Real-Time Water Quality Deployment Report

Outflow of the Steady at Rambler Mine

May 20 to
July 28, 2021

Newfoundland Labrador

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

Contents

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 20, 2021, a real-time water quality monitoring instrument was deployed at the station Outflow of the Steady. The instrument was deployed for a period of 69 days. This was the first deployment for this station in 2021.
- The station experienced issues with the hydrometric (stage/water quantity) equipment during this deployment, resulting in no stage data for this period. WRMD will troubleshoot and make repairs as soon as possible.
- Water Resources Management Division staff monitor the real-time web pages regularly.

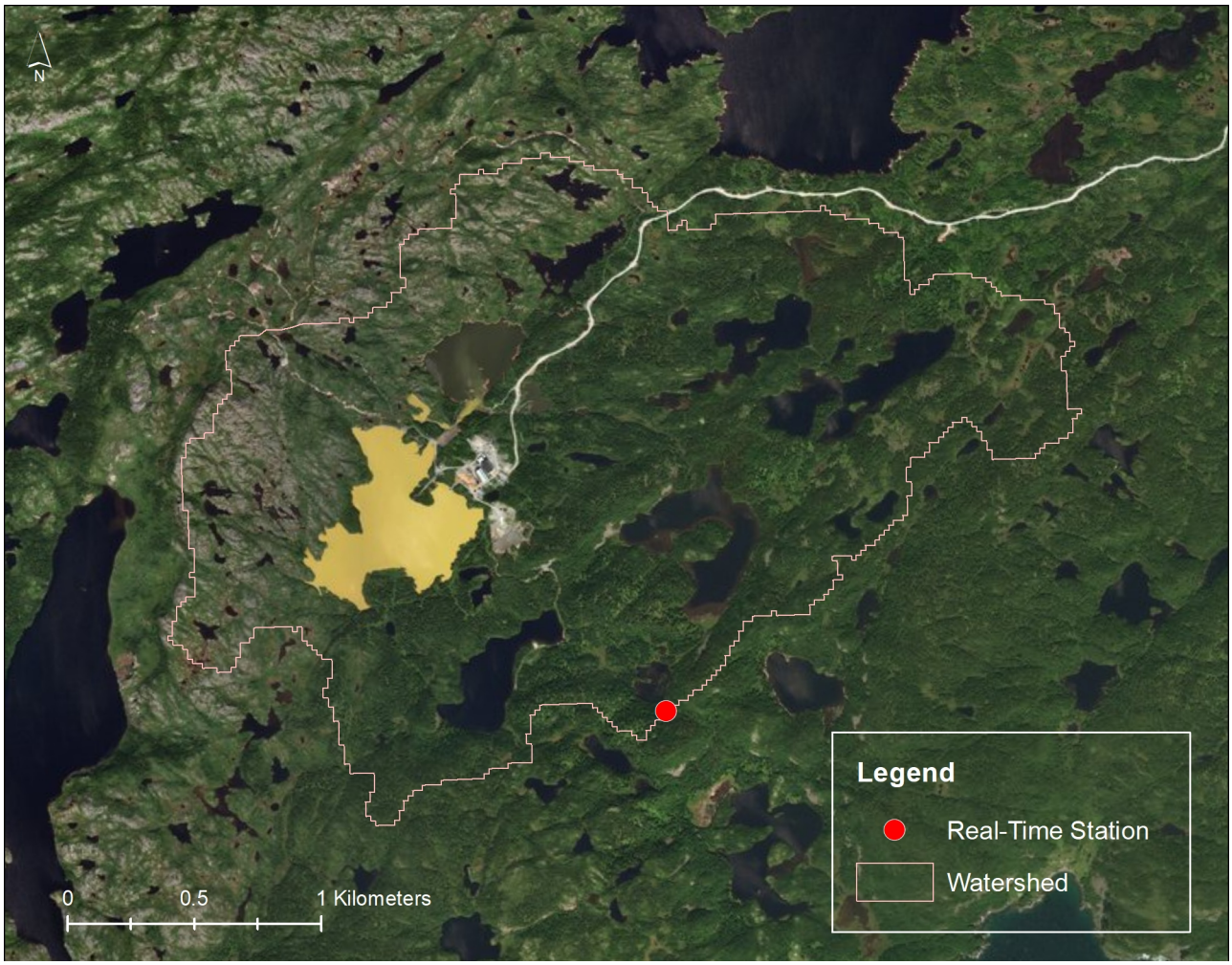

Figure 1: Location of the real-time station downstream of Rambler's Nugget Pond Mill tailings management facility

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 May 20 and July 28, 2021 are summarized in Table 2.

Table 2: Comparison rankings for Outflow of the Steady station May 20 – July 28, 2021.

Station	**Date**	**Action**	**Comparison Ranking**				
			Temperature	**pH**	**Conductivity**	**Dissolved Oxygen**	**Turbidity**
Outflow of the Steady	May 20, 2021	Deployment	Excellent	Good	Excellent	Excellent	Poor
	July 28, 2021	Removal	Good	Good	Excellent	Excellent	Excellent

- Deployment rankings were all ‘excellent’ or ‘good’ with the exception of turbidity which ranked ‘poor’. This is likely due to the QAQC sonde stirring up particles where it was placed as it read higher much (24.5NTU) than the field sonde (0.6NTU).
- At removal, all parameters ranked ‘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 20 to July 28 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 6.74 to 24.43ºC 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).

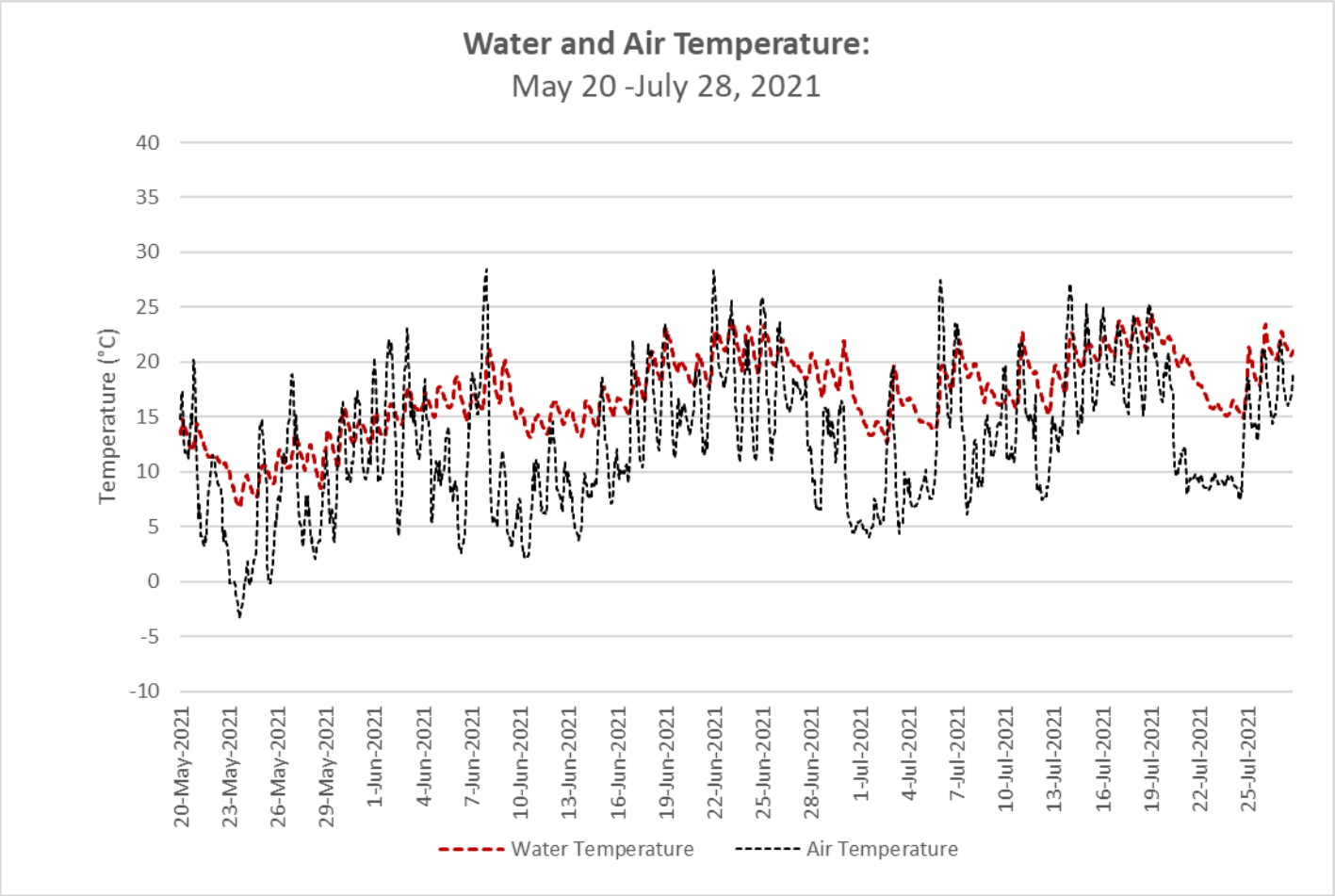

Figure 2: Water and Air Temperature – Outflow of the Steady

(Weather data collected at La Scie)

- pH ranged between 6.96 and 7.52 pH units throughout the deployment period, with a median value of 7.24 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. However, due to a sensor failure, stage data was unavailable during the deployment period.
- Overall, pH was generally stable during the first half of deployment, with a gradual increase over the second half of the deployment.

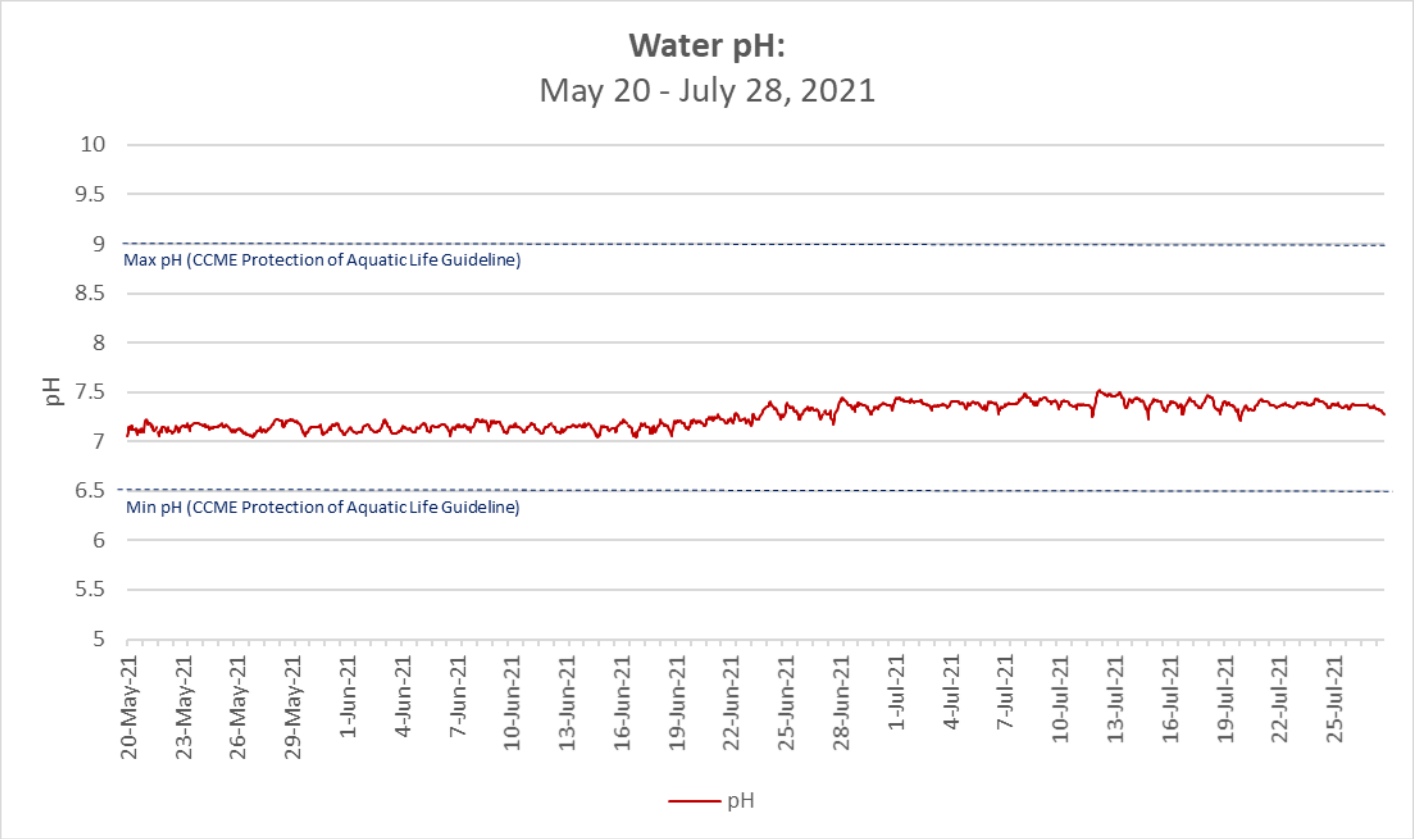

Figure 3: Water pH– Outflow of the Steady

- Specific conductivity ranged from 146.8 to 197.0 µs/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.

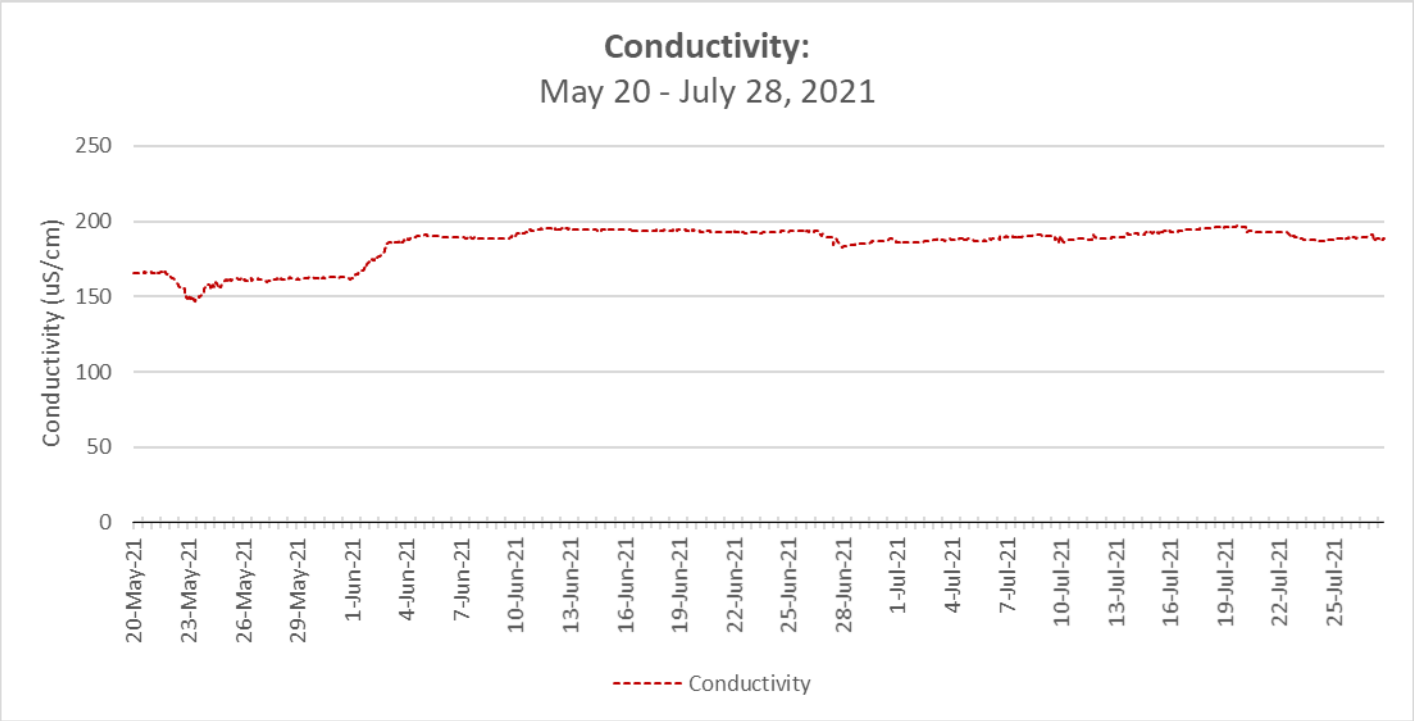

Figure 4: Specific Conductivity of Water - Outflow of the Steady

- The saturation of dissolved oxygen ranged from 91.7% to 114.8% and a range of 8.37 to 11.56 mg/l was recorded for the concentration of dissolved oxygen with a median value of 9.73 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 dark blue 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.

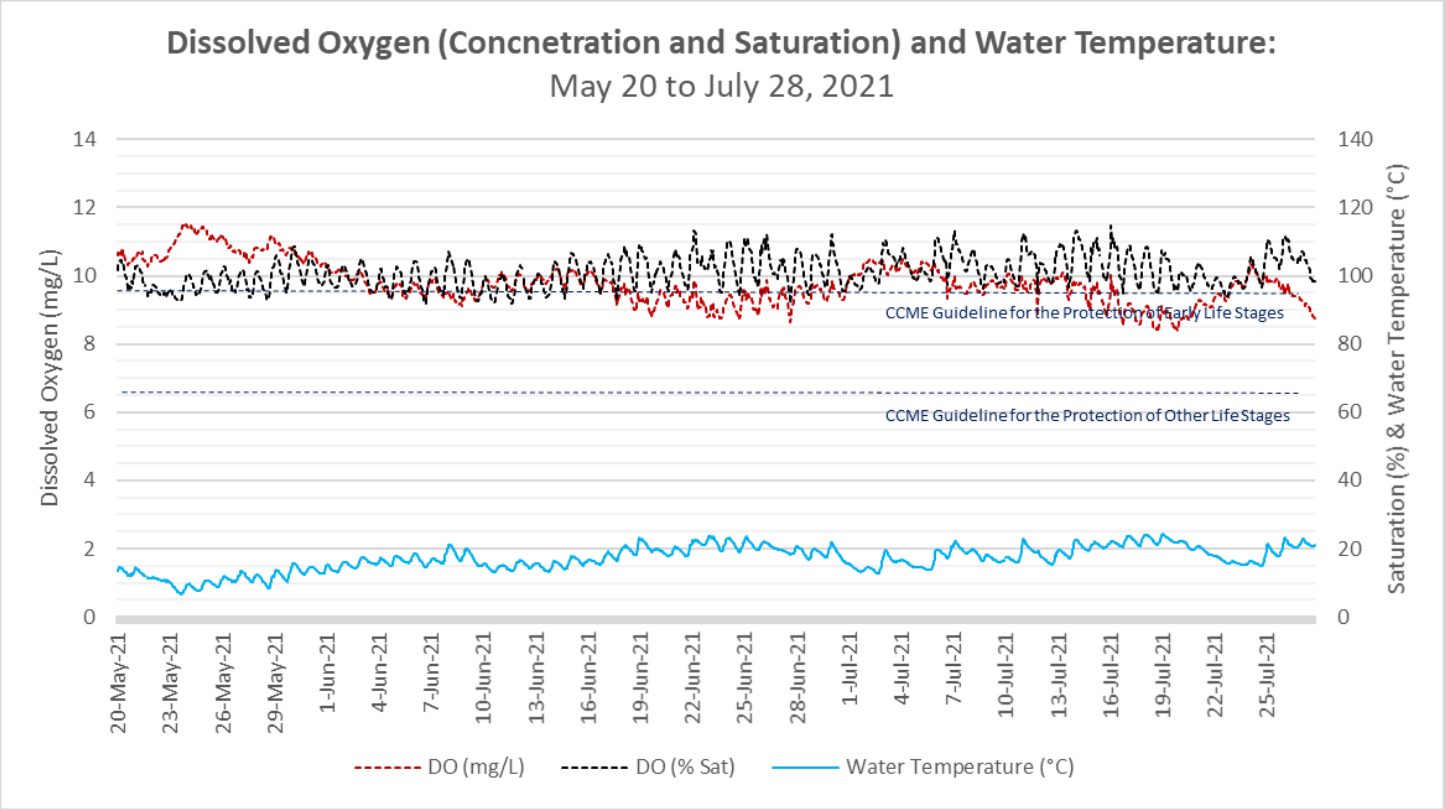

Figure 5: Dissolved Oxygen and Water Temperature – Outflow of the Steady

- Turbidity values range from 0.0 NTU to 2.1 NTU with a median of 0.2, indicating very clear background turbidity.
- Turbidity increased shortly after periods of precipitation, which likely increased the stage in the river (Figure 6). Due to a sensor failure, stage data was unavailable for the deployment period.

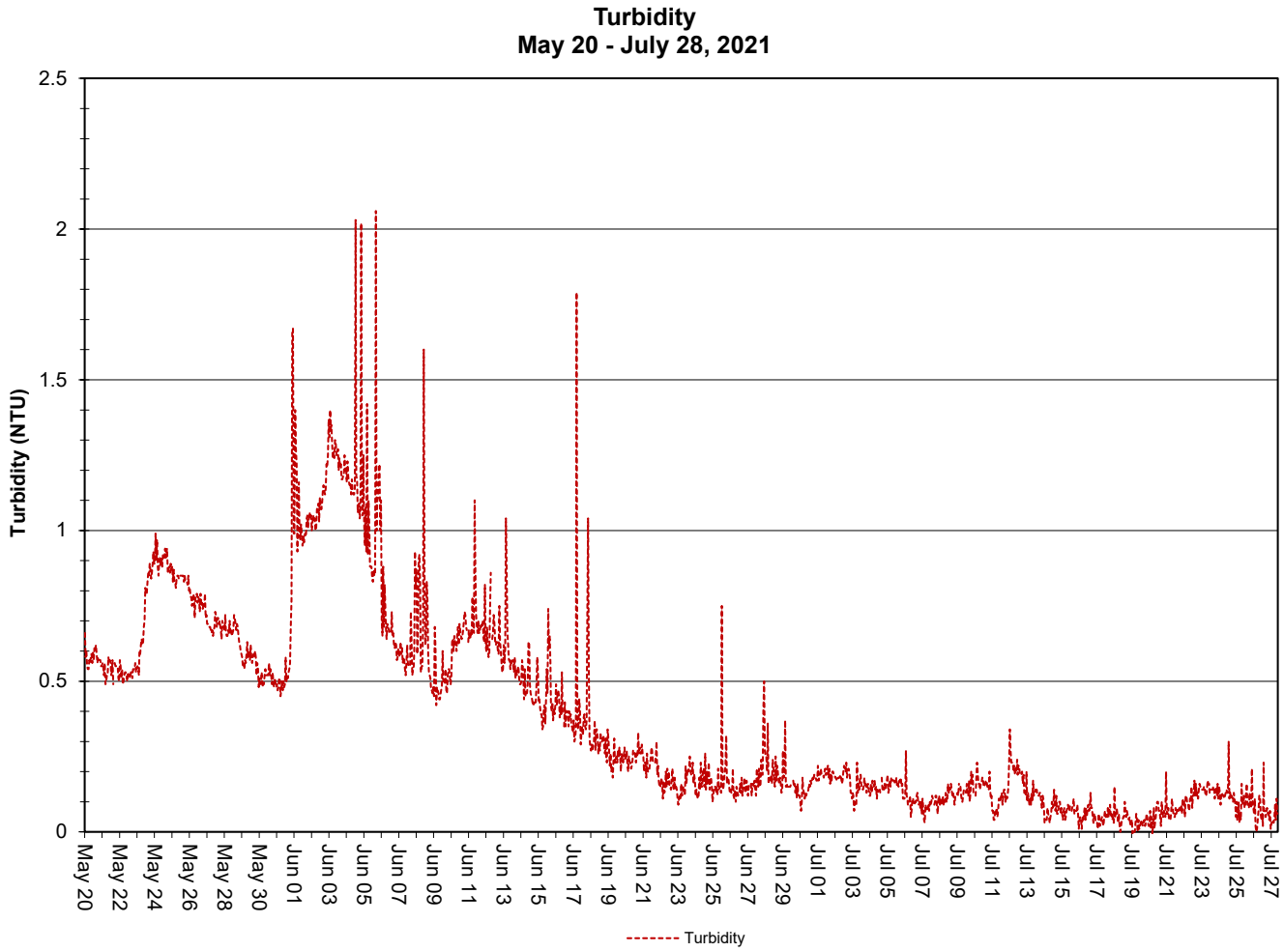

Figure 6: Turbidity – Outflow of the Steady

- Precipitation during the deployment period is graphed below (Figure 7). However, due to a sensor failure, stage data for the deployment period was unavailable.
- 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.

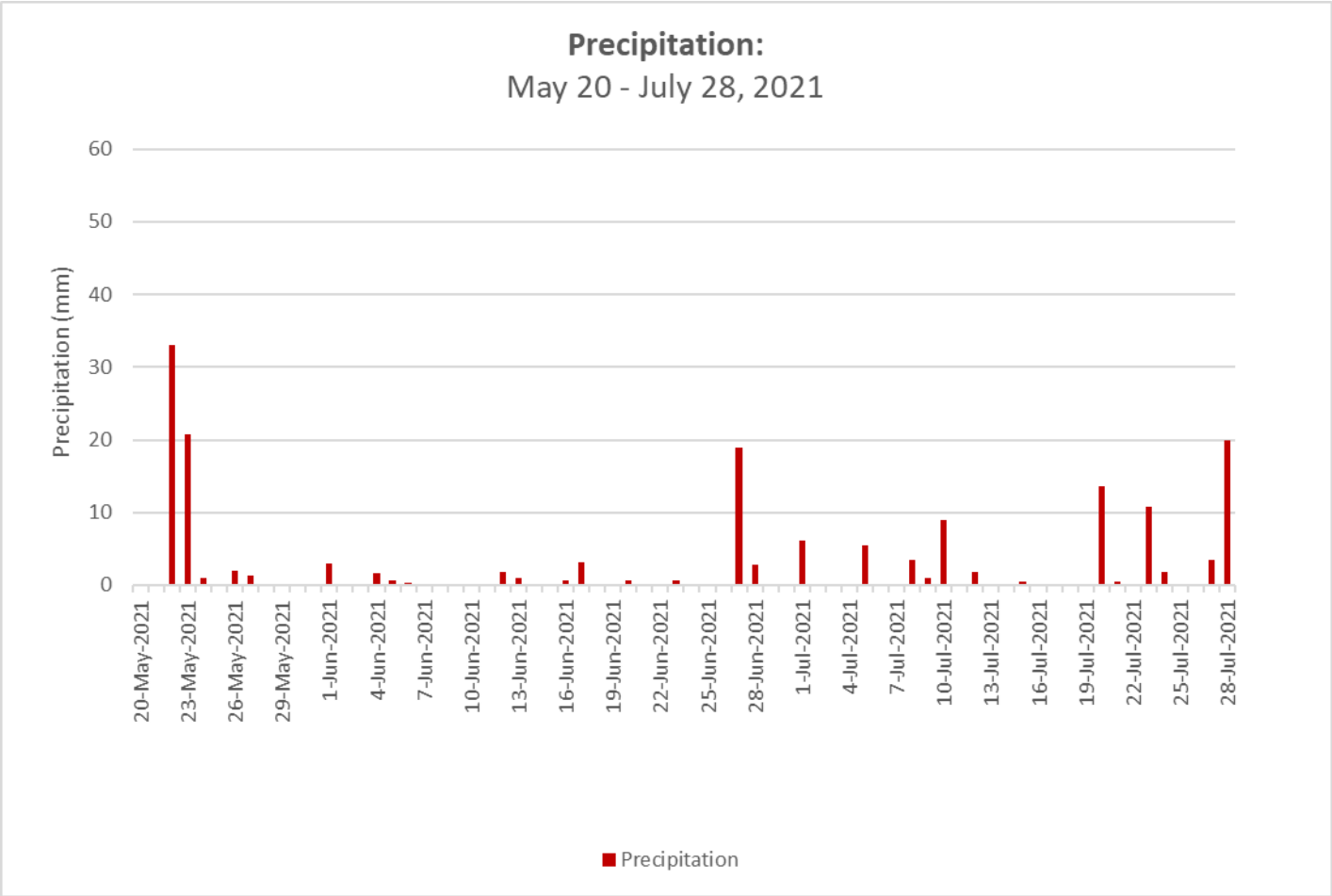

Figure 7: Precipitation – Outflow of the Steady

Conclusions

- An instrument was deployed at the Outflow of the Steady water quality monitoring station on May 20 and removed on July 28, 2021. This was the first deployment of the 2021 season.
- In most cases, weather related events (precipitation and spring ice thaw) explain parameter fluctuations.
- Water temperature increased during the deployment period, ranging from 6.74 down to 24.43°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 6.96 and 7.52. The brook is influenced by high precipitation events which decrease pH values for a short time.
- Specific conductivity ranged from 146.8 to 197.0 µs/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 2.1 NTU with a median of 0.2 NTU indicated low background turbidity.
- Stage data was unavailable during this deployment due to sensor failure.
- All data used in the preparation of the graphs and subsequent discussion adhere to stringent QA/QC protocol. Corrected data can be obtained upon request.

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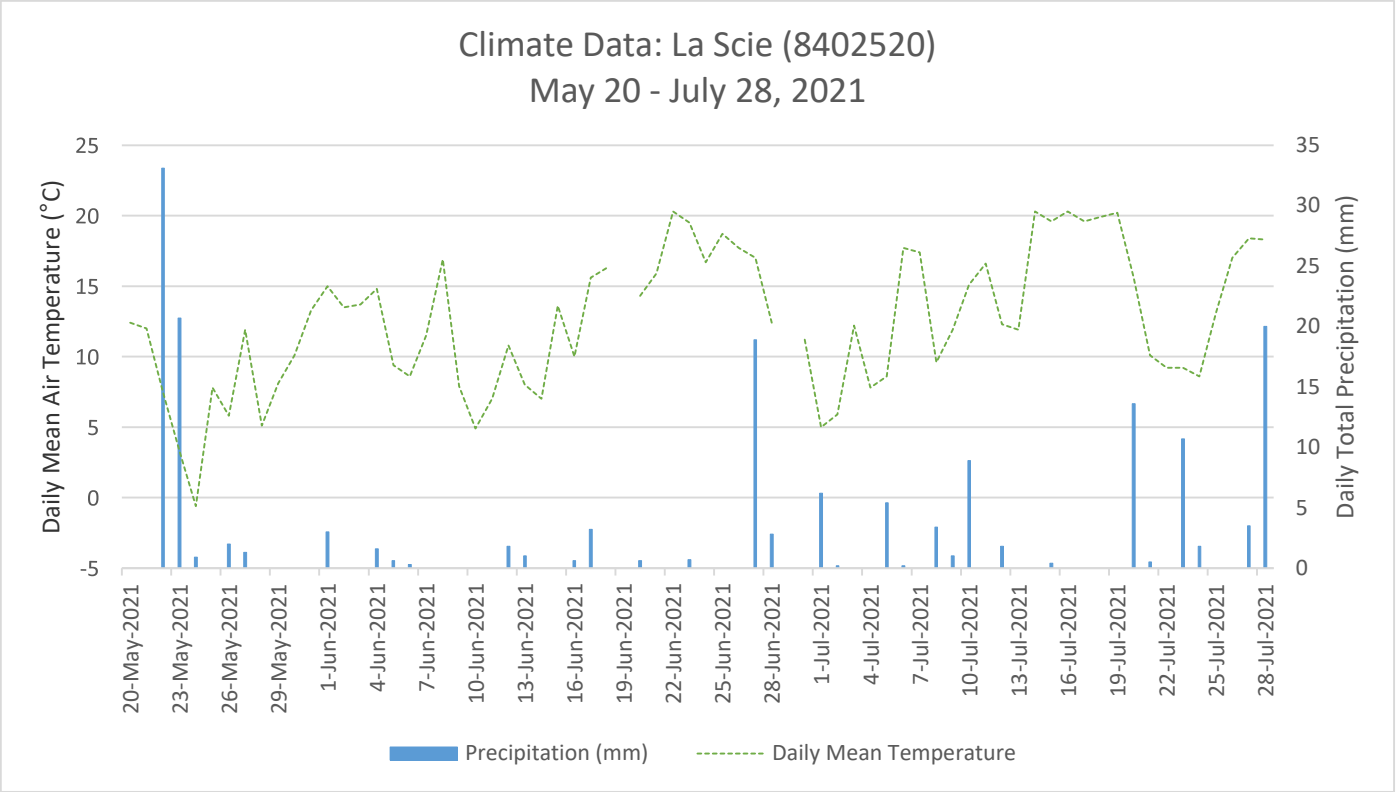
Appendix 1


Climate Data: La Scie (8402520)
May 20 - July 28, 2021
Daily Mean Air Temperature (°C)
Daily Total Precipitation (mm)
25
20
15
10
5
0
-5
35
30
25
20
15
10
5
0
20-May-2021
23-May-2021
26-May-2021
29-May-2021
1-Jun-2021
4-Jun-2021
7-Jun-2021
10-Jun-2021
13-Jun-2021
16-Jun-2021
19-Jun-2021
22-Jun-2021
25-Jun-2021
28-Jun-2021
1-Jul-2021
4-Jul-2021
7-Jul-2021
10-Jul-2021
13-Jul-2021
16-Jul-2021
19-Jul-2021
22-Jul-2021
25-Jul-2021
28-Jul-2021
Precipitation (mm)
Daily Mean Temperature