Real-Time Water Quality Deployment Report

Flora Creek below TLH

July 18 to
August 28, 2019

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 monitor the real-time web pages regularly.
- On July 18, 2019, a real-time water quality monitoring instrument was deployed at the station Flora Creek below TLH. The instrument was deployed for a period of 41 days.

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.

- Deployment and removal comparison rankings for the station on Flora Creek deployed between July 18 and August 28, 2019 are summarized in Table 2.

Table 2: Comparison rankings for Flora Creek below TLH station July 16 – August 28, 2019.

Station	Date	Action	Comparison Ranking				
			Temperature	pH	Conductivity	Dissolved Oxygen	Turbidity
Flora Creek below TLH	July 16, 2019	Deployment	Excellent	Good	Excellent	Fair	Excellent
	Aug 28, 2019	Removal	Excellent	Excellent	Excellent	Fair	Excellent

- At deployment, all parameters except dissolved oxygen ranked either 'good' or 'excellent'. Dissolved oxygen ranked 'fair'. The field instrument read a value of 9.99 mg/l, while the QA/QC instrument read a value of 9.45 mg/l.

- At removal, all parameters except dissolved oxygen ranked 'excellent'. Dissolved oxygen ranked 'fair'. The field instrument read a value of 9.53 mg/l, while the QA/QC instrument read a value of 8.92 mg/l.

  There are few circumstances which may cause less than ideal QA/QC rankings to be obtained. These include: the placement of the QA/QC sonde in relation to the field sonde, the amount of time each sonde was given to stabilize before readings were recorded; and deteriorating performance of one of the sensors.

Data Interpretation

- The following graphs and discussion illustrate water quality related events from July 18 to August 28 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 13.10 to 20.45°C during this deployment period (Figure 1).
- Water temperature increased after the end of July, and then fluctuated in a small range, before decreasing again during the later portion of August. Water temperature corresponds with ambient air temperature (Figure 1).

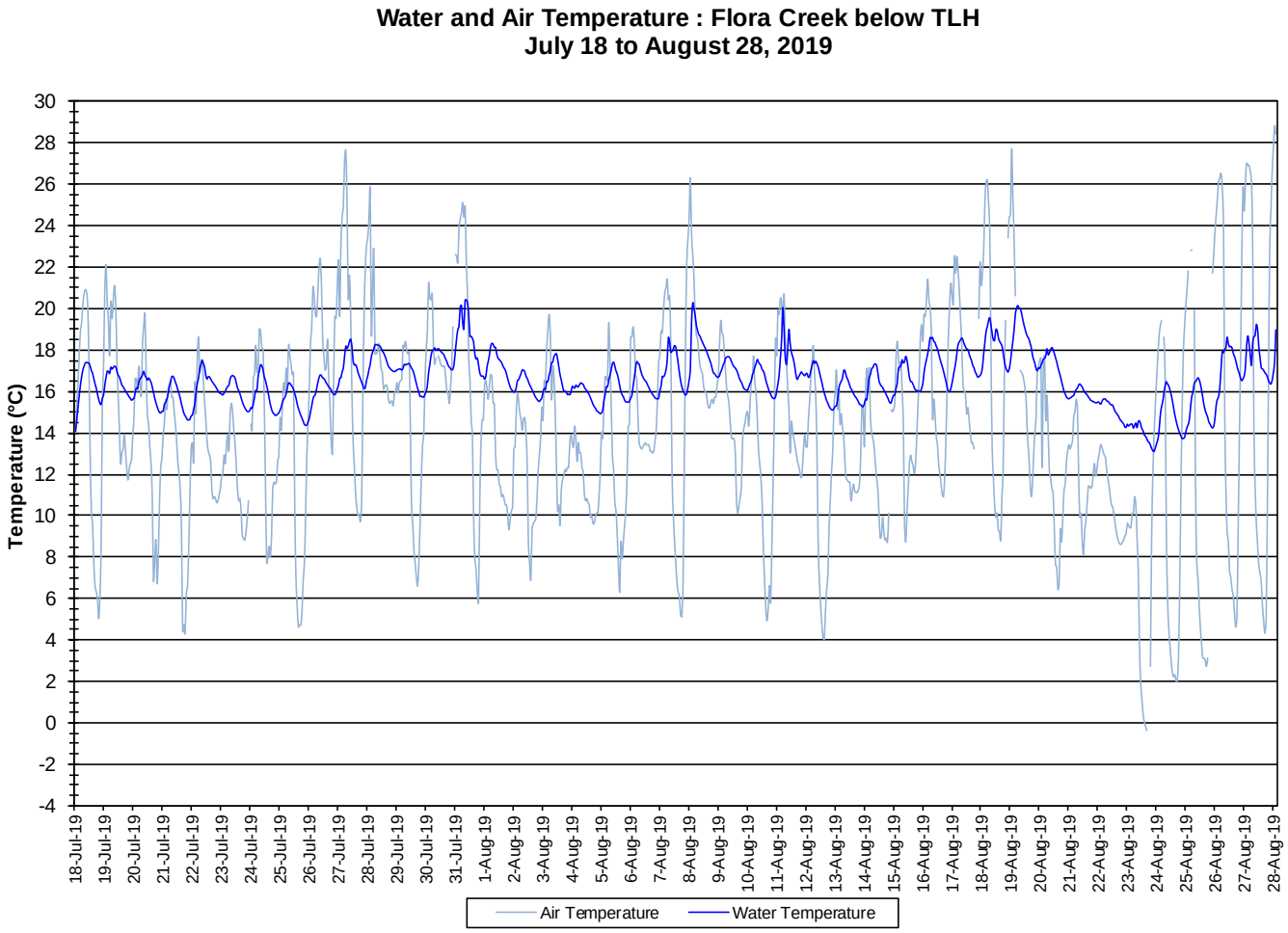

Figure 1: Water and Air Temperature - Flora Creek below TLH

(Weather data collected at Moosehead Lake)

- pH ranged between 7.35 and 7.66 pH units throughout the deployment period, with a median value of 7.48 units (Figure 2).
- 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.

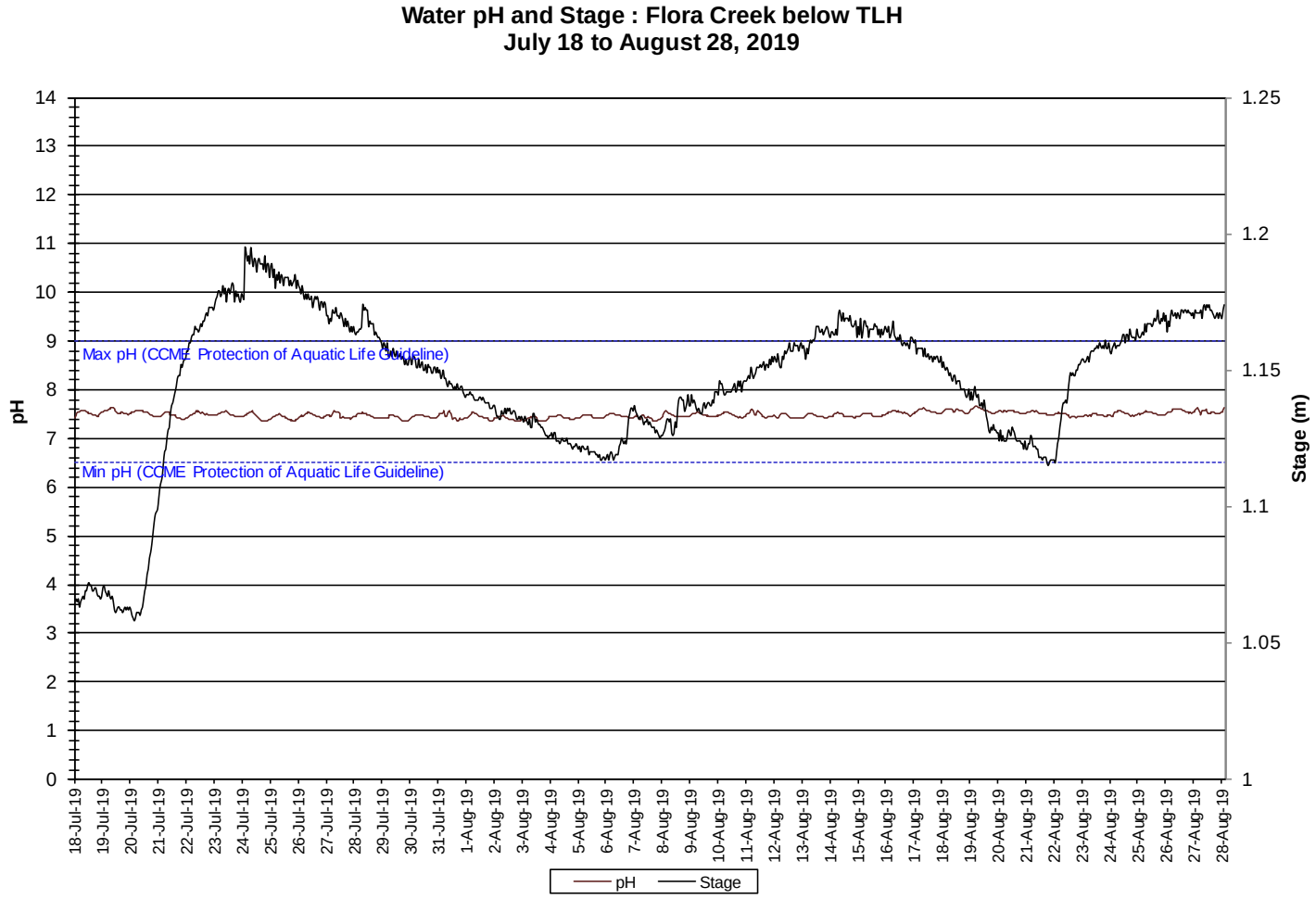

Figure 2: Water pH and Stage - Flora Creek below TLH

- Specific conductivity ranged from 56.3 to 61.9 µs/cm (Figure 3).
- Specific conductivity increased slightly over the course of this deployment period.
- There is a noticeable decrease in conductivity corresponding with a rainfall event and identified on the graph below. This is to be expected after rainfall as the increase in the amount of water in the creek dilutes the solids that are present, 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.

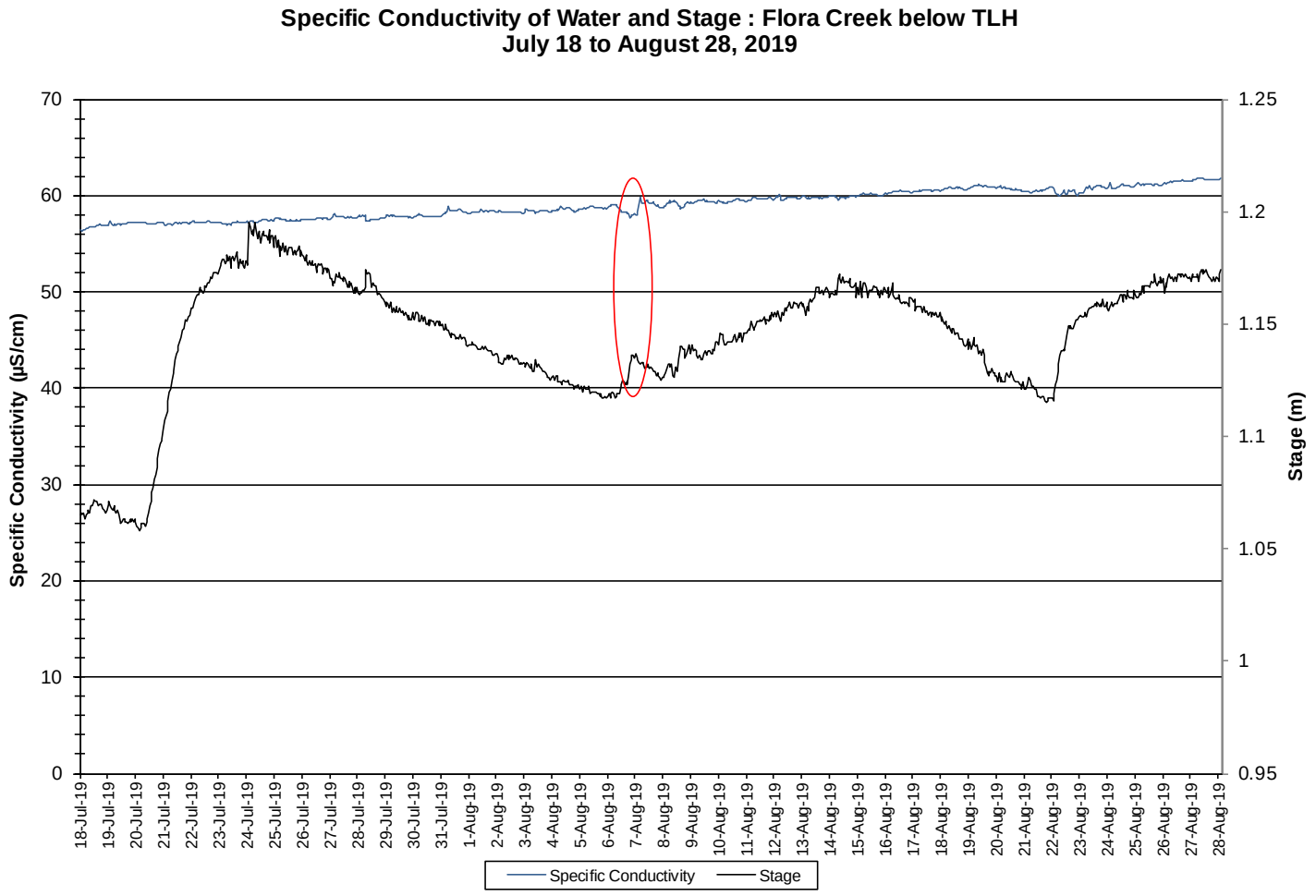

Figure 3: Specific Conductivity of Water and Stage - Flora Creek below TLH

- The saturation of dissolved oxygen ranged from 92.8 to 104.5% and a range of 9.10 to 10.04 mg/l was found for the concentration of dissolved oxygen with a median value of 9.46 mg/l (Figure 4).
- 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 4.
- Dissolved oxygen content fluctuates diurnally, displaying the inverse relationship to water temperature. DO decreases at the end of July, corresponding with the increase in water temperature.

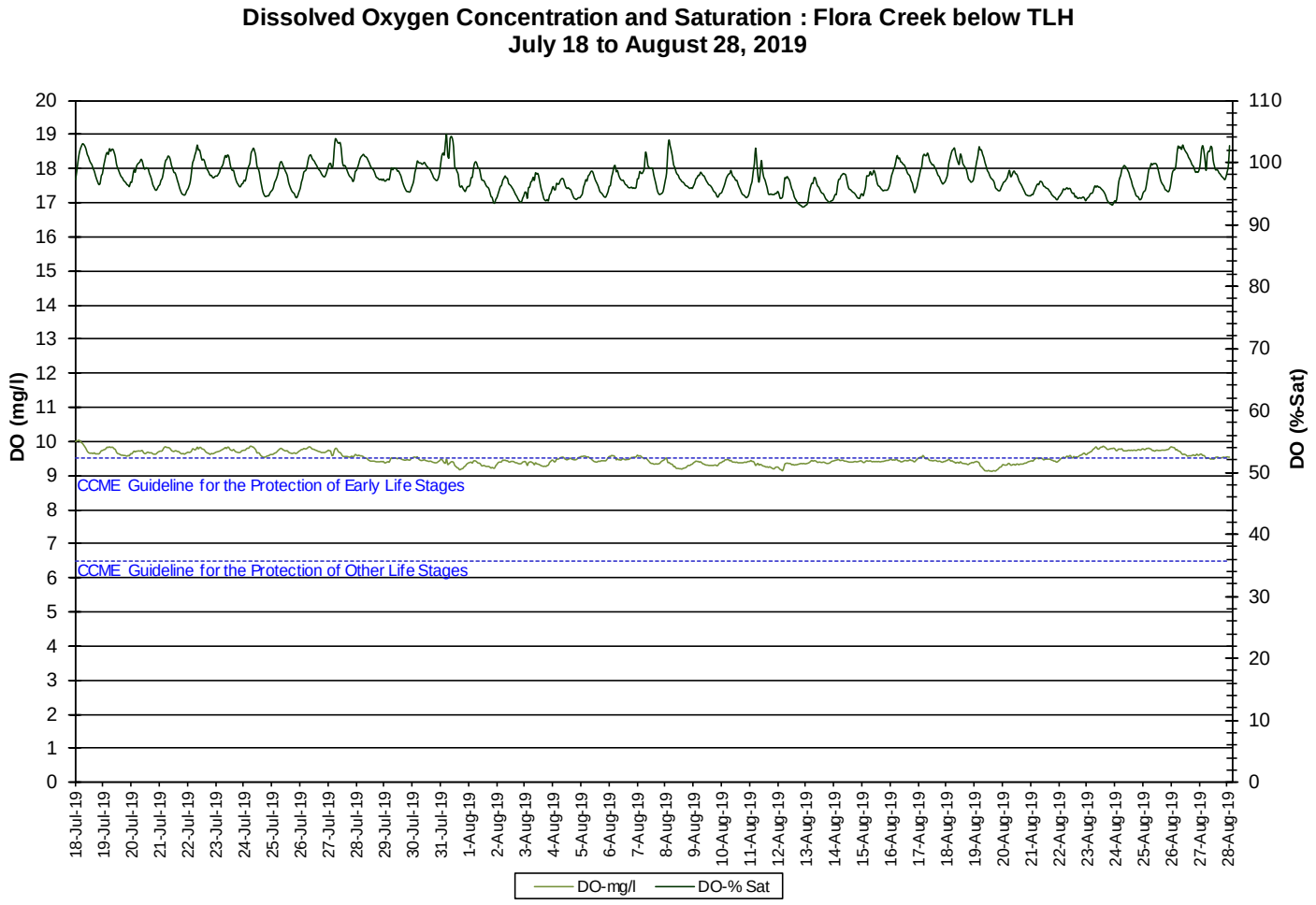

Figure 4: Dissolved Oxygen and Saturation - Flora Creek below TLH

- Turbidity values range from 26.0 NTU to 103.0 NTU. Overall, turbidity increased during this deployment period with a significant event in early August corresponding with high precipitation at the time and identified on the graph in red (Figure 5).
- This site has very turbid water at times.

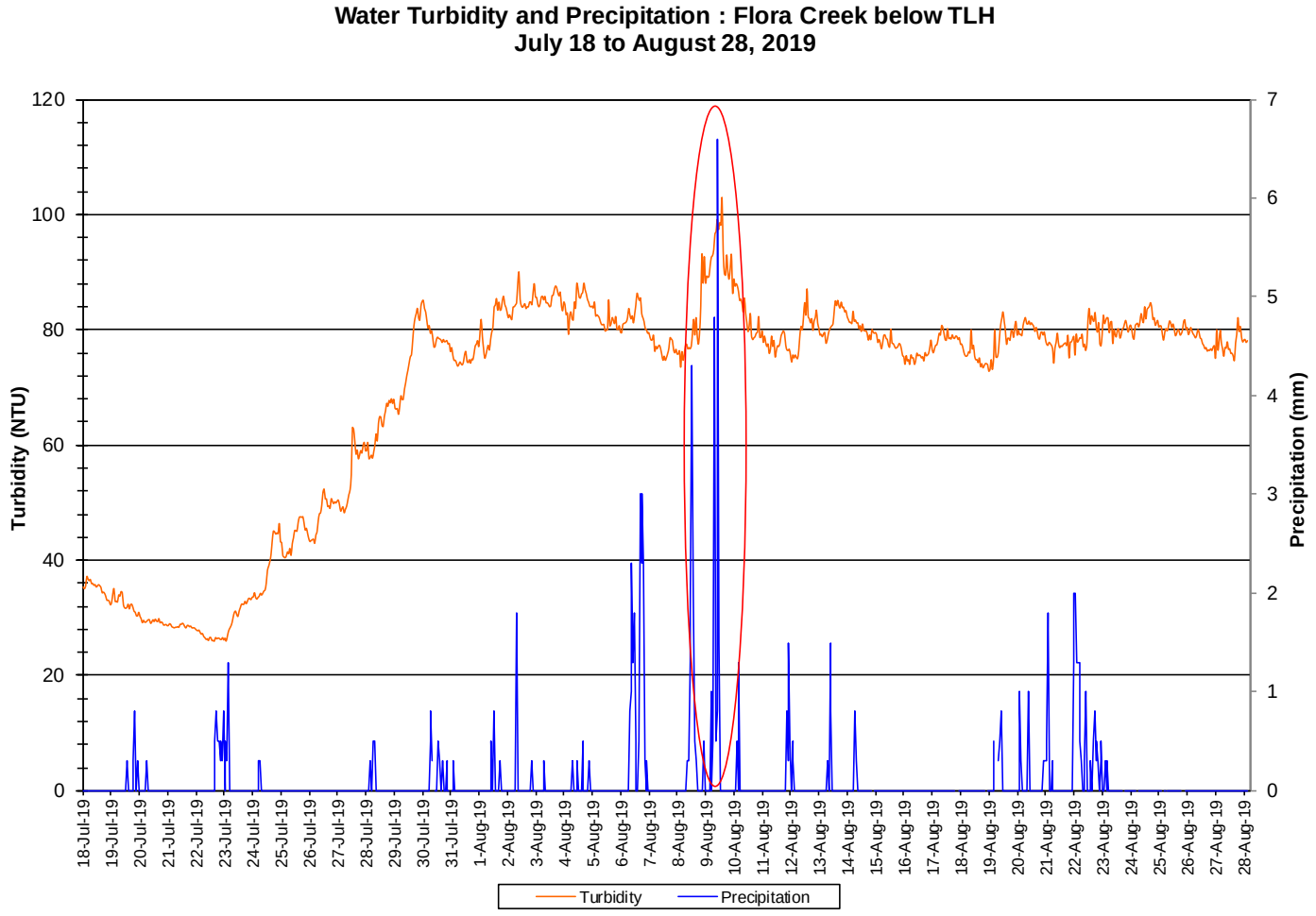

Figure 5: Turbidity - Flora Creek below TLH

- Precipitation and stage during the deployment period are graphed below (Figure 6). Stage increased during the later portion of July and then fluctuated for the remainder of the deployment 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.

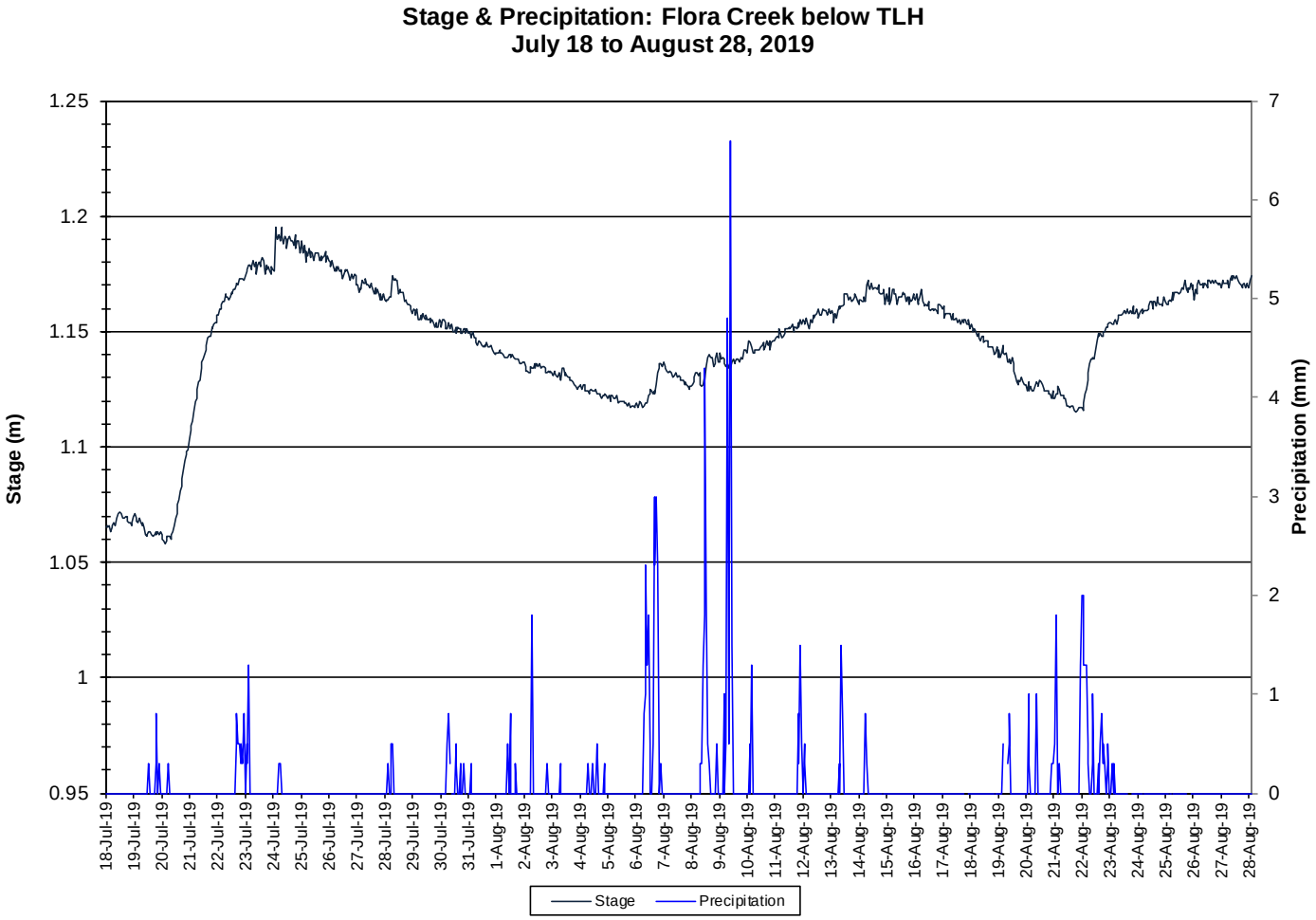

Figure 6: Precipitation and Stage – Flora Creek below TLH

Conclusions

- An instrument was deployed at the Flora Creek below TLH water quality monitoring station on July 18 and removed on August 28, 2019.
- In most cases, weather related events or increases/decreases in water level explain parameter fluctuations.
- Water temperature increased at the end of July and decreased again at the end of August, ranging between 13.10 and 20.45^{o}C.
- pH values were all within the recommended CCME Guidelines for the Protection of Aquatic Life. pH ranged between 7.35 and 7.66.
- Specific conductivity ranged from 56.3 to 61.9 µs/cm.
- Dissolved oxygen 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.
- Turbidity values increased over the deployment period.
- Stage increased at the end of July and then fluctuated for the remainder of the deployment period, as precipitation records varied.
- 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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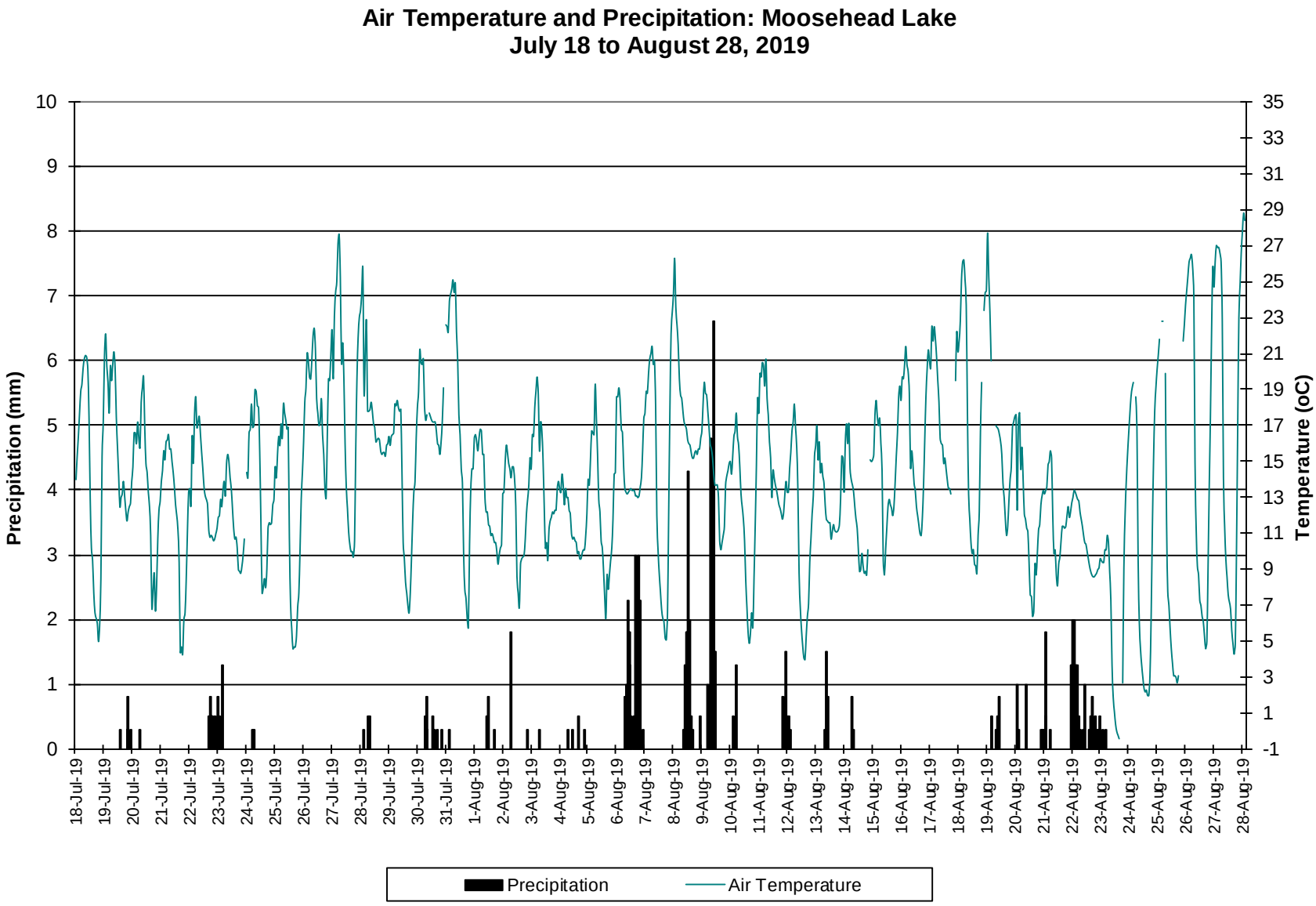
Appendix 1


Air Temperature and Precipitation: Moosehead Lake
July 18 to August 28, 2019
Precipitation (mm)
Temperature (oC)
Precipitation
Air Temperature

Appendix 2

QA/QC Grab Sample Results

REPORT OF ANALYSIS

Lab Report Number: 1912986

Cient:	Department of Environment	**COC Number:**	
Attention:	Ms. Leona Hyde	**Date Reported:**	2019-08-06
Client Project:		**Date Submitted:**	2019-07-23
Purchase Order:	2180014303	**Sample Matrix:**	Water

LAB ID	Supply / Description	Client Sample ID	Sample Date	ANALYTE	UNIT	MRL	RESULT
1442907	WS-S-0000 Flora Creek	2019-6316-00-SI-SP	2019-07-18	Alkalinity as CaCO3	mg/L	5	23
				Bromide	mg/L	0.25	<0.25
				Chloride	mg/L	1	<1
				Colour	TCU	2	47
				Conductivity	uS/cm	5	52
				Dissolved Organic Carbon	mg/L	0.5	4.0
				Fluoride	mg/L	0.10	<0.10
				Hardness as CaCO3	mg/L	1	27
				N-NH3 (Ammonia)	mg/L	0.010	<0.010
				N-NO2 (Nitrite)	mg/L	0.10	<0.10
				N-NO3 (Nitrate)	mg/L	0.10	<0.10
				pH		1.00	7.31
				Sulphate	mg/L	1	2
				Total Dissolved Solids (COND - CALC)	mg/L	1	34
				Total Kjeldahl Nitrogen	mg/L	0.15	<0.15
				Total Organic Carbon	mg/L	0.5	4.3
				Turbidity	NTU	0.1	23.0
				Aluminum	mg/L	0.01	0.02

Sample comment:

Report comment:

Eurofins (Ottawa) is accredited for specific parameters by CALA. The scope can be viewed at http://www.cala.ca/scopes/2602.pdf.
Results relate only to the parameters tested on the samples submitted.
Methods references and/or additional QA/QC information available on request.

APPROVAL: Sarah Horner

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Purchase Order:	2180014303	**Sample Matrix:**	Water

LAB ID	Supply / Description	Client Sample ID	Sample Date	ANALYTE	UNIT	MRL	RESULT
1442907	WS-S-0000	2019-6316-00-SI-SP	2019-07-18	Antimony	mg/L	0.0005	<0.0005
	Flora Creek			Arsenic	mg/L	0.001	<0.001
				Barium	mg/L	0.01	<0.01
Sample comment:				Boron	mg/L	0.01	<0.01
				Calcium	mg/L	1	6
				Cadmium	mg/L	0.0001	<0.0001
Report comment:				Chromium	mg/L	0.001	<0.001
				Copper	mg/L	0.001	<0.001
				Iron	mg/L	0.03	0.26
				Lead	mg/L	0.001	<0.001
				Magnesium	mg/L	1	3
				Manganese	mg/L	0.01	0.22
				Mercury	mg/L	0.0001	<0.0001
				Nickel	mg/L	0.005	<0.005
				Potassium	mg/L	1	<1
				Selenium	mg/L	0.001	<0.001
				Sodium	mg/L	2	<2
				Strontium	mg/L	0.001	0.010

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LAB ID	Supply / Description	Client Sample ID	Sample Date	ANALYTE	UNIT	MRL	RESULT
1442907	WS-S-0000	2019-6316-00-SI-SP	2019-07-18	Uranium	mg/L	0.001	<0.001
	Flora Creek			Zinc	mg/L	0.01	<0.01
				Phosphorus	mg/L	0.002	0.004
Sample comment:				Total Suspended Solids	mg/L	2	<2

Report comment:

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