Real-Time Water Quality Deployment Report

Flora Creek below TLH

July 21 to
August 30, 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 July 21, 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 40 days. The instrument was removed on August 30th, 2016.

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 July 21 and August 30, 2016 is summarized in Table 2.

Table 2: Comparison rankings for Flora Creek below TLH station July 21 – August 30, 2016.

Station	Date	Action	Comparison Ranking				
			Temperature	pH	Conductivity	Dissolved Oxygen	Turbidity
Flora Creek below TLH	July 21, 2016	Deployment	Excellent	Good	Good	Fair	Fair
	Aug 30, 2016	Removal	Excellent	Good	Excellent	Fair	Excellent

- At deployment, all parameters besides dissolved oxygen and turbidity ranked either 'excellent' or 'good'. Dissolved oxygen ranked 'fair', the field sonde read a value of 9.75 mg/l while the QA/QC sonde read a value of 9.15 mg/l. For turbidity, the field sonde read a value of 69.49 NTU and the QA/QC sonde read a value of 79.69 NTU. These rankings could be due to the placement of the QA/QC instrument in relation to the field sonde, or the amount of time the instrument was given to stabilize.

- At removal, all parameters besides dissolved oxygen ranked either 'good' or 'excellent'. Dissolved oxygen ranked fair, the field sonde read a value of 10.35 mg/l while the QA/QC sonde read a value of 9.58 mg/l. This ranking could be due to the placement of the QA/QC instrument in relation to the field sonde, or the amount of time the instrument was given to stabilize.

Data Interpretation

- The following graphs and discussion illustrate water quality-related events from July 21 to August 30 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 13.46 to 23.46^{o}C during this deployment period (Figure 1).
- Water temperature generally decreased throughout the deployment period, corresponding with decreasing ambient air temperature (Figure 2).

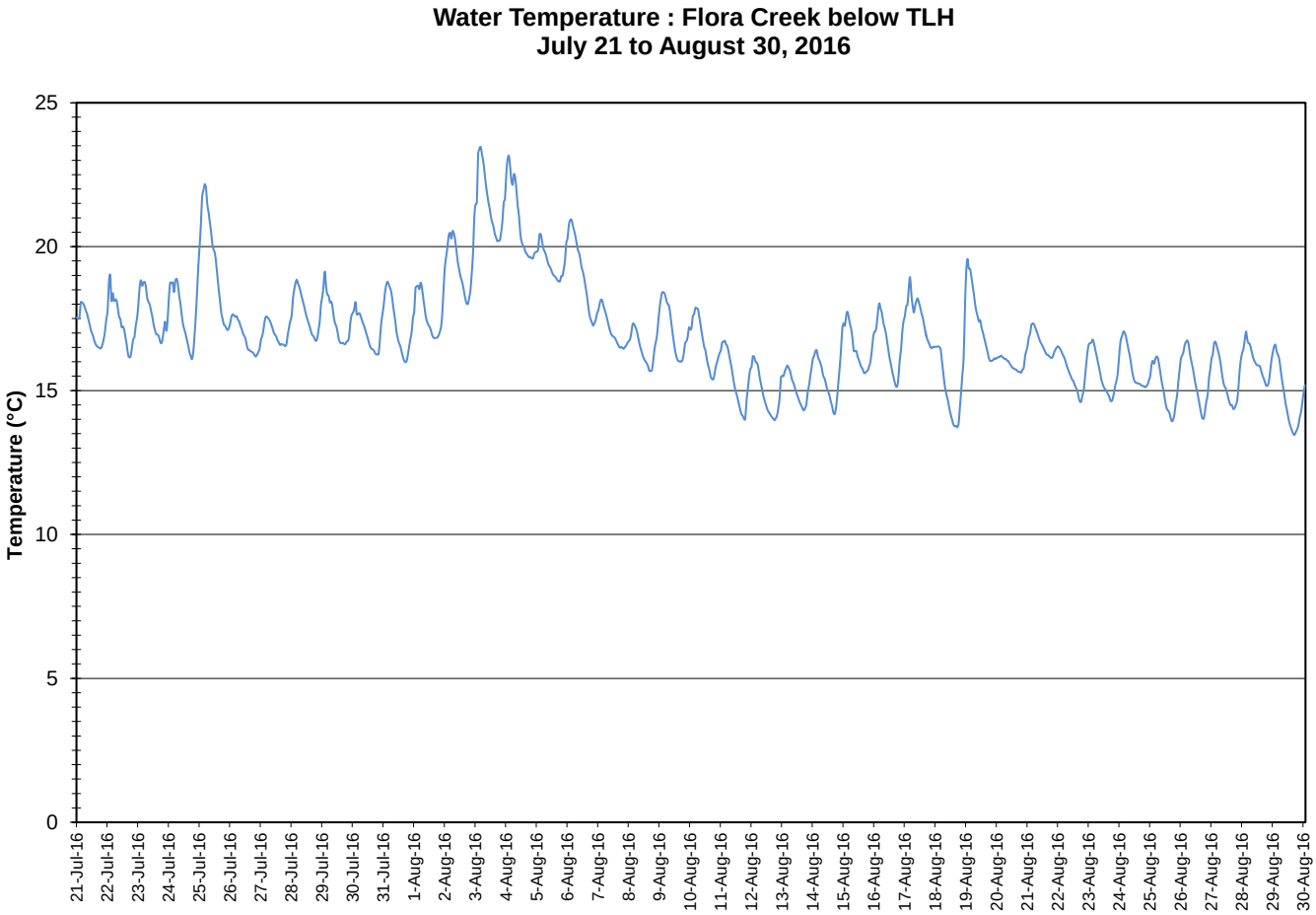


Figure 1: Water temperature - Flora Creek below TLH

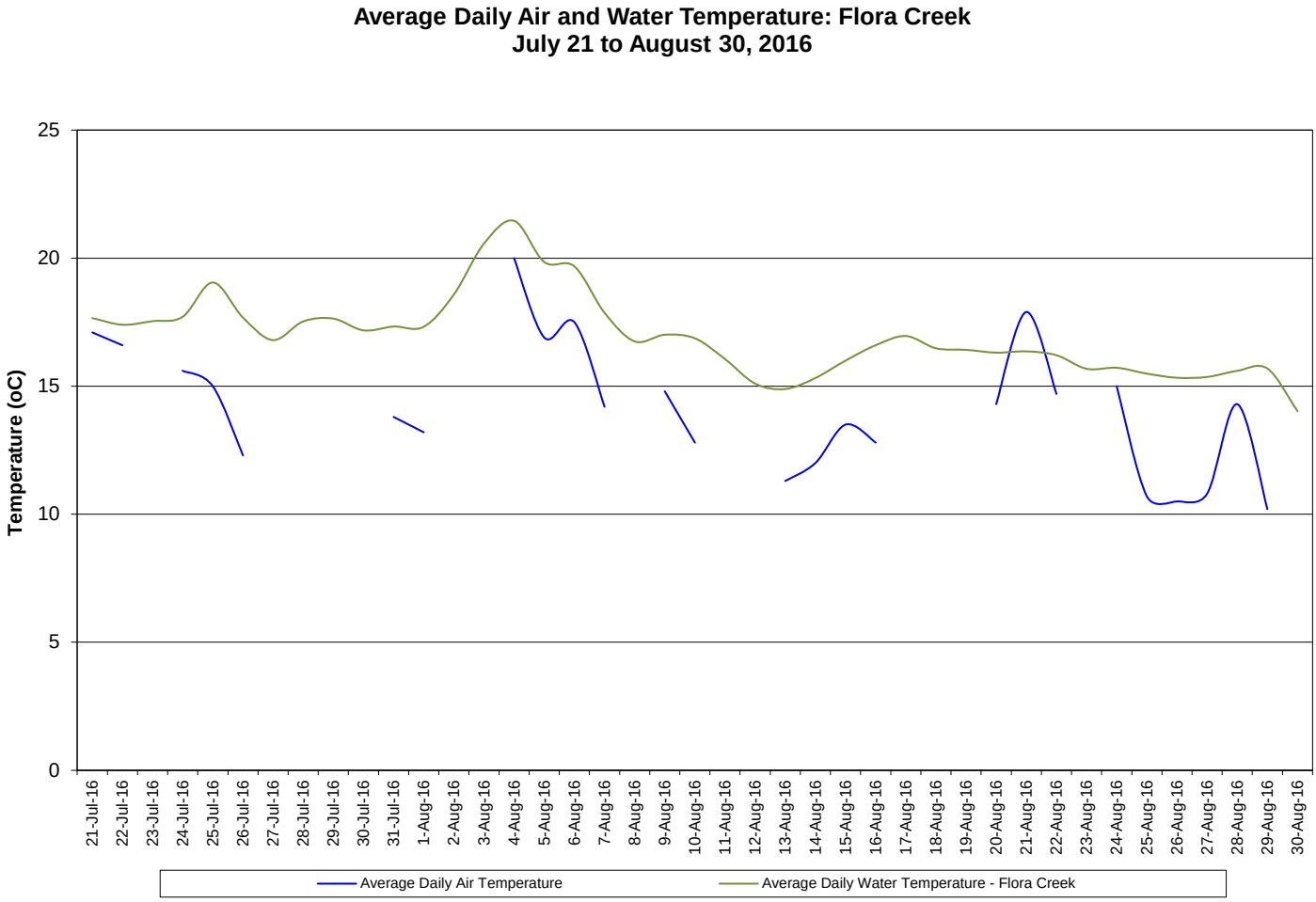


Figure 2: Average daily air and water temperatures - Flora Creek below TLH (weather data collected at Wabush Airport)

- pH ranged between 7.26 and 8.00 pH units throughout the deployment period, with a median value of 7.70 units (Figure 3). There is a noticeable drop in pH on the 18th of August; this is due to an increase in stage after a heavy rainfall event.
- 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.
- 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.

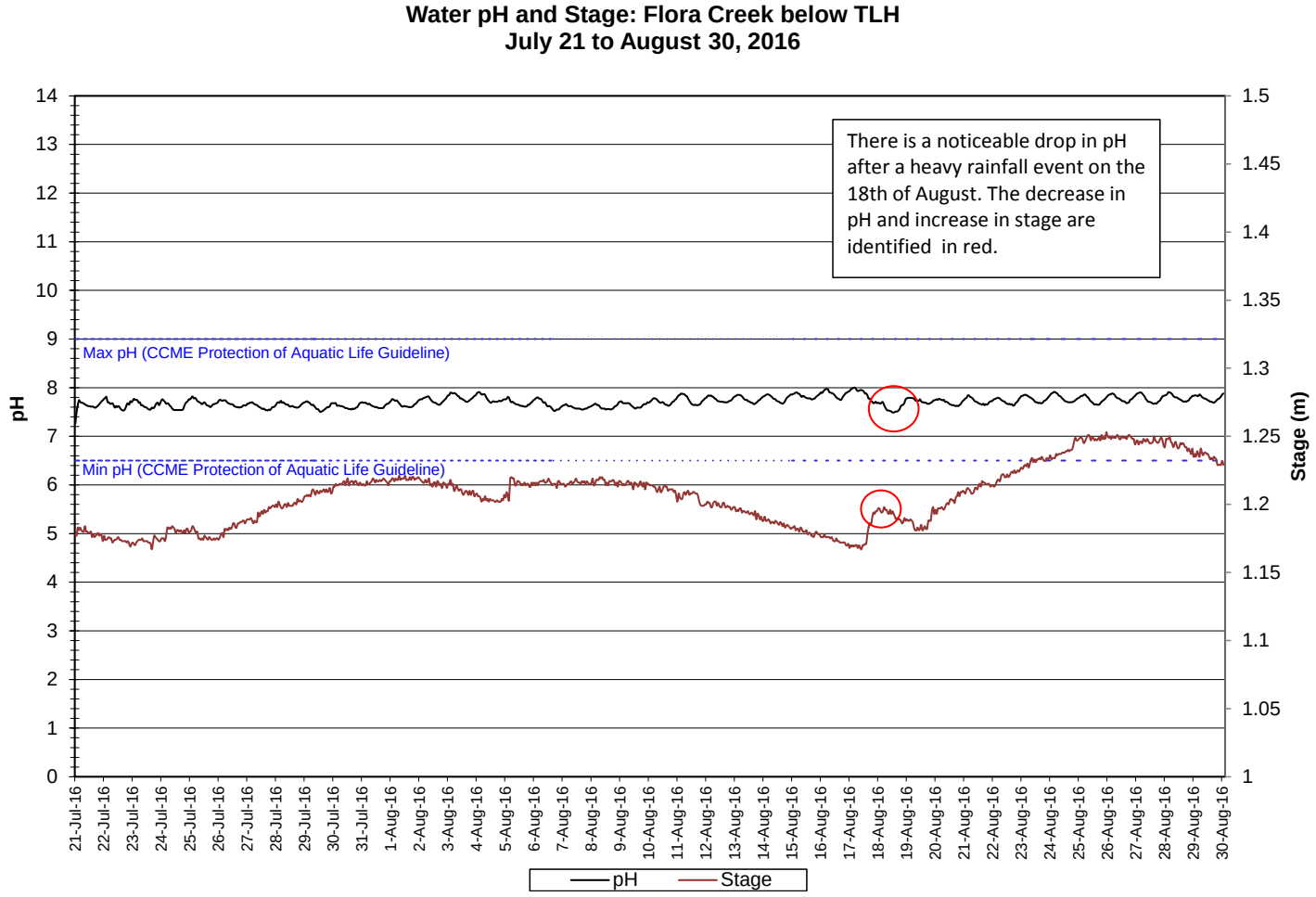


Figure 3: pH - Flora Creek below TLH

- Specific conductivity ranged from 71.5 to 76.5 µs/cm (Figure 4).
- Specific conductivity increased slightly over the course of this deployment period.
- There was a noticeable decrease in conductivity on the 18th of August, this correlates with a significant rainfall event that day. This occurs when an increased amount of water is introduced to the system and the amount of solids is diluted.
- Stage is 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.

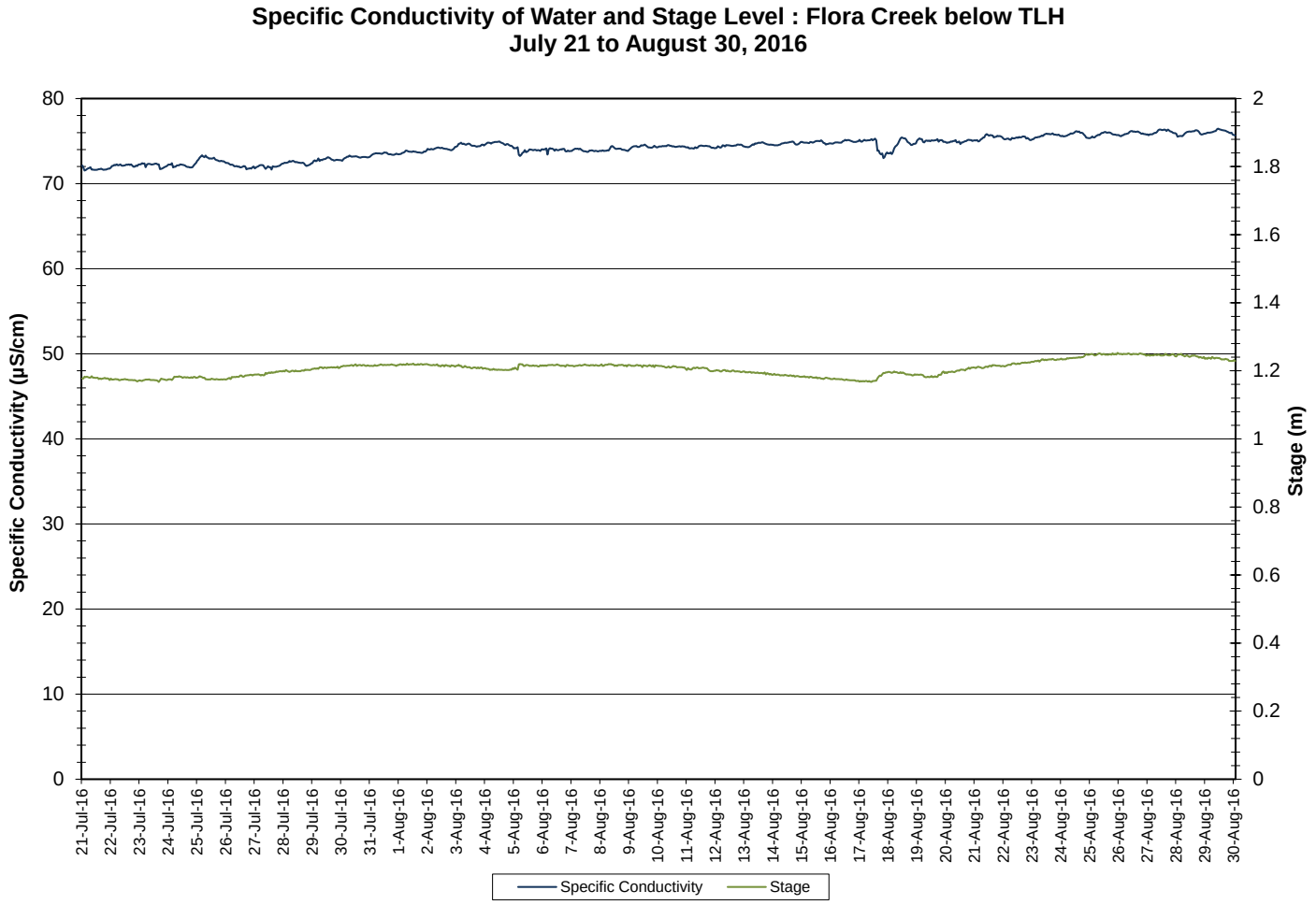


Figure 4: Specific conductivity and stage level - Flora Creek below TLH

- The saturation of dissolved oxygen ranged from 93.4 to 111.9% and a range of 8.92 to 10.34 mg/l was found in the concentration of dissolved oxygen with a median value of 9.65 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 is relatively stable during this deployment period, slightly increasing during the later portion of the period, this is due to a decrease in water temperature.

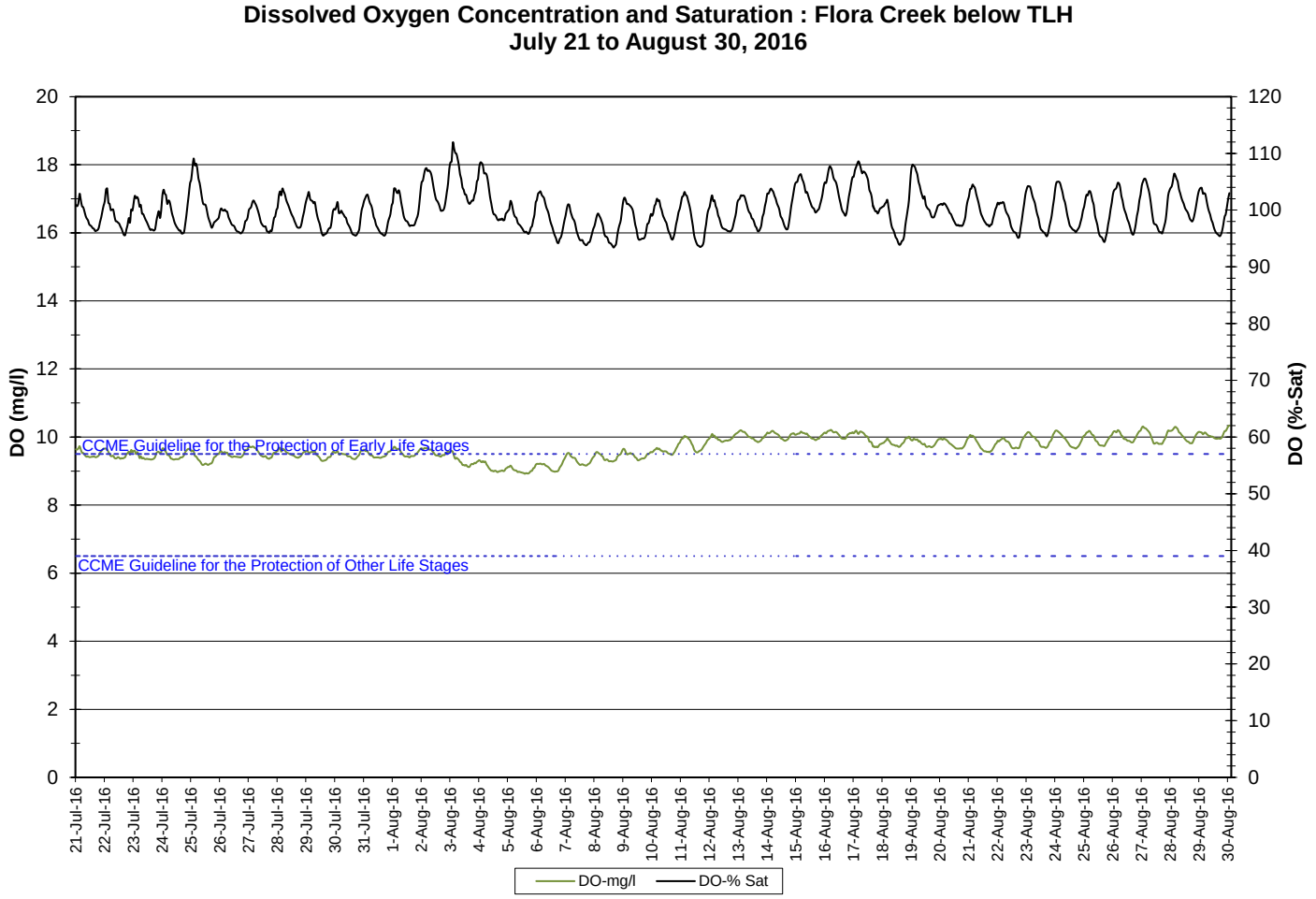


Figure 5: Dissolved oxygen and percent saturation - Flora Creek below TLH

- Turbidity values range from 5.5 NTU to 72.1 NTU, the highest readings being recorded at the beginning of the deployment period. Turbidity gradually decreases over the course of the period (Figure 6).
- This site has very turbid water at times. However, turbidity levels for this deployment period are significantly less than the previous deployment period.
- Stage does not greatly influence the turbidity levels at this station; turbidity is continually declining from the high runoff in the spring.
- 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.

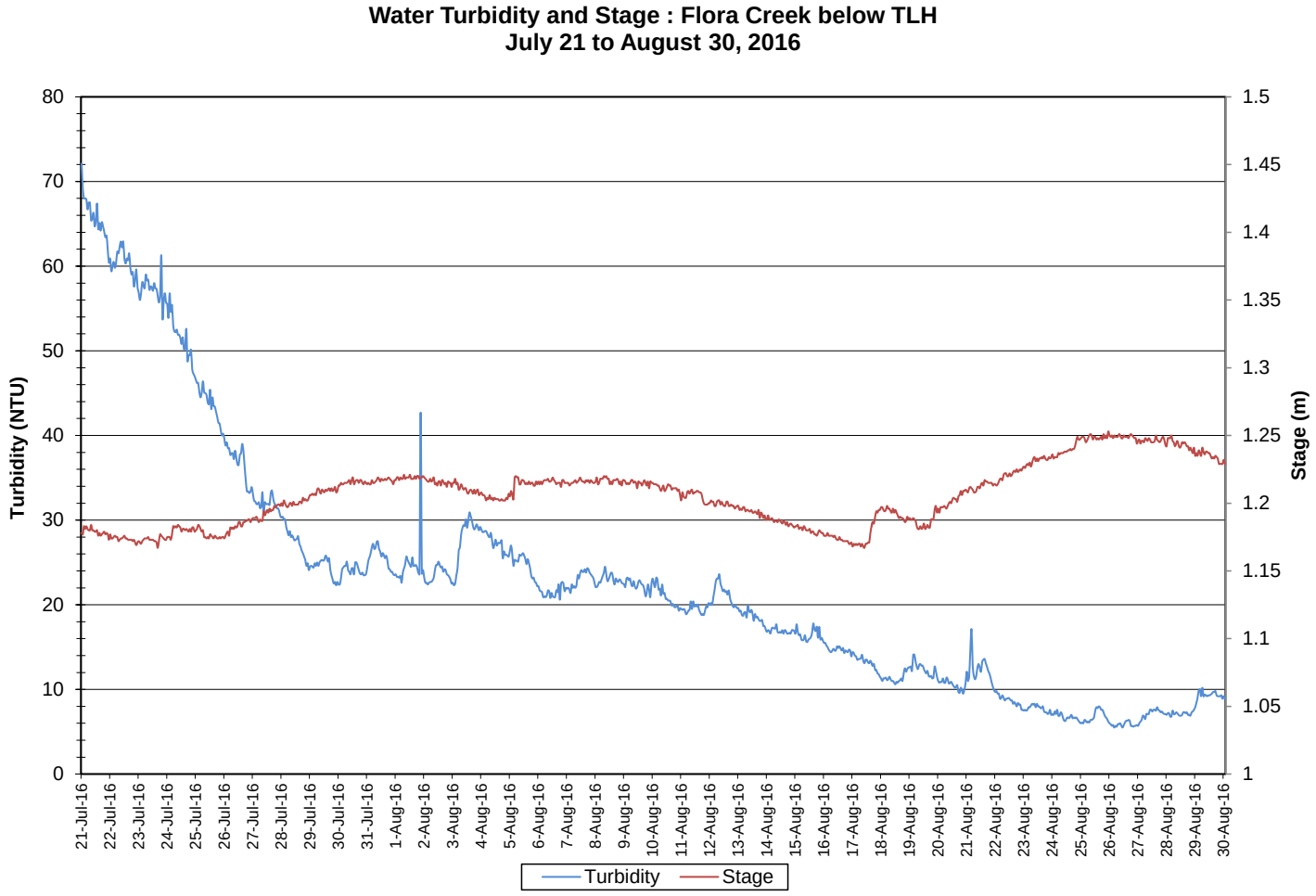


Figure 6: Turbidity - Flora Creek below TLH

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

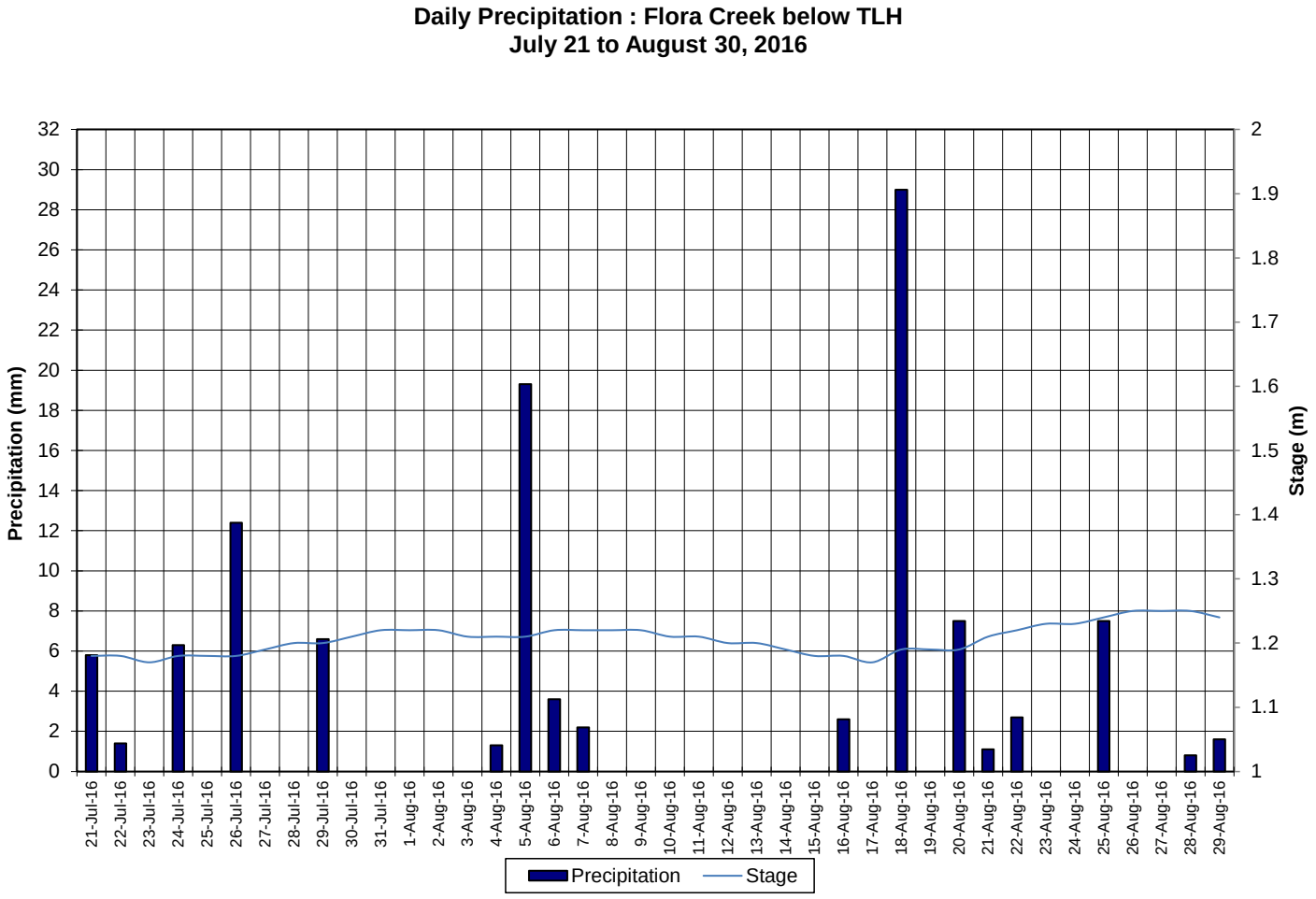


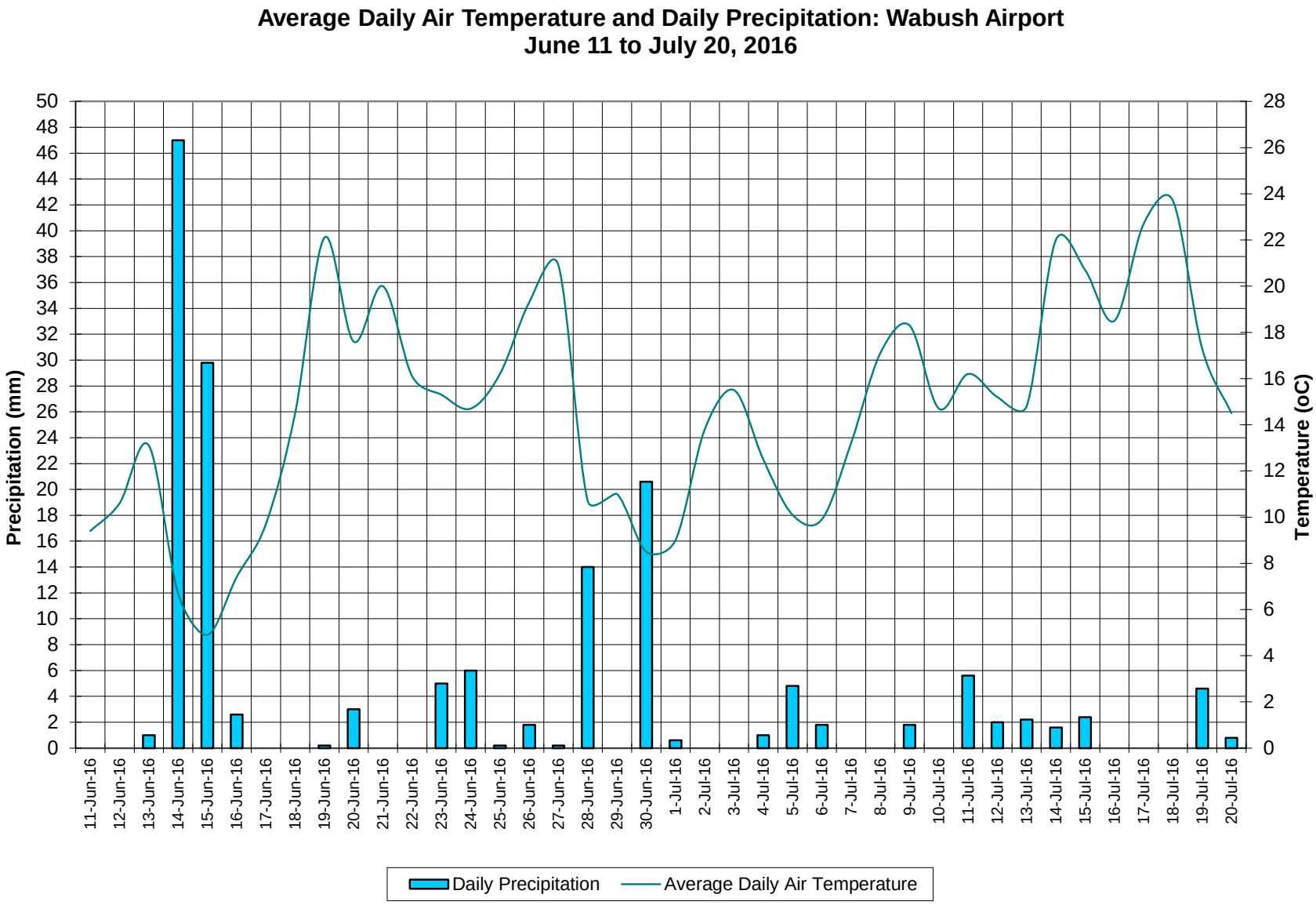
Figure 7: Precipitation and Stage – Flora Creek below TLH

Conclusions

- An instrument at the water quality monitoring station on the Flora Creek below TLH station was deployed on July 21 and removed on August 30, 2016, for cleaning and calibration.
- 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 13.46 and 23.46^{o}C.
- pH values were all within the recommended CCME Guidelines for the Protection of Aquatic Life. pH ranged between 7.26 and 8.00.
- Specific conductivity ranged from 71.5 to 76.5 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.
- Turbidity values decreased significantly over the deployment period.
- Stage was relatively 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.

Prepared by:
Maria Murphy
Department of Environment and Climate Change
Water Resources Management Division
Phone: 709.896.7981
Fax: 709.896.9566

Appendix 1


Average Daily Air Temperature and Daily Precipitation: Wabush Airport
June 11 to July 20, 2016
Precipitation (mm)
Temperature (oC)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
50
11-Jun-16
12-Jun-16
13-Jun-16
14-Jun-16
15-Jun-16
16-Jun-16
17-Jun-16
18-Jun-16
19-Jun-16
20-Jun-16
21-Jun-16
22-Jun-16
23-Jun-16
24-Jun-16
25-Jun-16
26-Jun-16
27-Jun-16
28-Jun-16
29-Jun-16
30-Jun-16
1-Jul-16
2-Jul-16
3-Jul-16
4-Jul-16
5-Jul-16
6-Jul-16
7-Jul-16
8-Jul-16
9-Jul-16
10-Jul-16
11-Jul-16
12-Jul-16
13-Jul-16
14-Jul-16
15-Jul-16
16-Jul-16
17-Jul-16
18-Jul-16
19-Jul-16
20-Jul-16
Daily Precipitation
Average Daily Air Temperature