Real-Time Water Quality Deployment Report

Outflow of the Steady at Rambler Mine

Deployment Period
July 19, 2022 to October 19, 2022

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 July 19, 2022, a real-time water quality monitoring instrument was deployed at the station Outflow of the Steady. The instrument was deployed for a period of 90 days. This was the second deployment for this station in 2022.
- Water Resources Management Division staff monitor the real-time web pages regularly.

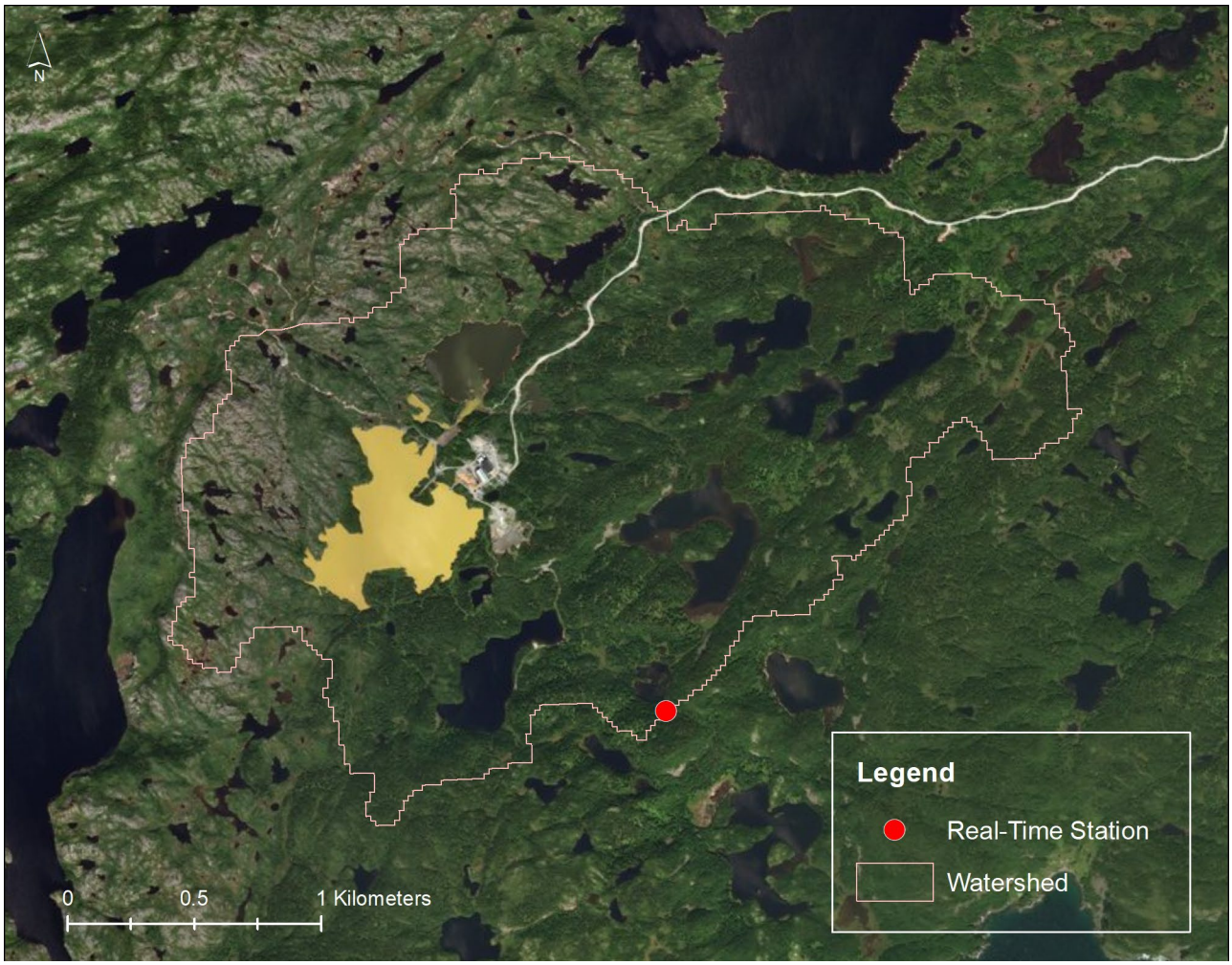

Figure 1: Location of the real-time station downstream of Rambler's Nugget Pond Mill tailings management facility

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 19 and October 19, 2022 are summarized in Table 2.

Table 2: Comparison rankings for Outflow of the Steady station July 19 – October 19, 2022.

Station	**Date**	**Action**	**Comparison Ranking**				
			Temperature	**pH**	**Conductivity**	**Dissolved Oxygen**	**Turbidity**
Outflow of the Steady	July 19, 2022	Deployment	Excellent	Good	Excellent	Excellent	Excellent
	Oct 19, 2022	Removal	Excellent	Marginal	Excellent	Fair	Excellent

- Deployment rankings were all ‘excellent’ or ‘good’.
- At removal, all parameters ranked ‘marginal’, ‘fair’, ‘good’ or ‘excellent’. The rankings of ‘marginal’ and ‘fair’ for pH and dissolved oxygen respectively, may be due to longer than expected deployment periods, resulting in some data drift.
- 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 19 to October 19 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.

Temperature

- Water temperature ranged from 8.29°C to 24.86°C, with an average of 17.37°C during this deployment period (Figure 2).
- Water temperature was consistent for the months of July and August and began to decrease in September, consistent with ambient air temperatures, as summer transitions to fall (Figure 2).

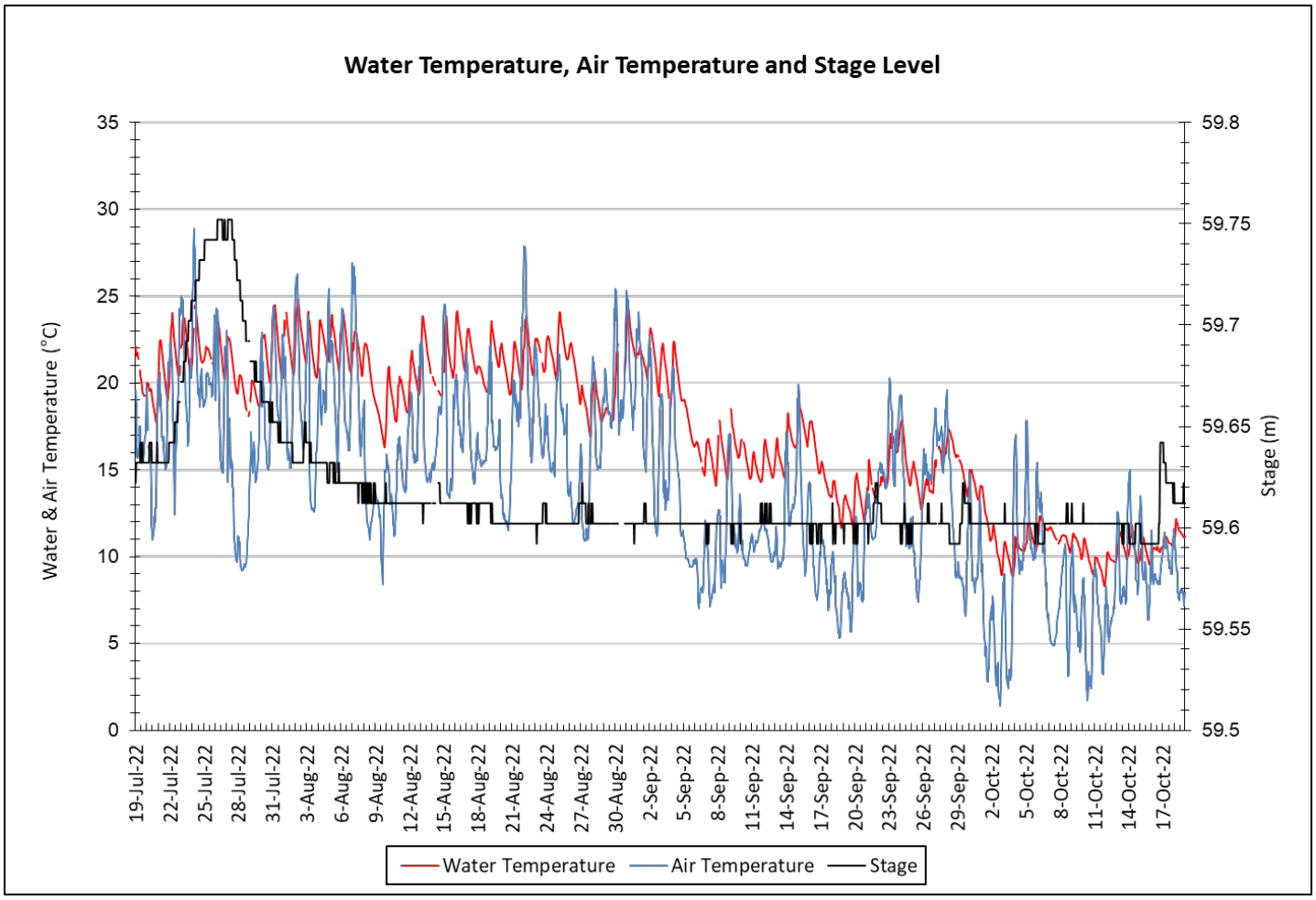

Figure 2: Water and Air Temperature – Outflow of the Steady

(Weather data collected at La Scie)

pH

- pH ranged between 6.64 and 7.16 pH units throughout the deployment period, with a mean value of 6.91 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 generally stable throughout the deployment.

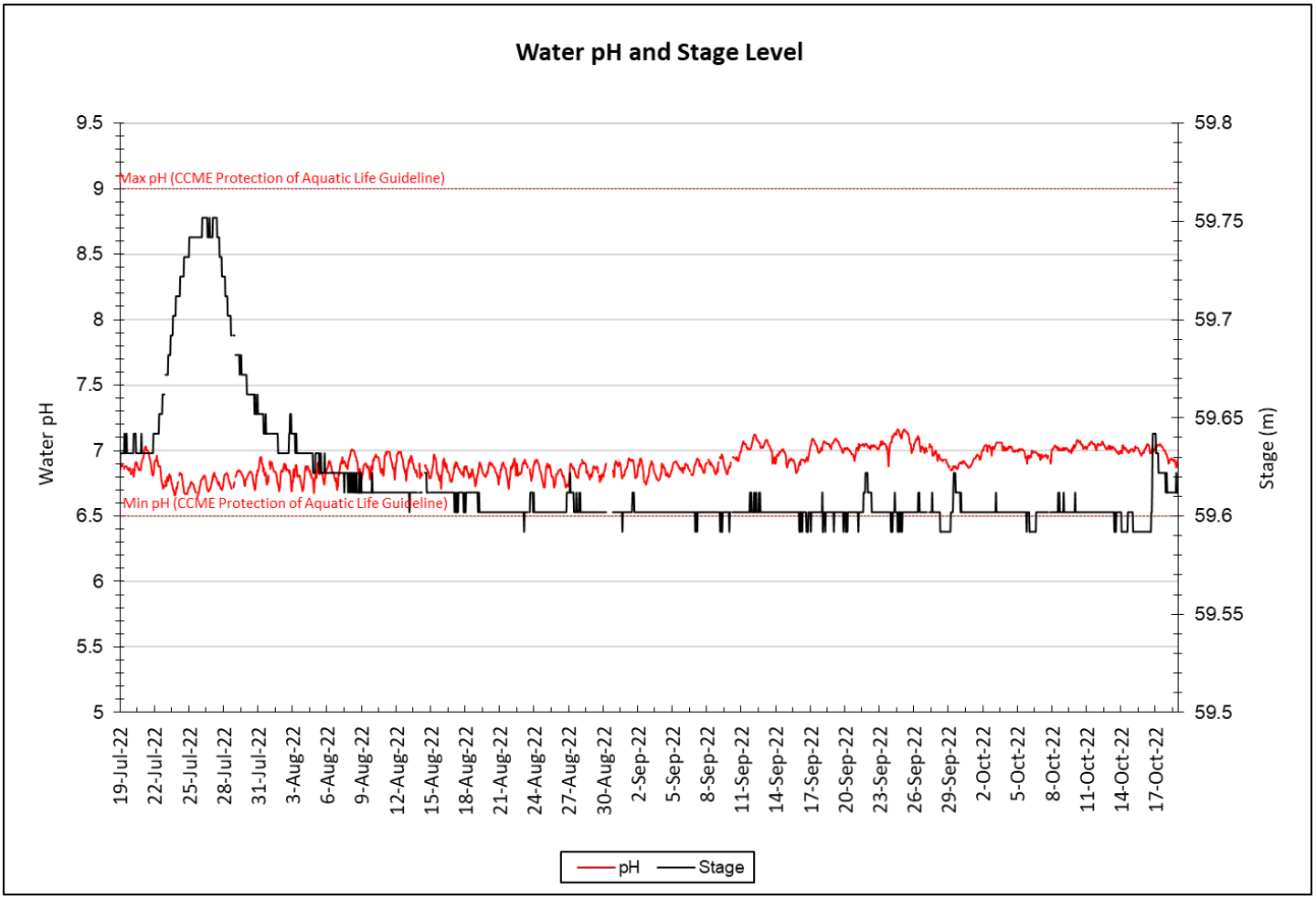

Figure 3: Water pH– Outflow of the Steady

Specific Conductivity

- Specific conductivity ranged from 149.9 to 217.3 µs/cm, with a mean value of 191.0 µs/cm (Figure 4).
- Specific conductivity steadily increased over the course of this deployment period while stage decreased.
- 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.

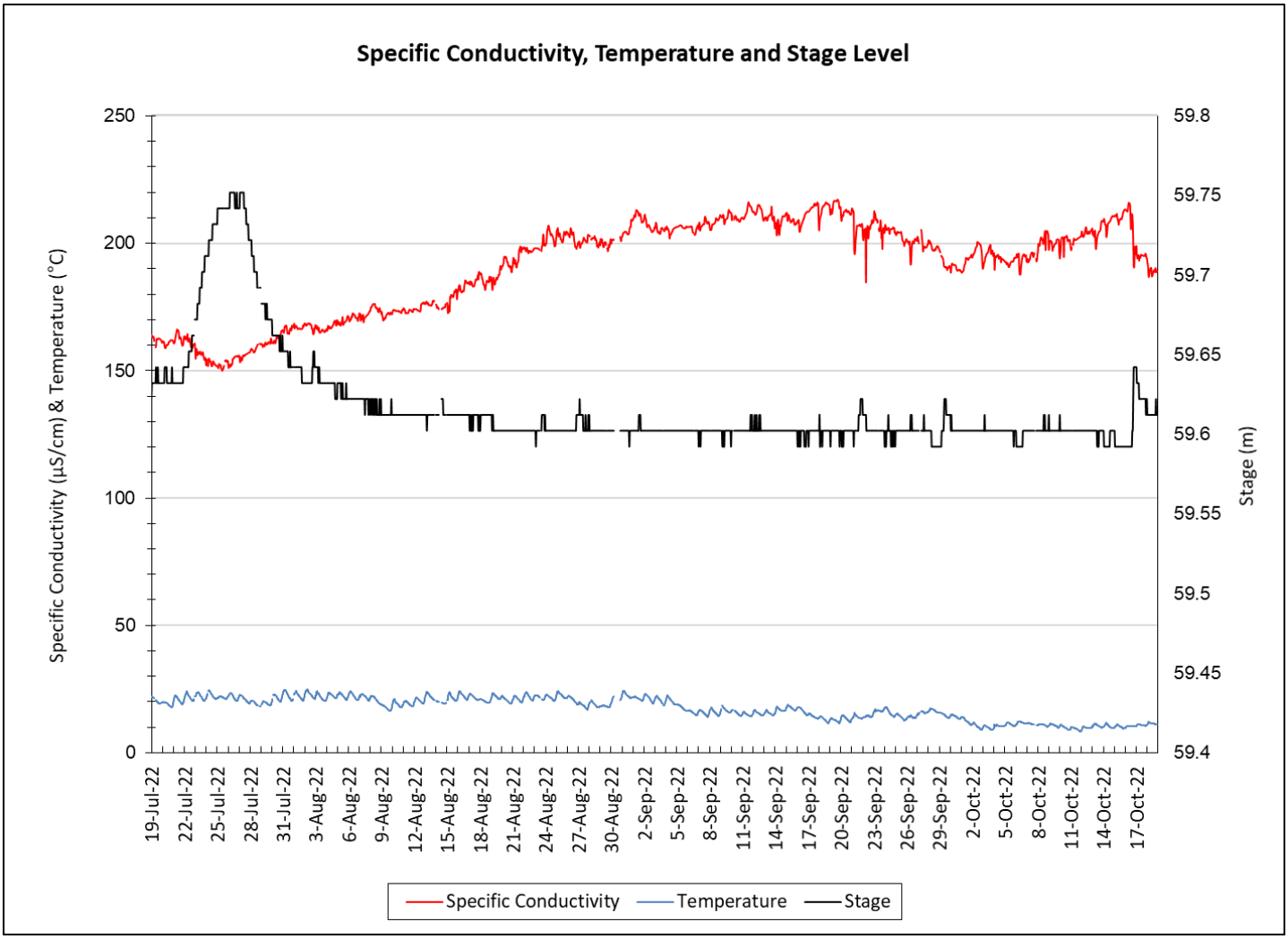

Figure 4: Specific Conductivity of Water - Outflow of the Steady

Dissolved Oxygen

- The saturation of dissolved oxygen ranged from 82.6% to 108.2% and a range of 7.49 to 11.05 mg/l was recorded for the concentration of dissolved oxygen with a mean value of 9.16 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 until October when the concentrations increased in correlation with decreasing temperatures.
- Dissolved oxygen content fluctuates diurnally, displaying the inverse relationship to water temperature.

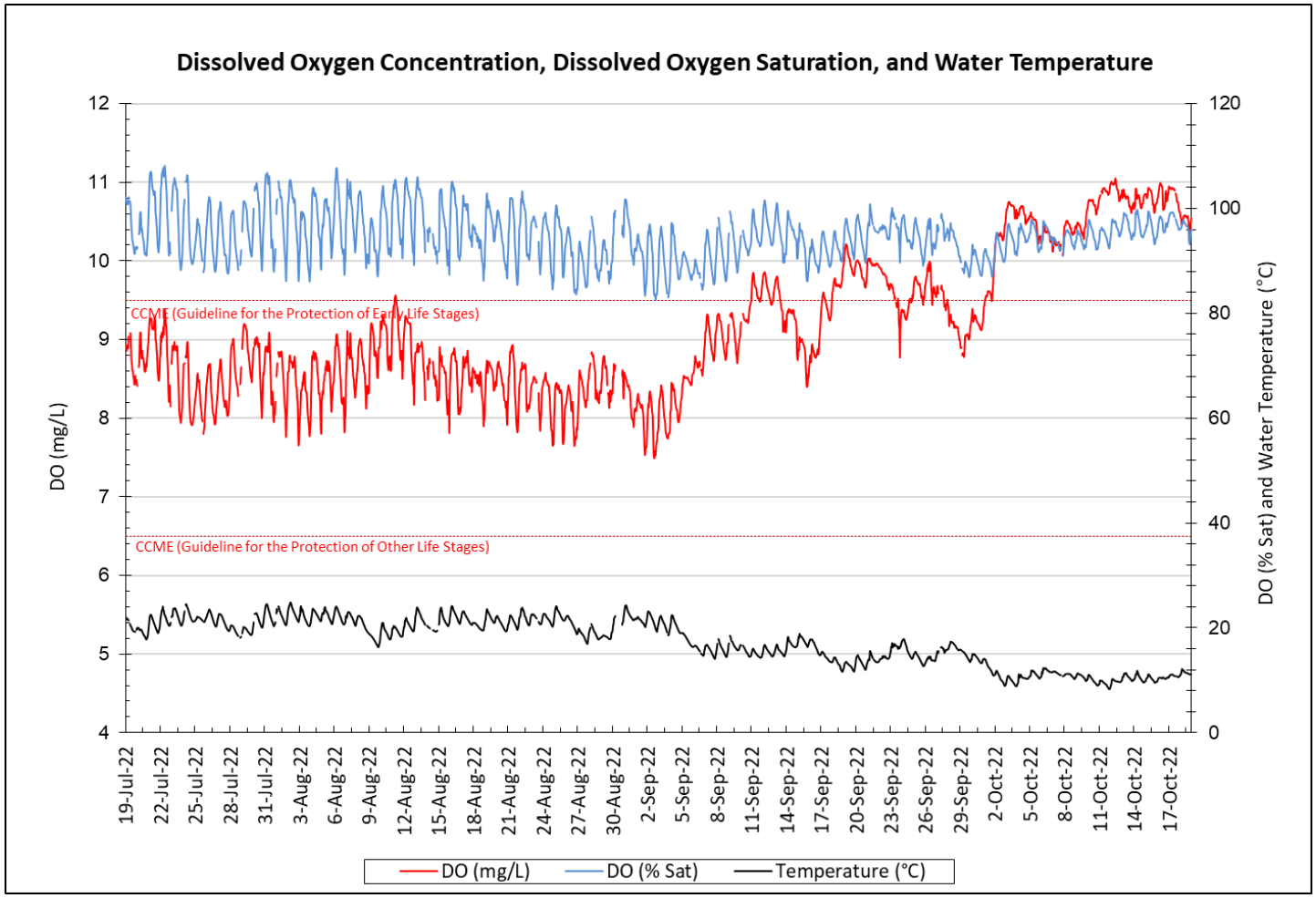

Figure 5: Dissolved Oxygen and Water Temperature – Outflow of the Steady

Turbidity

- Turbidity values range from 0.0 NTU to 2.5 NTU with a median of 0.3, indicating very clear background turbidity.
- Turbidity increased shortly after periods of precipitation, which likely increased the stage in the river (Figure 6).

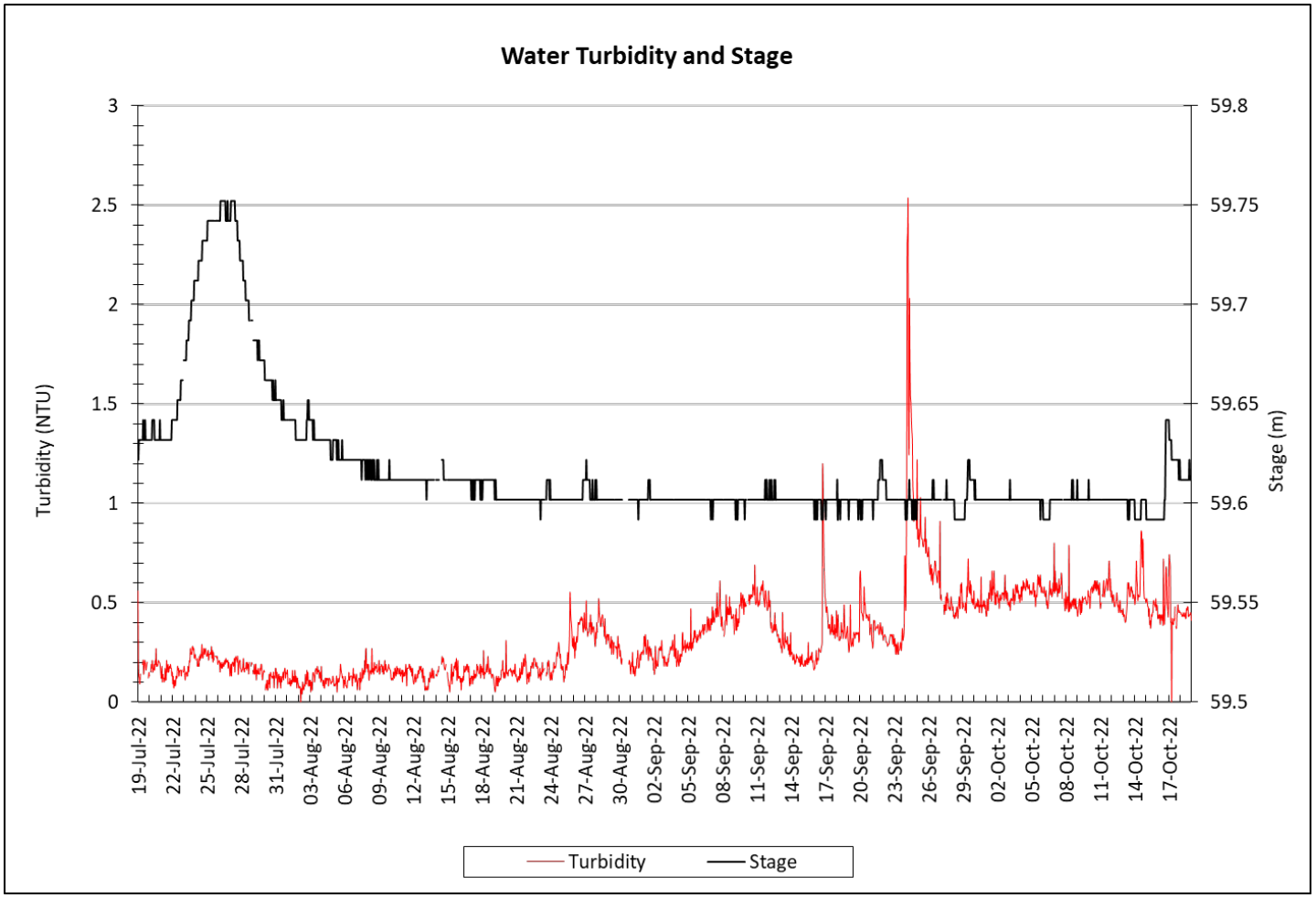

Figure 6: Turbidity – Outflow of the Steady

Precipitation

- Precipitation during the deployment period is graphed below (Figure 7).
- 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.

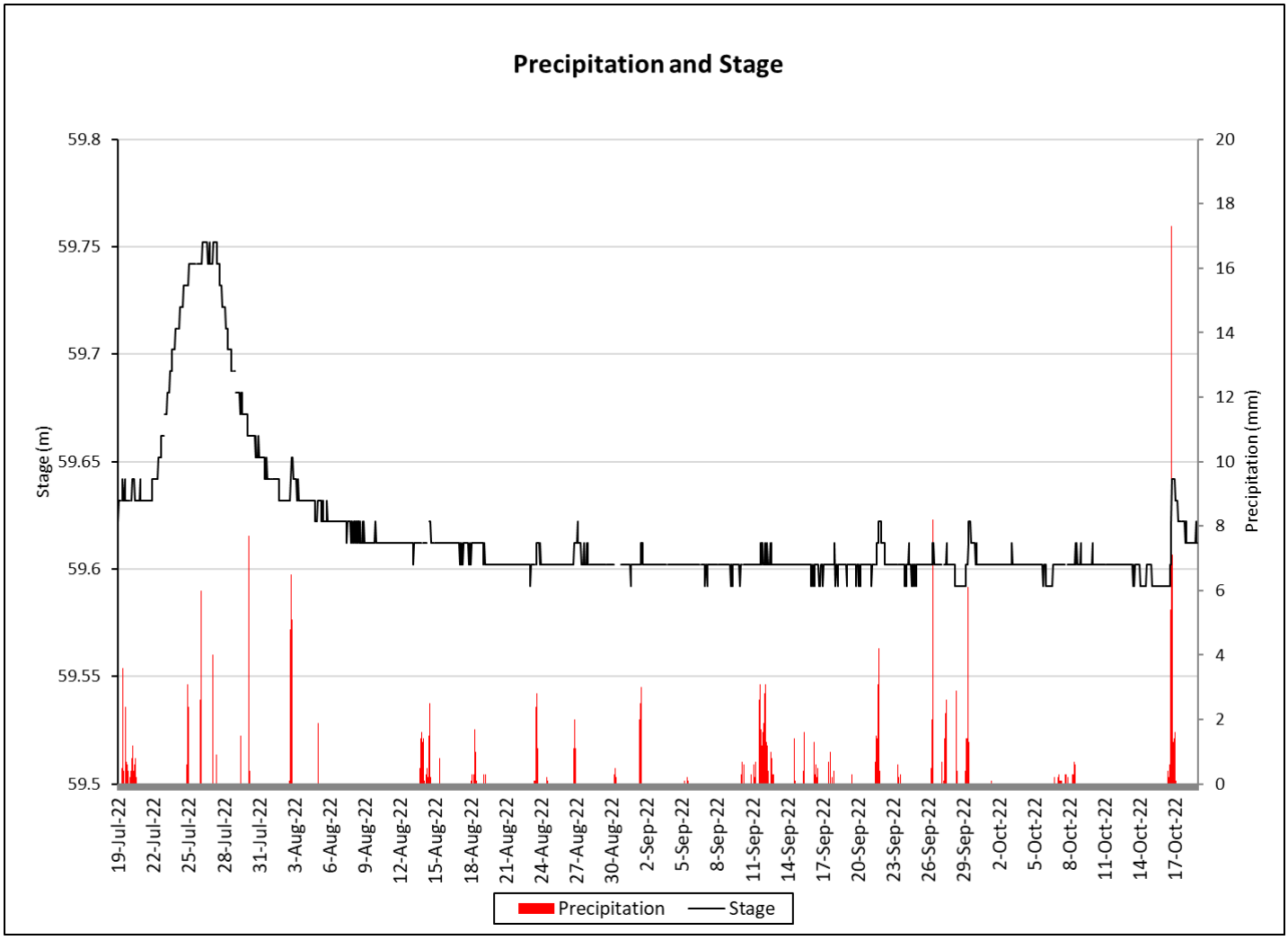

Figure 7: Precipitation – Outflow of the Steady

Conclusions

- An instrument was deployed at the Outflow of the Steady water quality monitoring station on July 19 and removed on October 19, 2022. This was the second deployment of the 2022 season.
- In most cases, weather related events (precipitation, temperature change) explain parameter fluctuations.
- Water temperature generally decreased during the deployment period, ranging from 8.29 °C to 24.86 °C. This is expected due to the influence of the ambient air temperature as the fall season progresses.
- pH values were all within the recommended CCME Guidelines for the Protection of Aquatic Life. pH ranged between 6.64 and 7.16. The brook is influenced by high precipitation events which decrease pH values for a short time.
- Specific conductivity ranged from 149.9 to 217.3 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 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 elevated water temperature.
- Turbidity values of 0.0 NTU to 2.5 NTU with a median of 0.3 NTU indicated low background turbidity.
- Stage was elevated in late July due to precipitation, but stable from early August onward.
- 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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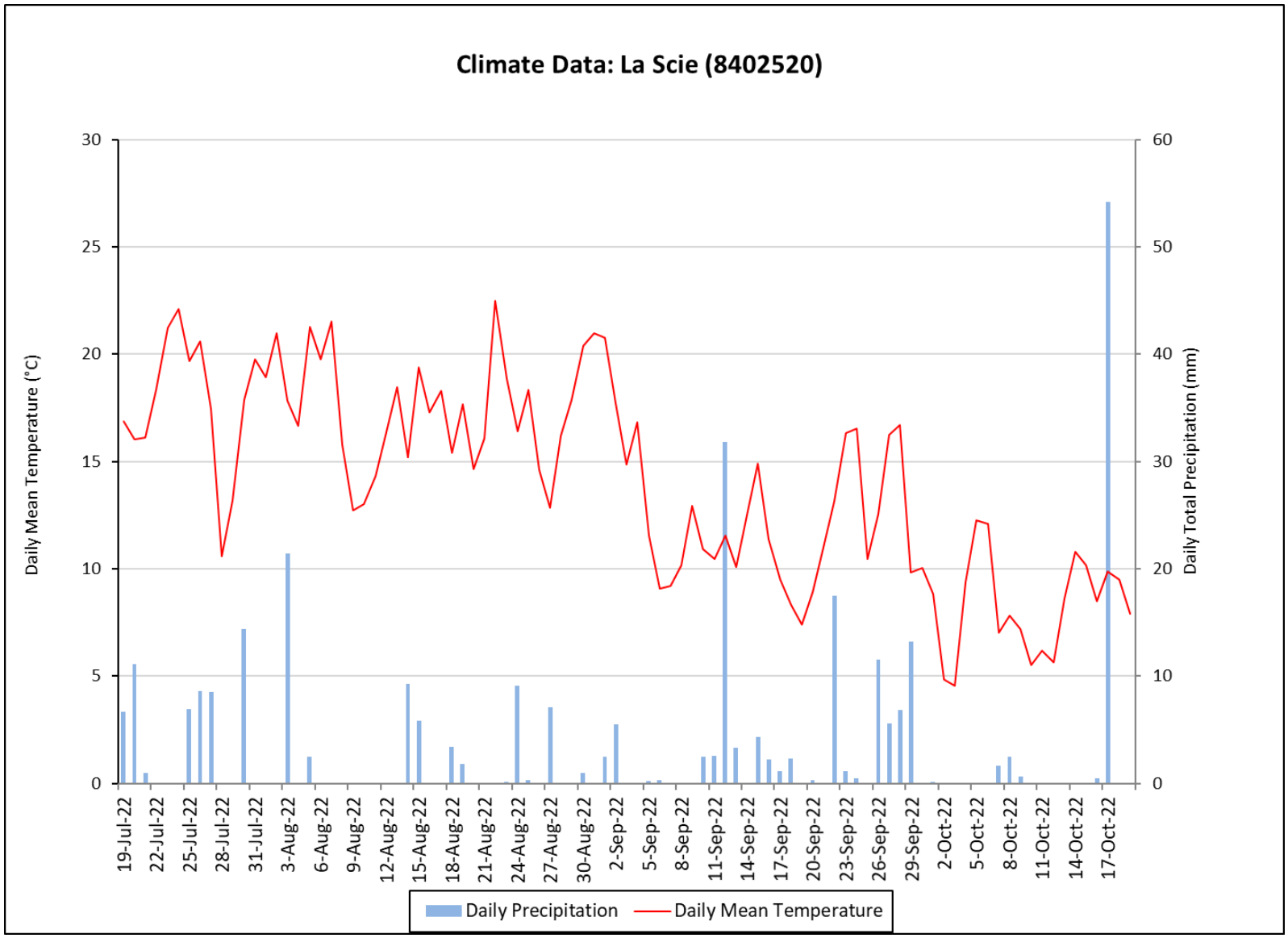
Appendix 1


Climate Data: La Scie (8402520)
Daily Mean Temperature (°C)
Daily Total Precipitation (mm)
30
25
20
15
10
5
0
60
50
40
30
20
10
0
19-Jul-22
22-Jul-22
25-Jul-22
28-Jul-22
31-Jul-22
3-Aug-22
6-Aug-22
9-Aug-22
12-Aug-22
15-Aug-22
18-Aug-22
21-Aug-22
24-Aug-22
27-Aug-22
30-Aug-22
2-Sep-22
5-Sep-22
8-Sep-22
11-Sep-22
14-Sep-22
17-Sep-22
20-Sep-22
23-Sep-22
26-Sep-22
29-Sep-22
2-Oct-22
5-Oct-22
8-Oct-22
11-Oct-22
14-Oct-22
17-Oct-22
Daily Precipitation
Daily Mean Temperature