Real-Time Water Quality Deployment Report

Outflow of the Steady at Rambler Mine

July 17 to
August 14, 2020

Newfoundland Labrador

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

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General

- The Water Resources Management Division, in partnership with Rambler Metals and Mining Canada Ltd., maintain one real-time water quality and water quantity station at the Outflow of the Steady.
- This station is situated downstream of the Nugget Pond Mill tailings management facility (Figure 1).
- On July 17, 2020, a real-time water quality monitoring instrument was deployed at the station Outflow of the Steady. The instrument was deployed for a period of 27 days. This was the second deployment for this station in 2020.
- Transmissions from this instrument ceased on July 25, 2020 due to a suspected lighting strike and was removed from service August 14, 2020.
- Water Resources Management Division staff monitor the real-time web pages regularly.

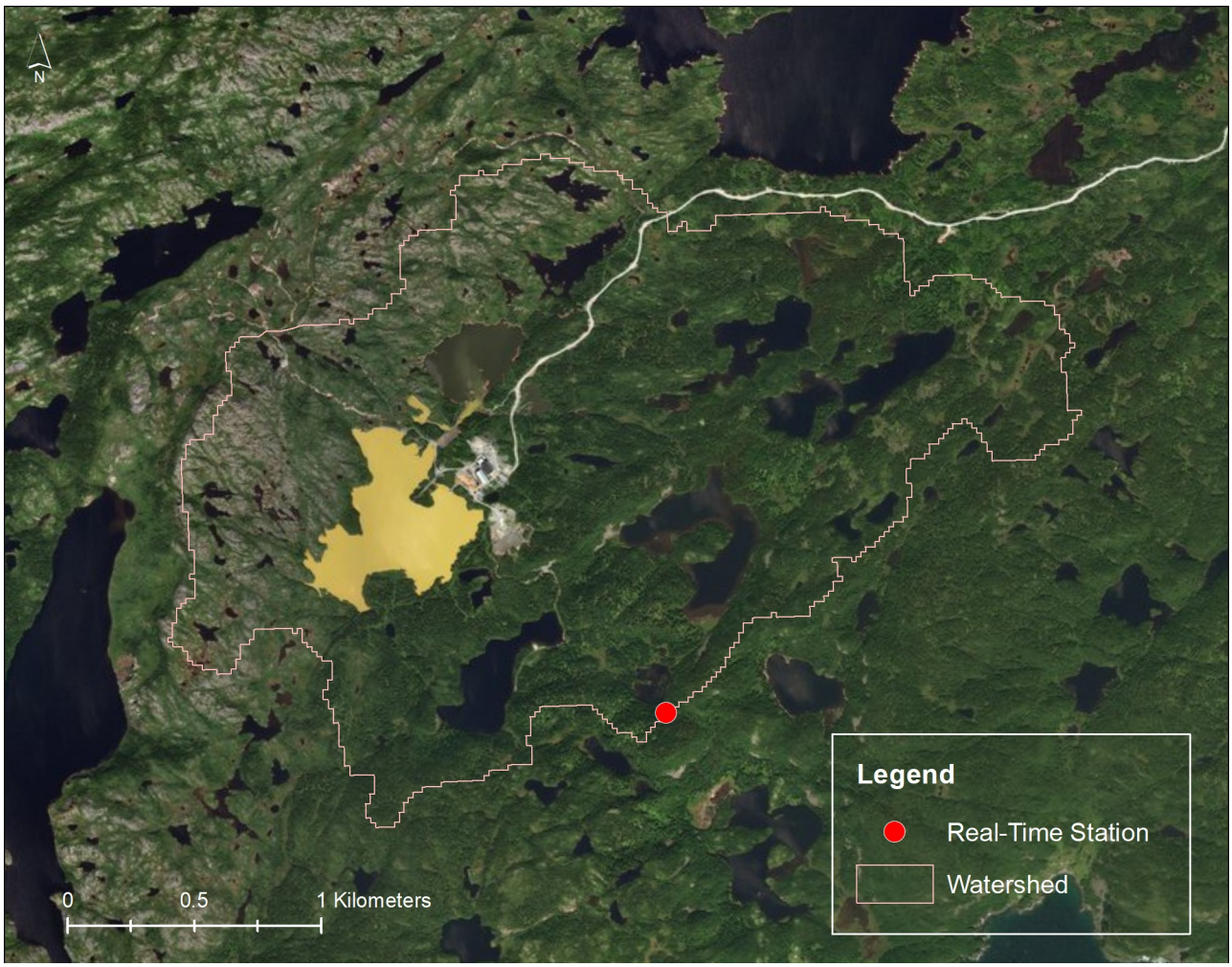

Figure 1: Location of the real-time station downstream of Rambler's Nugget Pond Mill tailings management facility

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 adjacent to 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 Outflow of the Steady deployed between July 17 and August 14, 2020 are summarized in Table 2.

Table 2: Comparison rankings for Outflow of the Steady station July 17 – August 14, 2020.

Station	**Date**	**Action**	**Comparison Ranking**				
			Temperature	**pH**	**Conductivity**	**Dissolved Oxygen**	**Turbidity**
Outflow of the Steady	July 17, 2020	Deployment	Excellent	Fair	Marginal	Excellent	Excellent
	August 14, 2020	Removal	NA	NA	NA	NA	NA

- At deployment, rankings were either 'excellent' or 'fair', with the exception of specific conductance, which ranked 'marginal'.
- At removal, all parameters could not be ranked (NA) due to the failure of the field instrument.
- There are a 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 17 to August 14 at the station Outflow of the Steady.
- Due to a suspected lightning strike which caused internal power loss to the water quality instrument, no log file data could be retrieved to supplement the data transmissions, resulting in no water quality data available after July 25th. For this reason, water quality data interpretation is only for data collected July 17th to 25th.
- 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. Corrected data can be obtained upon request.

Outflow of the Steady

- Water temperature ranged from 16.99 to 24.87°C during this deployment period (Figure 2).
- Water temperature was corresponding well with ambient air temperatures until instrument failure on July 25, 2020 (Figure 2).

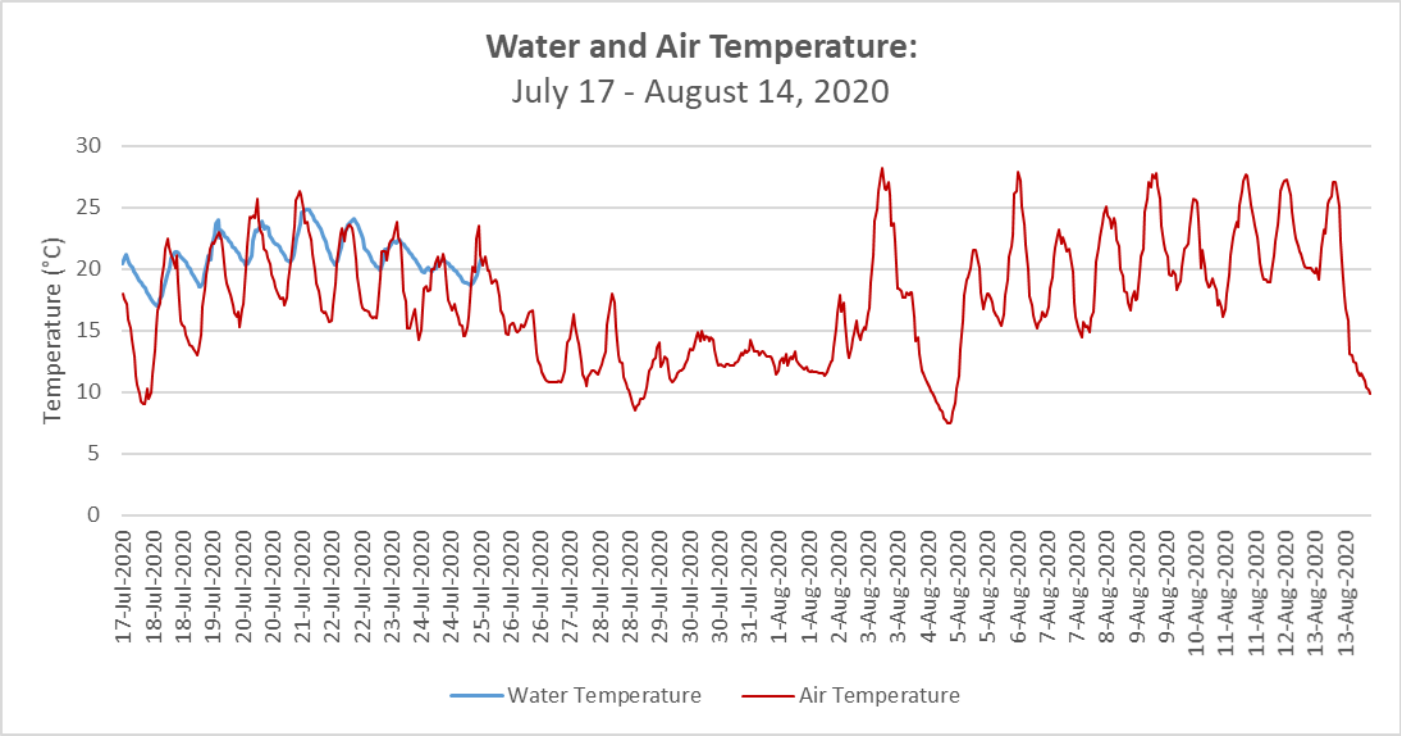

Figure 2: Water and Air Temperature – Outflow of the Steady

(Weather data collected at La Scie)

- pH ranged between 6.67 and 7.31 pH units throughout the deployment period, with a median value of 7.18 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.
- Significant rainfall (evident as a rise in stage levels) can cause a slight dip in pH levels. This is a common occurrence in freshwater as the slightly acidic rain influences the overall pH of the river for a short period of time.
- Overall, pH was stable during the functional portion of the deployment.

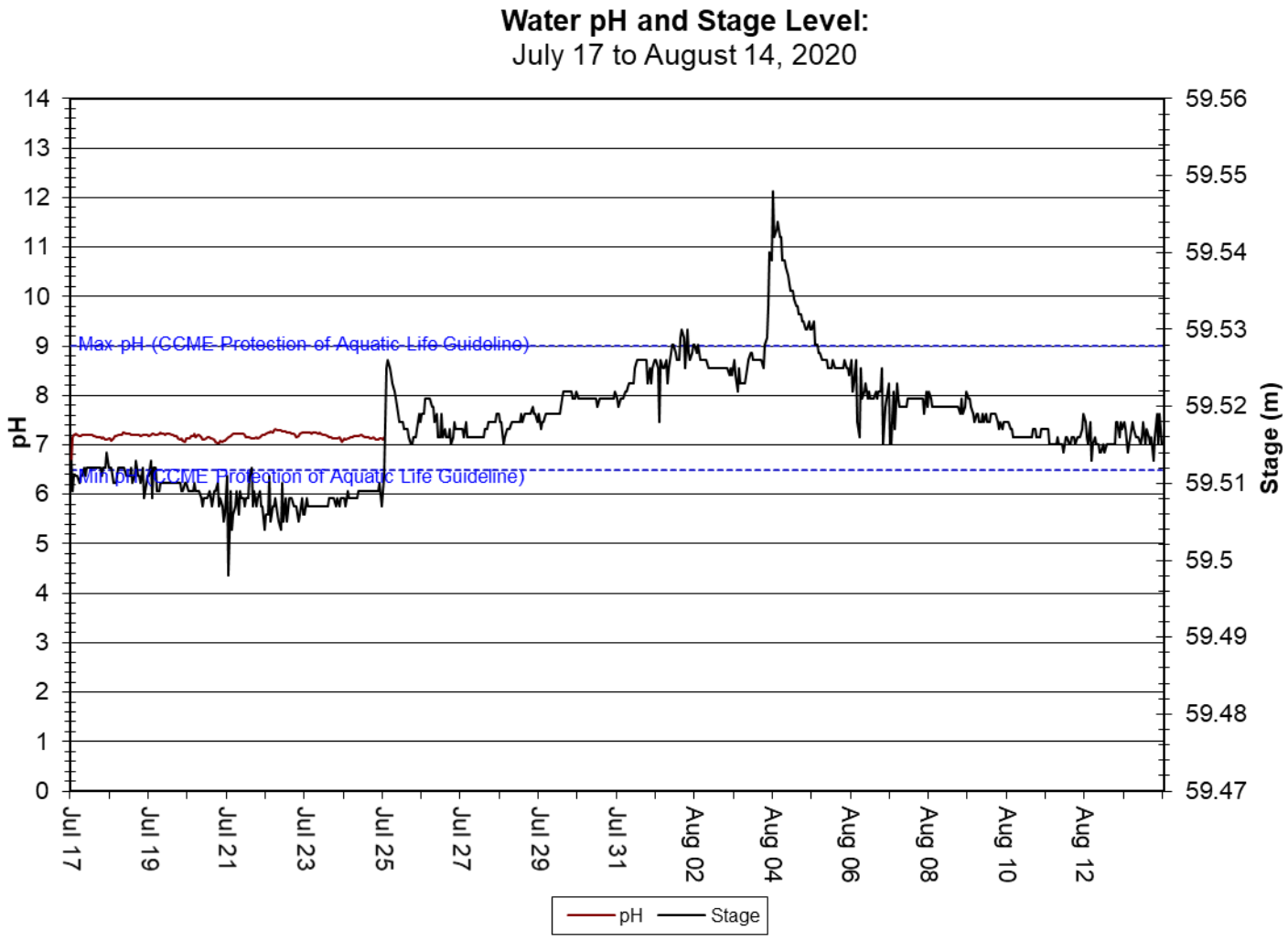

Figure 3: Water pH and Stage – Outflow of the Steady

- Specific conductivity ranged from 145.8 to 173.7 µs/cm (Figure 4).
- Specific conductivity was stable during the functional portion of 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. Corrected data can be obtained upon request.

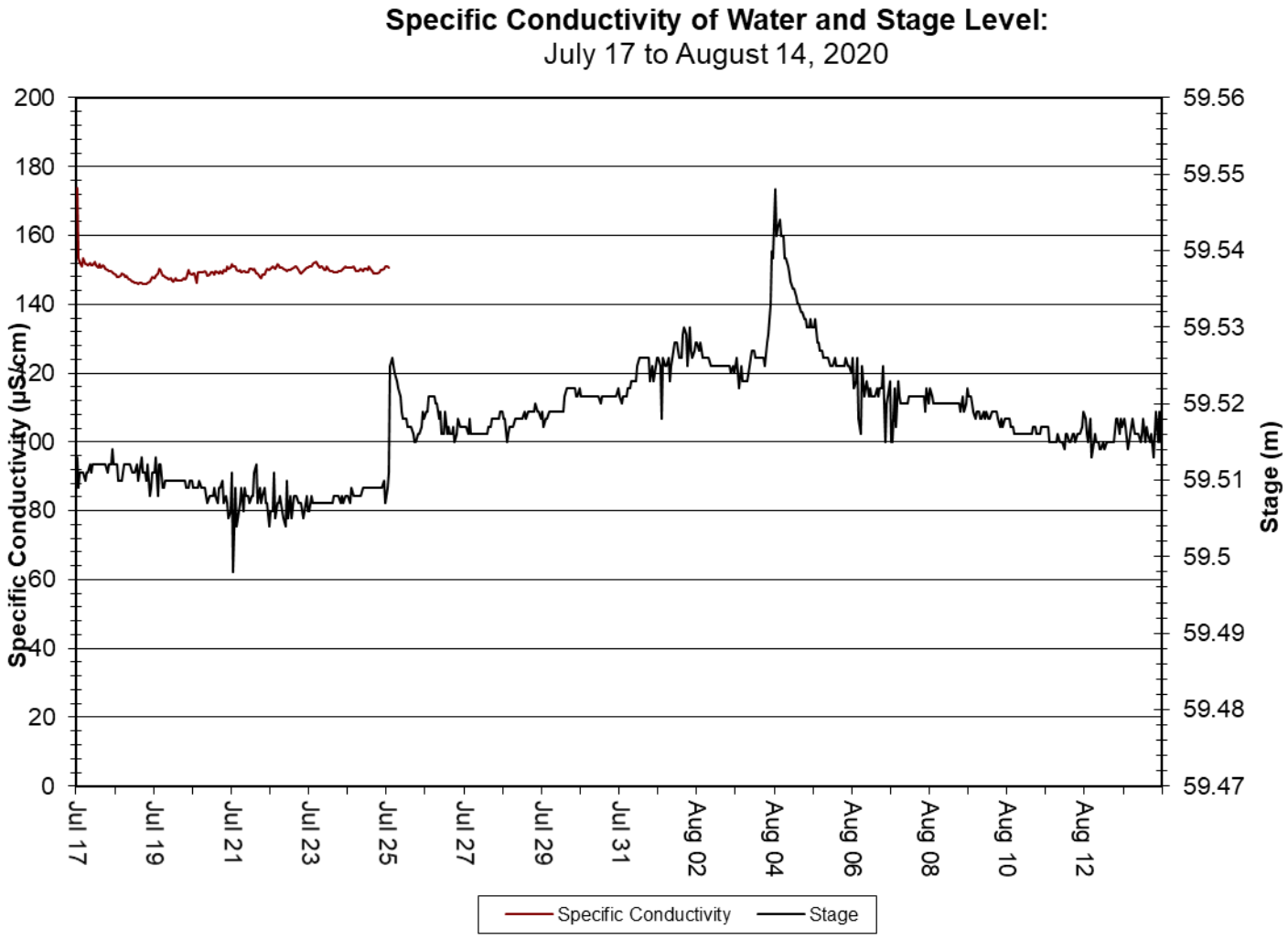

Figure 4: Specific Conductivity of Water and Stage - Outflow of the Steady

- The saturation of dissolved oxygen ranged from 89.6% to 111.8% and a range of 8.15 to 9.90 mg/l was recorded for the concentration of dissolved oxygen with a median value of 8.91 mg/l (Figure 5).
- All values were above the minimum CCME Guideline for the Protection of Other Life Stages of Cold Water Biota of 6.5 mg/l. The majority of values were below the minimum CCME Guideline for the Protection of Early Life Stages of Cold Water Biota value of 9.5 mg/l. The guidelines are indicated in red on Figure 5.
- Dissolved oxygen content fluctuates diurnally, displaying the inverse relationship to water temperature. Dissolved oxygen decreased during the first portion of this deployment period as water temperatures warmed, and continued to fluctuate throughout the functional portion of the deployment period.

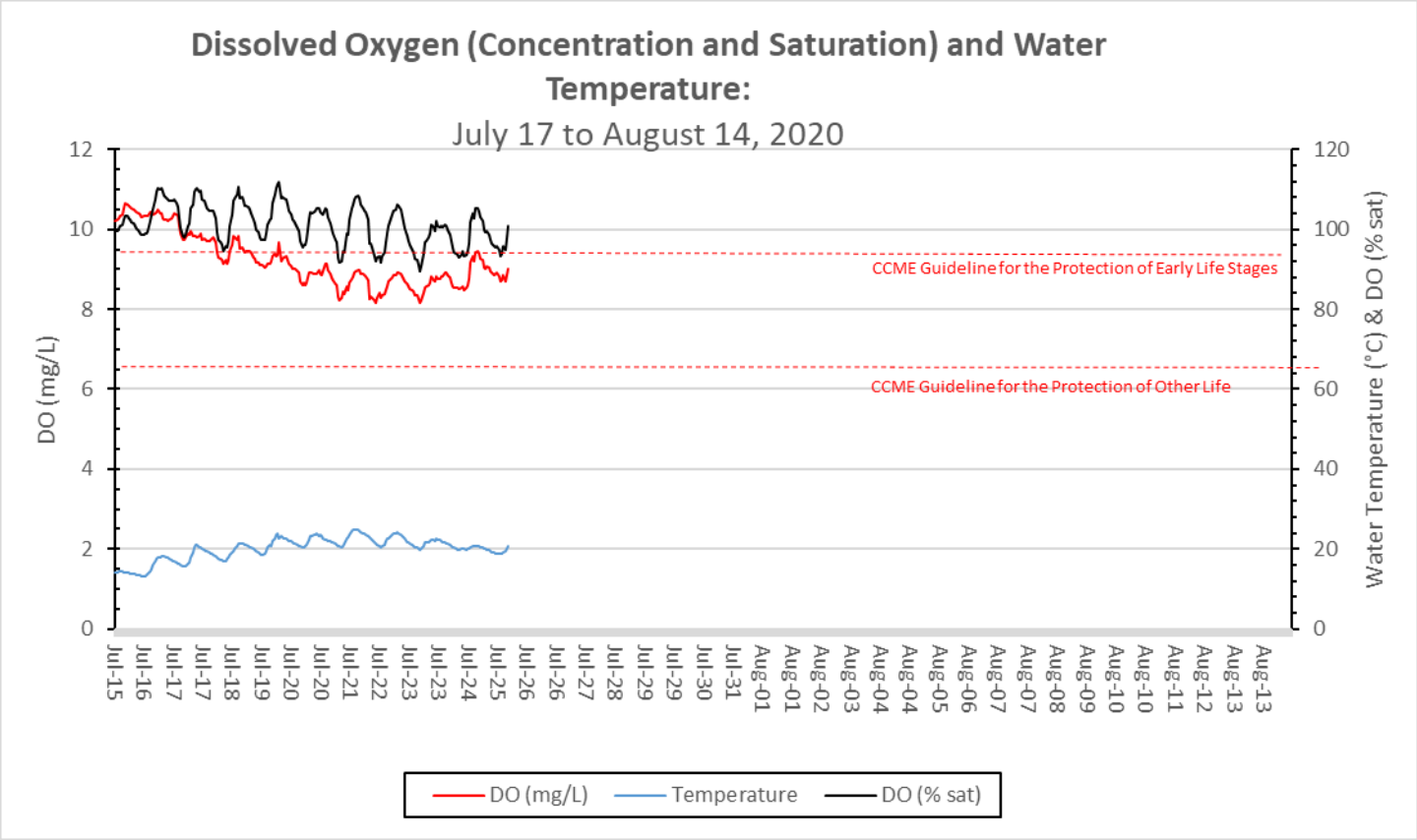

Figure 5: Dissolved Oxygen and Water Temperature – Outflow of the Steady

- Turbidity values range from 0.9 NTU to 1.1 NTU with a median of 1.0, indicating very clear background turbidity.
- Turbidity increased when water levels increased and decreased when stage decreased (Figure 6). This indicates rainfall may assist in flushing out sediment from the brook.

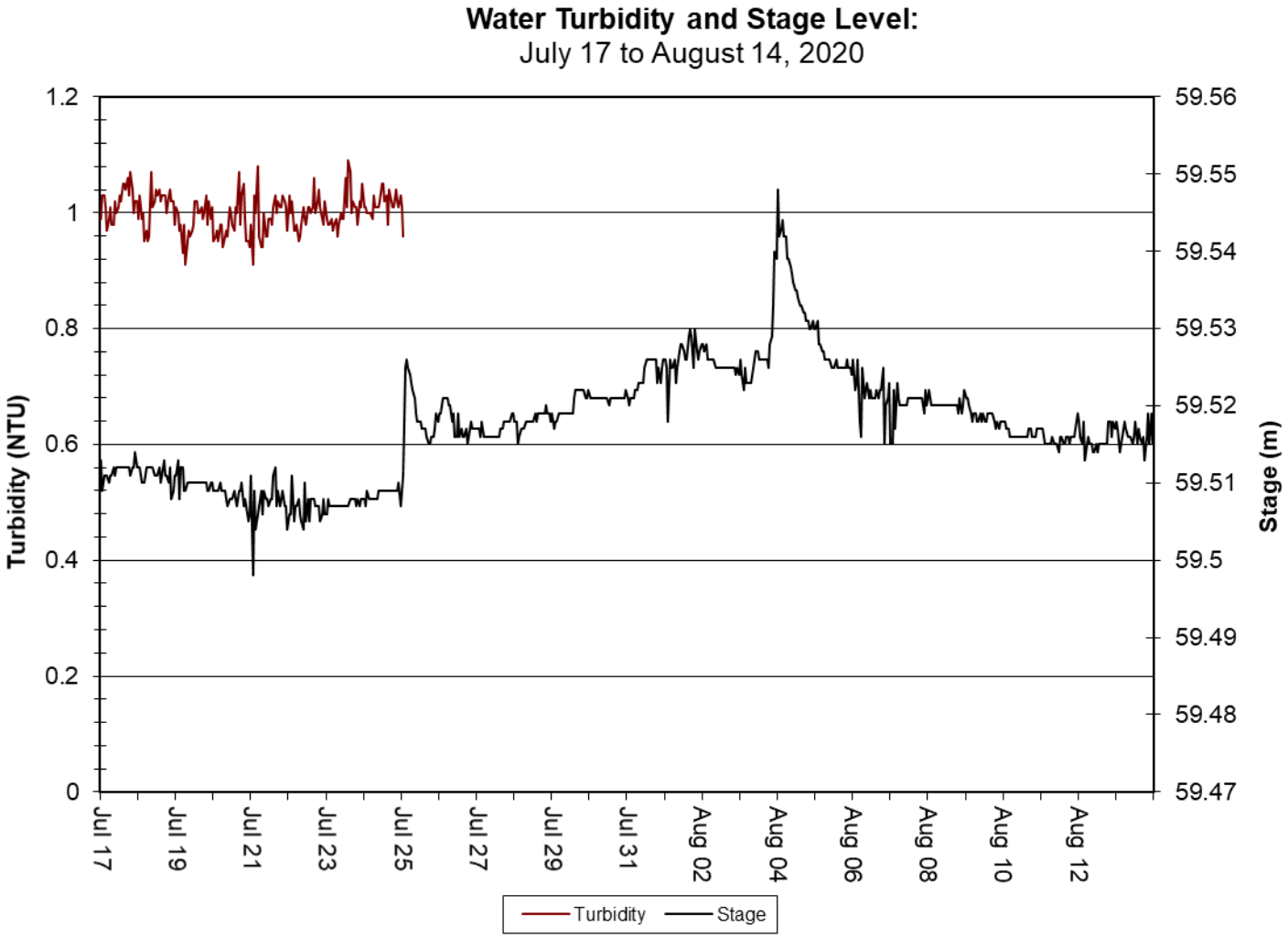

Figure 6: Turbidity and Stage – Outflow of the Steady

- Precipitation and stage during the deployment period are graphed below (Figure 7). Stage was generally stable during the duration of the deployment.
- 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. Corrected data can be obtained upon request.

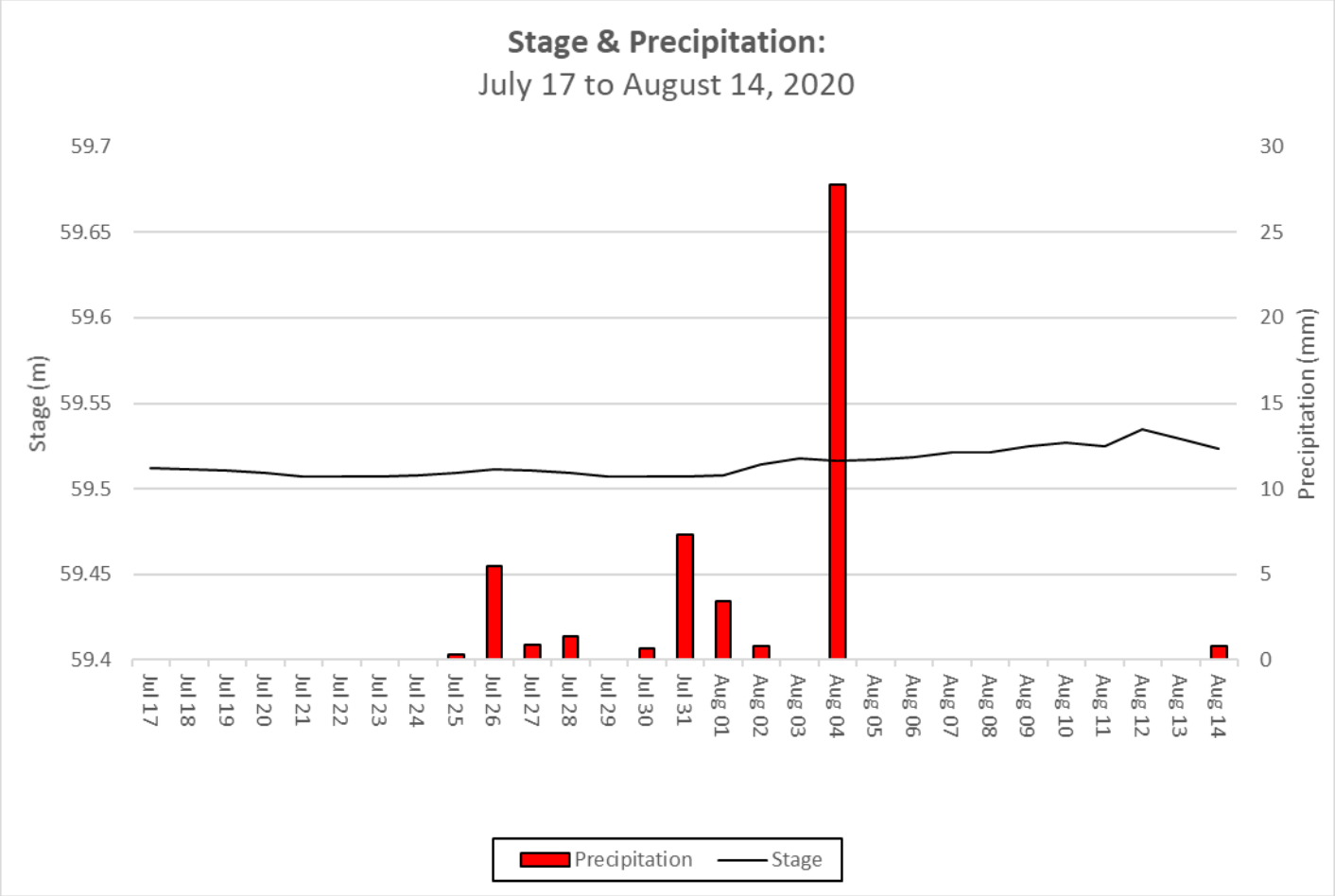

Figure 7: Precipitation and Stage – Outflow of the Steady

Conclusions

- An instrument was deployed at the Outflow of the Steady water quality monitoring station on July 17 and removed on August 14, 2020. This was the second deployment of the 2020 season. A suspected lightening strike on July 25, 2020 caused instrument failure that resulted in a lack of data between July 25th and August 14th, 2020.
- In most cases, weather related events or increases/decreases in water level explain parameter fluctuations.
- Water temperature increased during the deployment period, ranging from 16.99 to 24.87°C. The data confirmed water temperature was corresponding with ambient air temperatures until instrument failure on 25-July-2020.
- pH values were all within the recommended CCME Guidelines for the Protection of Aquatic Life. pH ranged between 6.67 and 7.31. The brook is influenced by high precipitation events which decrease pH values for a short time.
- Specific conductivity ranged from 145.8 to 173.7 µs/cm, showing stability during the deployment.
- 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. The values below this guideline correspond to a rise in water temperature.
- Turbidity values of 0.9 NTU to 1.1 NTU indicated low background turbidity. Increasing turbidity corresponded to increases in the water level at this site.
- Stage was generally stable for the duration of 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. Corrected data can be obtained upon request.

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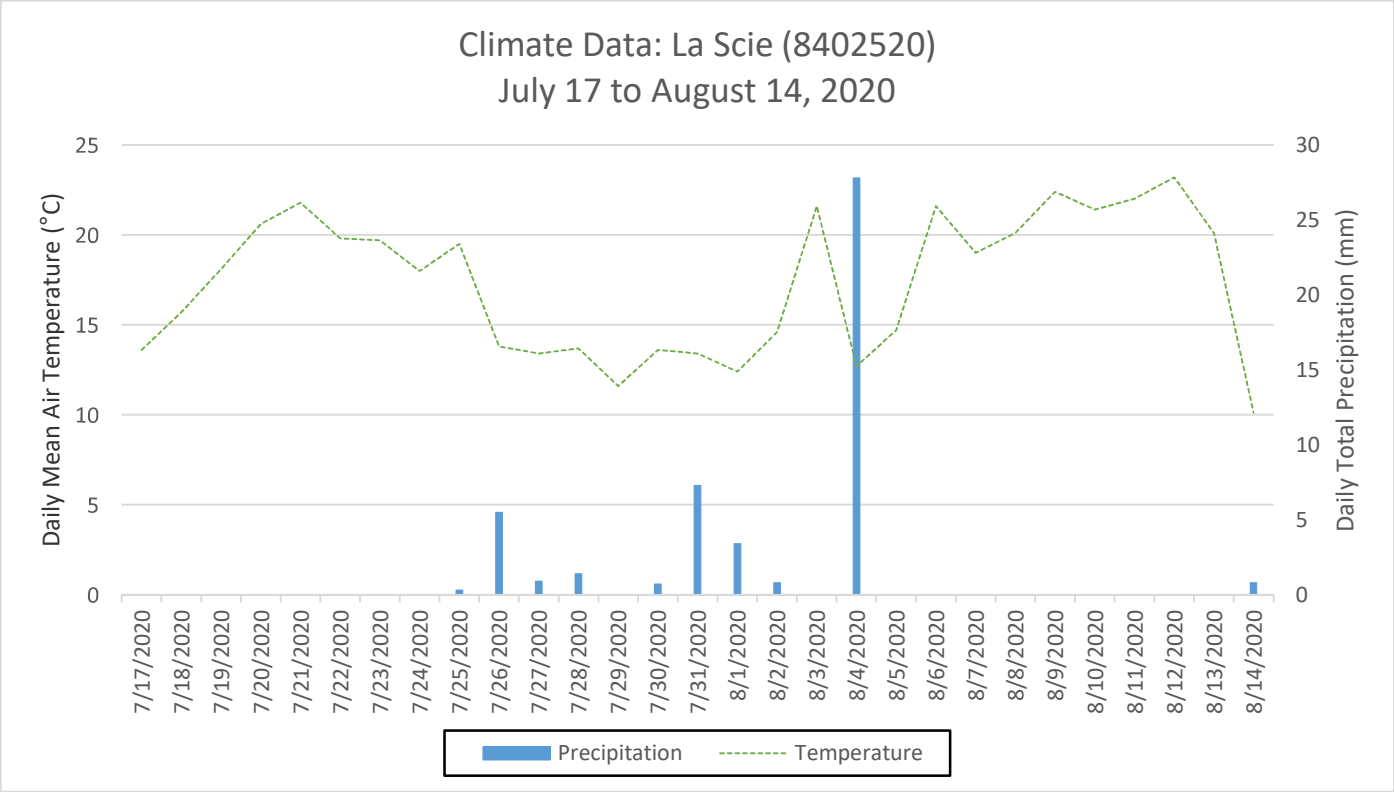
Appendix 1


Climate Data: La Scie (8402520)
July 17 to August 14, 2020
Daily Mean Air Temperature (°C)
Daily Total Precipitation (mm)
25
20
15
10
5
0
30
25
20
15
10
5
0
7/17/2020
7/18/2020
7/19/2020
7/20/2020
7/21/2020
7/22/2020
7/23/2020
7/24/2020
7/25/2020
7/26/2020
7/27/2020
7/28/2020
7/29/2020
7/30/2020
7/31/2020
8/1/2020
8/2/2020
8/3/2020
8/4/2020
8/5/2020
8/6/2020
8/7/2020
8/8/2020
8/9/2020
8/10/2020
8/11/2020
8/12/2020
8/13/2020
8/14/2020
Precipitation
Temperature