Real-Time Water Quality Deployment Report

Teck: Duck Pond Operations

May 27, 2020 to July 8, 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 May 27, 2020 to July 8, 2020.

These stations are a part of the Real-Time Water Quality 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 were 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 included in analysis.

The 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.

Due to a failure with the turbidity sensor on the QAQC sonde at deployment, there was no turbidity data to compare against the field sonde.

Table 1: Qualitative QAQC Ranking

Station	Date	Action	Comparison Ranking				
			Temperature	pH	Conductivity	Dissolved Oxygen	Turbidity
Tributary to Gill's Pond Brook	May 27 2020	Deployment	Excellent	Fair	Good	Good	N/A
	July 8 2020	Removal	Excellent	Excellent	Excellent	Excellent	Excellent
East Pond Brook below East Pond	May 27 2020	Deployment	Excellent	Excellent	Excellent	Excellent	N/A
	July 8 2020	Removal	Excellent	Good	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 Tributary to Gills Pond Brook recorded the lowest minimum value for water temperature at 8.51°C and East Pond Brook recorded the highest maximum value for water temperature at 28.15°C (Table 2). Tributary to Gills Pond Brook is shallower than East Pond brook and shaded by vegetation cover. Water temperatures are higher than the previous deployment as summer approached.

Both sets of data display the natural diurnal pattern that demonstrates the higher temperatures in the day light hours and lower temperatures in the nighttime hours. The stations mirrored each other during stage events. The high peak in stage in early June is evident on both graphs. The water temperature at both sites reacted by decreasing during the event and then increasing as the stage level decreased.

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 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 May 2020 to July 2020

Station	Mean	Median	Min	Max
East Pond Brook	16.64	15.91	9.32	28.15
Tributary to Gills Pond Brook	16.53	15.93	8.51	27.57

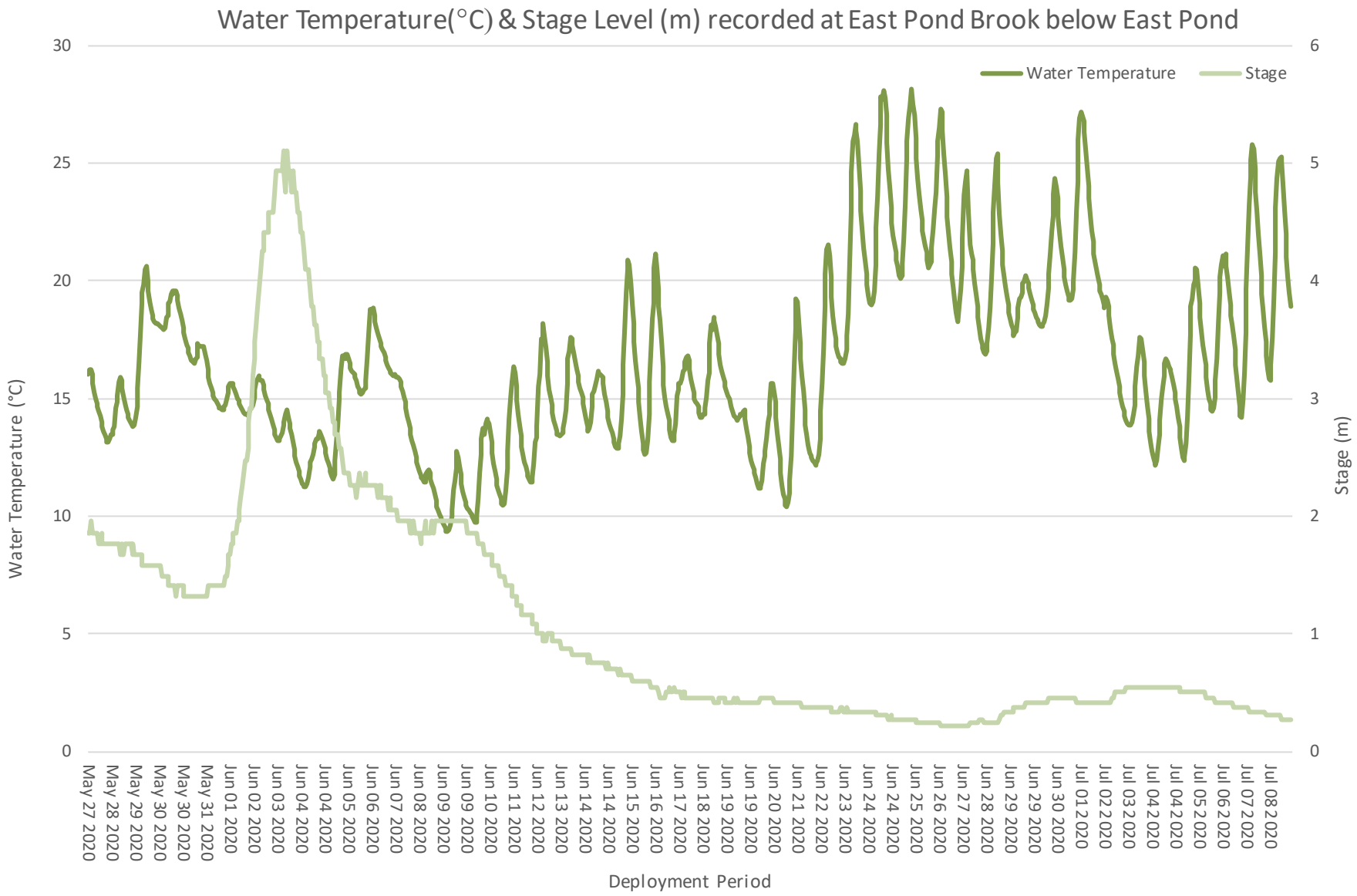

Figure 1. Water Temperature (°C) at East Pond Brook

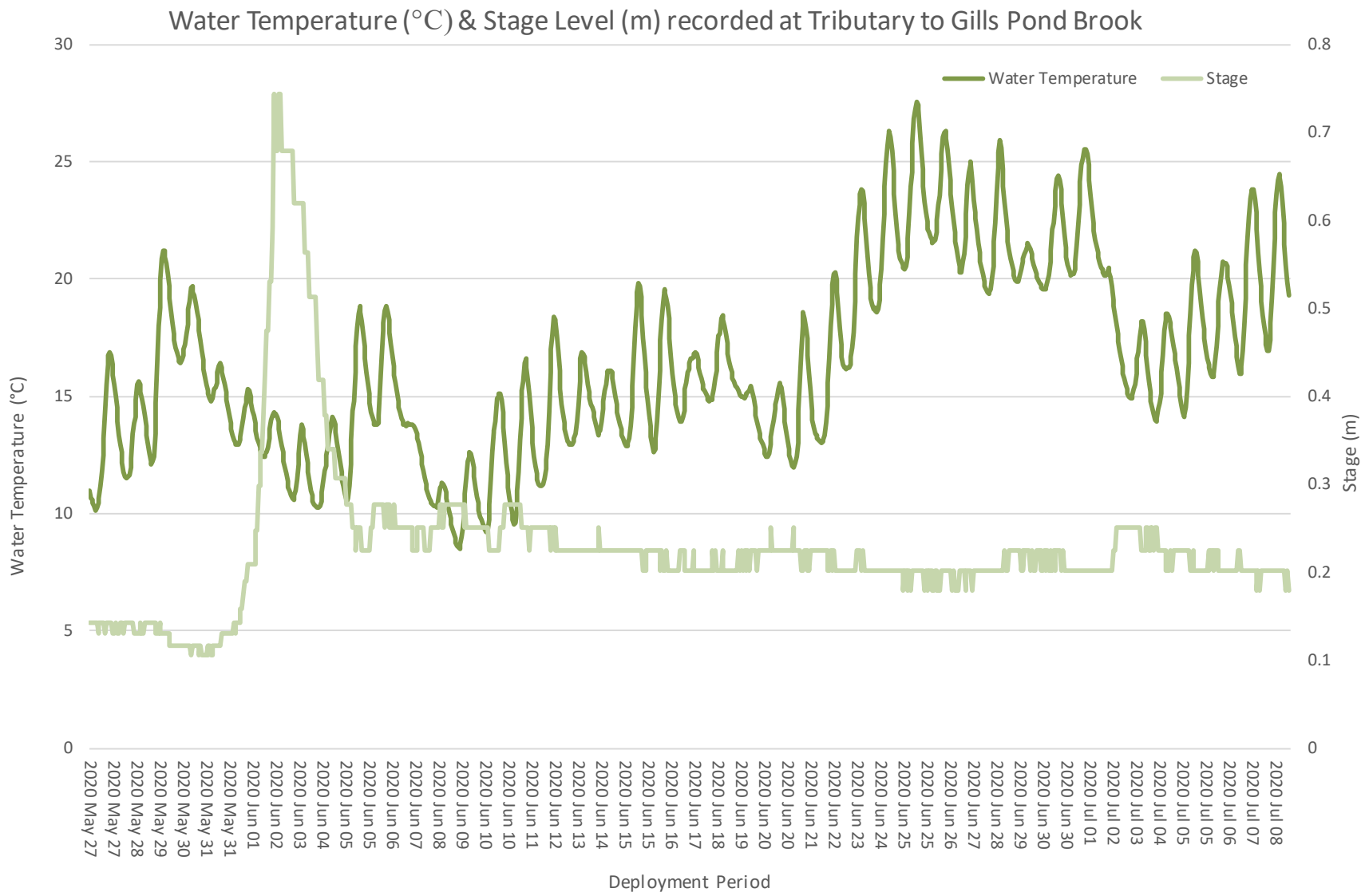

Figure 2. Water Temperature (°C) and Stage Level (m) at Tributary at Gills Pond Brook

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 6.02 (pH units) to a maximum of 7.48 (pH units) (Table 3). pH data at East Pond Brook ranged within 6.26 (pH units) and 7.15 (pH units).

This deployment captures pH data during the initial stages of summer. A large stage increase in early June causes the pH at both sites to decrease slightly before returning to a background range. pH at both sites increased slightly across deployment. During this time of year there is less precipitation and more evaporation. This can influence the pH to become more alkaline.

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. During deployment pH hovered around the minimum value at East Pond Brook, but was generally above the minimum Guideline value at Tributary to Gills Pond Brook.

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

Station	Mean	Median	Min	Max
East Pond Brook	6.63	6.63	6.26	7.15
Tributary to Gills Pond Brook	6.88	6.97	6.02	7.48

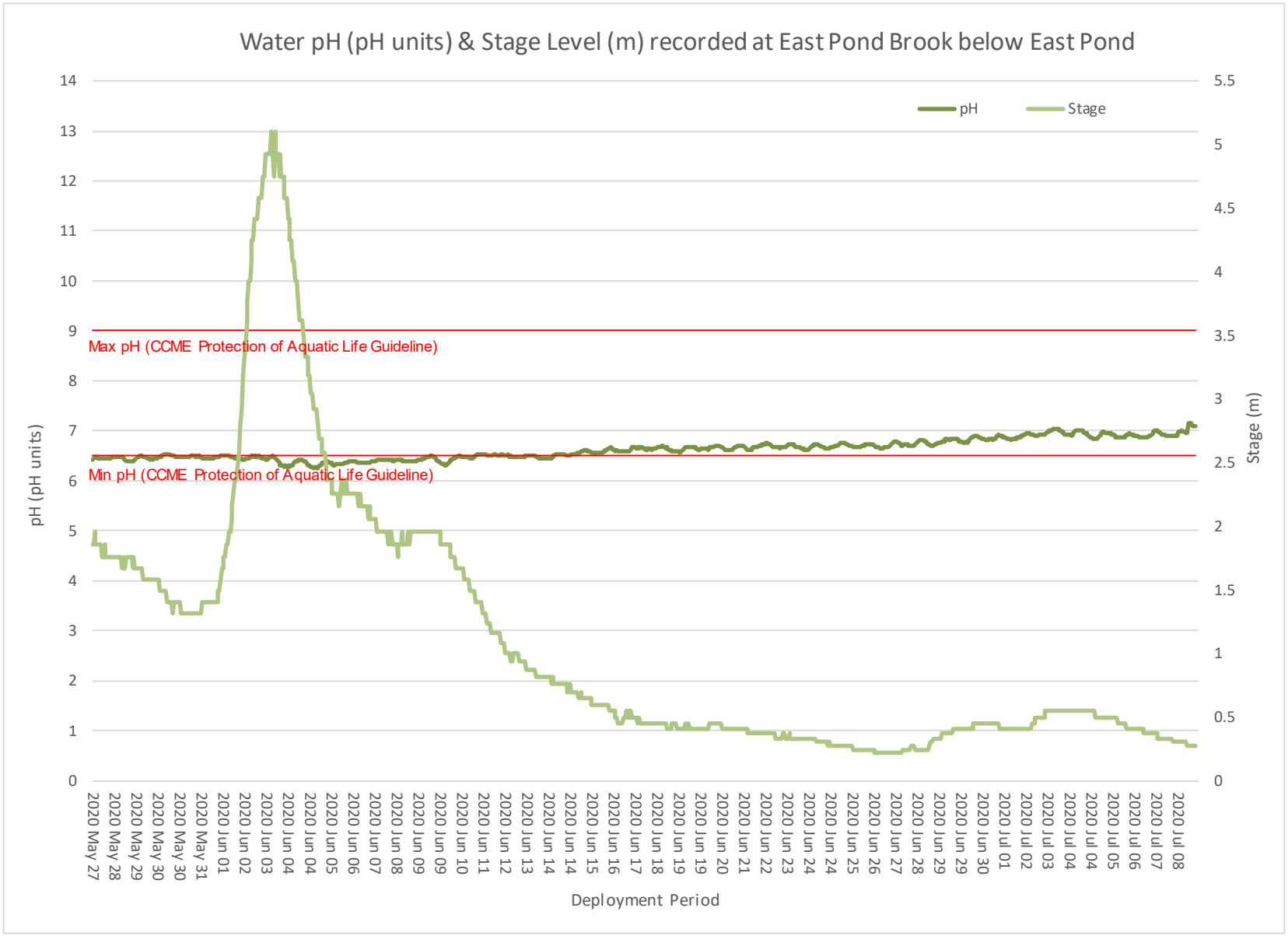

Figure 3. pH (pH units) and Stage Level (m) at East Pond Brook

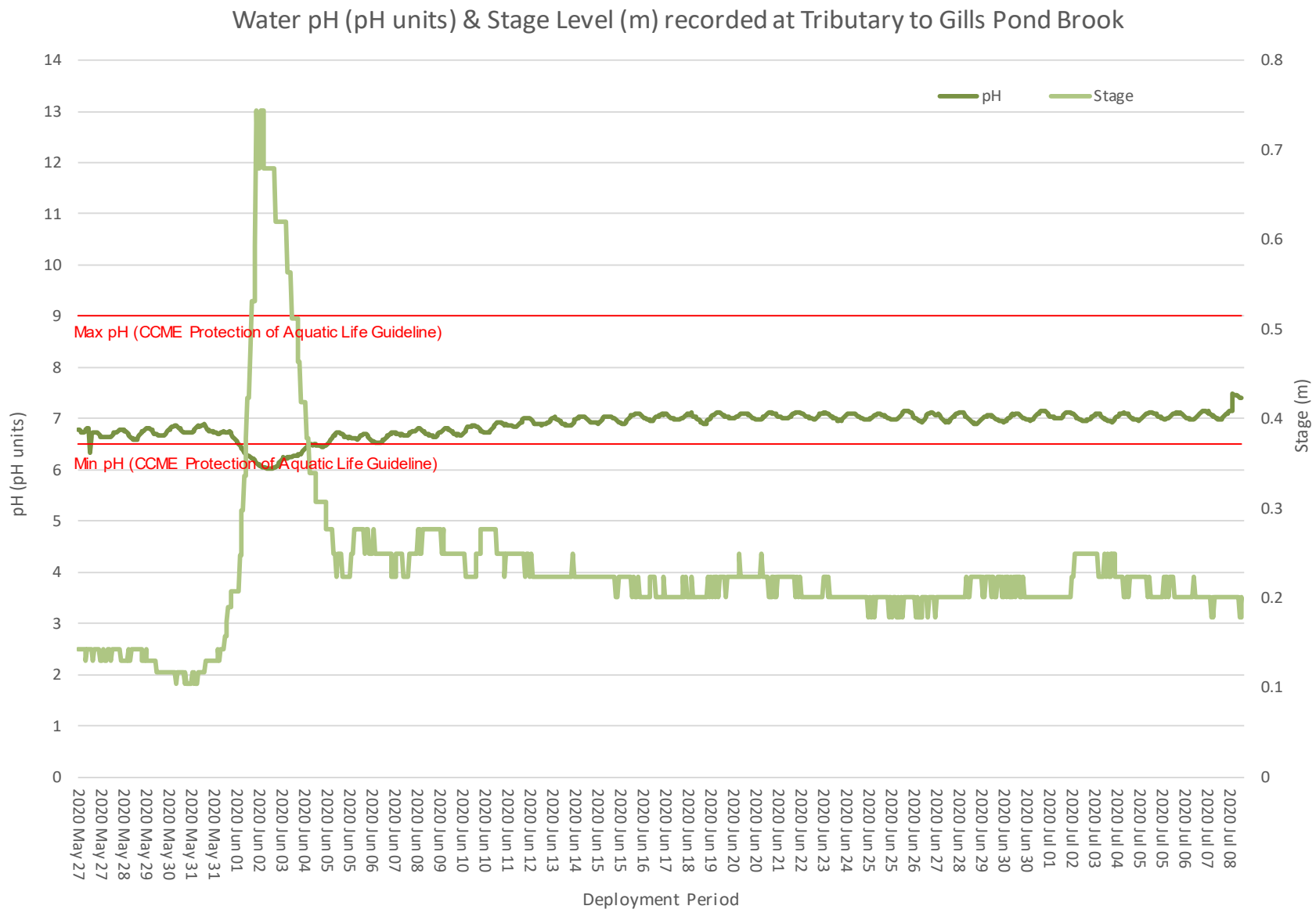

Figure 4. pH (pH units) and Stage Level (m) at Tributary at Gills Pond Brook

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 from Spring into Summer. Tributary to Gills Pond Brook has significantly higher conductivity data than East Pond Brook. This could be a result of several factors. A significant one being the diluted effluent that Duck Pond discharges into Tributary to Gills Pond brook. The conductivity of the brook would increase during discharge times. Figure 7 displays the effluent discharge (m^3/day) that occurred across deployment. The stage spike in early June influenced the specific conductivity at Tributary to Gills Pond Brook to decrease for a period, however, shortly after, the levels started to increase and continued to do so until the end of deployment. Other factors that can influence conductivity at this brook would be low precipitation and evaporation of water, which are a direct result of the warmer temperatures over summer.

The spike in stage level in early June, was also present at East Pond Brook below East Pond, however the specific conductivity responded with an increase (Figure 5), indicating that there was a flush of dissolved ions into the brook. For the remainder of deployment, conductivity levels continued to increase as the stage level decreased. Again, this was likely a result of low precipitation, evaporation of water and the concentration of dissolved organic matter and ions (Appendix I).

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

Station	Mean	Median	Min	Max
East Pond Brook	44.8	17.9	25.0	27.2
Tributary to Gills Pond Brook	527.4	650.0	77.8	804.0

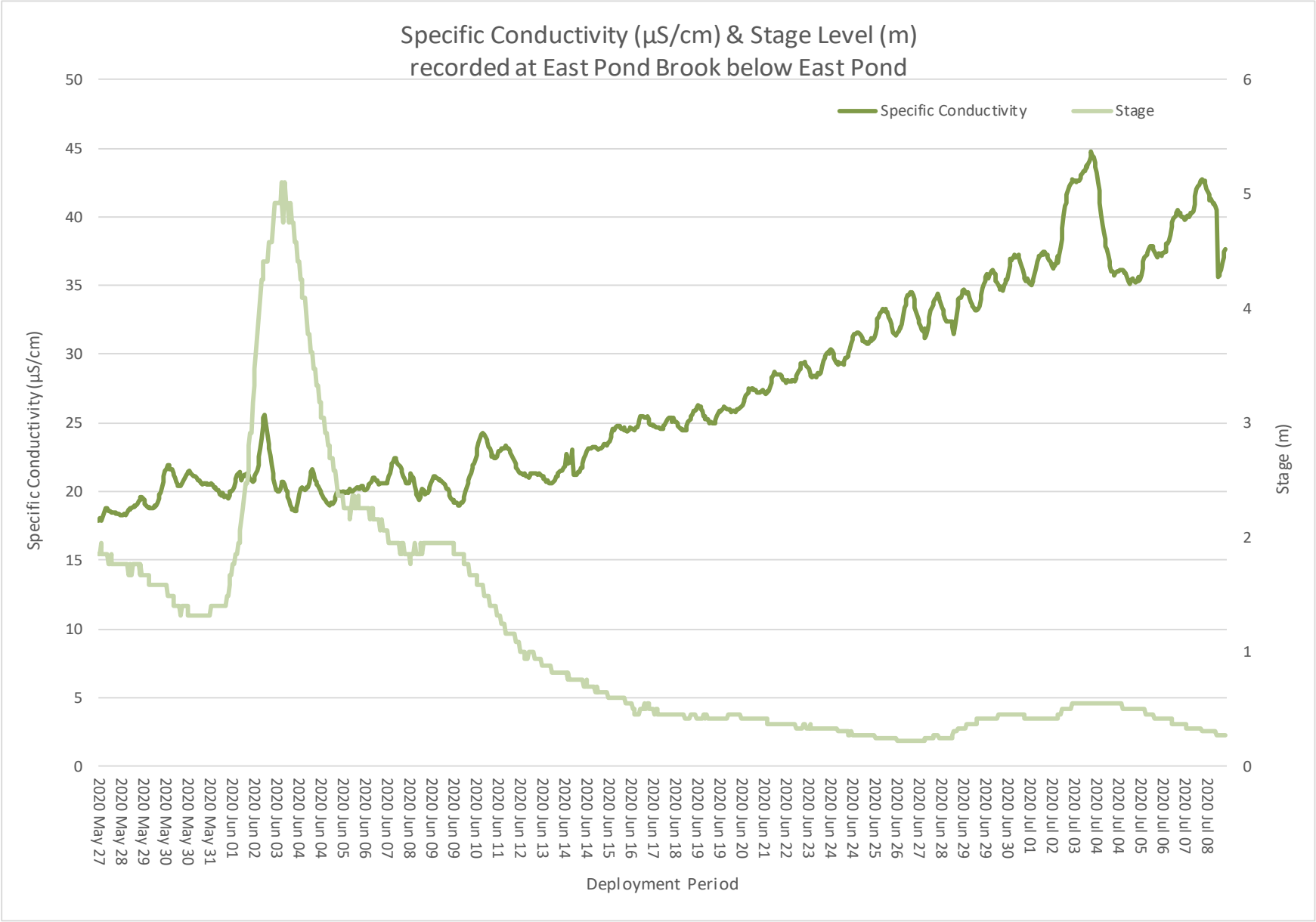

Figure 5. Specific Conductivity (µS/cm) and Stage Level (m) at East Pond Brook

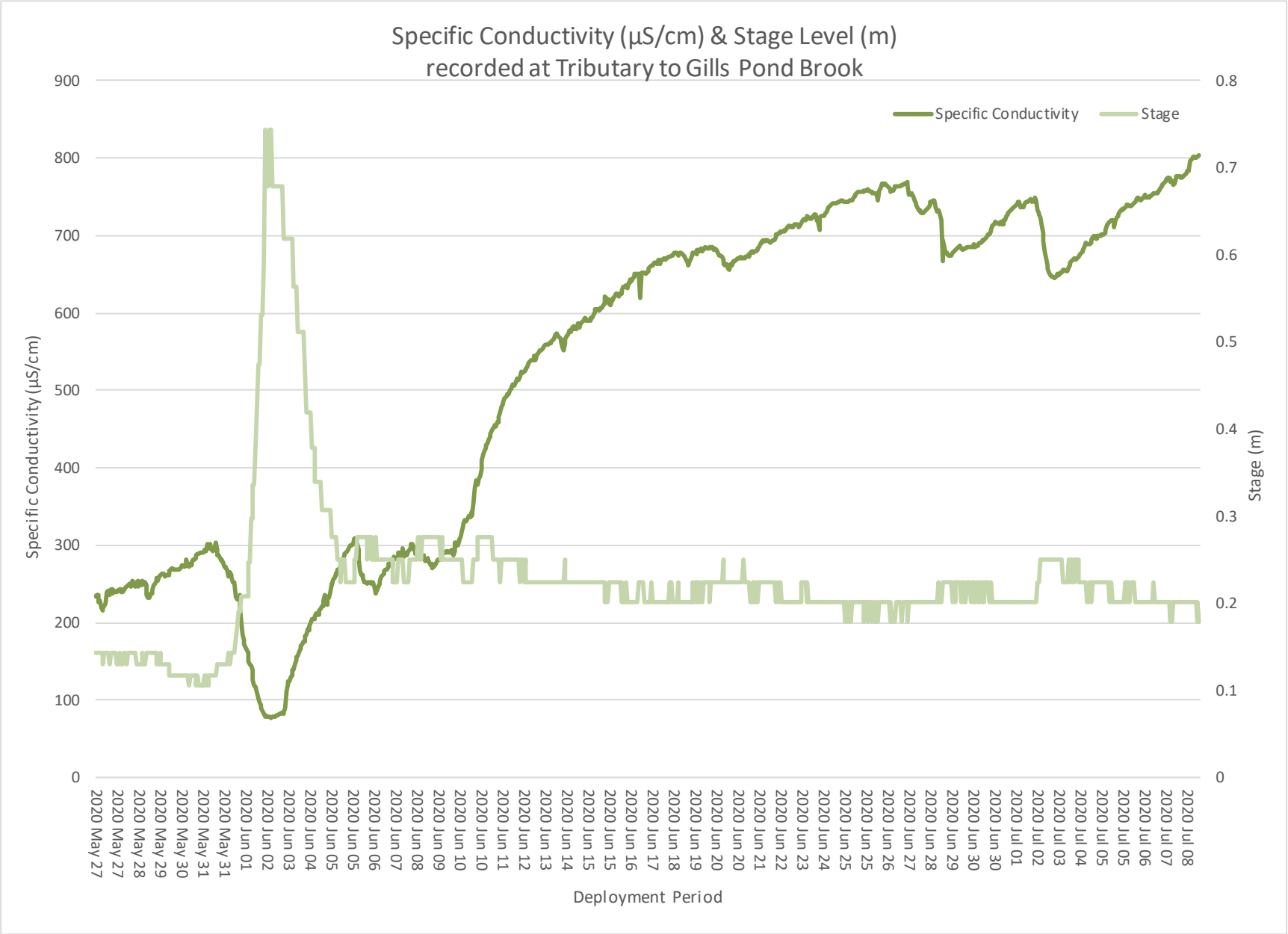

Figure 6. Specific Conductivity (µS/cm) and Stage Level (m) at Tributary at Gills Pond Brook

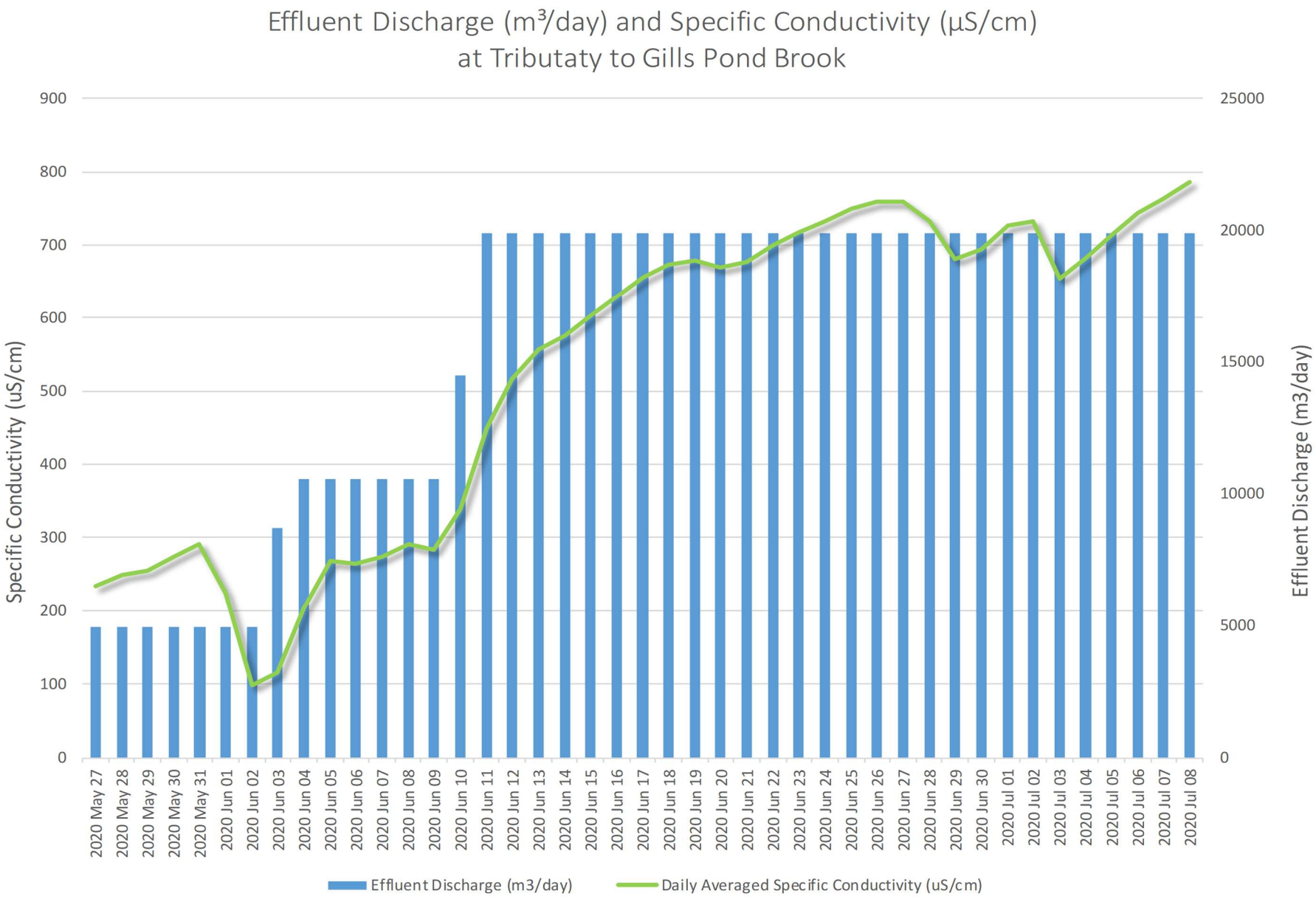

Figure 7. Effluent Discharge (m³/day) and Specific Conductivity (µS/cm) at Tributary at Gills Pond Brook

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 concentration (DO mg/L) at Tributary to Gills Pond Brook was sitting along the CCME guideline for the protection of early life stages, until the end of June when the dissolved oxygen concentration dropped. The decrease in DO (mg/L) was likely related to the increase in water temperature (Figure 2). Tributary to Gills Pond Brook recorded its highest water temperature during the same timeframe.

East Pond Brook below East Pond DO (mg/L) data displays a similar graph to Tributary to Gills Pond Brook. As the water temperature at the brook changes throughout the day, it influences the concentration of DO (mg/L) in the water column. This brook also displays the lowest DO (mg/L) at the end of June. Indicating that air temperatures (Appendix I) and consequently water temperatures were at the highest during that time.

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

Station	Mean	Median	Min	Max
Dissolved Oxygen (mg/L)				
East Pond Brook	9.35	9.46	7.48	10.93
Tributary to Gills Pond Brook	9.31	9.39	7.85	10.78
Dissolved Oxygen (%Sat)				
East Pond Brook	94.2	94.2	89.6	101.0
Tributary to Gills Pond Brook	94.0	93.7	84.9	99.8

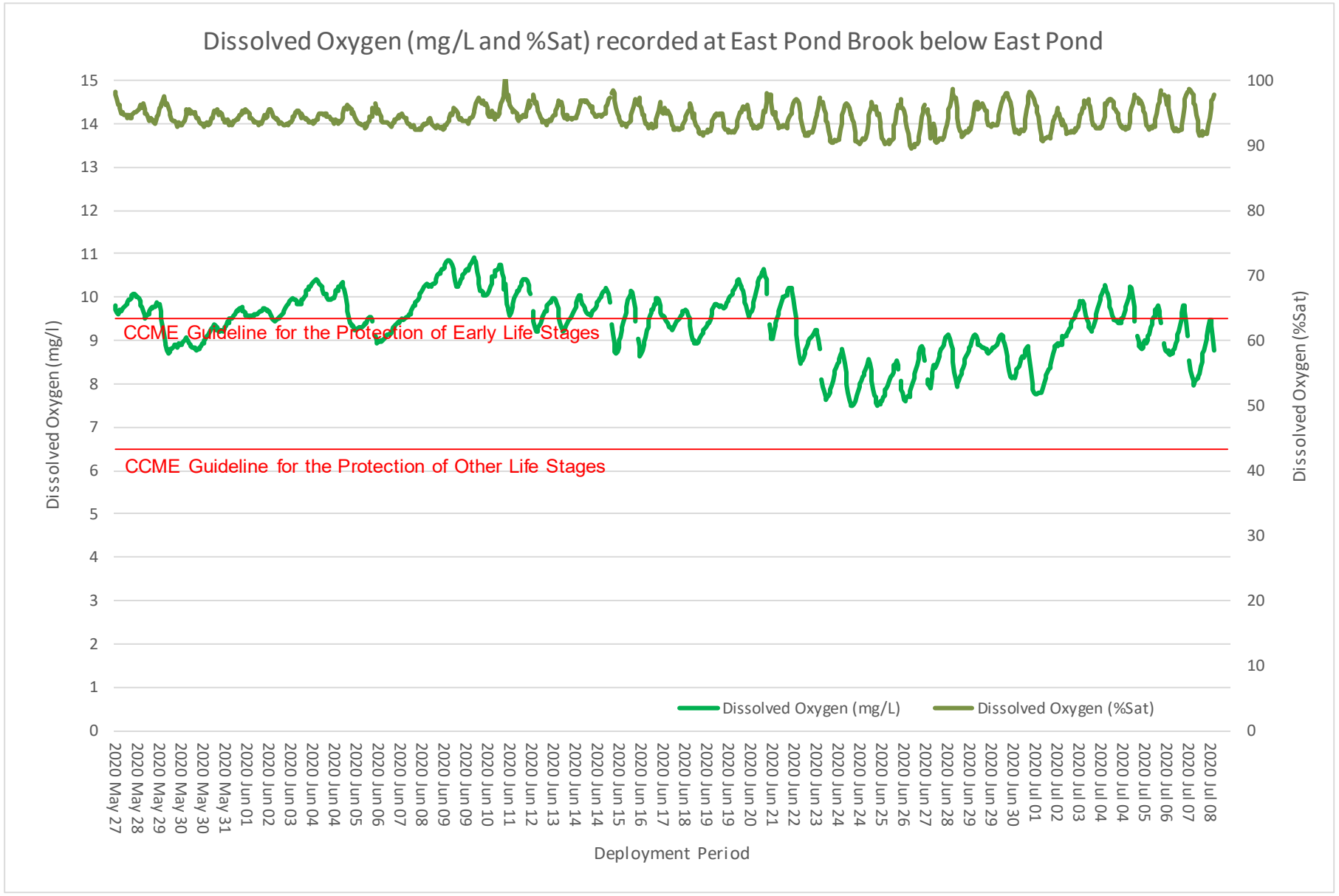

Figure 8. Dissolved Oxygen (mg/L & sat %) and Stage Level (m) at East Pond Brook

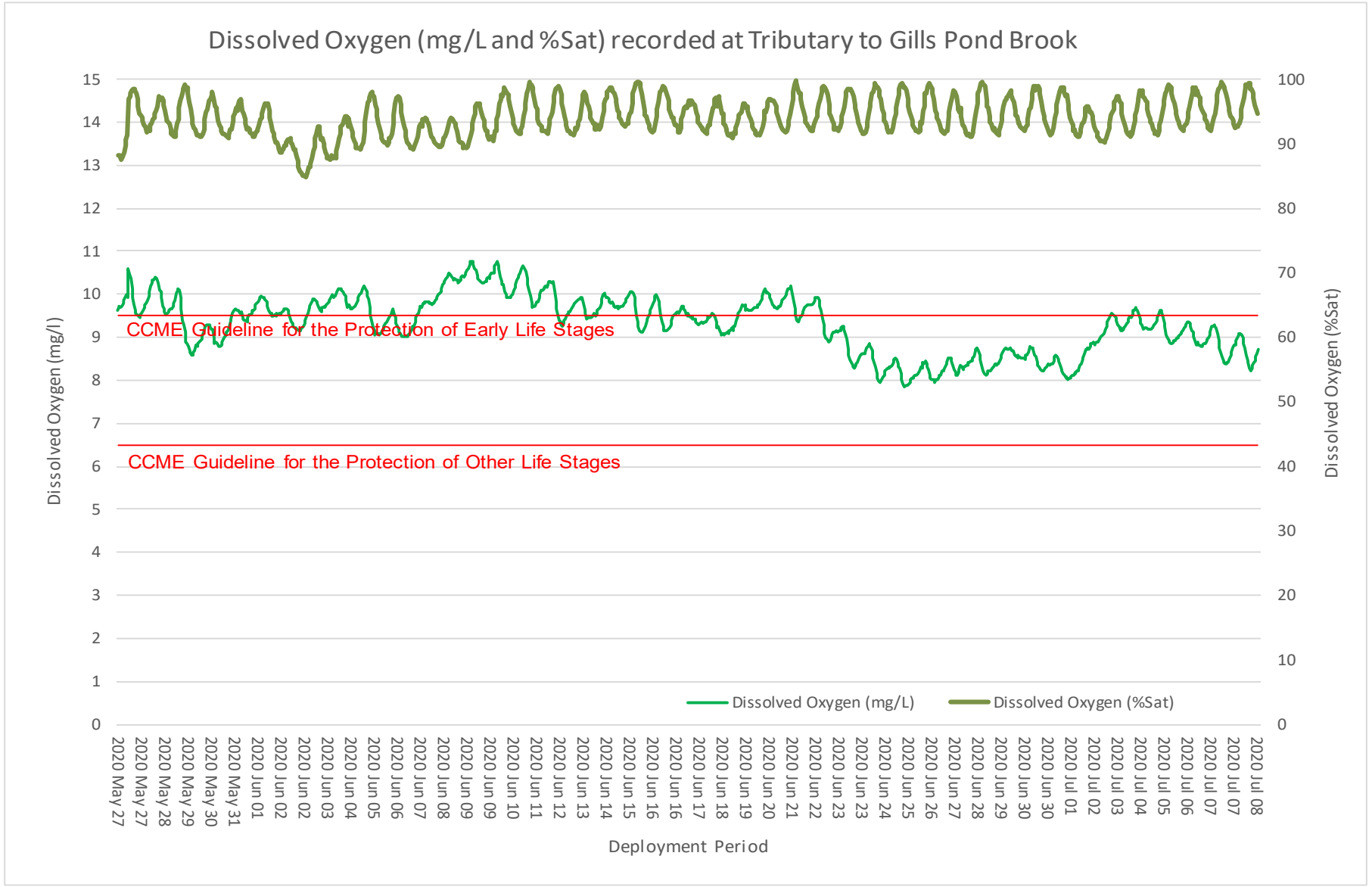

Figure 9. Dissolved Oxygen (mg/L & % Sat) at Tributary at Gills Pond Brook

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 tea-like color to the water, likely from the surrounding marsh and bog lands. It is common for surface water to have a background level of turbidity, as the surrounding ecosystem would be influencing the particulate matter that would be present. Persistent spikes and a prolonged increase in turbidity over a period would be of concern.

Tributary to Gills Pond Brook has higher turbidity data than East Pond. The turbidity at Tributary to Gills Pond Brook fluctuates throughout the deployment, however, the prominent spikes correspond with increases in stage. 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.

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

Station	Mean	Median	Min	Max
East Pond Brook	1.4	1.5	0.1	6.2
Tributary to Gills Pond Brook	0.3	0.0	0.0	20.2

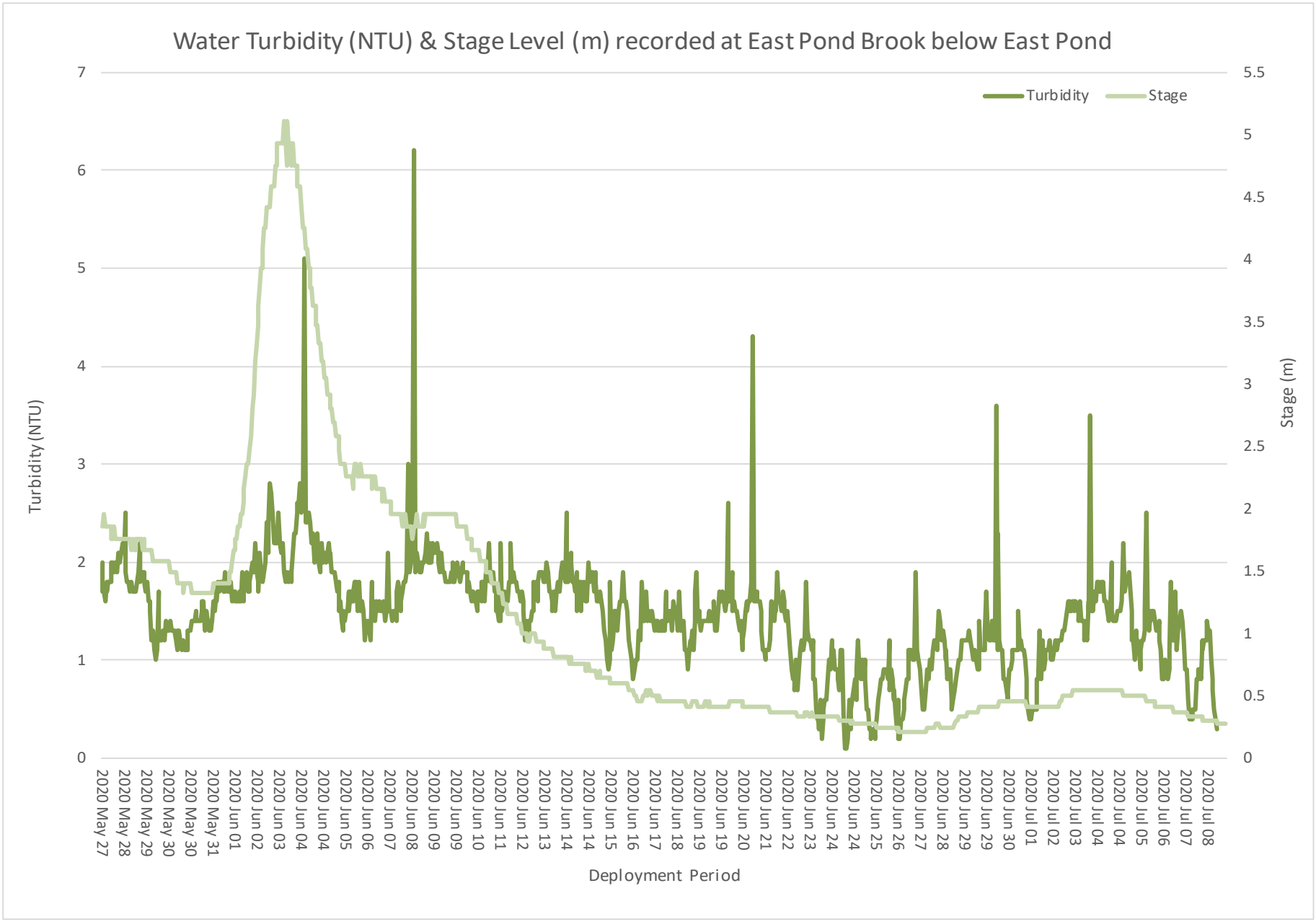


Figure 10. Turbidity (NTU) and Stage Level (m) at East Pond Brook

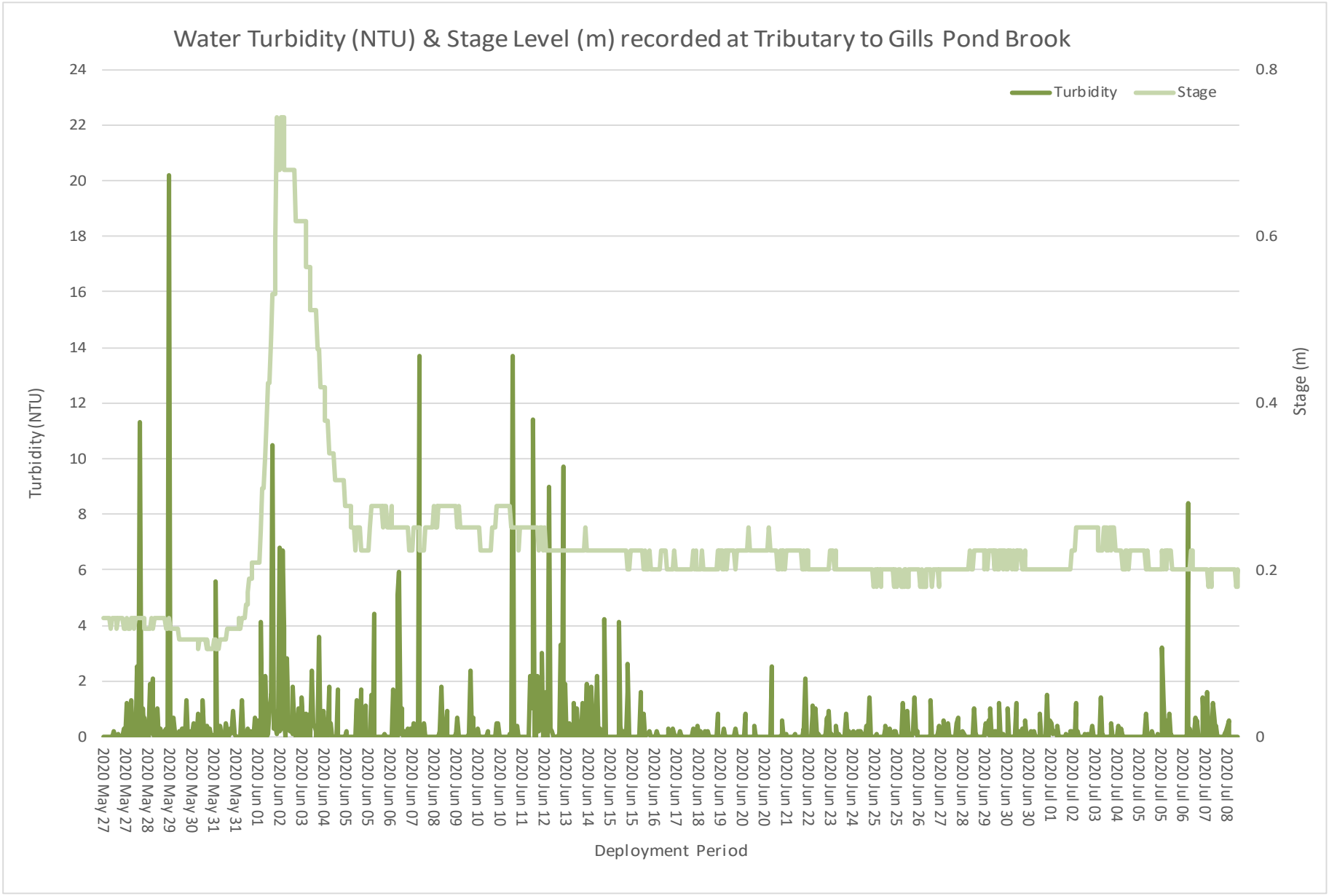
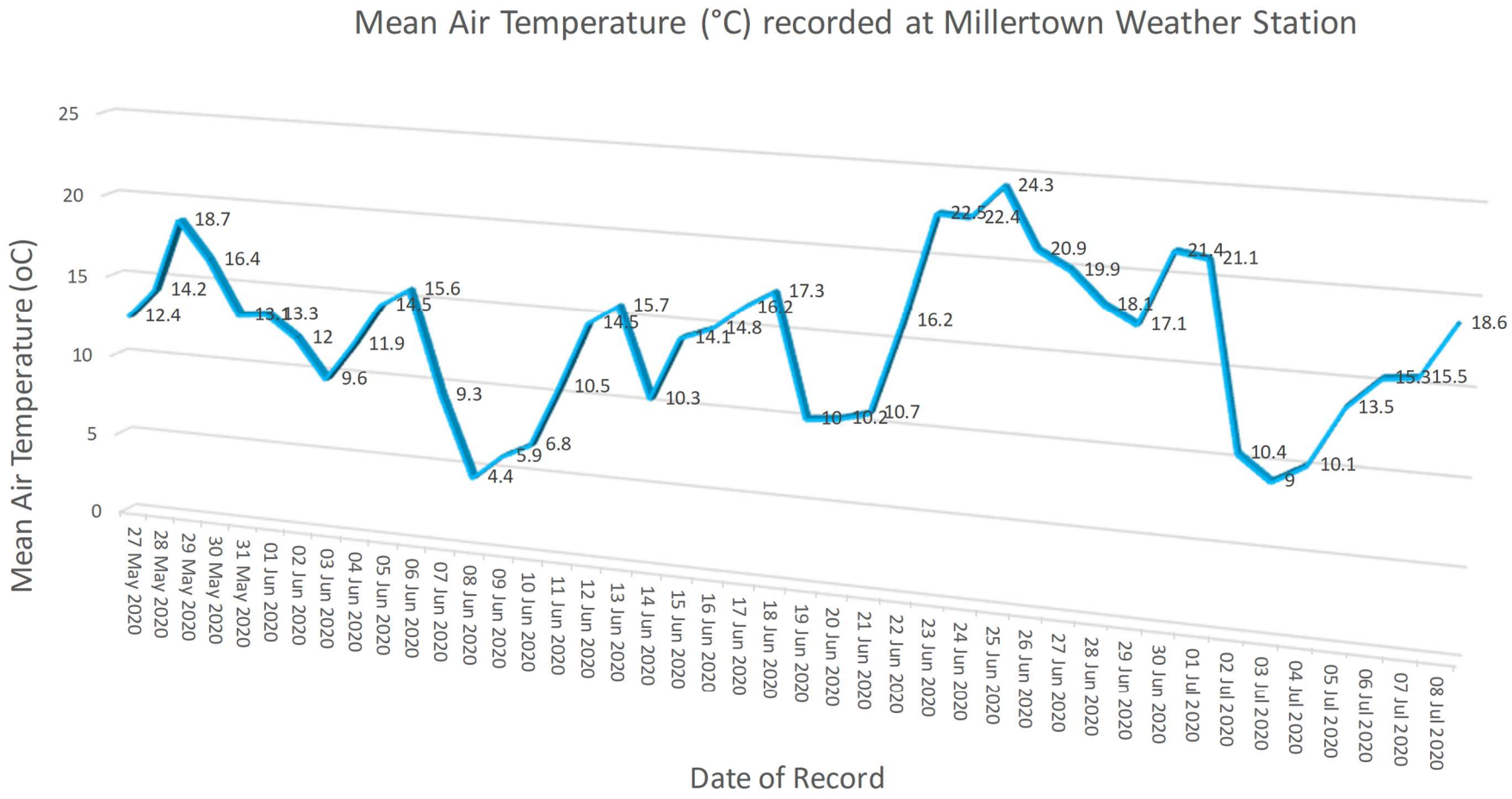


Figure 11. Turbidity (NTU) and Stage Level (m) at Tributary to Gills Pond Brook

APPENDIX I


Mean Air Temperature (°C) recorded at Millertown Weather Station
Mean Air Temperature (oC)
Date of Record
25
20
15
10
5
0
27 May 2020
28 May 2020
29 May 2020
30 May 2020
31 May 2020
01 Jun 2020
02 Jun 2020
03 Jun 2020
04 Jun 2020
05 Jun 2020
06 Jun 2020
07 Jun 2020
08 Jun 2020
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