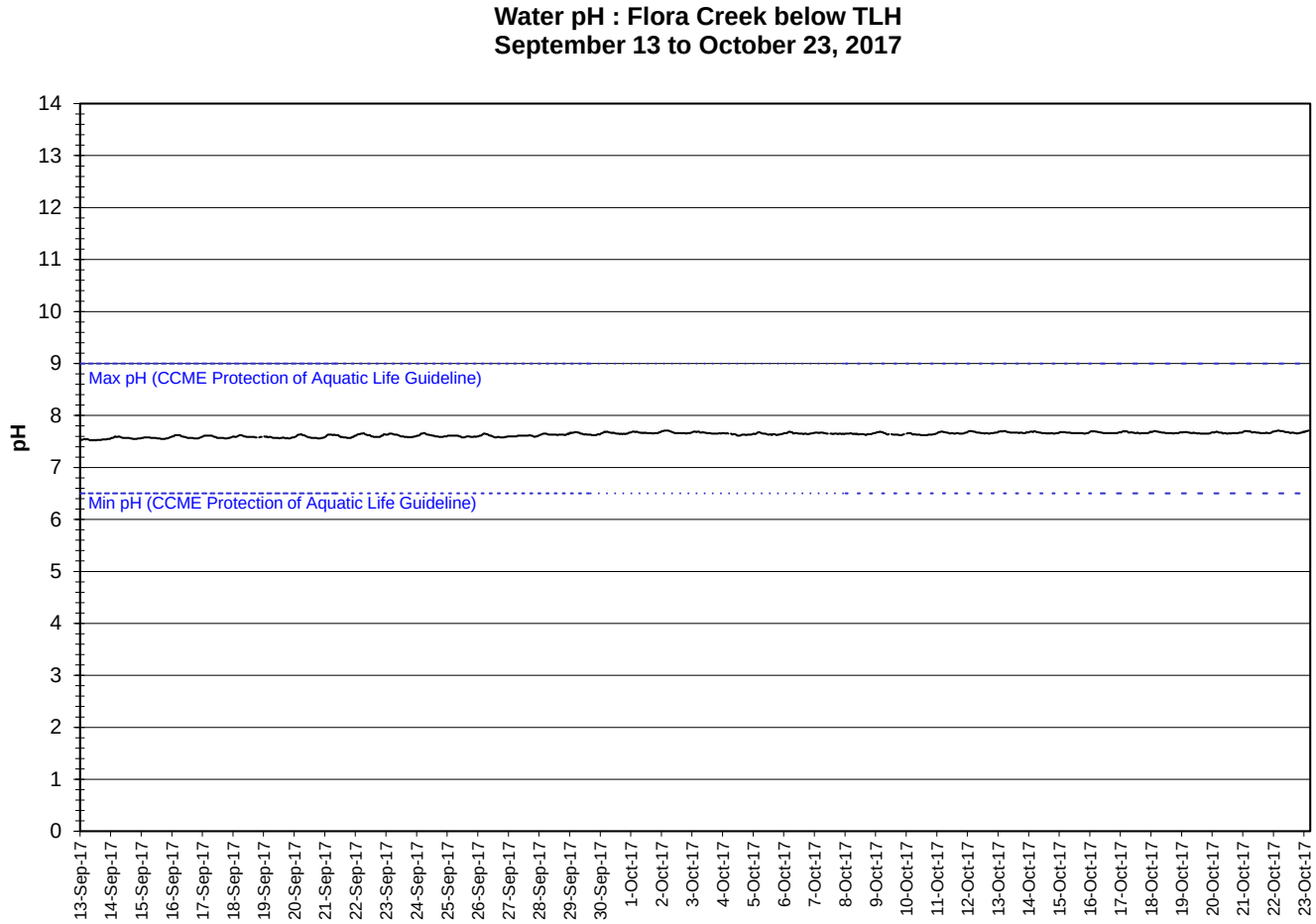

Figure 3: pH - Flora Creek below TLH

- Specific conductivity ranged from 64.7 to 67.7 µs/cm (Figure 4).
- Specific conductivity increased slightly over the course of this deployment period, with small decreases noted during or after precipitation events. These decreases display an inverse relationship to increases in stage. This is to be expected due to the increased amount of water in the creek, diluting the solids that are present. Thus, decreasing the conductivity. Decreases after high precipitation events are 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.

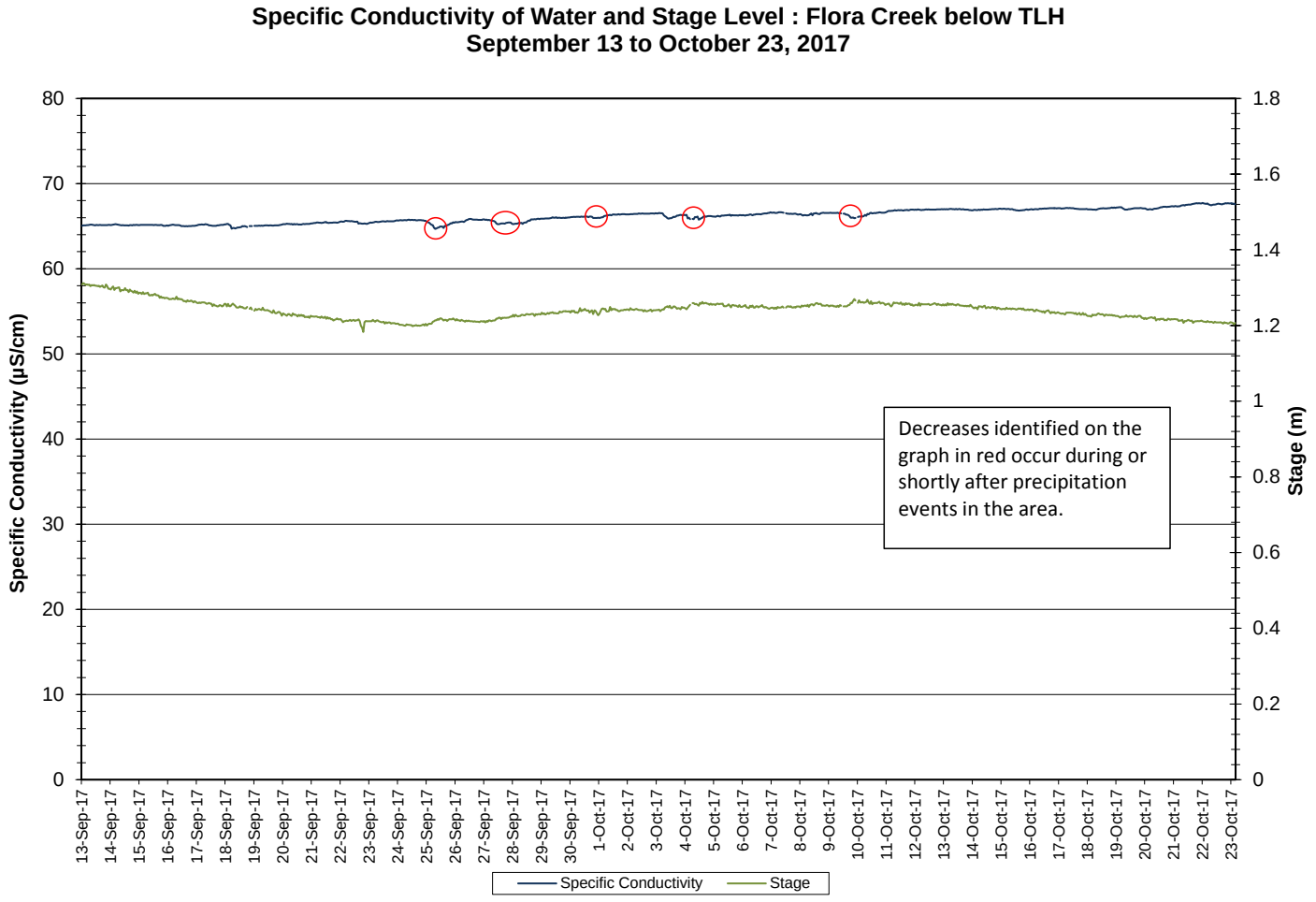

Figure 4: Specific conductivity and stage level - Flora Creek below TLH

- The saturation of dissolved oxygen ranged from 96.2 to 103.7% and a range of 10.46 to 13.70 mg/l was found in the concentration of dissolved oxygen with a median value of 12.13 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. DO increases over the course of this deployment period; this is due to decreasing water temperature in the fall season.

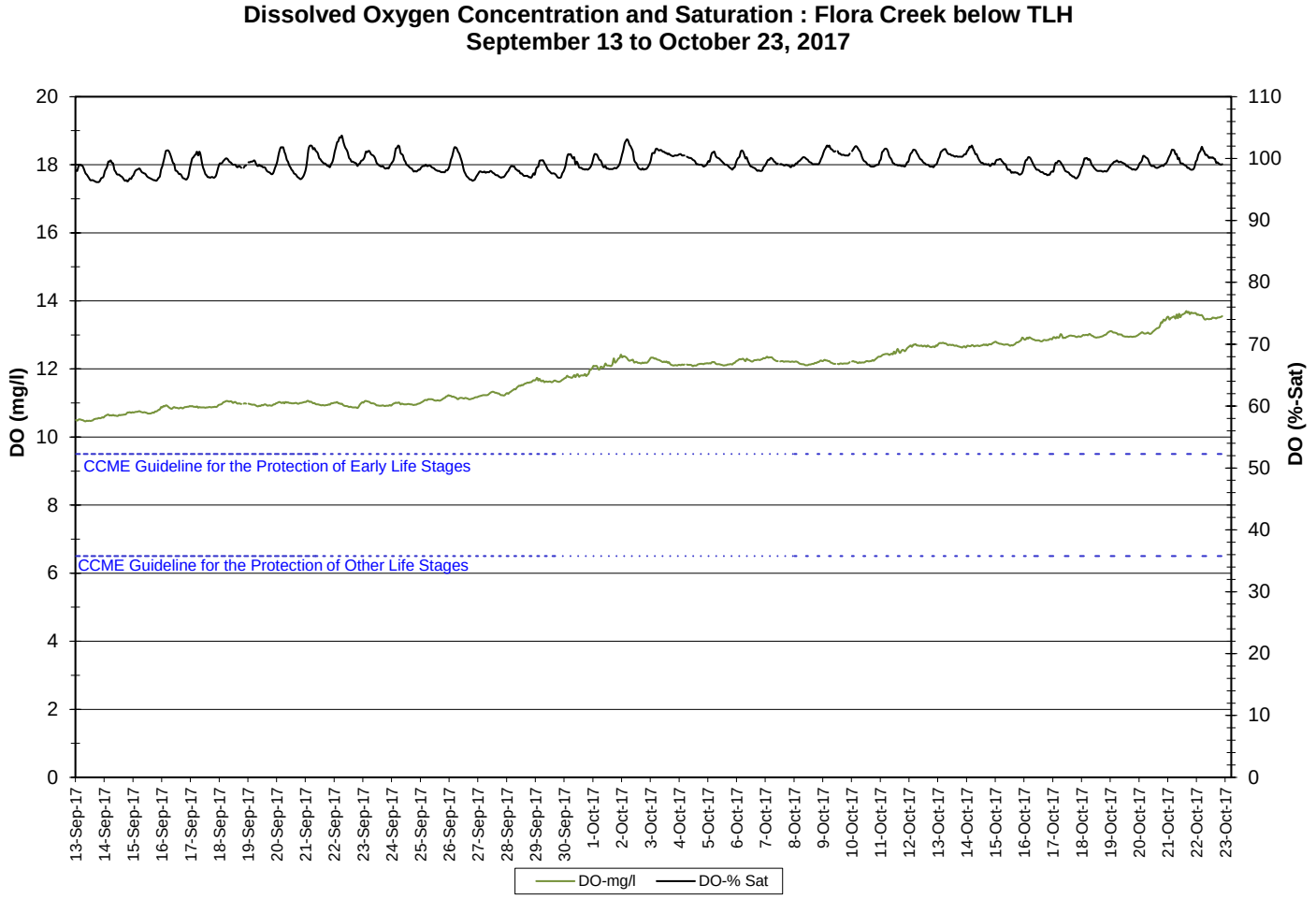

Figure 5: Dissolved oxygen and percent saturation - Flora Creek below TLH

Flora Creek below TLH, Newfoundland and Labrador

- Turbidity values range from 43.6 NTU to 125.9 NTU, the highest readings being recorded at the beginning of the deployment period. (Figure 6).
- This site has very turbid water at times. Turbidity decreased during this deployment period. There were a few spikes for unknown reasons, some may be attributed to precipitation events, but there were a number of days where precipitation data was not available.

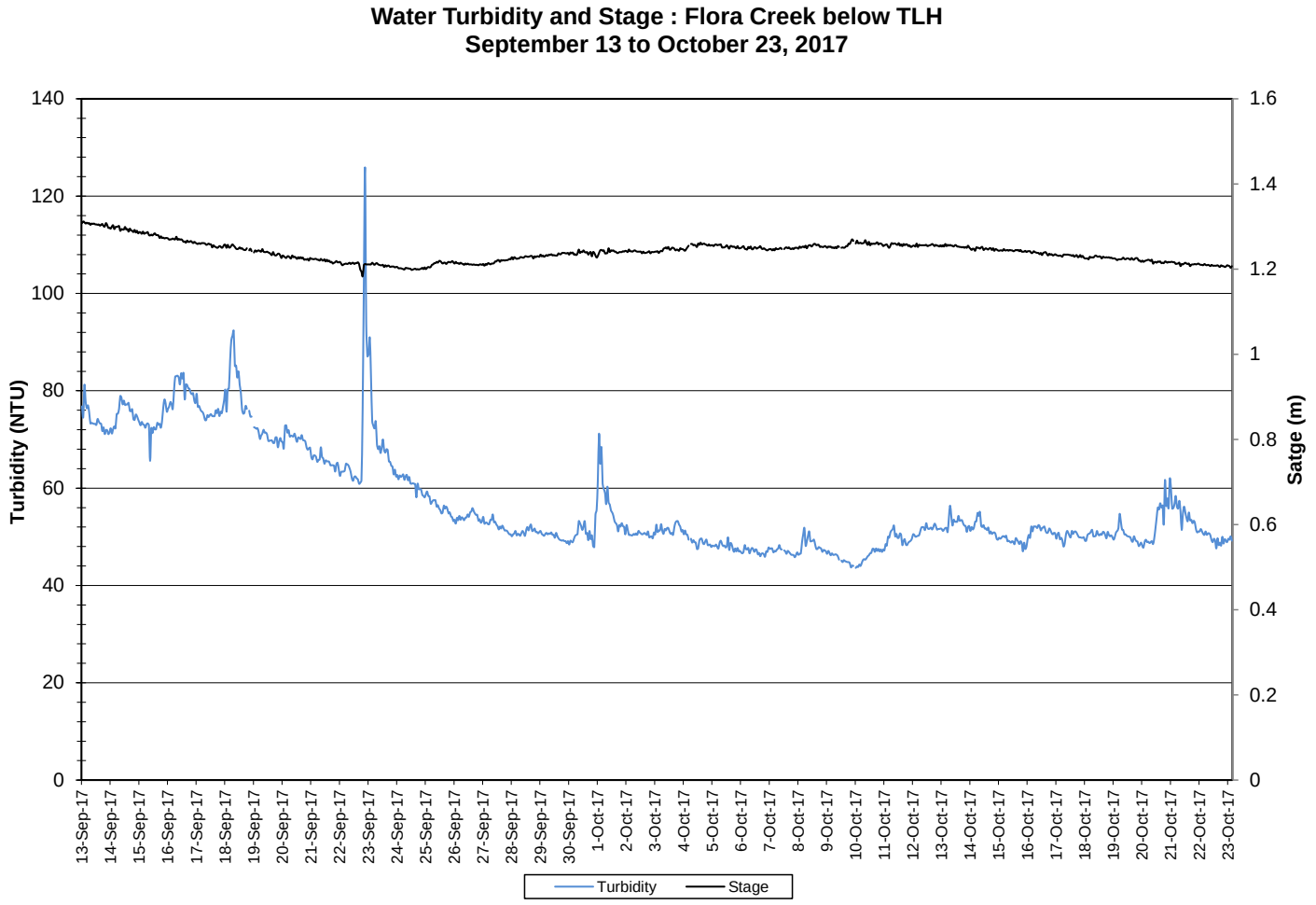

Figure 6: Turbidity and Stage - Flora Creek below TLH

- Precipitation and stage during the deployment period is graphed below (Figure 7). Stage decreased during the first portion of this deployment period and then remained relatively stable
- 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.

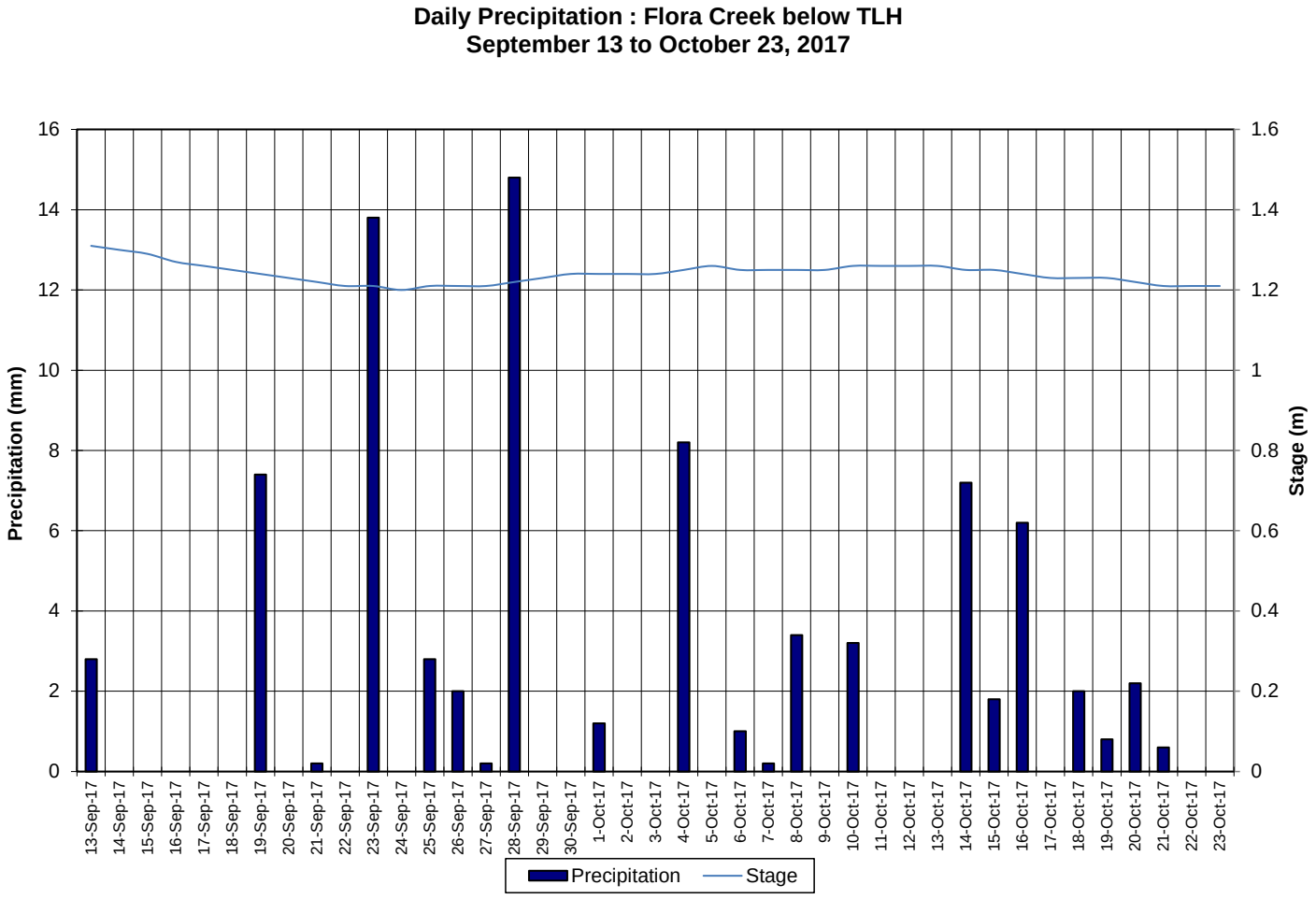

Figure 7: Precipitation and Stage – Flora Creek below TLH

(Weather data collected at Goose Bay, NL)

Conclusions

- An instrument at the water quality monitoring station on the Flora Creek below TLH station was deployed on September 13th for the final deployment of the 2017 season. It was removed on October 23rd, 2017.
- In most cases, weather related events or increases/decreases in water level could be used to explain the 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 later portion of the deployment period. Water temperature corresponded with air temperature. The temperature typically ranged between 1.80 and 12.76^{o}C.
- pH values were all within the recommended CCME Guidelines for the Protection of Aquatic Life. pH ranged between 7.52 and 7.71.
- Specific conductivity ranged from 64.7 to 67.7 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 decreased during this deployment period, with a few spikes.
- Stage decreased during the first part of the deployment period, and then remained relatively stable.
- 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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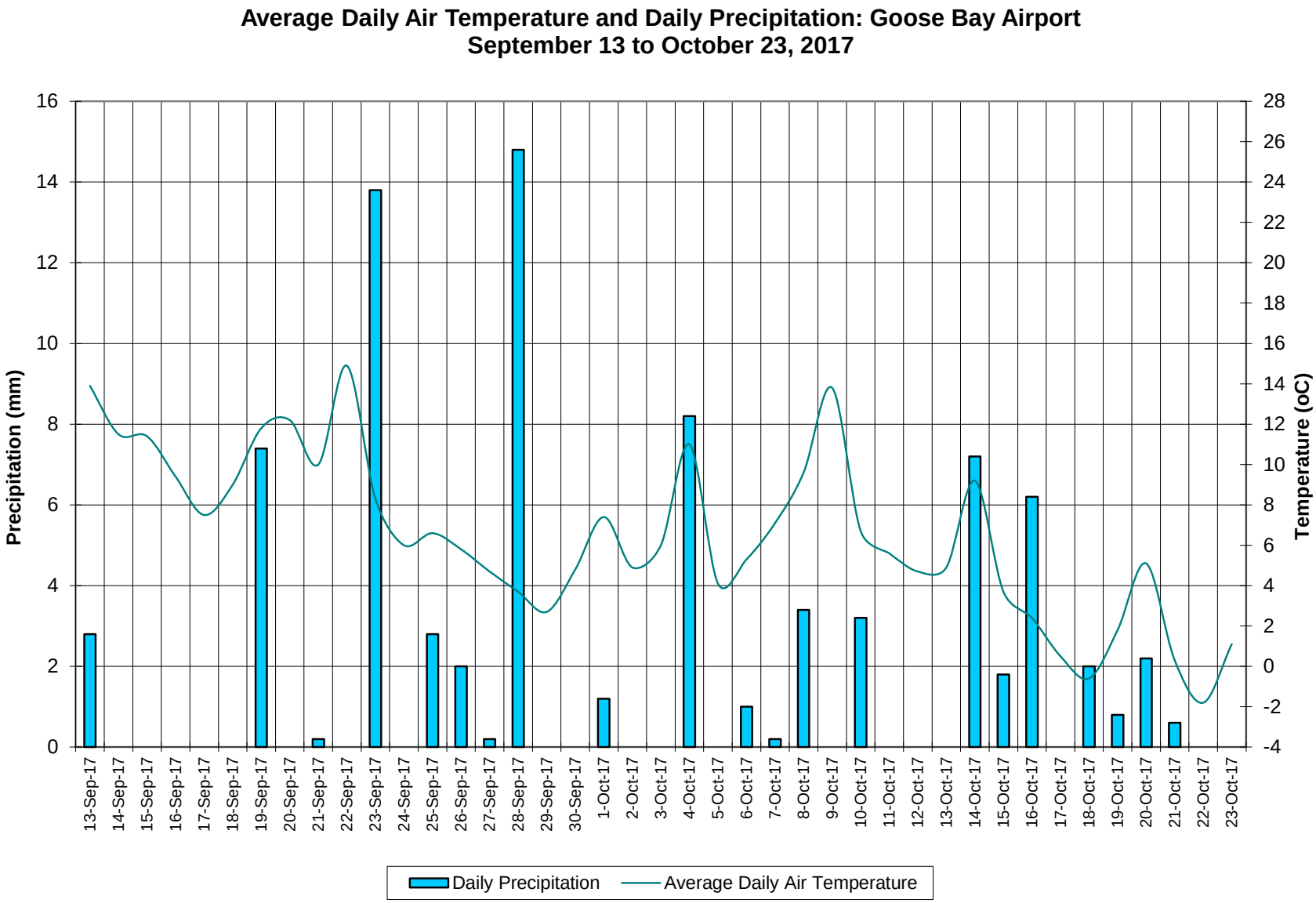
Appendix 1


Average Daily Air Temperature and Daily Precipitation: Goose Bay Airport
September 13 to October 23, 2017
Precipitation (mm)
Temperature (oC)
0
2
4
6
8
10
12
14
16
-4
-2
0
2
4
6
8
10
12
14
16
18
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26
28
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27-Sep-17
28-Sep-17
29-Sep-17
30-Sep-17
1-Oct-17
2-Oct-17
3-Oct-17
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22-Oct-17
23-Oct-17
Daily Precipitation
Average Daily Air Temperature