Real-Time Water Quality Deployment Report

Marathon Gold Corp Network

June 5 to July 13, 2023

Newfoundland Labrador

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

General

- The Water Resources Management Division (WRMD), in partnership with Marathon Gold Corp., began establishing a real time water quality, quantity and climate monitoring network in and around the Valentine Lake Gold Mine in central Newfoundland in 2022.

- Water quality instruments were installed at three stations in the Fall of 2022 for a month before removal to prevent damage during the winter season. Water quantity instrumentation remained installed and reported over the winter season. Water quality instrumentation was deployed in the spring on June 5th, 2023, when conditions allowed.
- The first deployment period of 2023 ran from June 5th to July 13th at which time the sondes were removed for routine maintenance and replaced with freshly calibrated instruments for the second deployment period.

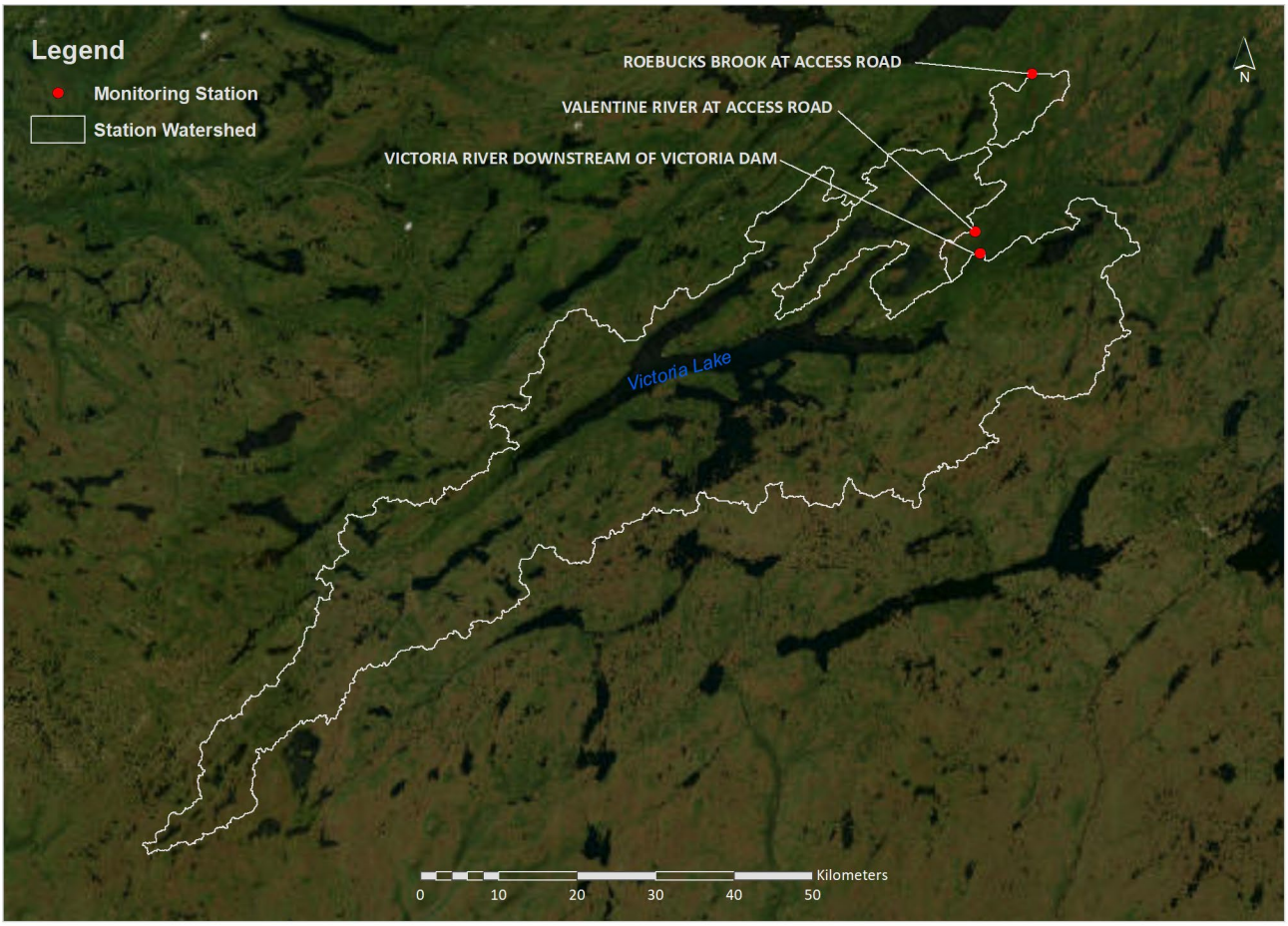


Figure 1: Location of the Marathon Gold Corp. Real Time Surface Water Quality Network (November 2022)

Station Installations

- Staff from WRMD installed equipment for Year 1 surface water and groundwater stations during two trips in Fall 2022. During the second installation trip in early November, surface water quality and quantity equipment was fully installed at three stations. Groundwater stations could not be completed due to delays with the water quality equipment from the manufacturer.
- Figure 1 above shows the locations of the three surface water stations (quality and quantity) installed around November 3rd, 2022. Water quality instruments remained in the water until December 1st, when all were removed to prevent damage during the winter. Water quantity instrumentation remained in the water for the winter season. The equipment sustained no significant damage through the winter.
- See Appendix A for surface water network locations, photos and metadata.

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 Marathon Gold Corp Surface Water Monitoring Network between June 5th and July 13th, 2023 are summarized in Table 2.

Table 2: Comparison rankings for Marathon Gold Corp. Surface Water Monitoring Network June 5 – July 13, 2023

Station	Date	Action	Comparison Ranking				
			Temperature	pH	Conductivity	Dissolved Oxygen	Turbidity
Victoria River	June 5, 2023	Deployment	Excellent	Good	Excellent	Excellent	Excellent
	July 13, 2023	Removal	Excellent	Good	Excellent	Good	Excellent
Valentine River	June 5, 2023	Deployment	Excellent	Fair	Excellent	Excellent	Excellent
	July 13, 2023	Removal	Excellent	Excellent	Excellent	Fair	Excellent
Roebucks Brook	June 5, 2023	Deployment	Excellent	Good	Excellent	Excellent	Excellent
	July 13, 2023	Removal	Excellent	Good	Good	Good	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.
- At deployment, all rankings were Good or Excellent with the exception of Valentine River temperature which ranked Fair for pH. This may be due to the sonde not having acclimated before values were read.
- At removal, the majority of rankings were Good or Excellent, with Valentine Rive reading Fair for DO. This is again likely due to the sensors not having fully acclimated to the environment before readings were recorded.

Data Interpretation

- The following graphs and discussion illustrate water quality related events from June 5th to July 13th, 2023 at the three surface water quality/quantity real time monitoring stations in the Marathon Gold Corp Network.

Victoria River

- Water temperature ranged from 8.54 °C to 25.24 °C during this deployment period (Figure 2).
- Water temperature showed an increasing trend throughout deployment, as spring turned into summer.

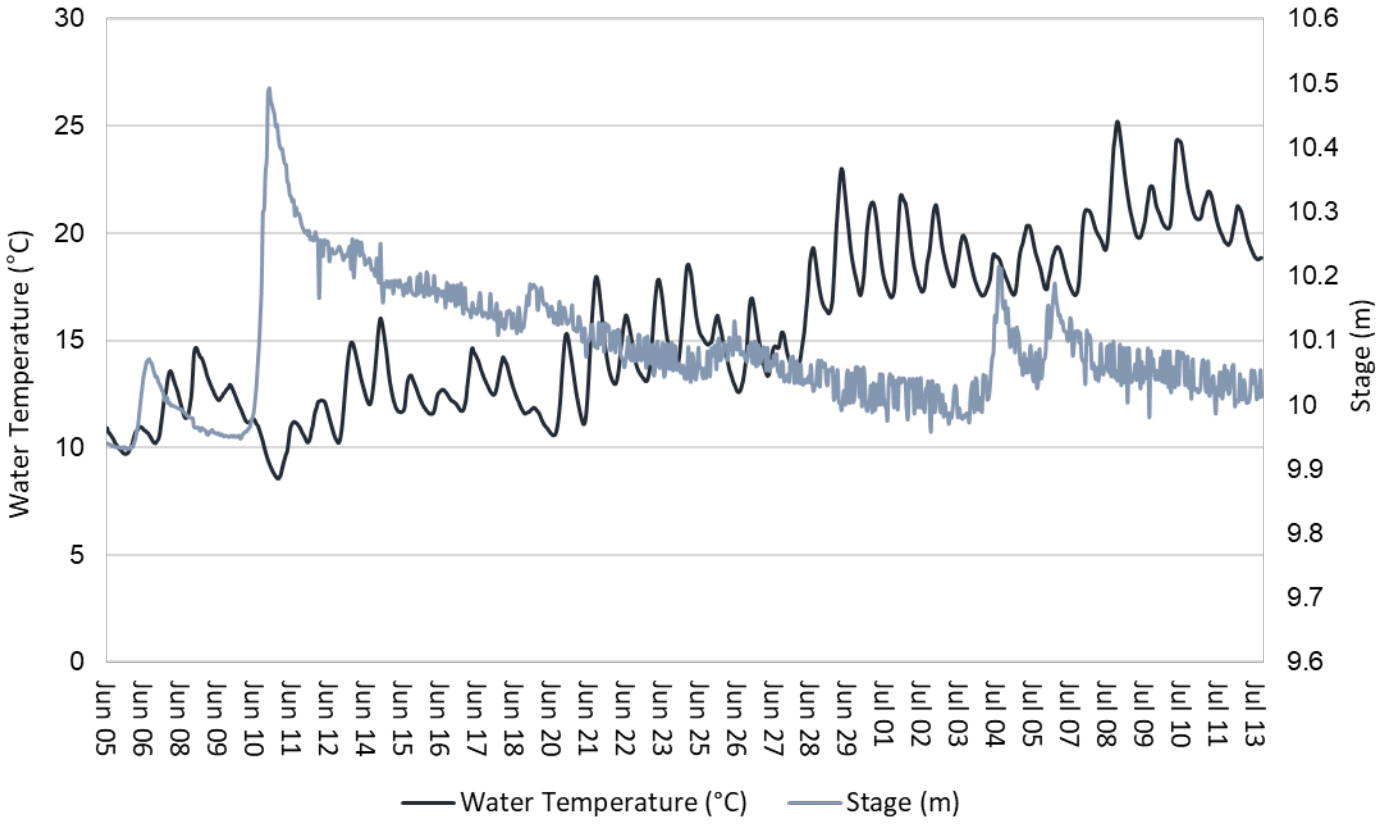


Figure 2: Water Temperature and Stage.

- pH ranged between 6.60 at beginning of the deployment and 7.21 pH units throughout the deployment period, with a median value of 6.83 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.
- Overall, pH was relatively stable for the deployment, but was occasionally affected by stage increases, such as when pH dropped on June 10th and when pH rose on July 4th, both at the same time that stage increased.

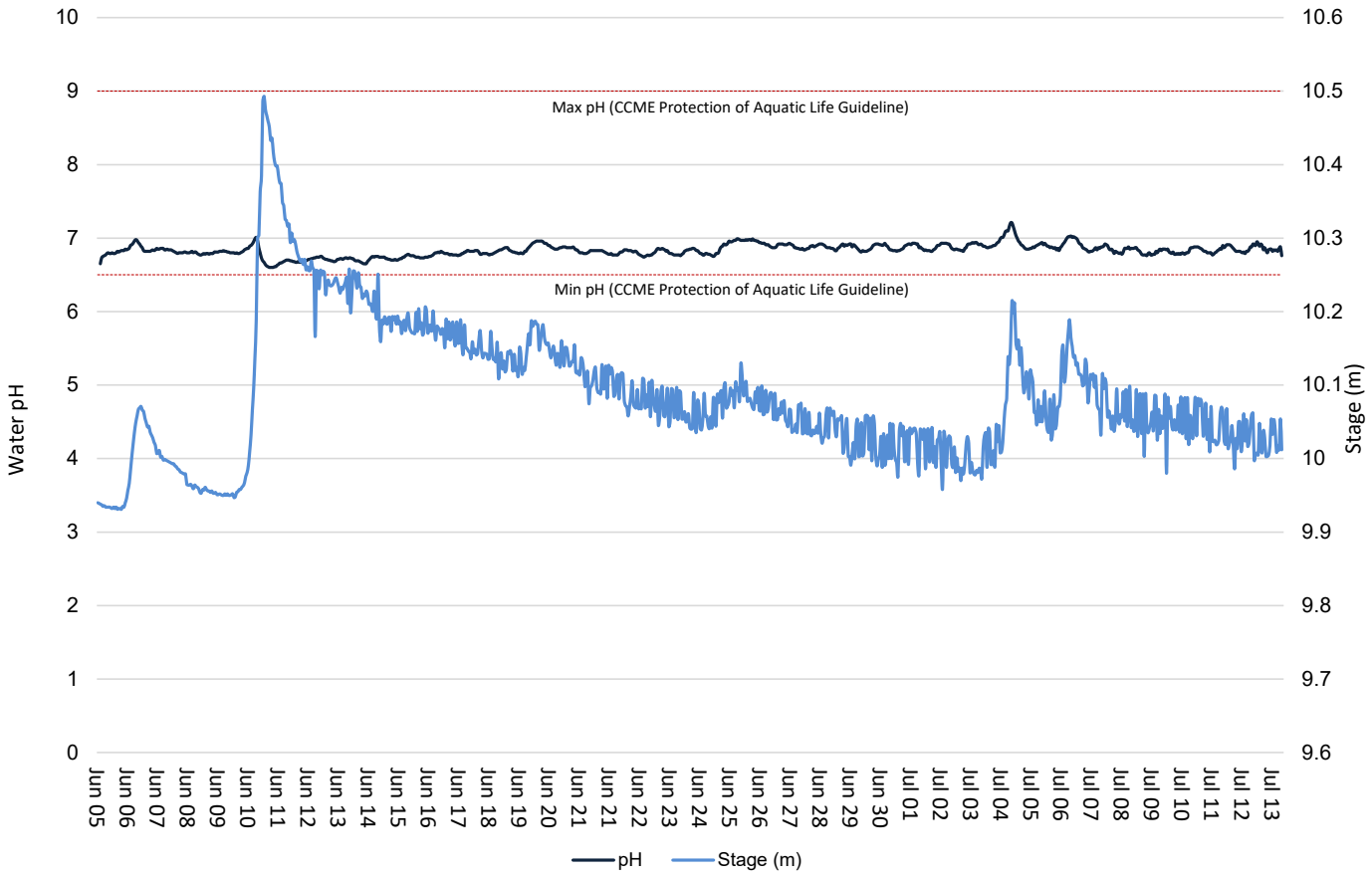


Figure 3: Water pH and Stage

- Specific conductivity ranged from 18.7 to 48.9 µs/cm (Figure 4) with a median of 21.6 µs/cm.
- Specific conductivity remained stable over the course of this deployment period while showing brief spikes during periods of high precipitation. This indicates the precipitation may cause particulates in the river sediment to re-suspend into the water column, increasing the conductivity for a short period of time before it settles out again.

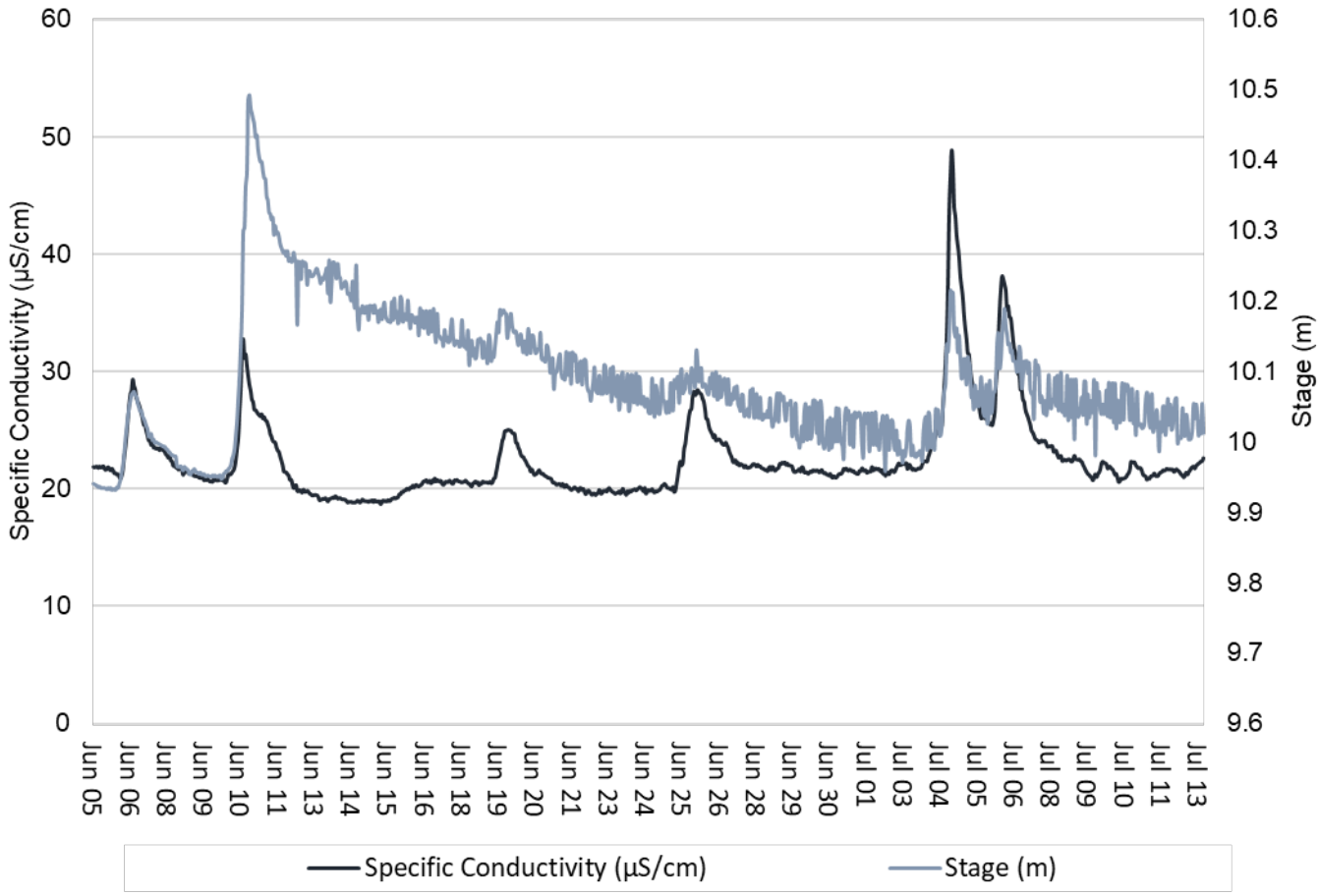


Figure 4: Specific Conductivity of Water and Stage

- The saturation of dissolved oxygen ranged from 87.1% to 104.6% and a range of 8.29 to 11.07 mg/l was found for the concentration of dissolved oxygen (Figure 5).
- All values were above the minimum CCME Guidelines for the Protection of Other Life Stages while the majority of values were above the minimum Guidelines for Early Life Stage of Cold Water Biota. The guidelines are indicated in red on Figure 5.
- Dissolved oxygen content fluctuates diurnally, displaying the inverse relationship to water temperature. Dissolved oxygen decreased steadily during the deployment period as water temperatures warmed into summer.

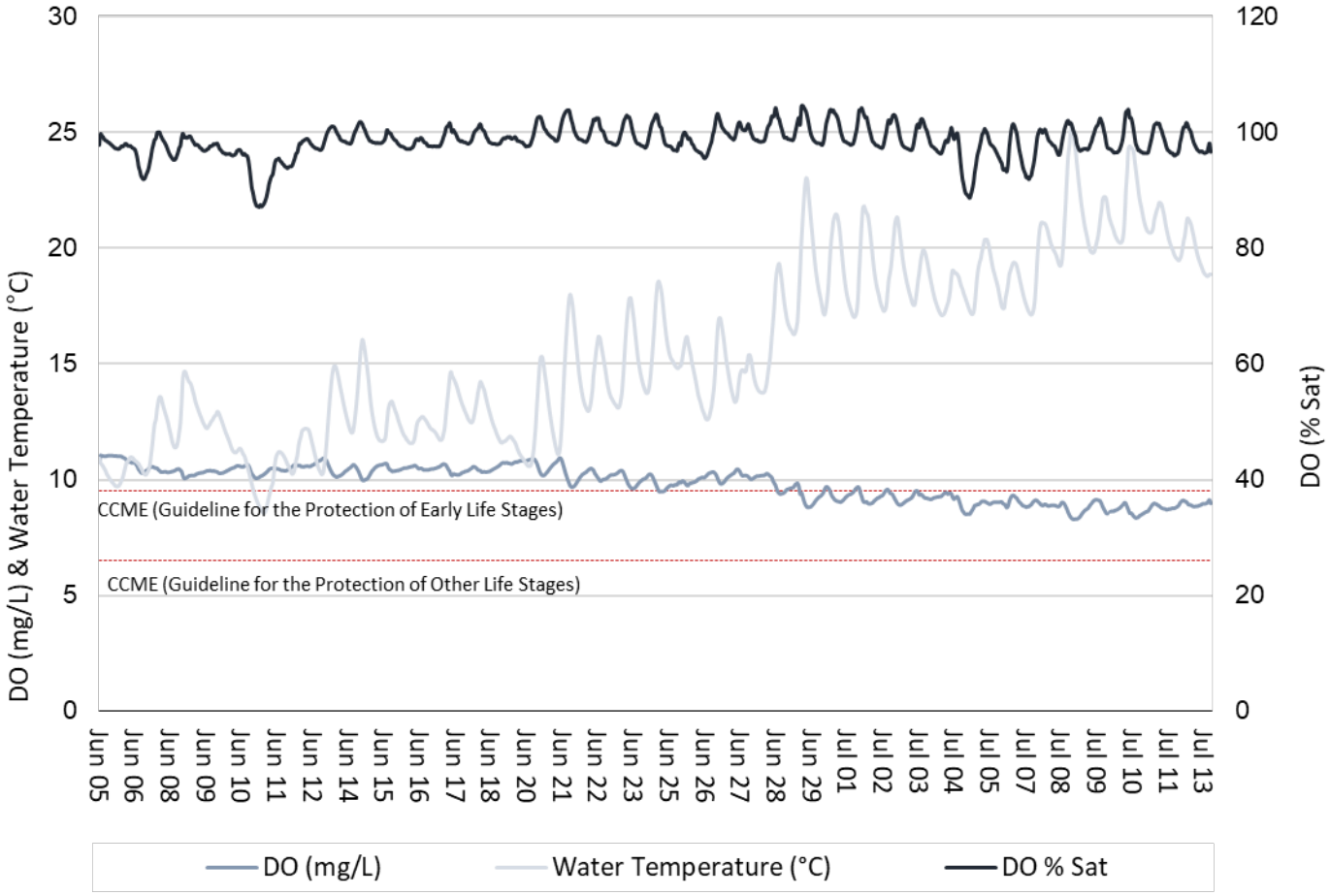


Figure 5: Dissolved Oxygen and Water Temperature

- Turbidity values range from -0.1 NTU to 8.9 NTU with a median of 0.2 .
- Turbidity remained low throughout deployment with occasional spikes associated with precipitation. (Figure 6). This indicates rainfall associated with stage increases may stir up sediments in the area for a brief period of time before returning to background levels.

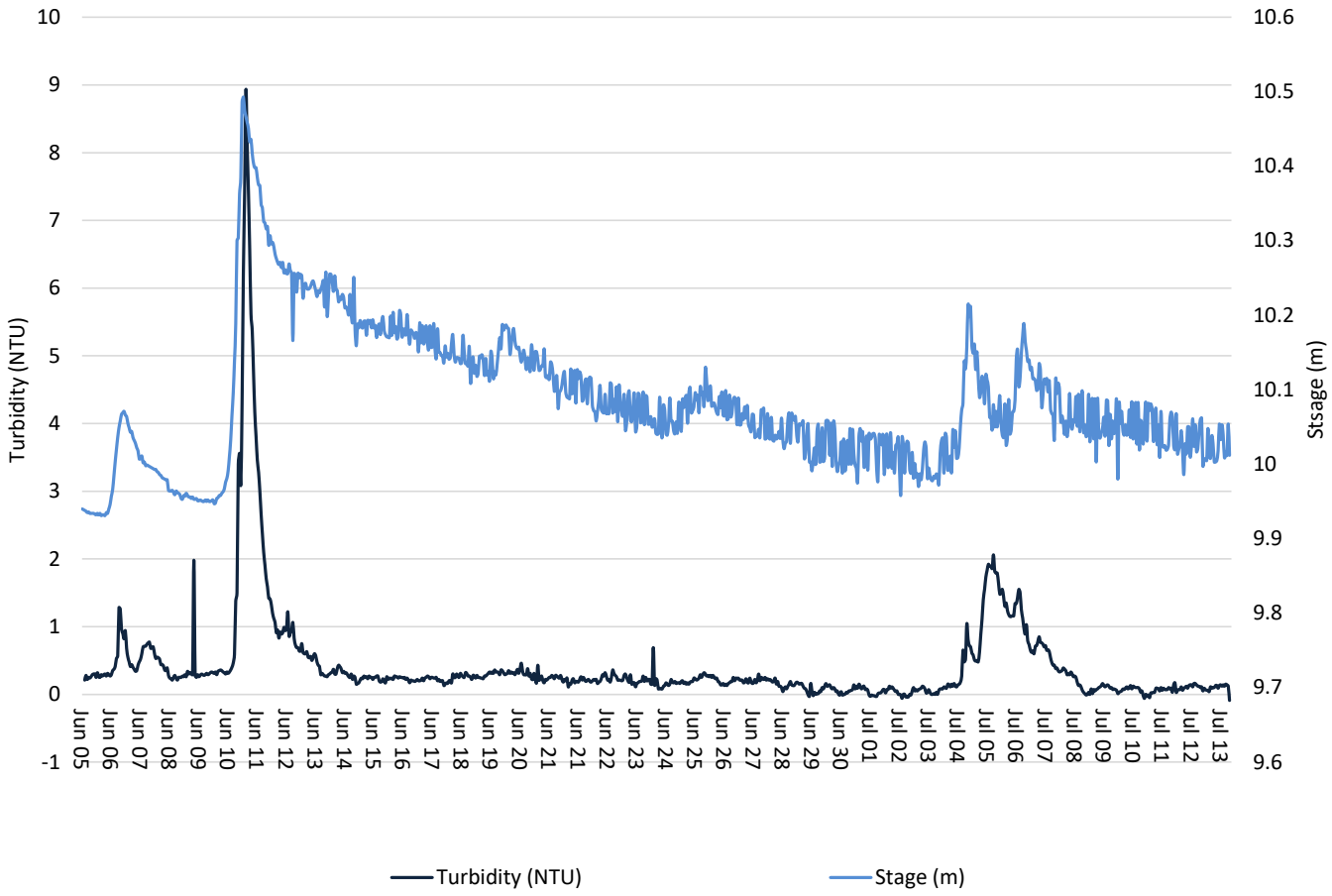


Figure 6: Turbidity and Stage

- Precipitation and stage during the deployment period are graphed below (Figure 7). Stage was decreasing gradually throughout deployment, influenced by several precipitation events, particularly the largest event on June 10th which caused a significant rise in stage.
- It is notable from the data that smaller precipitation events did not always lead to an increase in stage at this location.

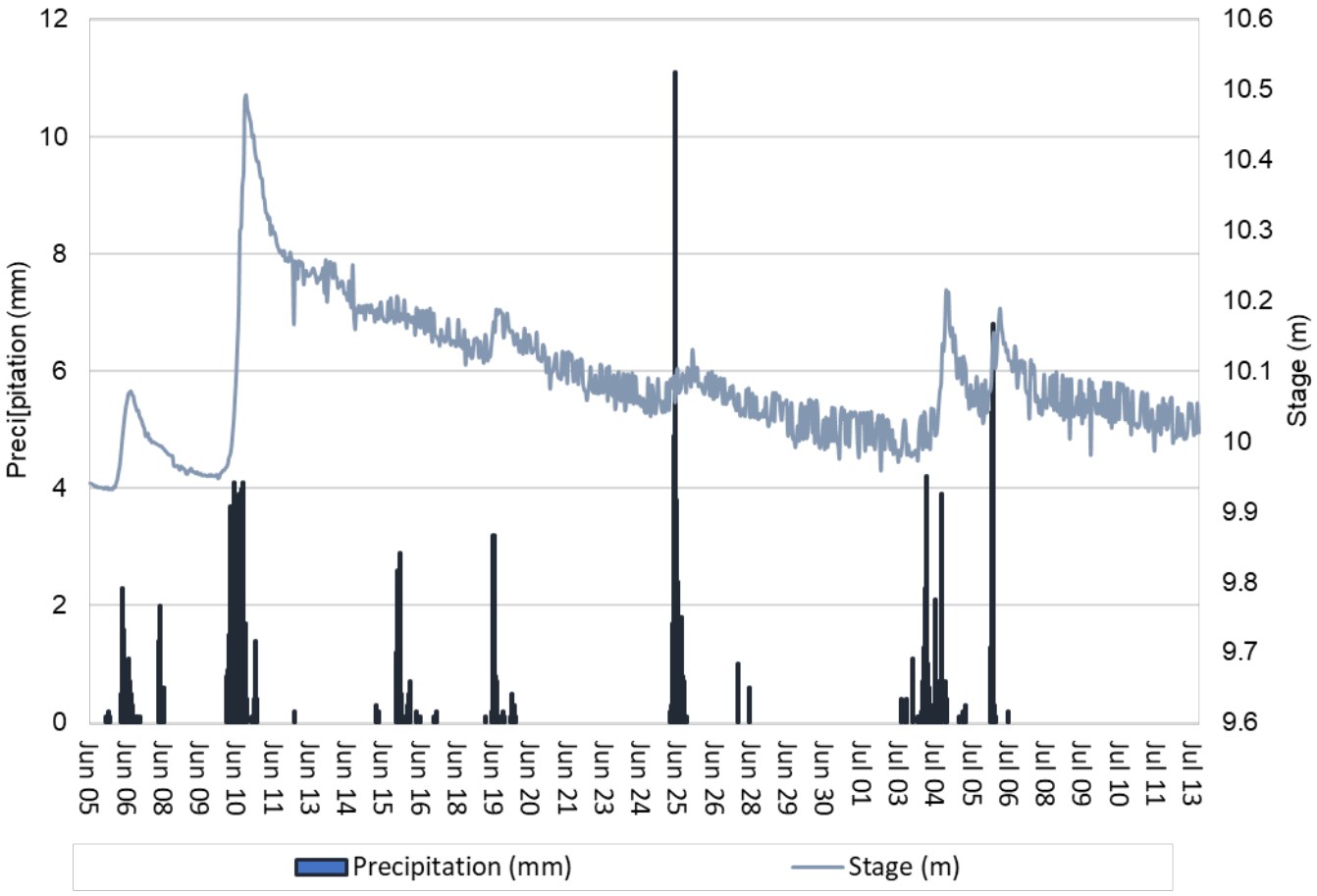


Figure 7: Precipitation and Stage

Valentine River

- Water temperature ranged from 9.48 to 25.49°C during this deployment period (Figure 8).
- Water temperature showed an increasing trend throughout deployment as spring turned into summer (Figure 8).

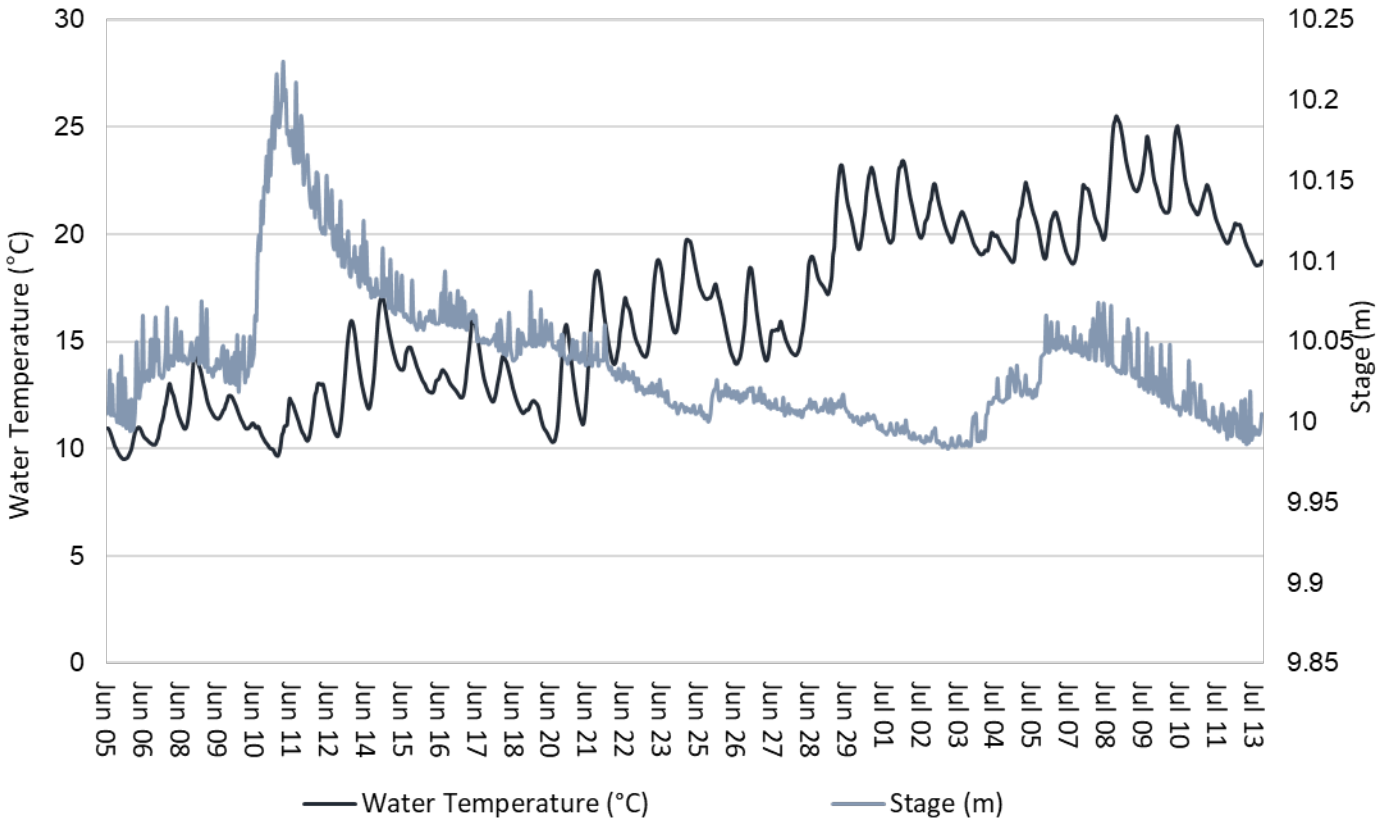


Figure 8: Water Temperature and Stage

- pH ranged between 6.58 and 7.11 pH units throughout the deployment period, with a median value of 6.88 units (Figure 9).
- 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 on June 11th (evident as a rise in stage levels) caused a slight dip in pH level. 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. This was also observed at the Victoria River station.
- Overall, pH was relatively stable for the deployment, but was influenced by large precipitation events.

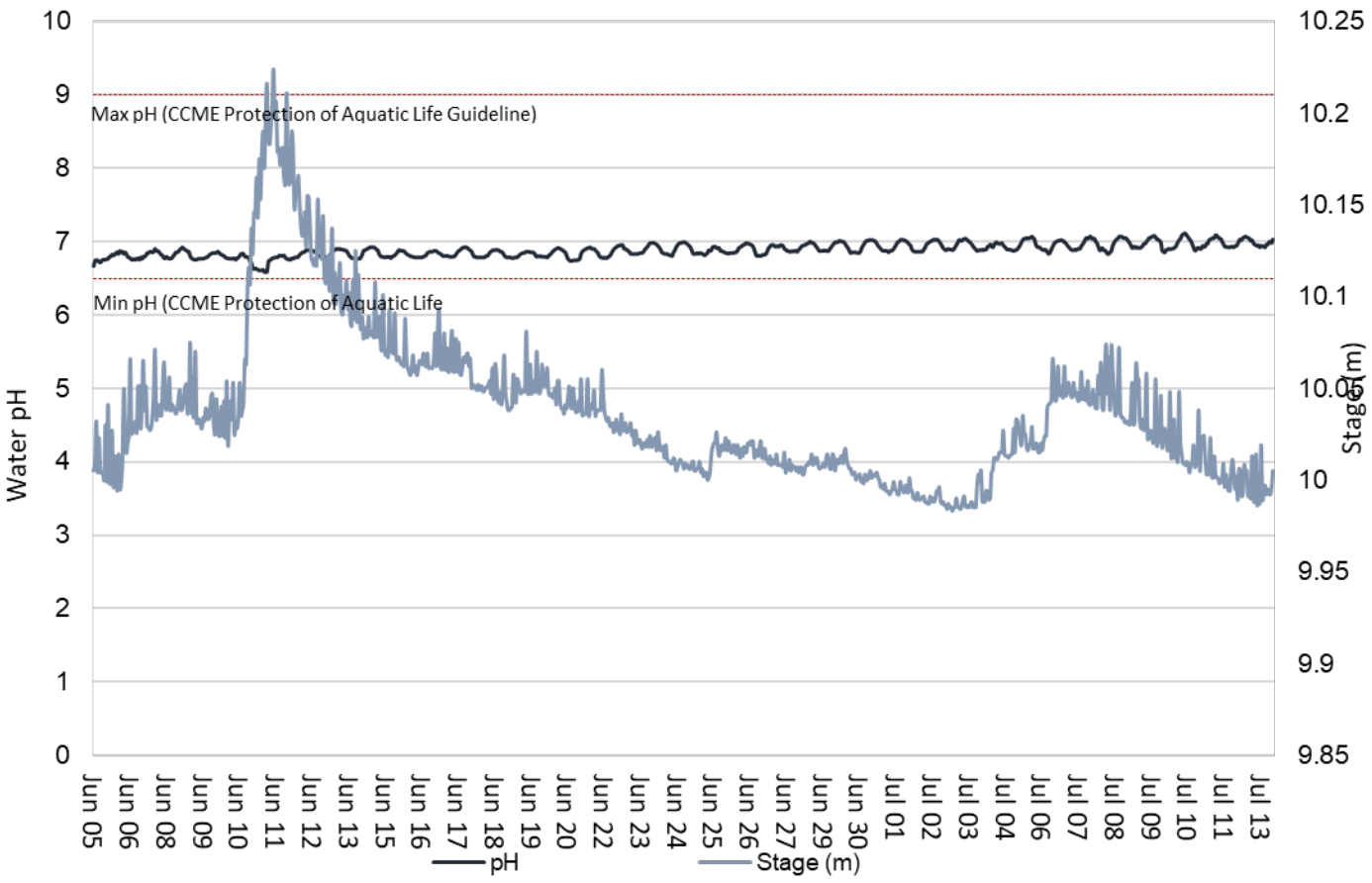


Figure 9: Water pH and Stage

- Specific conductivity ranged from 20.6 to 24.7 µs/cm (Figure 10) with a median of 23.0 µs/cm (Figure 10).
- Specific conductivity was relatively stable over the course of this deployment period, but was diluted by the stage increase on June 11th.

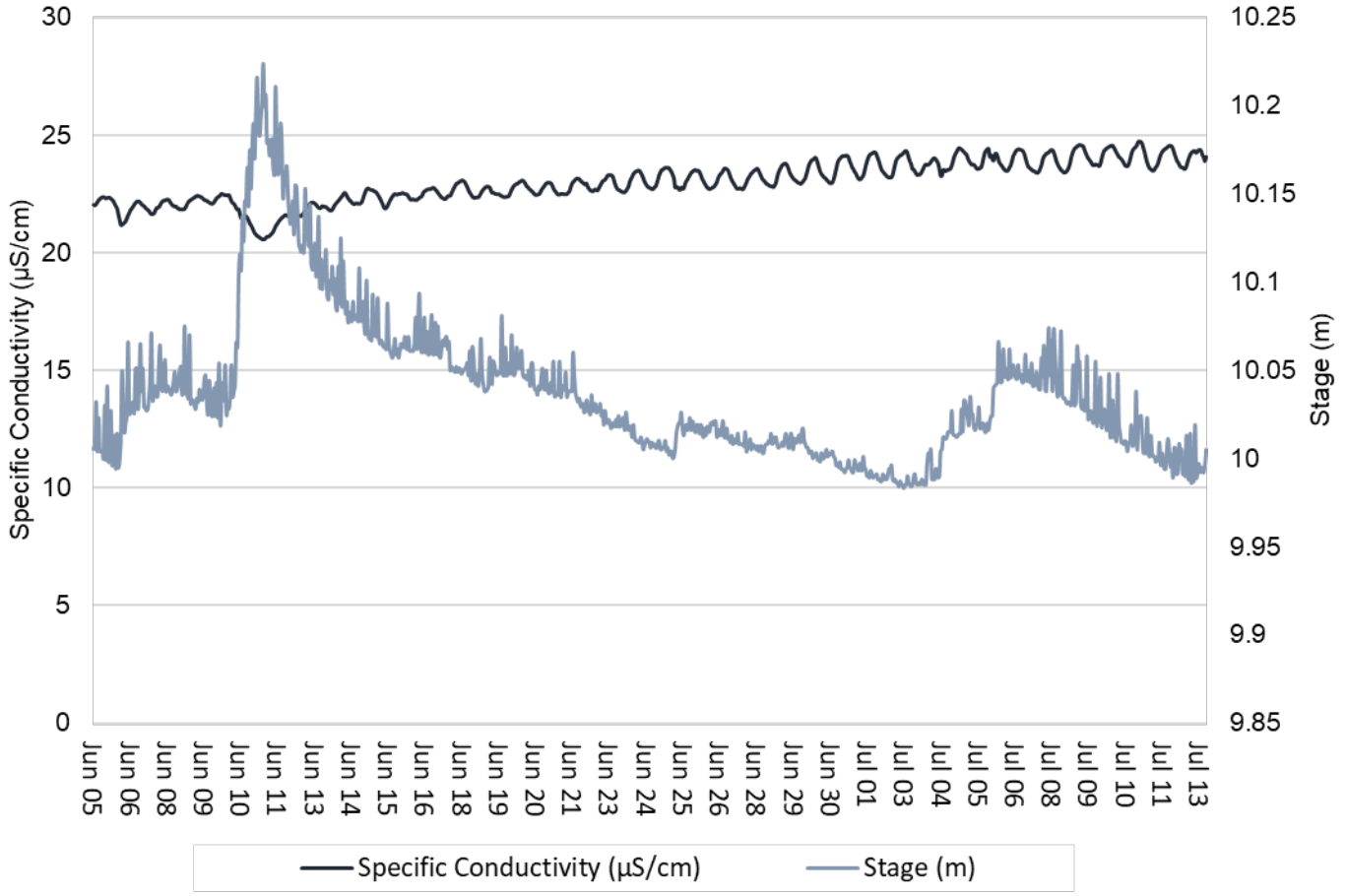


Figure 10: Specific Conductivity of Water and Stage

- The saturation of dissolved oxygen ranged from 99.5% to 105.9% and a range of 8.55 to 11.57 mg/l was found for the concentration of dissolved oxygen (Figure 11).
- All values were above the minimum CCME Guidelines for the Protection of Other Life Stages, while the majority of values were above the Guidelines for Early Life stages of cold water biota. The guidelines are indicated in red on Figure 11.
- Dissolved oxygen content fluctuates diurnally, displaying the inverse relationship to water temperature. Dissolved oxygen decreased slightly during the deployment period as water temperatures warmed into summer.

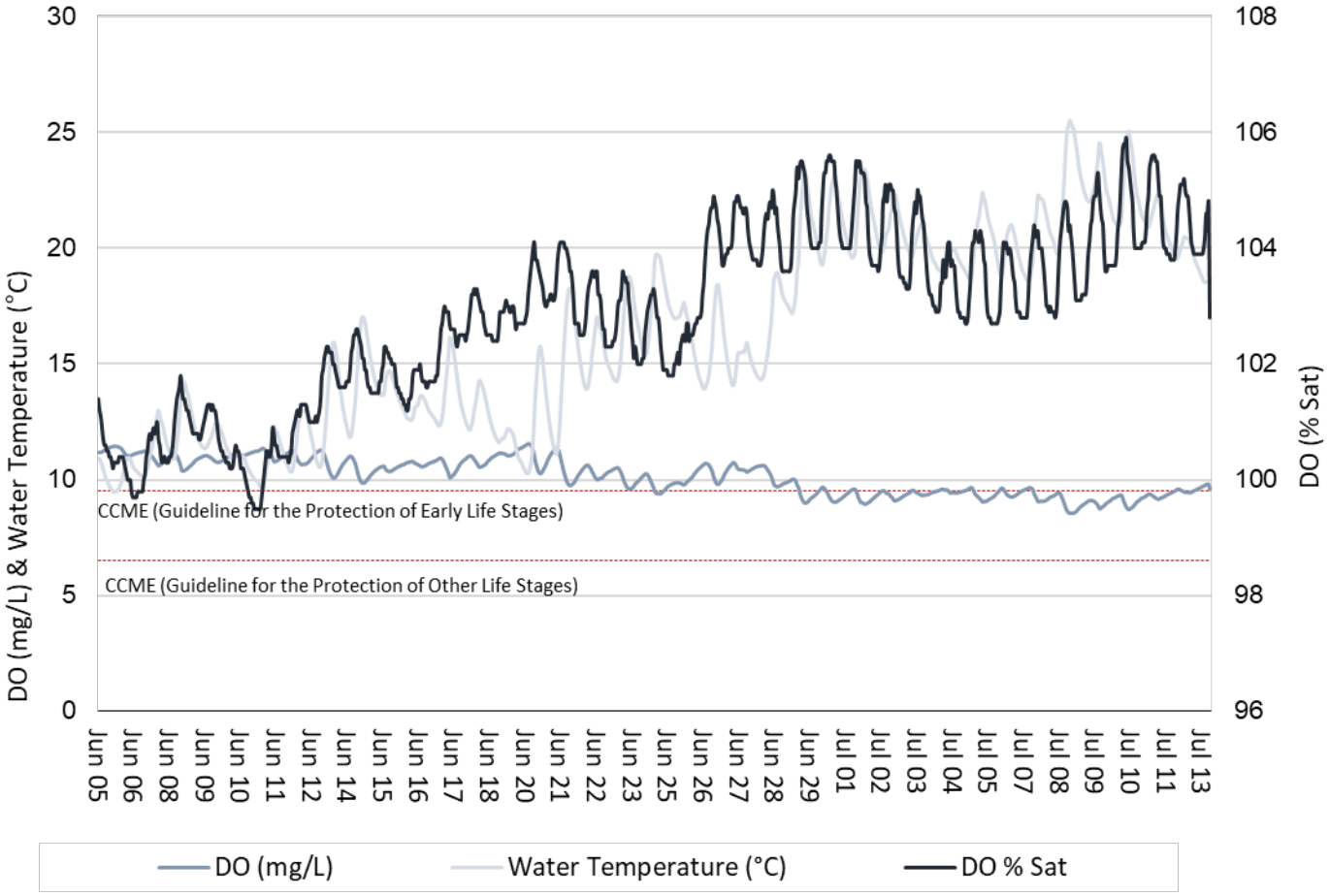


Figure 11: Dissolved Oxygen and Water Temperature

- Turbidity values range from -0.3 NTU to 0.3 NTU with a median of -0.1, indicating very clear background turbidity.
- Turbidity remained very low throughout deployment with a slight increasing trend. Turbidity increased temporarily during stage events associated with precipitation (Figure 12). This indicates rainfall associated with stage increases may stir up sediments in the area for a brief period of time before returning to background levels.

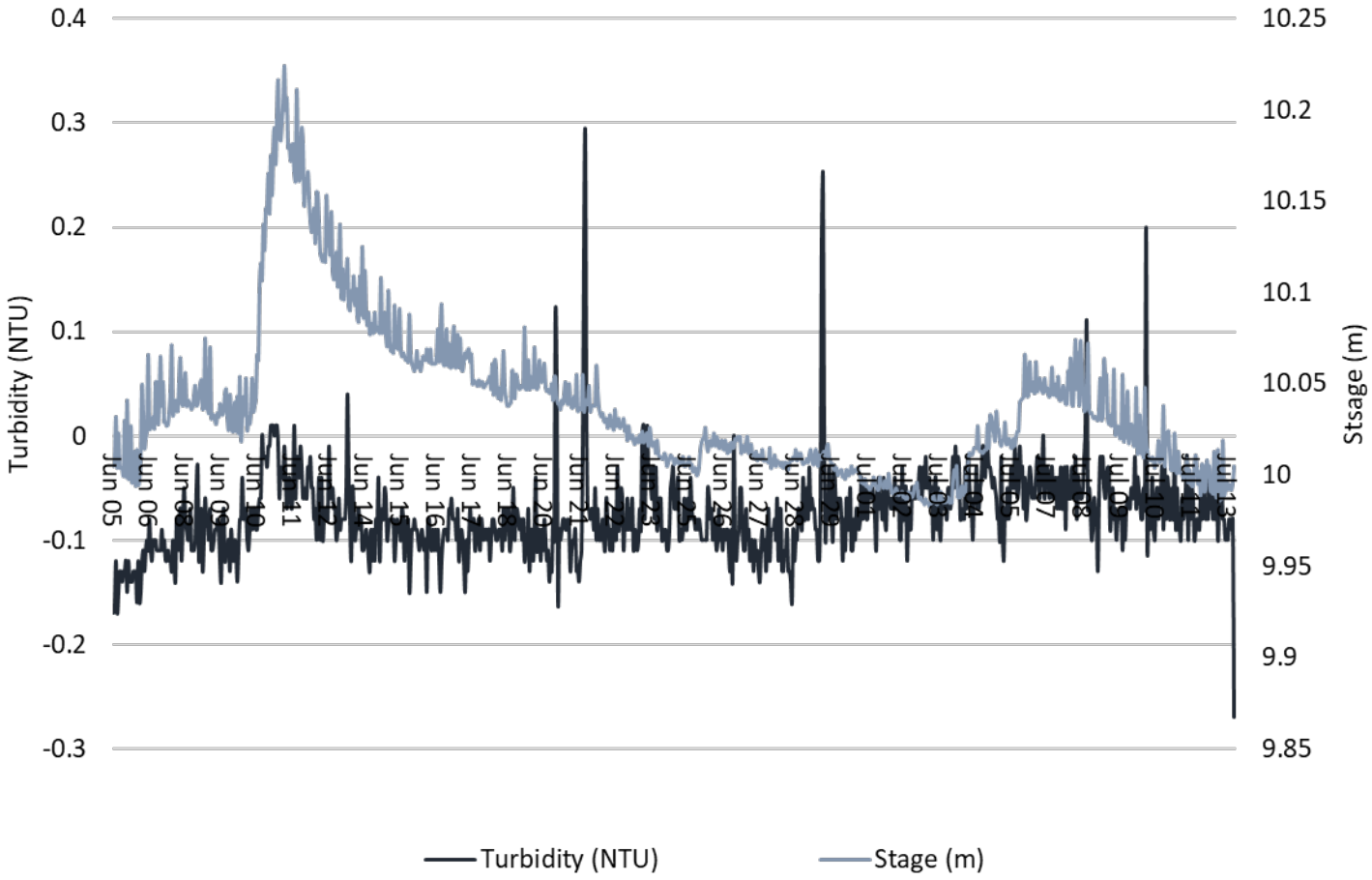


Figure 12: Turbidity and Stage

- Precipitation and stage during the deployment period are graphed below (Figure 13). Stage fluctuated throughout deployment, influenced by several major precipitation events, particularly the largest event on June 10th which caused a significant rise in stage.

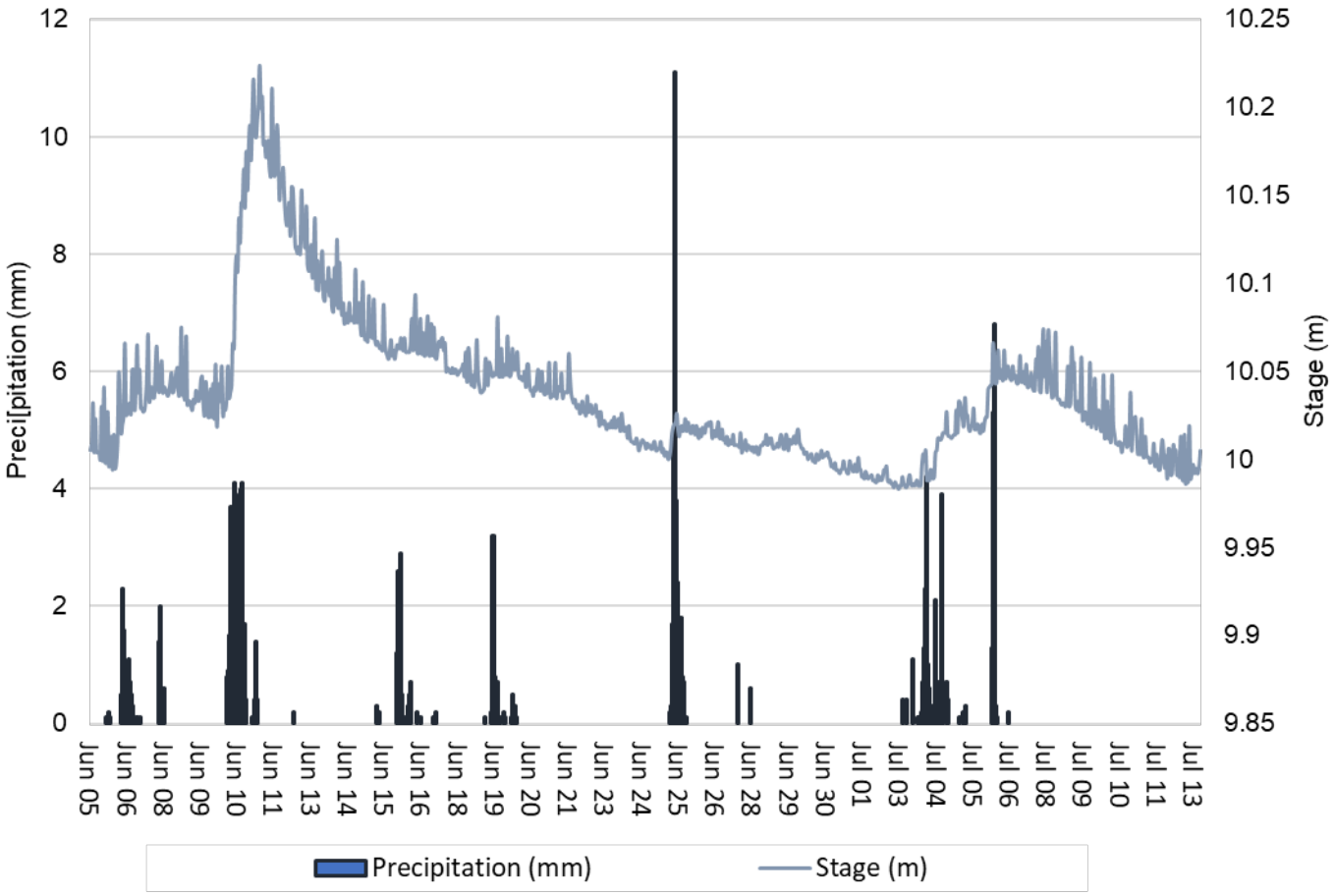


Figure 13: Precipitation and Stage

Roebucks Brook

- Water temperature ranged from 8.9 to 26.12°C during this deployment period (Figure 14).
- Water temperature showed an increasing trend throughout deployment, corresponding to ambient air temperatures as spring turned into summer (Figure 14). This trend was also observed at Victoria and Valentine Rivers.

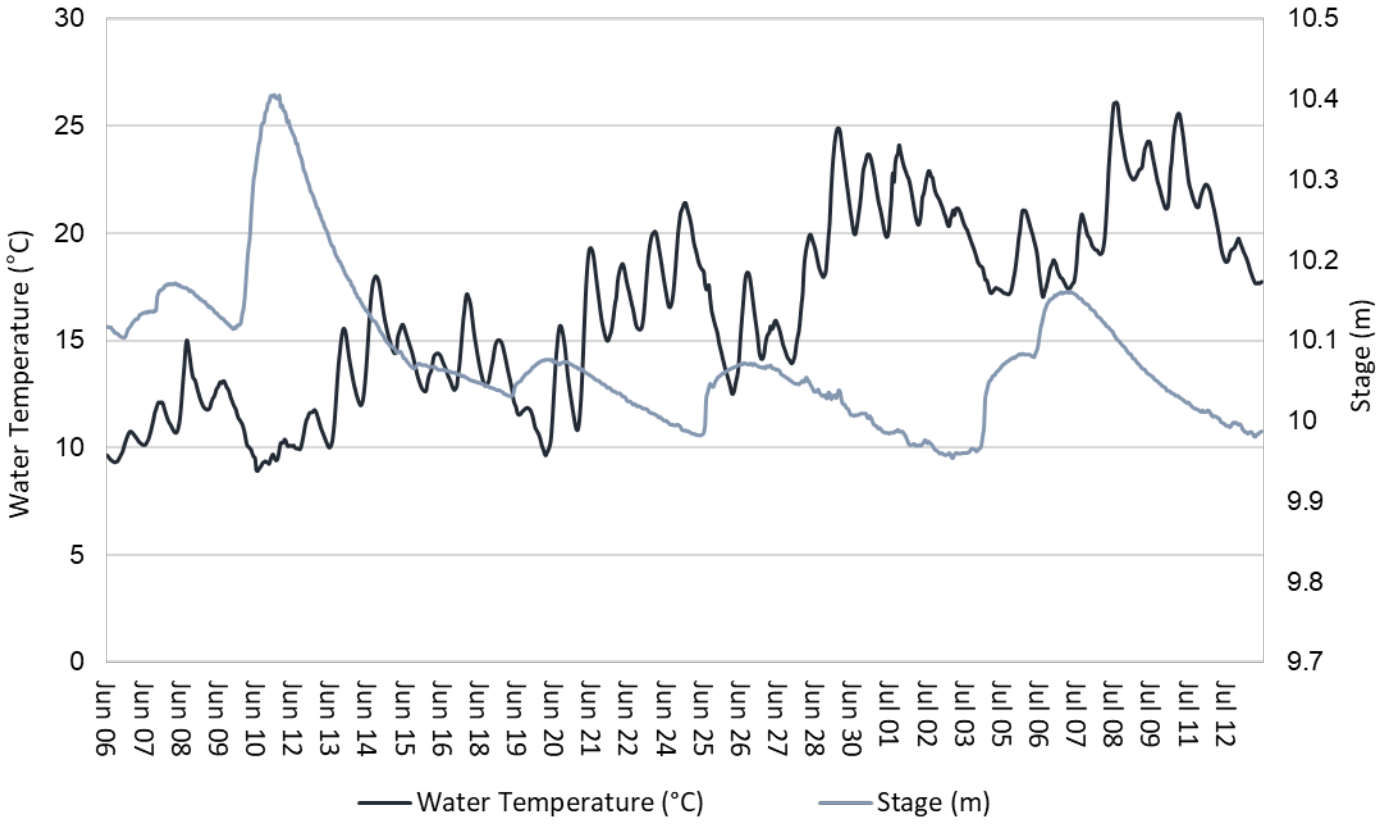


Figure 14: Water Temperature and Stage

- pH ranged between 6.20 and 7.05 pH units throughout the deployment period, with a median value of 6.81 units (Figure 15).
- The majority of values during the deployment are within the CCME Guidelines for the Protection of Aquatic Life (between 6.5 and 9 pH units). Values drop below the minimum threshold periodically during high stage events. pH fluctuates slightly during the day and night.
- Significant rainfall on June 10th (evident as rises in stage levels) caused a slight dip in pH. 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 relatively stable for the deployment, but was influenced by large precipitation events.

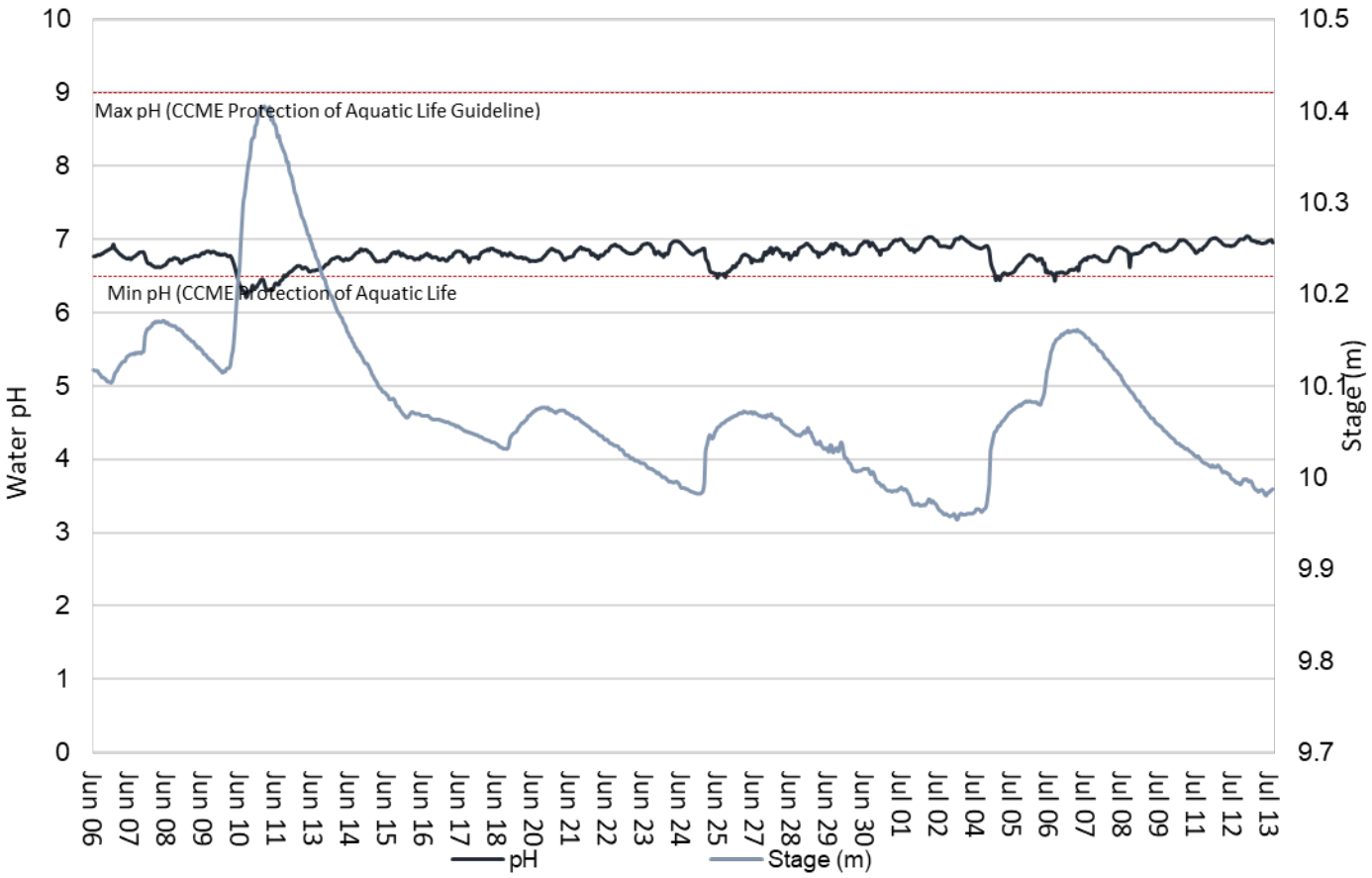


Figure 15: Water pH and Stage

- Specific conductivity ranged from 12.7 to 31.5 µs/cm (Figure 16) with a median of 19.3 µs/cm.
- Specific conductivity steadily increased over the course of this deployment period, but dropped temporarily during high stage events as the water column was diluted.

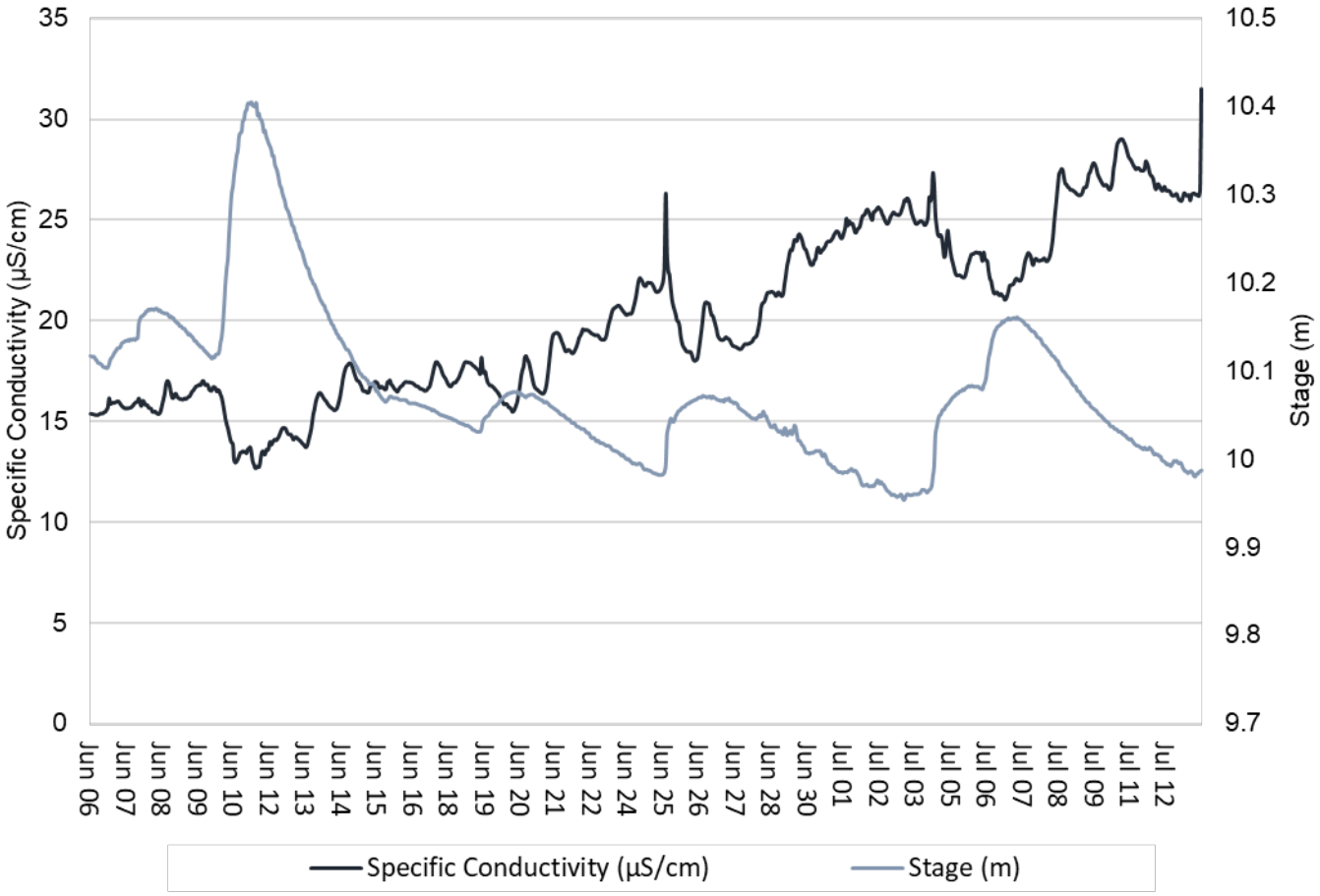


Figure 16: Specific Conductivity of Water and Stage

- The saturation of dissolved oxygen ranged from 90.4% to 102.8% and a range of 7.95 to 11.19 mg/l was found for the concentration of dissolved oxygen (Figure 17).
- All values were above the minimum CCME Guidelines for the Protection of Other Life Stages while the majority of values were below the guidelines for Early Life Stages when water was warmest, decreasing the available oxygen. The guidelines are indicated in red on Figure 5.
- Dissolved oxygen content fluctuates diurnally, displaying the inverse relationship to water temperature. Dissolved oxygen decreased steadily during the deployment period as water temperatures warmed into summer.

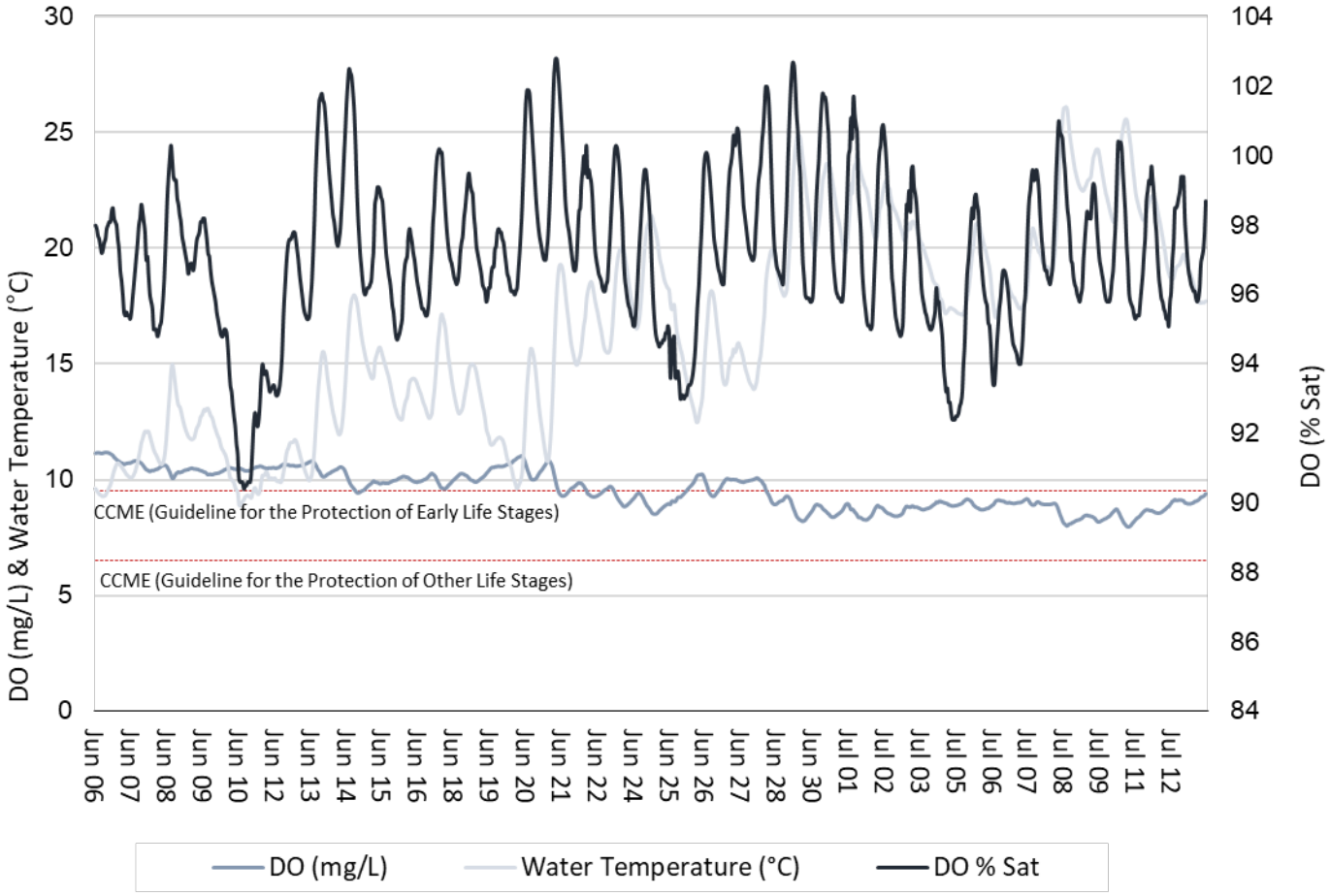


Figure 17: Dissolved Oxygen and Water Temperature

- Turbidity values range from 0.3 NTU to 488.3 NTU with a median of 2.2, indicating low background turbidity which was higher than Victoria or Valentine Rivers (Figure 18).
- Turbidity remained relatively stable throughout deployment with periodic spikes during stage events associated with precipitation such as June 25th and July 4th (Figure 18). This indicates rainfall associated with stage increases may stir up sediments in the area for a brief period of time before returning to background levels.

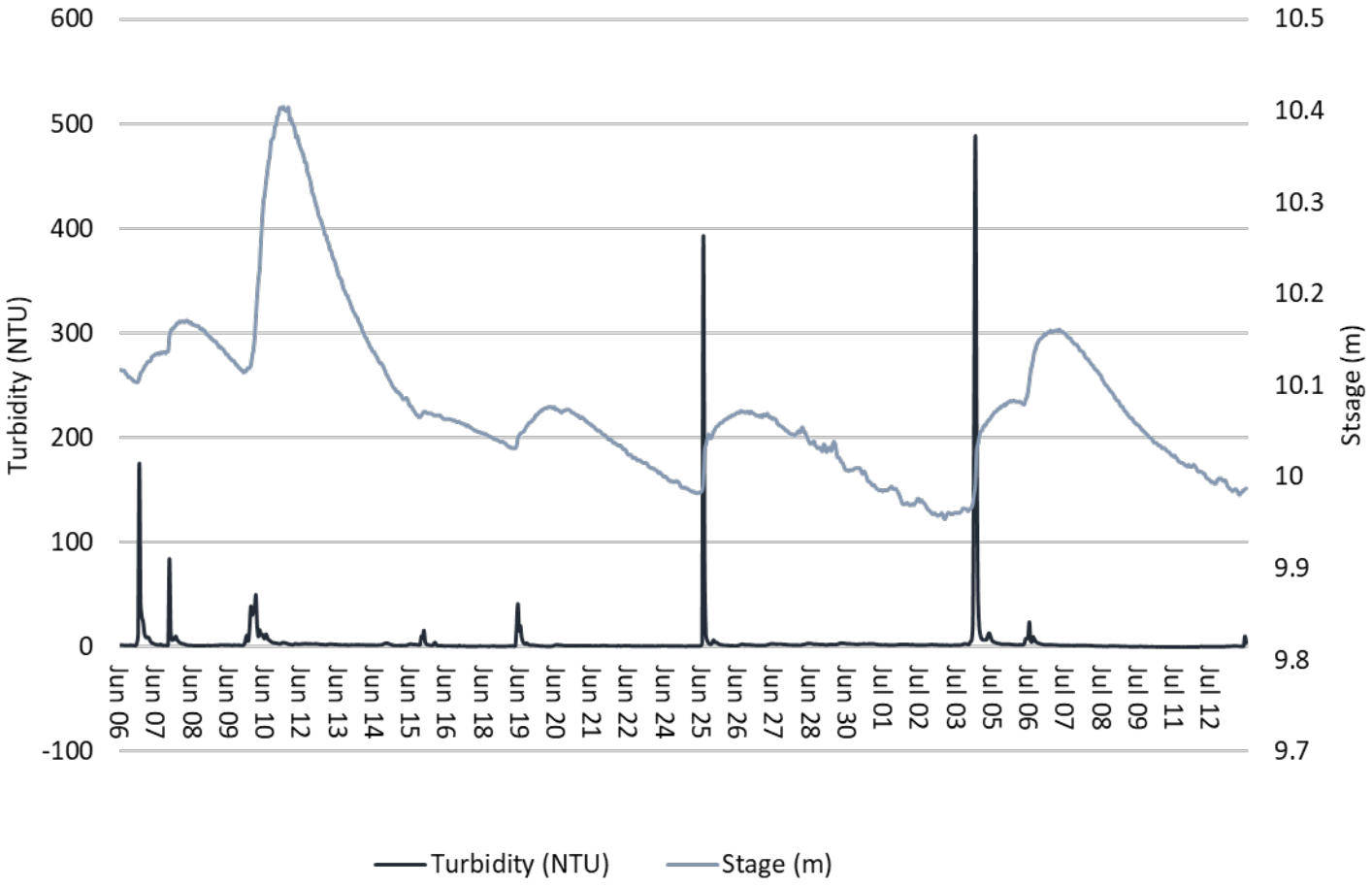


Figure 18: Turbidity and Stage

- Precipitation and stage during the deployment period are graphed below (Figure 19). Stage was decreasing gradually throughout deployment, but was influenced by several major precipitation events, particularly the largest event on June 10th which caused a significant rise in stage for several days.
- It is notable from the data that smaller precipitation events did not always lead to an increase in stage at this location.

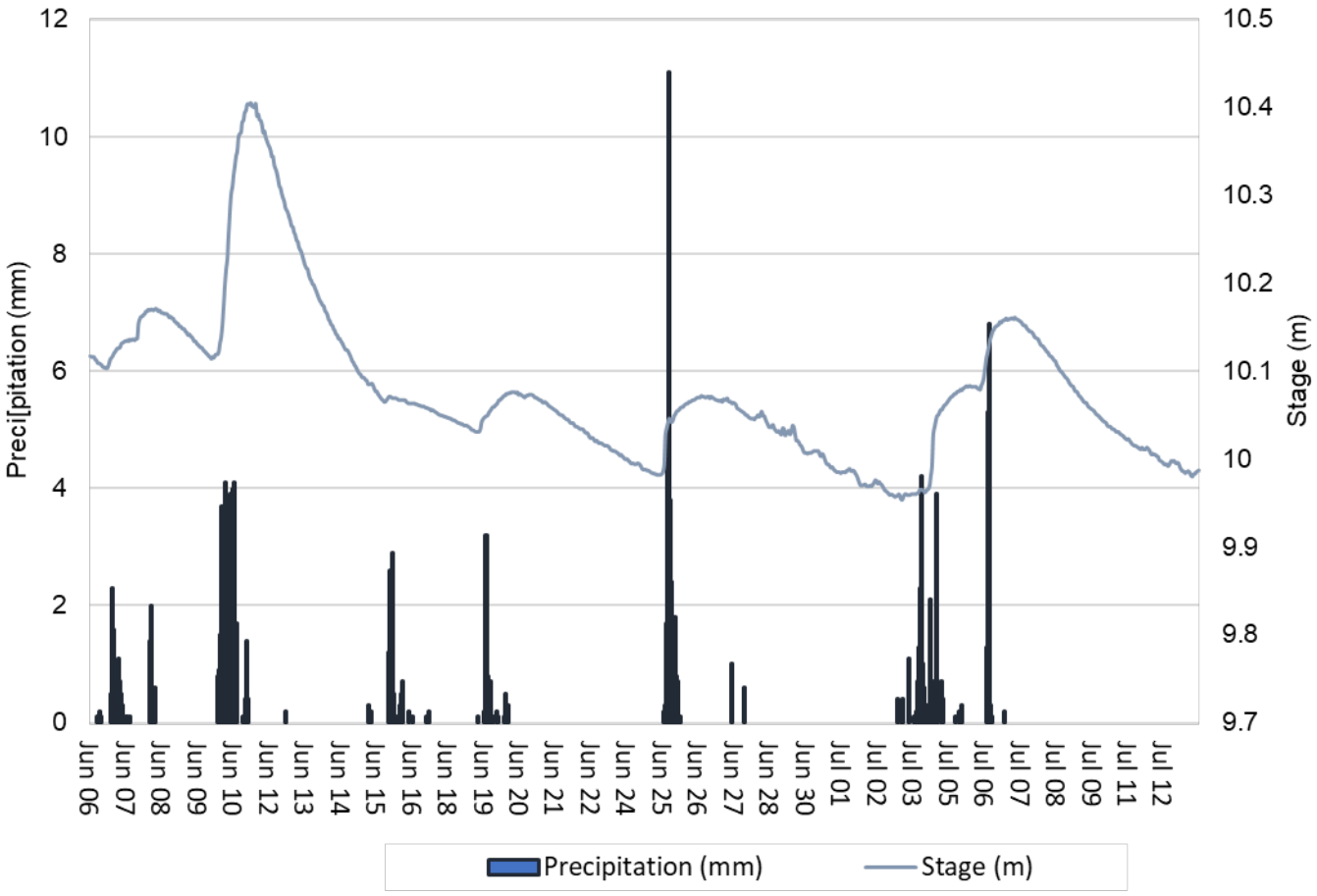


Figure 19: Precipitation and Stage

Conclusions

- In Spring 2023, water quality instruments were re-installed at Victoria River, Valentine River and Roebucks Brook. Groundwater stations and the weather station for the network were also installed in Spring and early summer 2023.
- Instruments were deployed at three real time water quality/quantity monitoring stations which form the Marathon Gold Corp monitoring network on June 5th and removed on July 13th 2023. This was the first deployment for the network in 2023.
- In most cases, weather related events or increases/decreases in water level explain parameter fluctuations.
- Water temperature was found to be generally increasing at all stations, as expected with seasonal air temperature warm into summer.
- Most pH values were within the recommended CCME Guidelines for the Protection of Aquatic Life at Victoria River, Valentine River and Roebucks Brook.
- Specific conductivity was mostly stable with occasional spikes at Victoria River, tended to increase at Roebucks Brook, while it was relatively stable at Valentine River.
- Dissolved oxygen values were above the minimum CCME Guidelines for the Protection of Other Life Stages at all stations throughout the deployment but was only above the Guidelines for Early Life Stage of Cold Water Biota for approximately first half of the deployment due to warming water temperatures.
- Low median turbidity values at Victoria and Valentine Rivers indicate low background turbidity at these locations. Roebucks Brook had a slightly higher median value, indicating background turbidity may be higher at this location, at least during this deployment. Turbidity values at all locations were influenced by precipitation and associated stage increases for a short period of time before returning to background levels.
- Stage at all locations was influenced by precipitation events which increased the stage, and showed numerous fluctuations, but overall demonstrated decreasing trends throughout the deployment.
- WRMD and Marathon Gold Crop staff will continue to work together in partnership to install, establish and maintain the real time monitoring network associated with the Valentine Lake gold project in central Newfoundland.

Prepared by:
Department of Environment & Climate Change
Water Resources Management Division

Appendix A: Real Time Surface Water Quality/Quantity Network

Station Name	Station Number	Latitude	Longitude	Equipment Depth
Victoria River Outlet	NF02YN0047	48.407878	-57.072439	0.9m
Valentine River Outlet	NF02YN0048	-57.078128	48.424644	0.15m
Roebucks Brook	NF02YN0049	-57.013102	48.544174	0.33m

Station Descriptions:

Victoria River

Station Location: Victoria River 6.3km downstream of Victoria dam, below quarry pit. Station setup on western shoreline. Access via ATV trail below quarry pit.



Valentine River

Station Location: Valentine River at access road, 1.9km downstream of Valentine Lake outlet. Station located 15m upstream of access road crossing bridge on southern shoreline.

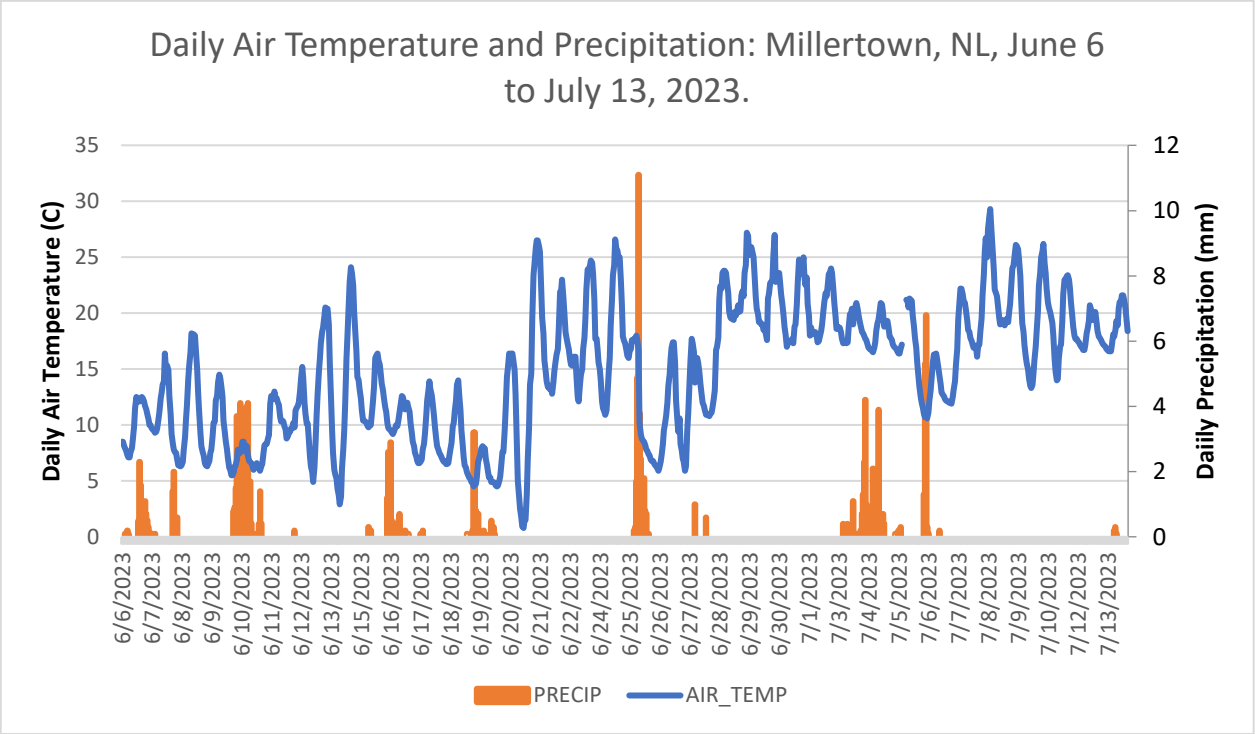


Roebucks Brook

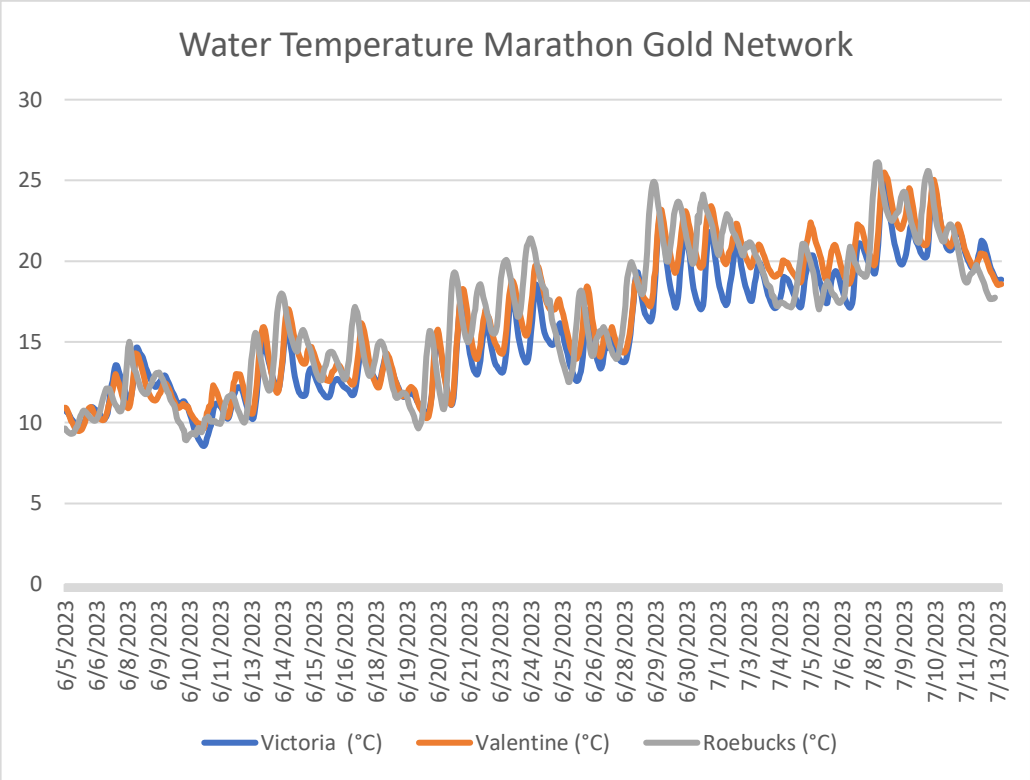
Station Location: Roebucks Brook 30m downstream of access road bridge crossing on western shoreline. Station is 1.6km downstream of Roebucks Lake outlet.

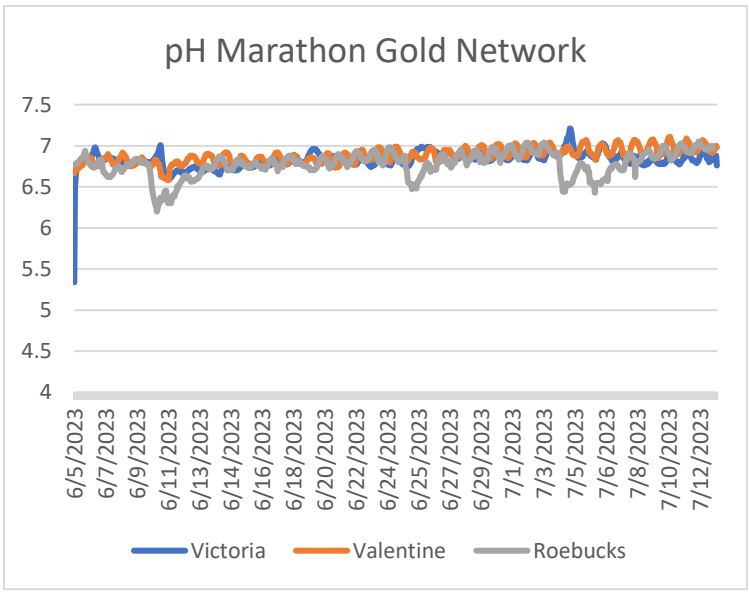


Appendix B: Weather Data from Millertown RCS



Appendix C: Station Parameter Comparison Graphs (raw data)





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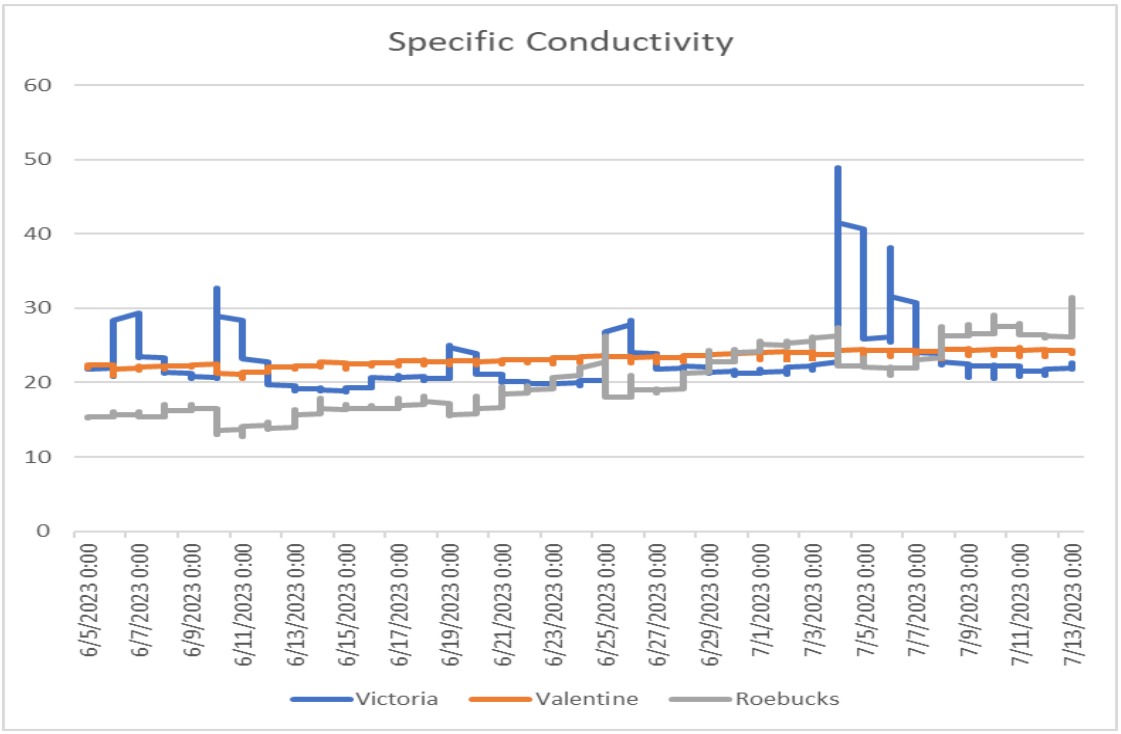
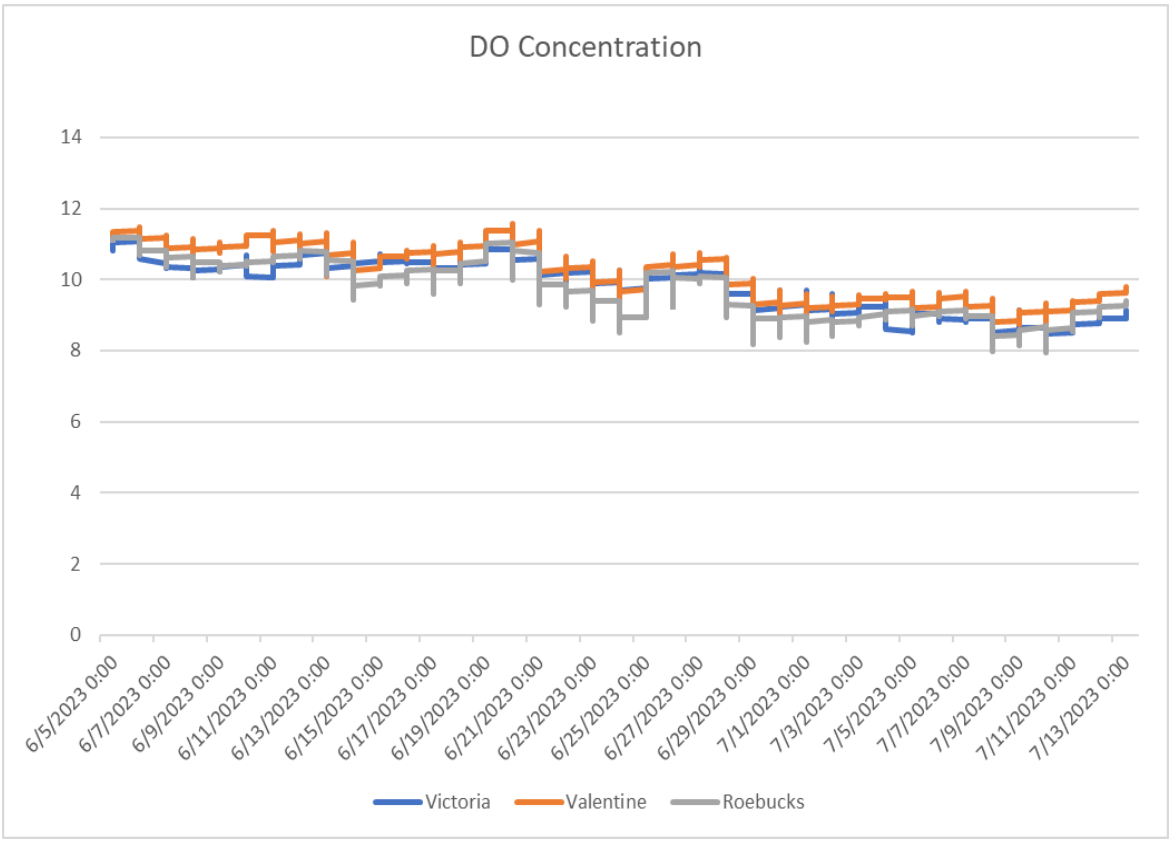
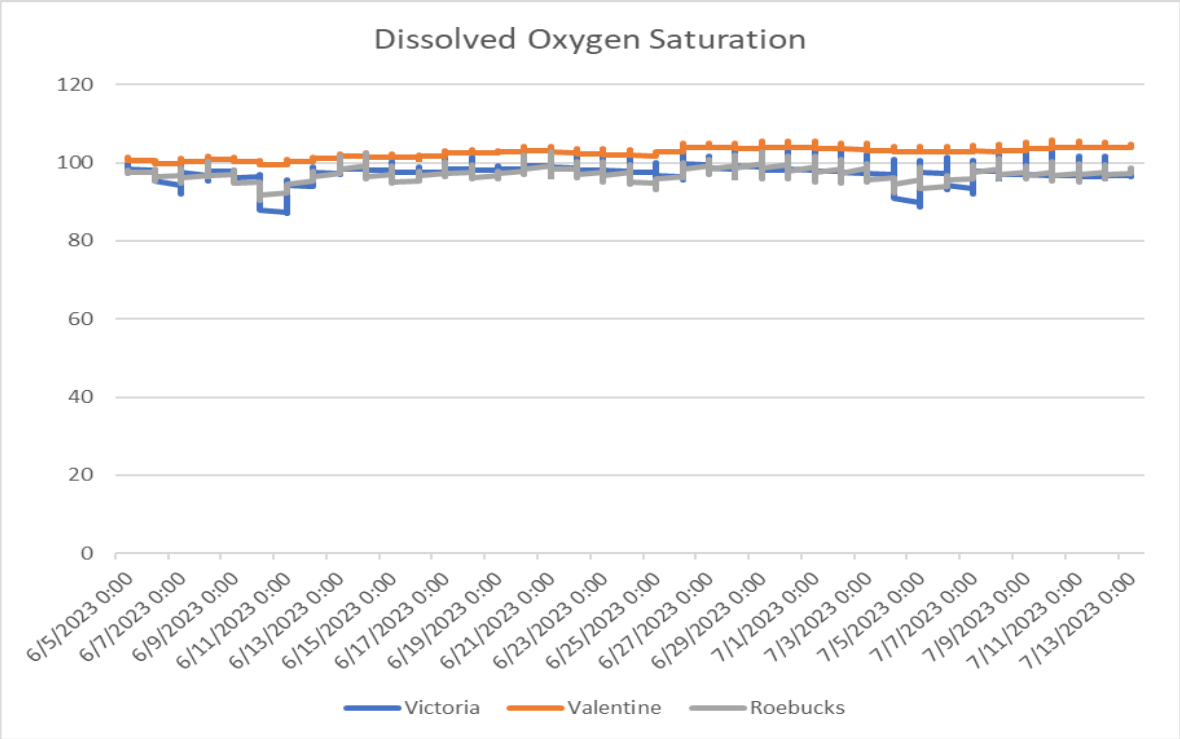
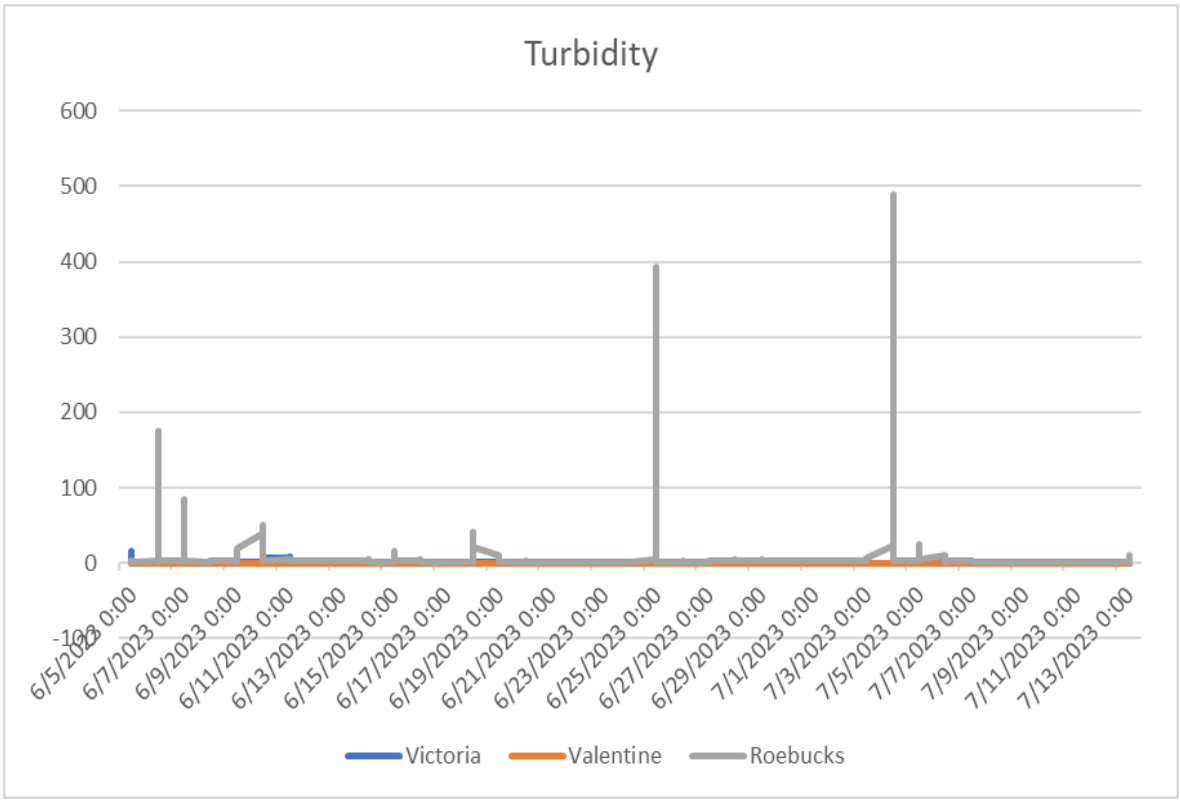




Marathon Gold Corp, Newfoundland and Labrador





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