Real-Time Water Quality Report

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

Deployment Period
June 20, 2022 to August 3, 2022

Newfoundland Labrador

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

Prepared by:

Tara Clinton
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
taraclinton@gov.nl.ca

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 on John Fitzpatrick Pond and Outflow of Unnamed Pond south of Long Pond, brooks 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. However 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 & 2). The new site was named John Fitzpatrick Pond and this report covers 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 2).

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.

Figure 1: Real-Time Water Quality and Quantity Station at John Fitzpatrick Pond

Figure 2: 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 3). 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 3).

Figure 3: 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	June 20	Deployment	Good	Excellent	Excellent	Fair	Fair
	August 3	Removal	Good	Good	Excellent	Excellent	Excellent
Unnamed Pond	June 20	Deployment	Fair	Excellent	Good	Excellent	Good
	August 3	Removal	Poor	Good	Excellent	Excellent	Excellent

At deployment of the field instrument at John Fitzpatrick Pond site, the water temperature, pH, and specific conductivity ranked 'Excellent' and 'Good' against the QA sonde data. The dissolved oxygen and turbidity data ranked as 'Fair' likely a result of the level of sediment disturbance in the brook during the time the reading was taken. At removal of the instrument, water temperature, pH, conductivity, dissolved oxygen and turbidity ranked from 'Excellent' to 'Good'.

When compared to the QAQC instrument at Outflow of Unnamed Pond south of Long Pond, the field instrument data ranked 'Fair' for temperature, with all other parameters ranking 'Excellent' or 'Good' for during the deployment. At removal, the rankings against the QA indicated likely influence from sediment buildup around the sonde. The temperature ranking at removal was 'Poor' with all other parameters ranking 'Excellent' and 'Good' for water temperature, conductivity, dissolved oxygen and turbidity.
The temperature ranking at the Unnamed Pond south of Long Pond, indicates that there might be discrepancies with the QAQC instrument. This will be investigated.

Concerns or Issues during the Deployment Period

There was no climate data available from Environment Canada's weather station in St. Lawrence for this deployment period.

There is no stage data available for John Fitzpatrick Pond during this deployment, at this time there was no instrumentation set up for stage.

Please note that the stage data recorded for Outflow of Unnamed Pond south of Long Pond 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.

John Fitzpatrick Pond

Water Temperature

Water temperature ranged from 14.95°C to 25.36°C during the deployment period (Figure 4). The average water temperature for the deployment is 18.97°C, warmer water temperatures at this time of year.

Water temperature displayed the natural diurnal pattern representing the influence of warmer air temperatures on the water body. Diurnal patterns of the water temperatures generally involve high temperatures during the daylight hours and the low temperatures representing the nighttime hours (Figure 4). As the deployment continues the temperatures remain stable throughout as the summer weather continues.

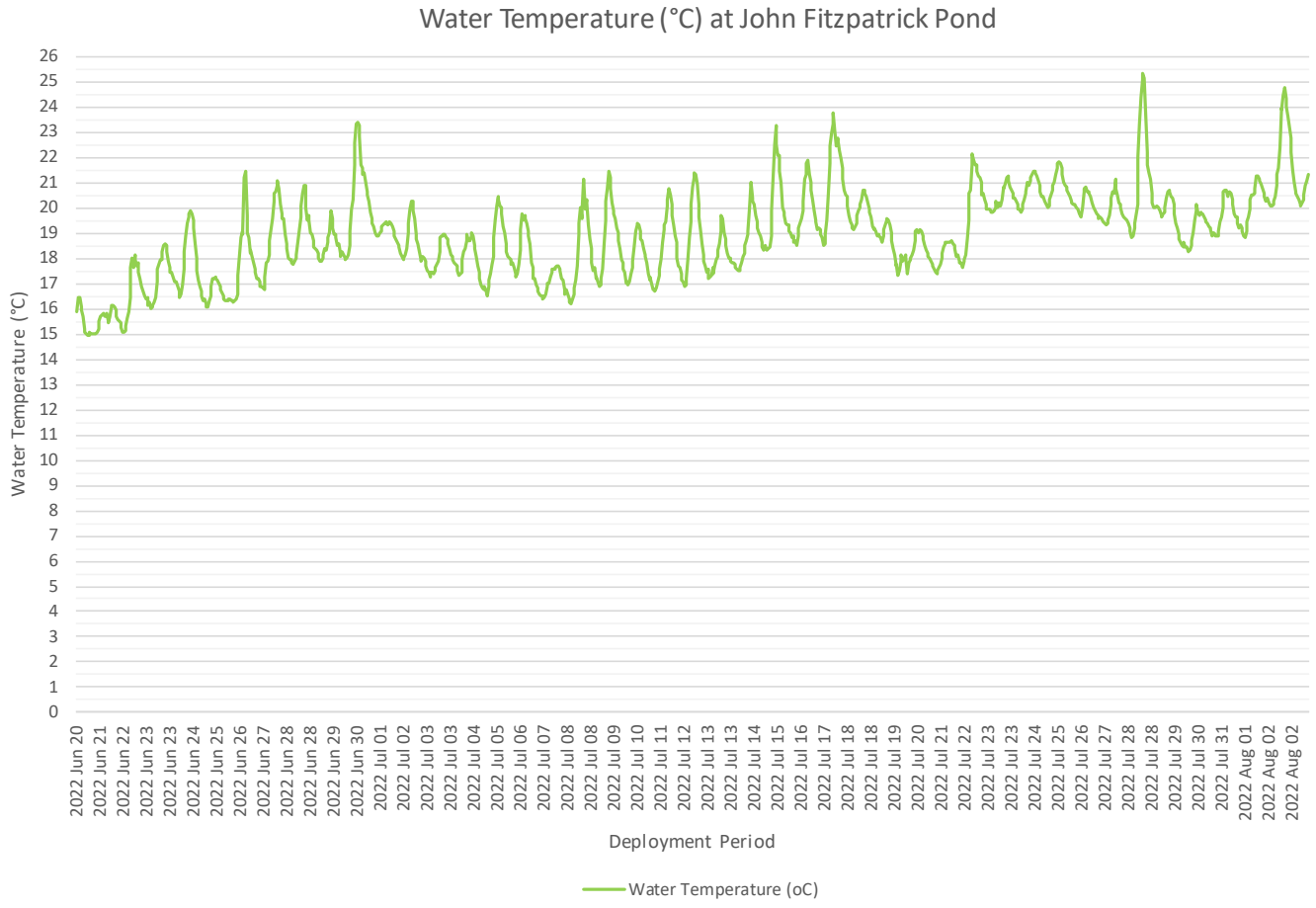

Figure 4: Water temperature (°C) values at Outflow of Grebes Nest Pond

pH

Throughout the deployment period, pH values ranged between 6.95 pH units and 7.85 pH units. The pH data remained within the Canadian Council of Ministers of the Environment (CCME) guidelines for the protection of aquatic life for the duration of the deployment.

The small increases in pH across deployment are likely influences by the intermittent stage level (Figure 5). On many days during this deployment, as stage decreases, the pH level also dips for a short period of time. pH levels are highest when stage is also high. This may indicate that a substance in the water during higher stage levels is keeping the pH levels high, and pH then drops when the addition of water into the system stops.

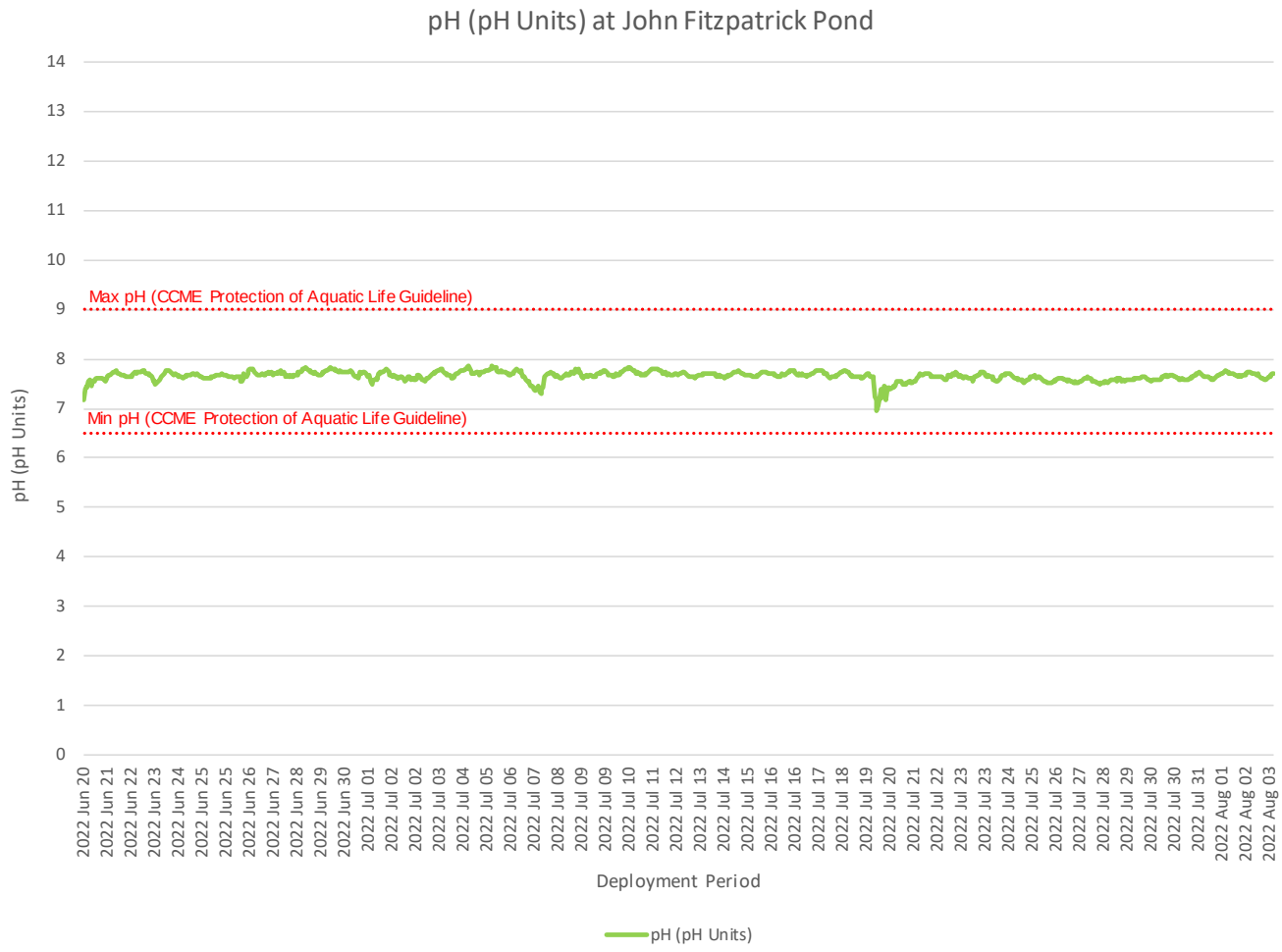

Figure 5: pH (pH units) values

Specific Conductivity

The conductivity levels were within 113.4 µS/cm and 165.6 µS/cm during this deployment period (Figure 6). The specific conductivity probe measured the diluted salts and inorganic materials present in the brook.

Across the deployment period, the conductivity in Grebes Nest fluctuated with the changes in stage level. During low to no stage increases, diluted salts and inorganic material will normally accumulate in the brook, slowly contributing to higher conductivity (Figure 6). Conductivity was stable throughout the deployment outside of two larger dips in July 7 and July 19, 2022 the rest of the deployment was without events.

The dips in conductivity are likely from a rainfall event. The rain dilutes the water column for a short period of time, this reduces the presence of any suspended particles or diluted salts.

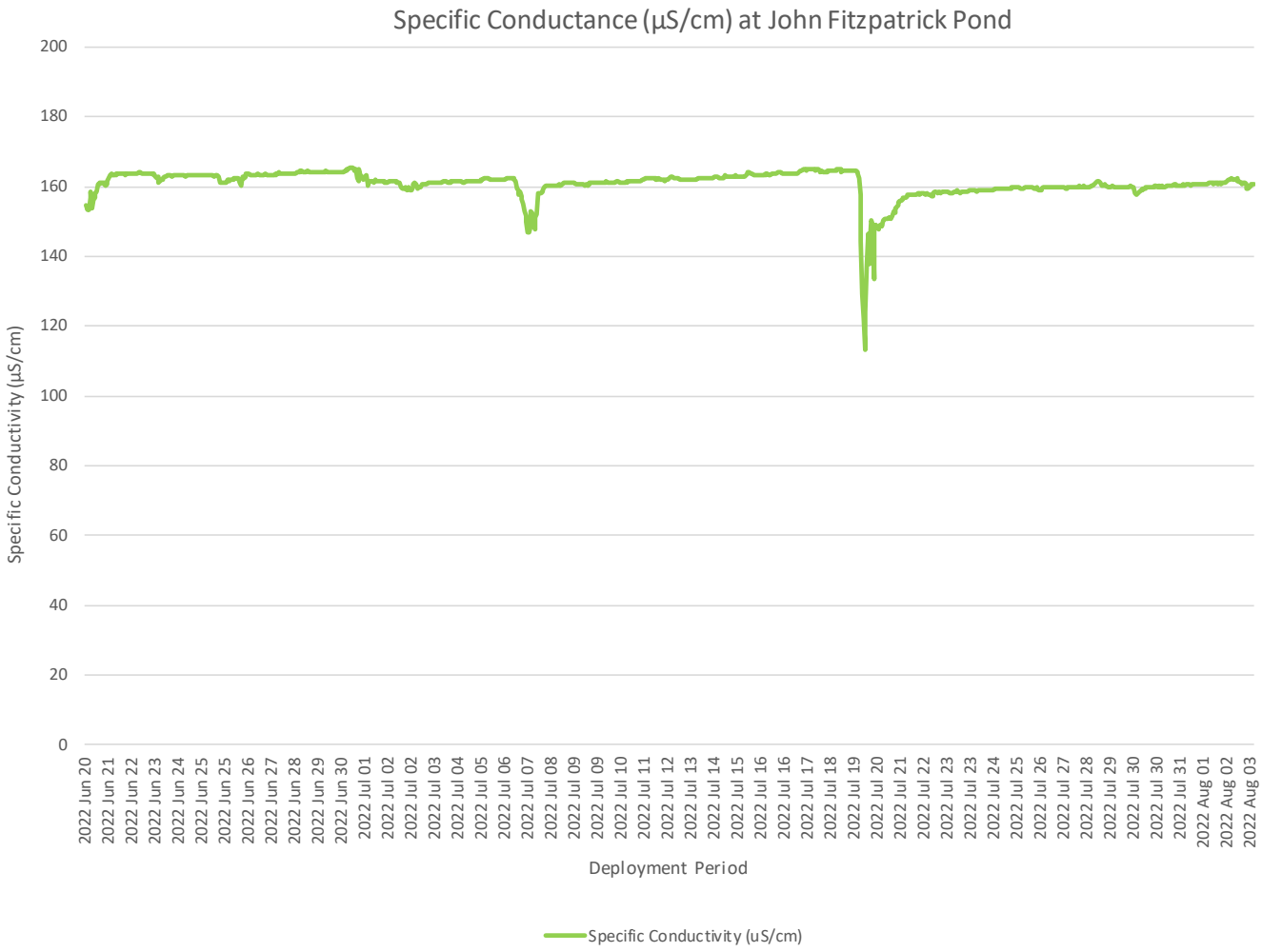

Figure 6: Specific conductivity (µS/cm) values

Dissolved Oxygen

The water quality instrument directly measures dissolved oxygen (mg/L) with the dissolved oxygen probe. The instrument then calculates percent saturation (% Sat) taking into account the water temperature.

During the deployment, the dissolved oxygen concentration levels ranged within a minimum of 8.2 mg/L to a maximum of 10.24 mg/L. The percent saturation levels for dissolved oxygen ranged within 89.1 % Saturation to 110.4 % Saturation (Figure 7).

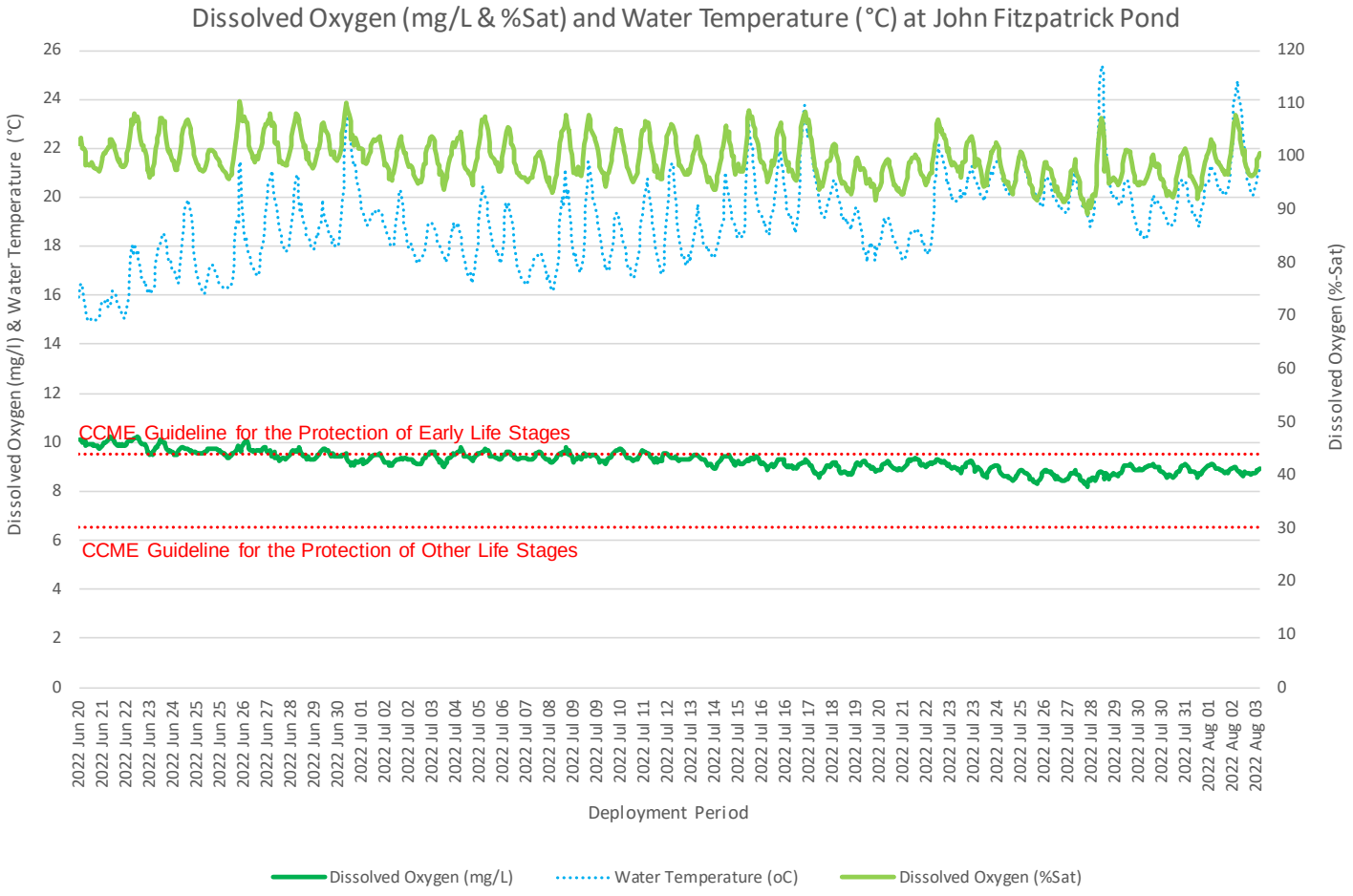

Figure 7: Dissolved Oxygen (mg/L & Percent Saturation) values and Water Temperature (°C)

Turbidity

Turbidity levels during the deployment ranged within 0.04 NTU and 30.58 NTU (Figure 8). The deployment data had a median of 1.01 NTU.

Turbidity was relatively stable during this deployment, with a single spike of 30.58 NTU which was likely a result of debris passing over the sensor while the instrument was taking a reading.

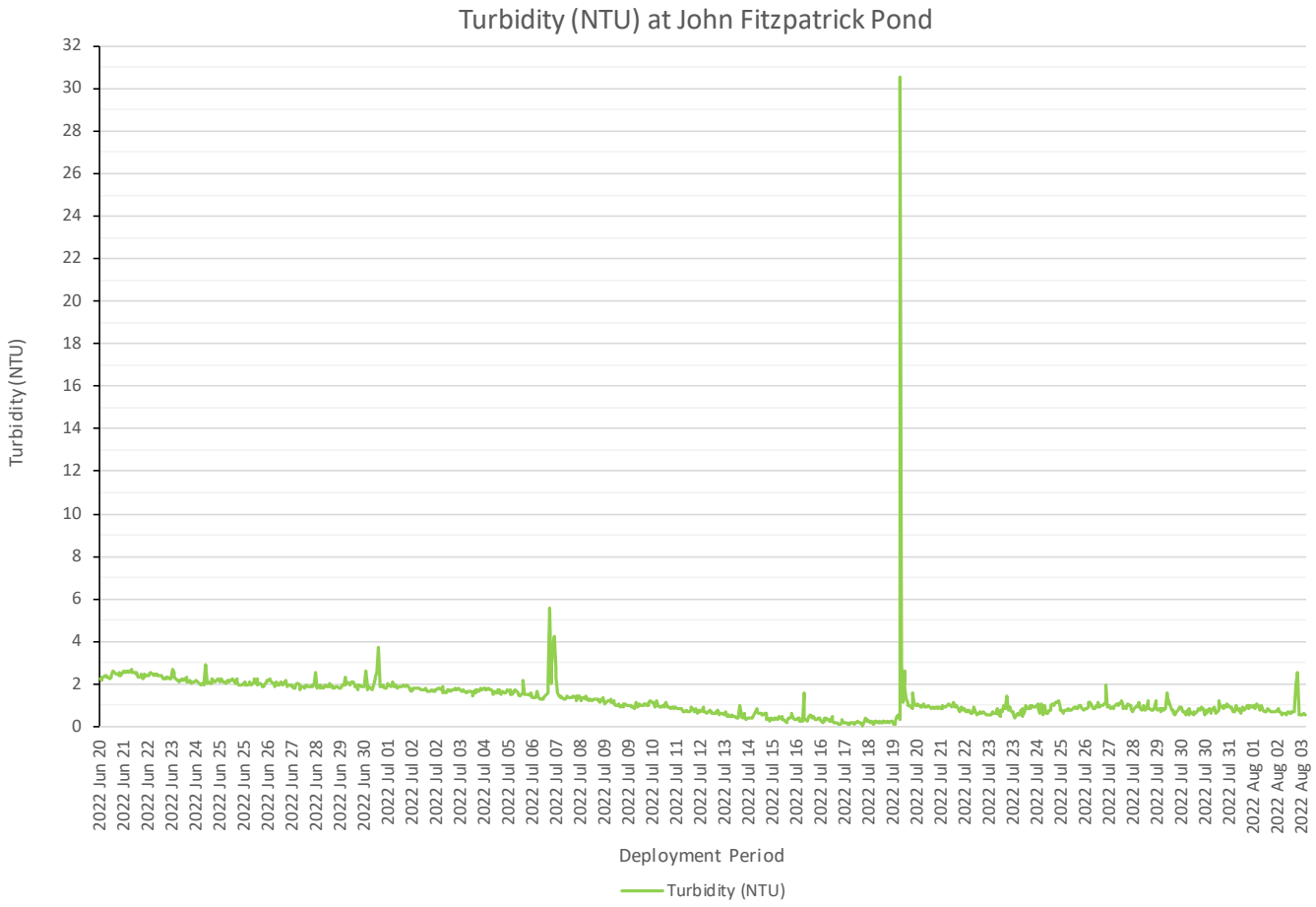

Figure 8: Turbidity (NTU) values.

Outflow of Unnamed Pond south of Long Pond

Water Temperature

Water temperature ranged from 13.20°C to 26.87°C during the deployment period (Figure 9). Water temperature displayed the natural diurnal pattern representing the influence of air temperature on the brook, with the high temperatures during the daylight hours and the low temperatures representing the nighttime hours.

Outside of the diurnal movement of the water temperature, the data does indicate small fluctuations corresponding to stage changes. As stage increases there is a slight decrease in the water temperature for a short period of time. These stage changes could be a result of precipitation.

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.

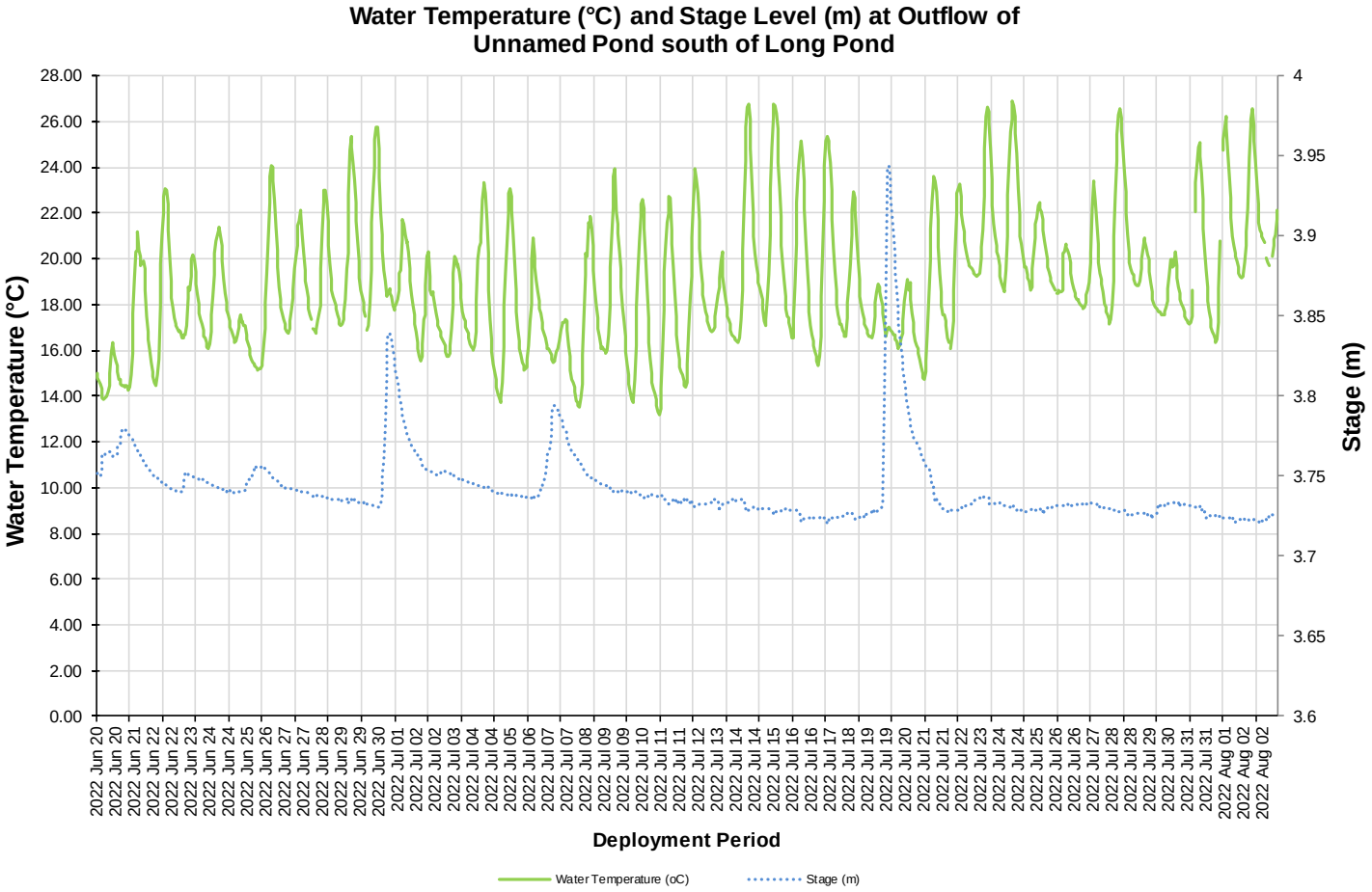

Figure 9: Water temperature (°C) values at Outflow of Unnamed Pond south of Long Pond

pH

Throughout this deployment period, pH values ranged within 7.31 pH units and 8.15 pH units (Figure 10), remaining within the Canadian Council of Ministers of the Environment (CCME) guidelines for aquatic life. The guidelines provide the overall range for the protection of aquatic life across all waterways in Canada. Every brook is different with its own specific natural background range.

Small decreases in pH during stage peaks are evident on Figure 10. The pH values returned to background levels shortly after each event, and overall the pH data was consistent across deployment. Natural processes such as rainfall and surrounding runoff will alter the pH of a brook for a period; however, it is the persistent long-term changes in pH that create the most damage to the natural aquatic environment.

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.

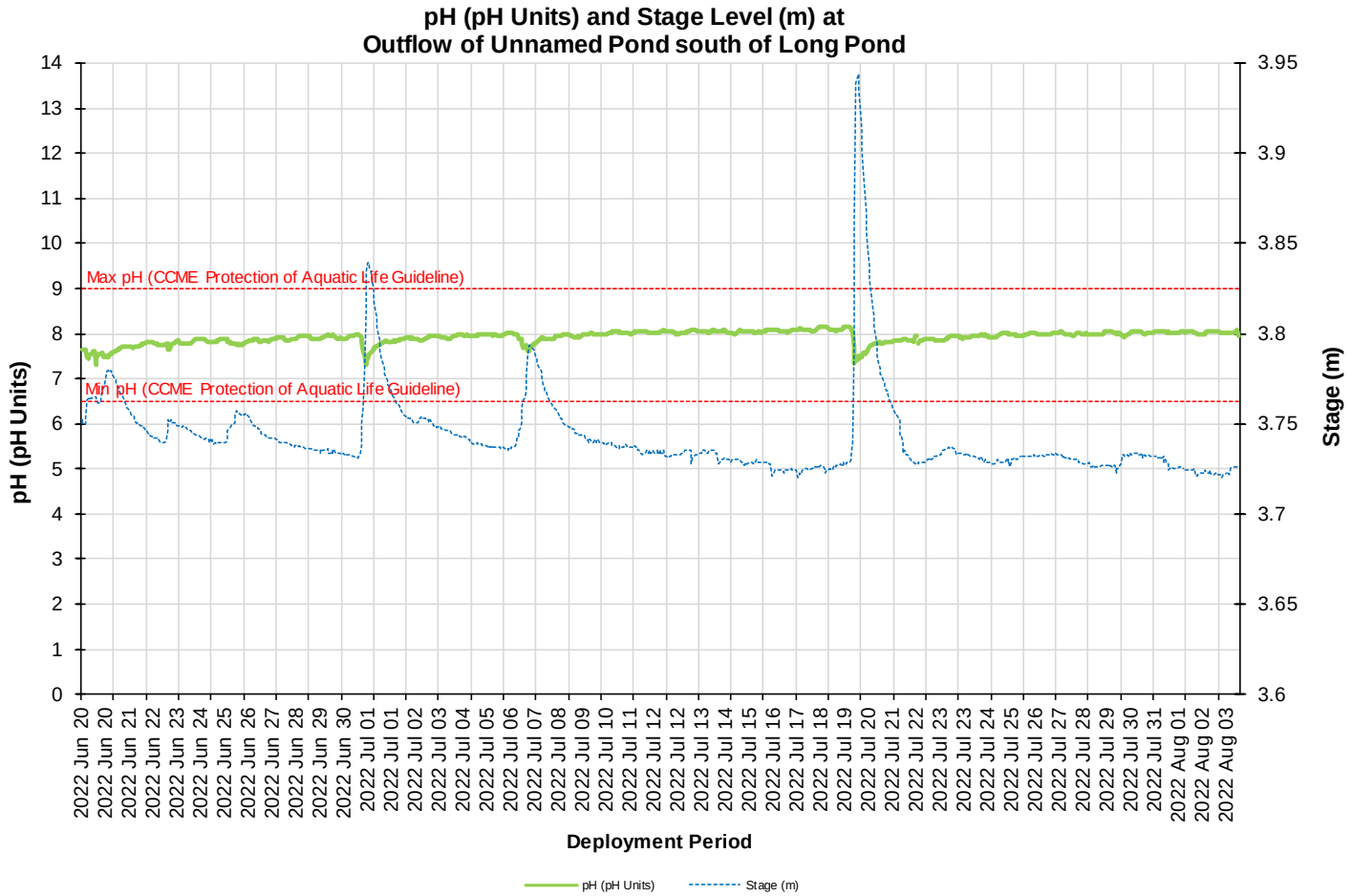

Figure 10: pH (pH units) at Outflow of Unnamed Pond south of Long Pond

Specific Conductivity

The conductivity levels ranged between 138.04 µS/cm and 342.8 µS/cm during deployment (Figure 11). The deployment period had a median of 264.41 µS/cm.

Changes in stage will influence the conductivity data (Figure 11). The extra volume of water during a stage increase will dilute the particulate matter present in a water column.

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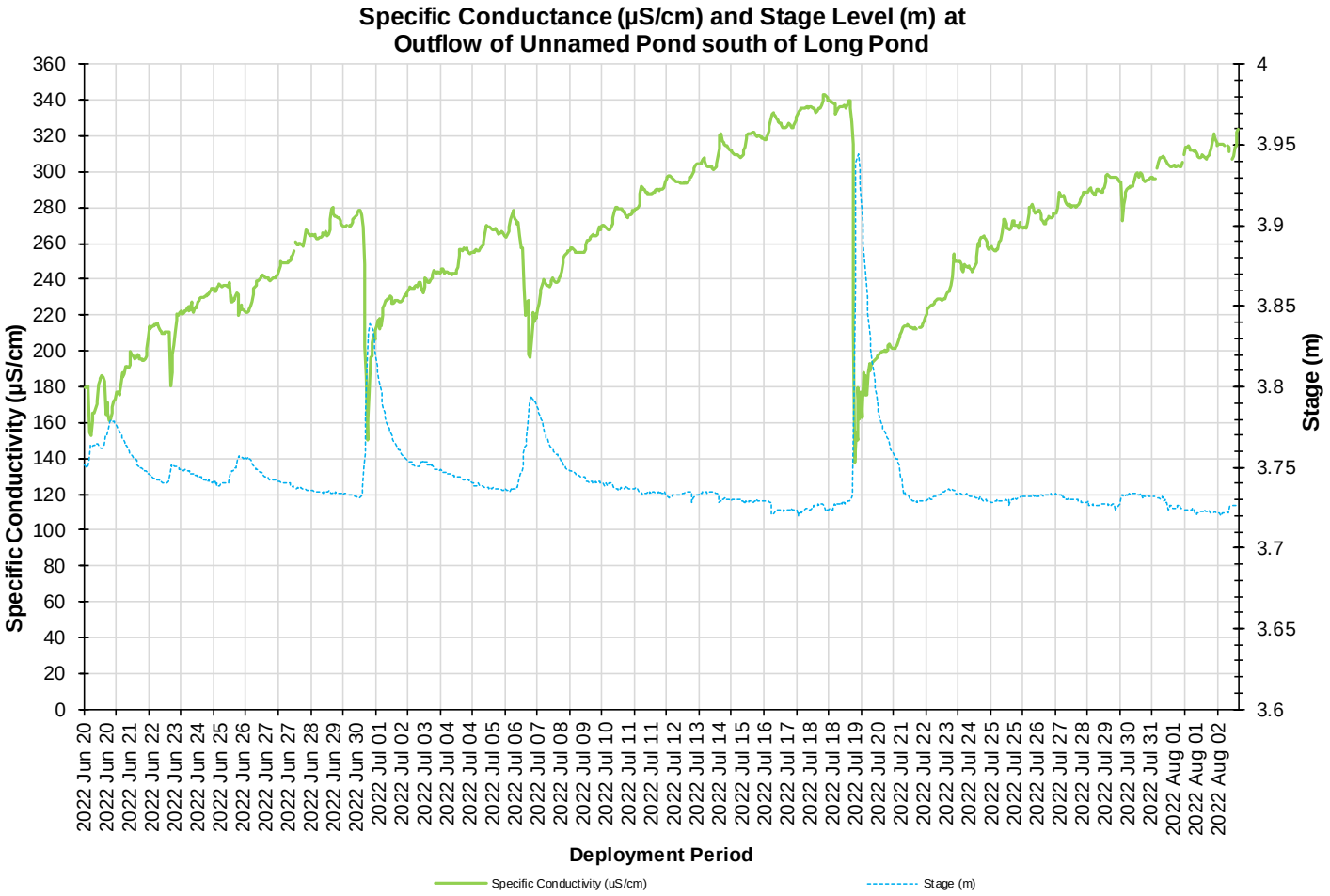

Figure 11: Specific conductivity (µS/cm) at Outflow of Unnamed Pond south of Long Pond

Dissolved Oxygen

The water quality instrument directly measures dissolved oxygen (mg/L) with the dissolved oxygen probe. The instrument then calculates percent saturation (% Sat) taking into account the water temperature. During this deployment, the dissolved oxygen levels ranged within 8.04 mg/L and 10.34 mg/L for concentration and 93.2 % and 103.4 % for percent saturation.

There is a natural diurnal pattern present in aquatic environments with dissolved oxygen. Oxygen concentration levels will fluctuate throughout night and day. Cooler night temperatures influence higher dissolved oxygen concentrations and warmer day temperatures influence lower concentrations. The movement in the diurnal pattern is evident on Figure 12. All other prominent dips/peaks - outside of the diurnal pattern - are a result of fluxes in water temperature or influences from rainfall/runoff.

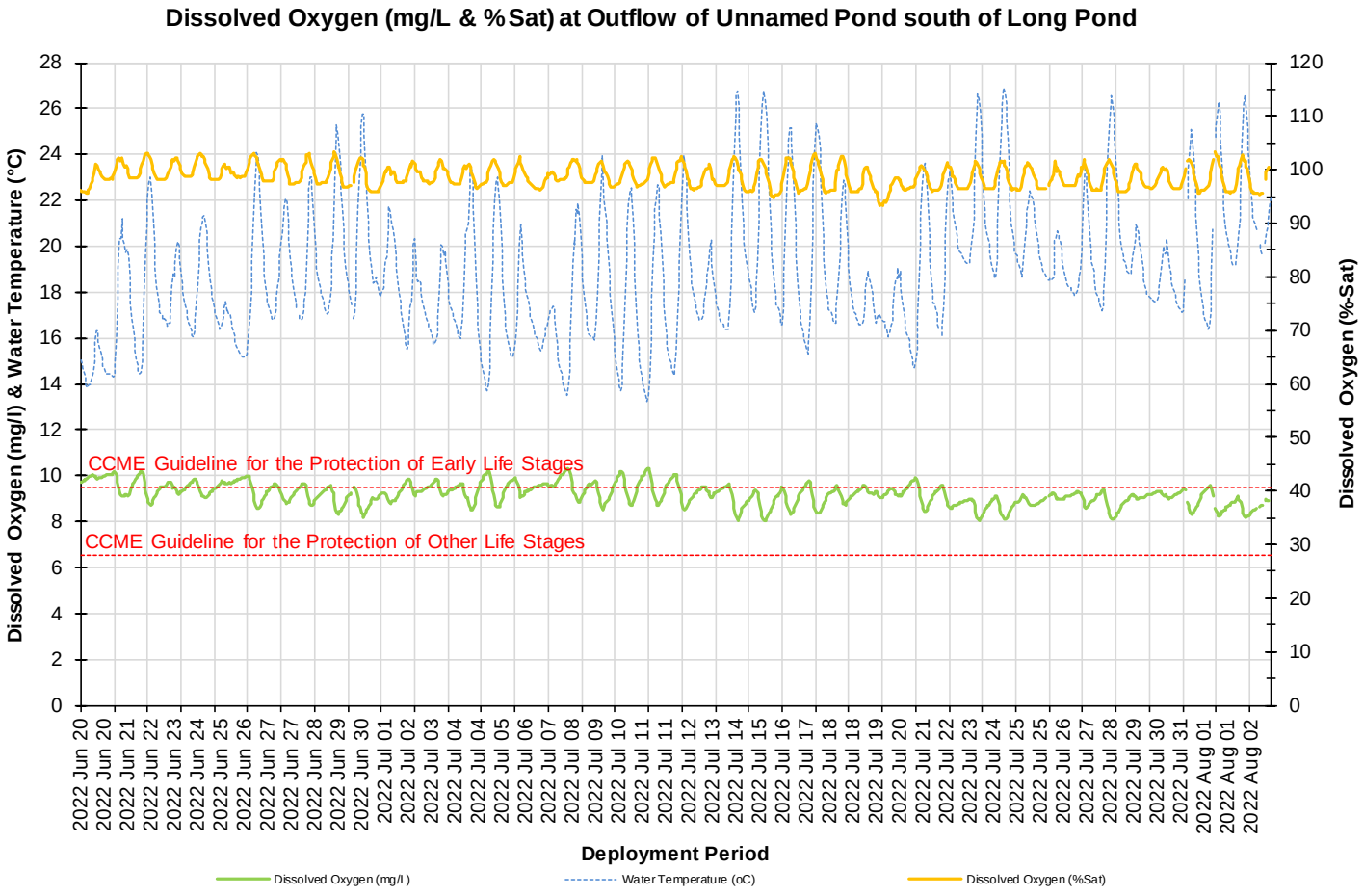

Figure 12: Dissolved Oxygen (%Sat & mg/L) at Outflow of Unnamed Pond south of Long Pond

Turbidity

Turbidity levels during the deployment ranged within 2 NTU and 12.9 NTU (Figure 13). The deployment data had a median of 3.9 NTU, indicating a slight increase in turbidity levels compared to previous deployment.

Turbidity remained below 6 NTU, outside the one large spike on July 19th which was 12.9 NTU likely a direct result of the large stage increase on the same day. Turbidity conditions continued to remain relatively low during this deployment which was likely a result of the work CFI have completed on reducing the runoff from the settling ponds upstream.

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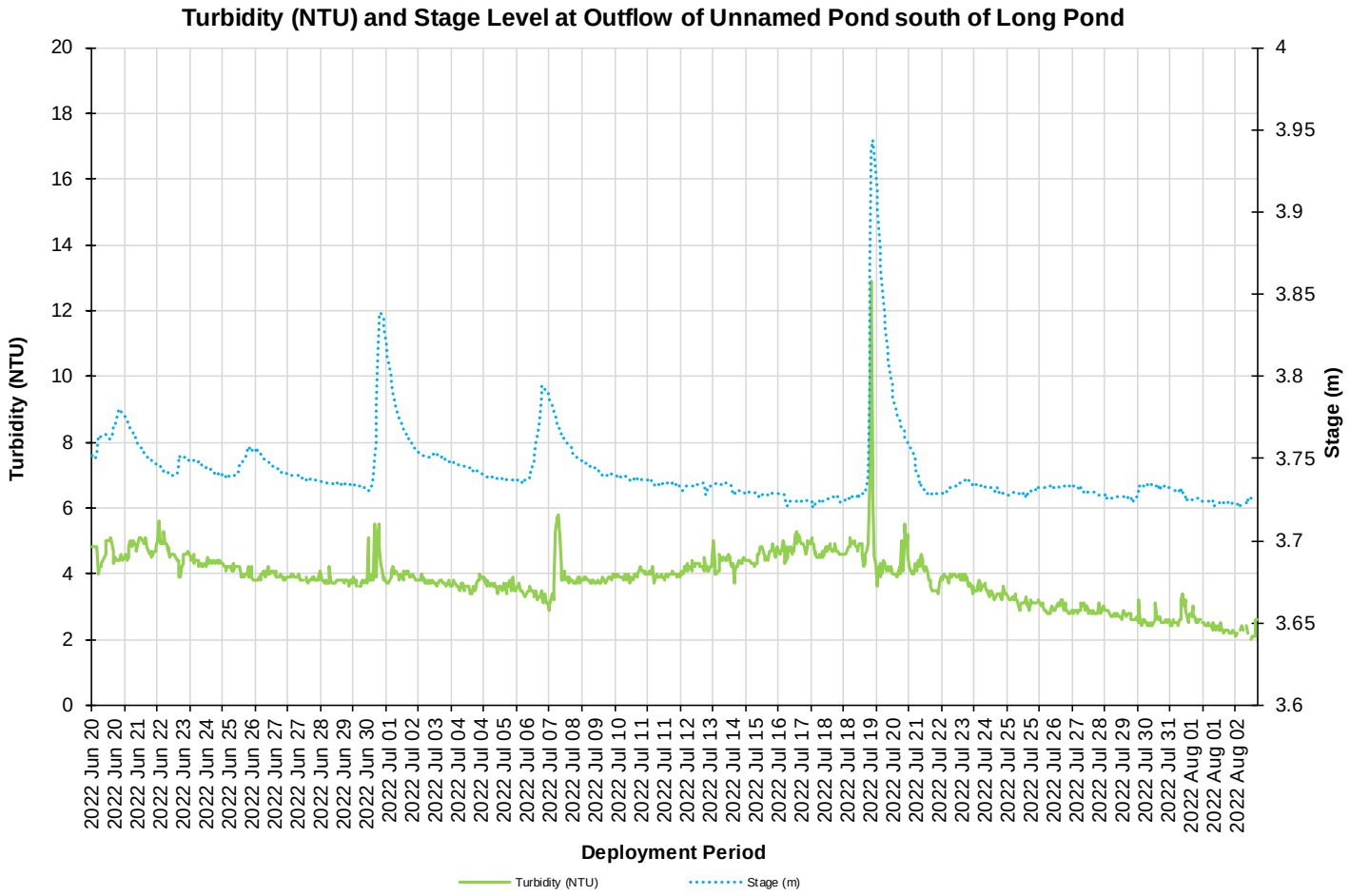

Figure 13: Turbidity (NTU) at Outflow of Unnamed Pond south of Long Pond

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 3.95m during the deployment. Stage increases during rainfall events (Figure 14) and during any surrounding snow or ice melt. However, direct snowfall will not cause stage to rise significantly.

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. The highest total precipitation was recorded on June 25th 2022 at 31.9 mm.

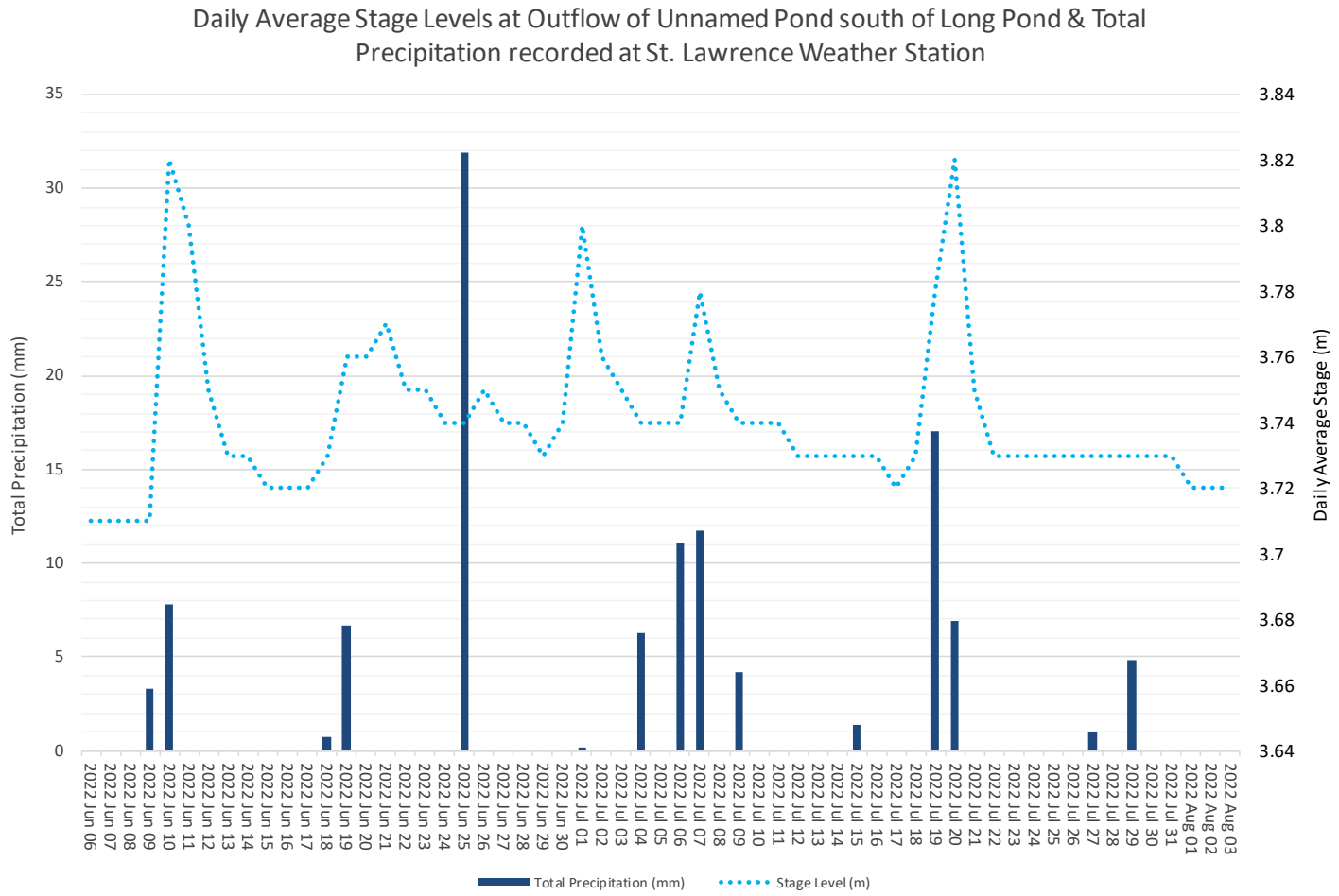

Figure 14: Daily averaged stage values and total precipitation.