Real-Time Water Quality Report

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

Deployment Period
May 9th, 2023 to June 14th, 2023

Newfoundland Labrador

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

Prepared by:

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General

The Water Resources Management Division (WRMD), in partnership with Water Survey of Canada (WSC) -Environment and Climate Change Canada (ECCC), maintain real-time water quality and water quantity monitoring stations in brooks on John Fitzpatrick Pond and Outflow of Unnamed Pond south of Long Pond, that are 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. It was decided to decommission Outflow to Grebes Nest station. In replacement, a new site was selected and the hut and all the water quality instrumentation was relocated to an area that has a consistent water supply and the capability to provide an overview of the water quality conditions (Figure 1). The new site was named John Fitzpatrick Pond and this report will cover the water quality data recorded at John Fitzpatrick Pond station.

John Fitzpatrick Pond

John Fitzpatrick station was established May 2022. The site was selected based on the location and consistent water supply throughout the year. Despite an expected small decrease in water level during the summer, this station will provide stable and beneficial water quality data for this site (Figure 1).

The Real Time station is established on the North West bank of John Fitzpatrick Pond, close to the only outflow from the pond. This pond is surrounded by natural habitat on the North East side, and on the south west 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 meters. 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

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.

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 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).

WRMD staff (Environment & Climate Change (ECC)) are responsible for maintenance of the real-time water quality monitoring equipment, as well as recording and managing the water quality data. Tara Clinton is ECC's main contact for the real-time water quality monitoring operation at Canada Fluorspar (NL) Inc, and is responsible for maintaining and calibrating the water quality instrument, as well as grooming, analyzing and reporting on water quality data recorded at the station.

WSC staff have an essential role in the data logging/communication aspect of the network and the maintenance of the water quantity monitoring equipment. WSC staff visit the site regularly to ensure the data logging and data transmitting equipment are working properly. WSC is responsible for handling stage and streamflow issues. The quantity data is raw data that is transmitted via satellite and published online along with the water quality data on the Real-Time Stations website. Quantity data has not been corrected or groomed when published online or used in the monthly reports for the stations. WSC is responsible for QA/QC of water quantity data. Corrected stage and streamflow data can be obtained upon request to WSC.

Table 1: Instrument Performance 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 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.

Table 2: Instrument performance rankings

Station	Date	Action	Comparison Ranking				
			Temperature	pH	Conductivity	Dissolved Oxygen	Turbidity
John Fitzpatrick	May 9th, 2023	Deployment	N/A	N/A	N/A	N/A	N/A
	June 14th, 2023	Removal	Good	Excellent	Good	Excellent	Excellent
Unnamed Pond	May 10th, 2023	Deployment	Excellent	Good	Excellent	Good	Excellent
	June 14th, 2023	Removal	Good	Excellent	Excellent	Excellent	Excellent

As a result of transmission issues at the John Fitzpatrick Station, the initial recording of measurements was not transmitted until around 21:00 on May 9th. Because there is an approximate 7-hour time difference between the transmission of field sonde data and the acquisition of QAQC measurements, QAQC data was excluded for the deployment. This omission was necessary to maintain accuracy in comparability due to the time lag. Upon the removal of the instrument, data ranked between excellent and good for all parameters.

In contrast to the QAQC instrument located at the Outflow of Unnamed Pond south of Long Pond, the field instrument data received ratings of 'Excellent' or 'Good' for all water quality parameters throughout the deployment. Upon removal, assessments against the QA instrument revealed that the parameter data were predominantly rated as 'Excellent,' with the exception of Temperature, which received a 'Good' ranking.

Issues during the May 9th to June 14th Deployment Period

Please note that the stage data recorded and displayed in this report, is raw data. It has not been corrected for backwater effect. WSC is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request to WSC.

Due to transmission issues, there are segments of missing Stage data for the John Fitzpatrick RTWQ station.

John Fitzpatrick Pond

Water Temperature

Water temperature ranged from 6.40°C to 18.63°C during the deployment period (Figure 3). The average water temperature for this deployment is 10.72°C.

Water temperature displayed a natural diurnal pattern. Water temperatures will be warmer during the daylight hours and then lower during the nighttime (Figure 3). As the deployment continued the water temperature remain stable while increasing slightly which would be typical for a Spring month.

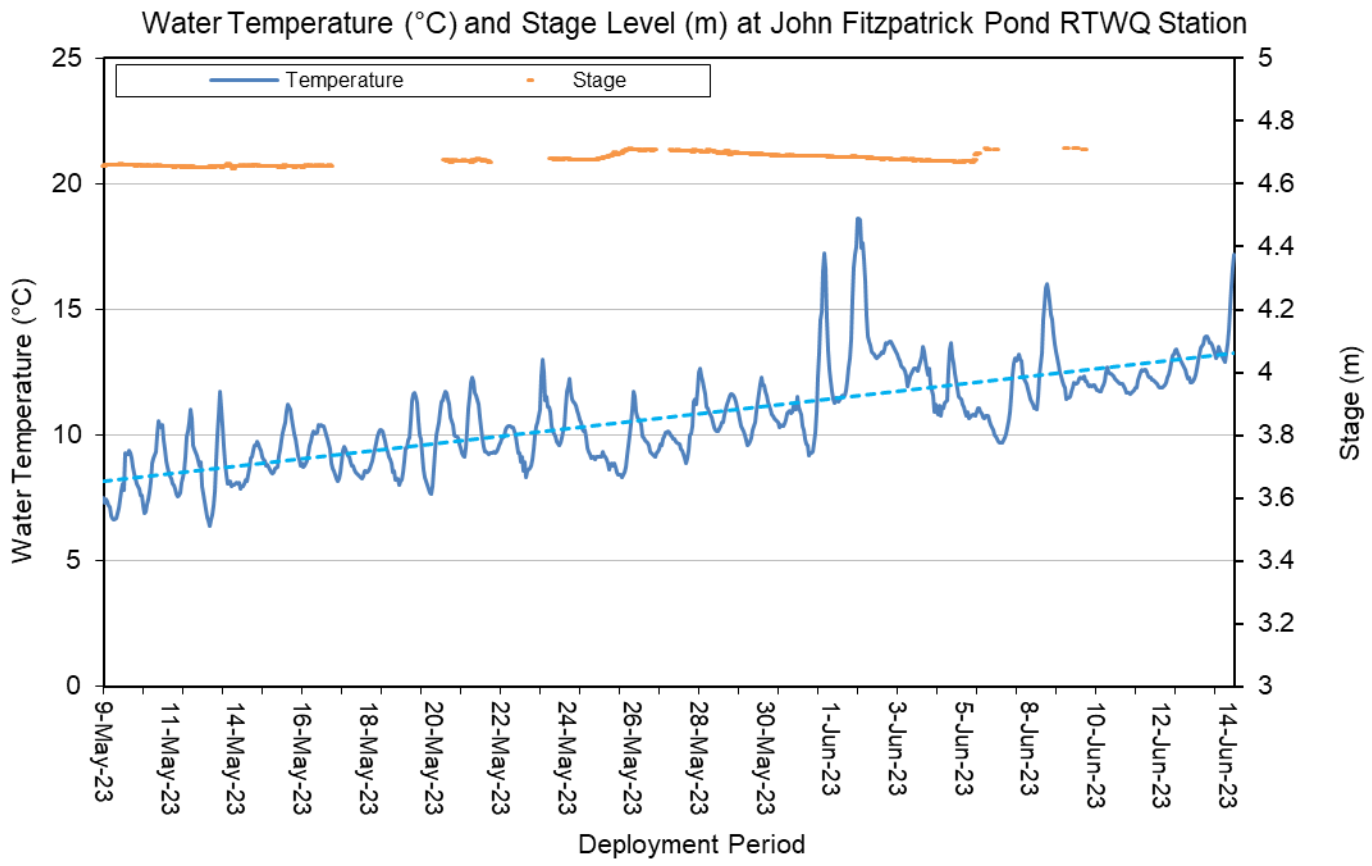


Figure 3: Water temperature at John Fitzpatrick Pond RTWQ Station (°C)

pH

Throughout the deployment period, pH values ranged between 7.36 pH units to 7.64 pH units with an average of 7.55 and remained stable other than small fluctuations (Figure 4).

A pH probe measures the acidity or alkalinity of a water body. pH is a measure of the concentration of hydrogen ions (H^+) in a solution. 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 (Figure 4).

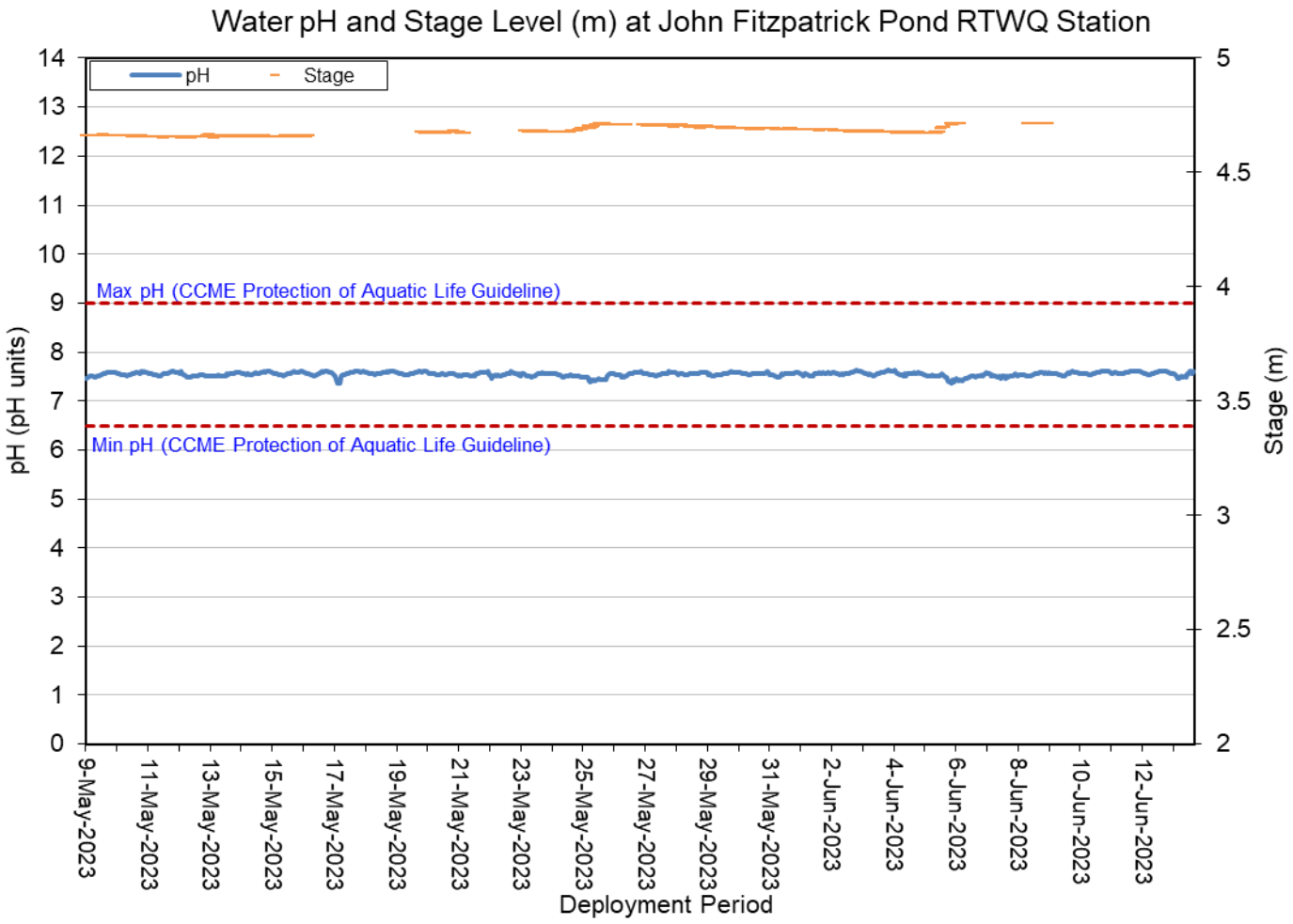


Figure 4: pH (pH units) values at John Fitzpatrick Pond RTWQ Station

Specific Conductivity

The conductivity levels were within 98.4 µS/cm and 110.0 µS/cm during this deployment period, with an average of 108.3 (Figure 5). 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.

Conductivity in John Fitzpatrick Pond will fluctuate with the changes in water level and during rainfall events. Conductivity was stable throughout the deployment, apart from several small dips like those recorded on May 17th, May 26th, and June 6th. These dips were likely a result of the rainfall (Appendix I) that was recorded by the weather station in St. Lawrence. The rain dilutes the water column for a short period of time, this reduces the presence of any suspended particles or diluted salts.

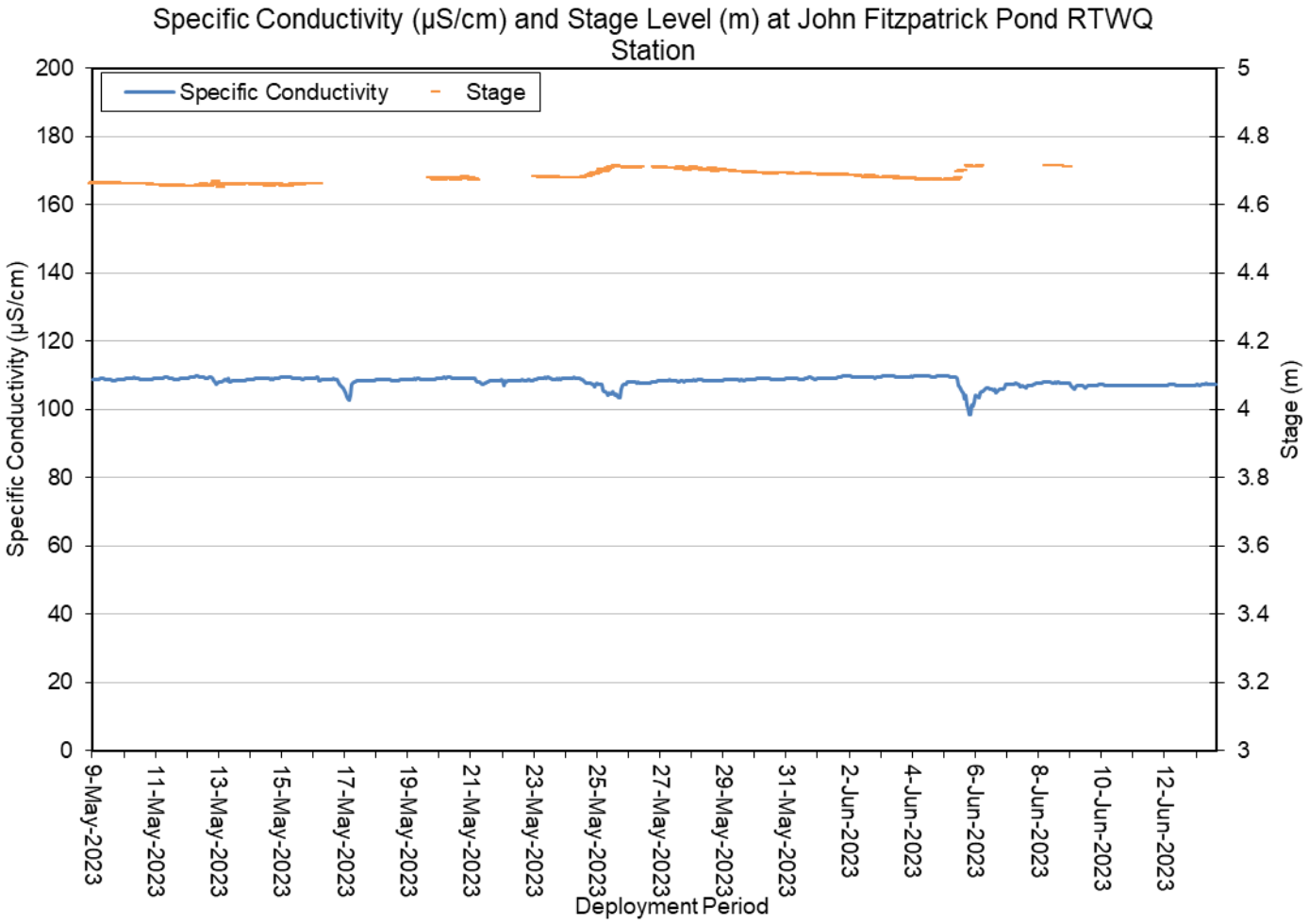


Figure 5: Specific conductivity (µS/cm) values at John Fitzpatrick Pond RTWQ Station

Dissolved Oxygen

Throughout the deployment, the concentrations of dissolved oxygen (DO) ranged from 9.99 mg/L to 11.74 mg/L. The corresponding dissolved oxygen percent saturation levels varied from 91.6% to 114.7% (Figure 6). It is noteworthy that while the DO concentrations exceeded the CCME Guidelines for the Protection of Aquatic Life, this outcome is anticipated due to the cooler water temperatures during this particular time of the year.

The DO probe directly measures oxygen dissolved (mg/L) in the water. The instrument then calculates percent saturation (% Sat) factoring in the water temperature. The level of dissolved oxygen in water 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.

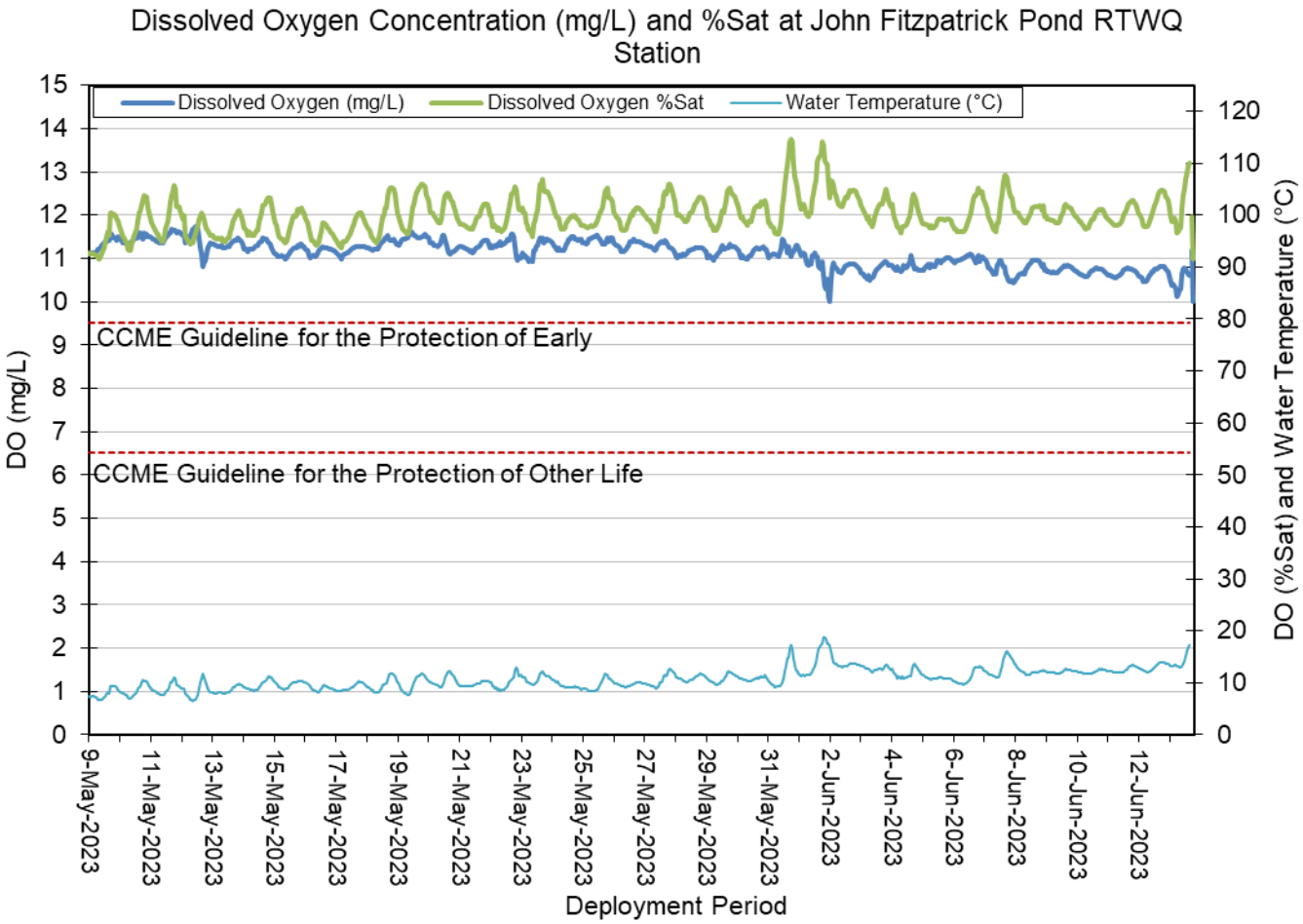


Figure 6: Dissolved Oxygen (mg/L & Percent Saturation) values and Water Temperature (°C) at John Fitzpatrick Pond RTWQ Station

Turbidity

Turbidity levels during the deployment ranged within 0.9 NTU and 8.0 NTU, with an average of 1.3 NTU (Figure 7). During the 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 relatively low and stable throughout the deployment period other than a few minor spikes, like on May 13th or June 6th which were likely a result of rainfall events that occurred at the same time (Appendix I).

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.

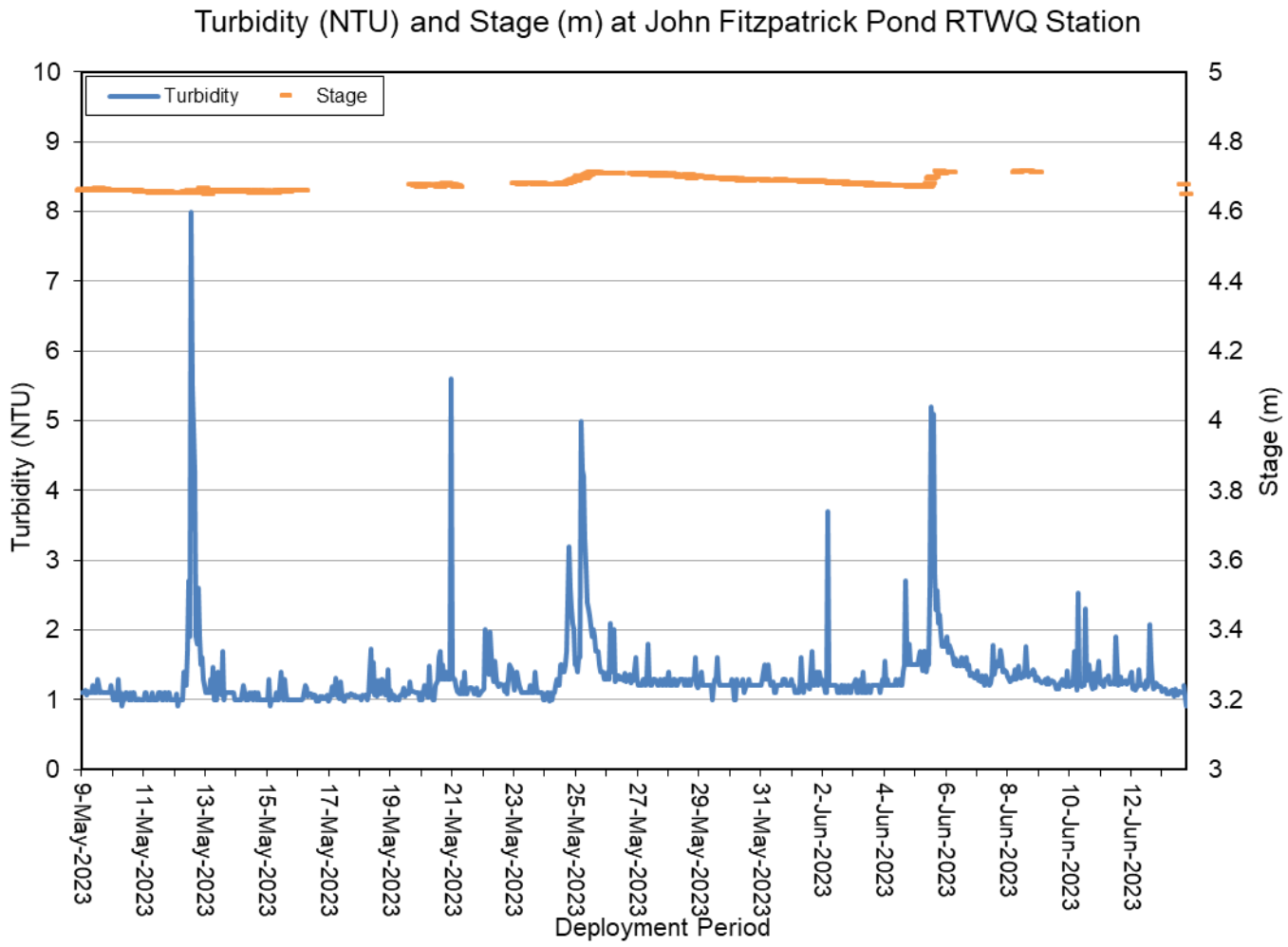


Figure 7: Turbidity (NTU) values at John Fitzpatrick Pond RTWQ Station

Daily Averaged Stage Level and Total Precipitation

Please note the stage data on the graph below is raw data. It has not been corrected for backwater effect. WSC is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request to WSC.

Due to transmission issues throughout the deployment, there are sections of missing data shown as gaps on the graph below (Figure 8)

Stage is an estimation of water level at the station and can explain some differences occurring with water quality parameters (i.e. Specific Conductivity, DO, turbidity). Stage ranged between 4.65m to 4.72m during the deployment. Large peaks in stage correspond with the total precipitation events as noted on Figure 8. Total Precipitation data was obtained from Environment Canada's St. Lawrence weather station.

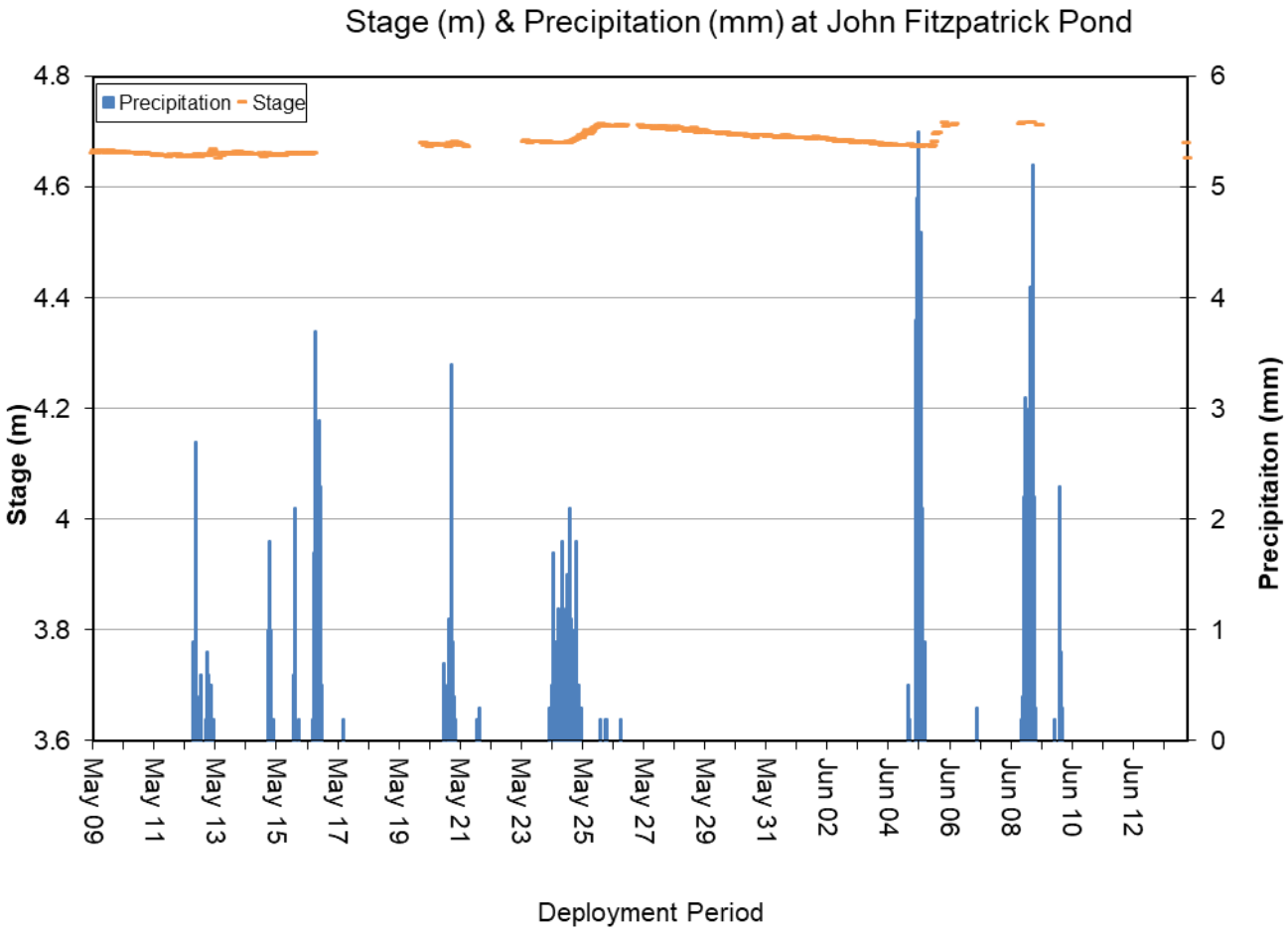


Figure 8: Daily averaged stage values at John Fitzpatrick Pond RTWQ Station and total precipitation.

Outflow of Unnamed Pond south of Long Pond

Water Temperature

Water temperature ranged from 3.38ºC to 22.14ºC during the deployment period, with an average of 10.82 °C (Figure 9). Decreases in water temperature correspond with higher stage, likely due to increased precipitation run-off. Temperature increased throughout the deployment period, which is typical for warming Spring months.

Please note that the stage data in this document is raw data. The data has not been corrected for backwater effect. WSC is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request to WSC.

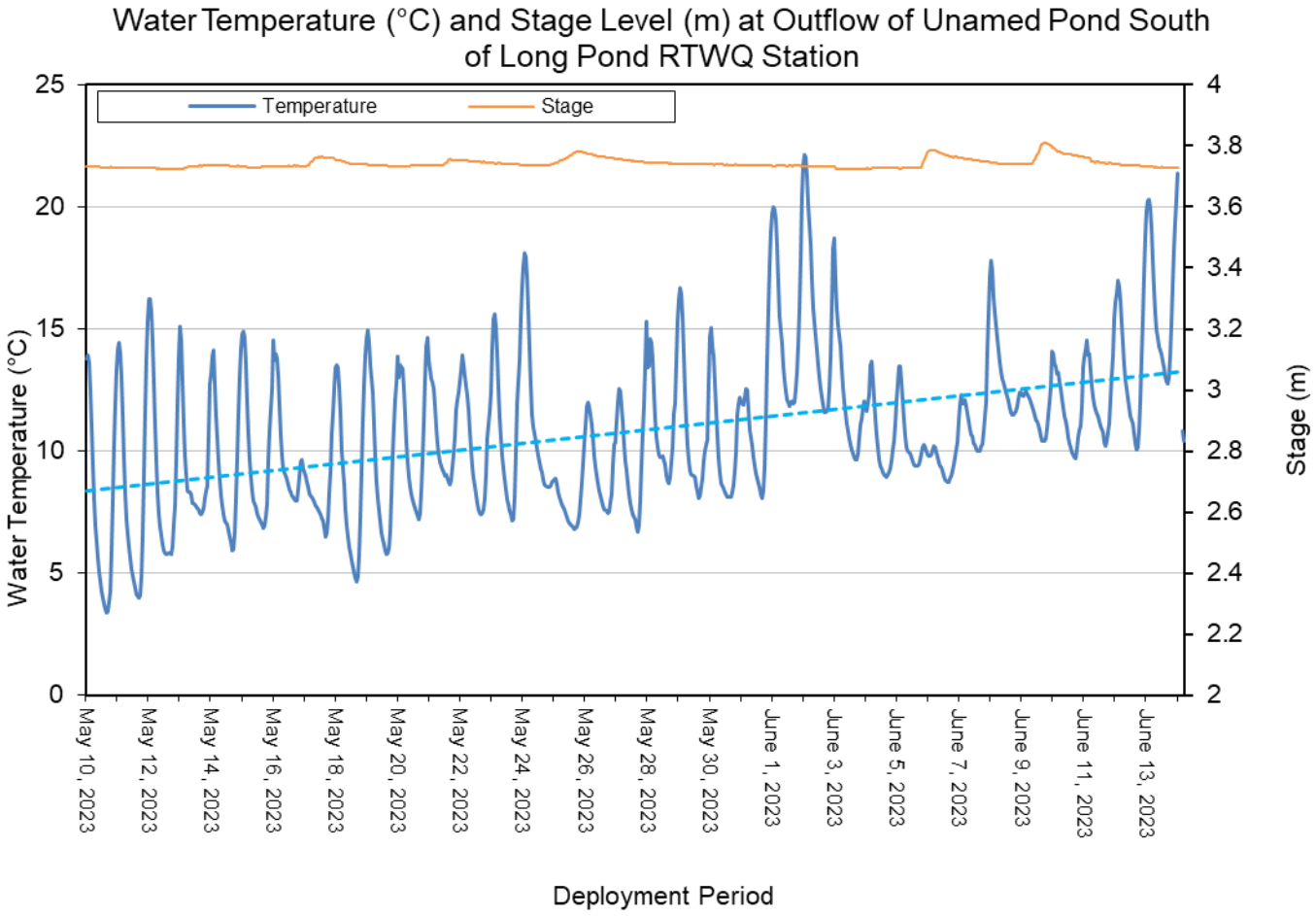


Figure 9: Water temperature (°C) values at Outflow of Unnamed Pond south of Long Pond

pH

Throughout this deployment period, pH values ranged within 7.41 pH units and 8.03 pH units with an average of 7.81 pH units (Figure 10), 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 during stage peaks are evident on Figure 10. pH does return to background levels after each event, and overall, the pH data was consistent across deployment.

Please note the daily averaged stage data on the graph below, is raw data. It has not been corrected for backwater effect. WSC is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request to WSC.

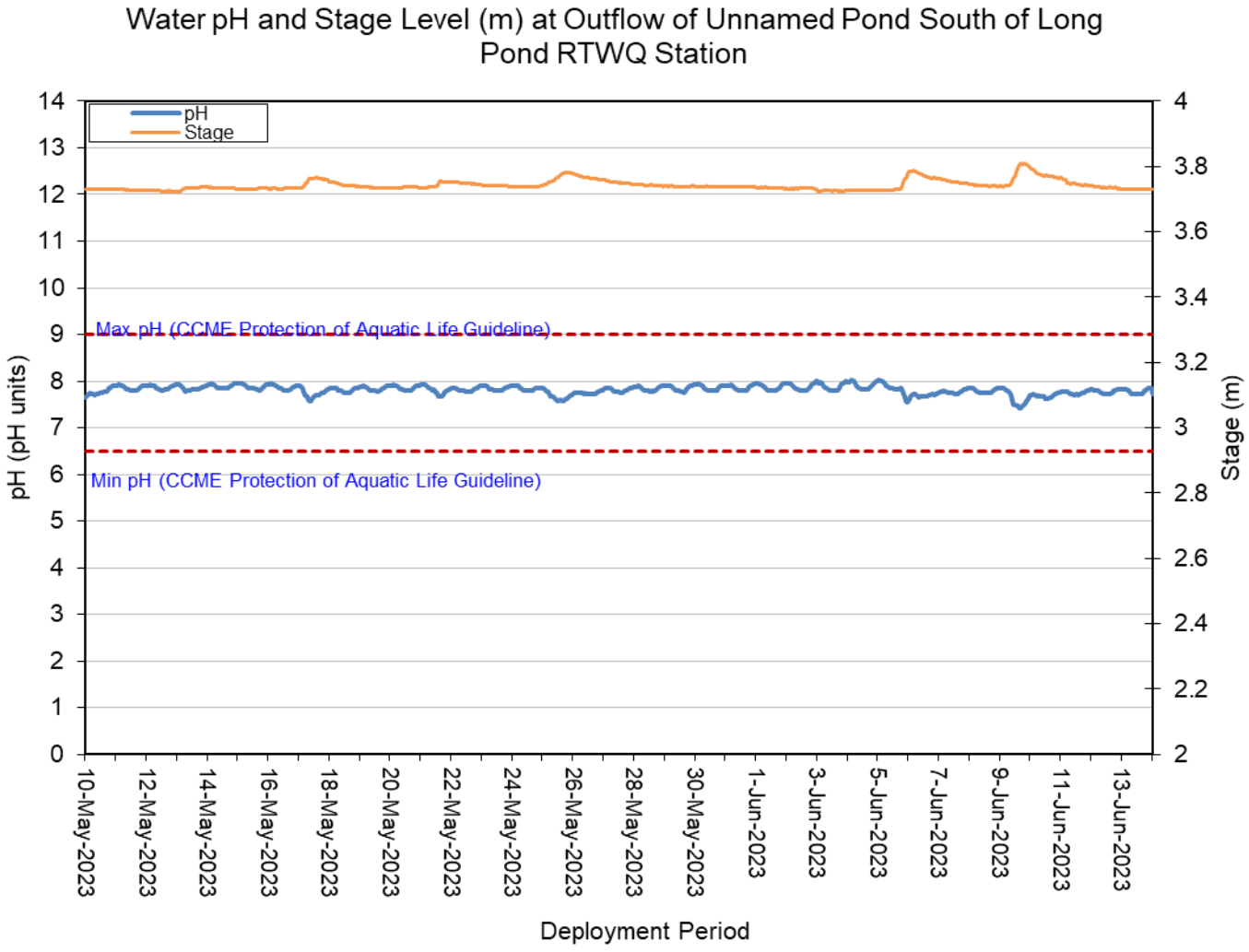


Figure 10: pH (pH units) at Outflow of Unnamed Pond south of Long Pond

Specific Conductivity

The conductivity levels ranged between 170.9 µS/cm and 302.9 µS/cm, with an average of 267.8 µS/cm during deployment (Figure 11).

Variations in water level, as depicted in the graph below, have a notable impact on conductivity data. This is evident in instances such as June 6th and June 10th, as highlighted below. When the water stage rises, often in response to precipitation events, conductivity tends to decrease. However, it generally returns to normal levels within a few days to weeks.

Please note the daily averaged stage data on the graph below, is raw data. It has not been corrected for backwater effect. WSC is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request to WSC.

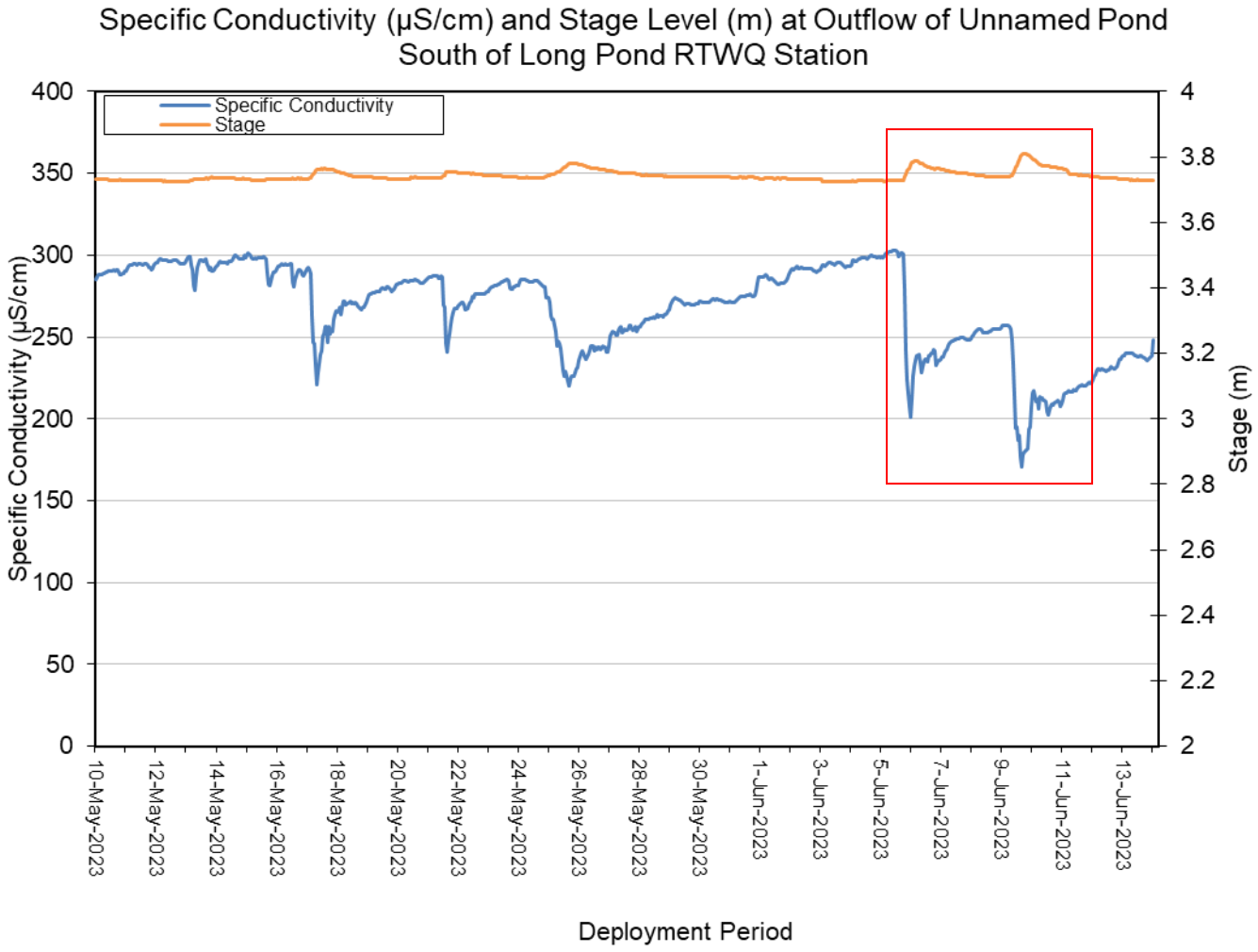


Figure 11: Specific conductivity (µS/cm) at Outflow of Unnamed Pond south of Long Pond

Dissolved Oxygen

During this deployment, the dissolved oxygen levels ranged within 9.00 mg/L and 13.06 mg/L for concentration and 95.1 % and 109.8 % for percent saturation.

Although DO levels remained outside of the CCME Guidelines for the Protection of Aquatic Life, this is to be expected given the cool temperatures. DO will start to decrease as water temperatures start to increase.

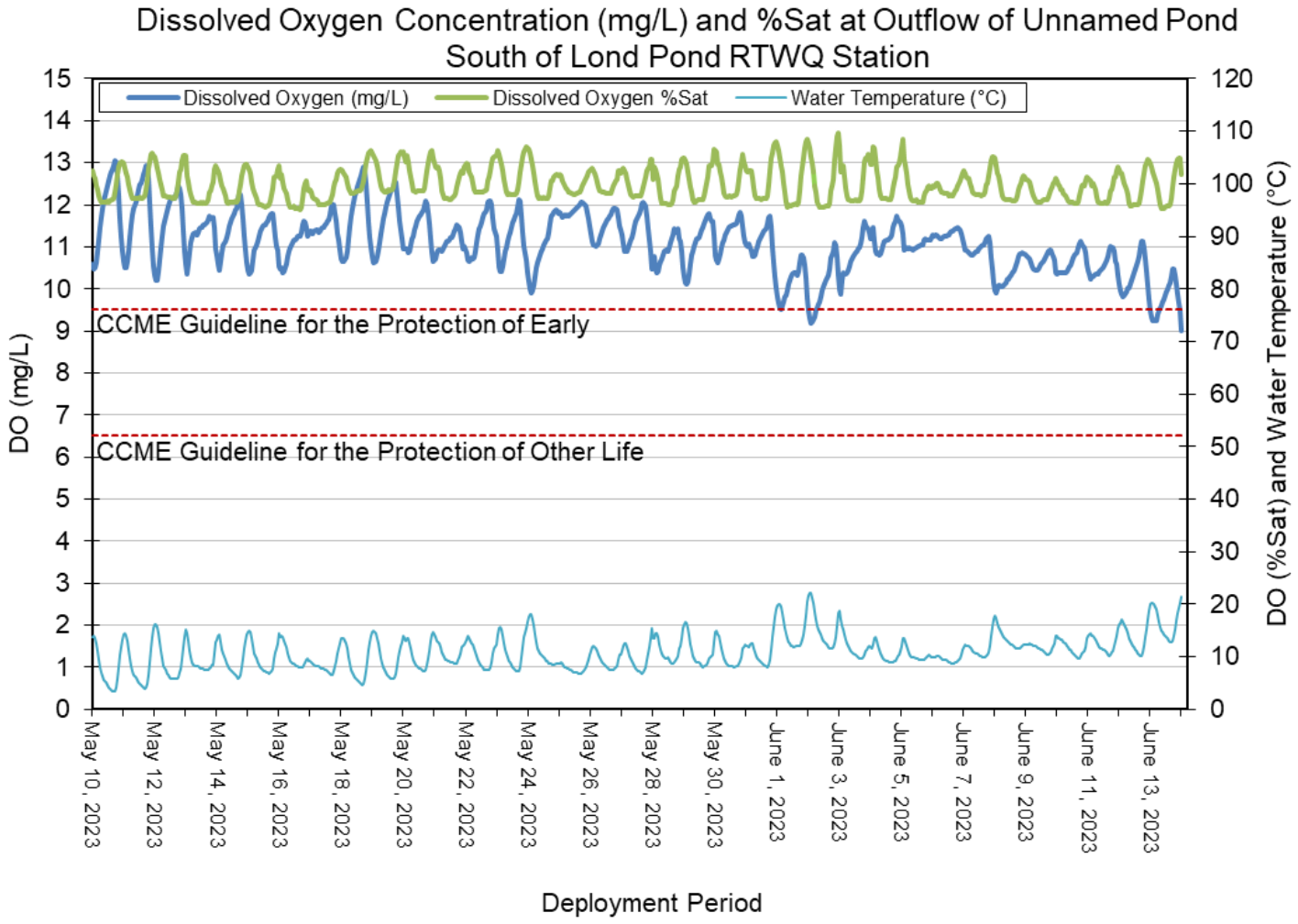


Figure 12: Dissolved Oxygen (%Sat & mg/L) at Outflow of Unnamed Pond south of Long Pond

Turbidity

Turbidity levels during the deployment ranged within 1.5 NTU and 3.8 NTU, with an average of 2.4 NTU (Figure 13). Turbidity remained stable and relatively low throughout the deployment period with some noticeable spikes that coincide with stage increases, like June 6th.

Please note the daily averaged stage data on the graph below, is raw data. It has not been corrected for backwater effect. WSC is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request to WSC.

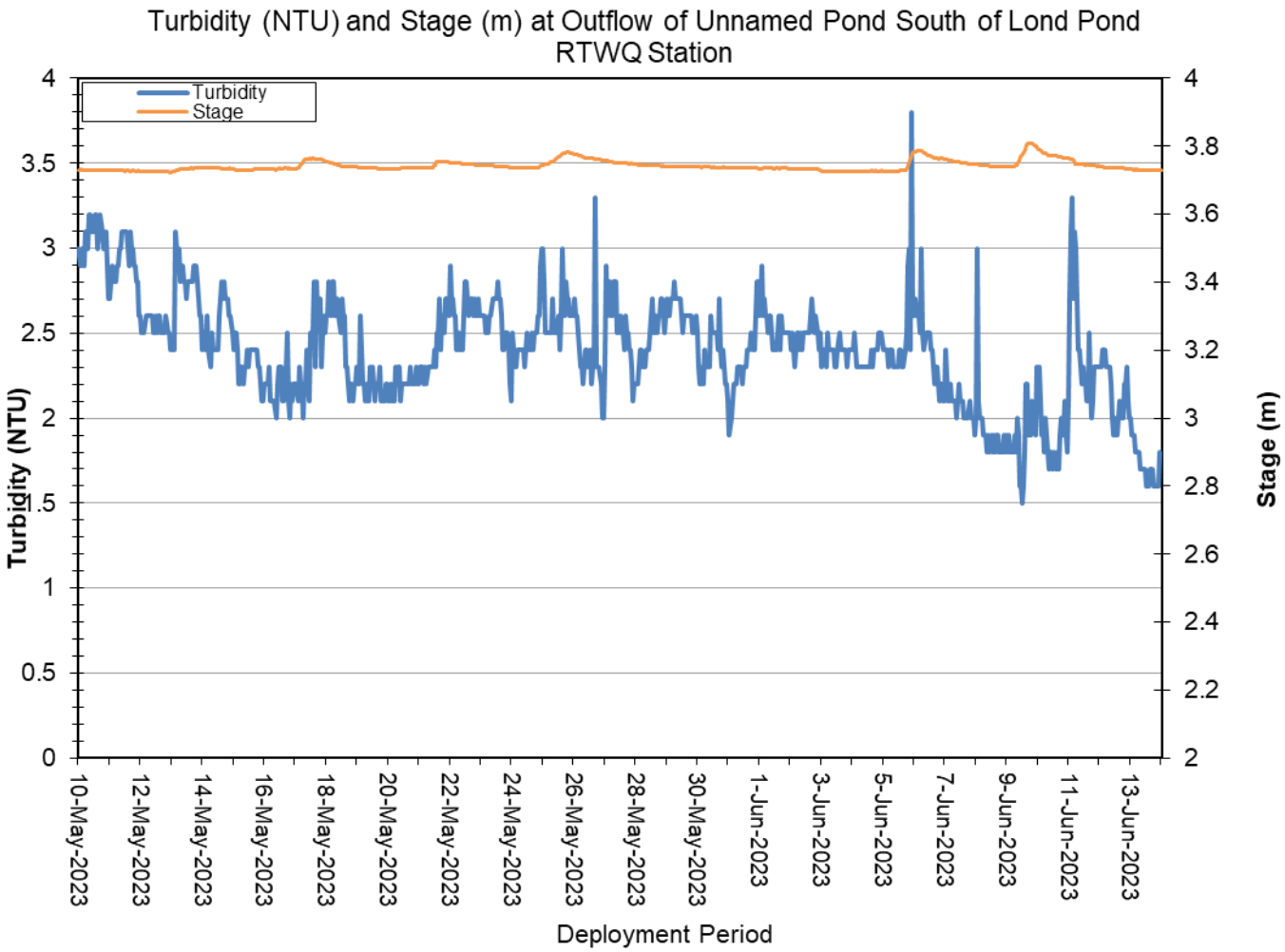


Figure 13: Turbidity (NTU) at Outflow of Unnamed Pond south of Long Pond

Daily Averaged Stage Level and Total Precipitation

Please note the stage data on the graph below is raw data. It has not been corrected for backwater effect. WSC is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request to WSC.

Stage is an estimation of water level at the station and can explain fluctuations occurring with other parameters (i.e. Specific Conductivity, DO, turbidity). Stage ranged between 3.72 m to 3.81m during the deployment. Large peaks in stage correspond with the total precipitation events as noted on Figure 14. Total Precipitation data was obtained from Environment Canada's St. Lawrence weather station.

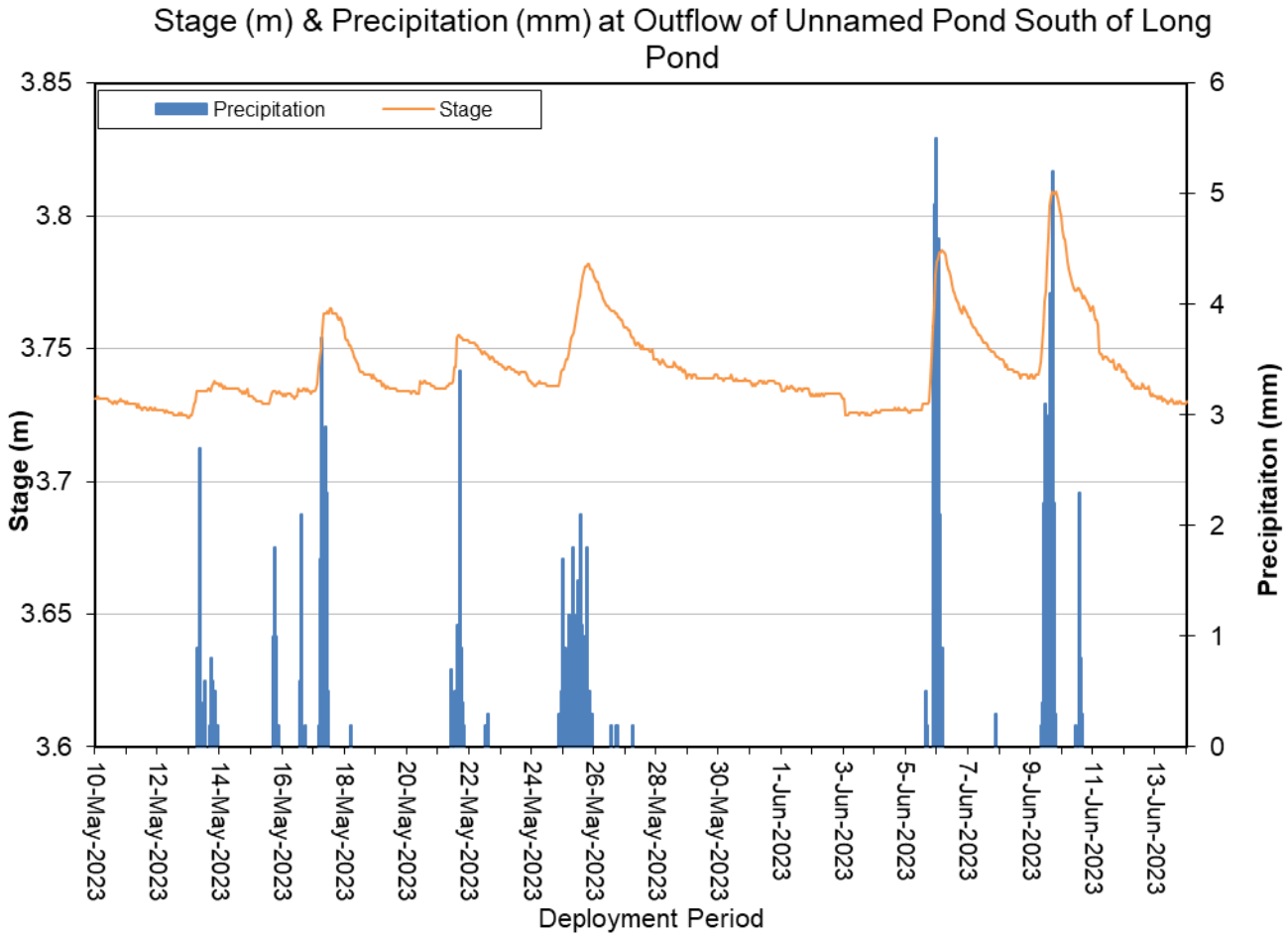
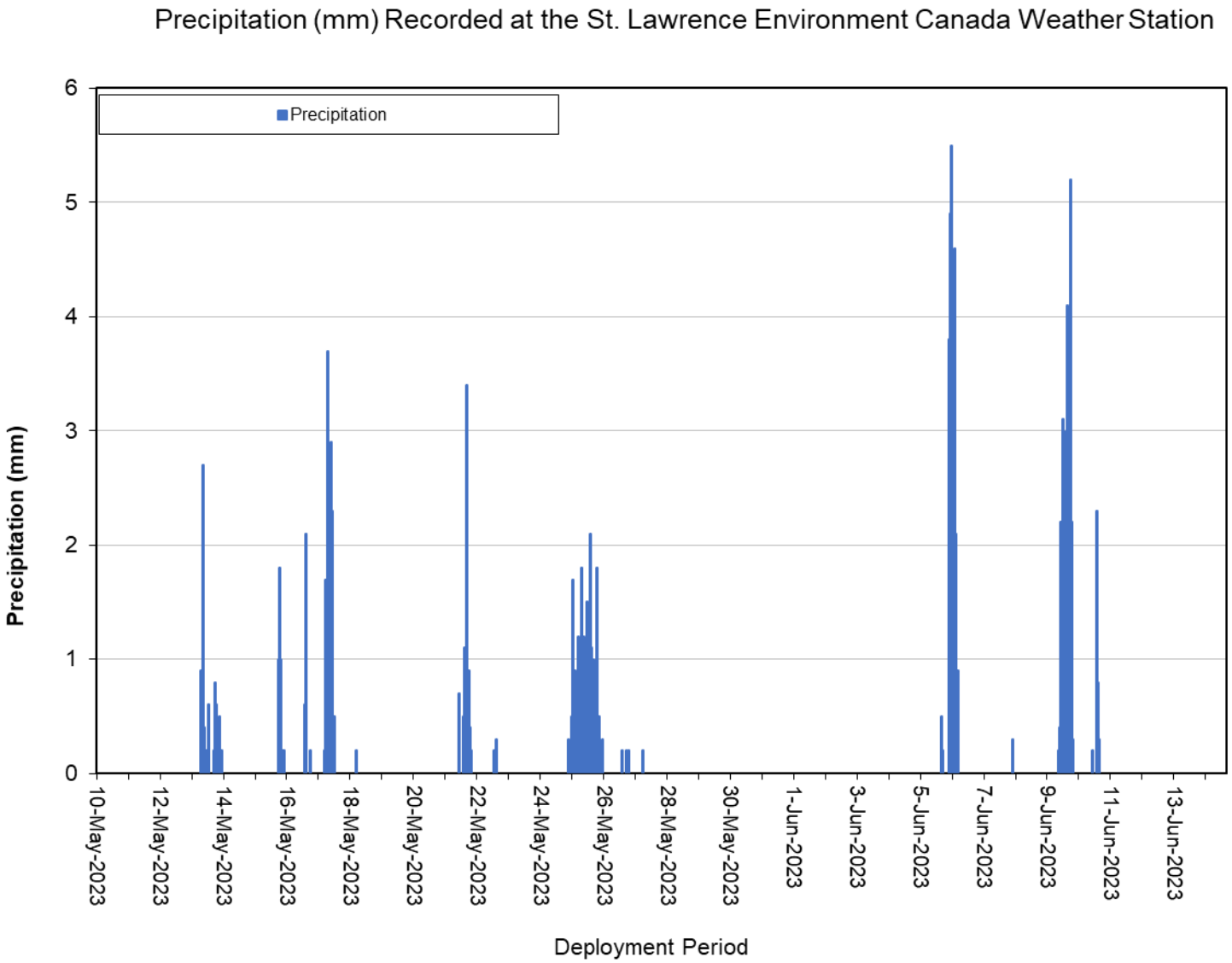


Figure 14: Daily averaged stage values and total precipitation.

APPENDIX I

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


Precipitation (mm) Recorded at the St. Lawrence Environment Canada Weather Station
Precipitation
Precipitation (mm)
0
1
2
3
4
5
6
10-May-2023
12-May-2023
14-May-2023
16-May-2023
18-May-2023
20-May-2023
22-May-2023
24-May-2023
26-May-2023
28-May-2023
30-May-2023
1-Jun-2023
3-Jun-2023
5-Jun-2023
7-Jun-2023
9-Jun-2023
11-Jun-2023
13-Jun-2023
Deployment Period