



Real-Time Water Quality Report

Canada Fluorspar (NL) Inc, Real-Time Water Quality Stations

Deployment Period
August 6th, 2024 to August 26th, 2024



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

Prepared by:

Victoria Hollohan
Environmental Scientist
Water Resources Management Division
Department of Environment & Climate Change
4th Floor, Confederation Building, West Block
PO Box 8700, St. John's NL A1B 4J6
victoriahollohan@gov.nl.ca

General

The Water Resources Management Division (WRMD) maintains real-time water quality and water quantity monitoring stations in John Fitzpatrick Pond and on Outflow of Unnamed Pond south of Long Pond, within the site of Canada Fluorspar (NL) Inc, St. Lawrence, Newfoundland & Labrador.

Decommission of Outflow of Grebes Nest Pond

Due to a change in the water supply for Outflow to Grebes Nest Pond station, it was determined that this brook would not provide consistent water supply to remain a monitoring station. Outflow to Grebes Nest station was decommissioned in May 2022. Instrumentation was relocated to John Fitzpatrick Pond (Figure 1).

John Fitzpatrick Pond

The site was selected based on the location and consistent water supply throughout the year. It is expected to provide stable and beneficial water quality data for this site (Figure 1).

The Real Time station is established on the northwest bank of John Fitzpatrick Pond, close to the only outflow from the pond. This pond is surrounded by natural habitat on the northeast side, and on the southwest side bordered by the CFI mine (Figure 1). There are two small brooks that periodically flow into this pond. This station will monitor the water quality and the stage level of the pond. The instrument is deployed, at a depth of approximately 1.0 meter. The GPS coordinates for this site are as follows: N 46° 54' 47.95" W 055° 27' 46.97" (Figure 1).



Figure 1: Real-Time Station at John Fitzpatrick Pond. Station hut (left) and instrument deployed in pond (right)

Outflow of Unnamed Pond south of Long Pond

The Outflow of Unnamed Pond south of Long Pond is established downstream of the Tailings Management Facility (TMF). This station will provide near real-time water quality and quantity data to ensure emerging issues associated with the TMF are detected, to allow the appropriate mitigation measures to be implemented in a timely manner, thus reducing any adverse effect on the downstream systems.

The location of Outflow of Unnamed Pond south of Long Pond was selected due to accessibility to the brook and the sufficient pool available to place the water quality and quantity instruments (See Figure 2). The stream originates from a small unnamed pond and meanders through a marsh environment alongside the TMF. The stream is approximately 1.0 to 2.0 meters wide. Where the instrument is deployed, there is a depth of approximately 1.0 to 1.5 meters. The GPS coordinates for this site are as follows: **N46° 54' 14.1" W055° 26' 37.5"**. The station hut was placed on the right bank looking downstream approximately 8 meters from the stream (Figure 2).



Figure 2: Real-Time Water Quality and Quantity Station at Outflow of Unnamed Pond south of Long Pond. Station hut (left) and instrument deployed in brook (right).

Quality Assurance and Quality Control

WRMD staff are responsible for maintenance and calibration of the real-time water quality monitoring equipment, as well as recording and managing the water quality data. As part of the Quality Assurance and Quality Control protocol (QA/QC), an assessment of the reliability of data recorded by an instrument is conducted at the beginning and end of the deployment period. The procedure is based on the approach used by the United States Geological Survey.

During deployment and removal, a QA/QC Sonde is temporarily deployed adjacent to the Field Sonde. Based on the degree of difference between the parameters on the Field Sonde and QA/QC Sonde at deployment and at removal, a qualitative statement is made on the data quality (Table 1). Values for temperature, pH, conductivity, dissolved oxygen, and turbidity are compared between the two instruments (Table 2). Additionally, grab samples are collected during deployment to compare pH, specific conductivity and turbidity values between the field instrument and grab samples (Table 3).

Table 1: Instrument Performance Ranking classifications for deployment and removal

Parameter	Rank				
	Excellent	Good	Fair	Marginal	Poor
Temperature (°C)	$\leq \pm 0.2$	$> \pm 0.2$ to 0.5	$> \pm 0.5$ to 0.8	$> \pm 0.8$ to 1	$< \pm 1$
pH (unit)	$\leq \pm 0.2$	$> \pm 0.2$ to 0.5	$> \pm 0.5$ to 0.8	$> \pm 0.8$ to 1	$> \pm 1$
Sp. Conductance ($\mu\text{S}/\text{cm}$)	$\leq \pm 3$	$> \pm 3$ to 10	$> \pm 10$ to 15	$> \pm 15$ to 20	$> \pm 20$
Sp. Conductance $> 35 \mu\text{S}/\text{cm}$ (%)	$\leq \pm 3$	$> \pm 3$ to 10	$> \pm 10$ to 15	$> \pm 15$ to 20	$> \pm 20$
Dissolved Oxygen (mg/L) (% Sat)	$\leq \pm 0.3$	$> \pm 0.3$ to 0.5	$> \pm 0.5$ to 0.8	$> \pm 0.8$ to 1	$> \pm 1$
Turbidity < 40 NTU (NTU)	$\leq \pm 2$	$> \pm 2$ to 5	$> \pm 5$ to 8	$> \pm 8$ to 10	$> \pm 10$
Turbidity > 40 NTU (%)	$\leq \pm 5$	$> \pm 5$ to 10	$> \pm 10$ to 15	$> \pm 15$ to 20	$> \pm 20$

It's important to note that the temperature sensor on any sonde is crucial. All other parameters can be categorized into subgroups: temperature-dependent, temperature-compensated, and temperature-independent. Due to the temperature sensor's placement on the sonde, the entire sonde must be at a constant temperature before the temperature sensor stabilizes. The values may take some time to reach the appropriate reading; if a reading is taken too soon, it may not accurately represent the conditions of the water body.

Table 2: QA/QC vs. Field Instrument performance rankings

Station	Date	Action	Comparison Ranking				
			Temperature	pH	Conductivity	Dissolved Oxygen	Turbidity
John Fitzpatrick	August 6 th , 2024	Deployment	Excellent	Excellent	Good	Excellent	Excellent
	August 26 th , 2024	Removal	Good	Excellent	Excellent	Excellent	Excellent
Unnamed Pond	August 6 th , 2024	Deployment	Good	Excellent	Fair	Good	Excellent
	August 26 th , 2024	Removal	Good	Excellent	Excellent	Excellent	Fair

When comparing the field instrument to the QAQC instrument data, both stations ranked Excellent to Fair for all parameters upon deployment and removal. 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. The Fair ranking for turbidity upon removal at Unnamed Pond is likely attributed to biofouling that accumulated on the field instrument throughout the deployment.

Table 3: Grab sample vs. Field Instrument Comparison Rankings

Station	Date	Action	pH	Comparison Ranking	
				Conductivity	Turbidity
John Fitzpatrick	August 6 th , 2024	Deployment	Excellent	Fair	Excellent
Unnamed Pond	August 6 th , 2024	Deployment	Good	Excellent	Excellent

When comparing the field instrument to grab sample data, all parameters rank Excellent to Fair. 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.

Issues Encountered

The John Fitzpatrick Pond RTWQ station ceased transmissions on July 29, 2024. During a site visit on August 6, it was discovered that an animal had damaged the GPS cable. Although transmissions were interrupted, the instrument continued to log data internally throughout this time. The data presented in this report was recovered from the internal log file. No hydrometric data is available for this period. The station remained offline for this deployment period while awaiting a replacement GPS cable. Water quality and hydrometric measurements will transmit once the GPS cable is replaced during the next site visit.

During a site visit to the Outflow of Unnamed Pond South of Long Pond RTWQ station on August 26, a water level survey identified inaccuracies in the hydrometric plate's measurements. As a result, hydrometric data has been excluded from this report.

John Fitzpatrick Pond

Water Temperature

Water temperatures ranged from 18.29°C to 23.93°C during the deployment period, with an average of 19.99°C. A slight increasing trend was observed throughout this deployment period, but temperatures generally stayed stable. A natural diurnal pattern was observed, with warmer temperatures during daylight hours and cooler temperatures at night (Figure 3).

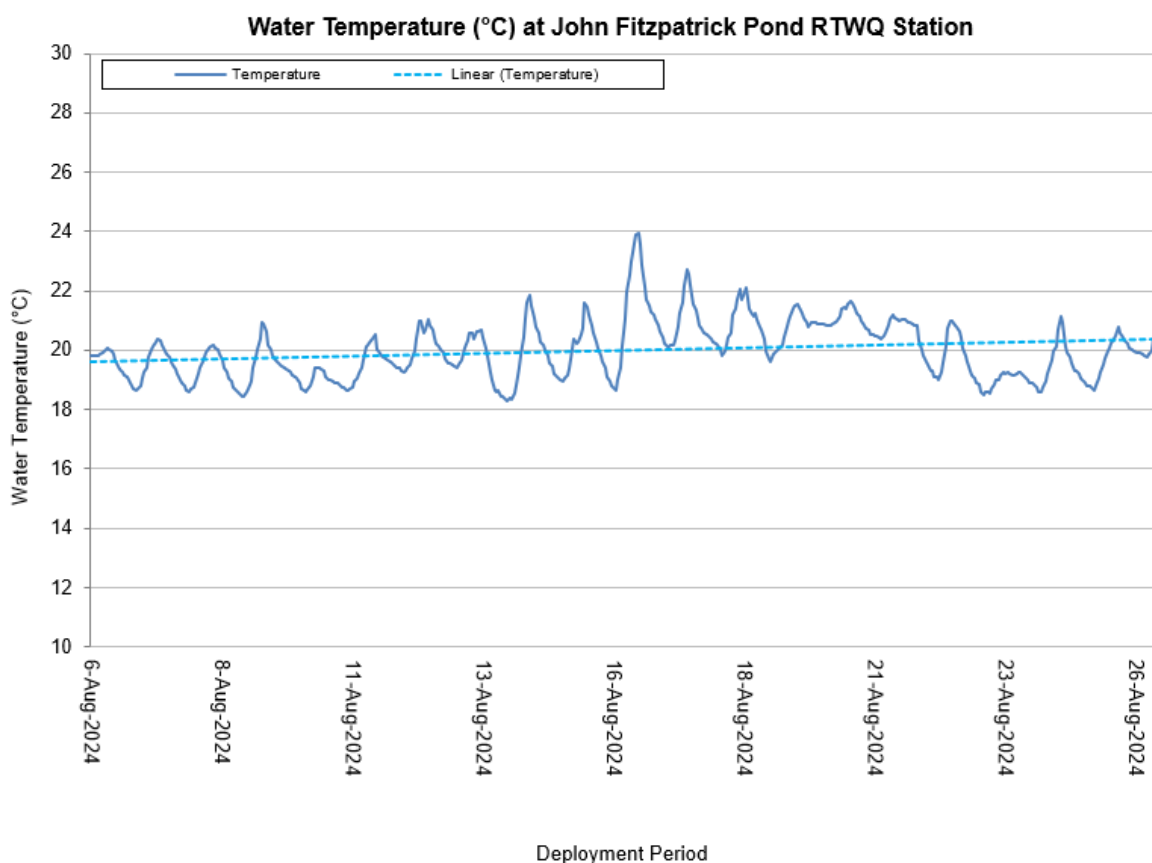


Figure 3: Water temperature at John Fitzpatrick Pond RTWQ Station (°C)

pH

Throughout the deployment period, pH values ranged from 7.42 to 8.43, with an average of 8.17 (Figure 4). The pH levels remained stable and consistent, with only minor fluctuations attributed to precipitation events.

A pH sensor measures the acidity or alkalinity of a water body. 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. Most aquatic organisms have a preferred pH range for optimal growth and survival, and deviations from this range can have significant ecological implications. The pH data at John Fitzpatrick Pond remained within the Canadian Council of Ministers of the Environment (CCME) guidelines of 6.5-9.0 pH units for the protection of aquatic life for the duration of the deployment period (Figure 4).

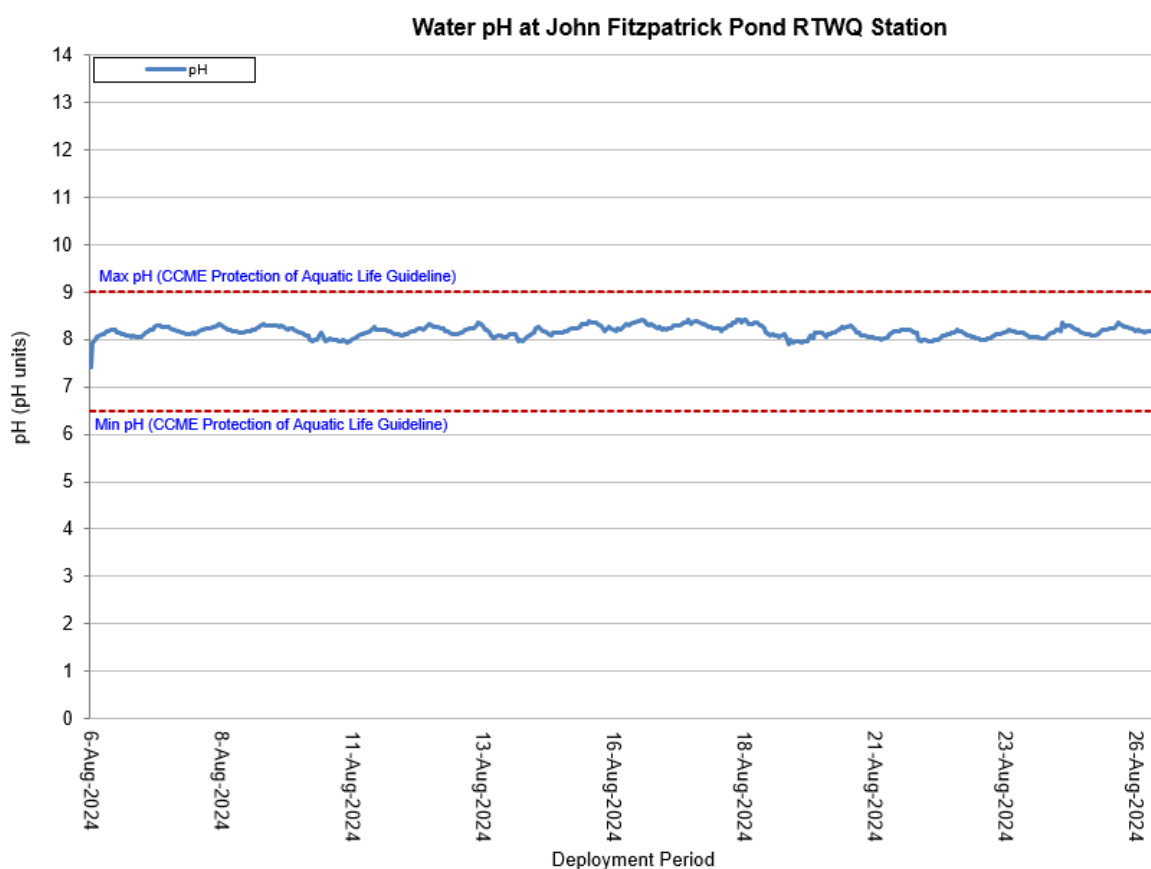


Figure 4: pH (pH units) values at John Fitzpatrick Pond RTWQ Station

Specific Conductivity

The specific conductivity levels were within 175.3 $\mu\text{S}/\text{cm}$ and 194.2 $\mu\text{S}/\text{cm}$ during this deployment period, with an average of 190.42 $\mu\text{S}/\text{cm}$ (Figure 5). Conductivity remained stable across the deployment period, with small periodic dips. Dips in conductivity levels coincide with precipitation events (Appendix I). The rain dilutes the water column for a short period of time, which reduces the concentration of any suspended particles or diluted salts.

Specific conductivity is commonly used as an indicator of the concentration of dissolved ions in water. These ions can include electrolytes like salts, acids, and bases. The higher the concentration of dissolved ions, the higher the specific conductivity of the water.

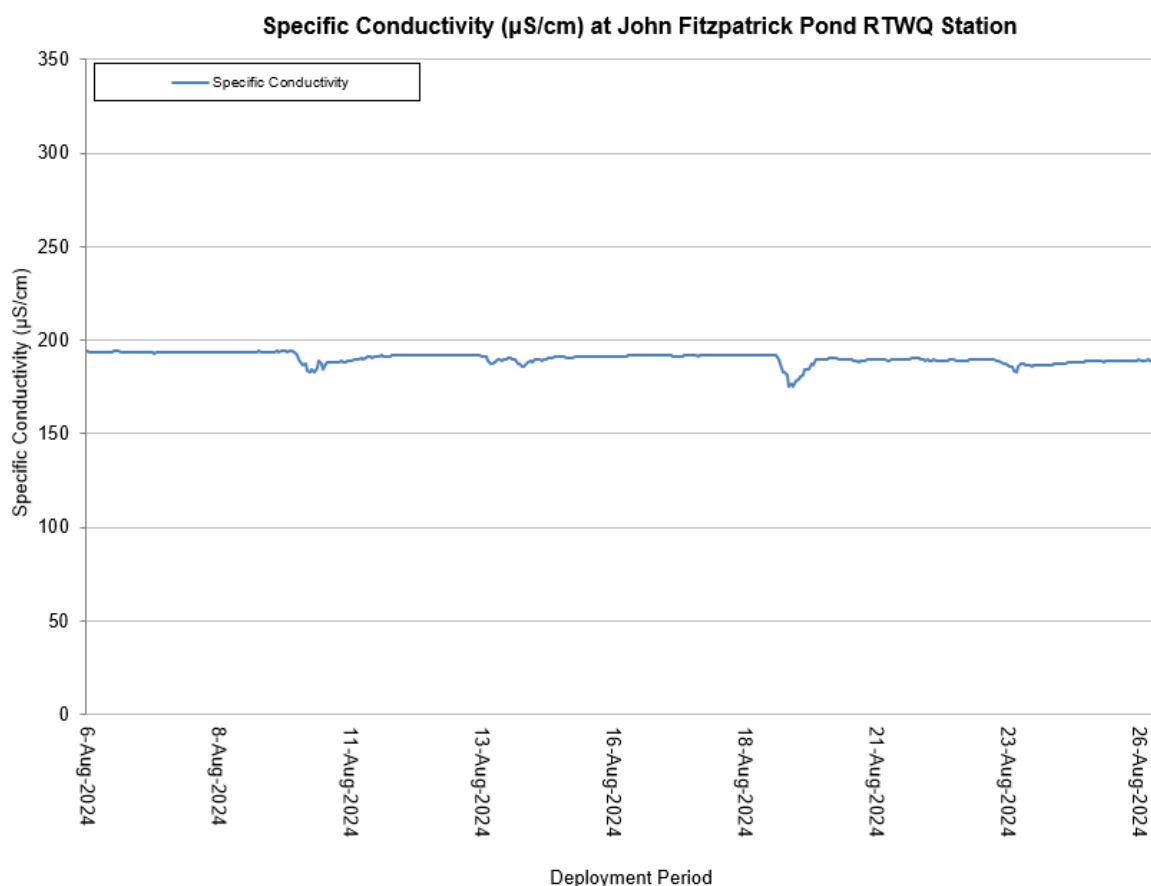


Figure 5: Specific conductivity ($\mu\text{S}/\text{cm}$) values at John Fitzpatrick Pond RTWQ Station

Dissolved Oxygen

Throughout the deployment, dissolved oxygen (DO) concentrations ranged from 8.47 mg/L to 10.15 mg/L, with corresponding DO percent saturation levels varying from 92.2% to 117.80% (Figure 6). Concentration values remained above the CCME Guideline for Protection of Other Life Stages but slightly below the CCME Guideline for the Protection of Early Life Stages for most of the deployment. DO levels remained stable throughout this period.

The DO probe measures oxygen directly dissolved in the water in milligrams per liter (mg/L). The instrument then calculates percent saturation (% Sat), considering the water temperature. Dissolved oxygen levels can vary based on factors such as temperature, pressure, and the presence of other dissolved substances. Warmer water tends to hold less dissolved oxygen than cooler water. Additionally, the presence of organic matter, pollutants, and certain chemical reactions can influence dissolved oxygen levels.

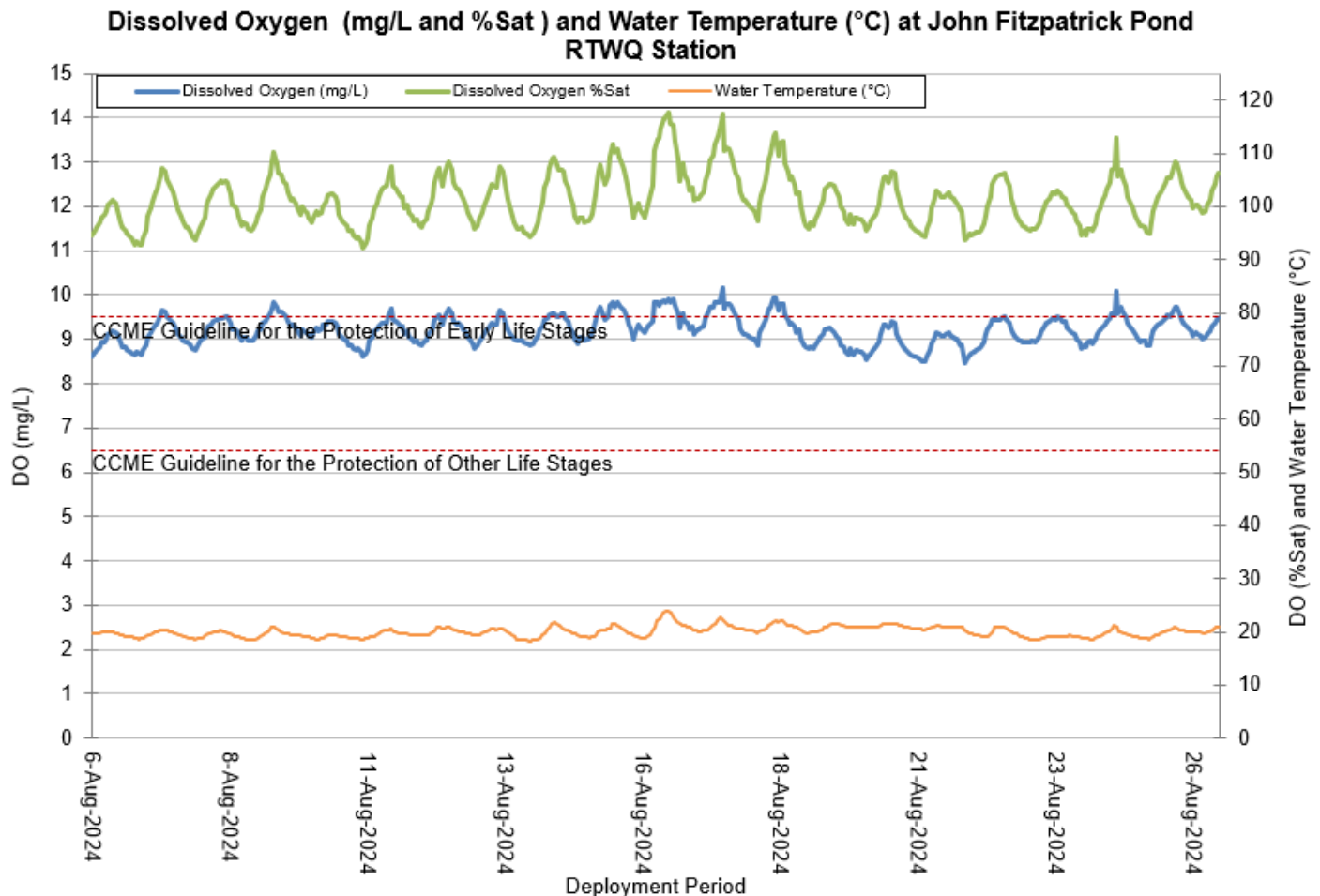


Figure 6: Dissolved Oxygen (mg/L & Percent Saturation) values and Water Temperature (°C) at John Fitzpatrick Pond RTWQ Station

Turbidity

Turbidity levels during the deployment ranged within 0.83 NTU and 2.25 NTU, with an average of 1.21 NTU. During a site visit to this station, it was noted that the pond is extremely clear with a rocky bottom made up of large rocks (Figure 1). Turbidity remained consistently low, with a slightly decreasing trend throughout the deployment period.

Turbidity sensors use light scattering or absorption principles to quantify the degree of cloudiness in the water. Turbidity is caused by suspended particles, such as silt, clay, organic matter, and plankton, that scatter and absorb light.

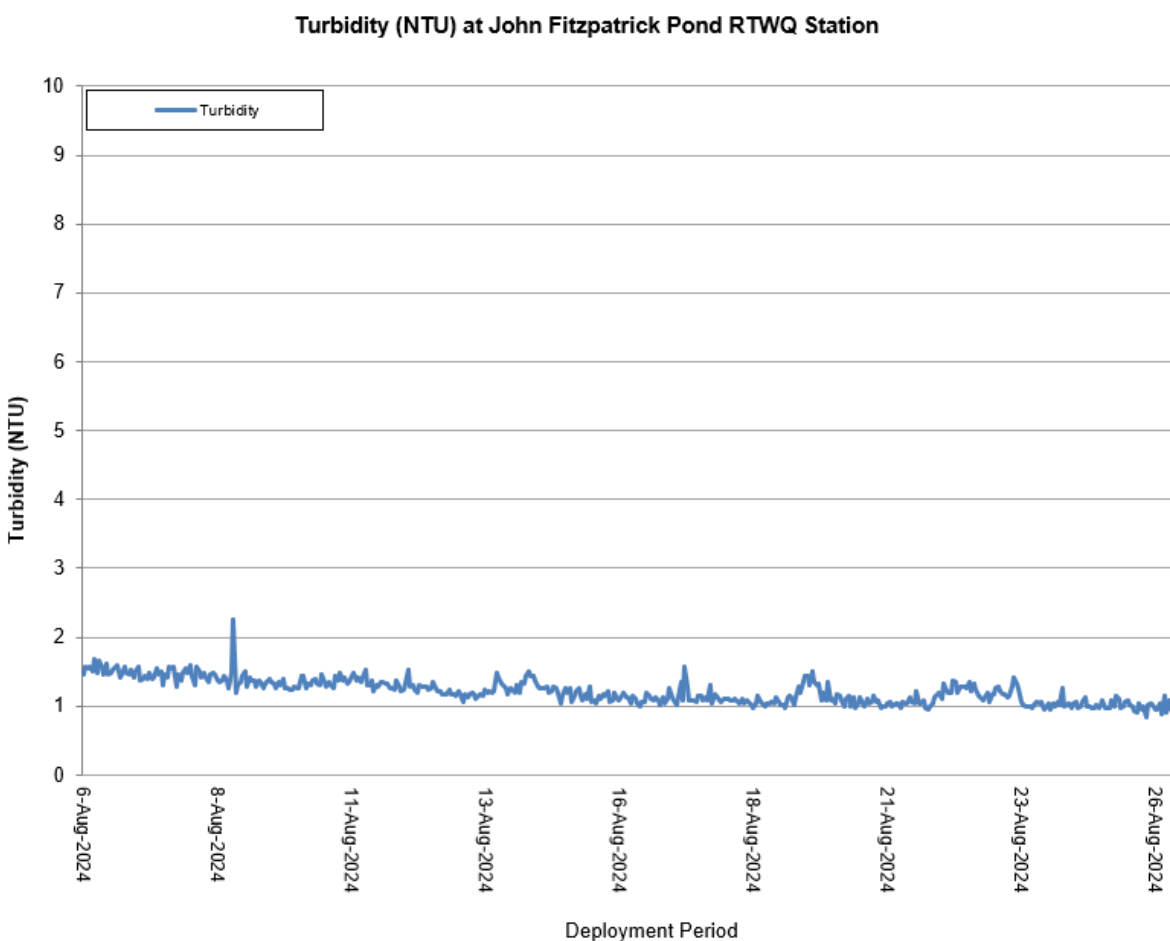


Figure 7: Turbidity (NTU) values at John Fitzpatrick Pond RTWQ Station

Outflow of Unnamed Pond south of Long Pond

Water Temperature

Water temperature ranged from 15.06°C to 26.02°C during the deployment period, with an average of 19.80°C (Figure 8). Temperature remained stable throughout the deployment period with a slight increasing trend.

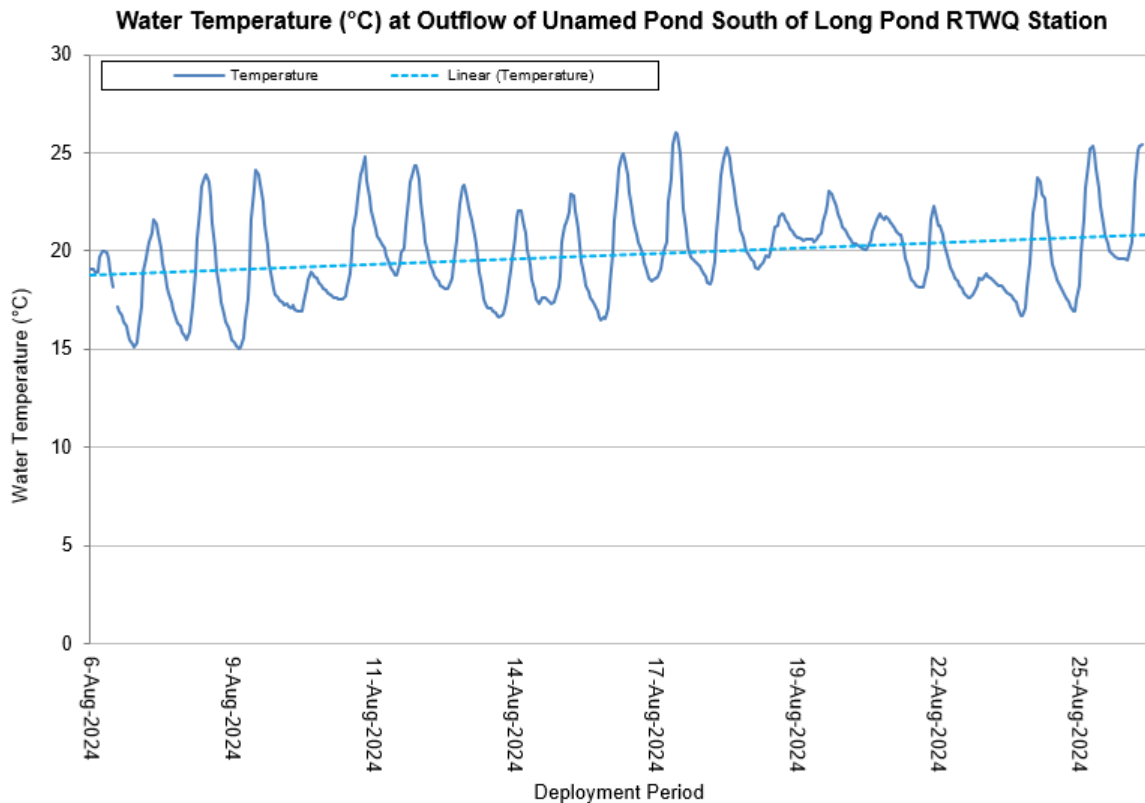


Figure 8: Water temperature (°C) values at Outflow of Unnamed Pond south of Long Pond RTWQ station

pH

Throughout this deployment period, pH values ranged within 7.27 pH units and 7.85 pH units with an average of 7.74 pH units (Figure 9), remaining within the Canadian Council of Ministers of the Environment (CCME) Guidelines for aquatic life of 6.5-9.0 pH units.

Small decreases in pH are evident on Figure 9. These coincide with precipitation events (Appendix I). pH does return to background levels after each event, and overall, the pH data was consistent across deployment.

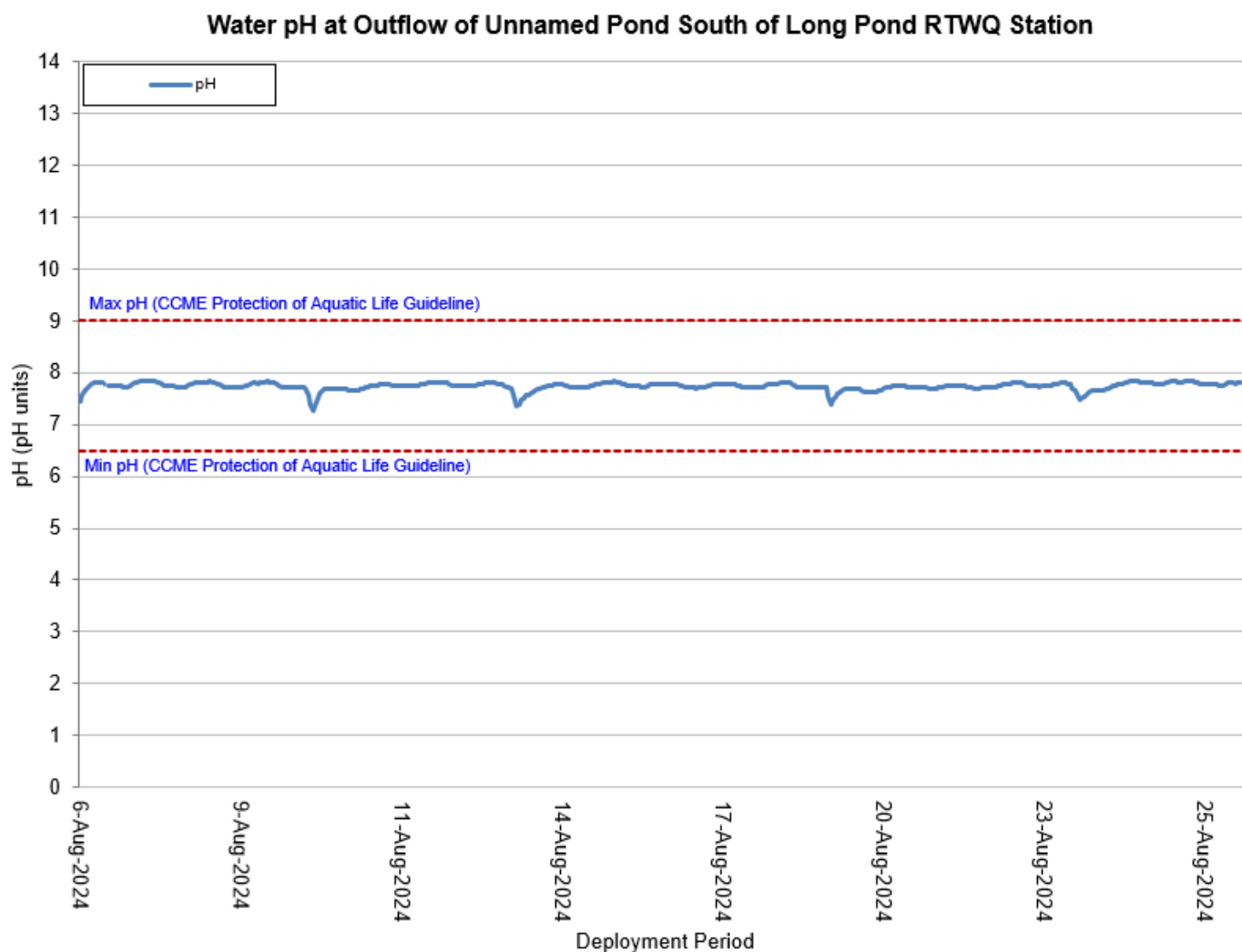


Figure 9: pH (pH units) at Outflow of Unnamed Pond south of Long Pond RTWQ station

Specific Conductivity

Conductivity levels ranged between 164.11 $\mu\text{S}/\text{cm}$ and 303.67 $\mu\text{S}/\text{cm}$, with an average of 267.11 $\mu\text{S}/\text{cm}$ during the deployment period.

There are several dips in conductivity on the graph below that can be linked to precipitation events (Appendix I) that occurred at the same time. Conductivity tends to decrease when the water body is diluted with rainwater, however, levels generally return to normal values within a few days.

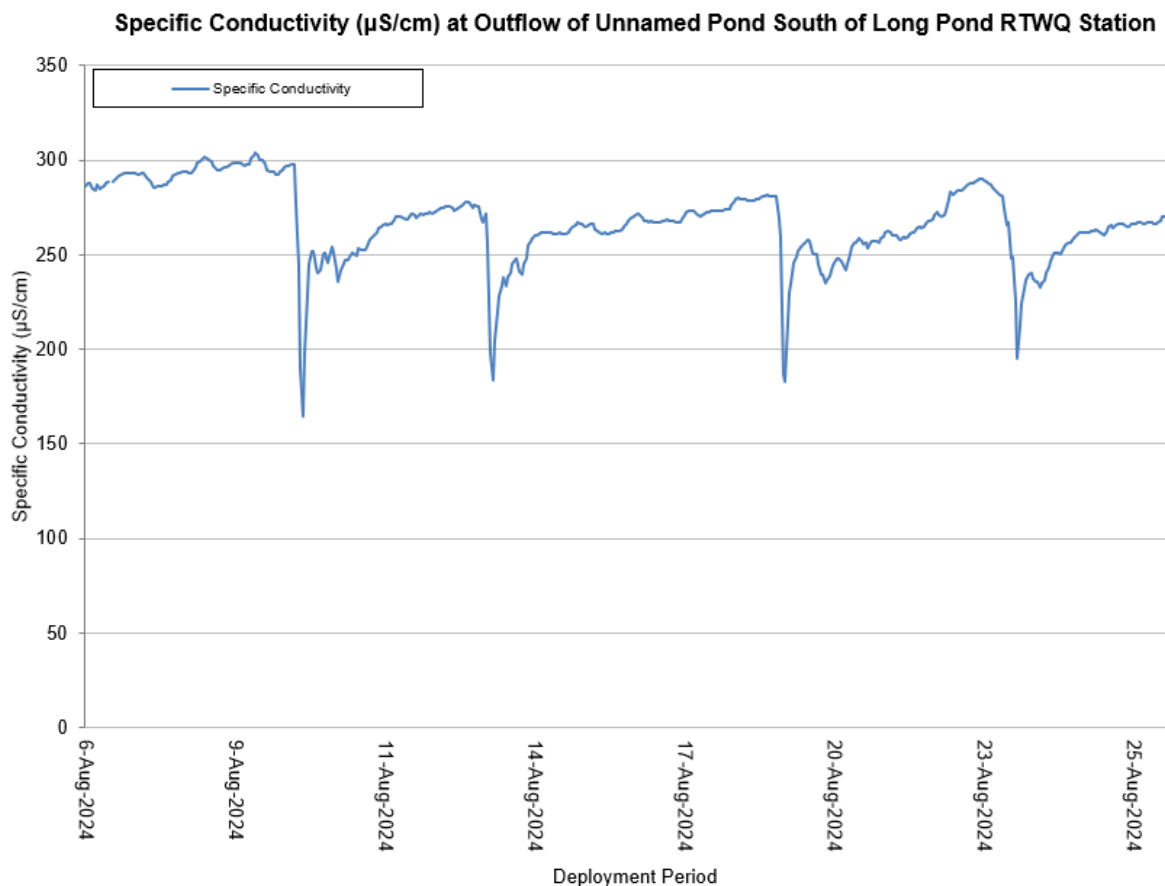


Figure 10: Specific conductivity ($\mu\text{S}/\text{cm}$) at Outflow of Unnamed Pond south of Long Pond RTWQ station

Dissolved Oxygen

During this deployment, dissolved oxygen concentrations ranged from 7.24 mg/L to 8.86 mg/L, with corresponding percent saturation values between 84.2% and 92.9%. Dissolved oxygen concentration levels remained above the CCME Guideline for the Protection of Other Life Stages, but slightly below the CCME Guideline for the Protection of Early Life Stages. This would be expected given the warmer water temperature during summer months.

Dissolved oxygen concentrations demonstrate an inverse relationship with water temperature, as depicted in the figure below. When water temperature increases, dissolved oxygen typically decreases (Figure 11).

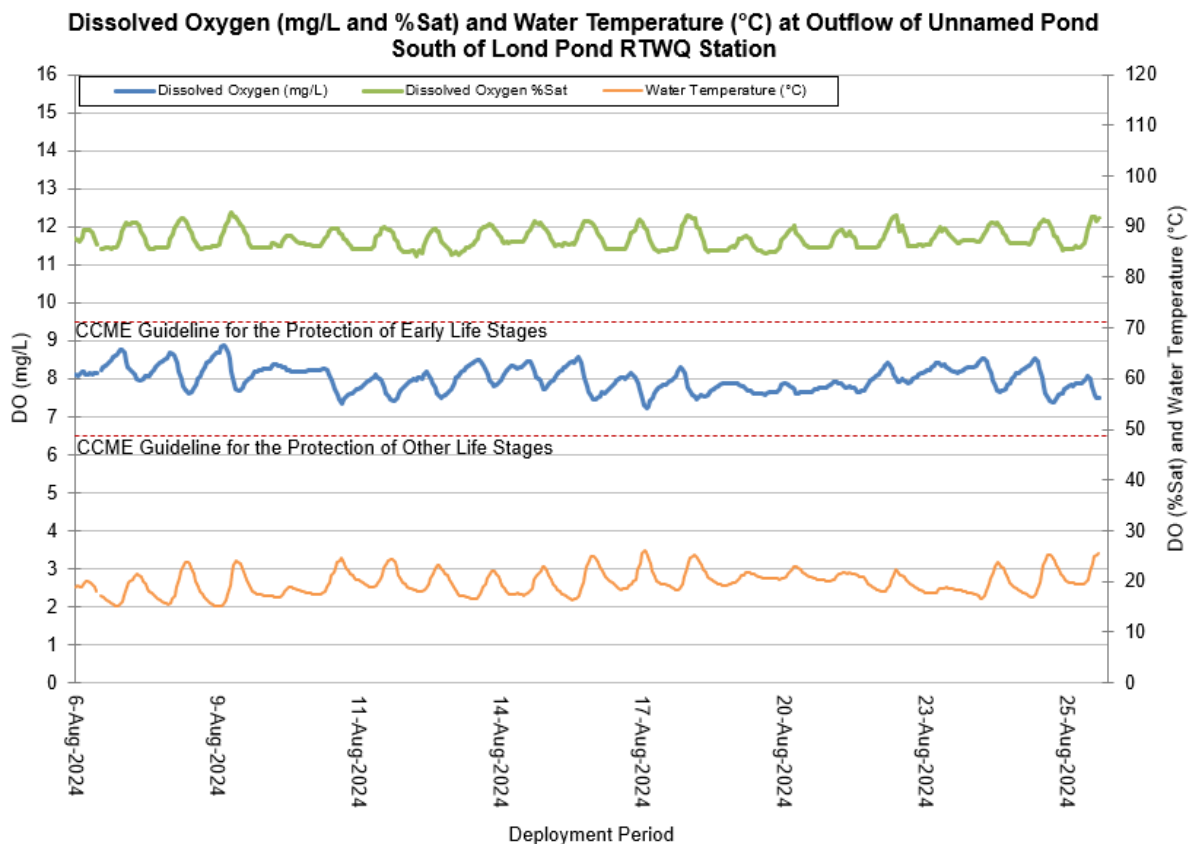


Figure 11: Dissolved Oxygen (%Sat & mg/L) at Outflow of Unnamed Pond south of Long Pond RTWQ station

Turbidity

Turbidity levels during the deployment ranged within 1.2 NTU and 5.7 NTU, with an average of 1.72 NTU (Figure 12).

The turbidity levels remained consistently low throughout the deployment period. Minor fluctuations in the data can be linked to precipitation events (Appendix I). Towards the end of this deployment period, turbidity started to rapidly increase due to biofouling accumulating on the sonde. Turbidity data after August 23rd was removed from the statistical analysis.

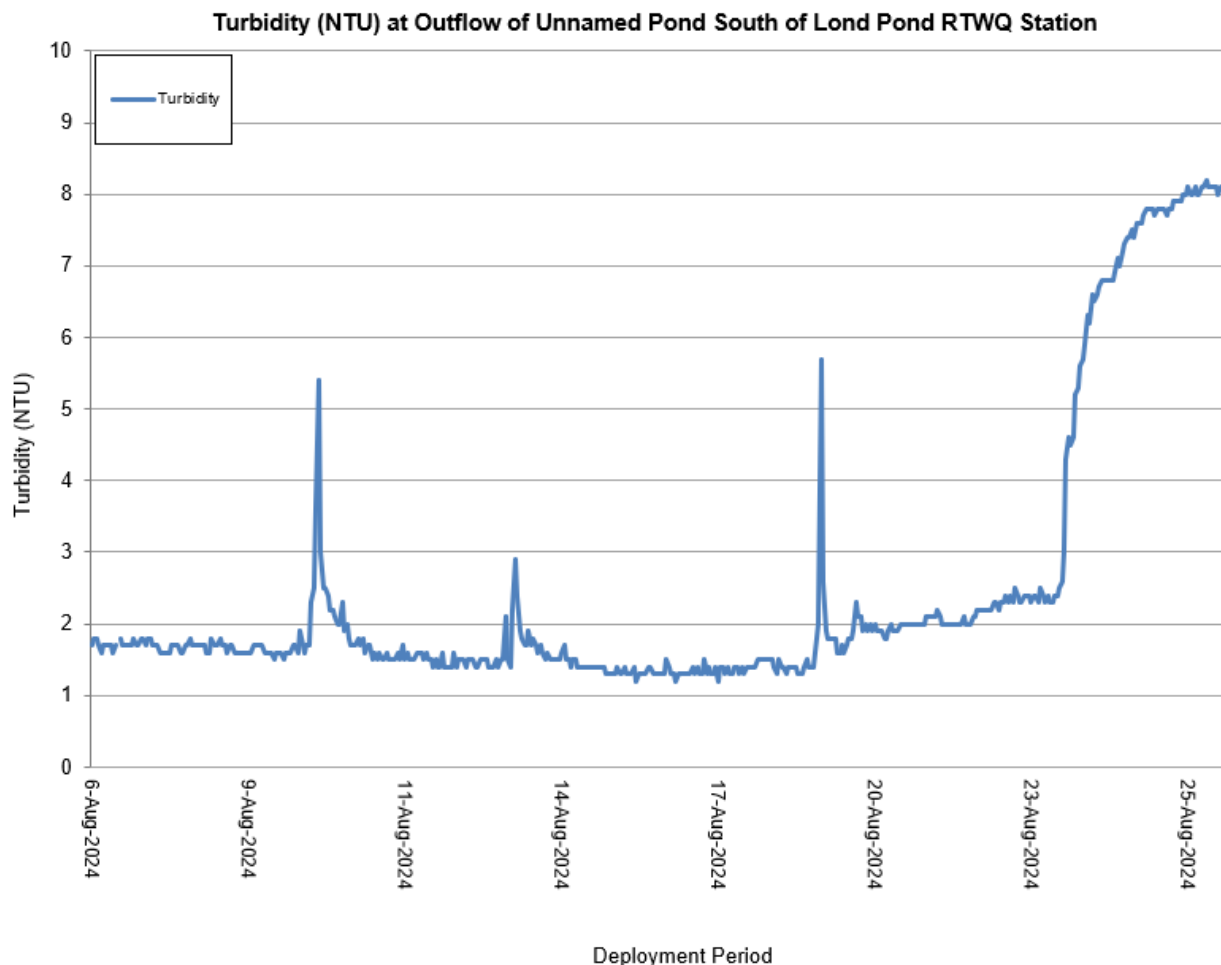


Figure 12: Turbidity (NTU) at Outflow of Unnamed Pond south of Long Pond RTWQ station

APPENDIX I

Total Precipitation and Air Temperature recorded at Environment Canada, St. Lawrence Weather Station

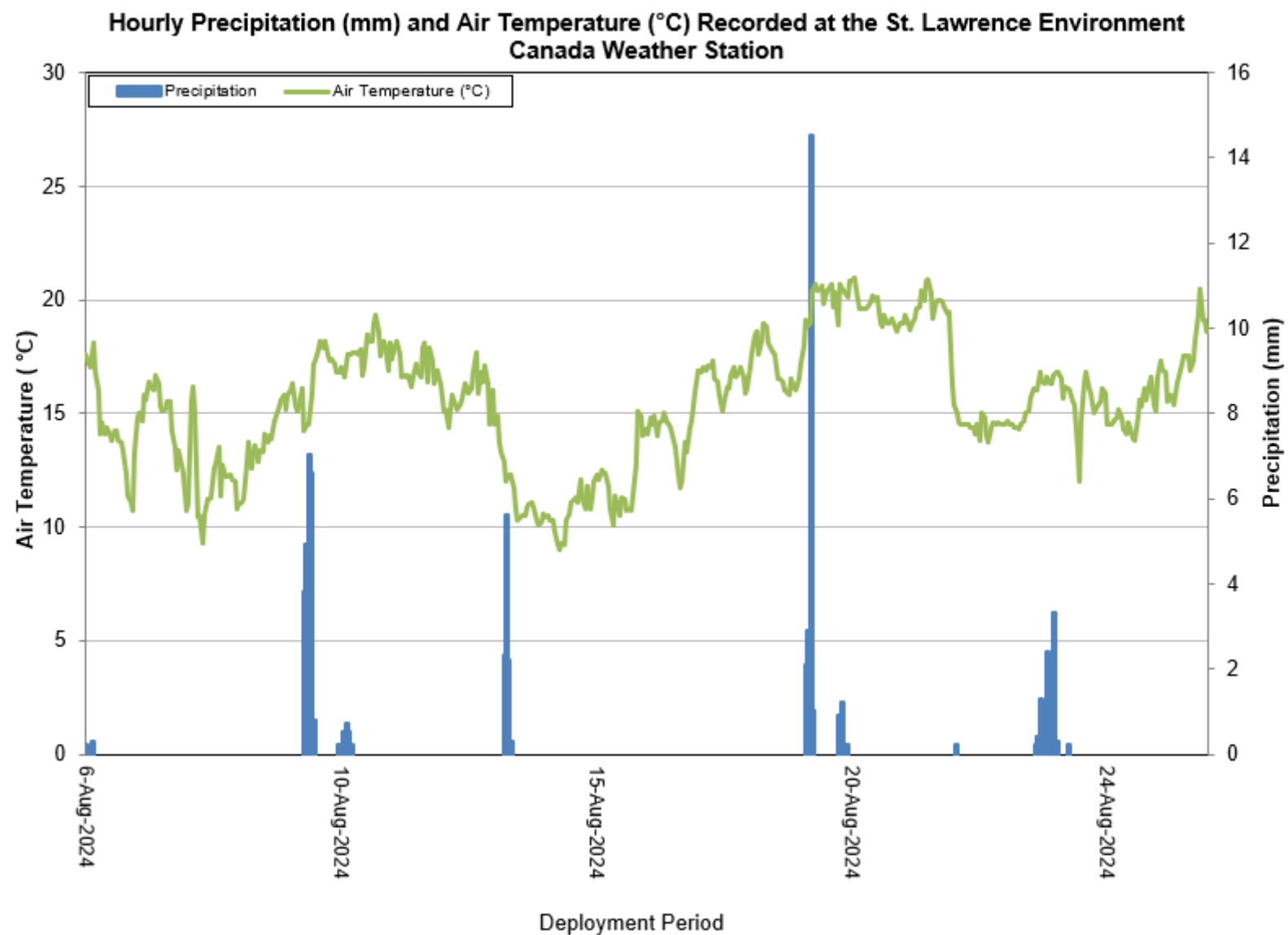


Figure 15: Precipitation recorded at Environment Canada Weather Station during the deployment period.

Appendix II

Parameter statistics for each RTWQ Station

Deployment Period Parameter Statistics for CFI RTWQ Stations

Deployment period: August 6th, 2024 to August 26th, 2024

John Fitzpatrick Pond RTWQ Station

Parameter	Max.	Min.	Median	Mean
Temperature(°C)	23.93	18.29	19.94	19.99
pH	8.43	7.42	8.18	8.17
Specific Conductivity (µS/cm)	194.20	175.30	191.00	190.42
TDS (g/mL)	0.09	0.08	0.09	0.09
Dissolved Oxygen (%Sat)	117.80	92.20	100.80	101.30
Dissolved Oxygen (mg/L)	10.15	8.47	9.20	9.20
Turbidity (NTU)	2.25	0.83	1.19	1.21
Stage (m)				

Table 3: John Fitzpatrick Pond RTWQ station deployment period parameter statistics.

Outflow of Unnamed Pond South of Long Pond RTWQ Station

Parameter	Max.	Min.	Median	Mean
Temperature(°C)	26.02	15.06	19.60	19.80
pH	7.85	7.27	7.75	7.74
Specific Conductivity (µS/cm)	303.67	164.11	267.08	267.11
TDS (g/mL)	0.20	0.11	0.17	0.17
Dissolved Oxygen (%Sat)	92.90	84.20	87.00	87.56
Dissolved Oxygen (mg/L)	8.86	7.24	7.99	8.00
Turbidity (NTU)	5.70	1.20	1.60	1.72
Stage (m)				
Flow				

Table 4: Outflow of Unnamed Pond South of Long Pond RTWQ station deployment period parameter statistics