Real-Time Water Quality Deployment Report

Marathon Gold Corp Network

November 3 to December 1, 2022

Newfoundland Labrador

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

General

- In 2022, 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.
- On November 3, 2022, the first round of station installations was completed, and included full setup of three surface water quality and quantity stations. A network of groundwater quality and quantity wells was partially completed at this time, but instruments were not installed due to equipment availability.
- Water quality instruments were installed at all three stations for 27 – 29 days before all were removed on December 1, 2022 to prevent damage during the winter season. Water quantity instrumentation remains installed and will report over the winter season. Water quality instrumentation will be re-installed in the spring when conditions allow.

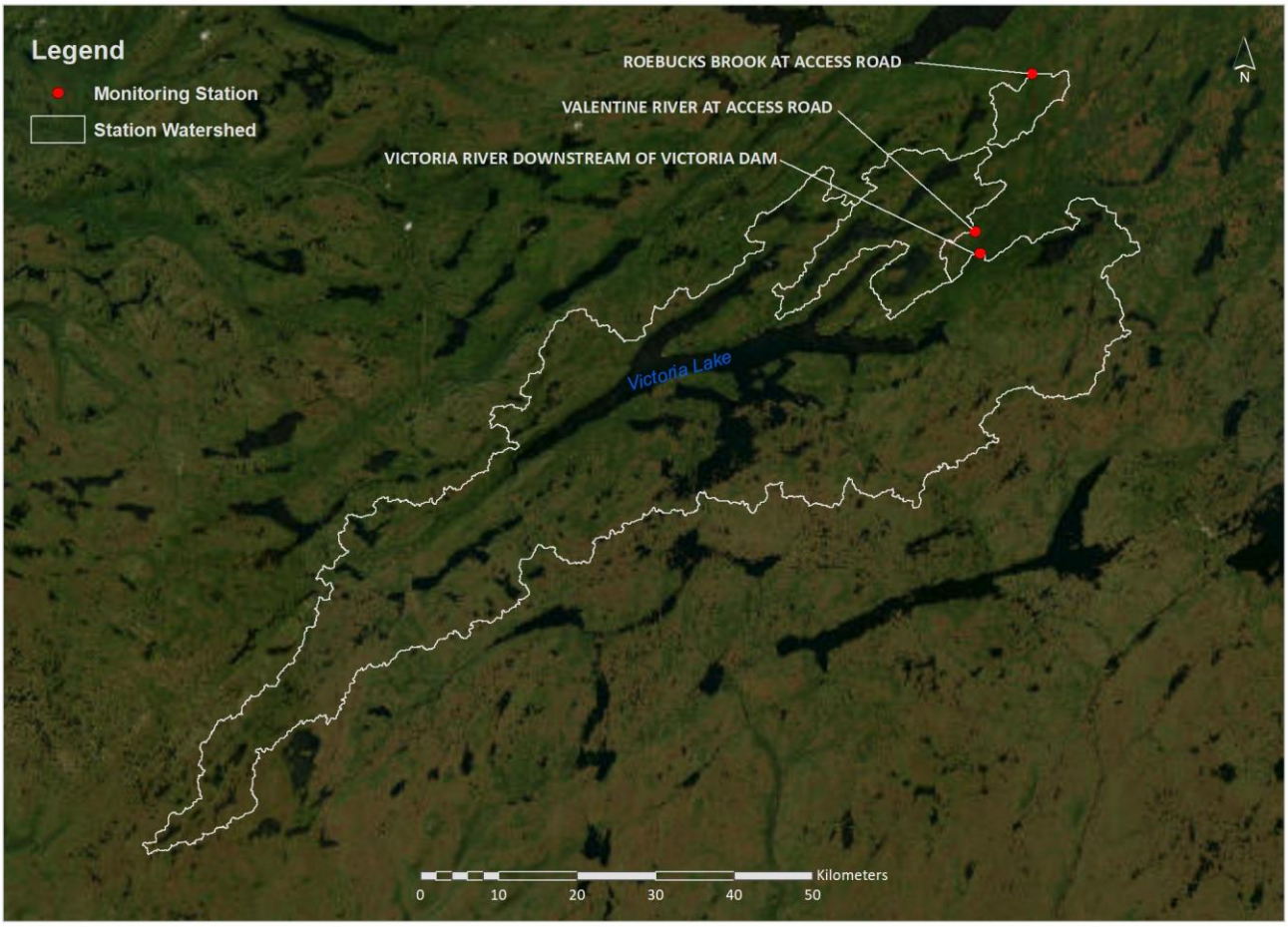


Figure 1: Location of the Marathon Gold Corp. Real Time Surface Water Quality Network (November 2022)

Station Installations

- Installation of the Marathon Gold Corporation real time monitoring network occurred in multiple phases in order to accommodate the large body of work and access to the location. 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 quality instruments will be re-installed in 2023 when climatic conditions permit. Water quantity instrumentation remained in the water for the winter season. Any damage this equipment may sustain will be assessed in the spring and deployment methods will be re-evaluated.
- In spring 2023, the groundwater monitoring network installation will be completed and the climate monitoring station will be fully installed.
- 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 November 3 and December 1, 2022 are summarized in Table 1.

Table 2: Comparison rankings for Marathon Gold Corp. Surface Water Monitoring Network November 3 – December 1, 2022

Station	Date	Action	Comparison Ranking				
			Temperature	pH	Conductivity	Dissolved Oxygen	Turbidity
Victoria River	Nov 4, 2022	Deployment	Excellent	Good	Excellent	Excellent	Excellent
	Dec 1, 2022	Removal	Good	Marginal	Excellent	Fair	Excellent
Valentine River	Nov 3, 2022	Deployment	Fair	Good	Excellent	Excellent	Excellent
	Dec 1, 2022	Removal	Excellent	Fair	Excellent	Marginal	Excellent
Roebucks Brook	Nov 3, 2022	Deployment	Excellent	Excellent	Good	Excellent	Excellent
	Dec 1, 2022	Removal	Good	Good	Excellent	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 was Fair. This may be due to the sonde not having acclimated before values were read. The sensor was Excellent upon removal.
- At removal, the majority of rankings were Good or Excellent, with a few reading Fair or Marginal. 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 November 3 to December 1, 2022 at the three surface water quality/quantity real time monitoring stations in the Marathon Gold Corp Network.

Victoria River

- Water temperature ranged from -0.08 to 12.16°C during this deployment period (Figure 2).
- Water temperature showed a decreasing trend throughout deployment, corresponding to ambient air temperatures as fall changed into winter.

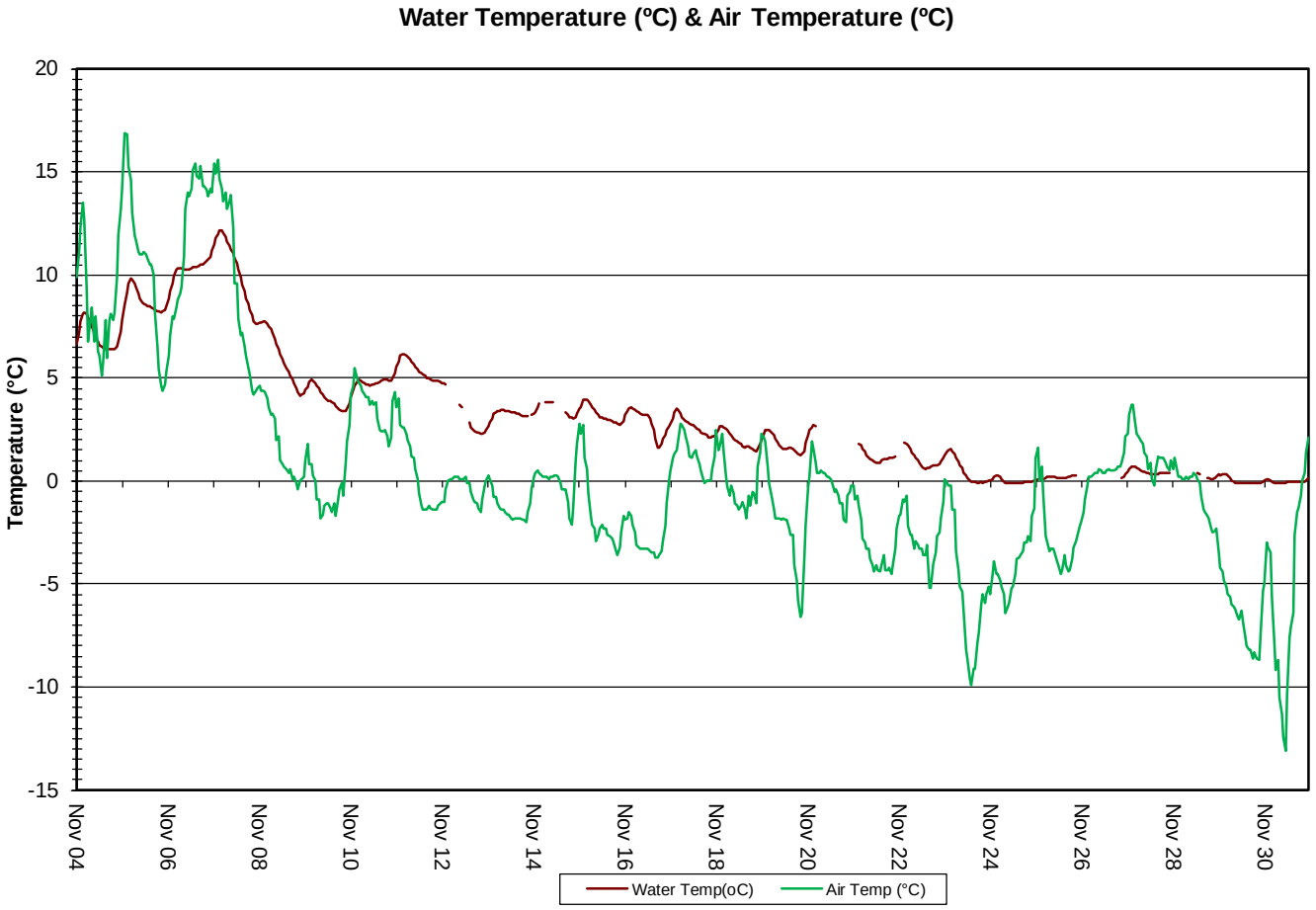


Figure 2: Water and Air Temperature

(Weather data collected at Millertown)

- pH ranged between 6.78 and 7.14 pH units throughout the deployment period, with a median value of 6.85 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 on November 12th (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.
- Overall, pH was relatively stable for the deployment, but was influenced by large precipitation events.

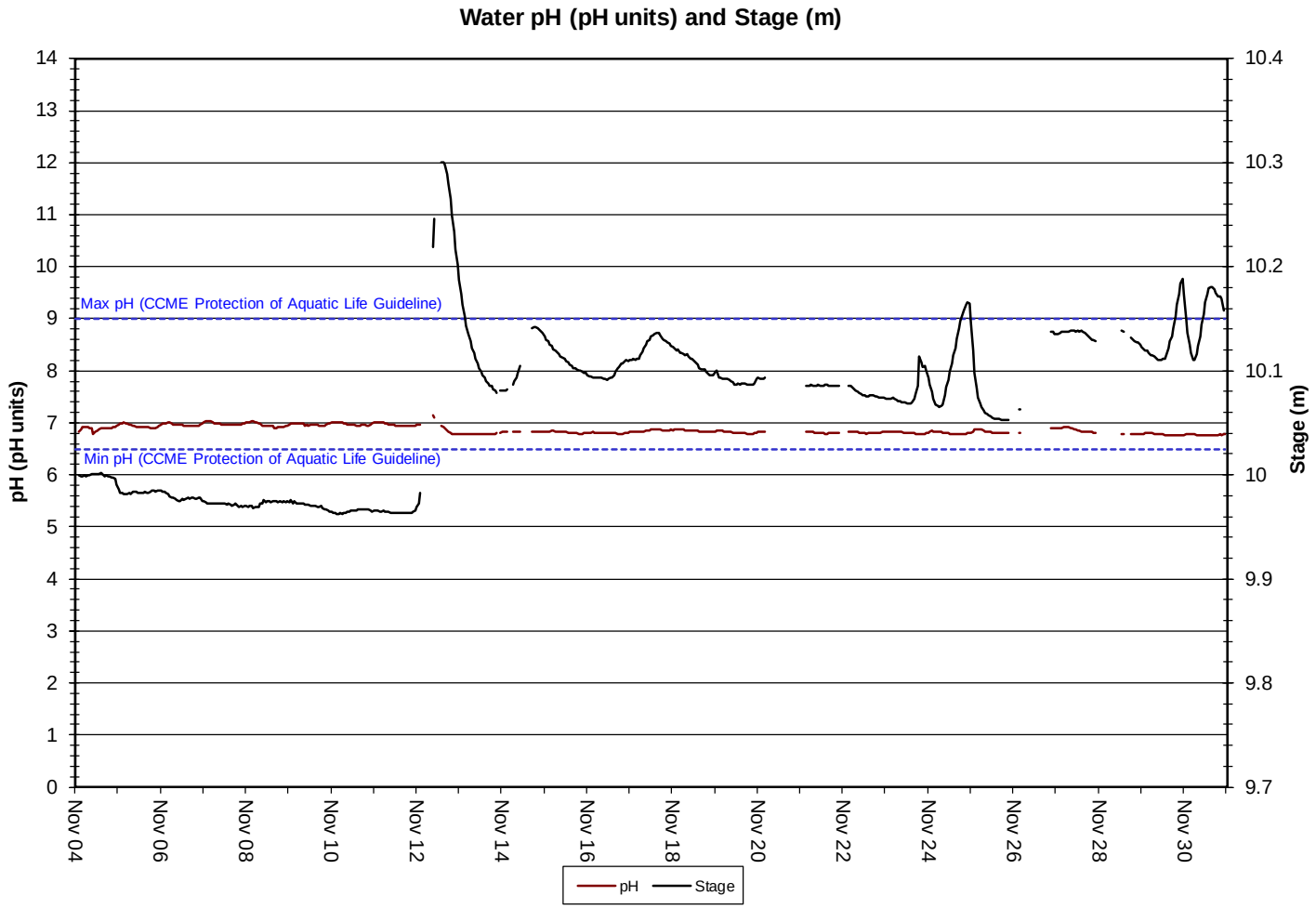


Figure 3: Water pH and Stage

- Specific conductivity ranged from 23.4 to 54.7 µs/cm (Figure 4) with a median of 26.6 µs/cm.
- Specific conductivity steadily decreased over the course of this deployment period, except during periods of high precipitation which caused stage increases and corresponding increases in conductivity for a short time. 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.

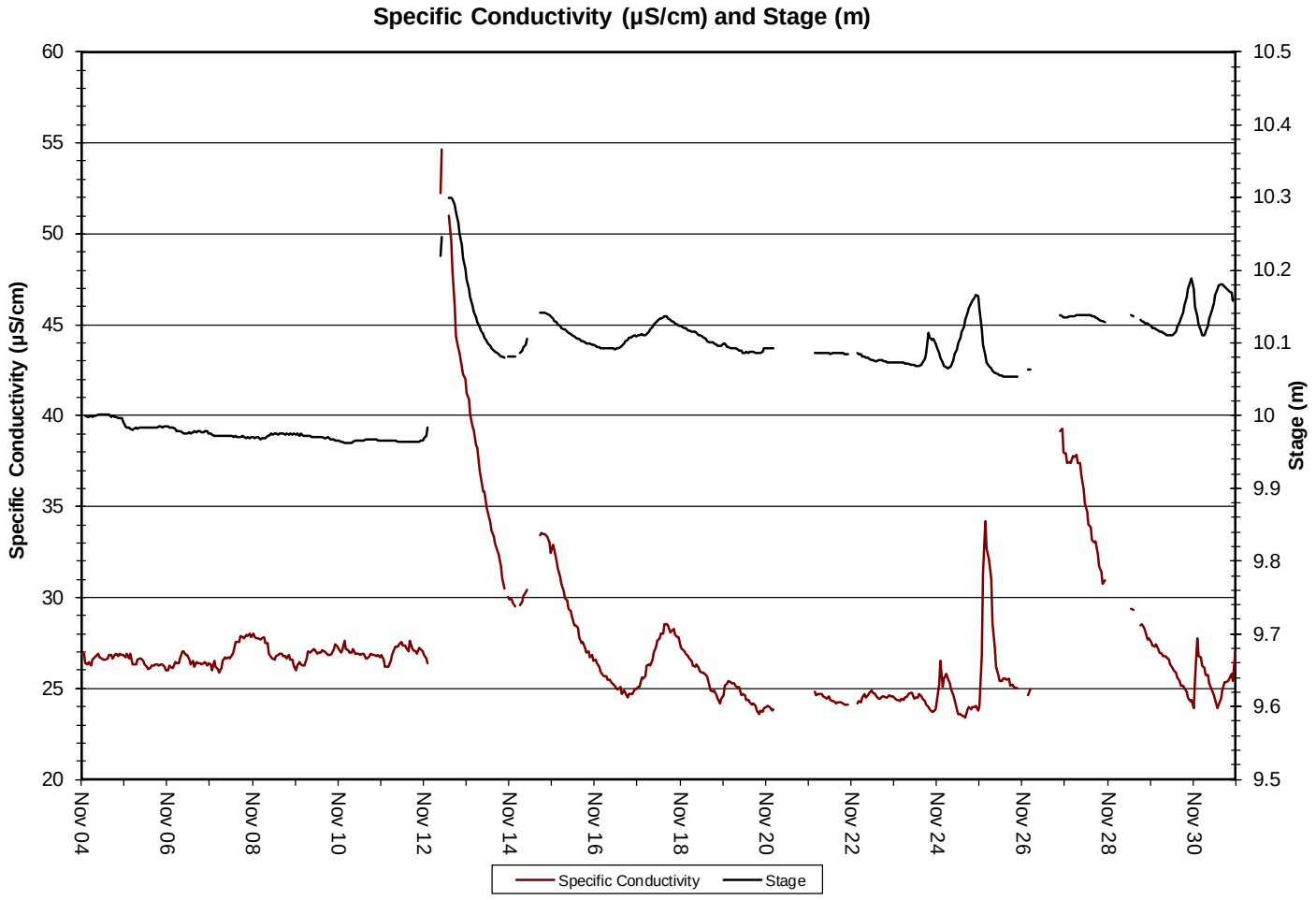


Figure 4: Specific Conductivity of Water and Stage

- The saturation of dissolved oxygen ranged from 90.9% to 102.4% and a range of 10.54 to 14.65 mg/l was found for the concentration of dissolved oxygen with a median value of 12.99 mg/l (Figure 5).
- All values were above the minimum CCME Guidelines for the Protection of Other Life Stages and Early Life Stage of Cold Water Biota. The guidelines are indicated in blue on Figure 5.
- Dissolved oxygen content fluctuates diurnally, displaying the inverse relationship to water temperature. Dissolved oxygen increased steadily during the deployment period as water temperatures cooled into winter. The only exception was November 8th when water temperatures increased and dissolved oxygen took a short-term corresponding decrease.

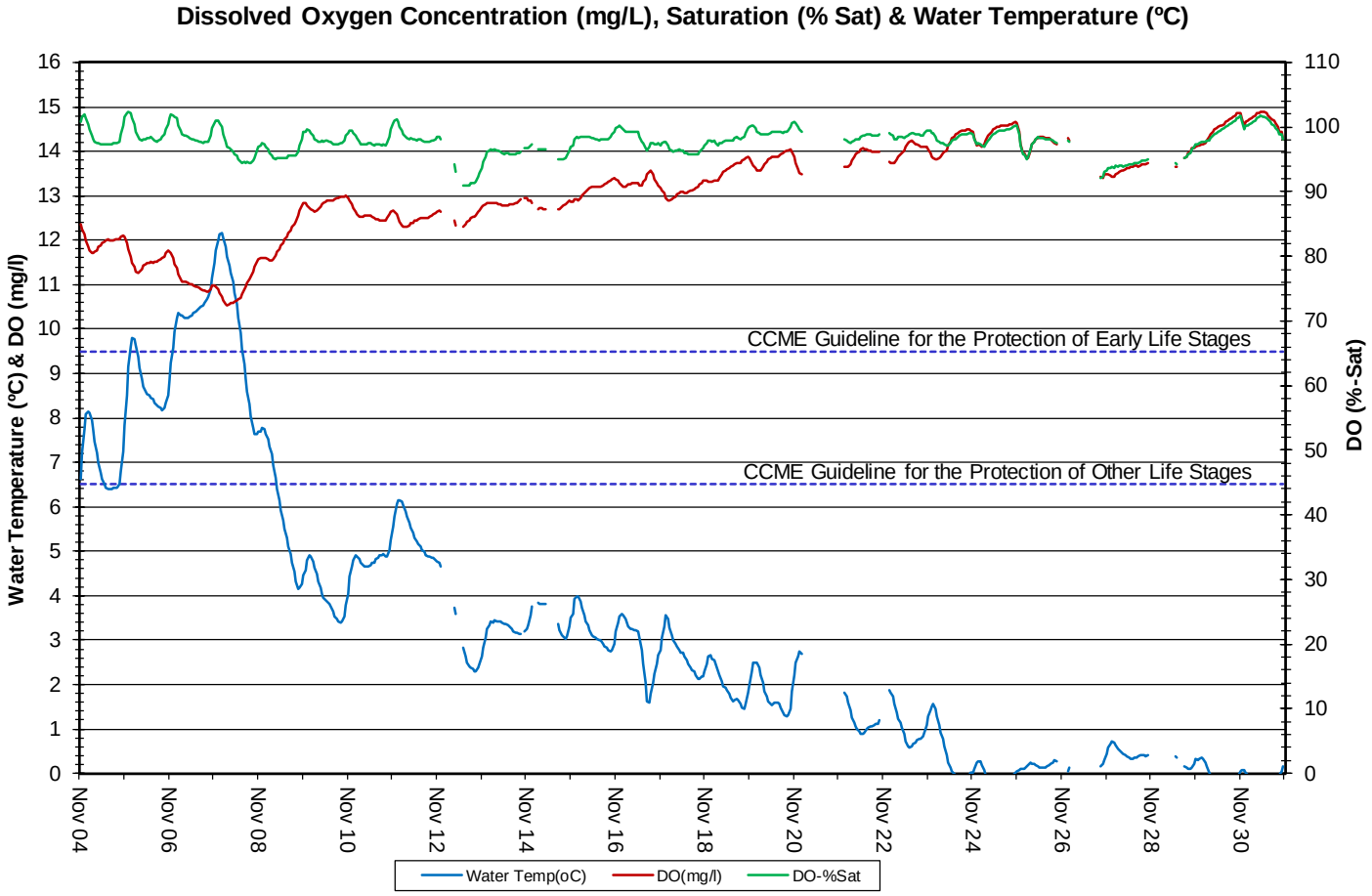


Figure 5: Dissolved Oxygen and Water Temperature

- Turbidity values range from 0.5 NTU to 6.5 NTU with a median of 0.9, 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 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.

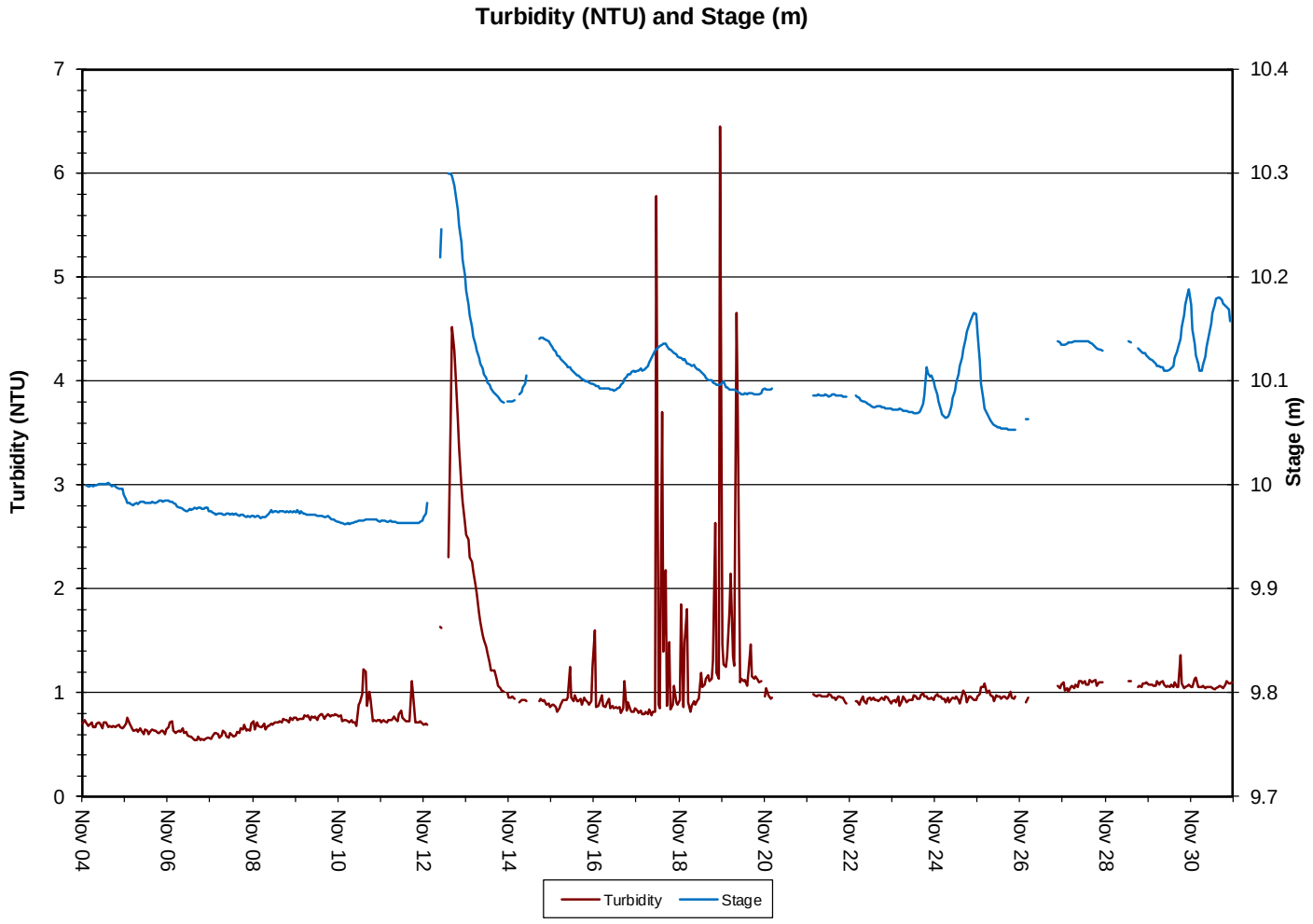


Figure 6: Turbidity and Stage

- Precipitation and stage during the deployment period are graphed below (Figure 7). Stage was increasing gradually throughout deployment, influenced by several major precipitation events, particularly the largest event on November 12th 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.

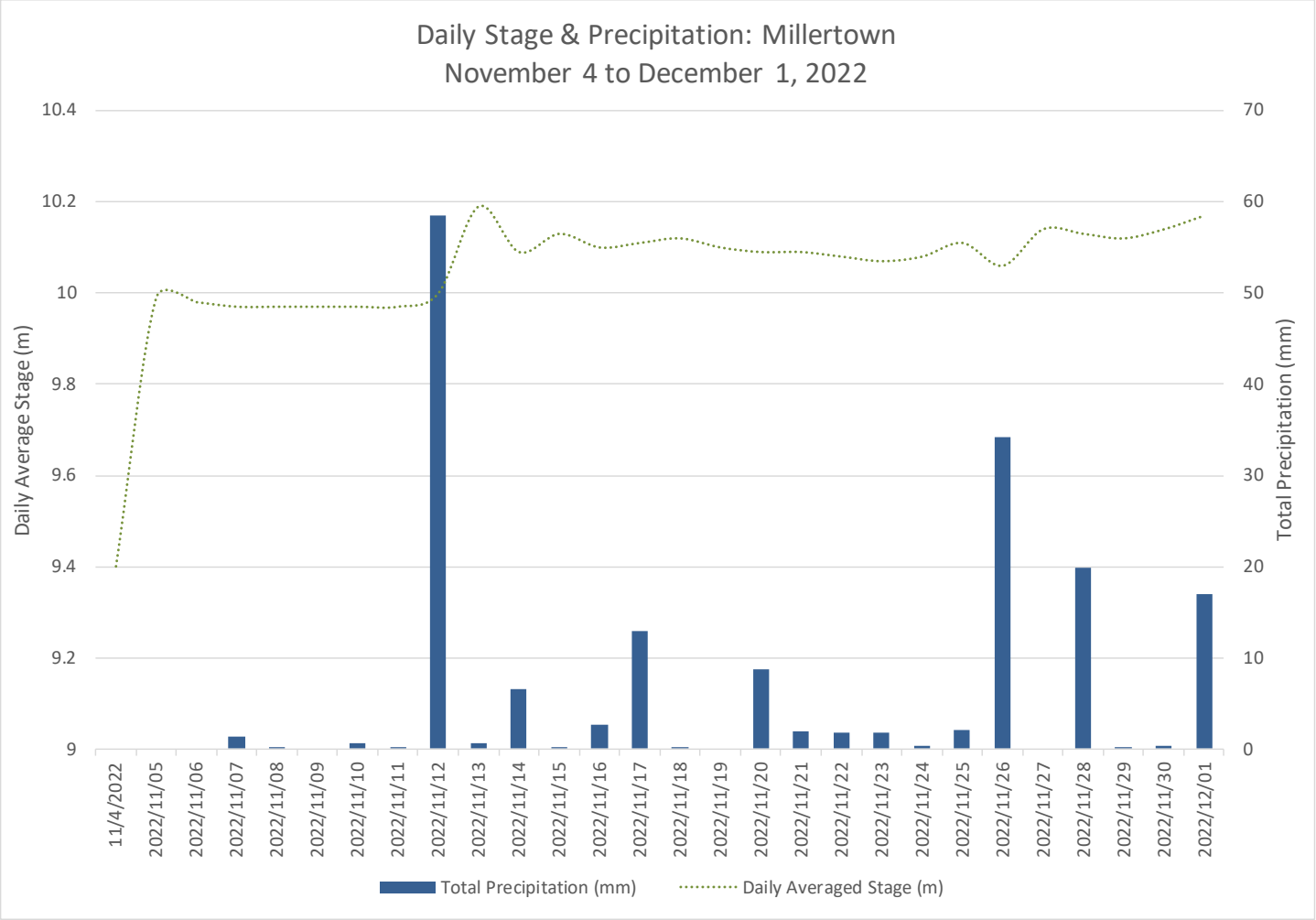


Figure 7: Precipitation and Stage

Valentine River

- Water temperature ranged from -0.10 to 11.83ºC during this deployment period (Figure 8).
- Water temperature showed a decreasing trend throughout deployment, corresponding to ambient air temperatures as fall changed into winter (Figure 8). Periodical increases in water temperature correspond to increases in air temperature.

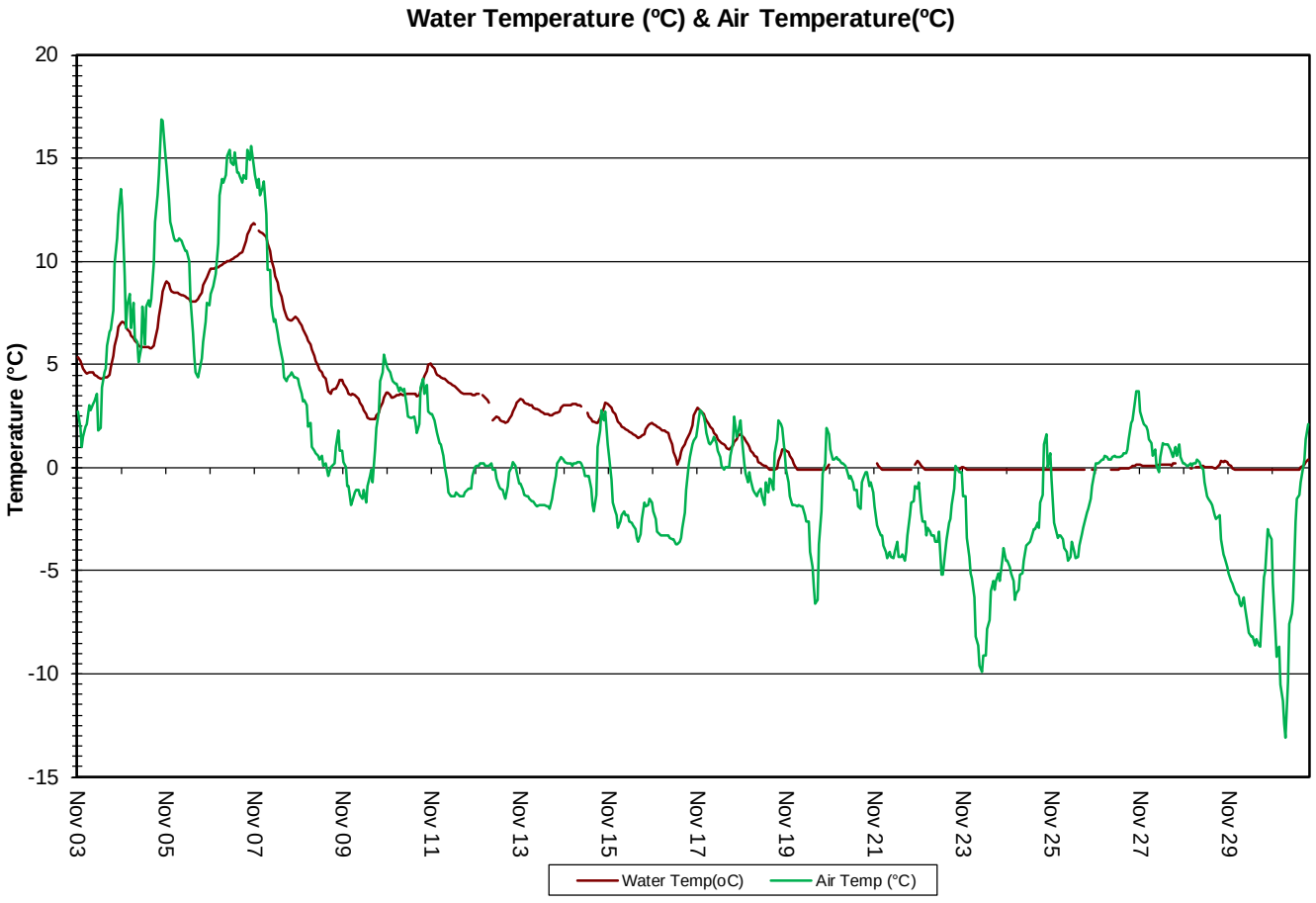


Figure 8: Water and Air Temperature

(Weather data collected at Millertown)

- pH ranged between 6.81 and 7.16 pH units throughout the deployment period, with a median value of 6.97 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 November 12th (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.

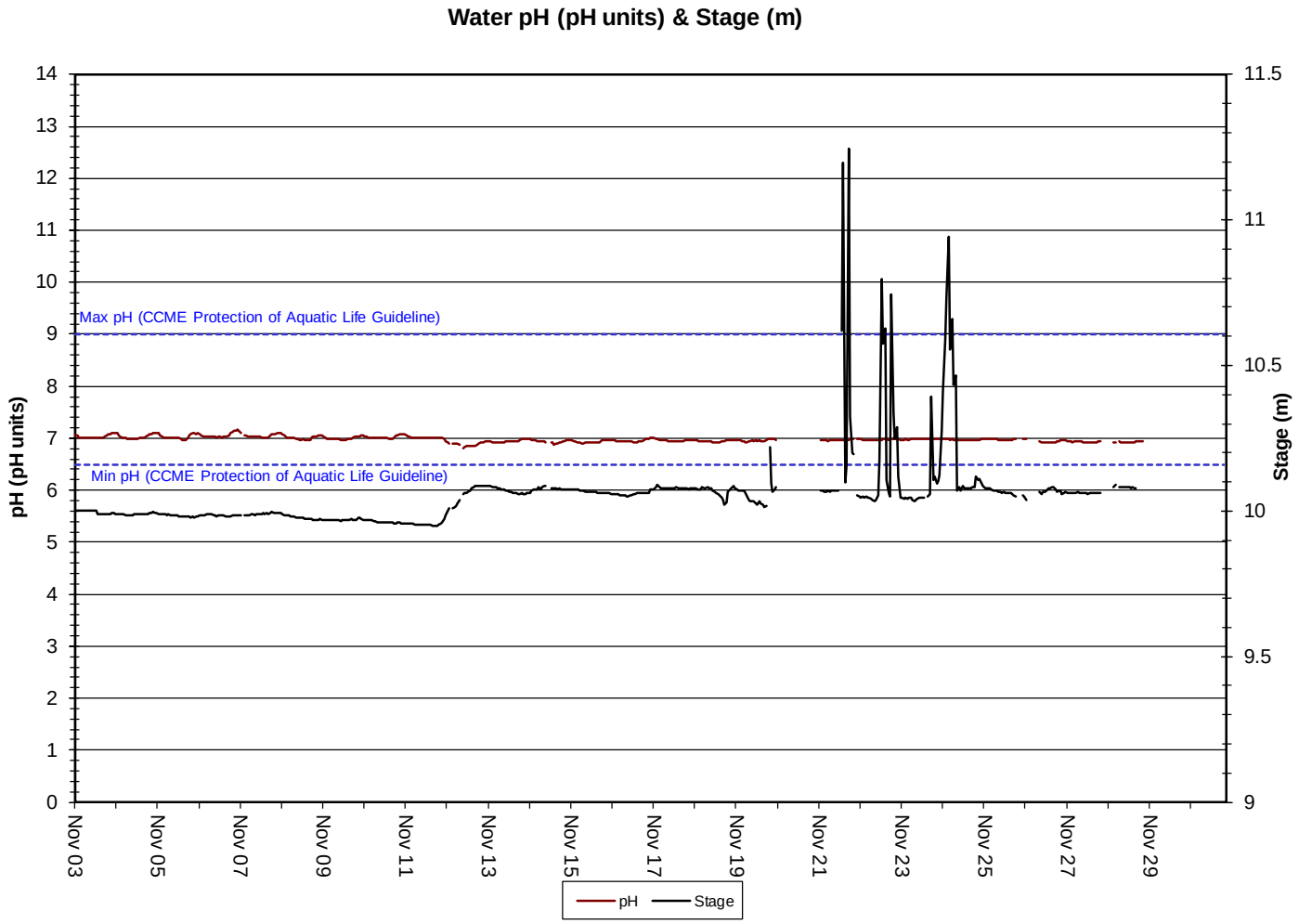


Figure 9: Water pH and Stage

- Specific conductivity ranged from 25.0 to 28.0 µs/cm (Figure 10) with a median of 25.9 µs/cm (Figure 10).
- Specific conductivity was relatively stable over the course of this deployment period, except during periods of high precipitation which caused stage increases and corresponding increases in conductivity. 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.

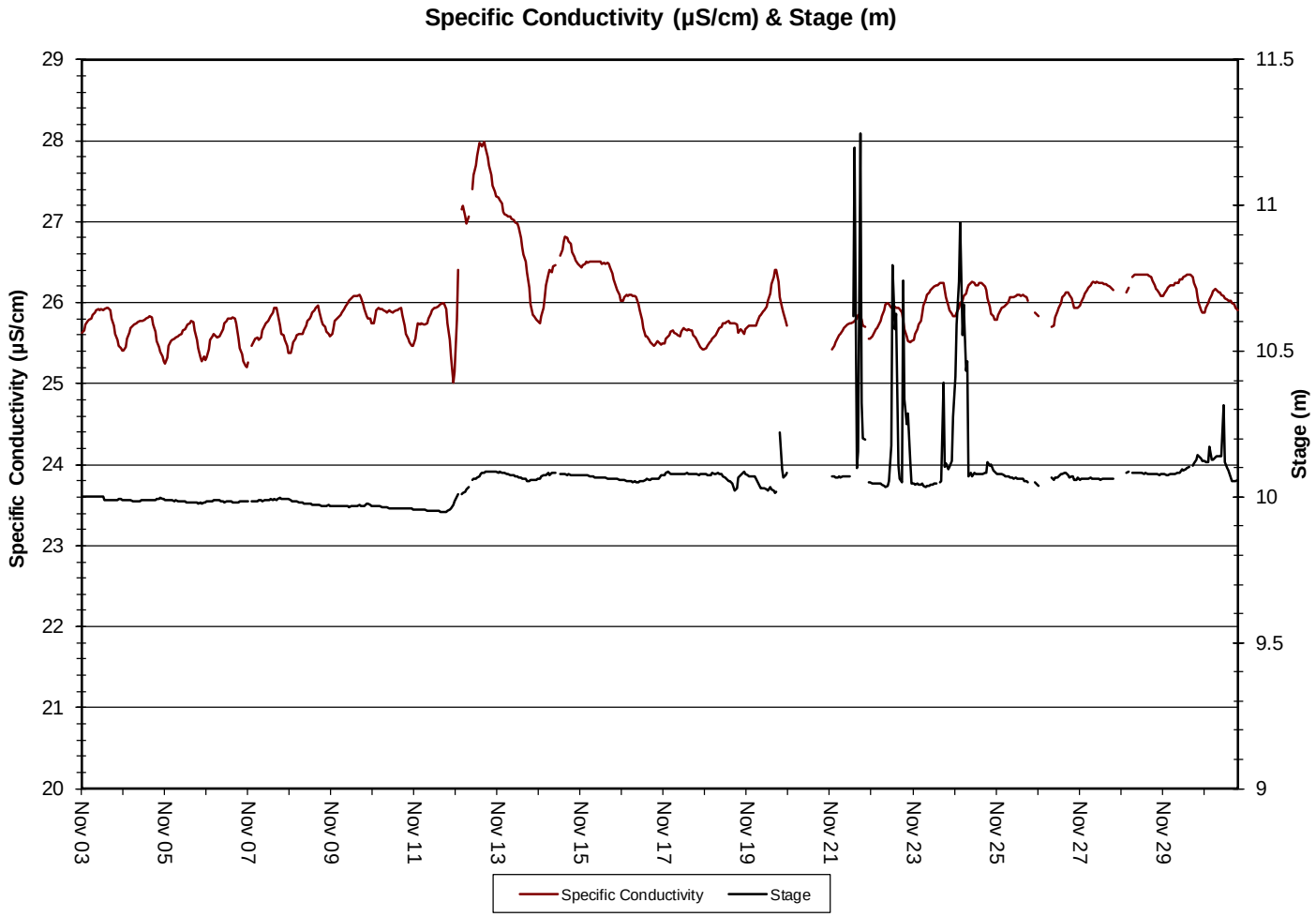


Figure 10: Specific Conductivity of Water and Stage

- The saturation of dissolved oxygen ranged from 97.6% to 102.3% and a range of 10.71 to 14.95 mg/l was found for the concentration of dissolved oxygen with a median value of 13.73 mg/l (Figure 11).
- All values were above the minimum CCME Guidelines for the Protection of Other Life Stages and Early Life Stage of Cold Water Biota. The guidelines are indicated in blue on Figure 11.
- Dissolved oxygen content fluctuates diurnally, displaying the inverse relationship to water temperature. Dissolved oxygen increased steadily during the deployment period as water temperatures cooled into winter. The only exception was November 8th when water temperatures increased and dissolved oxygen took a short-term corresponding decrease.

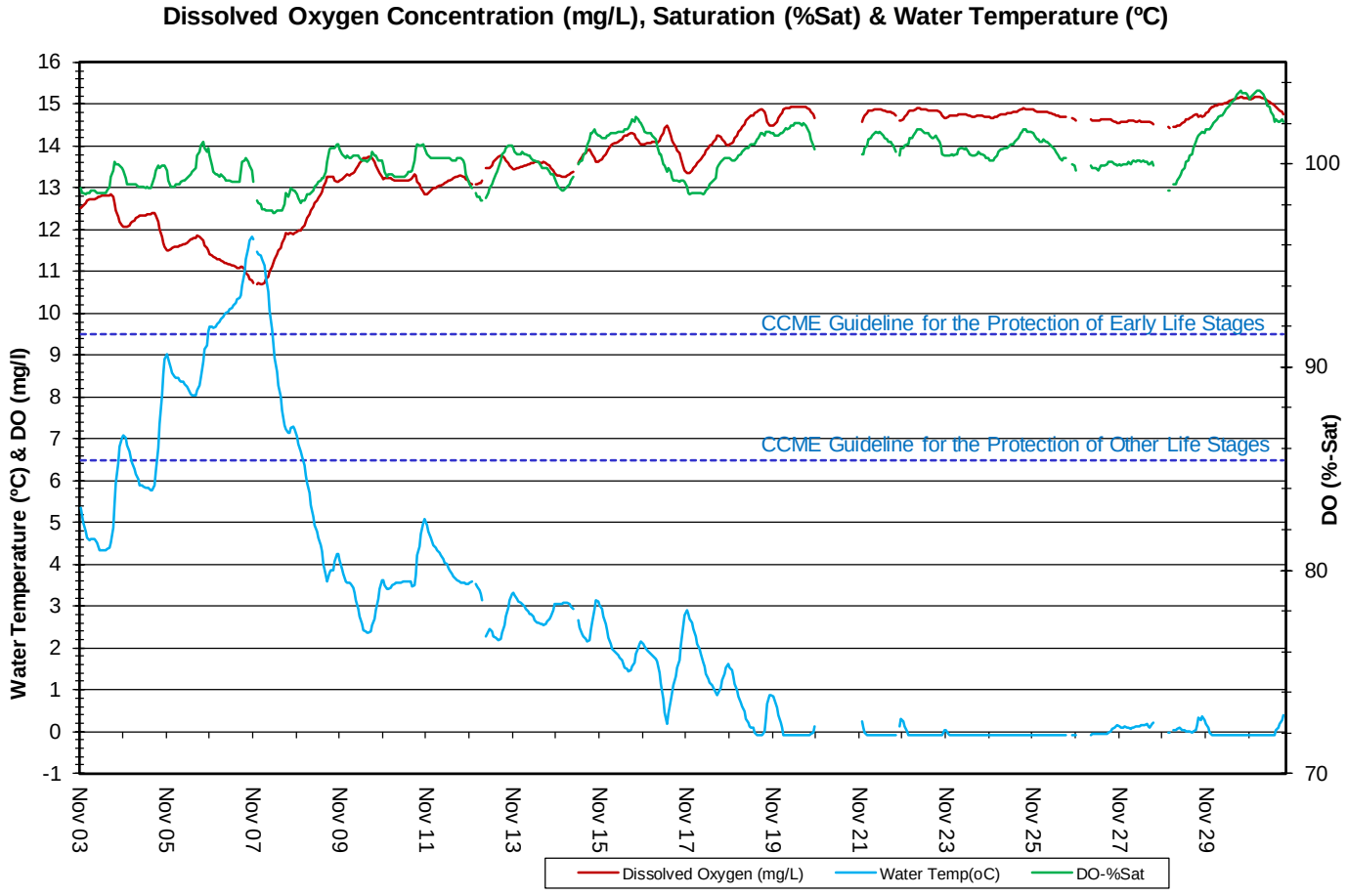


Figure 11: Dissolved Oxygen and Water Temperature

- Turbidity values range from 0.3 NTU to 2.0 NTU with a median of 0.6, 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.

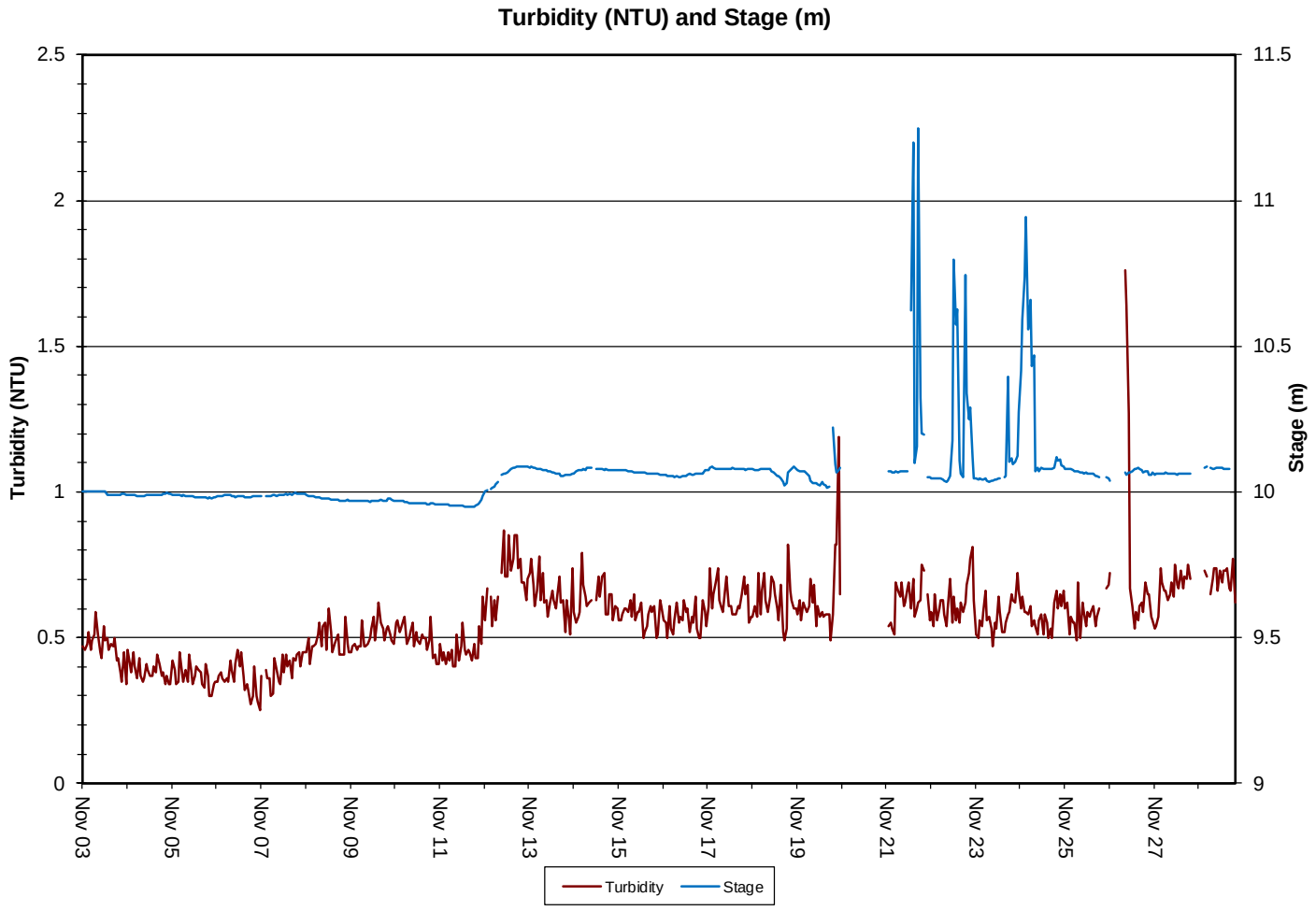


Figure 12: Turbidity and Stage

- Precipitation and stage during the deployment period are graphed below (Figure 13). Stage was increasing gradually throughout deployment, influenced by several major precipitation events, particularly the largest event on November 12th which caused a significant rise in stage.
- It is notable from the data that smaller precipitation events had more of an effect on this river than they did in Victoria River. The increases in stage in late November are likely the result of ice interfering with the hydrometric equipment as the increased were very short lived when analyzing hourly data (Figure 12 above).

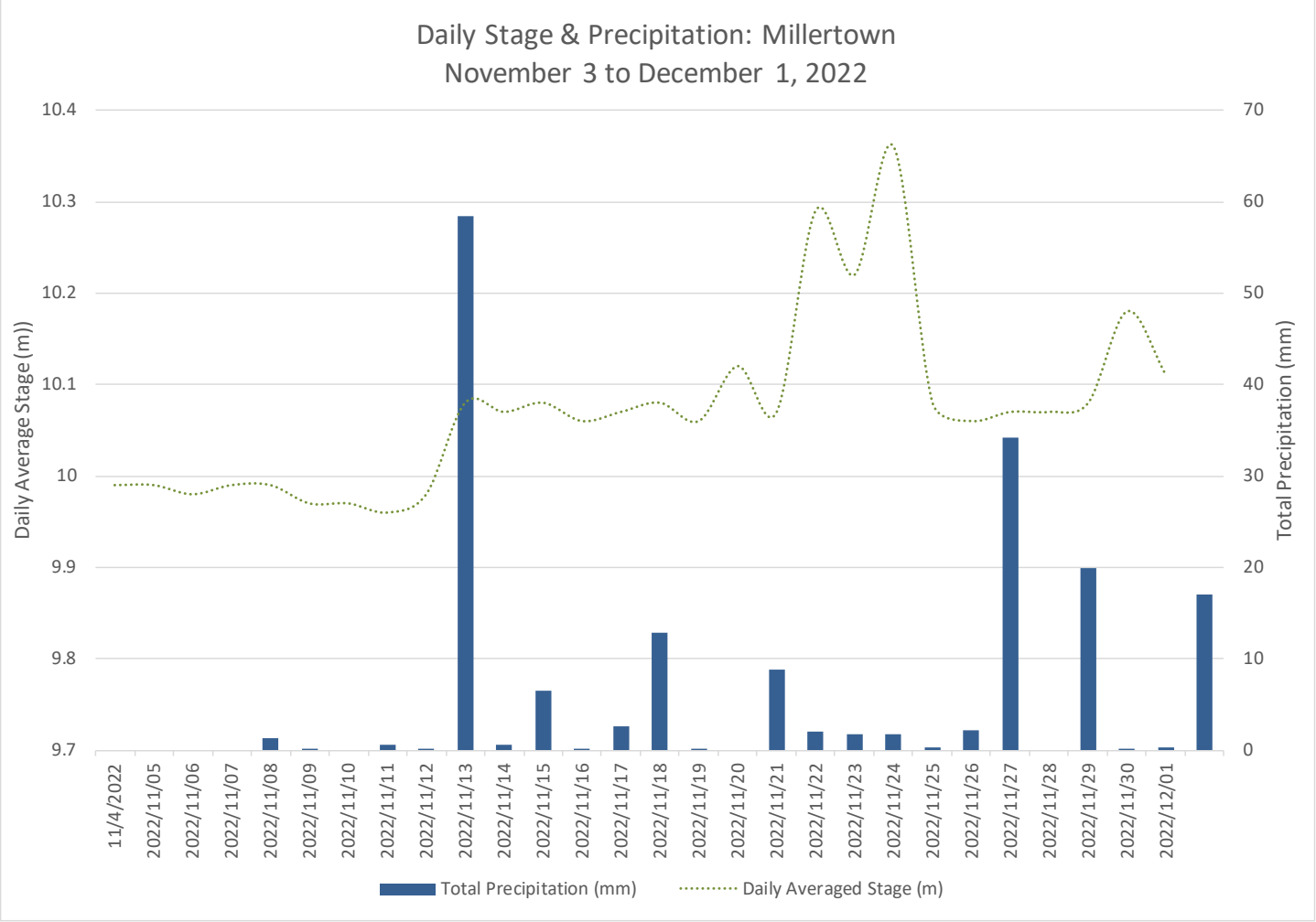


Figure 13: Precipitation and Stage

Roebucks Brook

- Water temperature ranged from -0.03 to 12.12°C during this deployment period (Figure 14).
- Water temperature showed a decreasing trend throughout deployment, corresponding to ambient air temperatures as fall changed into winter (Figure 2). This trend was also observed at Victoria and Valentine Rivers.

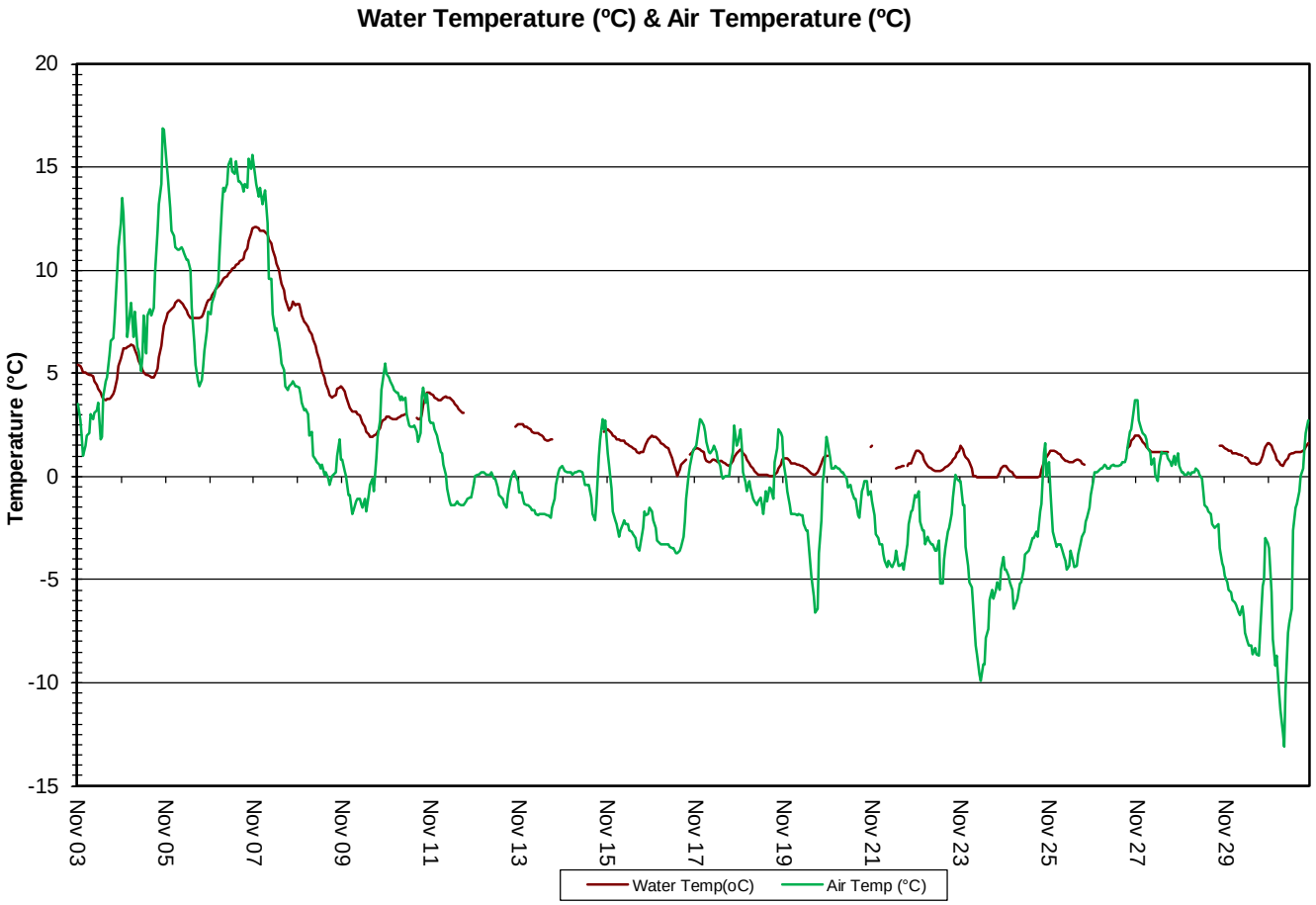


Figure 14: Water and Air Temperature

(Weather data collected at Millertown)

- pH ranged between 6.23 and 6.99 pH units throughout the deployment period, with a median value of 6.71 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 November 12th and 27th (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.

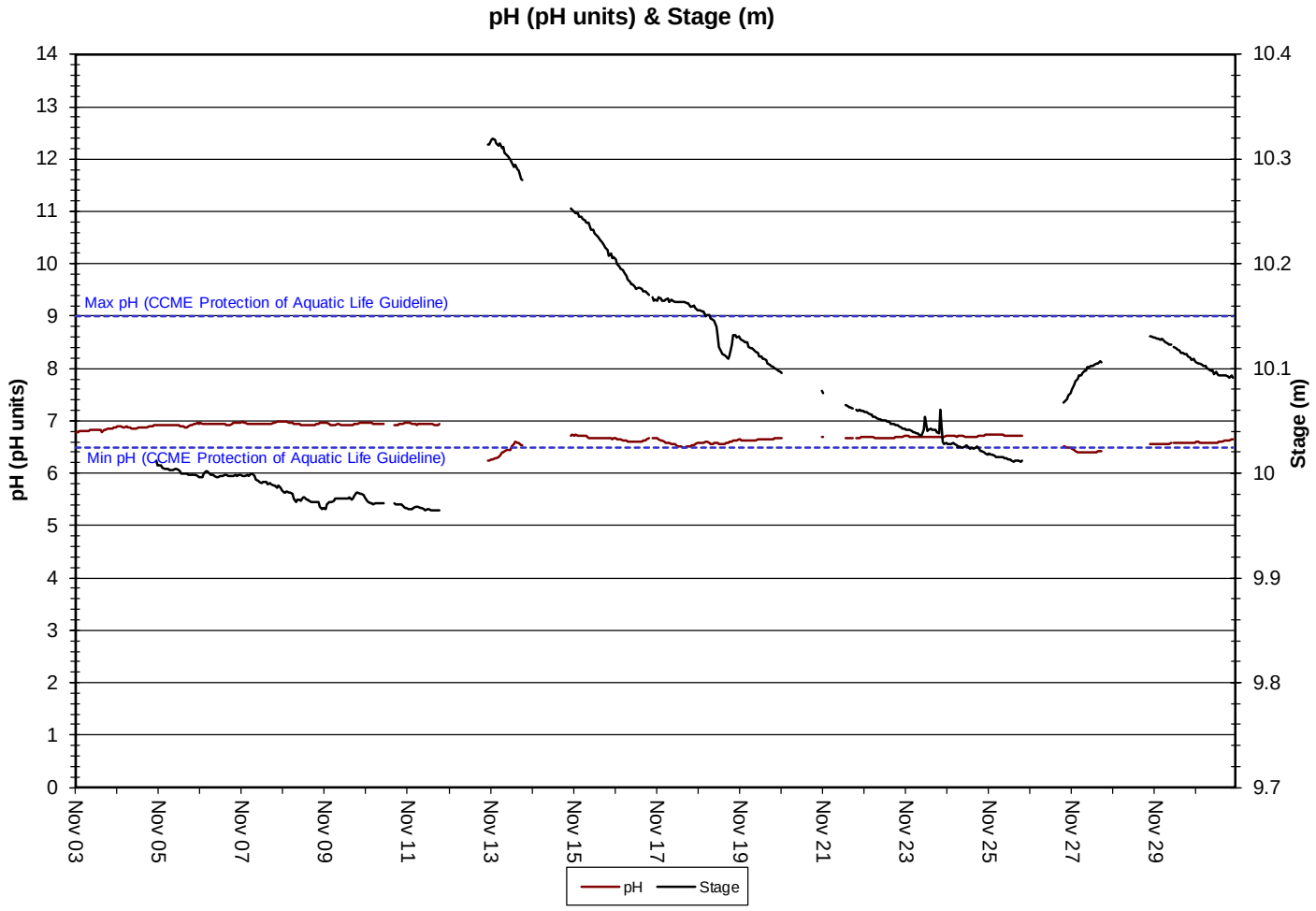


Figure 15: Water pH and Stage

- Specific conductivity ranged from 28.4 to 37.0 µs/cm (Figure 16) with a median of 32.3 µs/cm.
- Specific conductivity steadily decreased over the course of this deployment period. During periods of high precipitation and corresponding stage increases, conductivity in Roebucks Brook decreased. This is different from Victoria and Valentine Rivers.
- This drop in conductivity as more water is added the system indicates that there may be little organic debris and sediment in the area to re-suspend during higher flows. Instead, the additional water dilutes the system, decreasing the conductivity. Further data collection will be useful to further analyze conductivity patterns at this location as data was limited due to transmission issues.

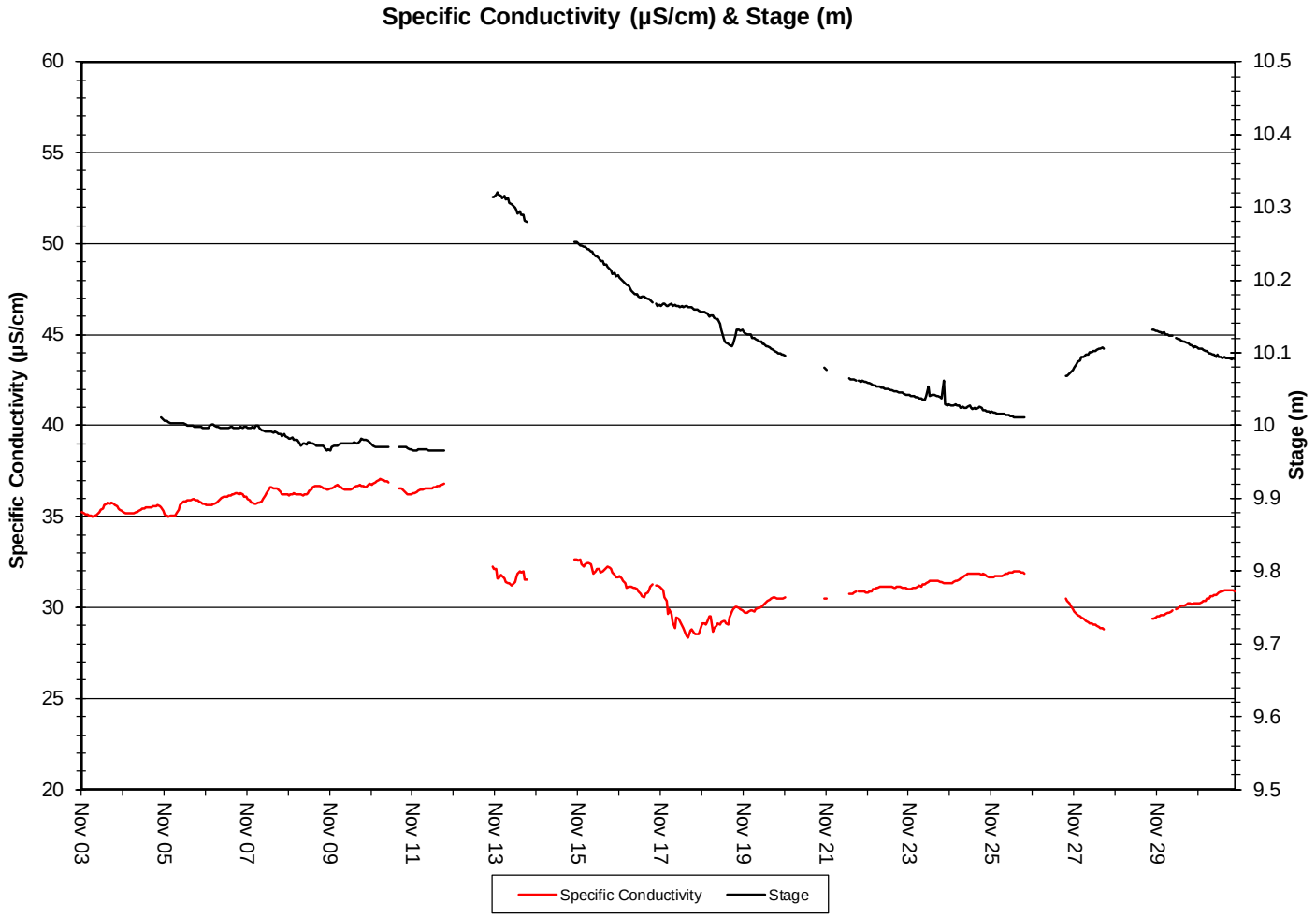


Figure 16: Specific Conductivity of Water and Stage

- The saturation of dissolved oxygen ranged from 92.5% to 98.4% and a range of 10.21 to 14.18 mg/l was found for the concentration of dissolved oxygen with a median value of 13.16 mg/l (Figure 17).
- All values were above the minimum CCME Guidelines for the Protection of Other Life Stages and Early Life Stage of Cold Water Biota. The guidelines are indicated in blue on Figure 5.
- Dissolved oxygen content fluctuates diurnally, displaying the inverse relationship to water temperature. Dissolved oxygen increased steadily during the deployment period as water temperatures cooled into winter. The only exception was November 8th when water temperatures increased and dissolved oxygen took a short-term corresponding decrease.

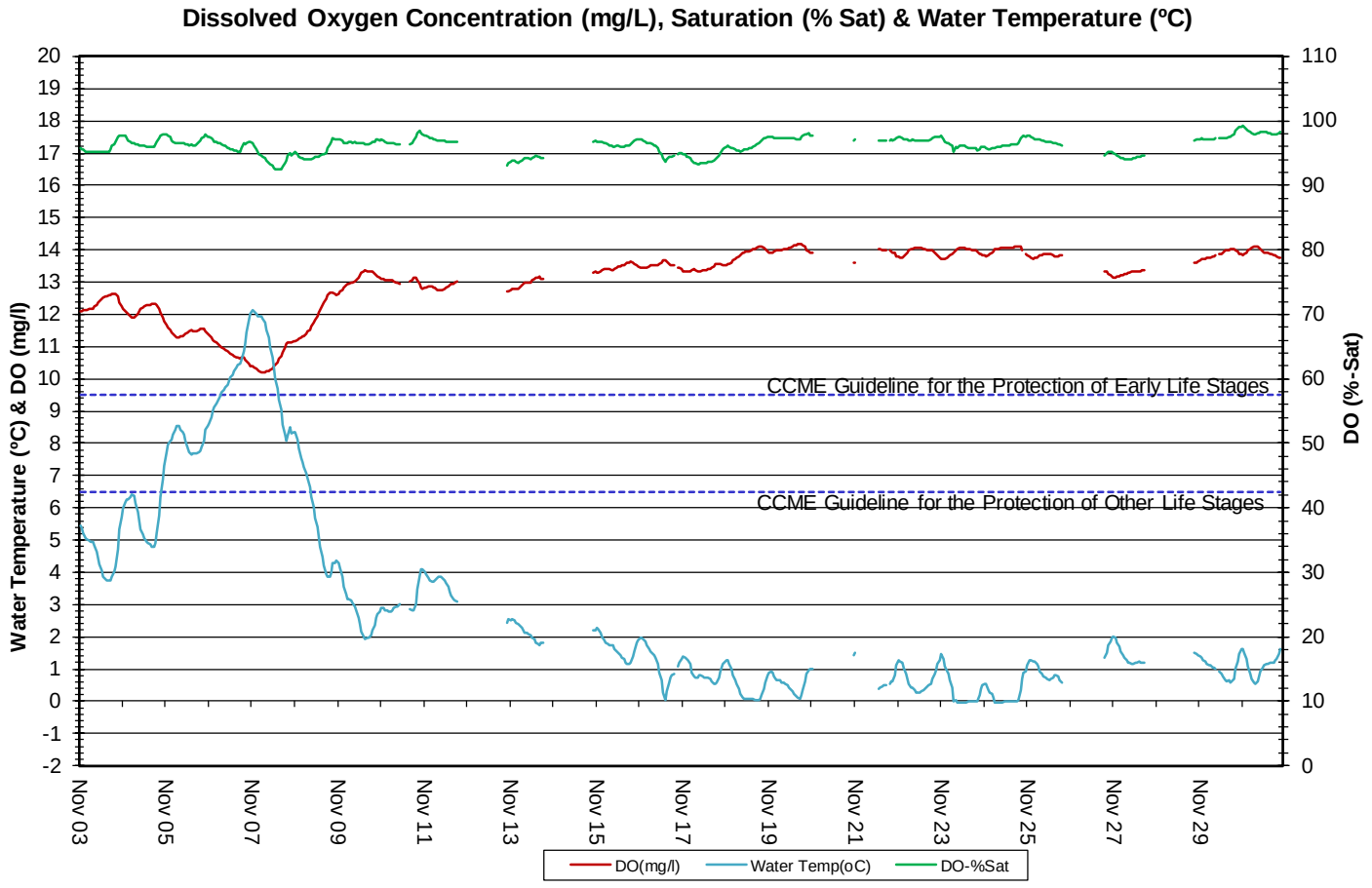


Figure 17: Dissolved Oxygen and Water Temperature

- Turbidity values range from 2.2 NTU to 8.9 NTU with a median of 3.0, indicating low background turbidity which was higher than Victoria or Valentine Rivers (Figure 18).
- Turbidity remained relatively stable throughout deployment with a slight decreasing trend. Turbidity increased temporarily during stage events associated with precipitation such as November 12th (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.

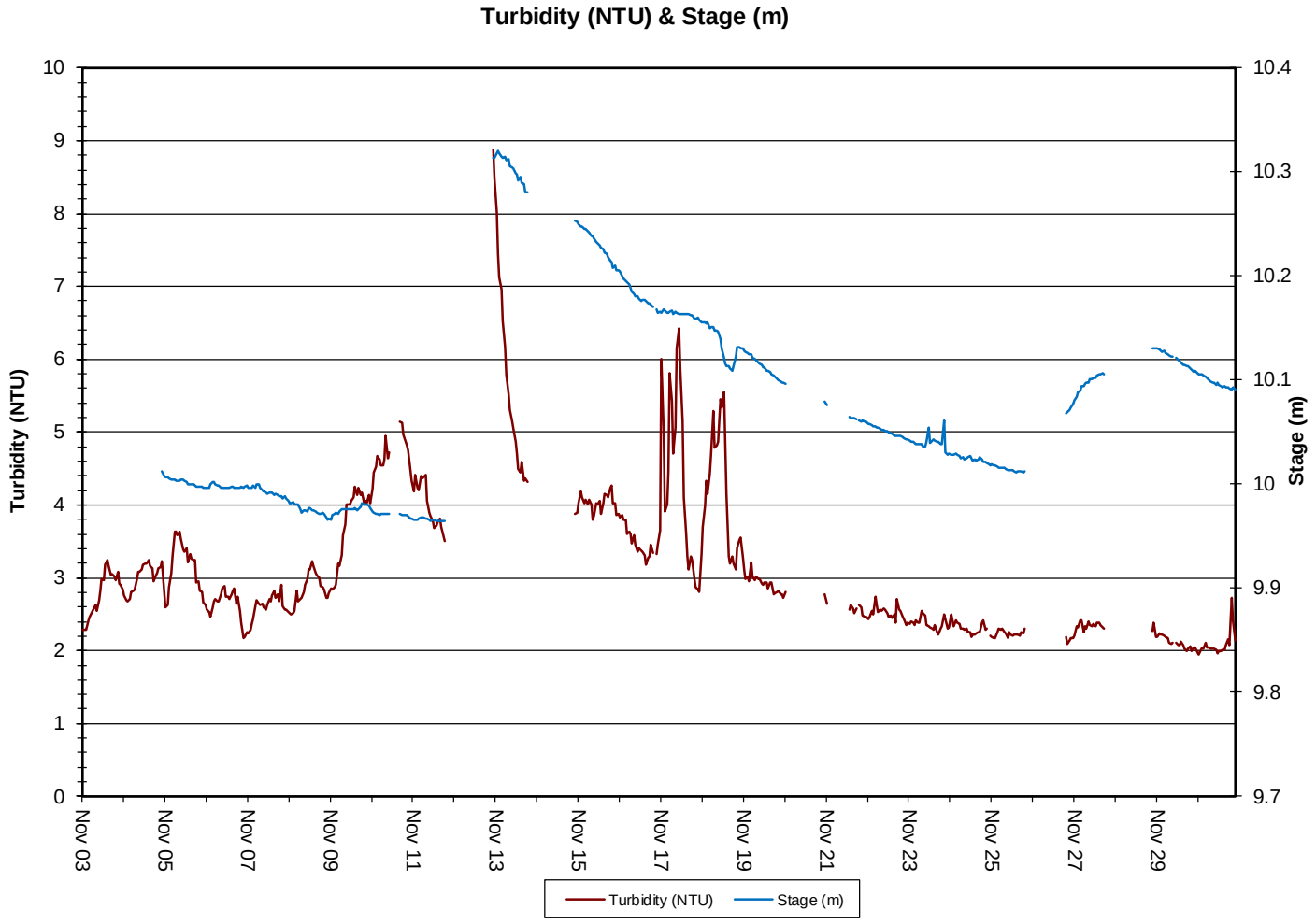


Figure 18: Turbidity and Stage

- Precipitation and stage during the deployment period are graphed below (Figure 19). Stage was increasing gradually throughout deployment, influenced by several major precipitation events, particularly the largest event on November 12th 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.

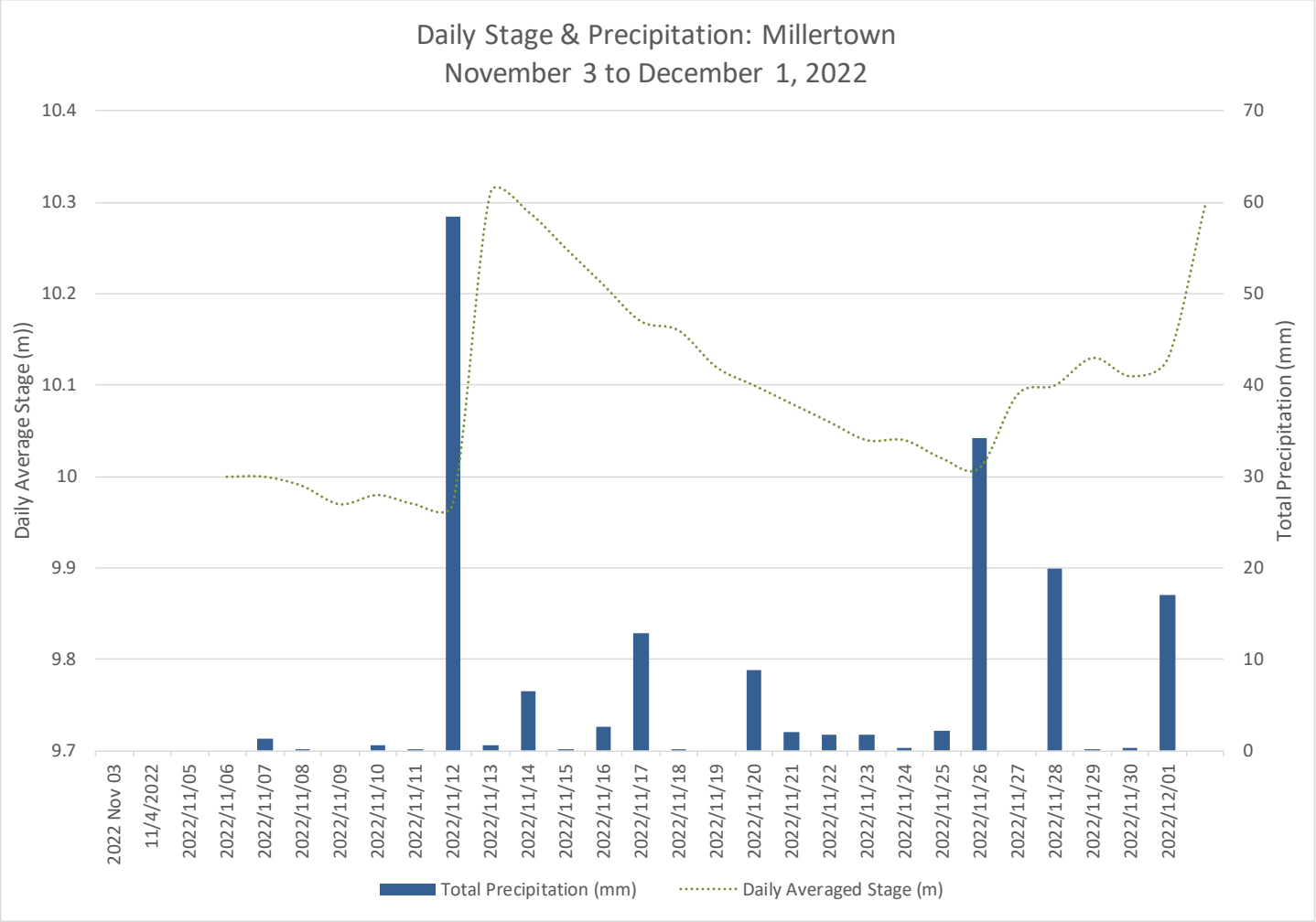


Figure 19: Precipitation and Stage

Conclusions

- Instruments were deployed at three real time water quality/quantity monitoring stations which form the Marathon Gold Corp monitoring network on November 3rd and removed on December 1st, 2022. This was the first deployment for the network and the only deployment in 2022.
- In most cases, weather related events or increases/decreases in water level explain parameter fluctuations.
- Water temperature was found to be generally decreasing at all stations, as expected with seasonal air temperature declines into winter.
- All pH values were within the recommended CCME Guidelines for the Protection of Aquatic Life at Victoria and Valentine River. At Roebucks Brook, pH dropped below the minimum guideline briefly during periods of high precipitation.
- Specific conductivity showed decreasing trends at Victoria River and 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 and Early Life Stage of Cold Water Biota at all stations throughout the deployment.
- 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 large precipitation events which increased the stage, and showed an overall increasing trend throughout the deployment.
- In Spring 2023, water quality instruments will be re-installed at Victoria River, Valentine River and Roebucks Brook. Groundwater stations and the weather station for the network will also be installed beginning in Spring 2023.
- 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 – November 2022

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:

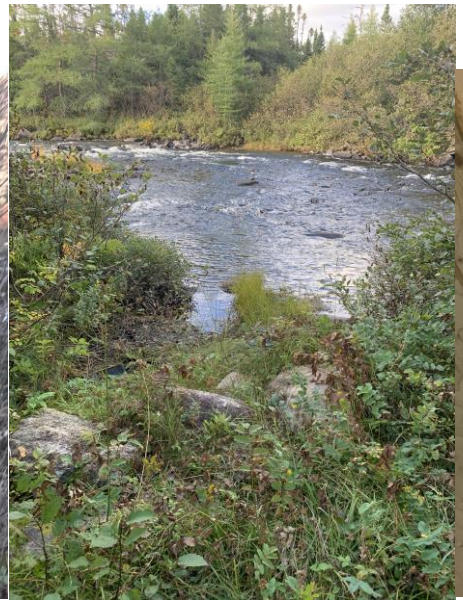
Victoria River

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

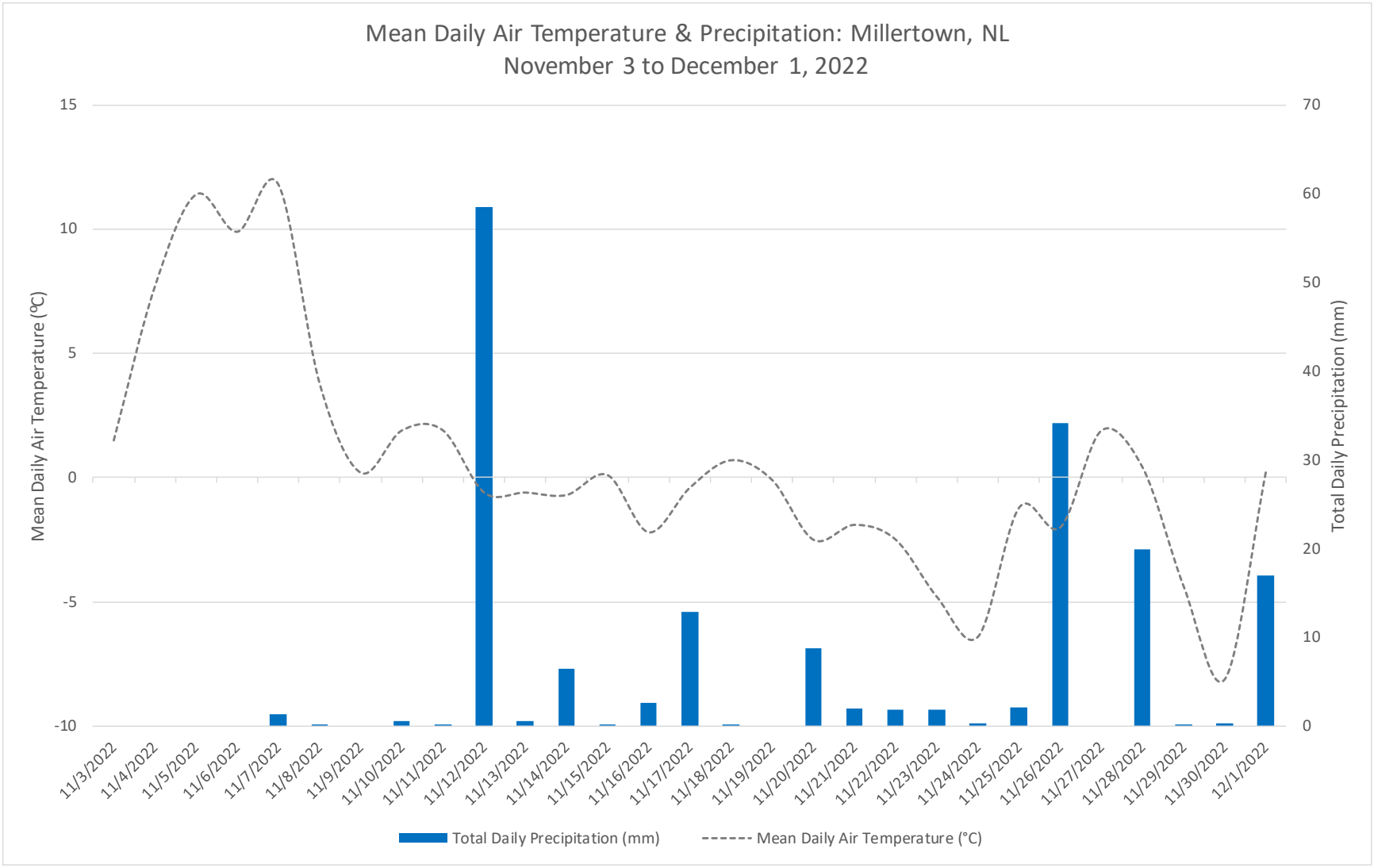
Station Location: Valentine River at access road, 1.9km downstream of Valentine Lake outlet. Station located 15m upstream of access road crossing bridge on southern shoreline.

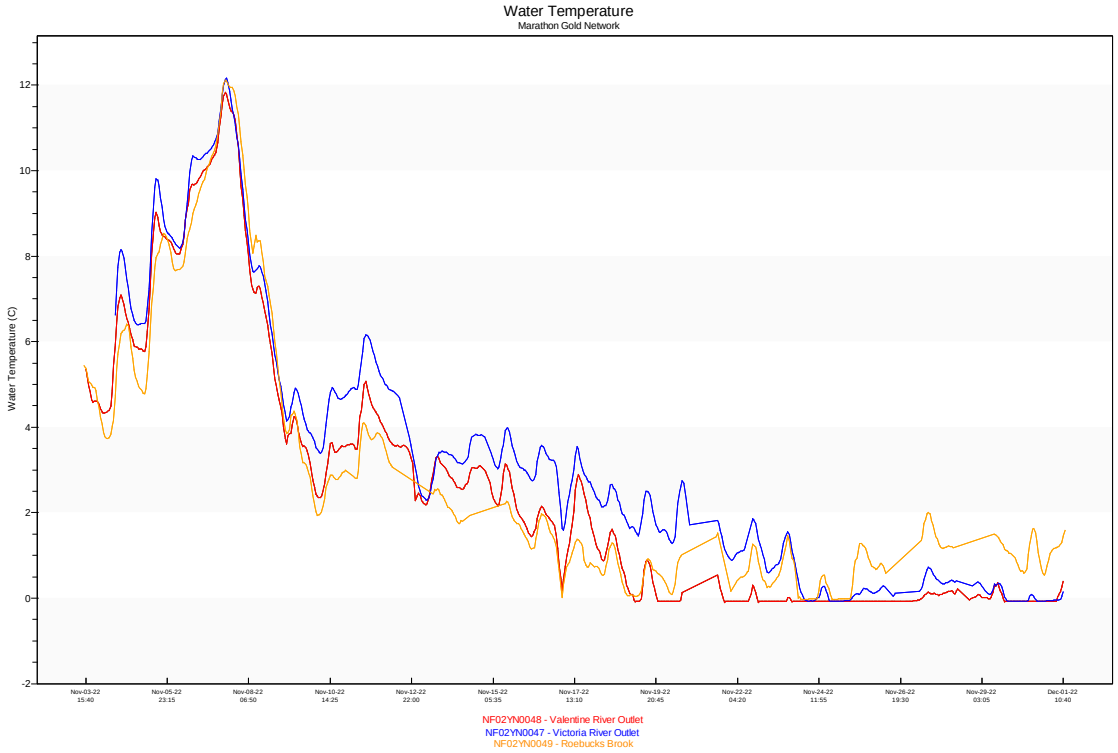

Roebucks Brook

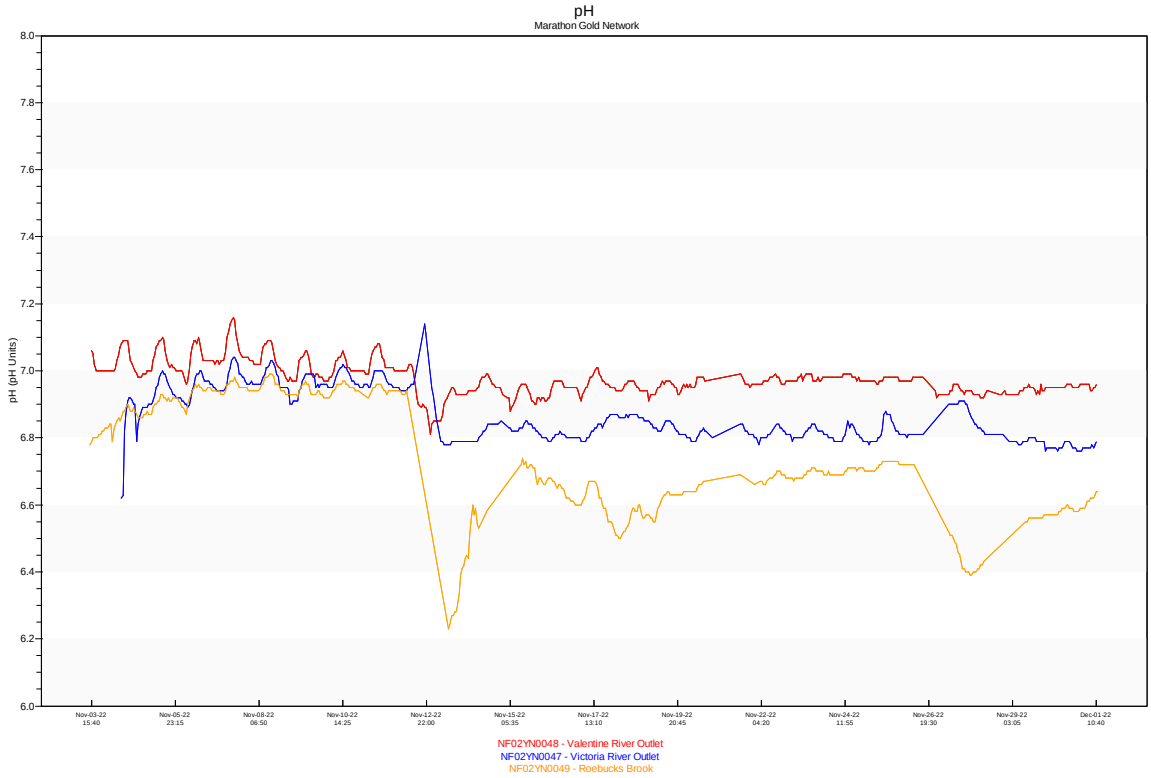
Station Location: Roebucks Brook 30m downstream of access road bridge crossing on western shoreline. Station is 1.6km downstream of Roebucks Lake outlet.

Appendix B: Weather Data from Millertown RCS

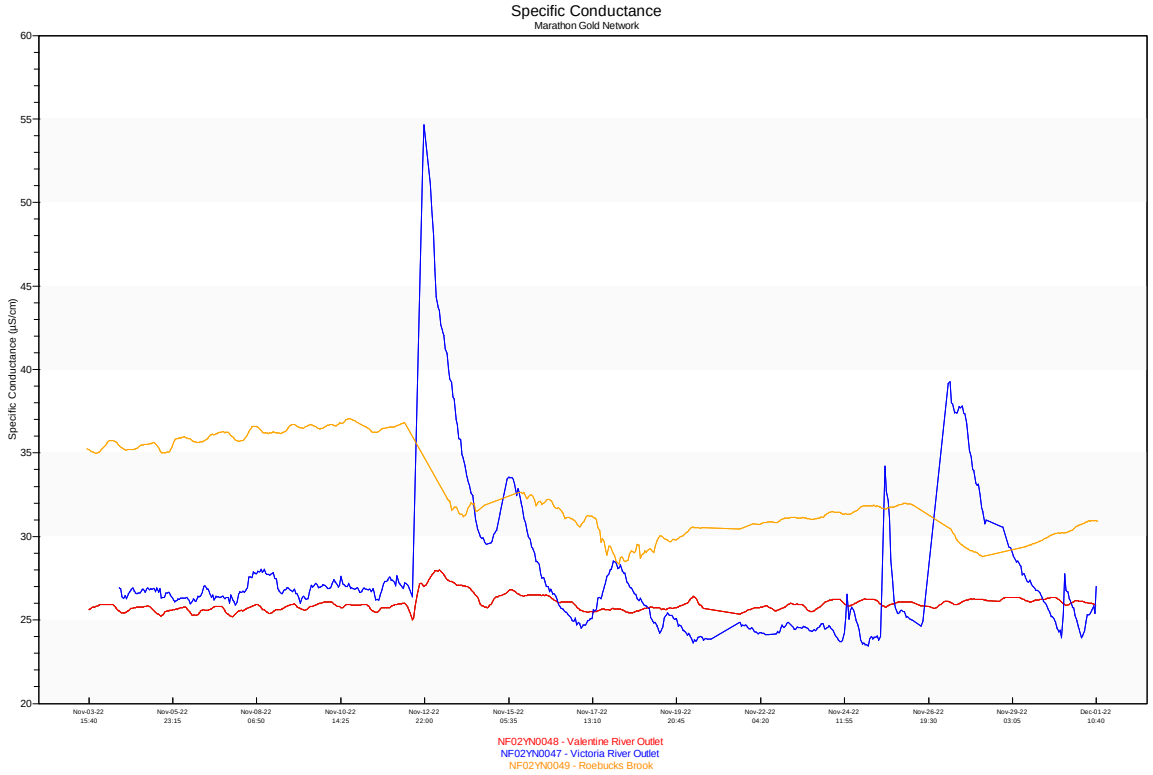


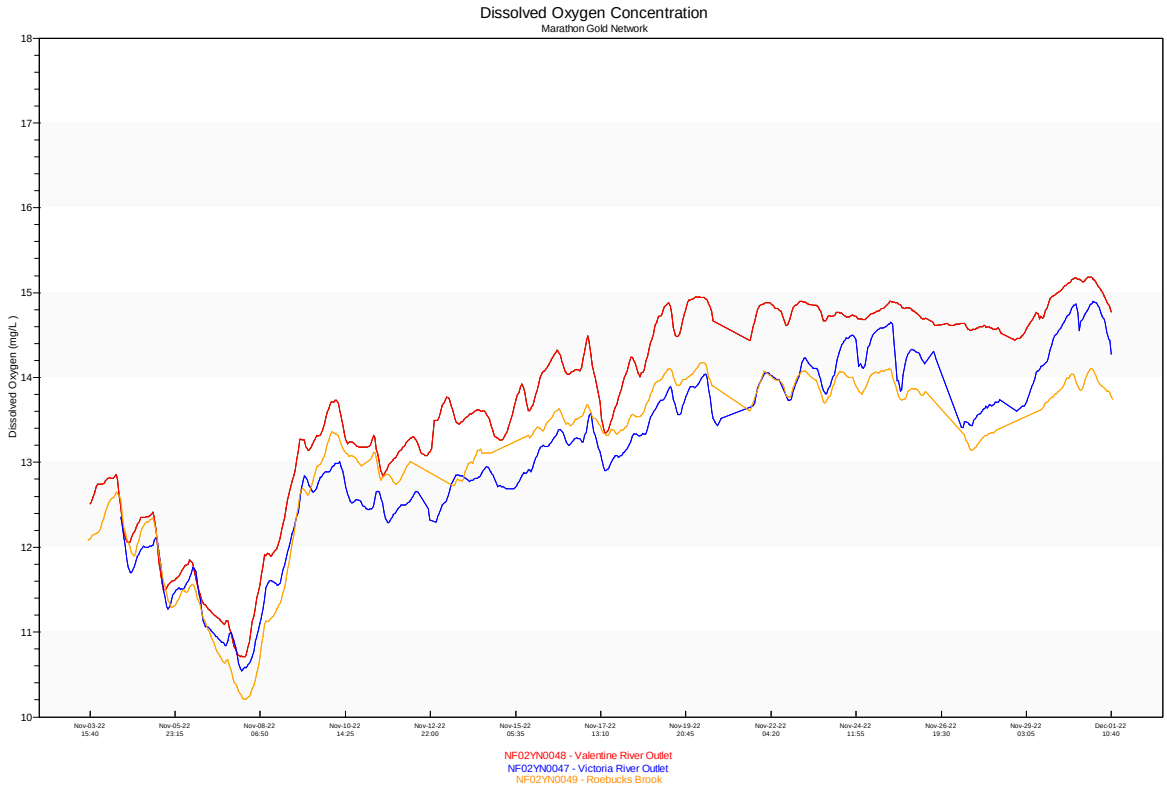
Appendix C: Station Parameter Comparison Graphs (raw data)



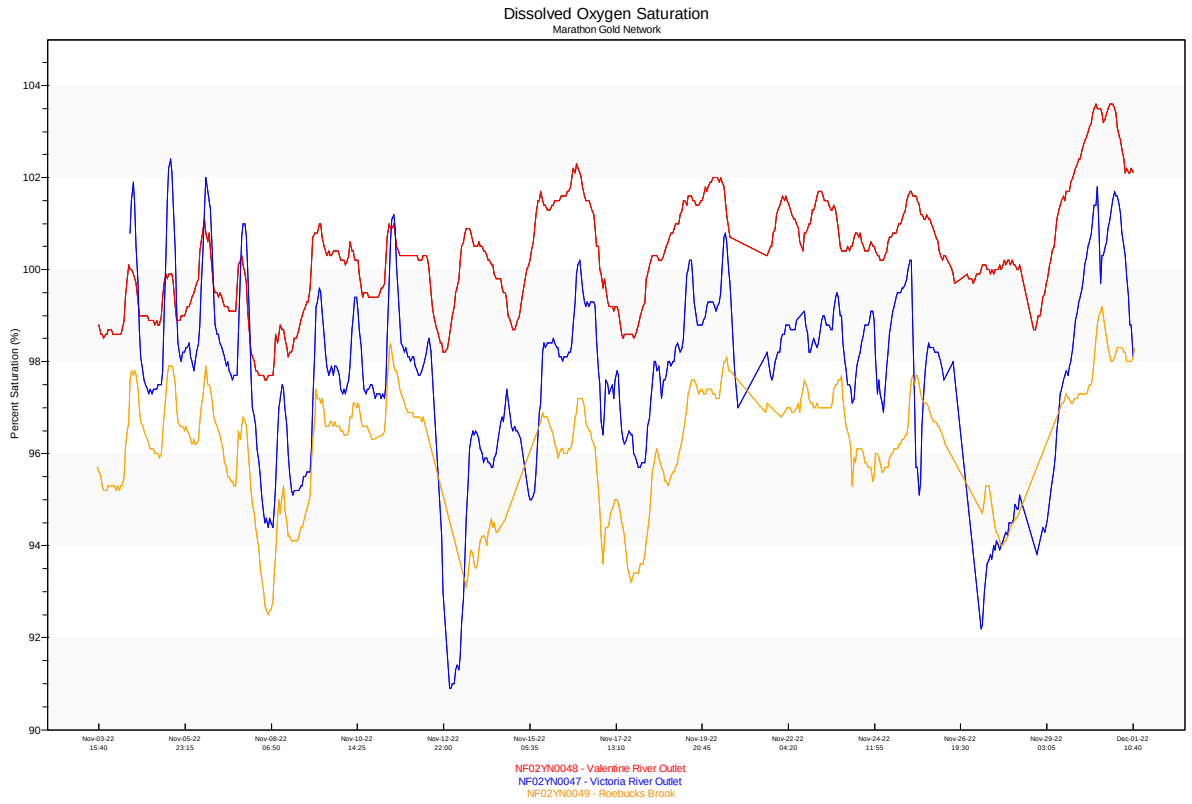


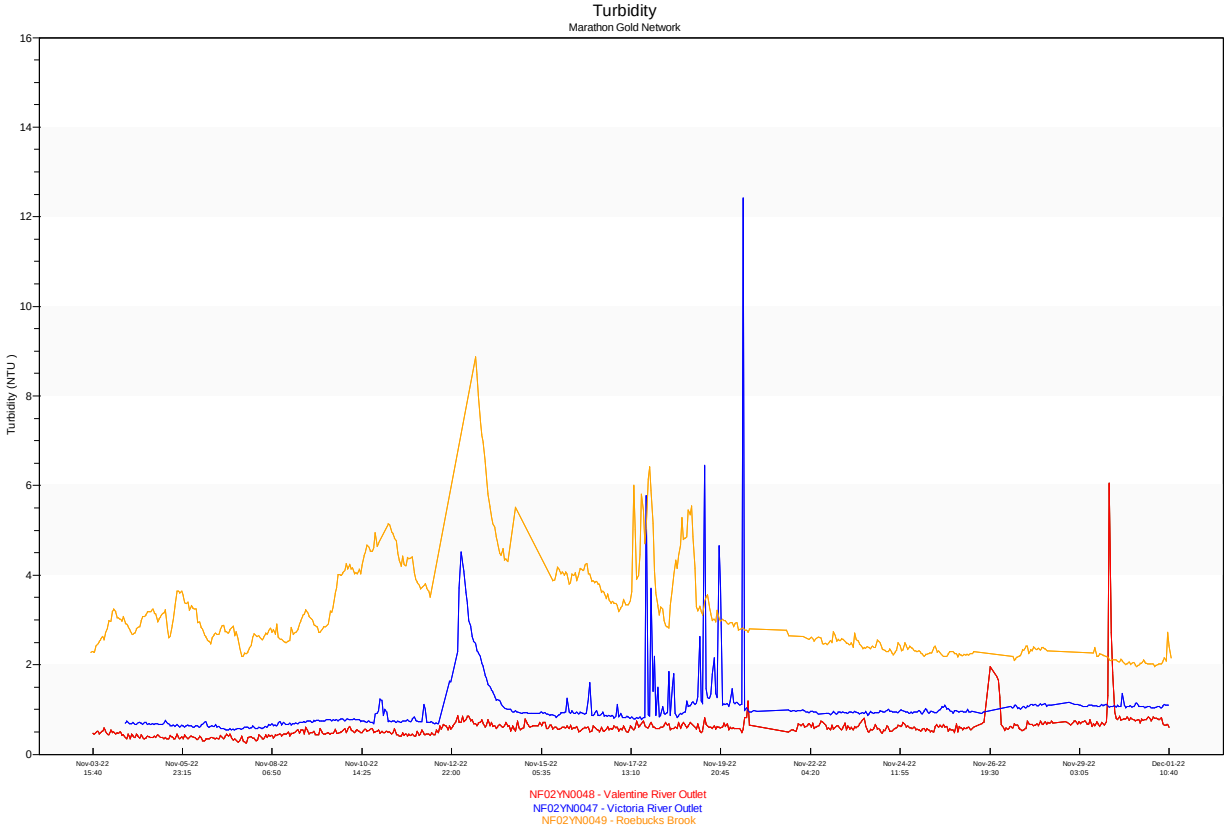
Marathon Gold Corp, Newfoundland and Labrador





Marathon Gold Corp, Newfoundland and Labrador





Marathon Gold Corp, Newfoundland and Labrador