

Real-Time Water Quality Deployment Report

Outflow of the Steady at Rambler Mine

May 26 to
July 17, 2020



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 May 26, 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 51 days. This was the first deployment for this station in 2020.
- Water Resources Management Division staff monitor the real-time web pages regularly.

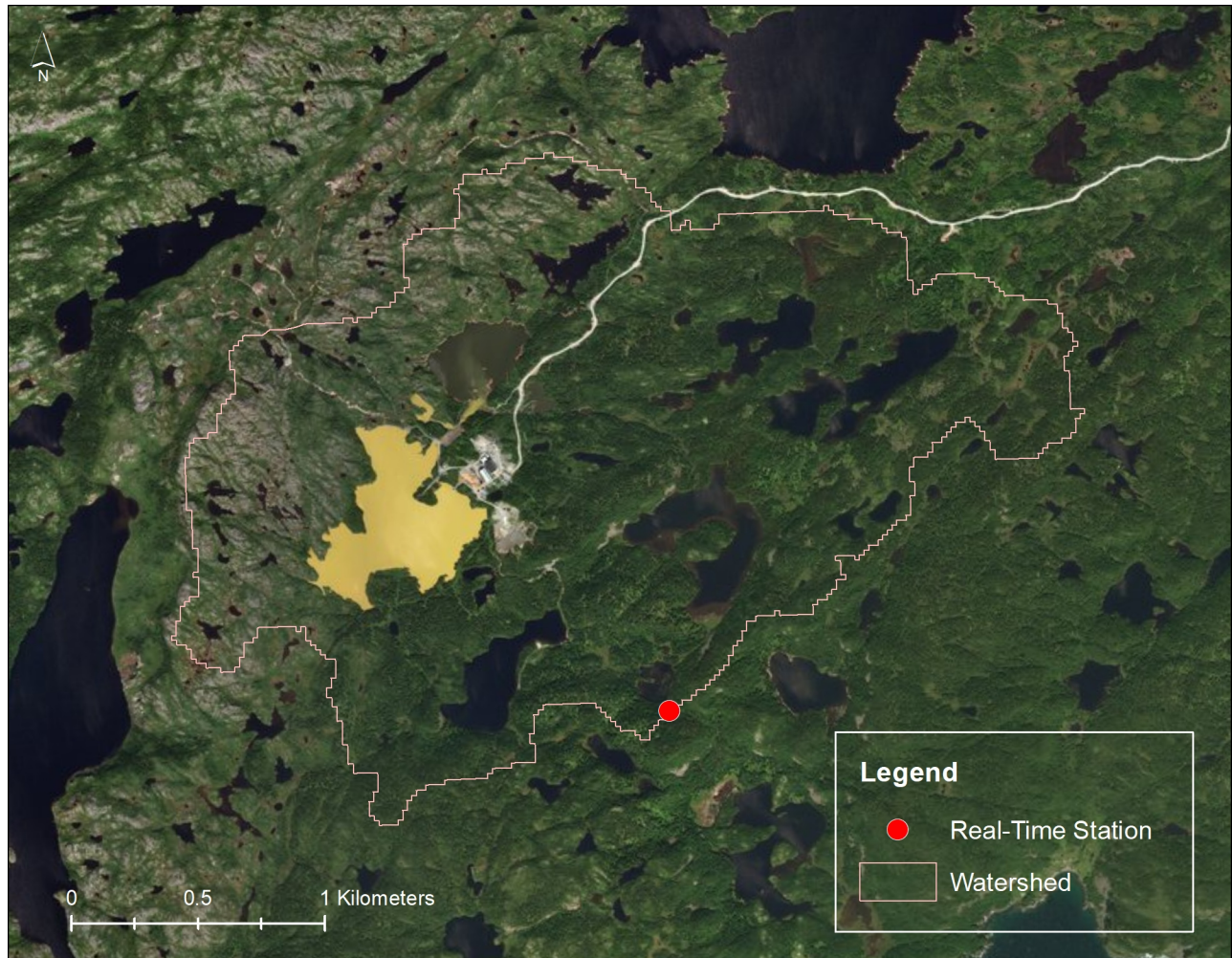


Figure 1: Location of the real-time station downstream of Rambler’s Nugget Pond Mill tailings management facility

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

Parameter	Rank				
	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 May 26 and July 17, 2020 are summarized in Table 2.

Table 2: Comparison rankings for Outflow of the Steady station May 26 – July 17, 2020.

Station	Date	Action	Comparison Ranking				
			Temperature	pH	Conductivity	Dissolved Oxygen	Turbidity
Outflow of the Steady	May 26, 2020	Deployment	Excellent	Good	Good	Excellent	NA
	July 17, 2020	Removal	Good	Excellent	Excellent	Excellent	Excellent

Outflow of the Steady at Rambler Mine, Newfoundland and Labrador

- Deployment rankings were either good or excellent with the exception of turbidity which could not be calculated due to a sensor malfunction on the QA/QC sonde.
- At removal, all parameters ranked either 'good' or 'excellent'.
- 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 May 26 to July 17 at the station Outflow of the Steady.
- 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 7.21 to 26.18°C during this deployment period (Figure 2).
- Water temperature steadily increased during the summer months of June and July. This increase in water temperature corresponds with ambient air temperatures as spring changes into summer (Figure 2).

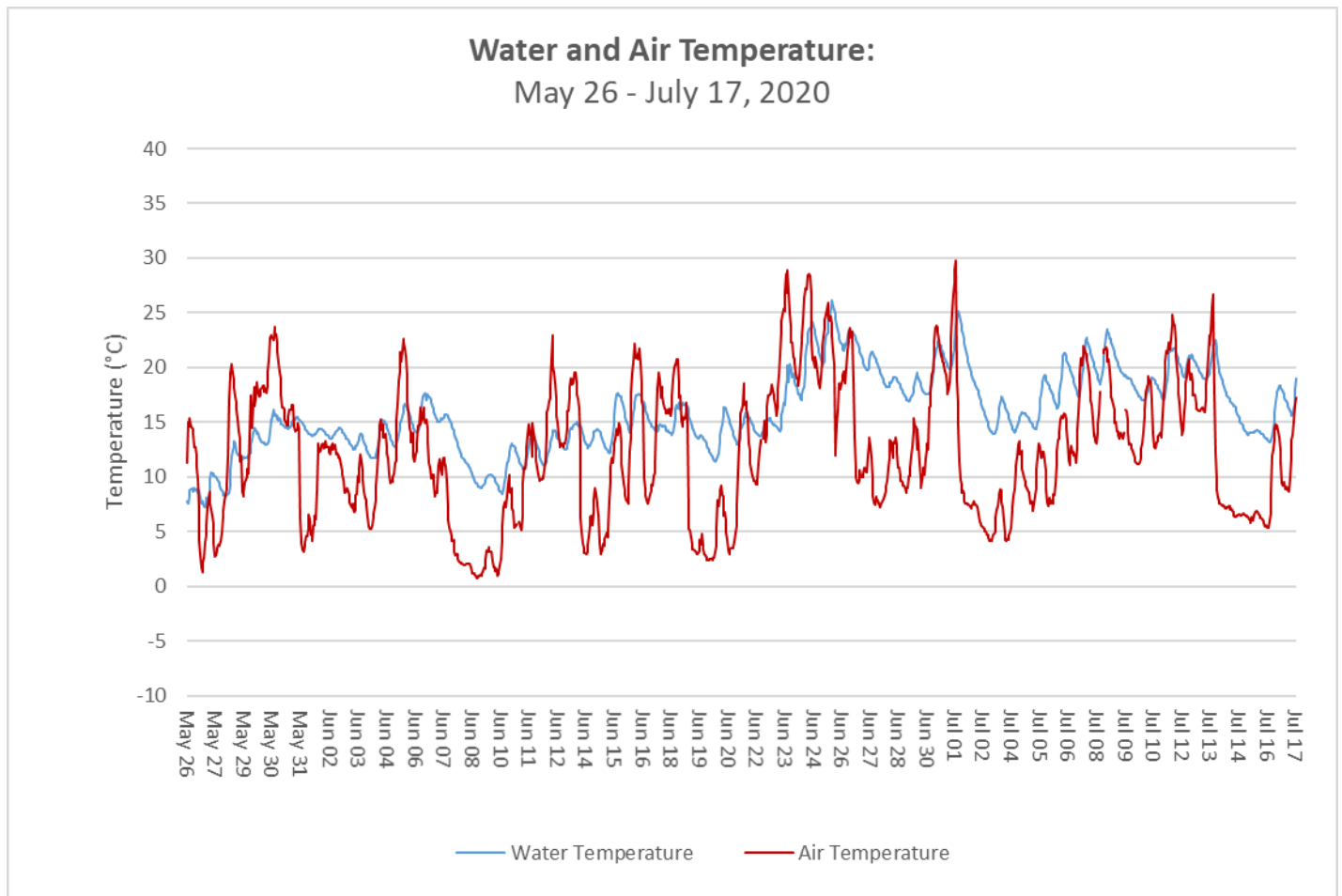


Figure 2: Water and Air Temperature – Outflow of the Steady
(Weather data collected at La Scie)

- pH ranged between 6.86 and 7.34 pH units throughout the deployment period, with a median value of 7.07 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 for the first portion of the deployment, but began trending upward in early July as stage decreased, indicating low precipitation.

Water pH and Stage Level:
May 26 to July 17, 2020

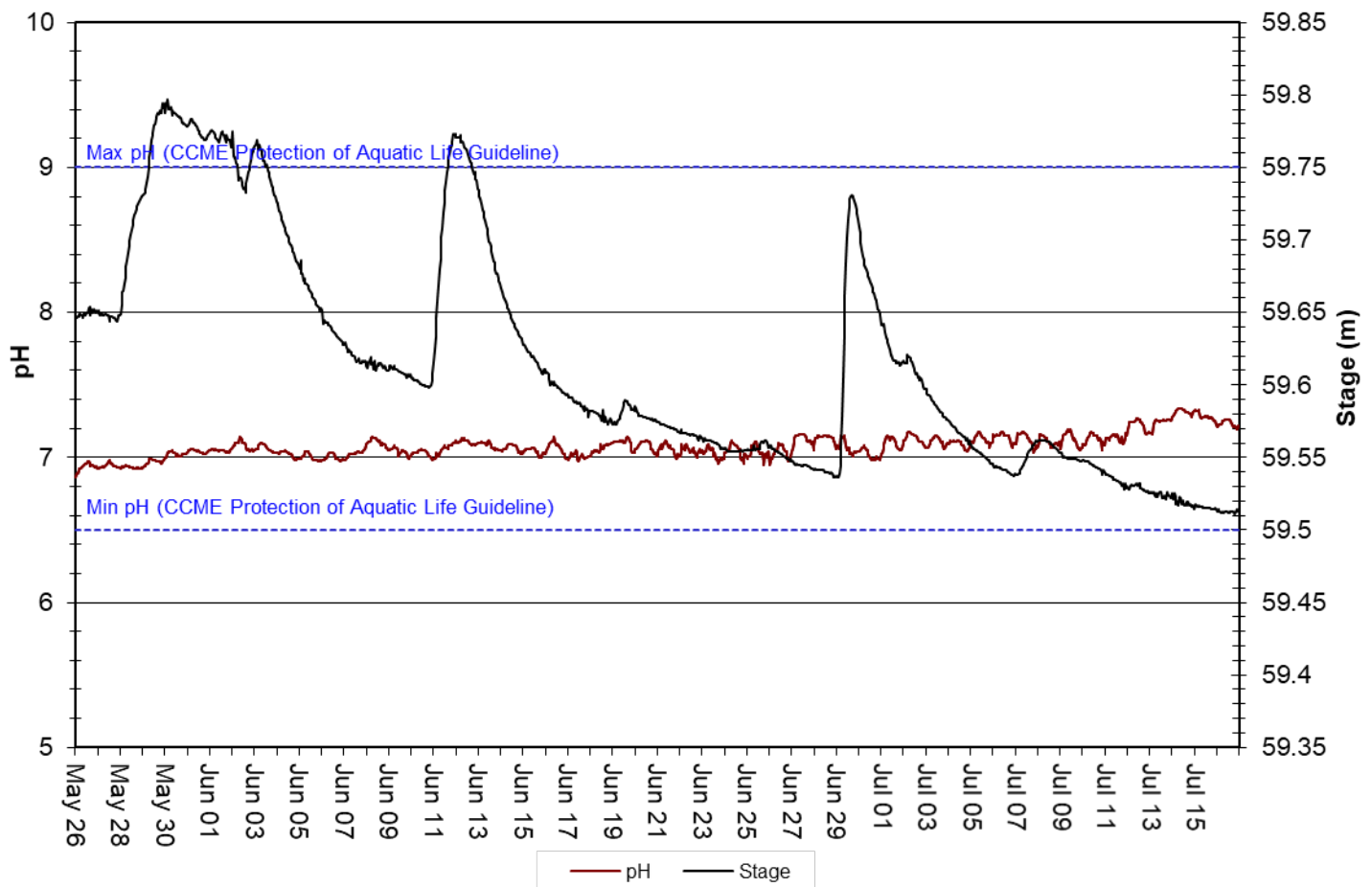


Figure 3: Water pH and Stage – Outflow of the Steady

- Specific conductivity ranged from 100.6 to 151.7 $\mu\text{S}/\text{cm}$ (Figure 4).
- Specific conductivity steadily increased over the course 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.

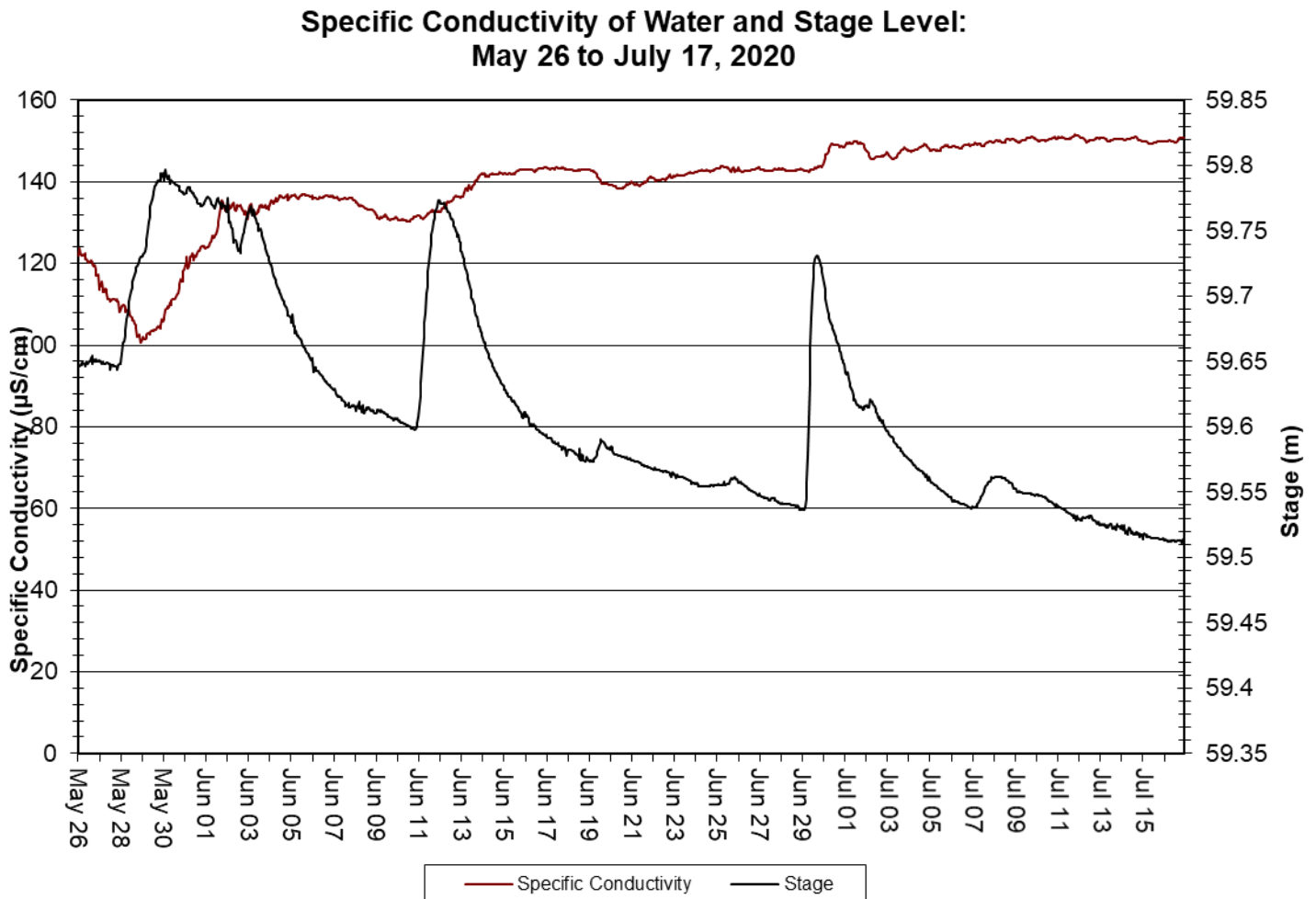


Figure 4: Specific Conductivity of Water and Stage - Outflow of the Steady

- The saturation of dissolved oxygen ranged from 90.9% to 113% and a range of 8.40 to 12.12 mg/l was recorded for the concentration of dissolved oxygen with a median value of 9.93 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 above 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 deployment period, corresponding closely to water temperature.

**Dissolved Oxygen (Concentration and Saturation) and Water Temperature:
May 26 to July 17, 2020**

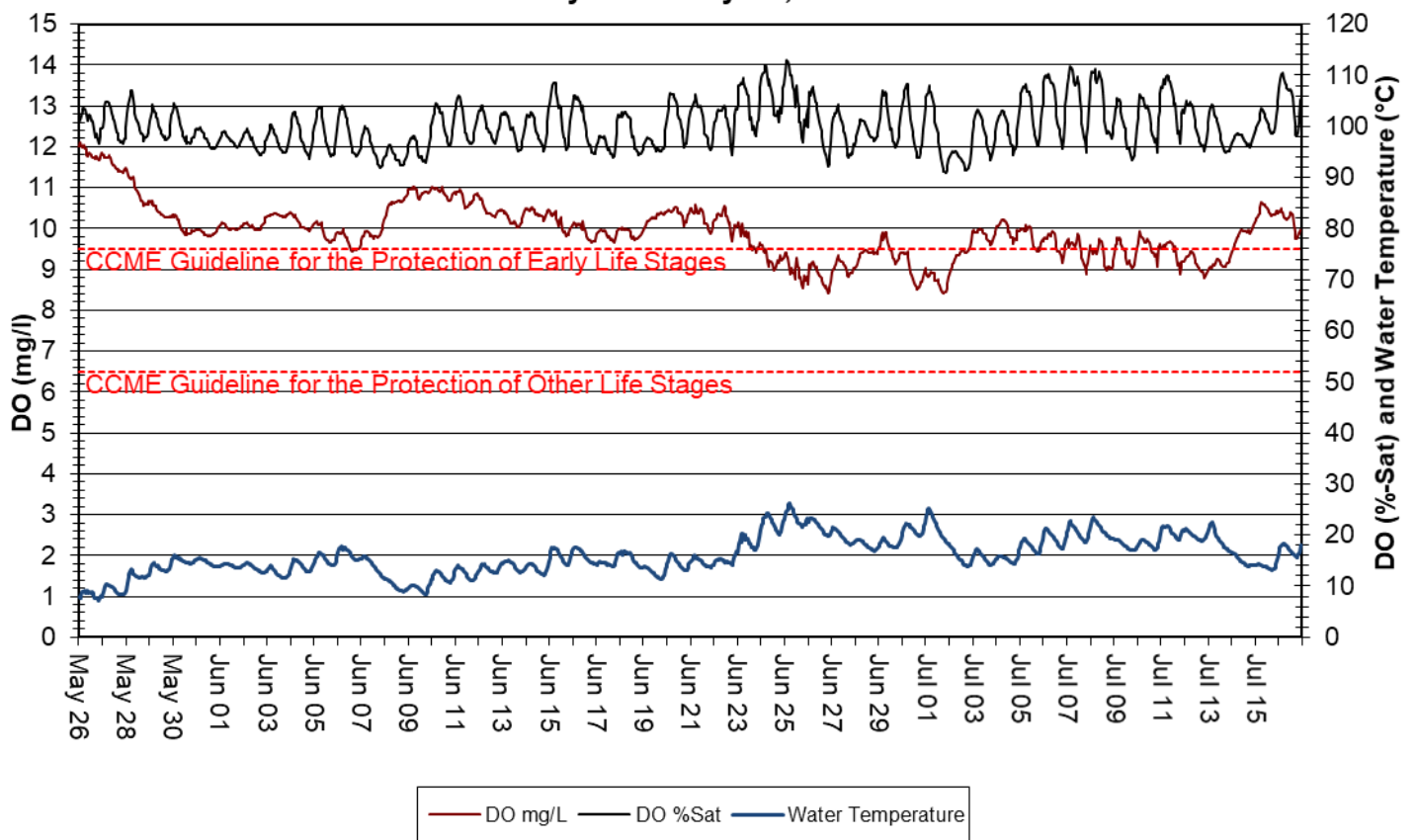


Figure 5: Dissolved Oxygen and Water Temperature – Outflow of the Steady

- Turbidity values range from 0.0 NTU to 1.6 NTU with a median of 0.4, 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.

**Water Turbidity and Stage Level:
May 26 to July 17, 2020**

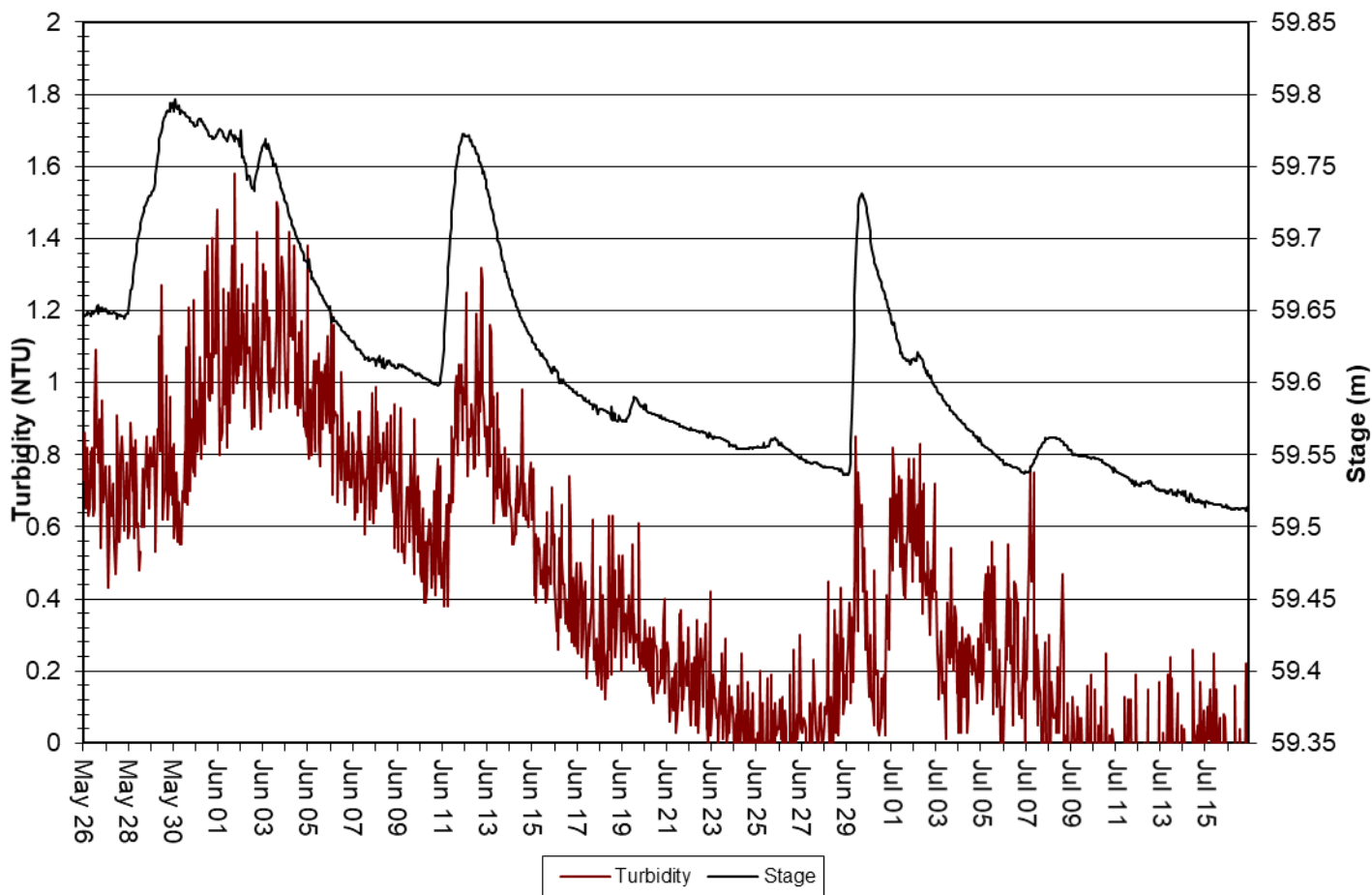


Figure 6: Turbidity and Stage – Outflow of the Steady

Outflow of the Steady at Rambler Mine, Newfoundland and Labrador

- Precipitation and stage during the deployment period are graphed below (Figure 7). Precipitation data for the majority of the deployment period was unavailable from the La Scie weather station. Stage was generally decreasing during the deployment, which is typical for this time of the year.
- It is notable from the data that precipitation did not always lead to an increase in stage at this location.
- 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.

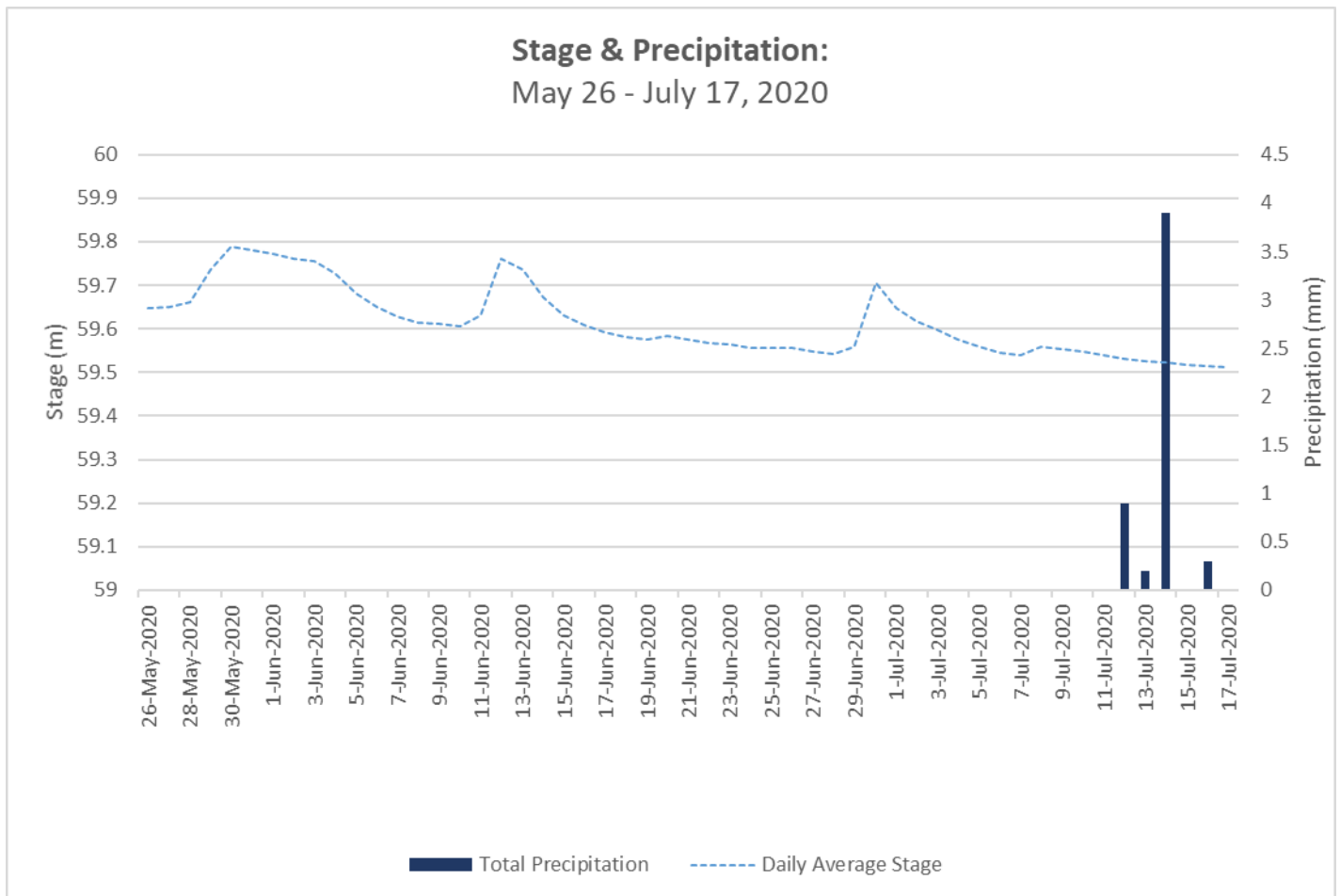


Figure 7: Precipitation and Stage – Outflow of the Steady

Conclusions

- An instrument was deployed at the Outflow of the Steady water quality monitoring station on May 26 and removed on July 17, 2020. This was the first deployment of the 2020 season.
- In most cases, weather related events or increases/decreases in water level explain parameter fluctuations.
- Water temperature increased during the deployment period, ranging from 7.21 down to 26.18°C. This is expected due to the influence of the ambient air temperature as it changes between seasons.
- pH values were all within the recommended CCME Guidelines for the Protection of Aquatic Life. pH ranged between 6.86 and 7.34. The brook is influenced by high precipitation events which decrease pH values for a short time.
- Specific conductivity ranged from 100.6 to 151.7 $\mu\text{s}/\text{cm}$, showing a slight increasing trend 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 above 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 0.0 NTU to 1.6NTU indicated low background turbidity. Increasing turbidity corresponded to increases in the water level at this site.
- Stage fluctuated during this deployment period, however there was a general decrease in stage during the deployment.
- 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

