Real-Time Water Quality Deployment Report

Flora Creek below TLH

June 4 to
July 7, 2015

Newfoundland Labrador

Government of Newfoundland & Labrador
Department of Environment and Conservation
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 June 4, 2015, a real-time water quality monitoring instrument was deployed at the station Flora Creek below TLH. The instrument was deployed for a period of 33 days. The instrument was removed on July 7th, 2015. This was the first deployment period for this 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 June 4 and July 7, 2015 is summarized in Table 2.

Table 2: Comparison rankings for Flora Creek below TLH station June 4 – July 7, 2015.

Station	Date	Action	Comparison Ranking				
			Temperature	pH	Conductivity	Dissolved Oxygen	Turbidity
Flora Creek below TLH	June 4, 2015	Deployment	Excellent	Excellent	Good	Excellent	Excellent
	July 7, 2015	Removal	Excellent	Good	Poor	Excellent	Excellent

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

- At removal, temperature, pH, dissolved oxygen and turbidity ranked 'excellent' or 'good'. Conductivity ranked 'poor', the field sonde read a value of 70.5 µs/cm and the QA/QC instrument read a value of 126.0 µs/cm. This could be due to the fact that occasionally the conductivity sensor on this instrument can take some time to stabilize.

Data Interpretation

- The following graphs and discussion illustrate water quality-related events from June 4 to July 7 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 5.02 to 19.49°C during this deployment period (Figure 1).
- Water temperature increased throughout the deployment period, corresponding with increasing ambient air temperature (Figure 2).

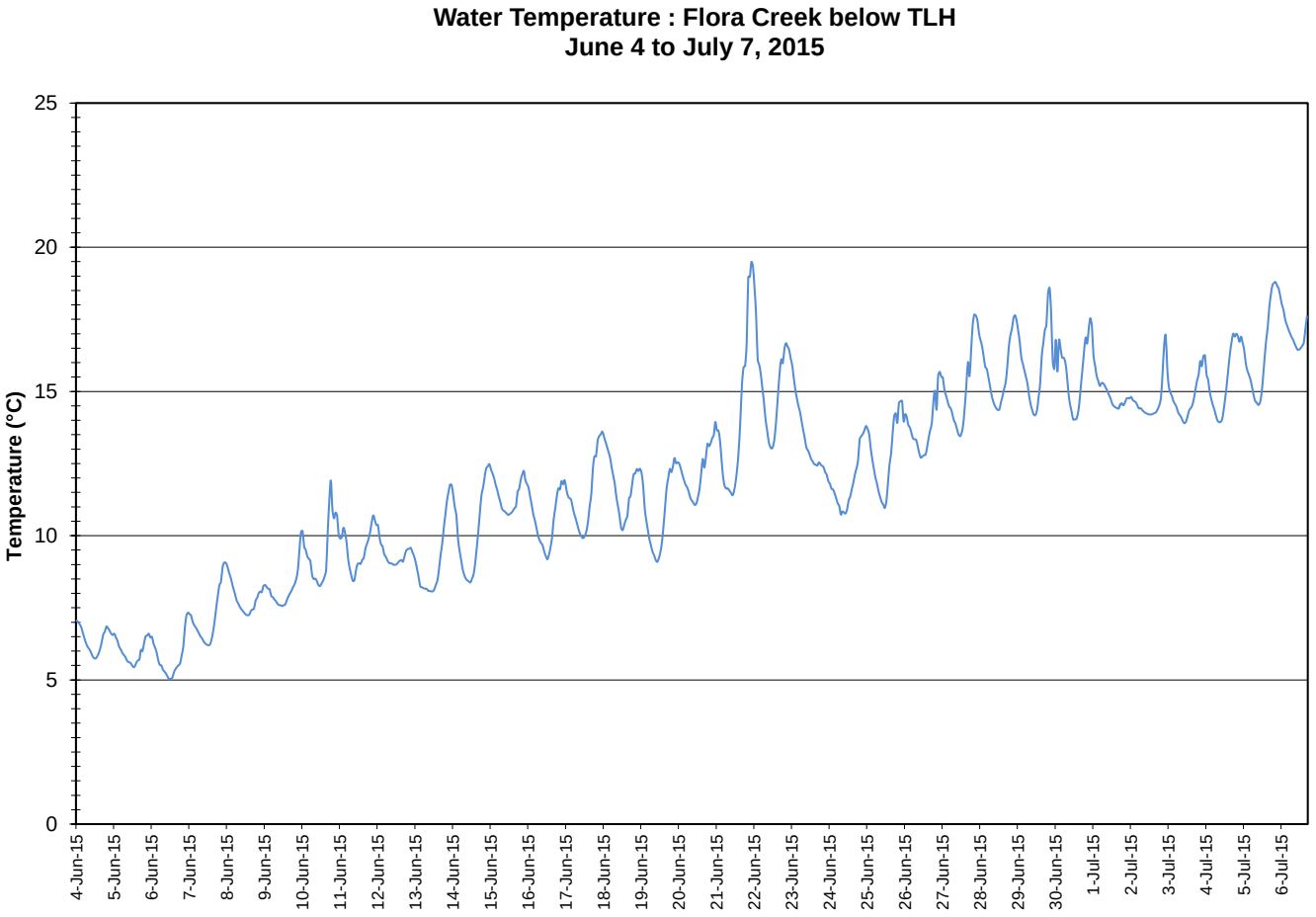

Figure 1: Water temperature - Flora Creek below TLH

Flora Creek below TLH, Newfoundland and Labrador

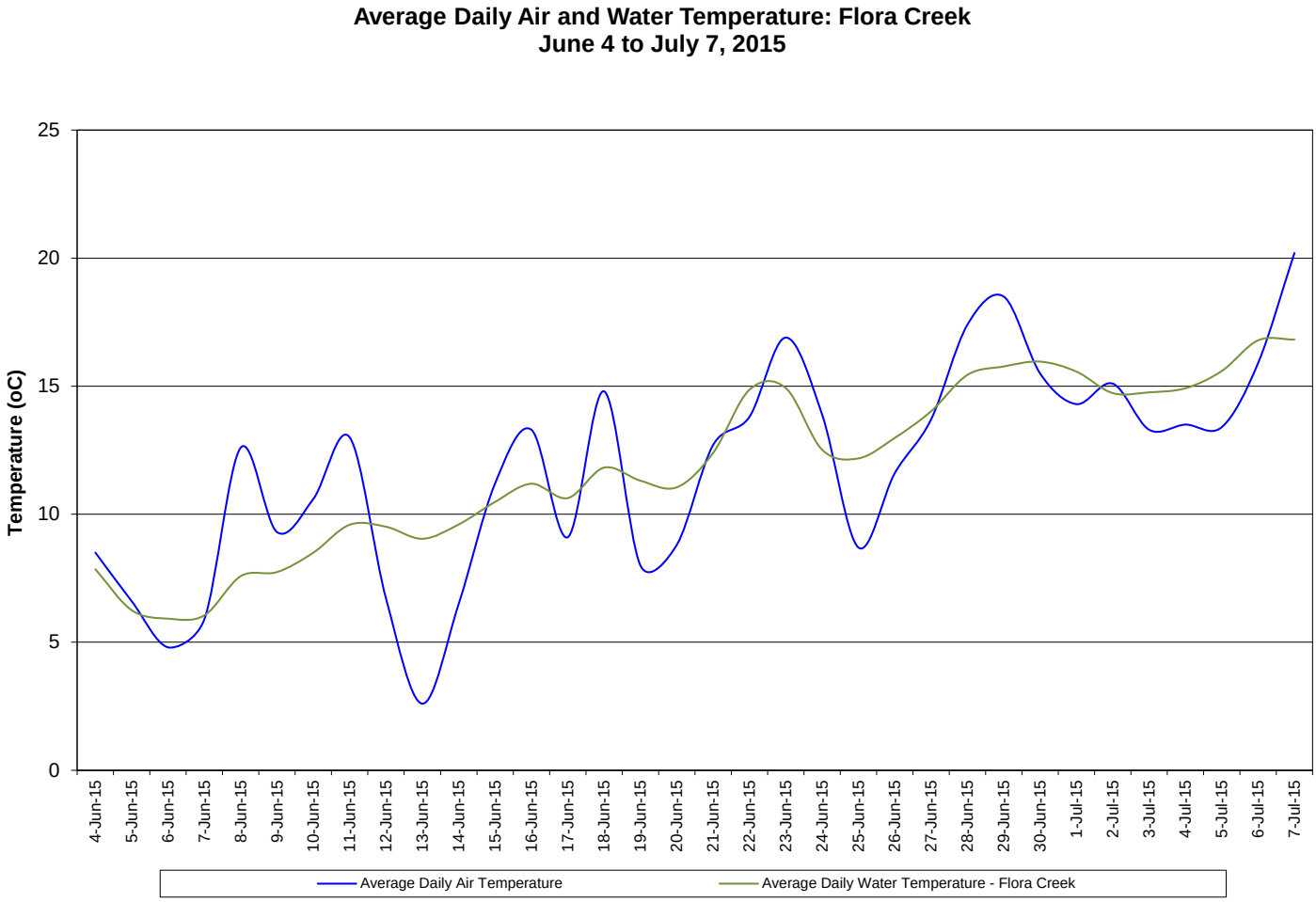

Figure 2: Average daily air and water temperatures - Flora Creek below TLH

(Weather data collected at Churchill Falls)

Flora Creek below TLH, Newfoundland and Labrador

- pH ranged between 7.11 and 7.73 pH units throughout the deployment period, with a median value of 7.64 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.

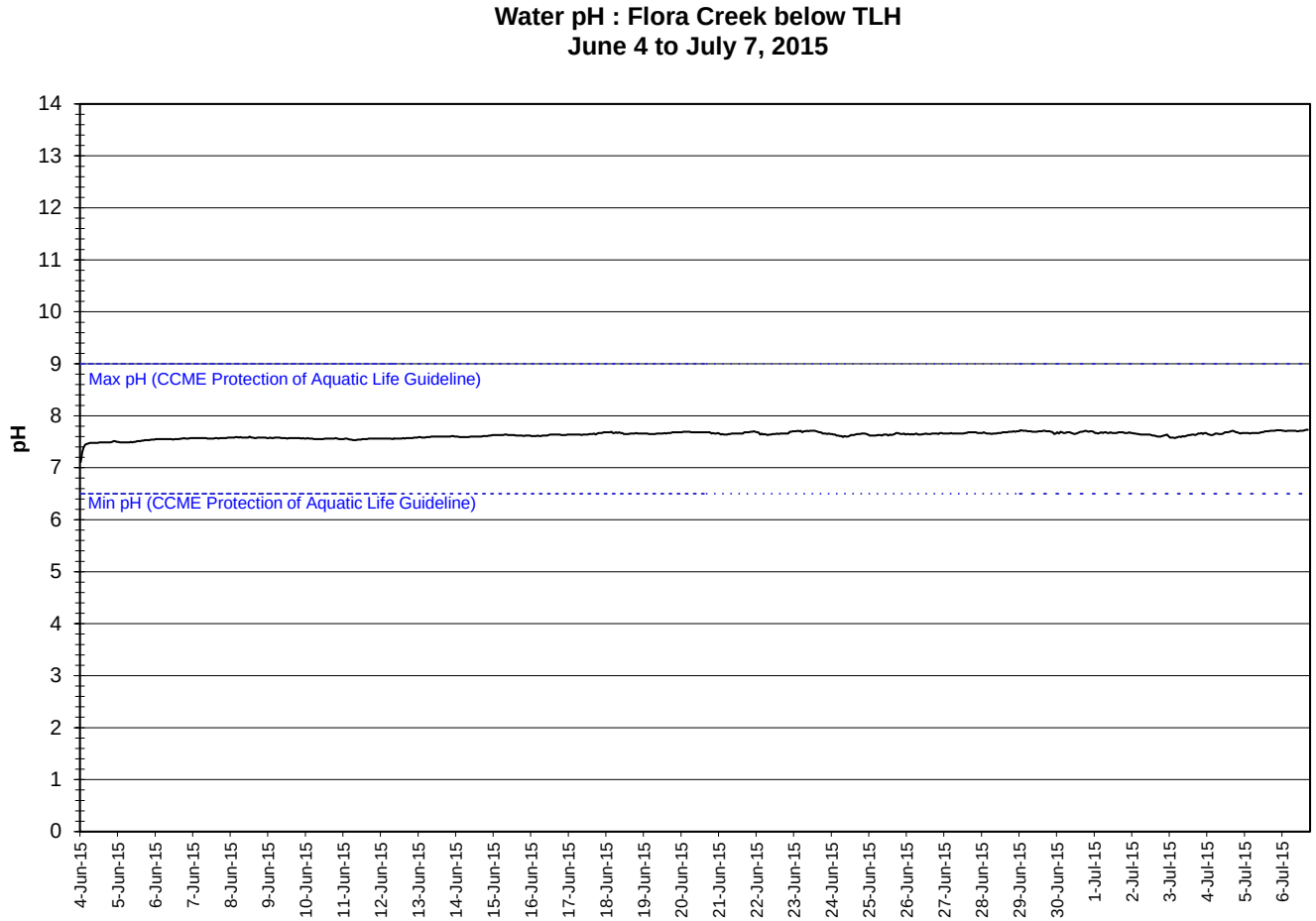

Figure 3: pH - Flora Creek below TLH

- Specific conductivity ranged from 61.6 to 77.9 µs/cm (Figure 4).
- Specific conductivity was relatively stable during the deployment period, slightly increasing during the later portion of the period, while stage decreased slightly then stabilized.
- 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.

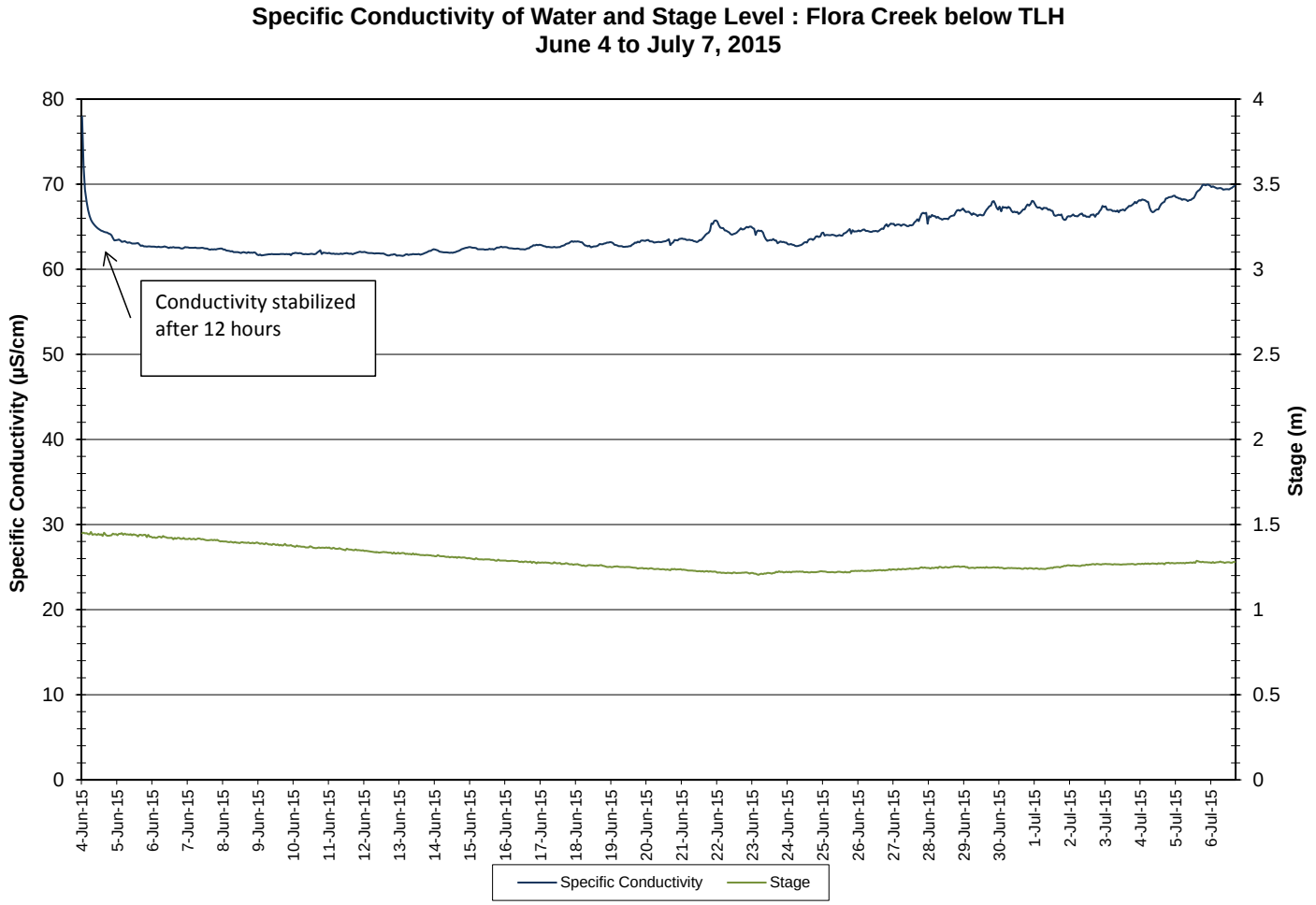

Figure 4: Specific conductivity and stage level - Flora Creek below TLH

- The saturation of dissolved oxygen ranged from 88.9 to 102.0% and a range of 8.88 to 11.64 mg/l was found in the concentration of dissolved oxygen with a median value of 10.04 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. There is a decreasing DO trend during this deployment period; this is due to the increasing water temperature trend.

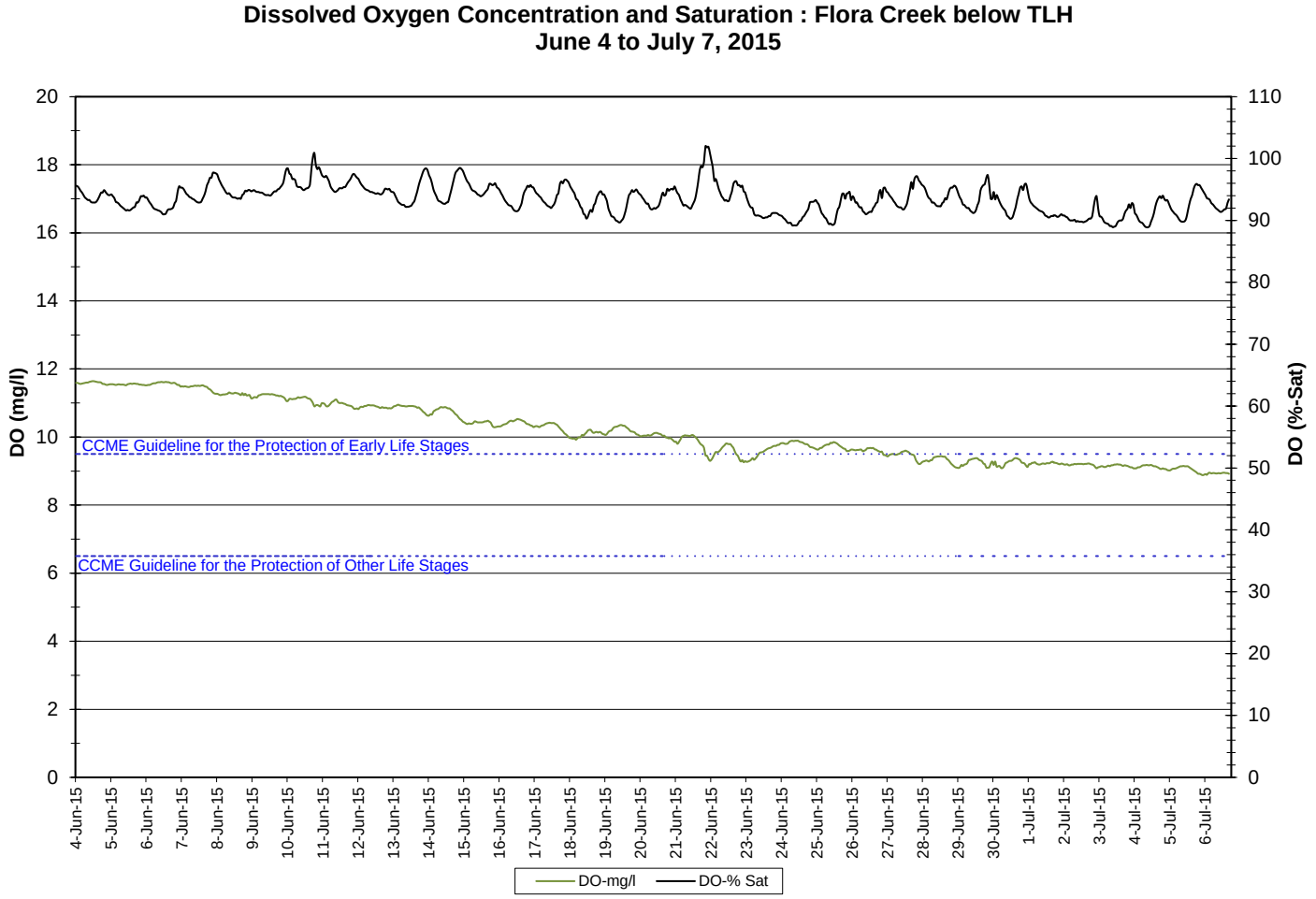

Figure 5: Dissolved oxygen and percent saturation - Flora Creek below TLH

Flora Creek below TLH, Newfoundland and Labrador

- Turbidity values range from 181.0 NTU to 837.9 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. It is likely that the high turbidity in June can be attributed to late snow melt/spring freshet.

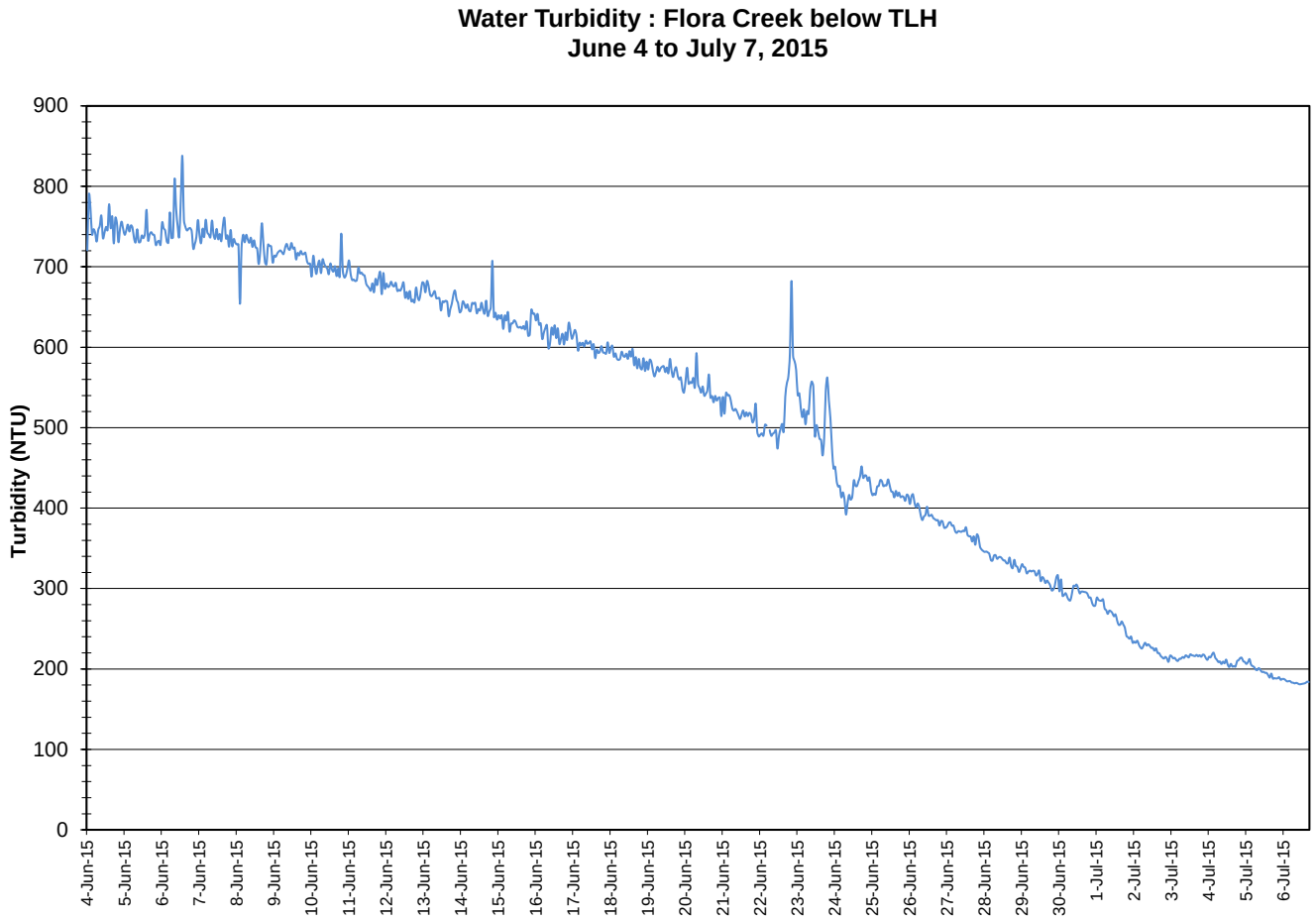

Figure 6: Turbidity - Flora Creek below TLH

- Precipitation and stage during the deployment period is graphed below (Figure 7). Stage decreased during the first portion of the deployment period and then began to increase slightly.
- It is important to note that weather data was collected from Churchill Falls, ~200 km away. Data from the local area was not available for this period.
- 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.

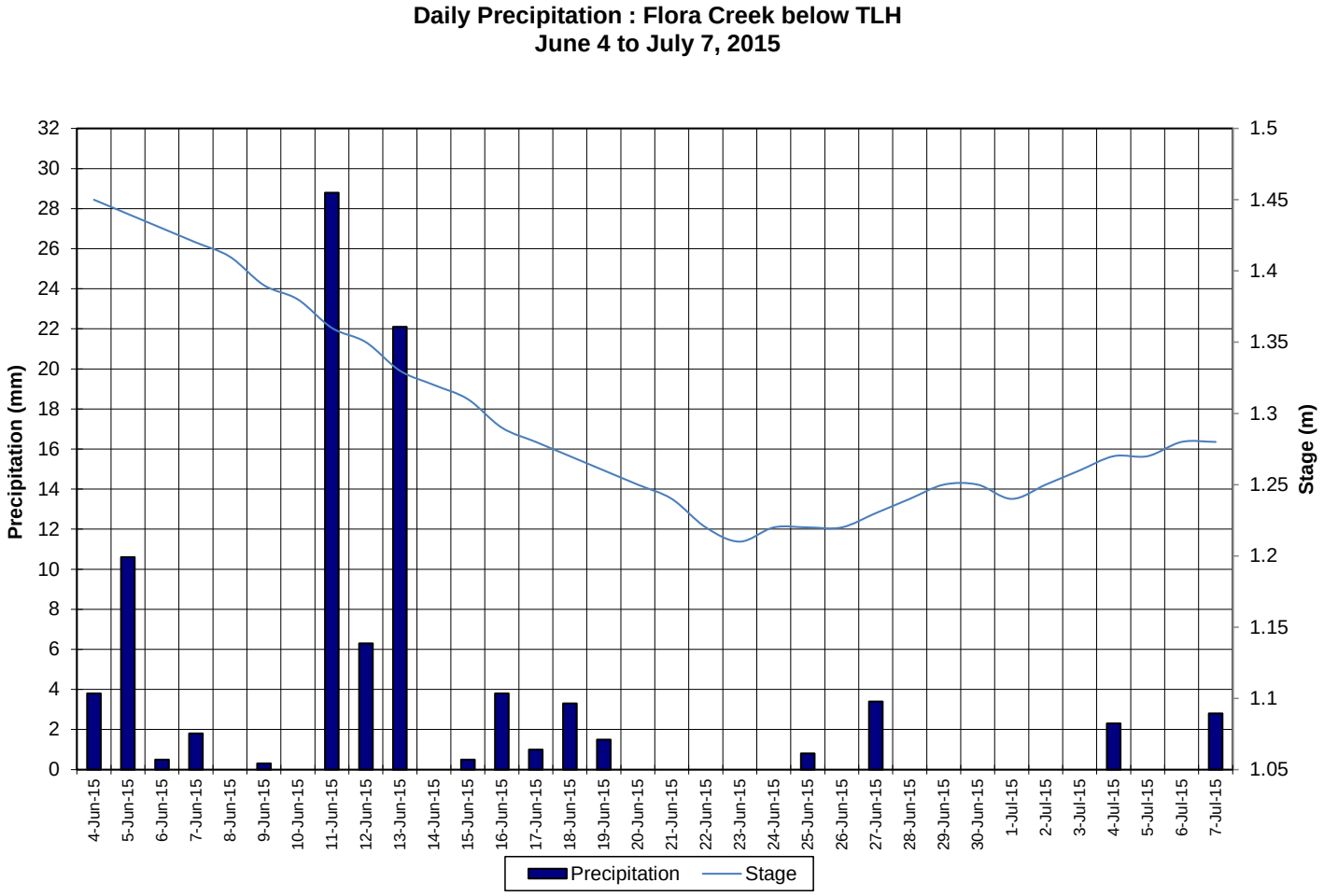

Figure 7: Precipitation and Stage – Flora Creek below TLH

(Weather data collected at Churchill Falls)

Conclusions

- An instrument at the water quality monitoring station on the Flora Creek below TLH station was deployed on June 4 and removed on July 7, 2015. This was the first deployment period for this 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 increased during the deployment period. Water temperature corresponded with air temperature. The temperature typically ranged between 5.02 and 19.49^{o}C.
- pH values were all within the recommended CCME Guidelines for the Protection of Aquatic Life. pH ranged between 7.11 and 7.73.
- Specific conductivity ranged from 61.6 to 77.9 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 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 decreased during the first portion of the deployment period and then began to increase slightly.
- 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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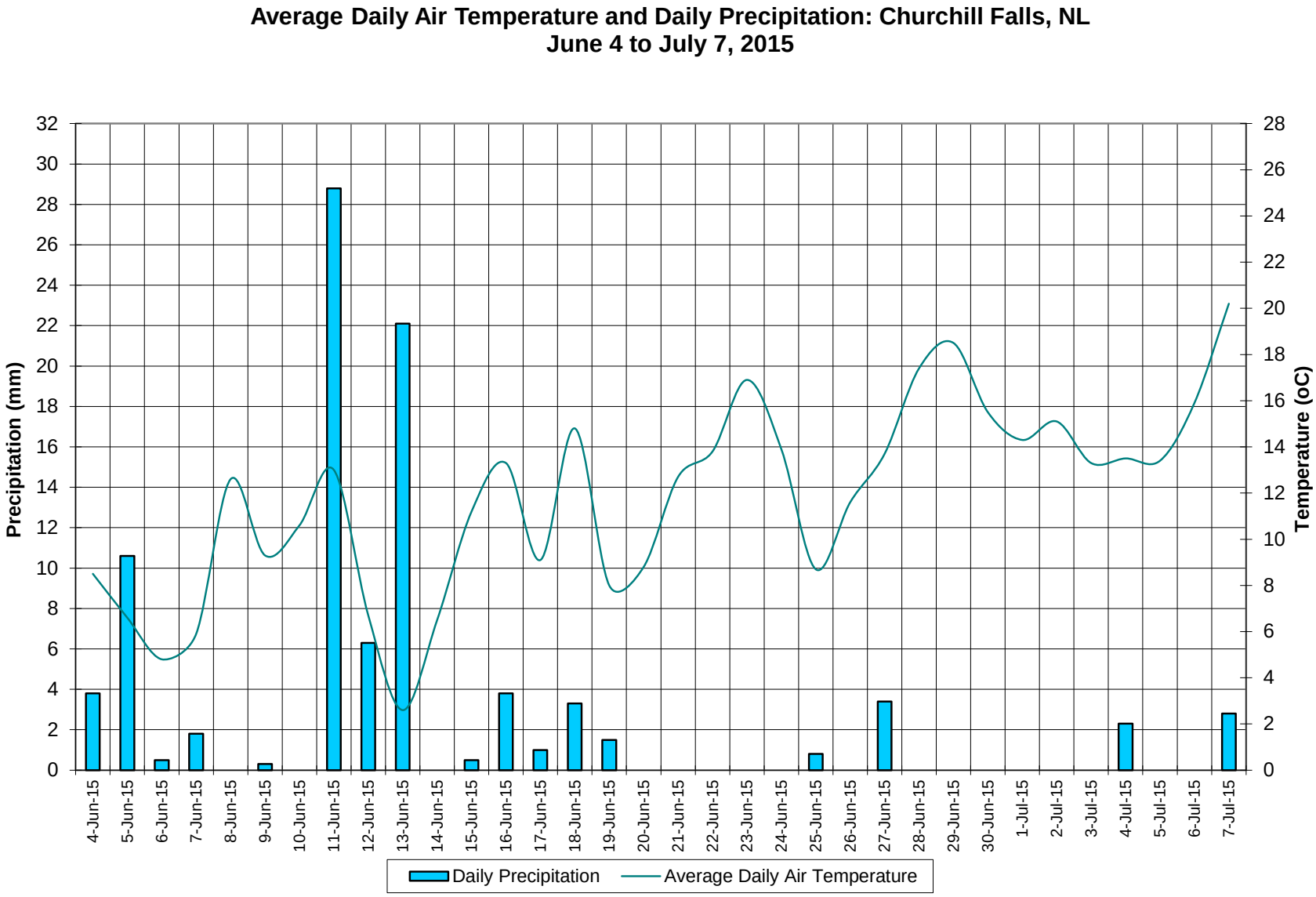
Appendix 1


Average Daily Air Temperature and Daily Precipitation: Churchill Falls, NL
June 4 to July 7, 2015
Precipitation (mm)
Temperature (oC)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
4-Jun-15
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27-Jun-15
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29-Jun-15
30-Jun-15
1-Jul-15
2-Jul-15
3-Jul-15
4-Jul-15
5-Jul-15
6-Jul-15
7-Jul-15
Daily Precipitation
Average Daily Air Temperature