Real-Time Water Quality Deployment Report

Teck: Duck Pond Operations

July 8, 2020 to August 19, 2020

Newfoundland Labrador

Government of Newfoundland & Labrador
Department of Environment, Climate Change & Municipalities
Water Resources Management Division
St. John's, NL, A1B 4J6 Canada

General

This report will review the water quality data for the following two real-time water quality monitoring stations at TECK Duck Pond, Tributary to Gills Pond Brook and East Pond Brook below East Pond for the duration of July 8, 2020 to August 19, 2020.

These stations are a part of the Real-Time Water Quality Monitoring Network. The stations are maintained by the Department of Environment, Climate Change and Municipalities, Water Resources Management Division (WRMD). WRMD staff are responsible for the maintenance and calibration of the water quality instruments deployed at these sites. The data recorded by the real-time water quality stations is available on the real-time website: www.gov.nl.ca/eccm/waterres/rti/stations/

For the purposes of this report, air temperature and total precipitation data is obtained from the weather station located in Millertown. For this deployment period there was no precipitation data available, therefore there will be no precipitation data graphed with air temperature in Appendix I.

During the deployment, Tributary to Gills Pond Brook stage data had been incorrectly adjusted, hence the large spike in stage from July 28 to August 18, 2020. The stage data was then adjusted back at the end of the deployment. Stage Level data is raw data, and the data has not been corrected. Corrected and finalized data may be retrieved from the Environment Climate Change Canada, Water Survey of Canada website.

The climate data was retrieved from https://climate.weather.gc.ca/climate_data/daily_data_e.html?hlyRange=2013-01-21%7C2020-05-28&dlyRange=2013-01-21%7C2020-05-28&mlyRange=%7C&StationID=50678&Prov=NL&urlExtension=_e.html&searchType=stnName&optLimit=yearRange&StartYear=2020&EndYear=2020&selRowPerPage=25&Line=0&searchMethod=contains&Month=5&Day=28&txtStationName=Millertown&timeframe=2&Year=2020

Maintenance and Calibration of Instrument

As part of the Quality Assurance and Quality Control protocol (QAQC), 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.

Upon deployment, a QA/QC Sonde is temporarily deployed *in situ*, adjacent to the Field Sonde. Depending on the degree of difference between each parameter from the Field and QAQC sondes a qualitative rank is assigned (See Table 1). The possible ranks, from most to least desirable, are: Excellent, Good, Fair, Marginal, and Poor. A grab sample is also taken for additional confirmation of conditions at deployment and to allow for future modelling studies.

At the end of a deployment period, a freshly cleaned and calibrated QAQC Sonde is placed *in situ*, adjacent to the Field Sonde. Values are compared between all parameters and differences are ranked for placement in Table 1.

Table 1: Qualitative QAQC Ranking

Station	Date	Action	Comparison Ranking				
			Temperature	pH	Conductivity	Dissolved Oxygen	Turbidity
Tributary to Gill's Pond Brook	July 8 2020	Deployment	Good	Excellent	Excellent	Excellent	Excellent
	Aug 19 2020	Removal	Excellent	Excellent	Excellent	Excellent	Excellent
East Pond Brook below East Pond	July 8 2020	Deployment	Excellent	Good	Good	Excellent	Excellent
	Aug 19 2020	Removal	Excellent	Marginal	Good	Excellent	Excellent

Data Interpretation

Water Temperature

Water Temperature is a major factor used to describe the characteristics of a water body. Temperature has major implications on both the ecology and chemistry of a water body, influencing processes such as the metabolic rate of aquatic plants and animals and the degree of dissolved oxygen saturation.

The statistical data for East Pond Brook below East Pond recorded the lowest minimum value for water temperature at 11.33°C and recorded the highest maximum value for water temperature at 27.87°C (Table 2). Tributary to Gills Pond Brook recorded a range of 11.95°C to 27.16°C. Water temperatures during this deployment relate to the warmer air temperatures occurring at this time of year. Both sets of water temperature data display the natural diurnal pattern that demonstrates the higher temperatures in the day light hours and lower temperatures in the nighttime hours.

Stage Level data is raw data, and the data has not been corrected. Stage level at Tributary to Gills Pond Brook had been adjusted in the middle of the deployment, causing the data to change significantly. This does not represent a stage increase. Corrected and finalized data may be retrieved from the Environment Climate Change Canada, Water Survey of Canada website https://www.canada.ca/en/environment-climate-change/services/water-overview/quantity/monitoring/survey.html

Table 2. Table of the statistical data for East Pond Brook and Tributary to Gills Pond Brook for July 2020 to August 2020

Station	Mean	Median	Min	Max
East Pond Brook	19.08	18.66	11.33	27.87
Tributary to Gills Pond Brook	19.45	19.24	11.95	27.16

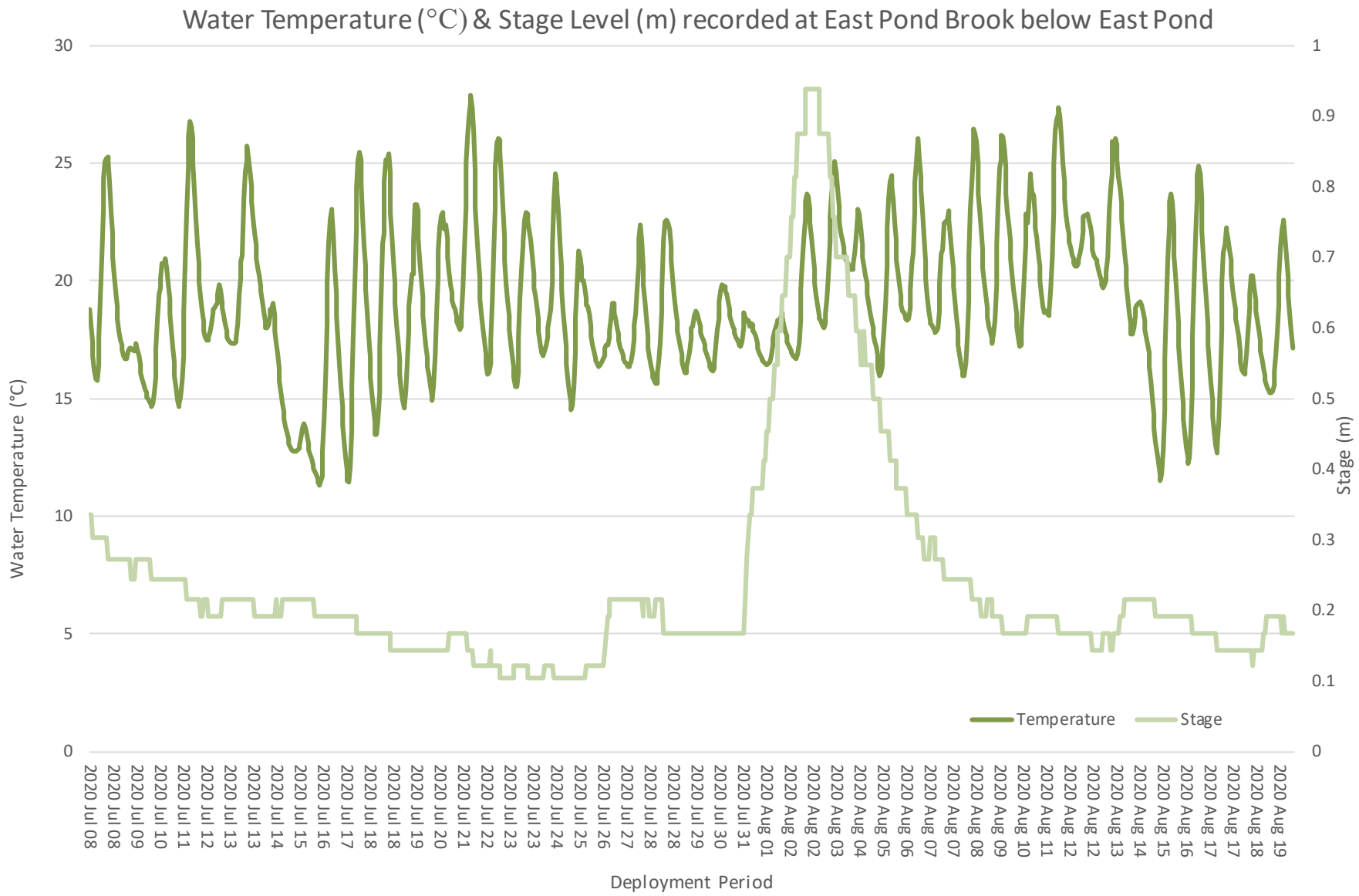


Figure 1. Water Temperature (°C) at East Pond Brook

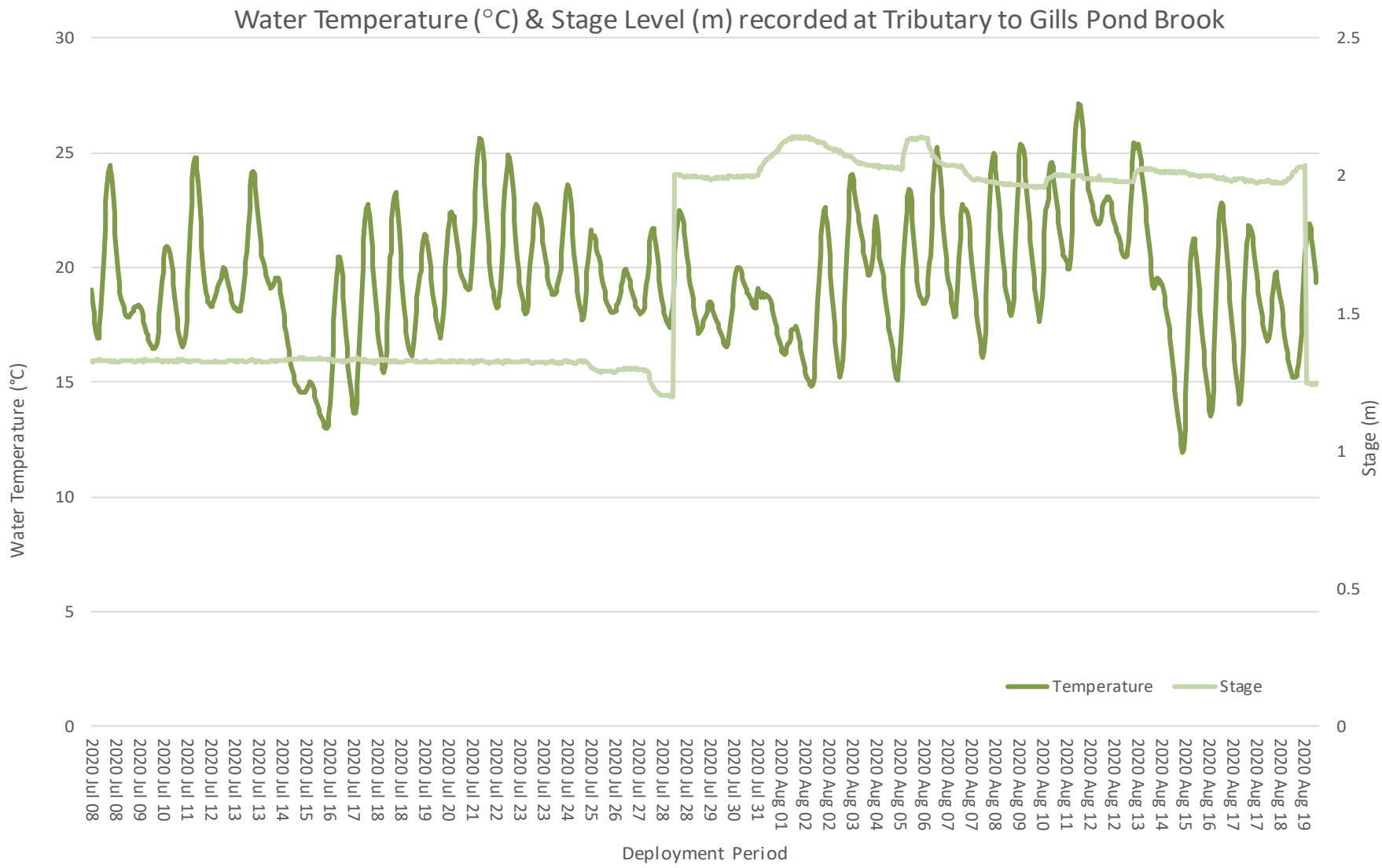


Figure 2. Water Temperature (°C) and Stage Level (m) at Tributary at Gills Pond Brook

pH

pH indicates the acidity or alkalinity of a solution. A value of 7.00 pH units denotes a neutral solution while lower values are acidic and higher values are basic. The pH levels at Tributary to Gills Pond Brook ranged within a minimum of 6.66 (pH units) to a maximum of 7.54 (pH units) (Table 3). pH data at East Pond Brook ranged within 6.88 (pH units) and 7.29 (pH units).

This deployment captures pH data during the summer. A large stage increase in early August causes the pH at Tributary to Gills Pond Brook to decrease slightly before returning to a background level. pH levels at both sites remained stable across the deployment.

The CCME guideline noted on the pH graph is a range by which to compare pH levels across Canada. It does not indicate the health of the brook. Due to the soil composition and natural geology of Newfoundland and Labrador, many of the brooks and waterways in the province have naturally lower pH ranges.

Stage Level data is raw data. This data has not been corrected. Stage level at Tributary to Gills Pond Brook had been adjusted in the middle of the deployment, causing the data to change significantly. This does not represent a stage increase. Corrected and finalized data, can be retrieved from the Environment Climate Change Canada, Water Survey of Canada website https://www.canada.ca/en/environment-climate-change/services/water-overview/quantity/monitoring/survey.html

Table 3. Table of the statistical data for East Pond Brook and Tributary to Gills Pond Brook for July 2020 to August 2020

Station	Mean	Median	Min	Max
East Pond Brook	7.04	7.04	6.88	7.29
Tributary to Gills Pond Brook	7.27	7.28	6.66	7.54

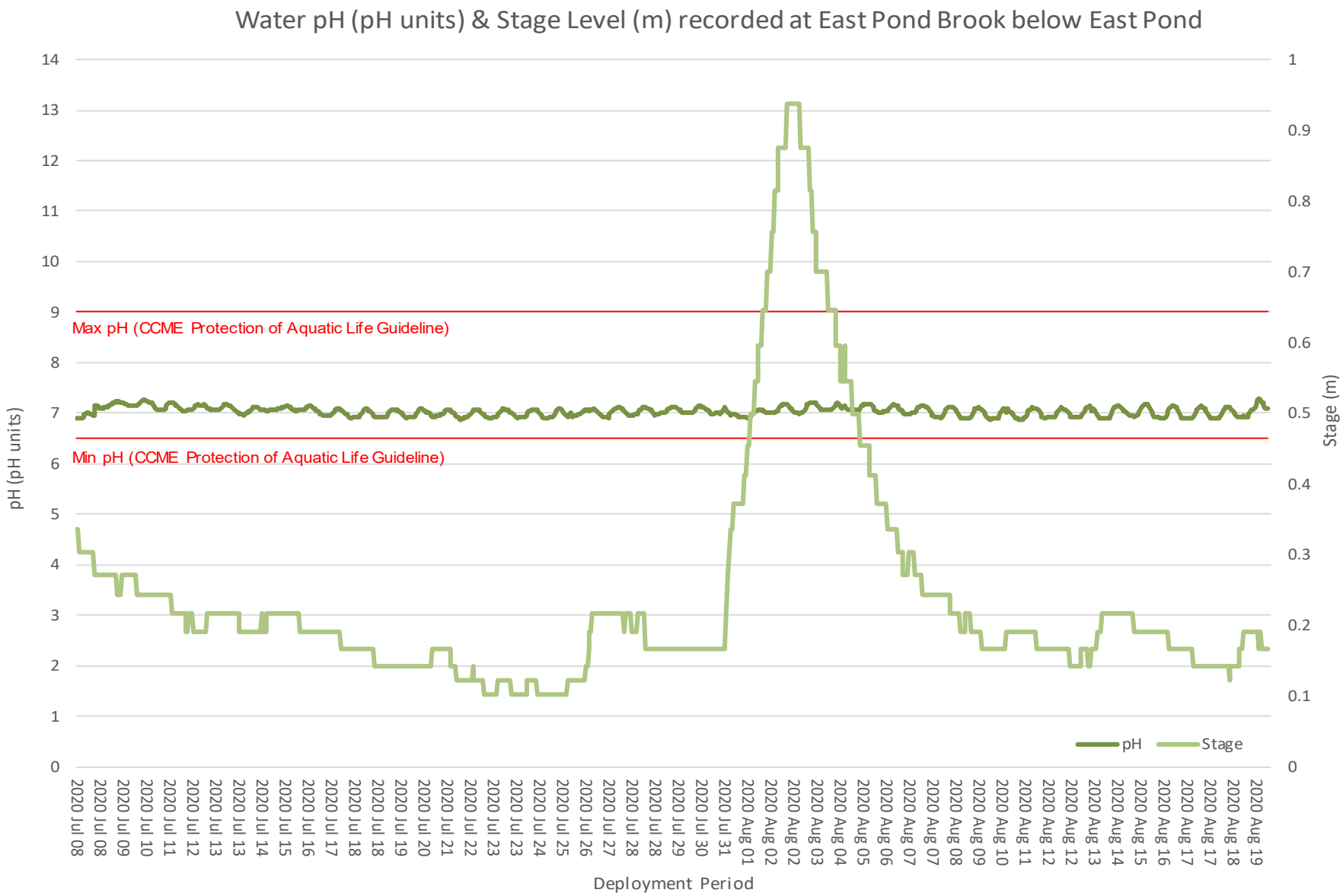


Figure 3. pH (pH units) and Stage Level (m) at East Pond Brook

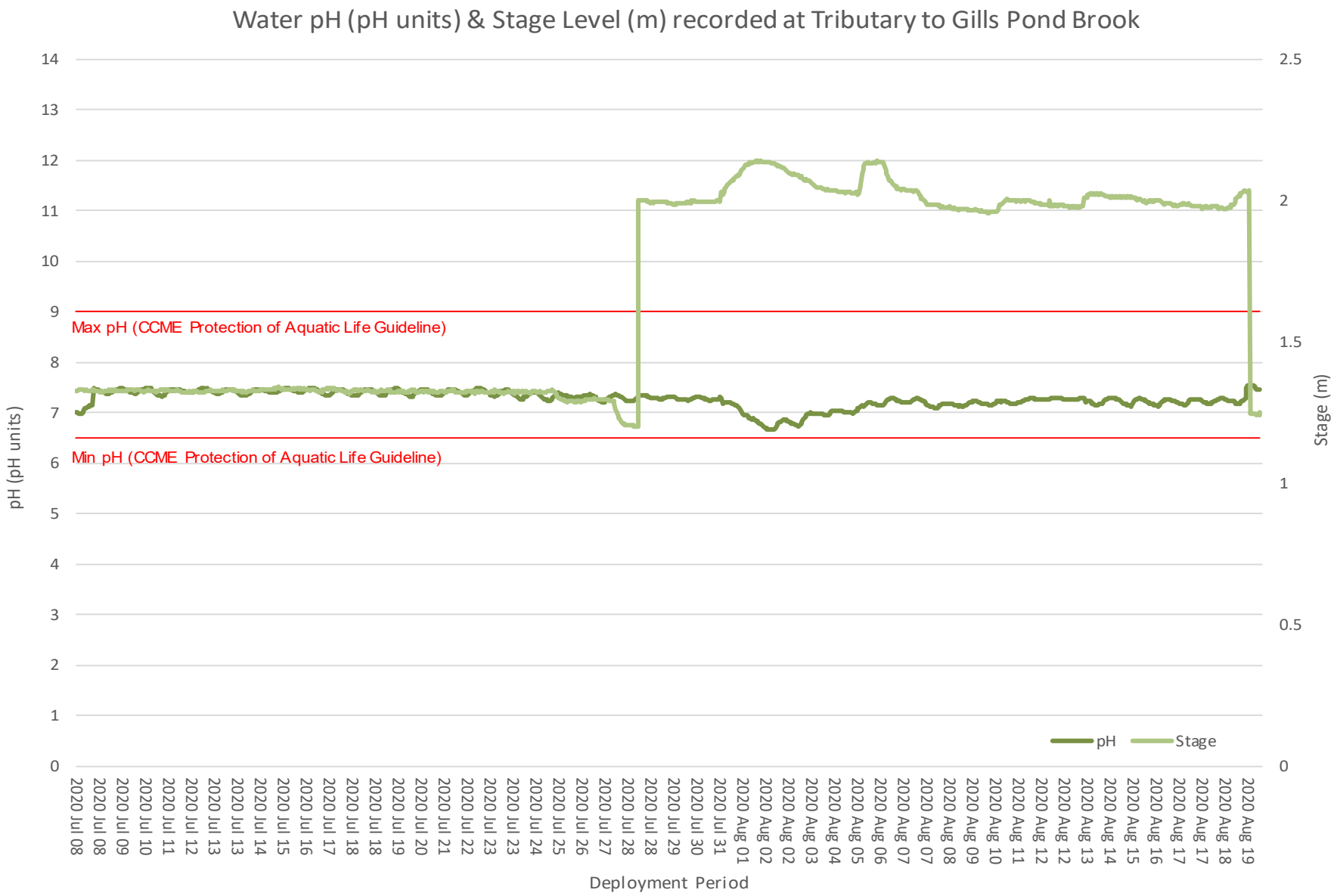


Figure 4. pH (pH units) and Stage Level (m) at Tributary at Gills Pond Brook

Specific Conductivity

Conductivity relates to the ability of an electric charge – or resistance – to pass through a solution. Conductivity is highly influenced by the concentration of dissolved ions in solution: distilled water has zero conductivity (infinite resistance) while salty solutions have high conductivity (low resistance). Specific Conductivity is corrected to 25^{o}C to allow comparison across variable temperatures.

The conductivity data captured the characteristics of the two water bodies during summer. Tributary to Gills Pond Brook has significantly higher conductivity data and a larger range of data than East Pond Brook. This could be a result of several factors, including the diluted effluent discharges into Tributary to Gills Pond brook from Duck Pond Mines. The effluent would increase the amount of dissolved ions in the water column during discharge, and therefore the conductivity would increase during discharge times. Figure 7 displays the effluent discharge (m^3/day) that occurred across deployment. Other factors that could influence conductivity are low precipitation and evaporation of water, both which are a direct result of the warmer temperatures occurring during summer.

There was an increase in stage level at Tributary to Gills Pond Brook on August 1 -2nd, however, the specific conductivity responded with a decrease (Figure 5), indicating that the dissolved ions in the water column were diluted or flushed out for a period of time. For the remainder of deployment, conductivity levels continued to respond to the stage level: as the stage increased so did conductivity.

East Pond Brook below East Pond station also displayed a rise in stage on August 1st, 2020. This increase influenced the specific conductivity to increase as well, before returning to background levels. Although there was no record of a large precipitation event on August 1 -2, 2020, there was a series of rainfall events that occurred over a couple of days leading up to August 1-2, 2020 which likely influenced the stage levels (Appendix I).

Stage Level data is raw data. This data has not been corrected. Stage level at Tributary to Gills Pond Brook had been adjusted in the middle of the deployment, causing the data to change significantly. This does not represent a stage increase. Corrected and finalized data may be retrieved from the Environment Climate Change Canada, Water Survey of Canada website https://www.canada.ca/en/environment-climate-change/services/water-overview/quantity/monitoring/survey.html

Table 4. Table of the statistical data for East Pond Brook and Tributary to Gills Pond Brook for July 2020 to August 2020

Station	Mean	Median	Min	Max
East Pond Brook	37.6	37.1	32.2	48.7
Tributary to Gills Pond Brook	665.7	736.5	134.8	916.0

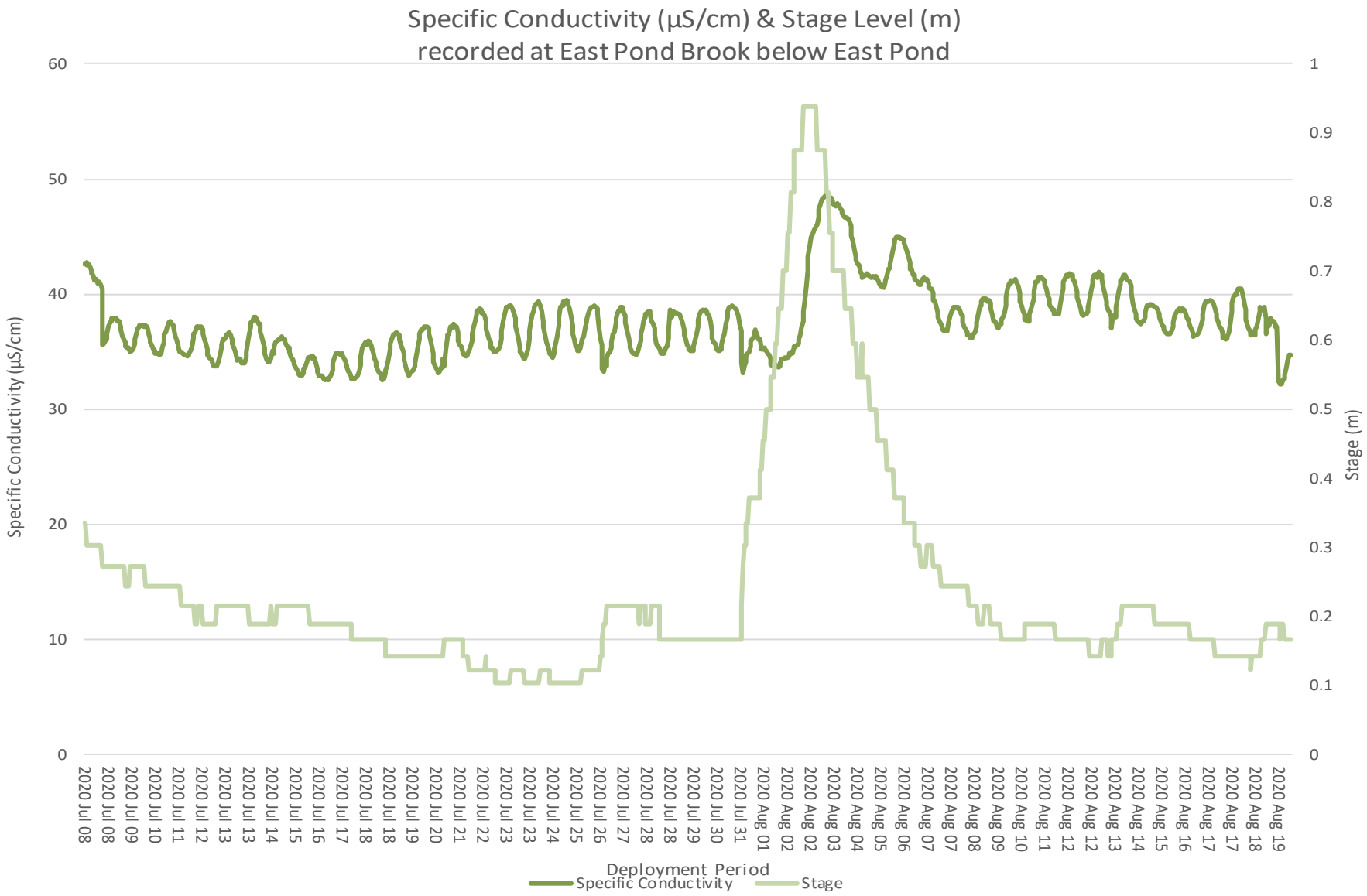


Figure 5. Specific Conductivity (µS/cm) and Stage Level (m) at East Pond Brook

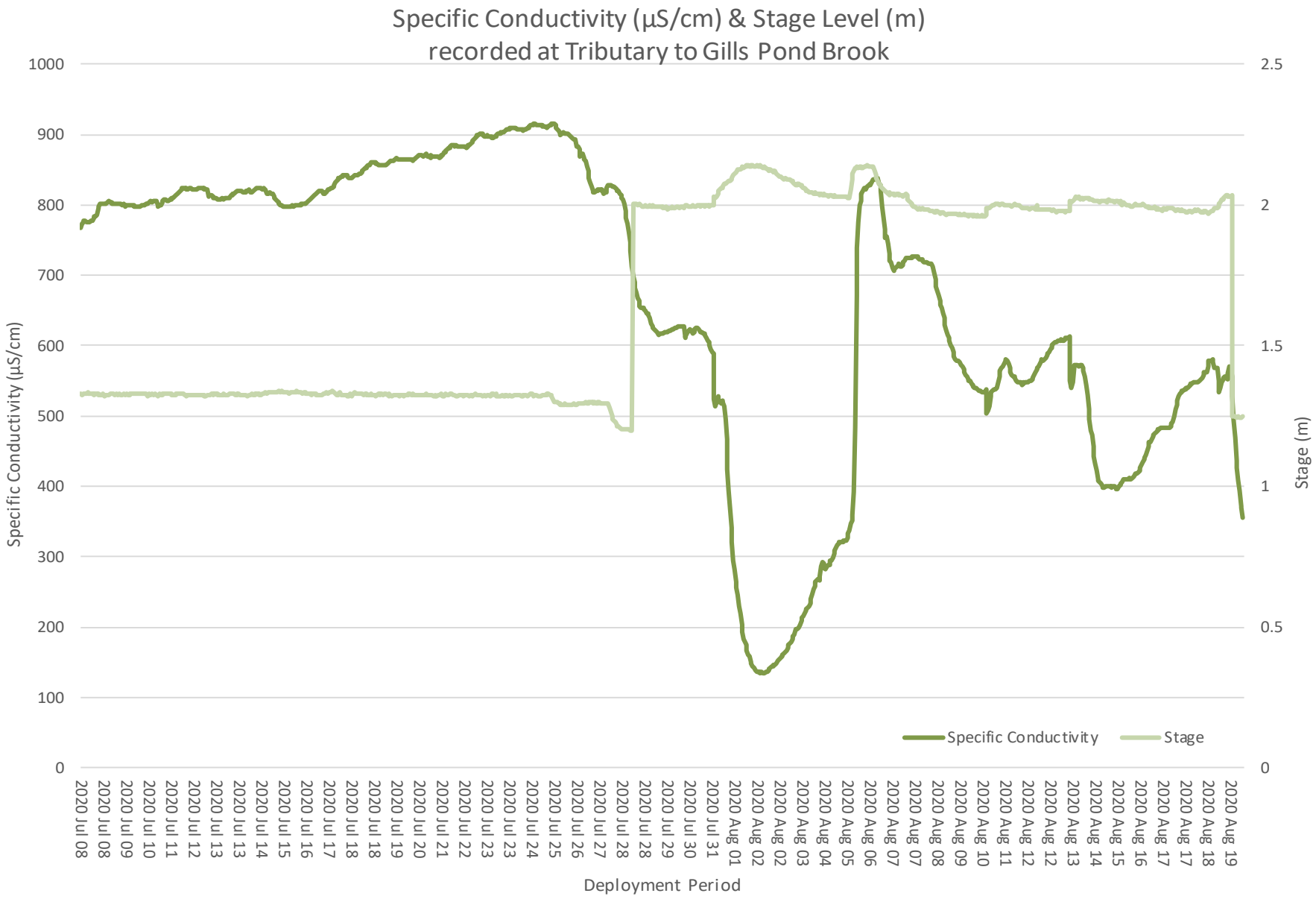


Figure 6. Specific Conductivity (µS/cm) and Stage Level (m) at Tributary at Gills Pond Brook

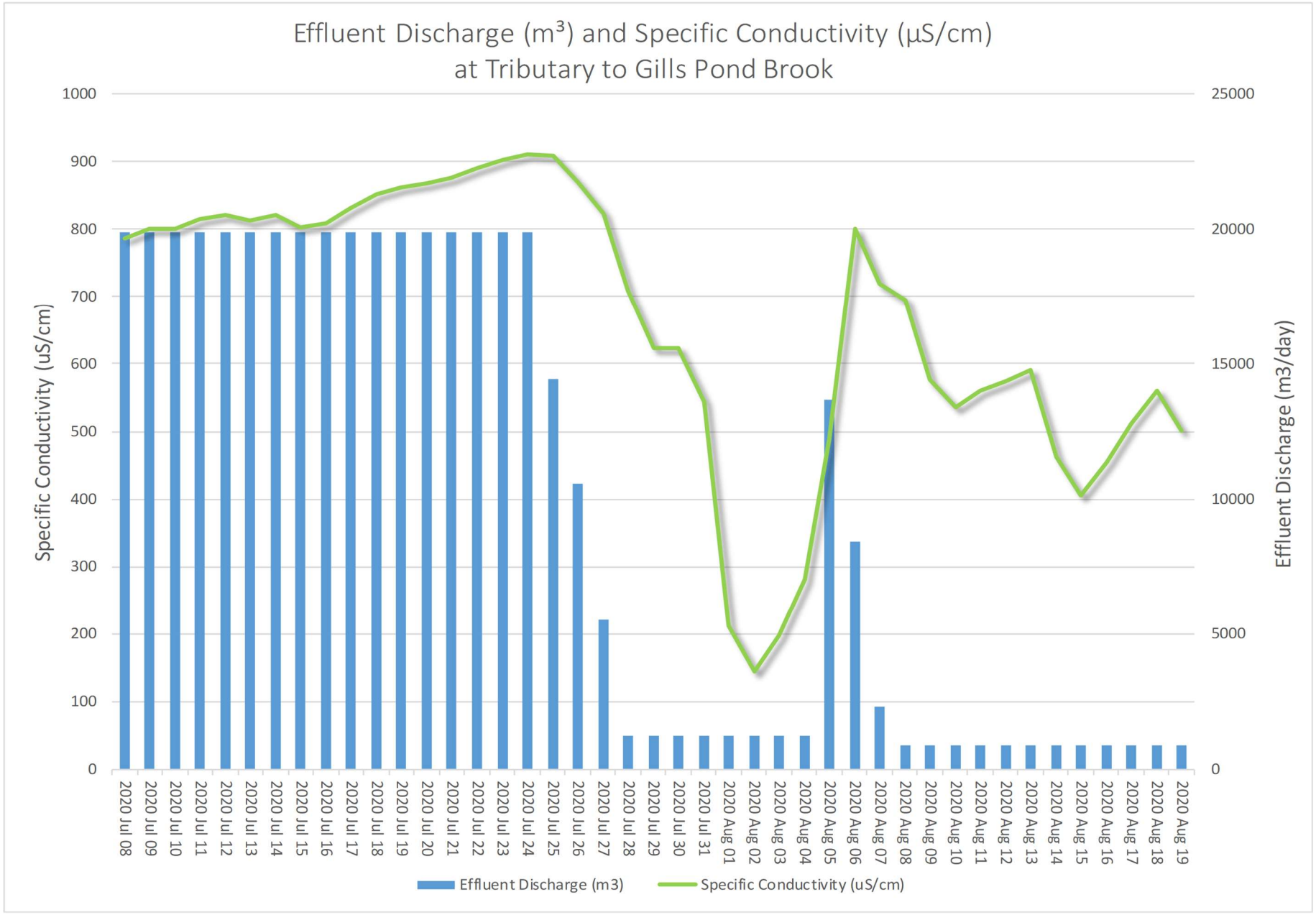


Figure 7. Effluent Discharge (m³/day) and Specific Conductivity (µS/cm) at Tributary at Gills Pond Brook

Dissolved Oxygen

Dissolved oxygen is a metabolic requirement of aquatic plants and animals. The concentration of oxygen in water depends on several factors, particularly temperature. The saturation of oxygen in water is inversely proportional to water temperature of the water body. Oxygen concentrations also tend to be higher in flowing water compared to still, lake environments. Low oxygen concentrations can give an indication of excessive decomposition of organic matter or the presence of oxidizing materials.

Dissolved oxygen concentrations (DO mg/L) at Tributary to Gills Pond Brook and East Pond Brook hovered below the CCME guideline for early life stages for the majority of the deployment. As the water temperature of the brook changed throughout the day, it influenced the concentration of DO (mg/L) in the water column. Both sites display small increases in DO mg/L on July 14 -15, 2020 and August 14-15, 2020. The increases correspond with small decreases in water temperature (Figure 2).

Table 5. Table of the statistical data for East Pond Brook and Tributary to Gills Pond Brook for July 2020 to August 2020

Station	Mean	Median	Min	Max
Dissolved Oxygen (mg/L)				
East Pond Brook	8.67	8.64	7.40	10.42
Tributary to Gills Pond Brook	8.65	8.66	7.47	10.04
Dissolved Oxygen (%Sat)				
East Pond Brook	93.3	92.8	86.8	102.1
Tributary to Gills Pond Brook	94.1	93.7	100.1	90.2

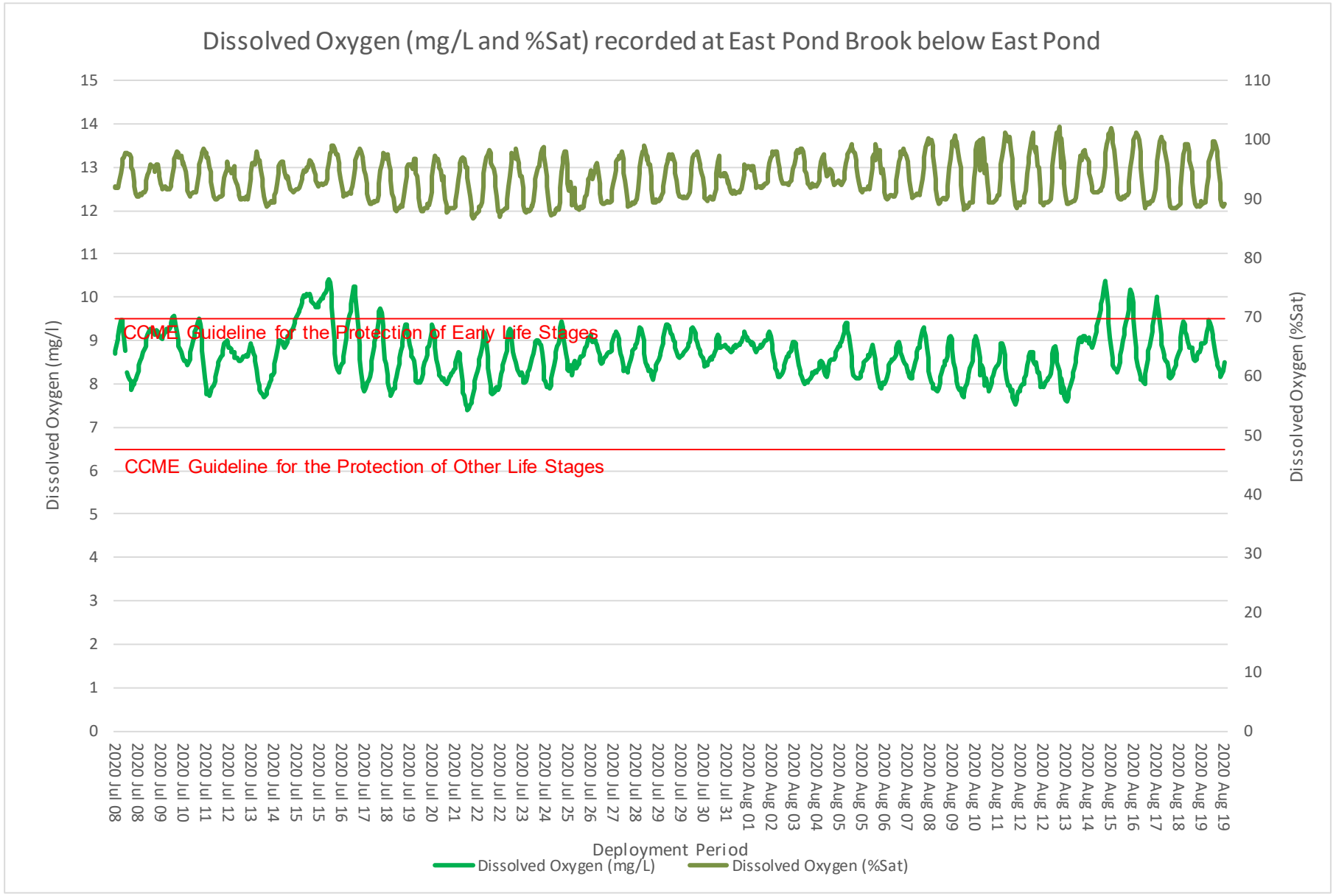


Figure 8. Dissolved Oxygen (mg/L & sat %) and Stage Level (m) at East Pond Brook

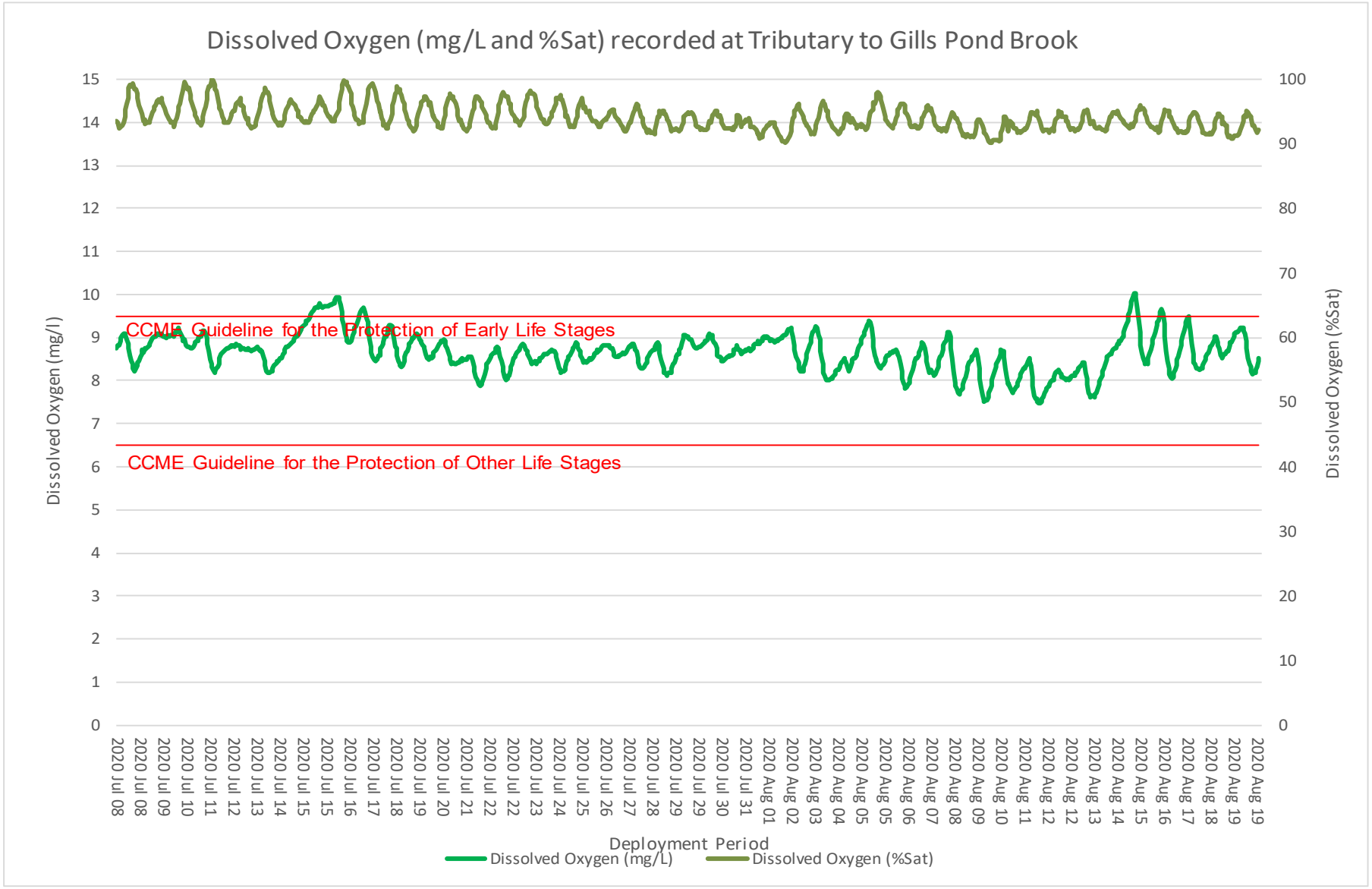


Figure 9. Dissolved Oxygen (mg/L & % Sat) at Tributary at Gills Pond Brook

Turbidity

Turbid water is typically caused by fine suspended solids, such as silt, clay, or organic material. Consistently high levels of turbidity tend to block sunlight penetration into a waterbody, discouraging plant growth. High turbidity can also damage the delicate respiratory organs of aquatic animals and cover spawning areas.

Turbidity levels are generally low at East Pond Brook below East Pond (Figure 10). East Pond Brook has a natural tea-like color to the water, likely influenced by the surrounding marsh and bog lands. It is common for surface water to have a level of background turbidity as the surrounding ecosystems can influence the particulate matter present naturally. Persistent spikes and a prolonged increase in turbidity over a period would be of concern.

East Pond Brook below East Pond recorded turbidity data within 0.0 NTU to 44.6 NTU. The turbidity at Tributary to Gills Pond Brook ranged within 0.0 NTU to 3.3 NTU. The effluent discharged into Tributary to Gills Pond can increase turbidity for a short period of time, however this was not evident during this deployment.

Stage Level data is raw data. This data has not been corrected. Stage level at Tributary to Gills Pond Brook had been adjusted in the middle of the deployment, causing the data to change significantly. This does not represent a stage increase. Corrected and finalized data may be retrieved from the Environment Climate Change Canada, Water Survey of Canada website https://www.canada.ca/en/environment-climate-change/services/water-overview/quantity/monitoring/survey.html

Table 6. Table of the statistical data for East Pond Brook and Tributary to Gills Pond Brook for July 2020 to August 2020

Station	Mean	Median	Min	Max
East Pond Brook	0.2	0.0	0.0	44.6
Tributary to Gills Pond Brook	0.1	0.0	0.0	3.3

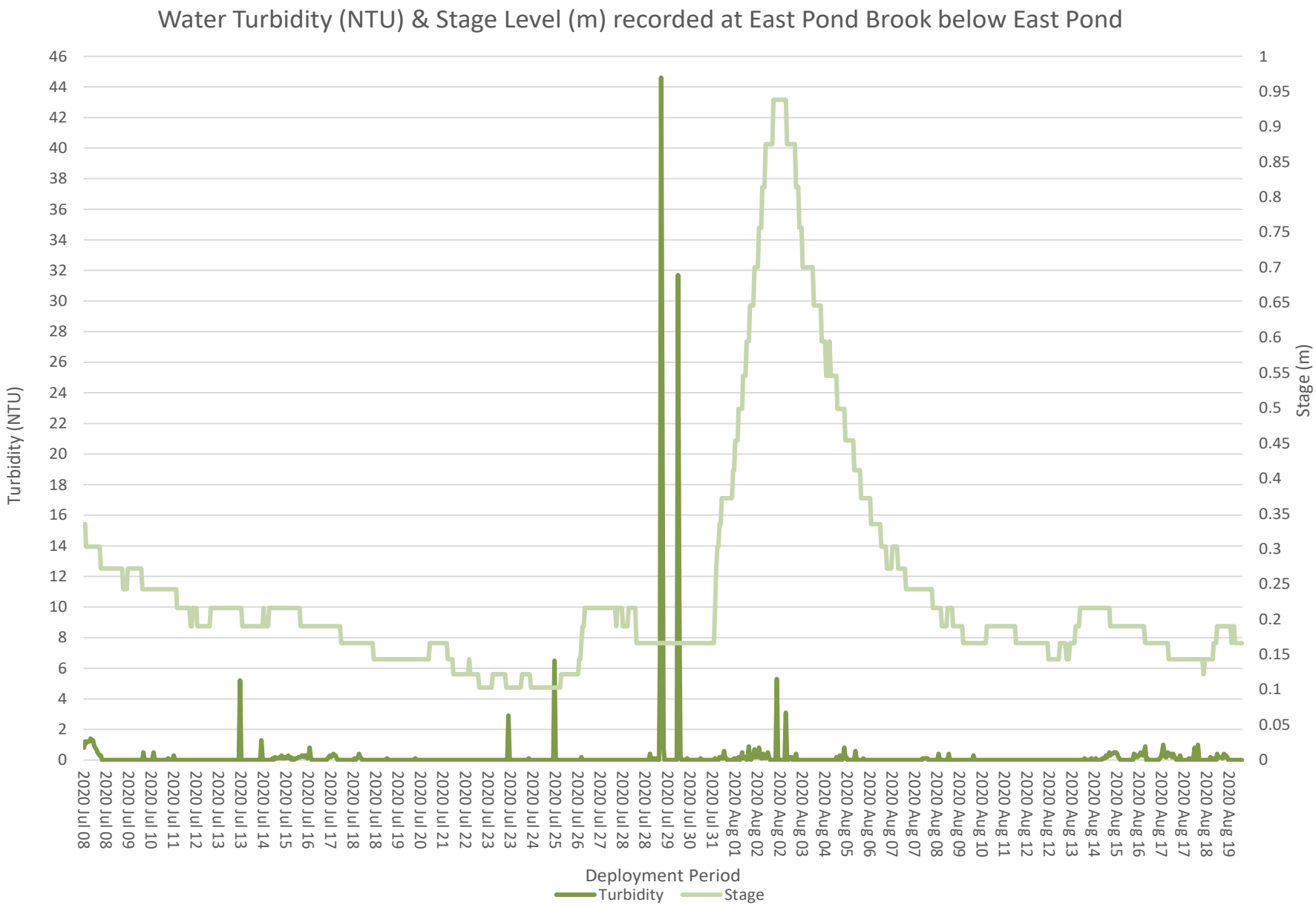


Figure 10. Turbidity (NTU) and Stage Level (m) at East Pond Brook

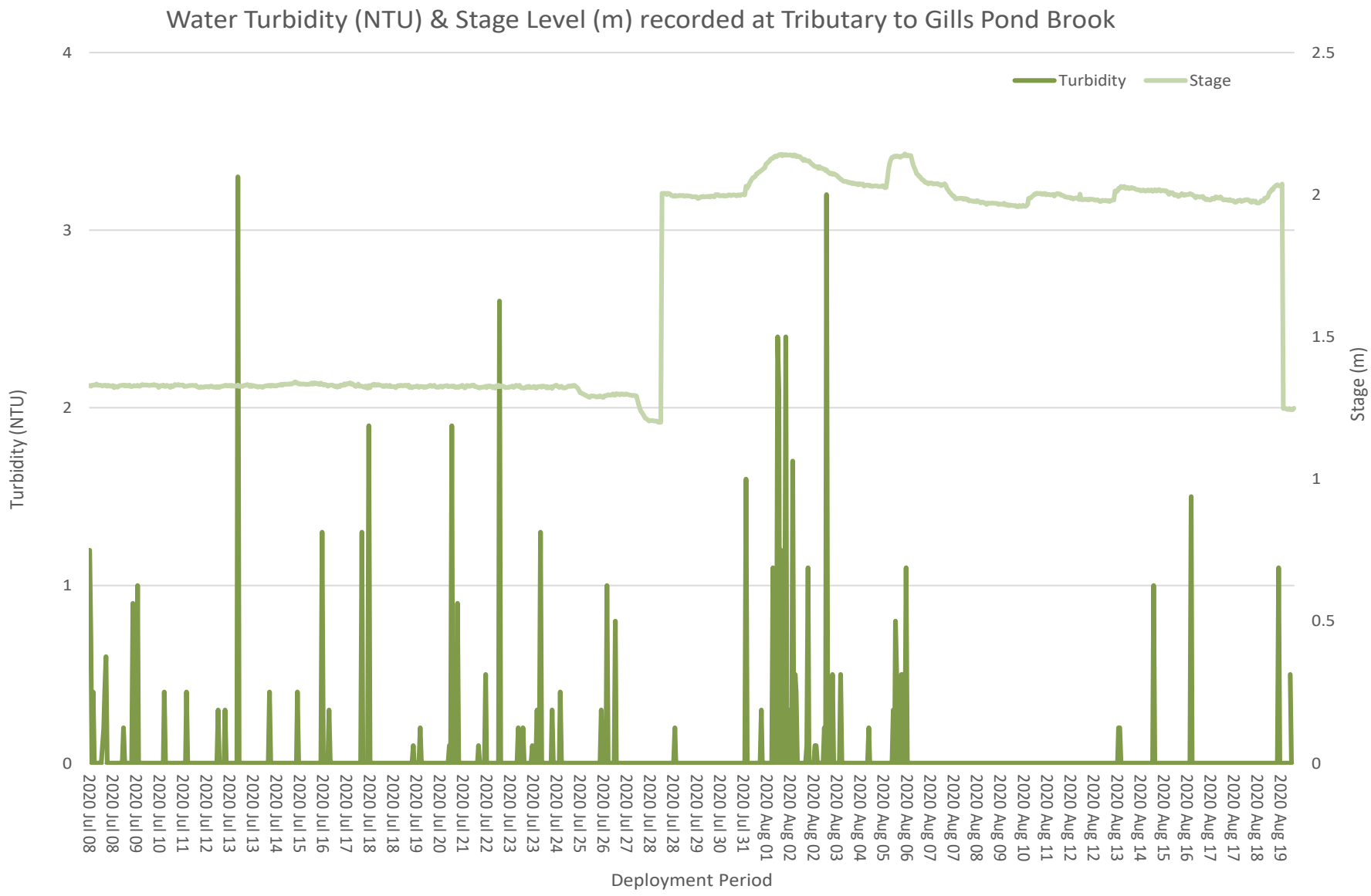
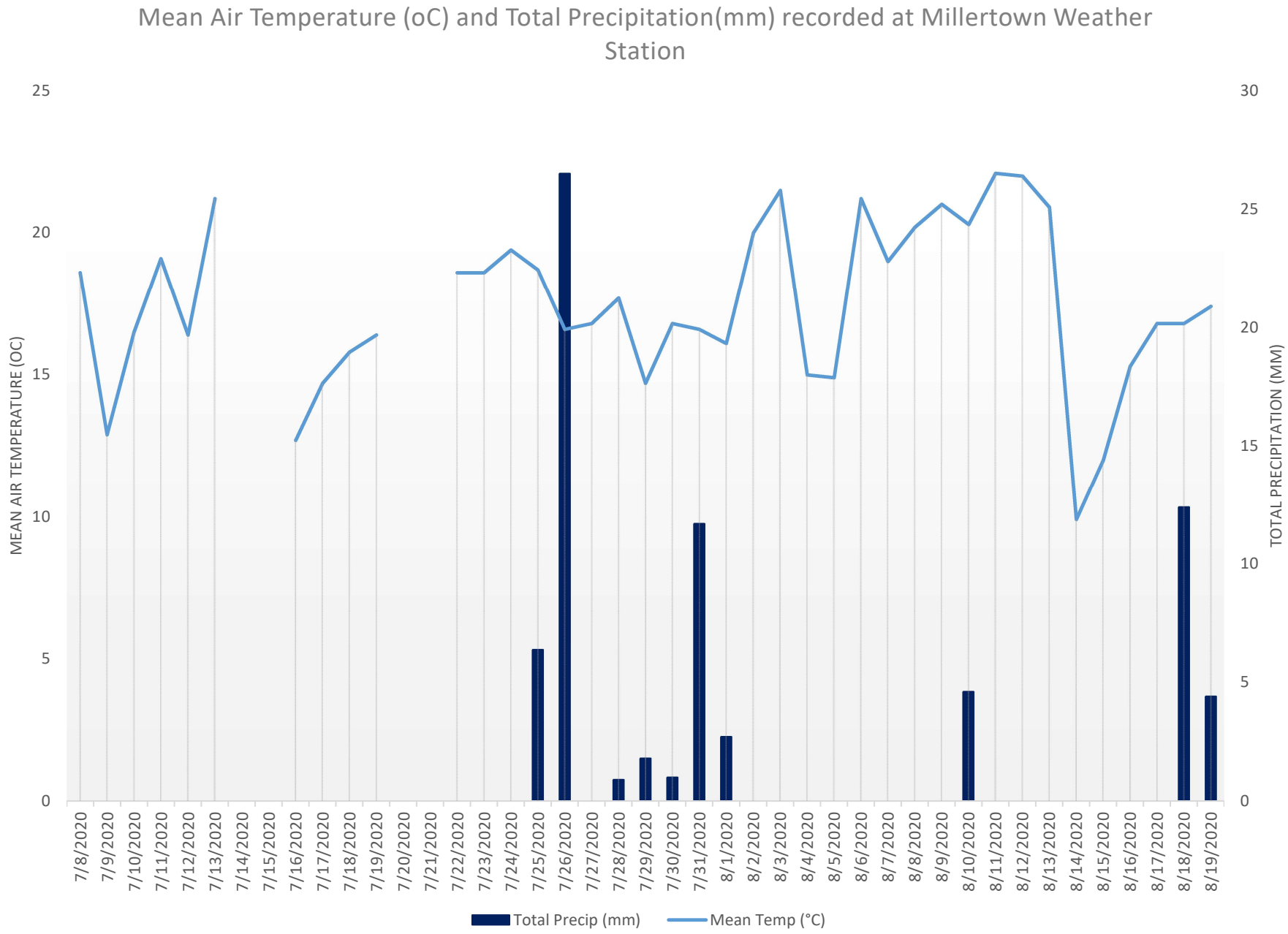


Figure 11. Turbidity (NTU) and Stage Level (m) at Tributary to Gills Pond Brook

APPENDIX I


Mean Air Temperature (oC) and Total Precipitation(mm) recorded at Millertown Weather Station
MEAN AIR TEMPERATURE (OC)
TOTAL PRECIPITATION (MM)
0
5
10
15
20
25
30
7/8/2020
7/9/2020
7/10/2020
7/11/2020
7/12/2020
7/13/2020
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8/16/2020
8/17/2020
8/18/2020
8/19/2020
Total Precip (mm)
Mean Temp (°C)