

Real Time Water Quality Deployment Report

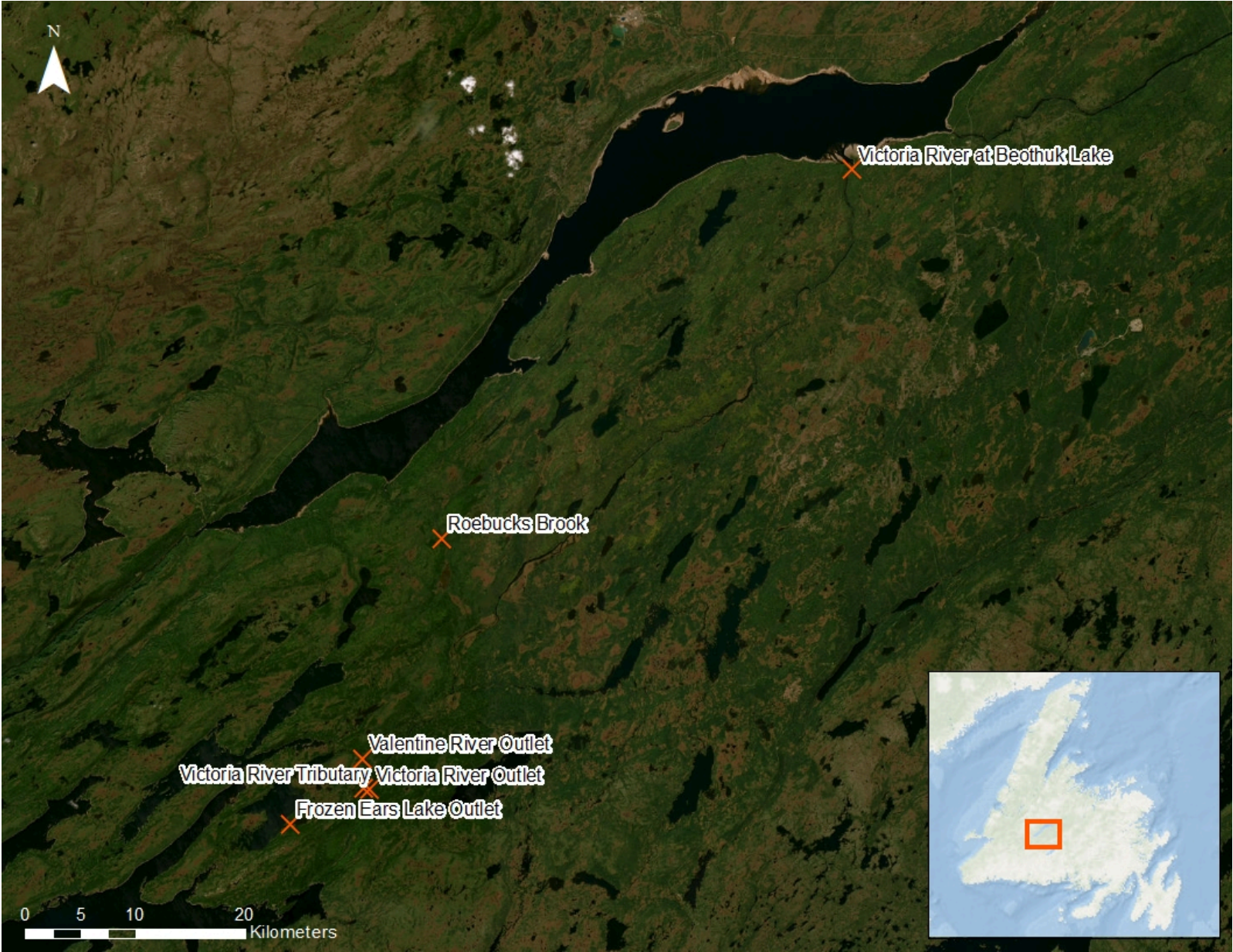
Calibre Mining: Valentine Gold Mine Network

2024-07-24 to 2024-09-10



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 on Beothuk Lake, Roebucks Brook at Access Road, Valentine River Outlet, Victoria River Tributary, Victoria River Outlet, and Frozen Ear 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 2024-07-24 to 2024-09-10.

Station Name	Station Number	Latitude	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	$\leq \pm 0.2$ units	$\leq \pm 0.21 - 0.5$ units	$\leq \pm 0.51 - 0.8$ units	$\leq \pm 0.81 - 1$ units	$> \pm 1$ units
Water Temperature	$\leq \pm 0.2^{\circ}\text{C}$	$\leq \pm 0.21 - 0.5^{\circ}\text{C}$	$\leq \pm 0.51 - 0.8^{\circ}\text{C}$	$\leq \pm 0.81 - 1^{\circ}\text{C}$	$> \pm 1^{\circ}\text{C}$
Dissolved oxygen	$\leq \pm 0.3$ mg/L	$\leq \pm 0.31 - 0.5$ mg/L	$\leq \pm 0.51 - 0.8$ mg/L	$\leq \pm 0.81 - 1$ mg/L	$> \pm 1$ mg/L
Turbidity	$\leq \pm 2$ turbidity units or $\leq \pm 5\%$, whichever is greater	$\leq \pm 2.1-5$ turbidity units or $\leq \pm 5.1-10\%$, whichever is greater	$\leq \pm 5.1-8$ turbidity units or $\leq \pm 10.1-15\%$, whichever is greater	$\leq \pm 8.1-10$ turbidity units or $\leq \pm 15.1-20\%$, whichever is greater	$> \pm 10$ turbidity units or $> \pm 20\%$, whichever is greater
Specific Conductance	$\leq \pm 3$ $\mu\text{S}/\text{cm}$ or $\leq \pm 3\%$, whichever is greater	$\leq \pm 3.1-10$ $\mu\text{S}/\text{cm}$ or $\leq \pm 3.1-10\%$, whichever is greater	$\leq \pm 10 - 15$ $\mu\text{S}/\text{cm}$ or $\leq \pm 10.1-15\%$, whichever is greater	$\leq \pm 15.1 - 20$ $\mu\text{S}/\text{cm}$ or $\leq \pm 15.1-20\%$, whichever is greater	$> \pm 20$ $\mu\text{S}/\text{cm}$ or $> \pm 20\%$, 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.

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, the rankings at each station all ranged between excellent to good, except for pH at Roebucks Brook and temperature at Victoria River at Beothuk Lake which ranked fair. Given the pH sensor on the instrument at Roebucks Brook failed midway through the deployment - the fair ranking is related to deteriorating performance of the sensor. The fair ranking for temperature at Victoria River at Beothuk Lake can likely be associated with the placement of the QAQC sonde compared to the field sonde and/or the amount of time each sonde was given to stabilize before readings were recorded.

Upon removal, all parameters ranked excellent or good except for dissolved oxygen at Victoria River Outlet. The fair ranking at Victoria River Outlet is likely associated with placement of the QAQC sonde or time given for each sonde to stabilize. There is no ranking for pH at Roebucks Brook because the pH sensor failed on the field instrument mid-way through the deployment period.

Grab sample rankings ranged between excellent to good, except for pH at Victoria River Outlet which ranked fair. The fair ranking at Victoria River Outlet is likely a result of differences in the sampling location/depth compared to the field sonde or insufficient equilibration time for the field sonde before taking initial measurements.

QAQC Rankings

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

Water Temperature



Deployment Period Statistics (°C)				
Station Name	Minimum	Maximum	Average	Median
Frozen Ears Lake Outlet	10.14	32.01	19.68	19.26
Roebucks Brook	9.93	29.11	18.47	18.17
Valentine River Outlet	12.22	28.61	19.97	19.77
Victoria River at Beothuk Lake	12.96	28.13	20.29	19.96
Victoria River Outlet	14.20	27.24	20.12	19.80
Victoria River Tributary	11.66	24.27	18.25	18.11

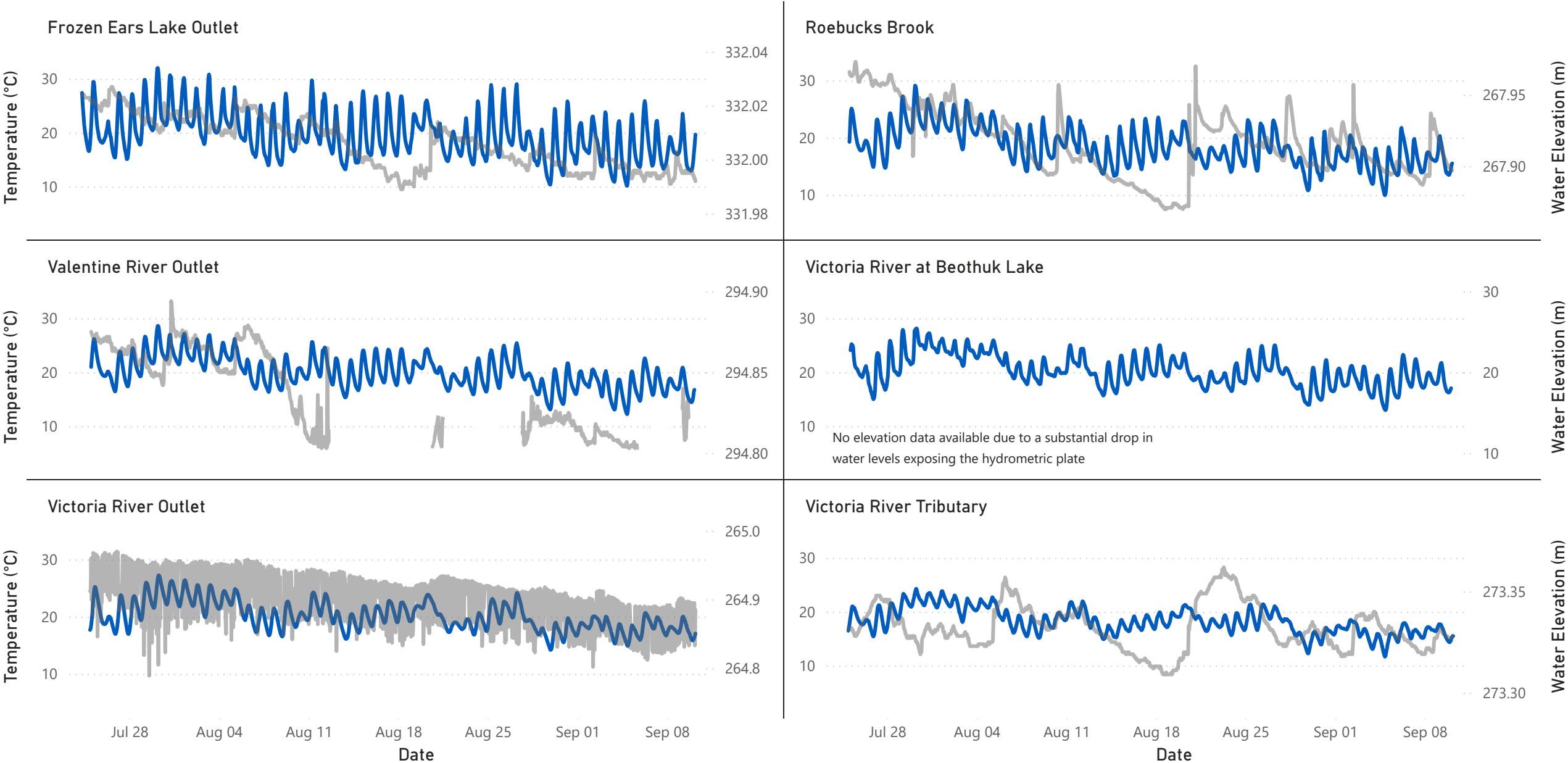
Water temperature is a critical parameter for wildlife, as many organisms cannot regulate their own body temperatures and instead depend on surrounding air and water conditions. Water temperature can be influenced by industrial inputs or alterations to natural environments, such as the removal of trees 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. A natural daily cycle was also observed, with higher temperatures during the day and lower temperatures at night. Median values at all stations were very close in range.

Water Temperature Station Graphs

Temperature (°C) and Water Elevation (m)

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



Deployment Period Statistics (pH Units)				
Station Name	Minimum	Maximum	Average	Median
Frozen Ears Lake Outlet	6.92	8.53	7.41	7.29
Roebucks Brook	7.08	7.49	7.21	7.19
Valentine River Outlet	7.11	7.92	7.36	7.31
Victoria River at Beothuk Lake	7.22	7.77	7.46	7.44
Victoria River Outlet	6.81	7.61	7.23	7.25
Victoria River Tributary	7.57	8.05	7.91	7.92

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.

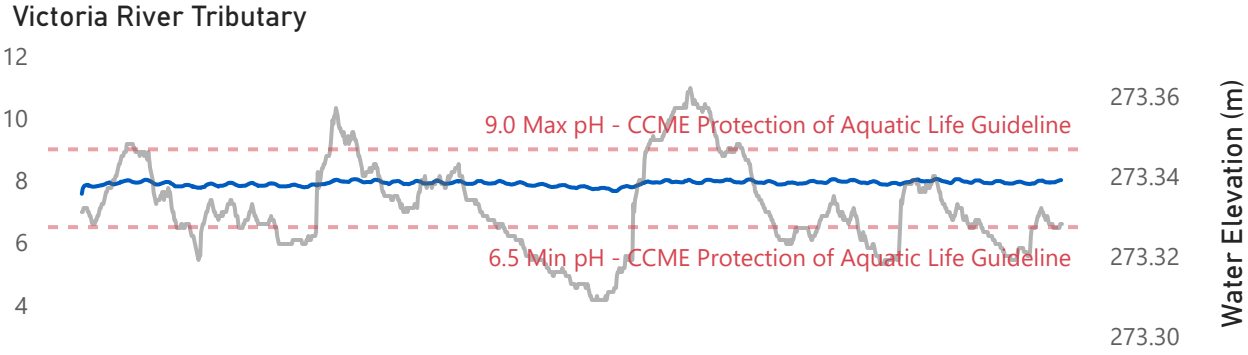
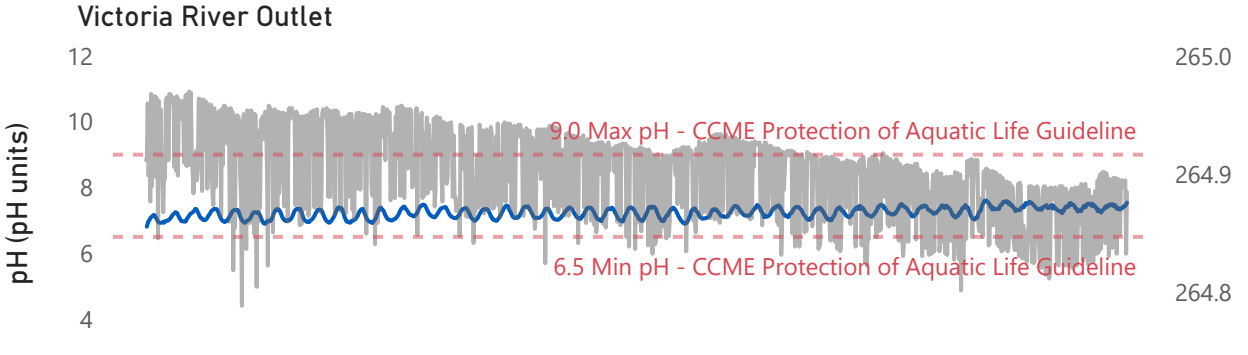
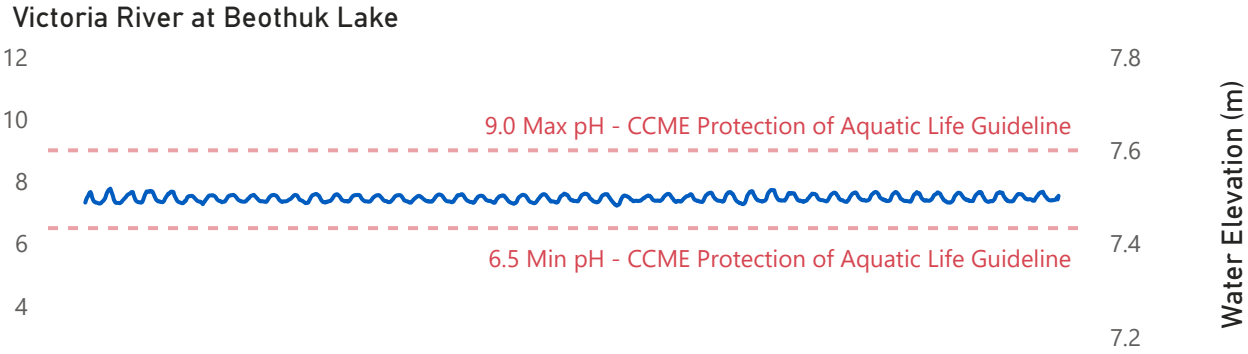
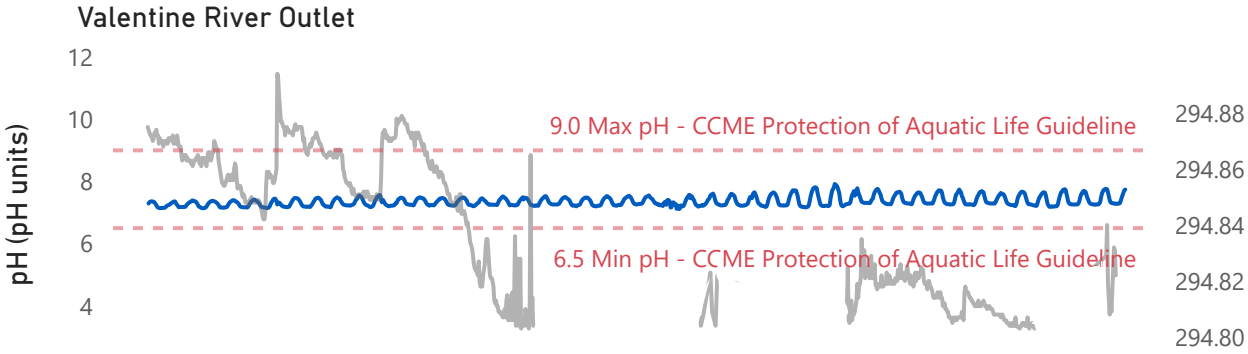
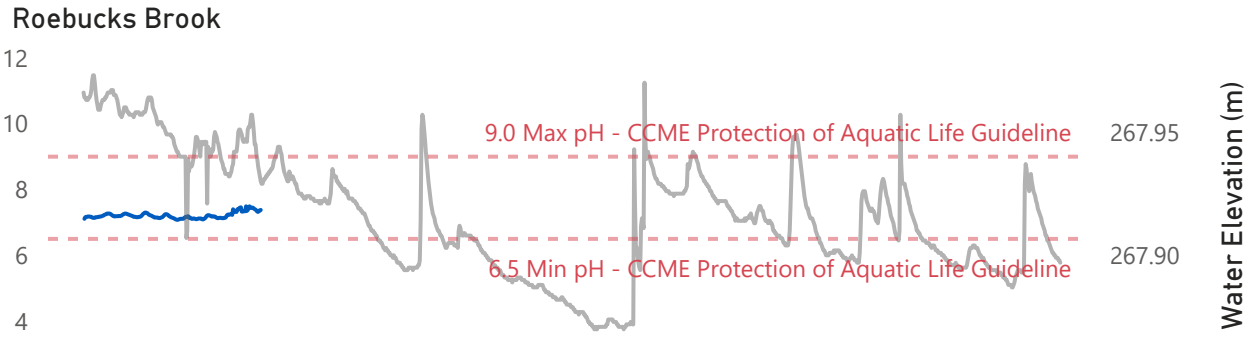
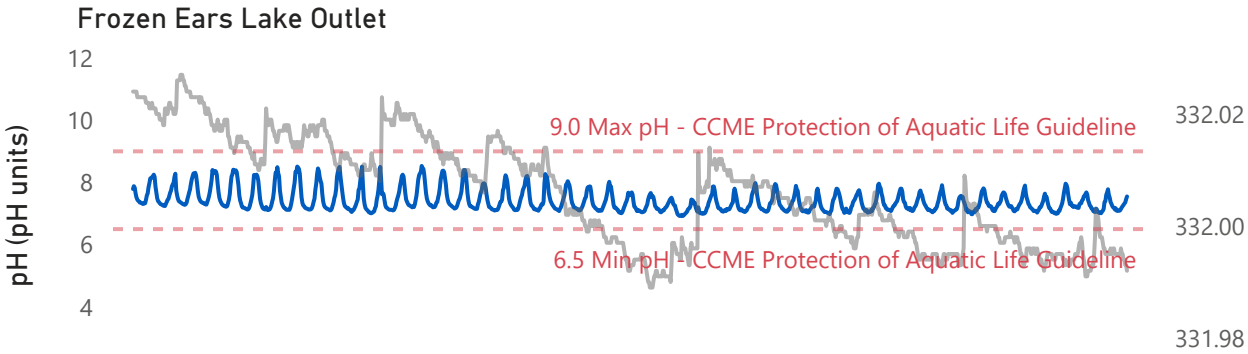
pH at all six stations remained within the CCME Guidelines for the Protection of Aquatic Life throughout the deployment period. pH remained generally stable, with small fluctuations likely being attributed to precipitation events. Rainwater, with its naturally lower pH, temporarily dilutes the water column, causing a short-term decrease in pH. However, pH levels typically return to baseline within a few days.

The instrument deployed at Roebucks Brook station experienced pH sensor failure on August 2, with erratic and erroneous values of up to 15 pH units being reported. This data was removed from the dataset.

pH Station Graphs



● pH (pH units) ● Water Elevation (m)



Jul 28 Aug 04 Aug 11 Aug 18 Aug 25 Sep 01 Sep 08

Jul 28 Aug 04 Aug 11 Aug 18 Aug 25 Sep 01 Sep 08

Specific Conductivity

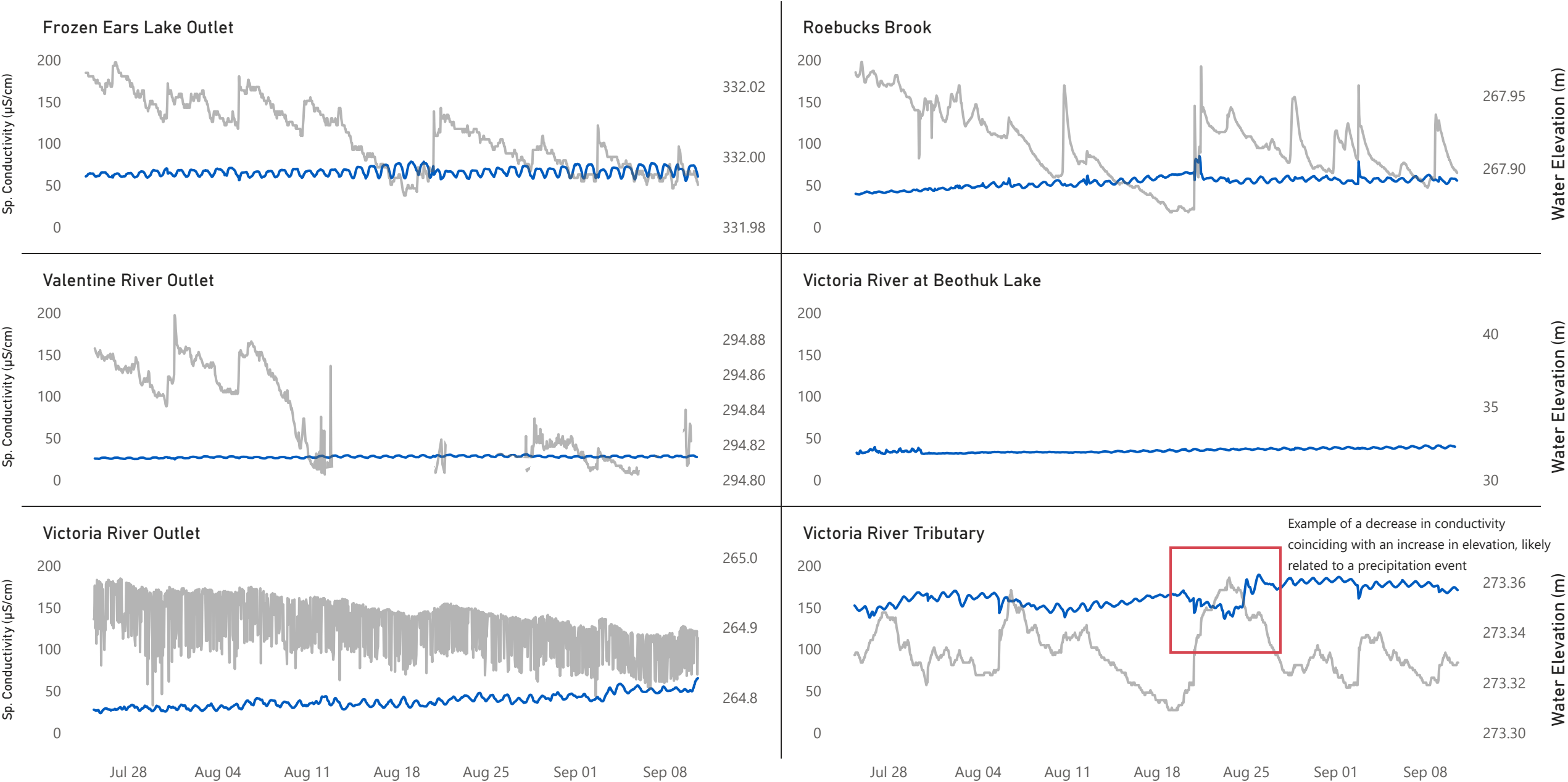
Station Name	Deployment Period Statistics (µS/cm)			
	Minimum	Maximum	Average	Median
Frozen Ears Lake Outlet	55.38	78.24	66.12	66.09
Roebucks Brook	38.88	84.95	53.51	54.49
Valentine River Outlet	24.61	30.47	27.51	27.43
Victoria River at Beothuk Lake	30.90	41.17	35.29	34.95
Victoria River Outlet	23.37	65.25	37.92	36.96
Victoria River Tributary	136.75	189.31	163.84	162.95

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 six stations, conductivity data displays a slight increase as water levels decrease throughout the deployment period. This trend can be explained by rising air temperatures, which lead to water evaporation and result in a higher concentration of dissolved ions remaining in the water. Fluctuations in conductivity are more often than not related to precipitation events. Background conductivity levels at Victoria River Tributary were slightly higher this deployment period compared to the other stations. This could be attributed to decreased water levels.

Specific Conductivity Station Graphs

● Specific Conductivity (μS/cm) ● Water Elevation (m)



Dissolved Oxygen

Station Name	Deployment Period Statistics							
	Minimum (mg/L)	Minimum (% Sat.)	Maximum (mg/L)	Maximum (% Sat.)	Average (mg/L)	Average (% Sat.)	Median (mg/L)	Median (% Sat.)
Frozen Ears Lake Outlet	3.83	42.80	12.31	148.60	7.99	88.02	7.74	80.70
Roebucks Brook	6.45	69.40	10.86	107.10	8.57	91.06	8.62	90.80
Valentine River Outlet	7.64	93.10	10.78	104.50	8.92	97.78	8.90	97.20
Victoria River at Beothuk Lake	7.54	86.00	10.81	114.90	9.17	101.18	9.20	101.10
Victoria River Outlet	7.31	84.00	10.61	117.30	8.92	98.24	8.97	97.90
Victoria River Tributary	7.02	80.60	10.62	100.20	8.63	91.38	8.68	91.50

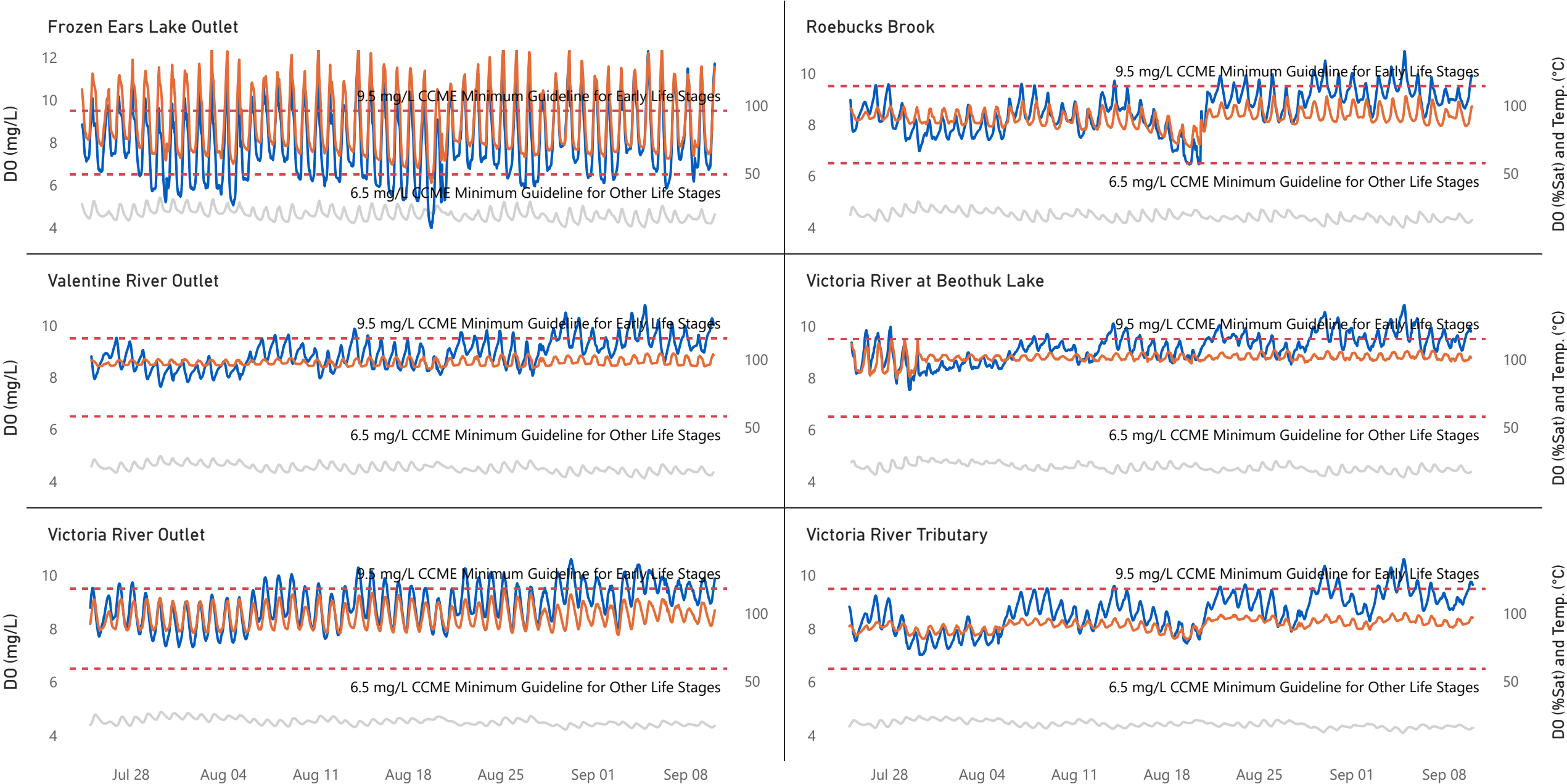
Dissolved oxygen (DO) is crucial for supporting aquatic life, and the CCME (Canadian Council of Ministers of the Environment) Freshwater Aquatic Life guidelines establish reference values to evaluate waterway health. The minimum DO guideline is 9.5 mg/L for early life stages in cold water species and 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 six stations, primarily influenced by temperature fluctuations and the respiration of aquatic plants. An evident inverse relationship was identified between DO levels and water temperature as can be seen on the station graphs on the following page. During the deployment period, DO levels generally remained above the CCME guideline for the protection of other life stages (6.5mg/L) at all stations except for Frozen Ears Lake Outlet station. DO levels were below the CCME guideline for the protection of early life stages (9.5mg/L) for the majority of the first half of the deployment period, but started to peak above the minimum guideline value of 9.5 mg/L more frequently in the later half of the period.

The Frozen Ears Lake Outlet station is an exposed area with no vegetation cover, characterized by shallow, slow-moving water, and is particularly sensitive to air temperature changes. Additionally, DO at this station may be influenced by reduced aeration and/or stagnant pools of water due to low water levels, as well as potentially significant biological activity during the summer. These conditions lead to significant pronounced diurnal variations in DO levels, as illustrated in the figure on the next page.

Dissolved Oxygen Station Graphs

● DO (mg/L) ● Water Temperature (°C) ● Percent Saturation



Turbidity

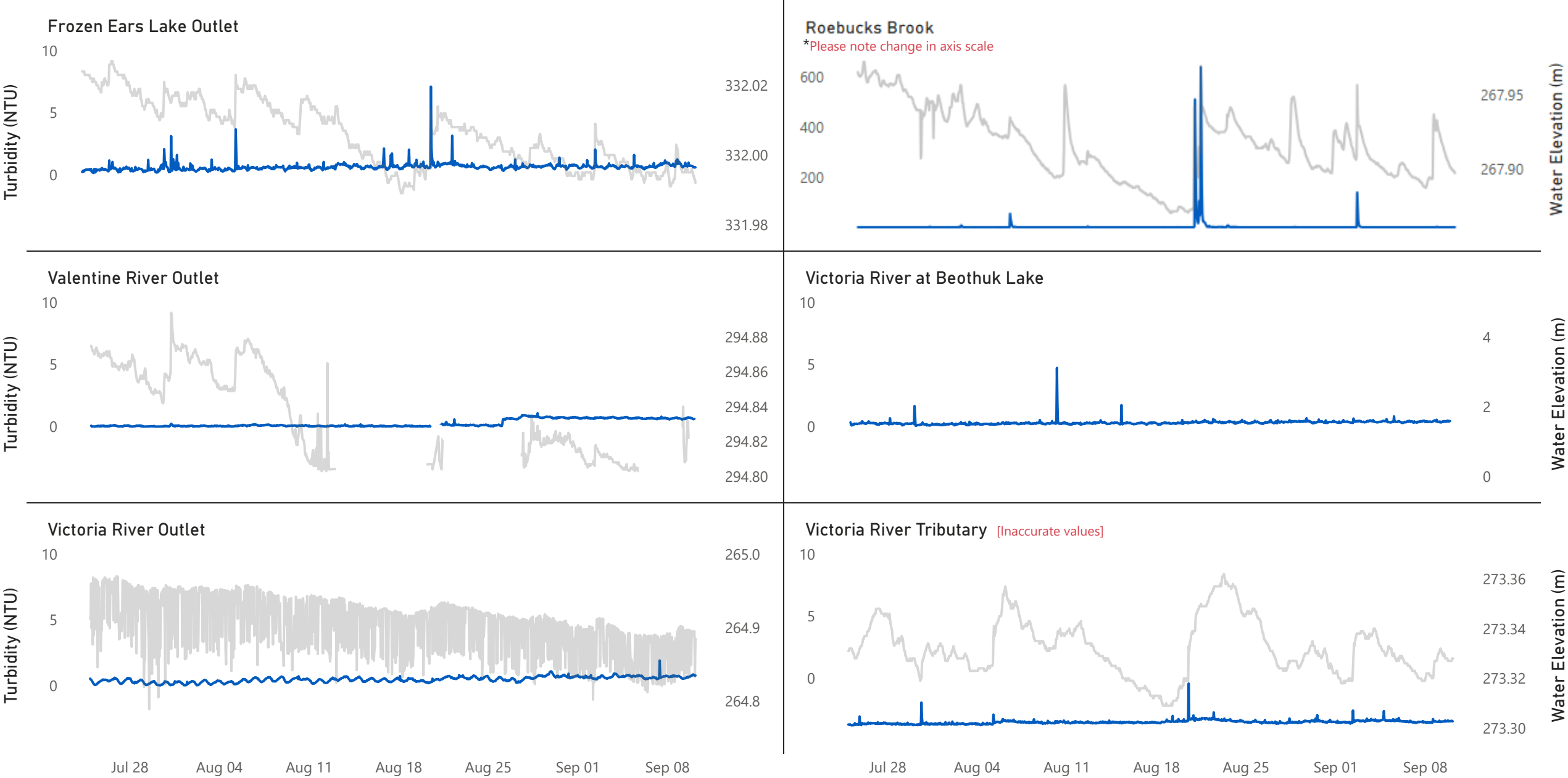
Deployment Period Statistics (NTU)				
Station Name	Minimum	Maximum	Average	Median
Frozen Ears Lake Outlet	0.15	7.10	0.64	0.61
Roebucks Brook	0.16	637.68	3.47	0.63
Valentine River Outlet	0.00	1.07	0.29	0.10
Victoria River at Beothuk Lake	0.07	4.72	0.31	0.30
Victoria River Outlet	0.00	1.89	0.46	0.47
Victoria River Tributary <small>[Inaccurate values]</small>	-3.79	-0.42	-3.52	-3.54

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 six stations, indicating clear and pristine water conditions. Medians were comparable at all stations except for Victoria River Tributary. Negative turbidity values, such as at Victoria River Tributary, occur when the water being measured has lower turbidity than the zero standards used during calibration. These values were kept in the dataset to monitor trends and investigate the relationship between turbidity and elevation however the values are inaccurate. In general, water elevation increases associated with precipitation events led to turbidity spikes. Background turbidity levels and spikes are slightly higher at Roebucks Brook due to the sonde's placement downstream of a bridge crossing a dirt access road. Turbidity spikes coincide with elevation increases from run-off from the access road, however values do return to background levels shortly after.

Turbidity Station Graphs

● Turbidity (NTU) ● Water Elevation (m)



Water Elevation



Deployment Period Statistics (m)				
Station Name	Minimum	Maximum	Average	Median
Frozen Ears Lake Outlet	331.99	332.03	332.01	332.01
Roebucks Brook	267.87	267.97	267.92	267.92
Valentine River Outlet	294.80	294.89	294.84	294.85
Victoria River Outlet	264.79	264.97	264.90	264.91
Victoria River Tributary	273.31	273.36	273.33	273.33

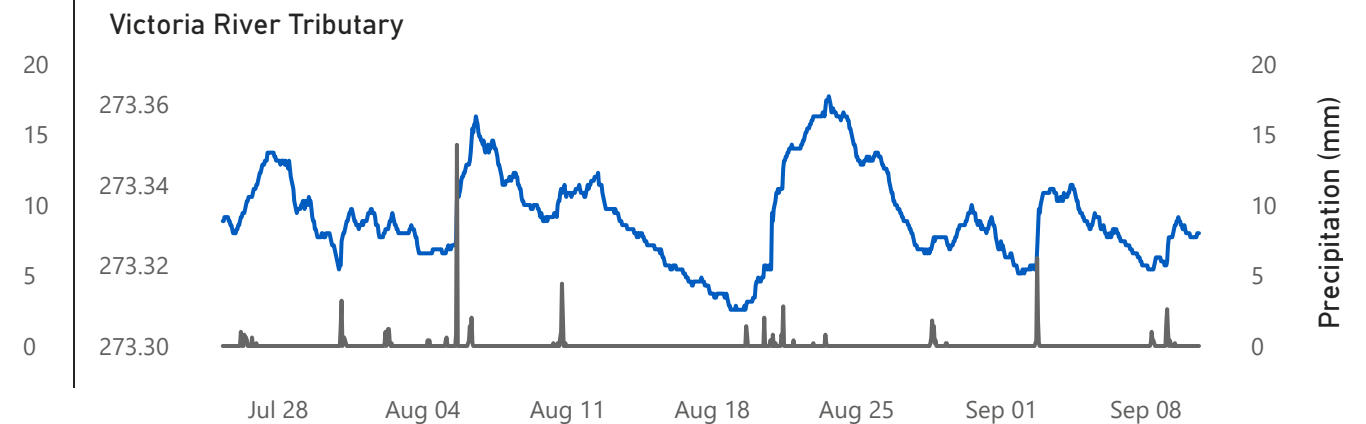
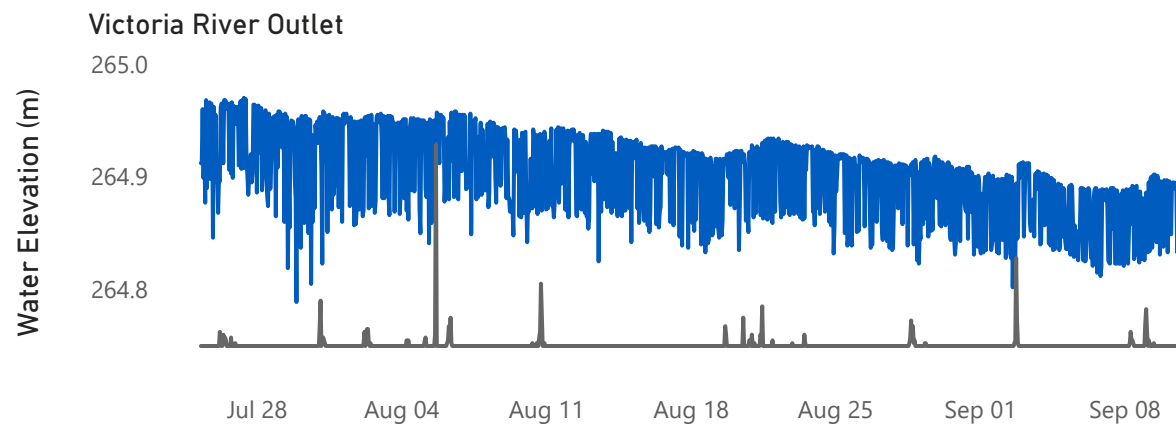
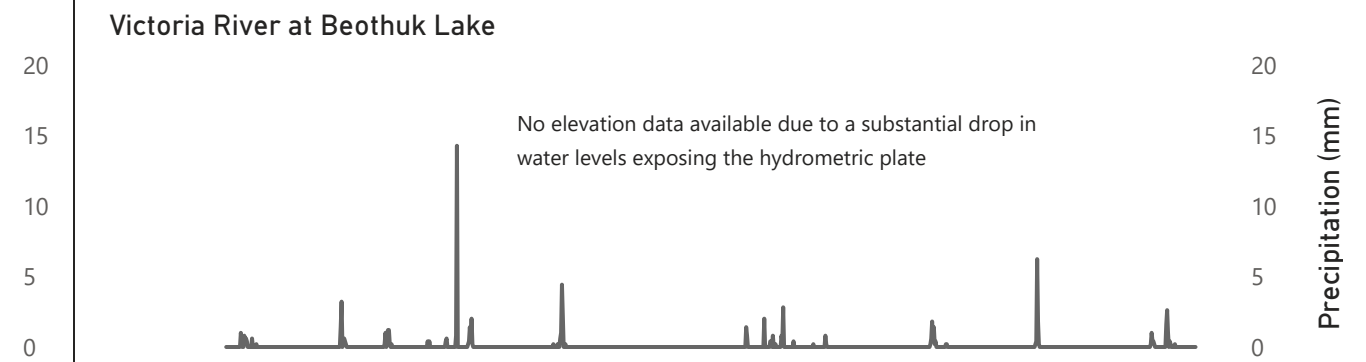
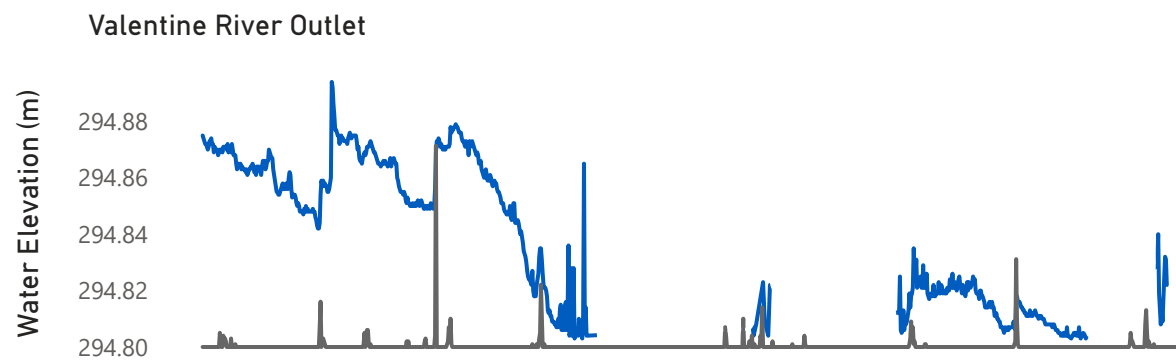
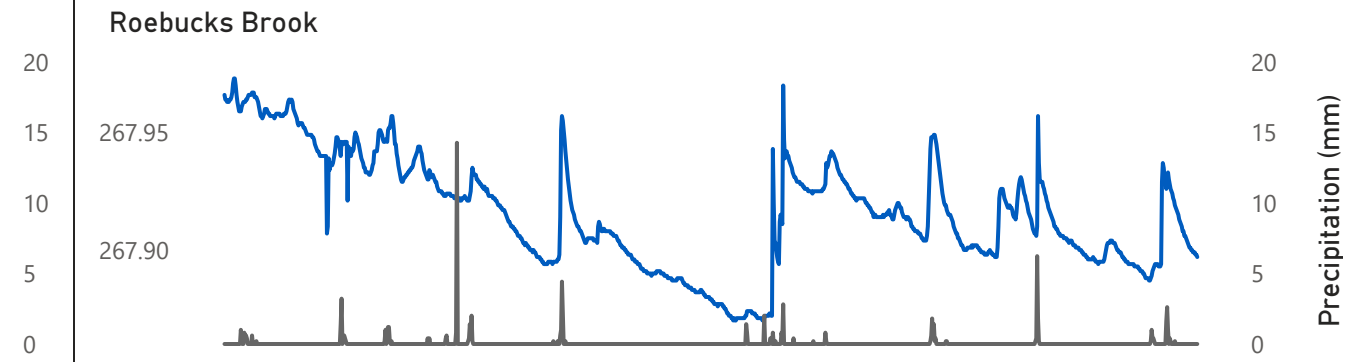
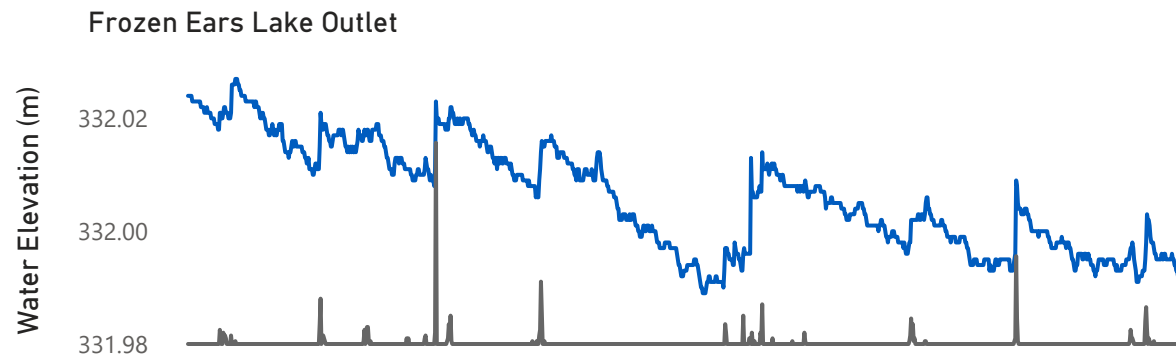
WRMD transitioned from reporting stage values to water elevation in Fall 2024. Water elevation provides an estimate of the water level at a monitoring station and plays a vital role in analyzing trends in water quality data, particularly for parameters such as specific conductivity, pH, and turbidity. Water elevation generally rises during precipitation events as rainwater and runoff enter the water column. By monitoring 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 generally showed a decreasing trend over the deployment period, which can be attributed to hot seasonal temperatures and lack of precipitation. 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.

Water elevation at Victoria River Outlet fluctuates more frequently due to an upstream dam where flow is regulated. There is no water elevation data for Victoria River at Beothuk Lake for this deployment period. Due to substantial drops in water elevation from when the station was installed in June 2024, the hydrometric plate was no longer submerged in the river. This will be addressed by repositioning the plate into a deeper section of the river next site visit. The inaccurate values were removed from the dataset. There is a gap in hydrometric data at Valentine River Outlet station due to lack of water exposing the hydrometric plate as well.

Water Elevation Station Graphs

● Water Elevation (m) ● Precipitation (mm)



Precipitation Data

Retrieved from the Calibre Mining (Marathon Gold) MET Station



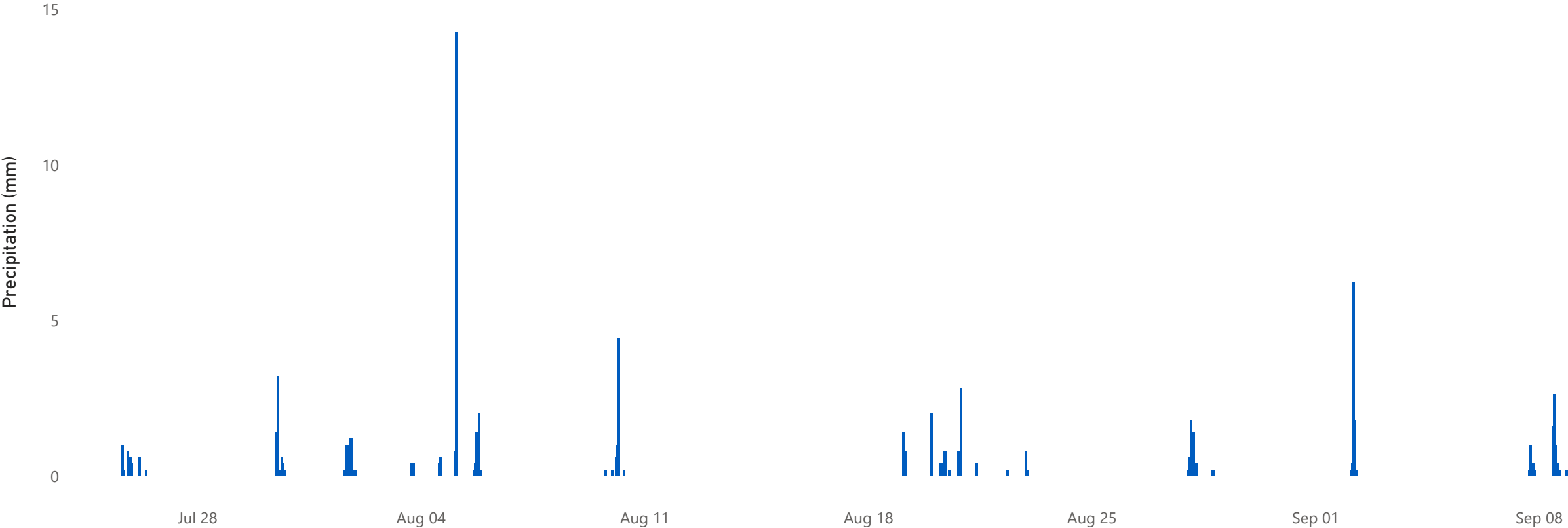
0.07
Average (mm/hr)

0.00
Minimum (mm/hr)

0.00
Median (mm/hr)

14.27
Maximum (mm/hr)

77.79
Total Precip. (mm)

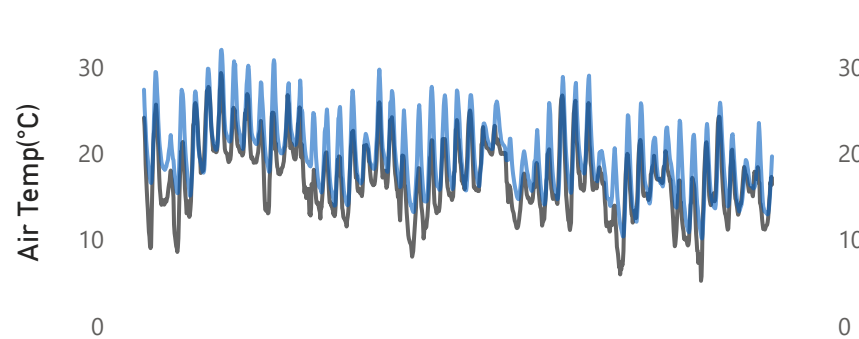


Air Temperature Data

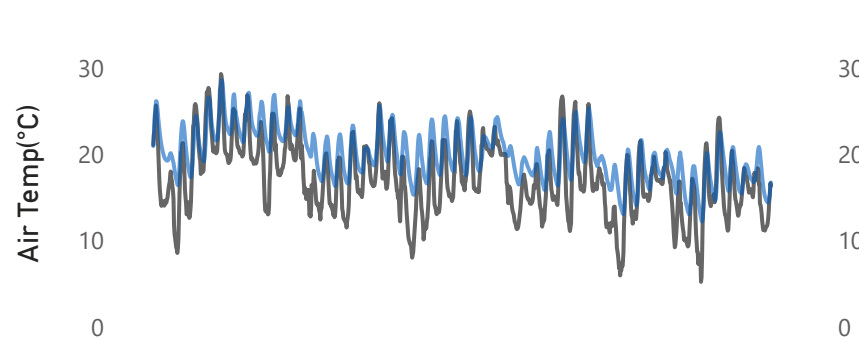
● Air Temperature (°C) ● Water Temperature (°C)

Retrieved from the Calibre Mining (Marathon Gold) MET Station

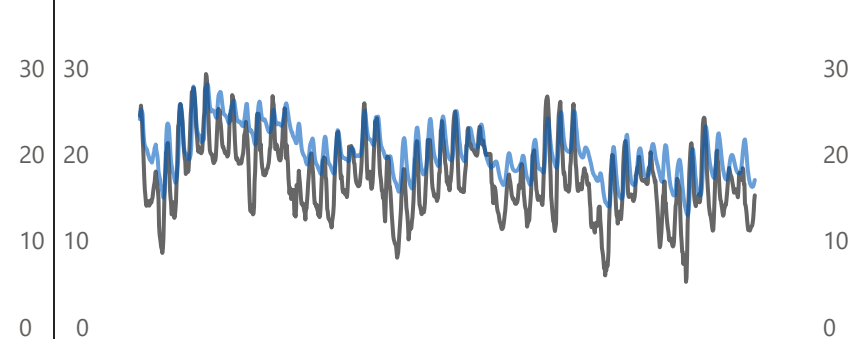
Frozen Ears Lake Outlet



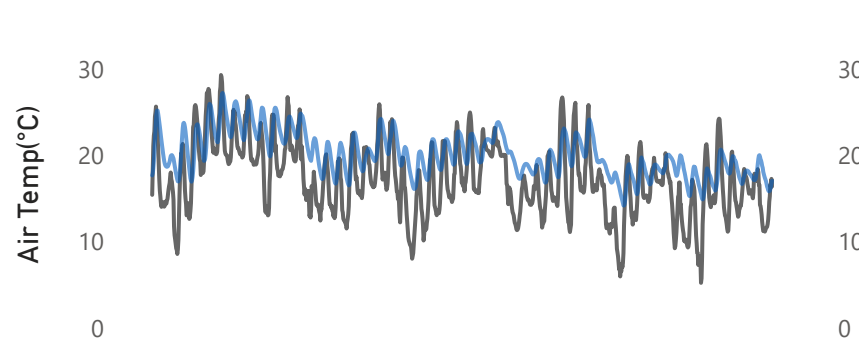
Valentine River Outlet



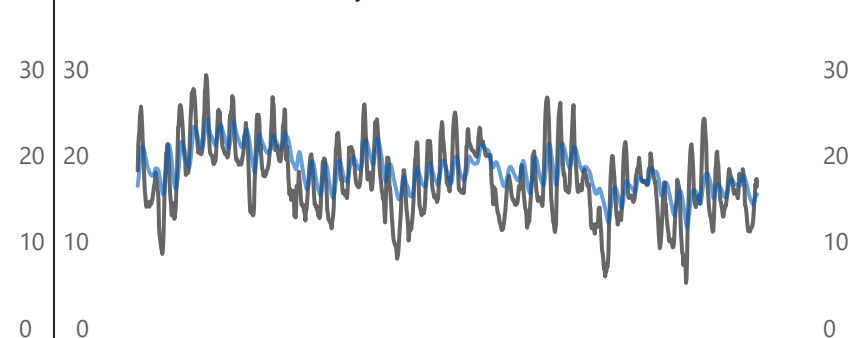
Victoria River at Beothuk Lake



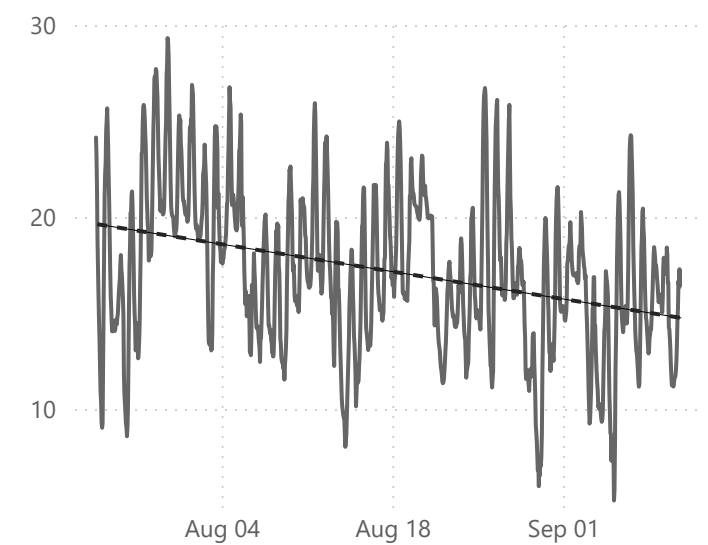
Victoria River Outlet



Victoria River Tributary



Air Temperature Trendline



17.20
Average (°C)

16.92
Median (°C)

5.23
Minimum (°C)

29.32
Maximum (°C)