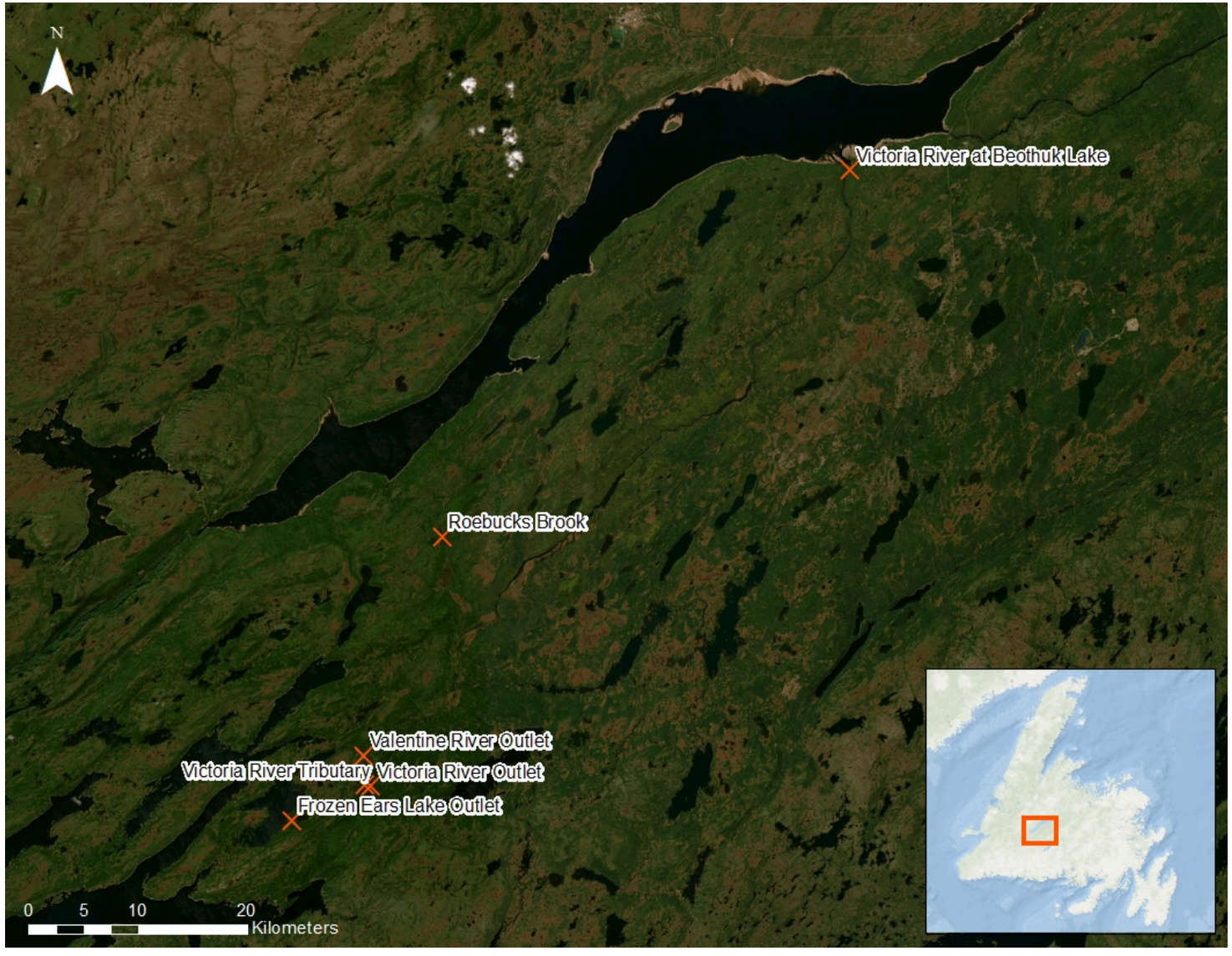
# Real Time Water Quality Deployment Report
# Calibre Mining: Valentine Gold Mine Network

2024-10-09 to 2024-11-13

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

# Valentine Gold Mine Network




The Water Resources Management Division (WRMD), in collaboration with Calibre Mining (formerly Marathon Gold) maintain twelve real-time water quality (RTWQ) and water quantity monitoring stations. These stations are part of a real-time network designed to monitor, process, and share water quality and quantity data with both WRMD and Calibre Mining, supporting the evaluation and management of water resources. The network also provides early detection of potential or emerging water issues, allowing for prompt response and implementation of mitigation measures.

Six of these stations focus on surface water and will be addressed in this report. The remaining six stations are groundwater monitoring wells which are reported annually. The six surface water stations are located at Victoria River at Beothuk Lake, Roebucks Brook at Access Road, Valentine River Outlet, Victoria River Tributary, Victoria River Outlet, and Frozen Ears Outlet. Victoria River at Beothuk Lake and Frozen Ear Outlet are both new stations, installed on June 10, 2024, and June 11, 2024, respectively.

This report covers the monitoring period from 2024-10-09 to 2024-11-13. The sondes were removed for the winter season at the end of this deployment period, and will be redeployed in Spring 2025.

| Station Name | Station Number | Latitutde | Longitude |
|---|---|---|---|
| Frozen Ear Lake Outlet | NF02YN0052 | 48.39 | -57.14 |
| Victoria River Outlet | NF02YN0047 | 48.41 | -57.07 |
| Victoria River Tributary | NF02YN0050 | 48.41 | -57.08 |
| Valentine River Outlet | NF02YN0048 | 48.42 | -57.08 |
| Roebucks Brook | NF02YN0049 | 48.54 | -57.01 |
| Victoria River at Beothuk Lake | NF02YN0051 | 48.74 | -56.68 |

# Quality Assurance and Quality Control Procedures

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. 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.

| Parameter | Excellent | Good | Fair | Marginal | Poor |
|---|---|---|---|---|---|
| pH | ≤ ± 0.2 units | ≤ ± 0.21 - 0.5 units | ≤ ± 0.51 - 0.8 units | ≤ ± 0.81 - 1 units | > ± 1 units |
| Water Temperature | ≤ ± 0.2°C | ≤ ± 0.21 - 0.5°C | ≤ ± 0.51 - 0.8°C | ≤ ± 0.81 - 1°C | > ± 1°C |
| Dissolved oxygen | ≤ ± 0.3 mg/L | ≤ ± 0.31 -0.5 mg/L | ≤ ± 0.51 - 0.8 mg/L | ≤ ± 0.81 - 1 mg/L | > ± 1 mg/L |
| Turbidity | ≤ ± 2 turbidity units or ≤ ± 5%, whichever is greater | ≤ ± 2.1-5 turbidity units or ≤ ± 5.1-10 %, whichever is greater | ≤ ± 5.1-8 turbidity units or ≤ ± 10.1-15 %, whichever is greater | ≤ ± 8.1-10 turbidity units or ≤ ± 15.1-20 %, whichever is greater | > ± 10 turbidity units or > ± 20 %, whichever is greater |
| Specific Conductance | ≤ ± 3 µS/cm or ≤ ± 3%, whichever is greater | ≤ ± 3.1-10 µS/cm or ≤ ± 3.1-10%, whichever is greater | ≤ ± 10 - 15 µS/cm or ≤ ± 10.1-15 %, whichever is greater | ≤ ± 15.1 - 20 µS/cm or ≤ ± 15.1-20 %, whichever is greater | > ± 20 µS/cm or > ± 20 %, whichever is greater |

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. There are a few circumstances which may cause QA/QC rankings below excellent, including 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.

The temperature sensor on any sonde is the most important. All other parameters can be divided into subgroups of: temperature dependent, temperature compensated, and temperature independent. Due to the temperature sensor's location on the sonde, the entire sonde must be at a constant temperature before the temperature 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.

Additionally, grab samples are collected during deployment to compare pH, specific conductivity and turbidity values between the field instrument and grab samples. Variability in results may be attributed to differences in the sampling location or depth relative to the sonde's deployment site or insufficient equilibration time for the sonde when initial field data was collected.

## Station Malfunction

Due to power issues encountered at Roebucks Brook RTWQ station, there is no water quality data available past October 22nd.

## Hydrometric Data

Water Resources Management Division hydrometric (stage and flow) data is quality controlled on a less frequent basis than water quality data due to differences in protocols. The hydrometric data shown in this report is provisional and has not undergone quality control checks.

# QAQC
## Deployment Rankings

At the time of deployment and removal, the rankings at each station all ranged between excellent to good for all parameters.

Due to power issues experienced at the Roebucks Brook RTWQ station, there was no field sonde removal data available thus no removal rankings are available.

Since the sondes were removed for the winter season at the end of this deployment period, grab samples were collected during the removal, in addition to the routine deployment grab samples. The grab samples collected during deployment all ranked excellent or good at each station, except for pH at Valentine River Outlet which ranked fair. The fair ranking can likely be associated with the differences in the sampling location or depth relative to the sonde's deployment site. The grab samples collected during removal also ranked excellent or good except for pH at Roebucks Brook. Since there was no removal field sonde data at Roebucks Brook, the grab samples were compared to the QAQC data. The fair ranking is likely due to placement of QAQC sonde or insufficient time for the QAQC sonde to equilibrate.

QAQC Rankings

| Station | Parameter | Deployment Rank | Grab Sample Deployment | Removal Rank | Grab Sample Removal |
|---|---|---|---|---|---|
| Frozen Ear Lake Outlet | Dissolved Oxygen (mg/l) | Good | | Excellent | |
| Frozen Ear Lake Outlet | pH | Good | Fair | Excellent | Excellent |
| Frozen Ear Lake Outlet | Specific Conductivity (µS/cm) | Excellent | Good | Excellent | Good |
| Frozen Ear Lake Outlet | Temperature (°C) | Excellent | | Excellent | |
| Frozen Ear Lake Outlet | Turbidity (NTU) | Excellent | Excellent | Excellent | Excellent |
| Roebucks Brook | Dissolved Oxygen (mg/l) | Excellent | | No data | |
| Roebucks Brook | pH | Excellent | Good | No data | Fair |
| Roebucks Brook | Specific Conductivity (µS/cm) | Excellent | Excellent | No data | Excellent |
| Roebucks Brook | Temperature (°C) | Excellent | | No data | |
| Roebucks Brook | Turbidity (NTU) | Excellent | Excellent | No data | Good |
| Valentine River Outlet | Dissolved Oxygen (mg/l) | Excellent | | Excellent | |
| Valentine River Outlet | pH | Good | Good | Good | Excellent |
| Valentine River Outlet | Specific Conductivity (µS/cm) | Good | Excellent | Excellent | Excellent |
| Valentine River Outlet | Temperature (°C) | Excellent | | Excellent | |
| Valentine River Outlet | Turbidity (NTU) | Excellent | Excellent | Excellent | Excellent |
| Victoria River at Beothuk Lake | Dissolved Oxygen (mg/l) | Excellent | | Excellent | |
| Victoria River at Beothuk Lake | pH | Excellent | Excellent | Excellent | Excellent |
| Victoria River at Beothuk Lake | Specific Conductivity (µS/cm) | Excellent | Excellent | Excellent | Excellent |
| Victoria River at Beothuk Lake | Temperature (°C) | Good | | Excellent | |
| Victoria River at Beothuk Lake | Turbidity (NTU) | Excellent | Excellent | Excellent | Excellent |
| Victoria River Outlet | Dissolved Oxygen (mg/l) | Excellent | | Excellent | |
| Victoria River Outlet | pH | Good | Good | Excellent | Excellent |
| Victoria River Outlet | Specific Conductivity (µS/cm) | Good | Excellent | Excellent | Excellent |
| Victoria River Outlet | Temperature (°C) | Excellent | | Excellent | |
| Victoria River Outlet | Turbidity (NTU) | Excellent | Good | Excellent | Excellent |
| Victoria River Tributary | Dissolved Oxygen (mg/l) | Excellent | | Excellent | |
| Victoria River Tributary | pH | Excellent | Excellent | Excellent | Excellent |
| Victoria River Tributary | Specific Conductivity (µS/cm) | Excellent | Excellent | Excellent | Good |
| Victoria River Tributary | Temperature (°C) | Excellent | | Excellent | |
| Victoria River Tributary | Turbidity (NTU) | Excellent | Excellent | Excellent | Excellent |

# Water Temperature

Newfoundland Labrador

## Deployment Period Statistics (°C)

| Station Name | Minimum | Maximum | Average | Median |
|---|---|---|---|---|
| Frozen Ears Lake Outlet | 0.68 | 13.13 | 5.94 | 6.22 |
| Roebucks Brook [Limited Data: October 10-22] | 5.39 | 10.76 | 8.55 | 8.70 |
| Valentine River Outlet | 0.88 | 12.15 | 5.93 | 5.84 |
| Victoria River at Beothuk Lake | 1.66 | 12.15 | 6.50 | 6.58 |
| Victoria River Outlet | 2.43 | 11.69 | 6.84 | 6.73 |
| Victoria River Tributary | 0.03 | 11.83 | 5.86 | 6.03 |

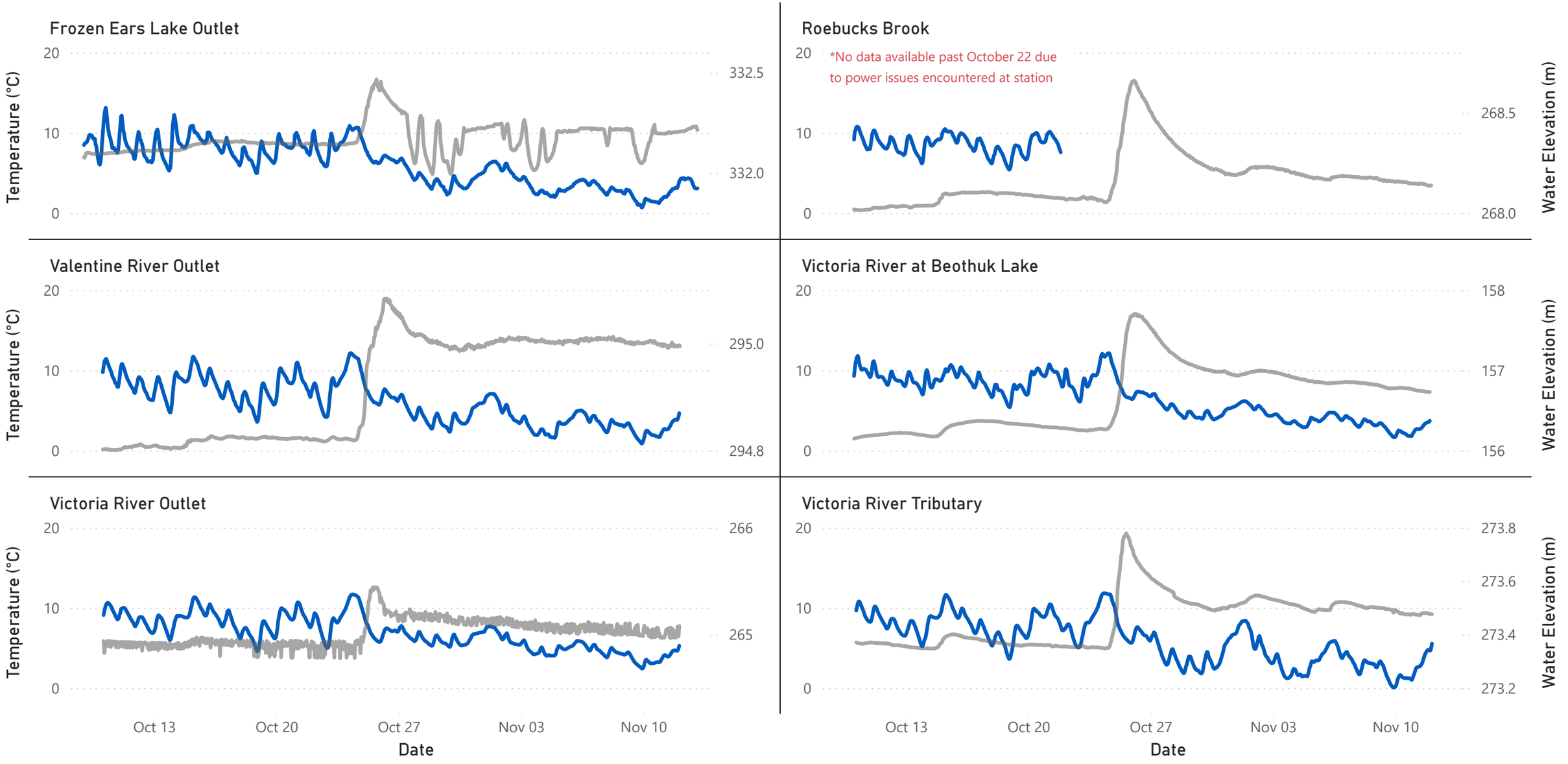
Water temperature is a critical parameter for wildlife, as many organisms cannot regulate their own body temperatures and instead depend on surrounding air and water conditions. Water temperature can be influenced by industrial inputs or alterations to natural environments, such as the removal of trees and vegetation, which eliminates the protective canopy they provide. Additionally, water temperature impacts other monitored parameters, including dissolved oxygen and specific conductivity.

Water temperatures were consistent throughout the deployment period, with a slight decreasing trend observed throughout the network. This trend would be expected as the season transitions from fall to winter. A natural daily cycle was also observed, with higher temperatures during the day and lower temperatures at night. Medians are comparable at all stations, except for Roebucks Brook which can be attributed to the lack of data throughout the second half of the deployment period when water temperatures were lower.

# Water Temperature Station Graphs

Temperature (°C) and Water Elevation (m)

● Temperature (°C) ● Water Elevation (m)



# pH

Newfoundland Labrador

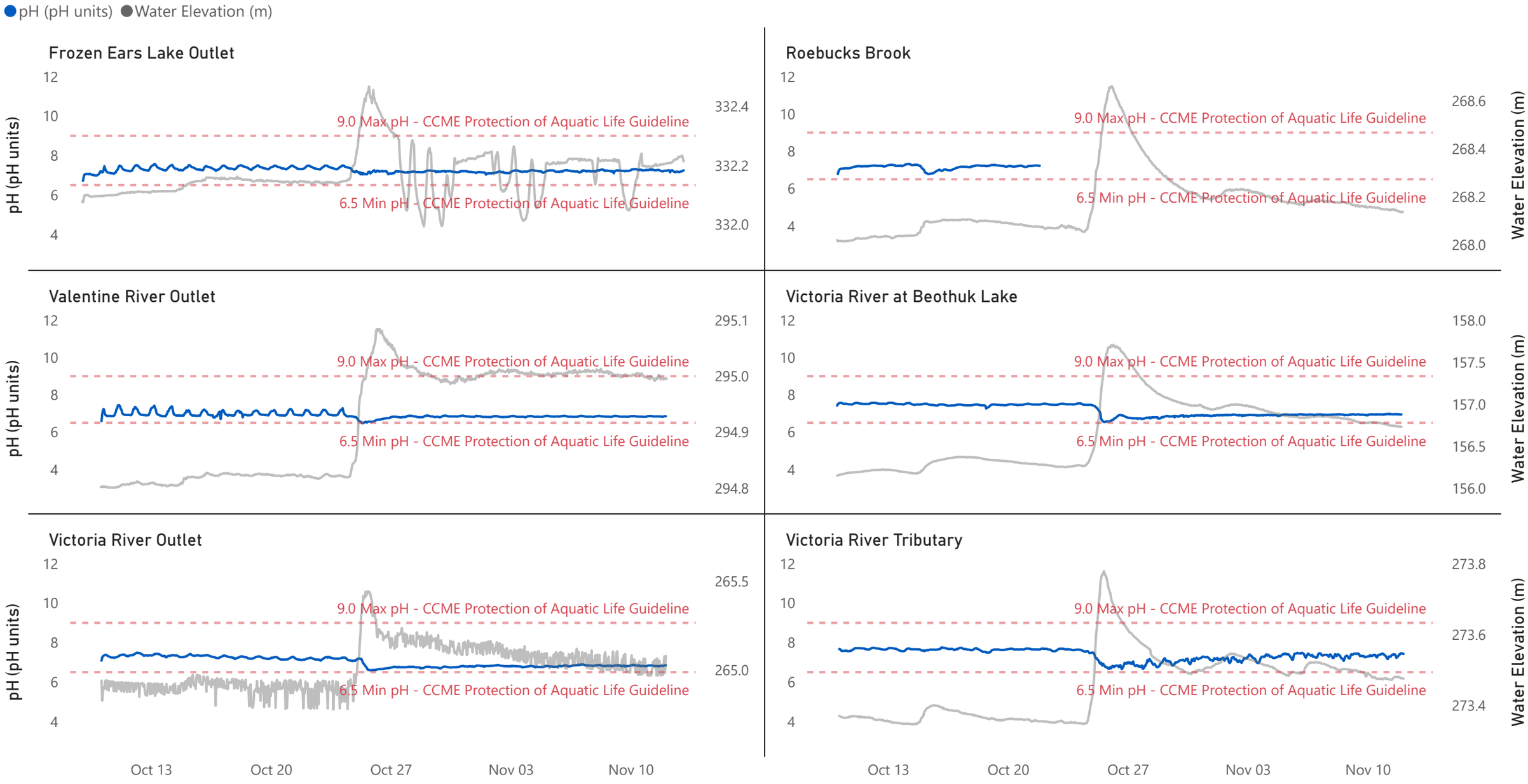
**Deployment Period Statistics (pH Units)**

| Station Name | Minimum | Maximum | Average | Median |
|---|---|---|---|---|
| Frozen Ears Lake Outlet | 6.72 | 7.57 | 7.26 | 7.24 |
| Roebucks Brook | 6.78 | 7.32 | 7.16 | 7.20 |
| Valentine River Outlet | 6.47 | 7.45 | 6.90 | 6.86 |
| Victoria River at Beothuk Lake | 6.54 | 7.57 | 7.16 | 6.95 |
| Victoria River Outlet | 6.60 | 7.49 | 7.01 | 6.85 |
| Victoria River Tributary | 6.65 | 7.75 | 7.38 | 7.42 |

pH relates to the free hydrogen ions in water, and it is a measure of acidity in water. pH is a critical parameter because it influences the solubility of minerals and chemicals, the availability of nutrients, and the biological processes that occur in aquatic ecosystems. The Canadian Council of Ministers of the Environment (CCME) Freshwater Aquatic Life guideline provides a basis by which to judge the overall health of the brook. Their freshwater guidelines recommend a minimum pH of 6.5 and a maximum pH of 9.0; however, many rivers in Newfoundland and Labrador are naturally more acidic due to the local geology.

pH at all stations remained within the CCME Guidelines for the Protection of Aquatic Life throughout the deployment period, except for a very brief dip below 6.5 pH units at Valentine River Outlet. pH remained relatively stable, with small fluctuations likely resulting from precipitation events. Rainwater, with its naturally lower pH, temporarily dilutes the water column, causing a short-term decrease in pH. However, pH levels typically return to baseline within a few days to weeks. Substantial decreases in pH can be observed around October 25th at all stations, coinciding with a water elevation increase and can be attributed to a significant precipitation event that occurred at the same time. pH levels slowly started rising back to background levels within the weeks to follow.

# pH Station Graphs



# Specific Conductivity

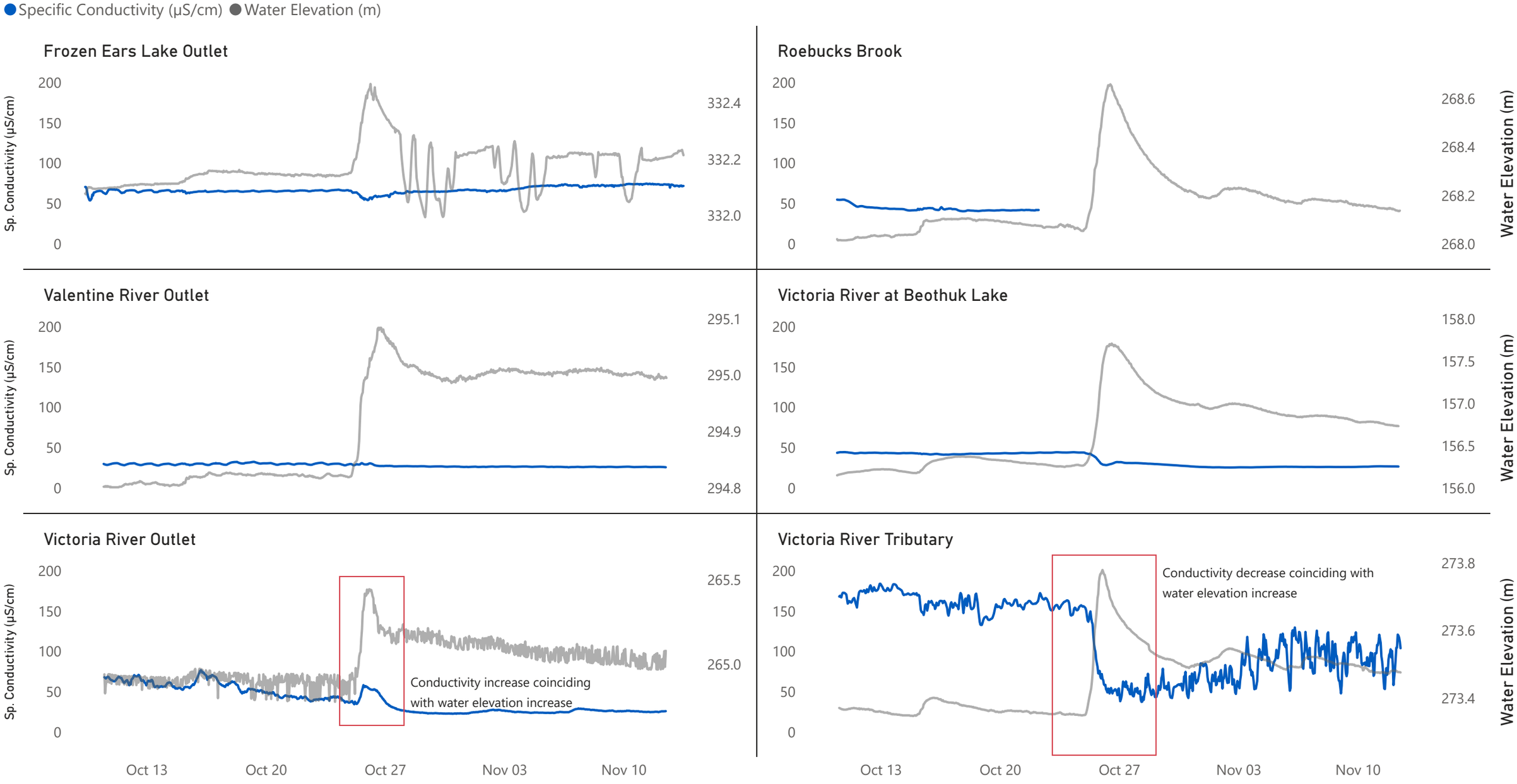
Newfoundland Labrador

| Deployment Period Statistics (µS/cm) | | | | |
|---|---|---|---|---|
| **Station Name** | **Minimum** | **Maximum** | **Average** | **Median** |
| **Frozen Ears Lake Outlet** | **53.70** | **74.58** | **66.81** | **65.77** |
| **Roebucks Brook** | **40.35** | **54.82** | **43.55** | **42.42** |
| **Valentine River Outlet** | **25.50** | **32.27** | **27.94** | **27.17** |
| **Victoria River at Beothuk Lake** | **25.29** | **44.39** | **34.42** | **30.84** |
| **Victoria River Outlet** | **22.59** | **76.71** | **39.40** | **34.96** |
| **Victoria River Tributary** | **37.31** | **184.07** | **115.55** | **114.00** |

Specific conductivity is a common indicator of the concentration of dissolved ions in water, such as salts, acids, and bases. Higher concentrations of dissolved ions result in higher specific conductivity, while pure water exhibits low conductivity. Specific conductivity is often affected by precipitation. During precipitation events, rainwater can temporarily dilute the water column, resulting in a short-term decrease in conductivity. However, high precipitation events can also cause a temporary increase in conductivity if sediment from the bottom of the waterbody is disturbed around the sensor or if runoff carrying dissolved ions enters the water column.

Across all stations, specific conductivity is relatively stable throughout the deployment period. Conductivity is slightly more variable at Victoria River Outlet and Victoria River Tributary. Conductivity decreases at Frozen Ears Lake Outlet, Victoria River at Beothuk Lake and Victoria River Tributary around October 25th, which can be attributed to increased water elevation from a precipitation event. Conductivity increased at Victoria River Outlet from that same precipitation event due to the location of the sonde in the water body. The Victoria River Outlet is located near a large embankment, which likely contributes to runoff entering the waterbody close to the sonde's placement in the river. Furthermore, the sonde is positioned in a soft, muddy substrate, making it more susceptible to increased disturbance during precipitation events. This location may account for the observed increases in conductivity during elevation increases, as runoff introduces additional dissolved ions into the water column.

# Specific Conductivity Station Graphs



# Dissolved Oxygen

Newfoundland Labrador

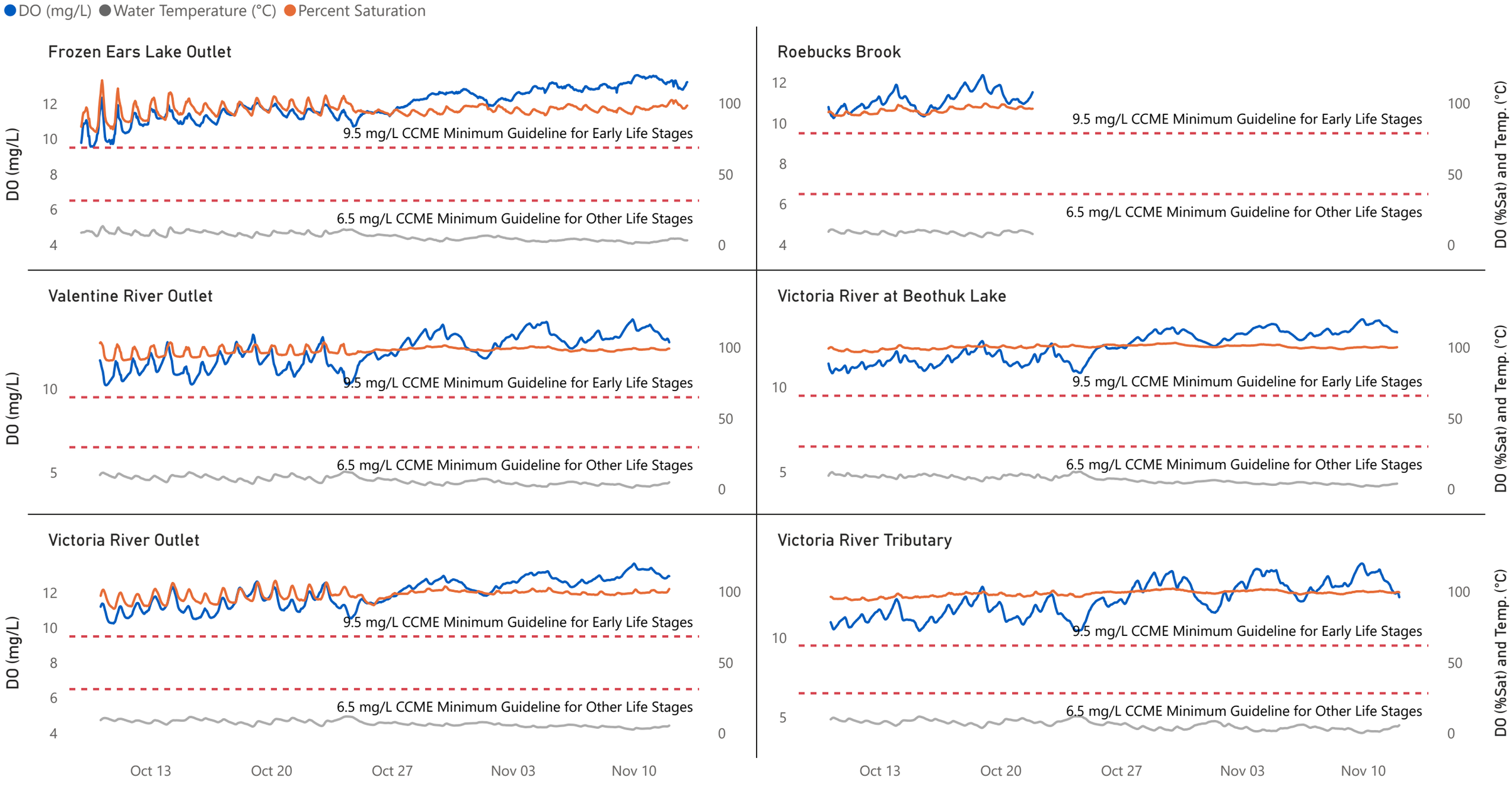
## Deployment Period Statistics

| Station Name | Minimum (mg/L) | Minimum (% Sat.) | Maximum (mg/L) | Maximum (% Sat.) | Average (mg/L) | Average (% Sat.) | Median (mg/L) | Median (% Sat.) |
|---|---|---|---|---|---|---|---|---|
| Frozen Ears Lake Outlet | 9.53 | 79.80 | 13.61 | 116.40 | 11.97 | 95.64 | 11.87 | 95.60 |
| Roebucks Brook | 10.25 | 91.20 | 12.37 | 99.90 | 11.15 | 95.31 | 11.10 | 95.50 |
| Valentine River Outlet | 10.22 | 90.80 | 14.18 | 103.80 | 12.27 | 97.94 | 12.27 | 98.40 |
| Victoria River at Beothuk Lake | 10.83 | 96.70 | 14.01 | 103.40 | 12.40 | 100.44 | 12.43 | 100.50 |
| Victoria River Outlet | 10.24 | 88.00 | 13.65 | 107.80 | 11.98 | 98.05 | 12.06 | 98.80 |
| Victoria River Tributary | 10.43 | 93.70 | 14.66 | 102.30 | 12.40 | 98.72 | 12.31 | 99.10 |

Dissolved oxygen (DO) is crucial for supporting aquatic life, and the CCME (Canadian Council of Ministers of the Environment) Freshwater Aquatic Life guidelines establish reference values to evaluate waterway health. The minimum DO guideline is 9.5 mg/L for early life stages in cold water species and 6.5 mg/L for other life stages. DO concentrations can fluctuate due to factors such as water temperature, atmospheric pressure, and the presence of other dissolved substances. Warmer water typically holds less dissolved oxygen than cooler water.

Throughout the deployment period, daily variations in DO levels were observed at all stations, primarily influenced by temperature fluctuations and the respiration of aquatic plants. There is a slight increasing trend in the DO concentration data at all stations which coincides with decreasing water temperatures. An evident inverse relationship was identified between DO levels and water temperature as can be seen on the station graphs on the following page. Throughout the deployment, DO levels at all stations stayed above the CCME guideline for the protection of other life stages (6.5 mg/L) and the guideline for early life stages (9.5 mg/L). At several stations, a noticeable reduction in variability of percent saturation levels occurred after a precipitation event on October 25th. After precipitation, when water levels rise, the larger volume of water becomes less sensitive to air temperature changes, resulting in more stable temperatures. Since water temperature and DO levels are inversely related, the stabilization of temperature helps reduce fluctuations in DO concentration, leading to more stable percent saturation.

# Dissolved Oxygen Station Graphs



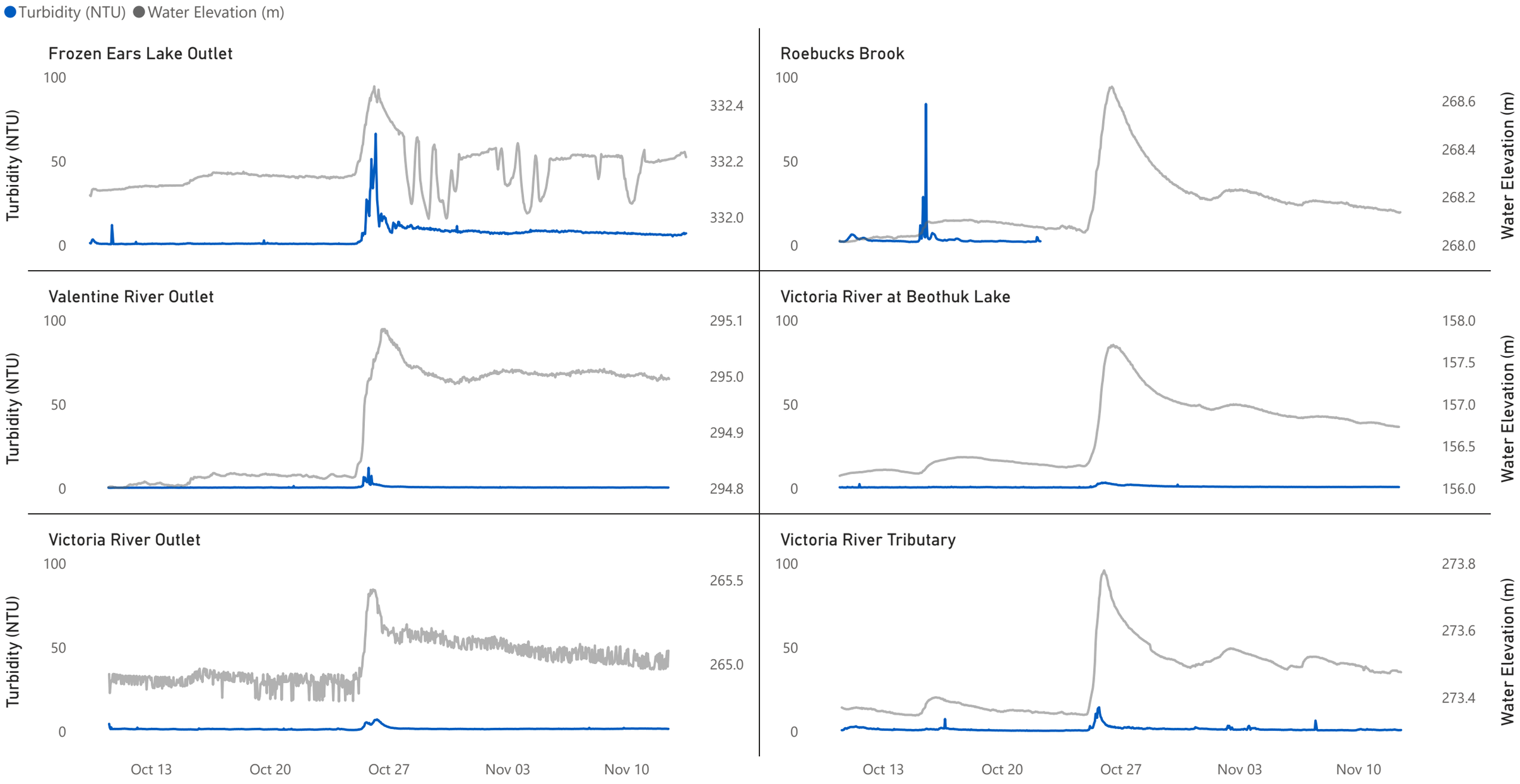
# Turbidity

| Deployment Period Statistics (NTU) | | | | |
|---|---|---|---|---|
| **Station Name** | **Minimum** | **Maximum** | **Average** | **Median** |
| **Frozen Ears Lake Outlet** | **0.47** | **66.28** | **5.40** | **6.33** |
| **Roebucks Brook** | **1.83** | **83.98** | **3.34** | **2.42** |
| **Valentine River Outlet** | **0.22** | **12.15** | **0.58** | **0.45** |
| **Victoria River at Beothuk Lake** | **0.36** | **3.39** | **0.85** | **0.75** |
| **Victoria River Outlet** | **0.81** | **7.10** | **1.56** | **1.43** |
| **Victoria River Tributary** | **0.32** | **14.31** | **1.33** | **1.02** |

Turbidity, a measure of water cloudiness, often increases during precipitation events as runoff carries silt and debris into the waterbody. High turbidity values can reduce light penetration for aquatic plants, disrupt benthic habitats and potentially harm fish gills or damage monitoring equipment.

Throughout the deployment period, turbidity levels remained consistently low at all stations, indicating clear and pristine water conditions. Medians were comparable at all stations except for Frozen Ears Lake Outlet which had a slightly higher median. In general, water elevation increases associated with precipitation events led to temporary turbidity spikes. There was a substantial precipitation event on October 25th that resulted in turbidity spikes at all stations, however turbidity values returned to background levels within the days that followed. Roebucks Brook also experienced a turbidity spike around October 15th which coincides with a precipitation event.

# Turbidity Station Graphs



# Water Elevation

Newfoundland Labrador

| Deployment Period Statistics (m) | | | | |
|---|---|---|---|---|
| **Station Name** | **Minimum** | **Maximum** | **Average** | **Median** |
| **Frozen Ears Lake Outlet** | **331.99** | **332.47** | **332.17** | **332.15** |
| **Roebucks Brook** | **268.01** | **268.66** | **268.17** | **268.15** |
| **Valentine River Outlet** | **294.80** | **295.08** | **294.92** | **294.99** |
| **Victoria River at Beothuk Lake** | **156.15** | **157.71** | **156.67** | **156.77** |
| **Victoria River Outlet** | **264.78** | **265.44** | **265.02** | **265.00** |
| **Victoria River Tributary** | **273.35** | **273.78** | **273.46** | **273.48** |

WRMD transitioned from reporting stage values to water elevation in Fall 2024. Water elevation provides an estimate of the water level at a monitoring station and plays a vital role in analyzing trends in water quality data, particularly for parameters such as specific conductivity, pH, and turbidity. Water elevation generally rises during precipitation events as rainwater and runoff enter the water column. By monitoring water elevation alongside precipitation events, we can better interpret our data, distinguish whether an elevation increase is caused by rainfall or potential industrial activities, and assess its impact on water quality. Precipitation data was obtained from the Calibre Mining (Marathon Gold) meteorological (MET) station, which is located on-site and maintained collaboratively by WRMD and Calibre Mining.

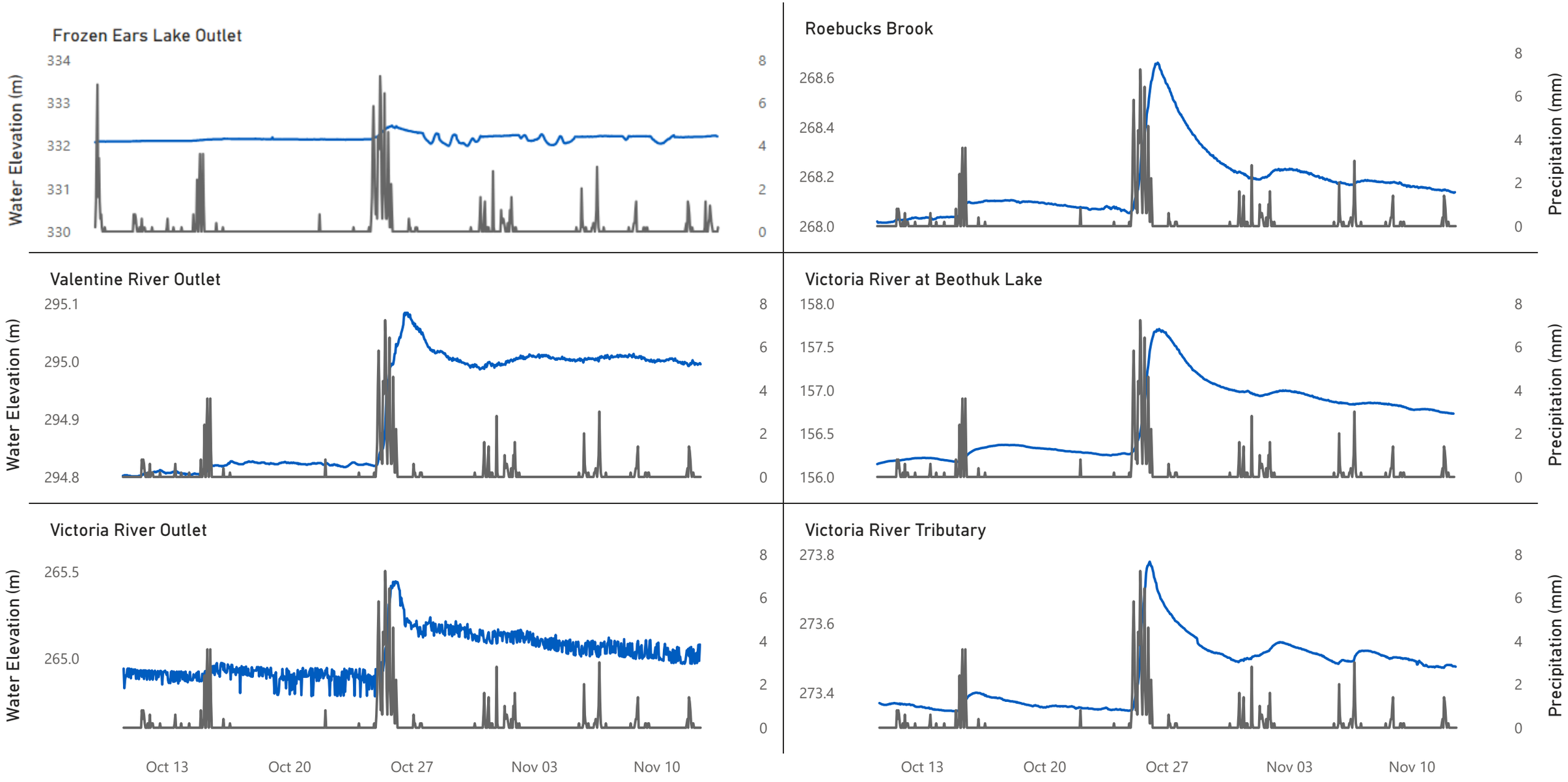
Water elevation at all six stations fluctuated throughout the deployment period. The station graphs on the following page demonstrates the effect of precipitation events on elevation, showing distinct elevation spikes occurring during or shortly after rainfall. The precipitation event on October 25th caused water elevation to increase and remain elevated for the rest of the deployment period, although levels were slowly decreasing.

Water elevation at Victoria River Outlet fluctuates more frequently due to an upstream dam where flow is regulated. Water elevation data at Frozen Ears Lake Outlet displays periodic dips throughout remainder of the deployment period.

# Water Elevation Station Graphs

Newfoundland Labrador

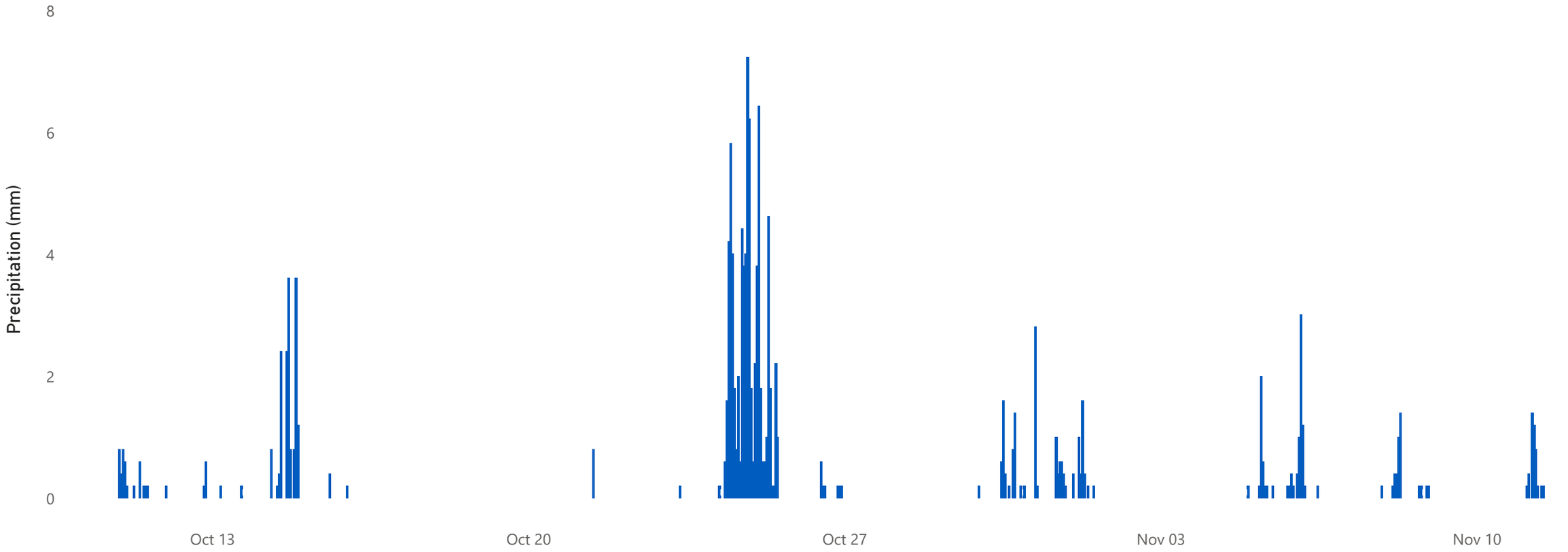
● Water Elevation (m) ● Precipitation (mm)



# Precipitation Data

## Retrieved from the Calibre Mining (Marathon Gold) MET Station

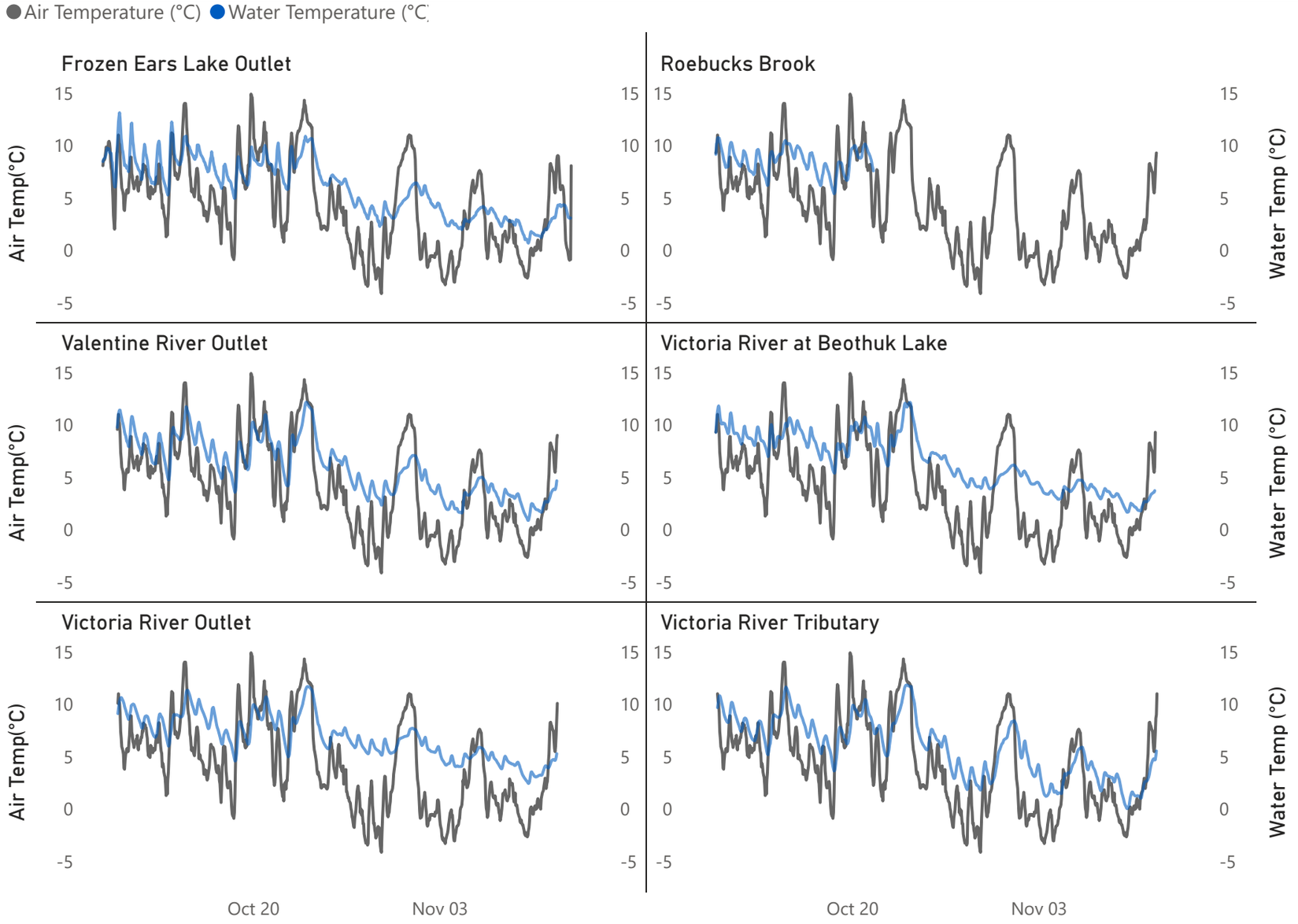
| 0.18 | 0.00 | 0.00 | 7.24 | 137.28 |
|---|---|---|---|---|
| Average (mm/hr) | Minimum (mm/hr) | Median (mm/hr) | Maximum (mm/hr) | Total Precip. (mm) |

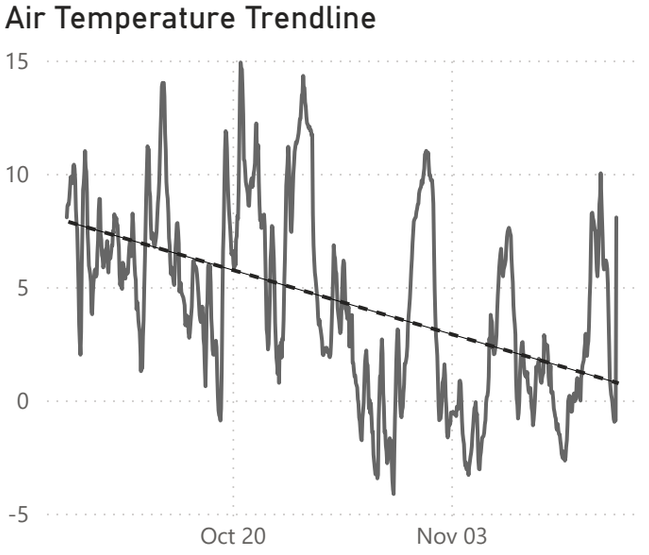


# Air Temperature Data

## Retrieved from the Calibre Mining (Marathon Gold) MET Station

Newfoundland Labrador




| 4.24 | 3.89 |
|---|---|
| Average (°C) | Median (°C) |
| -4.14 | 14.91 |
| Minimum (°C) | Maximum (°C) |