# Real-Time Water Quality Deployment Report

## Teck: Duck Pond Operations

**December 3, 2019 to May 27, 2020**

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 December 3, 2019 through to May 27 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/

The length of the deployment, 175 days, was a result of the instruments remaining in the brook over the winter season. This is a common occurrence at these sites during this time of year. The instruments remain protected under the ice and continue to provide data throughout the deployment. Maintenance was also delayed due to travel restrictions associated with Covid-19.

From February 1, 2020 through to February 26, 2020 Tributary to Gills Pond Brook had intermittent transmission issues and data was not collected during this time. During the QAQC check of the turbidity data for December 3 2019 to the end of deployment, it was determined that the turbidity data did not represent the brook. The data was removed from the statistical analysis for Tributary to Gills Pond Brook and is not included in the report.

During this deployment East Pond Brook below East Pond was damaged during a high stage event and there is evidence that large debris damaged the field cable and disconnected the instrument from the station. There is no data recorded at this site after January 13, 2020. Due to the large amount of data missing from this site, no statistical analysis was completed.

For the purposes of this report, air temperature and total precipitation data were used from the weather station located in Millertown. 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.

**Table 1: Qualitative QAQC Ranking**

| Station | Date | Action | Comparison Ranking | | | | |
|---|---|---|---|---|---|---|---|
| | | | Temperature | pH | Conductivity | Dissolved Oxygen | Turbidity |
| **Tributary to Gill's Pond Brook** | Dec 3 2019 | Deployment | Excellent | Poor | Good | Poor | Excellent |
| | May 27 2020 | Removal | Good | Excellent | Fair | Poor | Cannot Rank |
| **East Pond Brook below East Pond** | Dec 3 2019 | Deployment | No | QA | QC | Results | Collected |
| | May 27 2020 | Removal | Fair | Excellent | Excellent | Excellent | Excellent |

**Data Interpretation**

## Water Temperature

Water Temperature is a major factor used to describe water quality. Temperature has major implications on both the ecology and chemistry of a water body, governing 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 -0.41°C. Due to the damage sustained at East Pond Brook after a high flow event there is only data from December 3rd 2019 to January 13th, 2020. During this time the water temperature at East Pond Brook ranged from 1.74°C to 0.0°C (Table 2).

At Tributary to Gills Pond Brook water temperature was low over the course of the deployment until April, when the temperatures started to increase. This change in water temperature is a natural process as the seasons change from Winter into Spring temperatures. Water temperature has a natural diurnal pattern 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 (Appendix II). 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 December 2019 to May 2020**

| Station | Mean | Median | Min | Max |
|---|---|---|---|---|
| East Pond Brook (*Dec 2019 –Jan 2020) | 0.099* | 0.02* | 0.0* | 1.74* |
| Tributary to Gills Pond Brook | 1.14 | 0.12 | -0.41 | 14.97 |

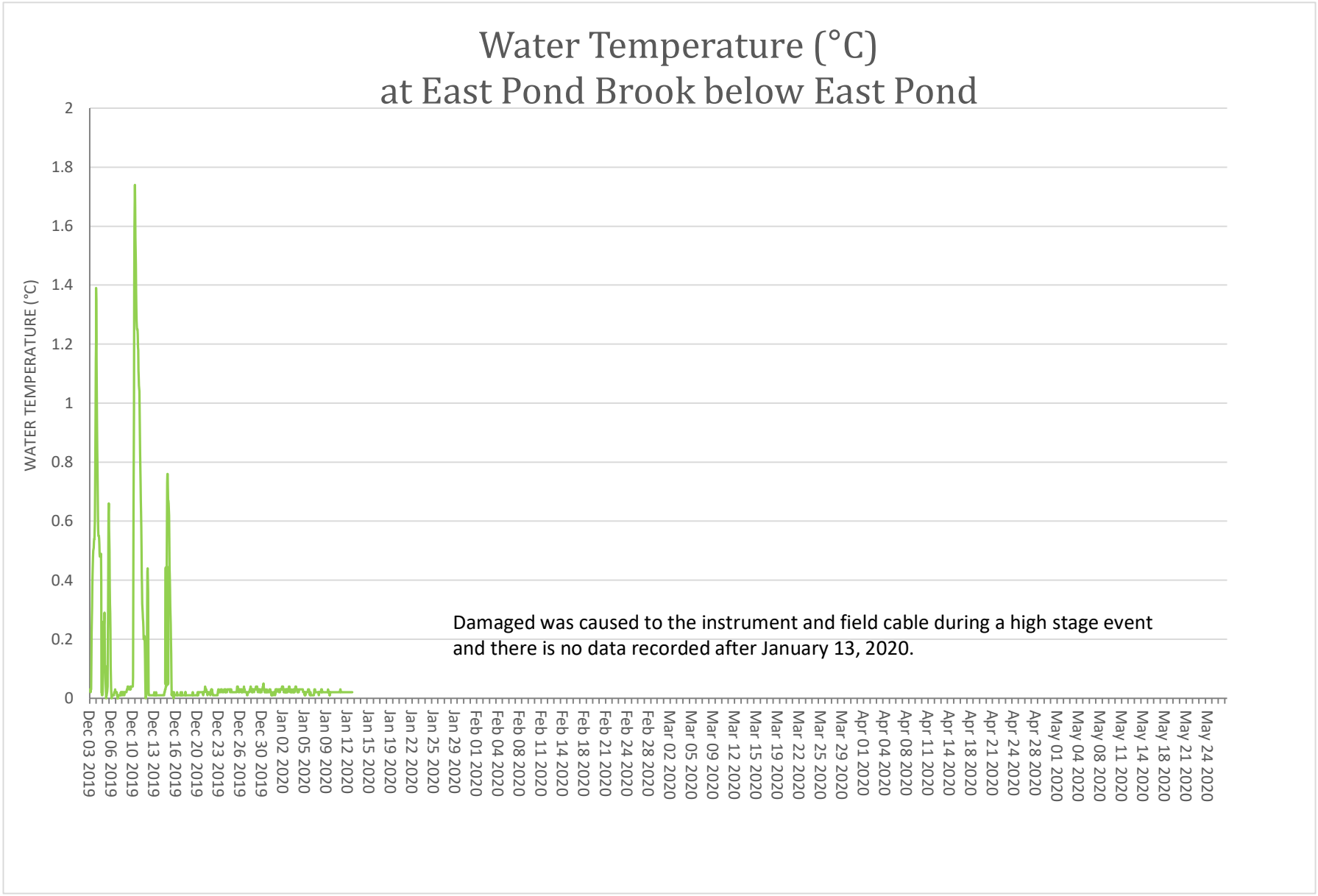


**Figure 1. Water Temperature (°C) at East Pond Brook**

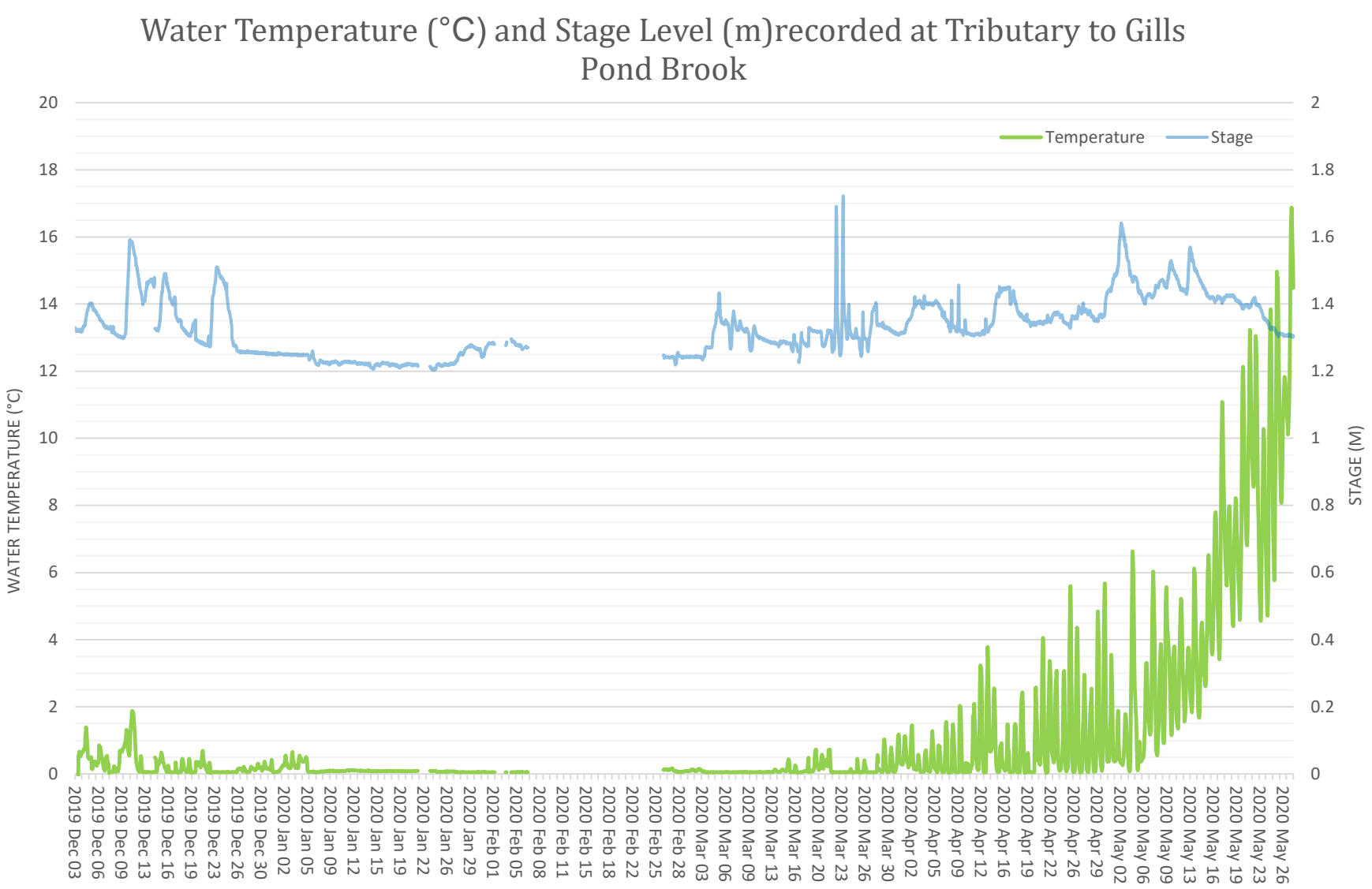


**Figure 2. Water Temperature (°C) and Stage Level (m) at Tributary at Gills Pond Brook**

**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 5.90 (pH units) to a maximum of 7.21 (pH units) (Table 3). pH data at East Pond Brook was limited from Dec 3rd 2019 to January 13th, 2020 and ranged from 5.71 pH units to 6.49 pH units at this time. During the QAQC check at deployment of the instrument in Tributary to Gills Pond, the check indicated "Poor" for pH, however, it was determined later that the QAQC instrument was not functioning correctly. During removal of the instrument the pH data ranked as "excellent".

This was a long deployment and the data captures pH data during the winter and through the spring. Winter pH is stable and maintains values just above the CCME guideline. Spring pH is irregular and influenced by the changes in the natural environment as the snow and ice melt and the ground thaws. Generally, as the stage increased, pH acidity increased, and as stage decreased, pH returned to background levels.

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. 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 December 2019 to May 2020**

| Station | Mean | Median | Min | Max |
|---|---|---|---|---|
| East Pond Brook (*Dec 2019-Jan 2020) | 6.246* | 6.26* | 5.71* | 6.49* |
| Tributary to Gills Pond Brook | 6.81 | 6.73 | 5.90 | 7.21 |

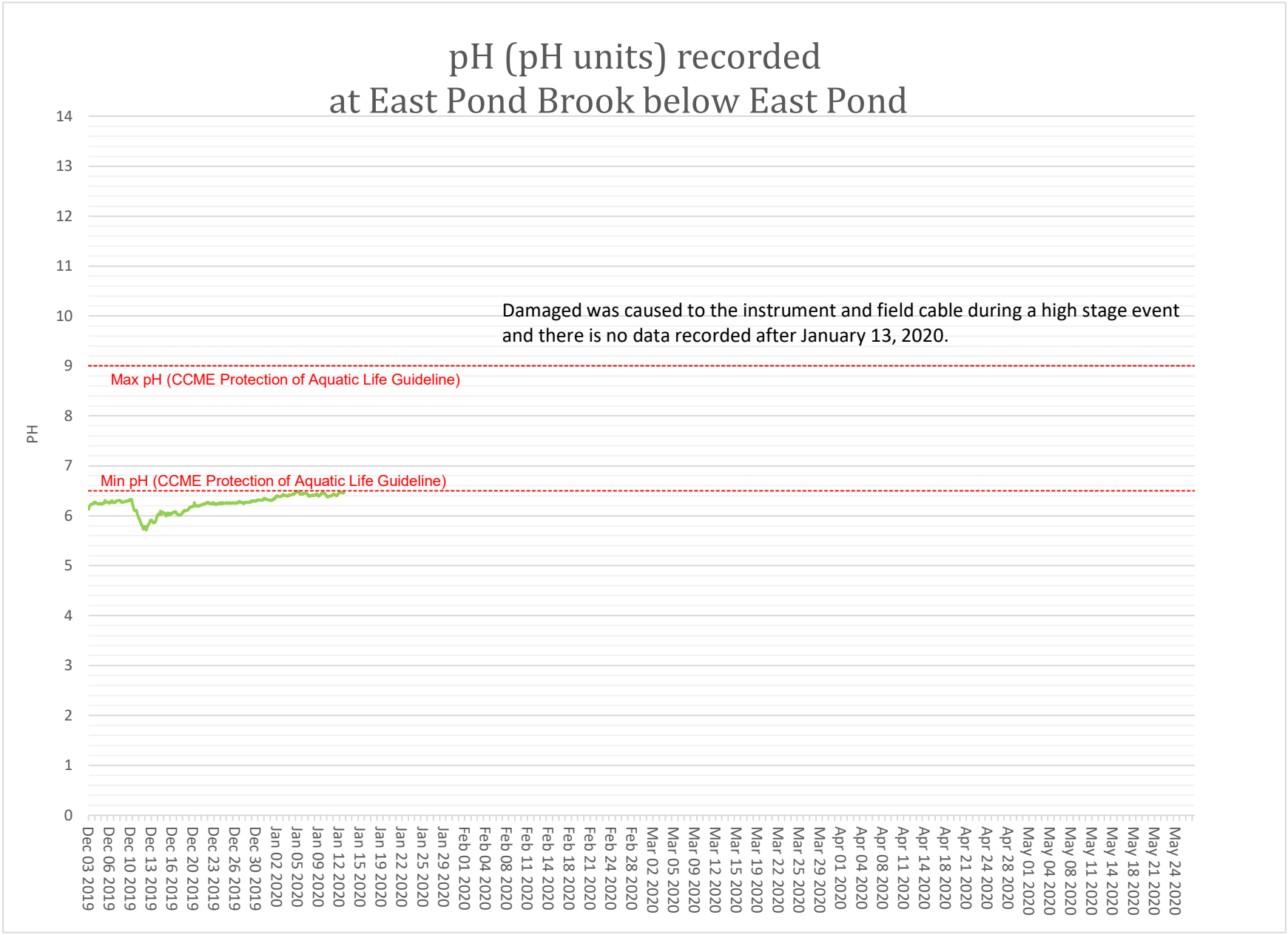


**Figure 3. pH (pH units) and Stage Level (m) at East Pond Brook**

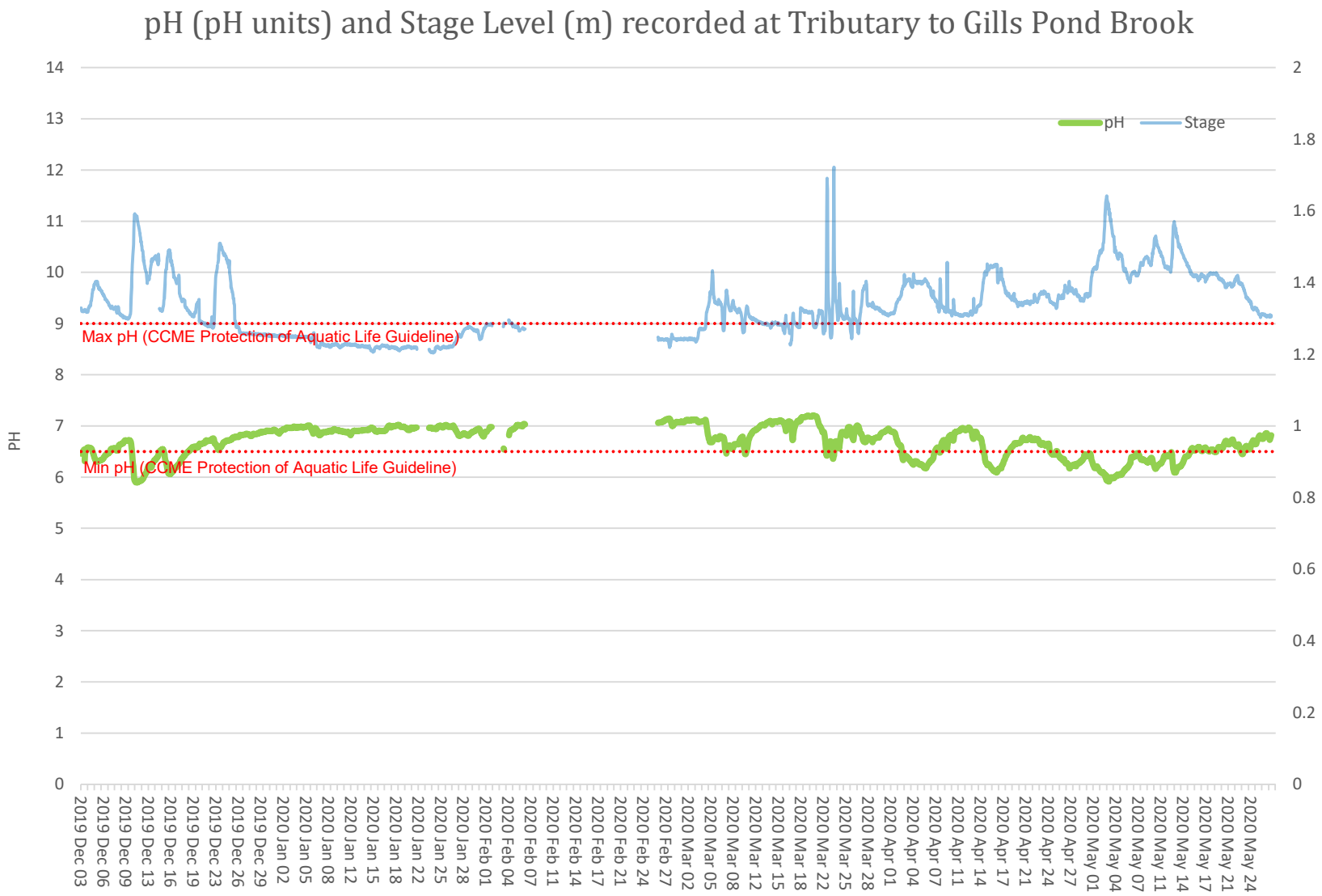


**Figure 4. pH (pH units) and Stage Level (m) at Tributary at Gills Pond Brook**

## 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.

This deployment captured the change across the Winter season into the Spring. Conductivity increased at Tributary to Gills Pond Brook during the Winter season. This was a result of lower stage, less runoff and reduced rainfall (Figure 6).

During the short period for which data is available at East Pond Brook, specific conductivity was steadily increasing. The specific conductivity data from December 2019 to January 2020 ranged from 30.5µS/cm to 14.5µS/cm.

Tributary to Gills Pond Brook had peaks of conductivity during the colder temperatures. This was likely a result of the effluent discharged into the brook and the lower stage levels. Conductivity events around early February and on March 20$^{th}$ can be connected to the discharge (Figure 7). The peaks in conductivity during April are likely a result of the spring thaw, releasing increased minerals and organic matter into the stream (Appendix I).

Stage Level data is raw data (Appendix II). This 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 4. Table of the statistical data for East Pond Brook and Tributary to Gills Pond Brook for December 2019 to May 2020**

| Station | Mean | Median | Min | Max |
|---|---|---|---|---|
| East Pond Brook (*Dec 2019 – Jan 2020) | 23.20* | 22.2* | 14.5* | 30.5* |
| Tributary to Gills Pond Brook | 367.8 | 301.5 | 28.5 | 964.0 |

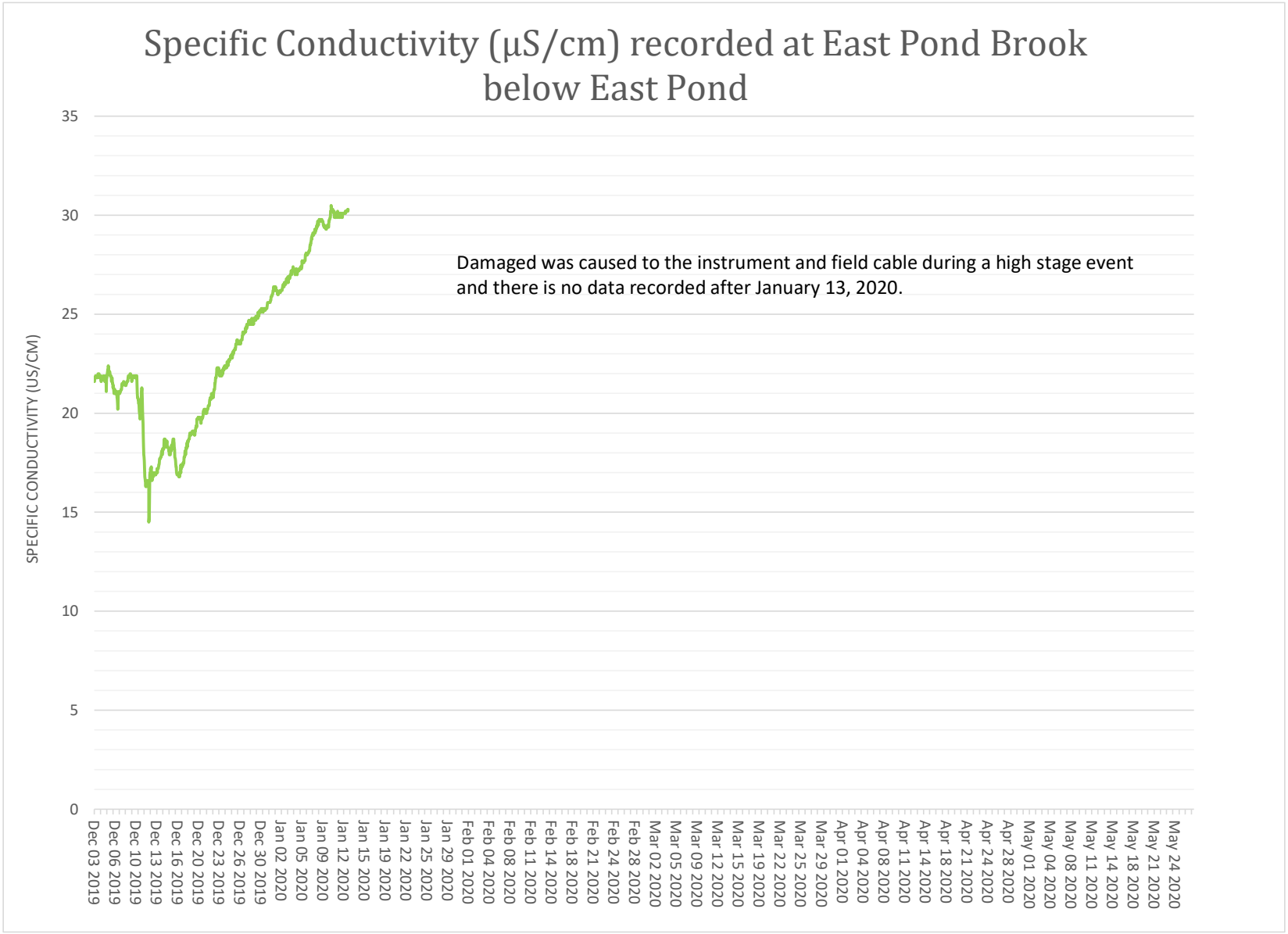


**Figure 5. Specific Conductivity (µS/cm) and Stage Level (m) at East Pond Brook**

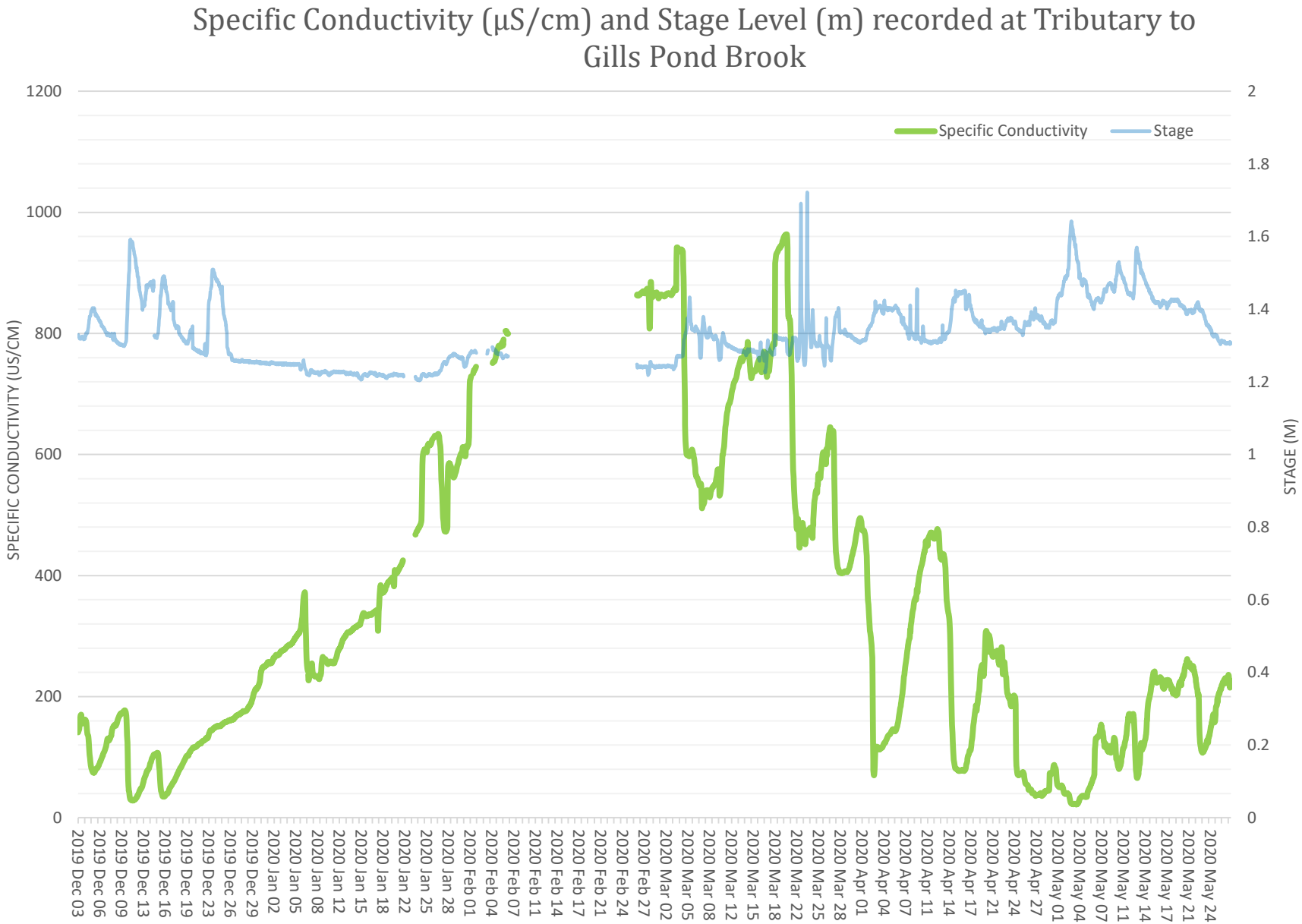


**Figure 6. Specific Conductivity (µS/cm) and Stage Level (m) at Tributary at Gills Pond Brook**

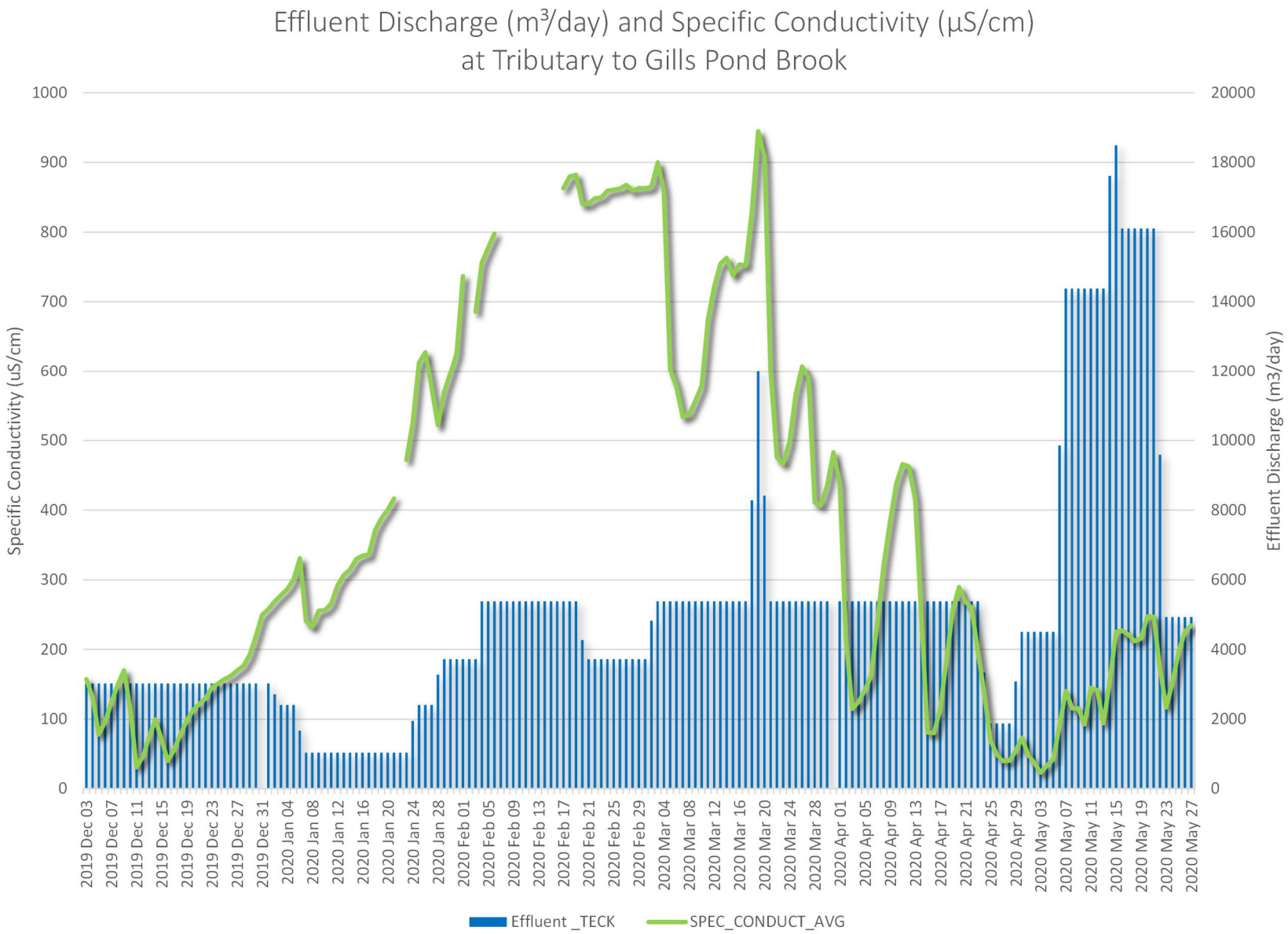


**Figure 7. Effluent Discharge (m³/day) and Specific Conductivity (µS/cm) at Tributary at Gills Pond Brook**

## 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 at Tributary to Gills Pond Brook remained above the CCME guideline for aquatic life for the majority of the deployment. As the water temperature increased near the end of deployment, the dissolved oxygen concentration started to decrease (Figure 8 & 9). This natural process occurs in every water body (Appendix I).

Tributary to Gills Pond Brook had a minimum dissolved oxygen concentration of 11.10mg/L which occurred in May as the water temperatures increased. The brook had a maximum of 13.54mg/L which was recorded during the cooler part of the deployment in December. During the short period of time that data was collected at East Pond brook below East Pond, the data ranged from 12.87mg/L to 14.18mg/L.

**Table 5. Table of the statistical data for East Pond Brook and Tributary to Gills Pond Brook for December 2019 to May 2020**

| Station | Mean | Median | Min | Max |
|---|---|---|---|---|
| Dissolved Oxygen (mg/L) | | | | |
| East Pond Brook (*Dec 2019-Jan 2020) | 13.48* | 13.47* | 12.87* | 14.18* |
| Tributary to Gills Pond Brook | 12.17 | 12.21 | 11.10 | 13.54 |
| Dissolved Oxygen (%Sat) | | | | |
| East Pond Brook (*Dec 2019-Jan 2020) | 93.3* | 93.6* | 88.9* | 97.9* |
| Tributary to Gills Pond Brook | 84.9 | 85.1 | 76.9 | 92.0 |

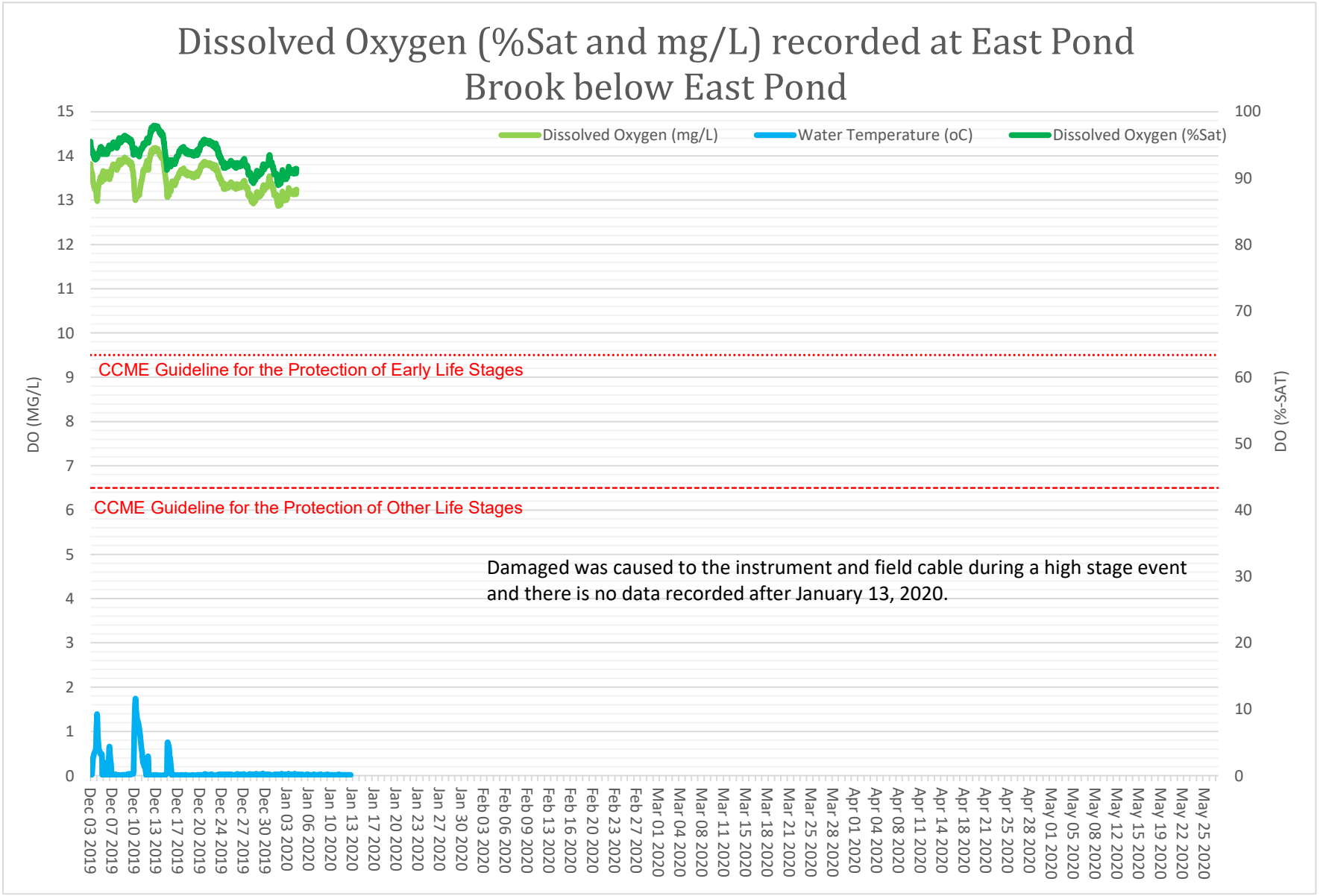


**Figure 8. Dissolved Oxygen (mg/L & sat %) and Stage Level (m) at East Pond Brook**

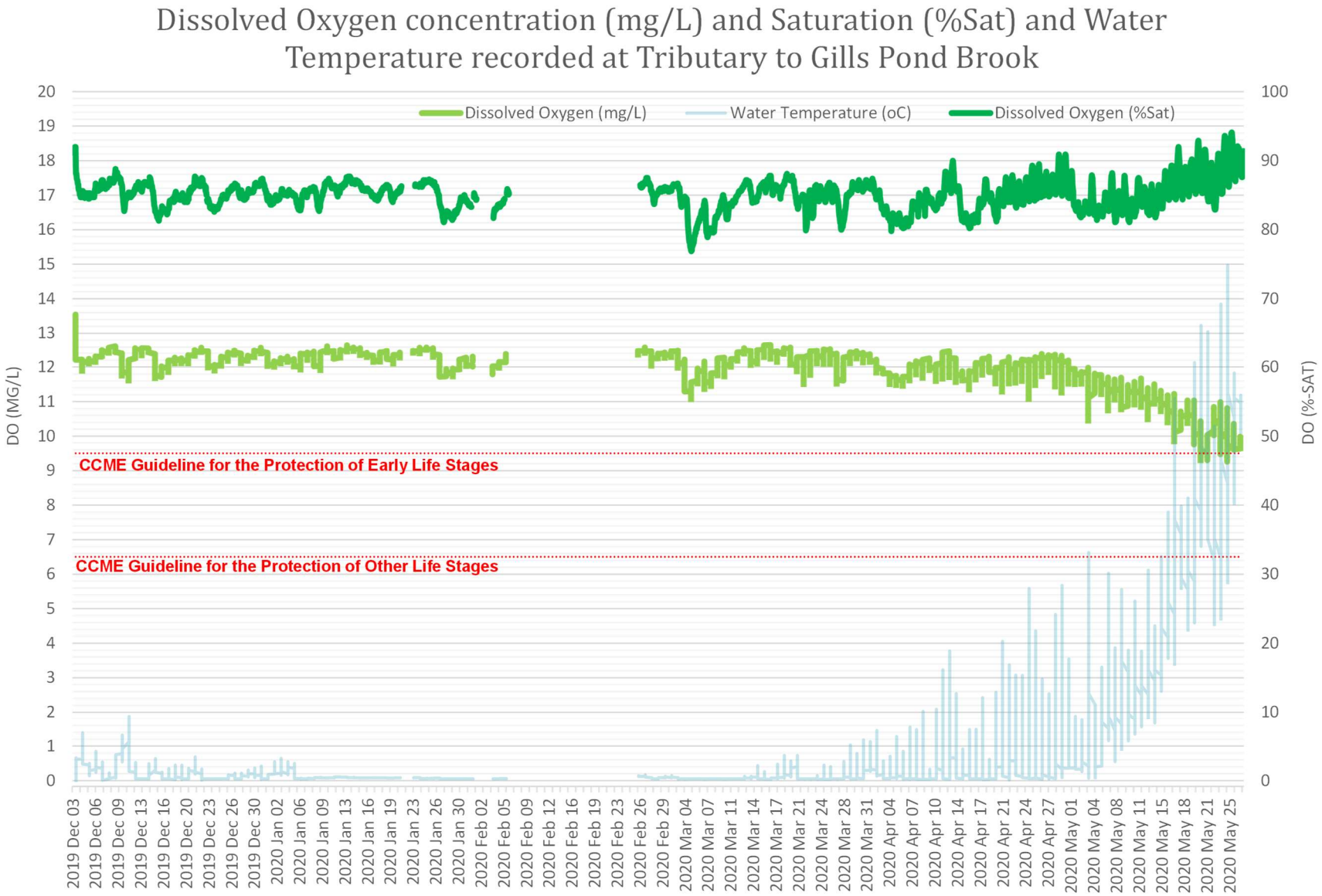


**Figure 9. Dissolved Oxygen (mg/L & % Sat) at Tributary at Gills Pond Brook**

## 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 Tributary to Gills Pond Brook (Figure 11). However, the instrument recorded continuous 0.0 NTU across the deployment, which can indicate an issue with the turbidity sensor. It would be expected that turbidity levels in a natural waterway would vary as it is influenced by its surroundings.

East Pond Brook displayed a high spike in turbidity on December 13 and 14, 2019, the increase in turbidity corresponds with precipitation data collected during that period (Appendix I). Unfortunately, East Pond Brook station was damaged during a high stage event and the instrument was unable to transmit data after January 13th 2020 (Appendix II).

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**Table 6. Table of the statistical data for East Pond Brook and Tributary to Gills Pond Brook for December 2019 to May 2020**

| Station | Mean | Median | Min | Max |
|---|---|---|---|---|
| East Pond Brook* | 19.9* | 0.5* | 0.0* | 262.4* |
| Tributary to Gills Pond Brook | 0.0 | 0.0 | 0.0 | 0.0 |

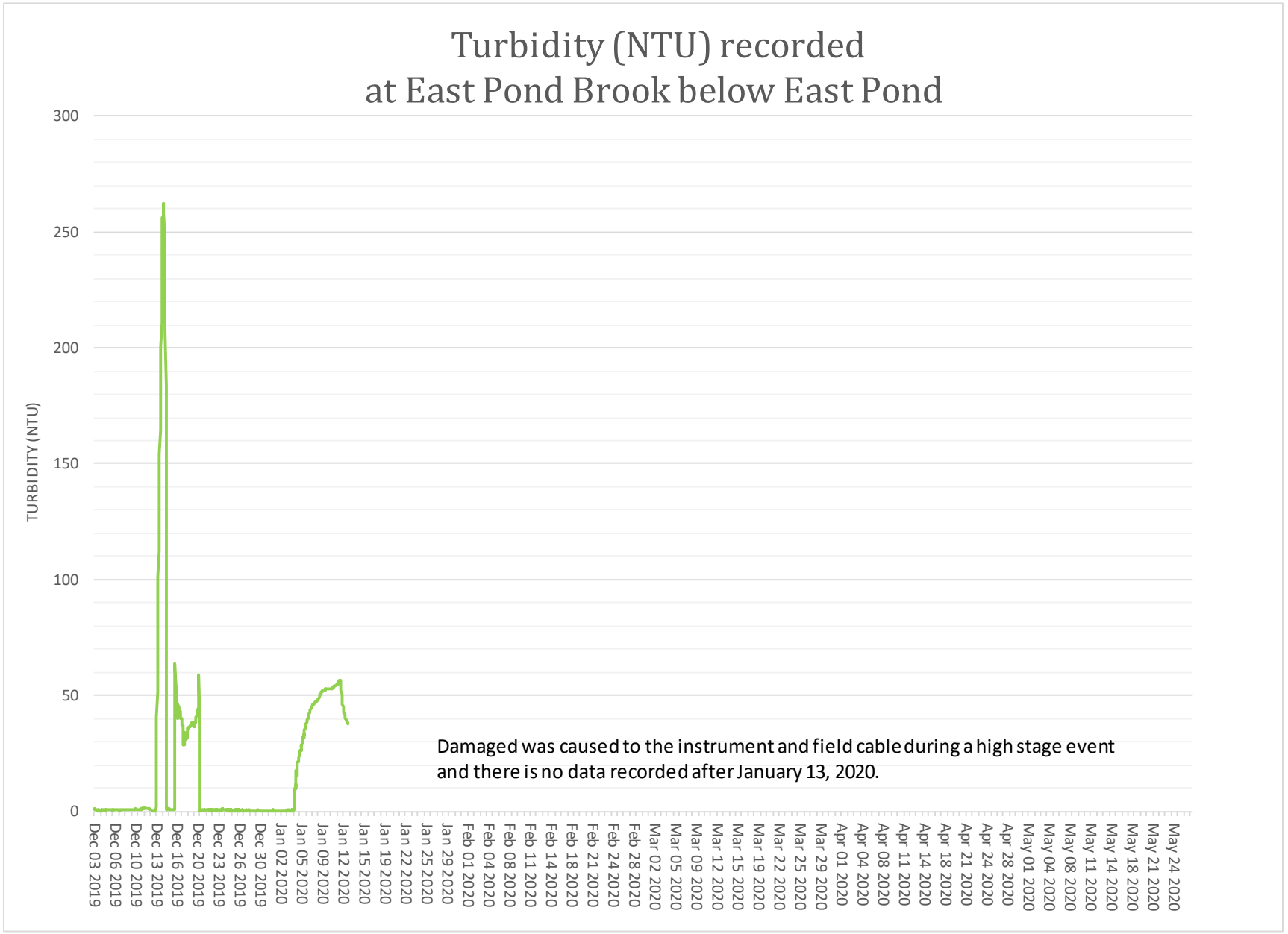



**Figure 10. Turbidity (NTU) and Stage Level (m) at East Pond Brook**

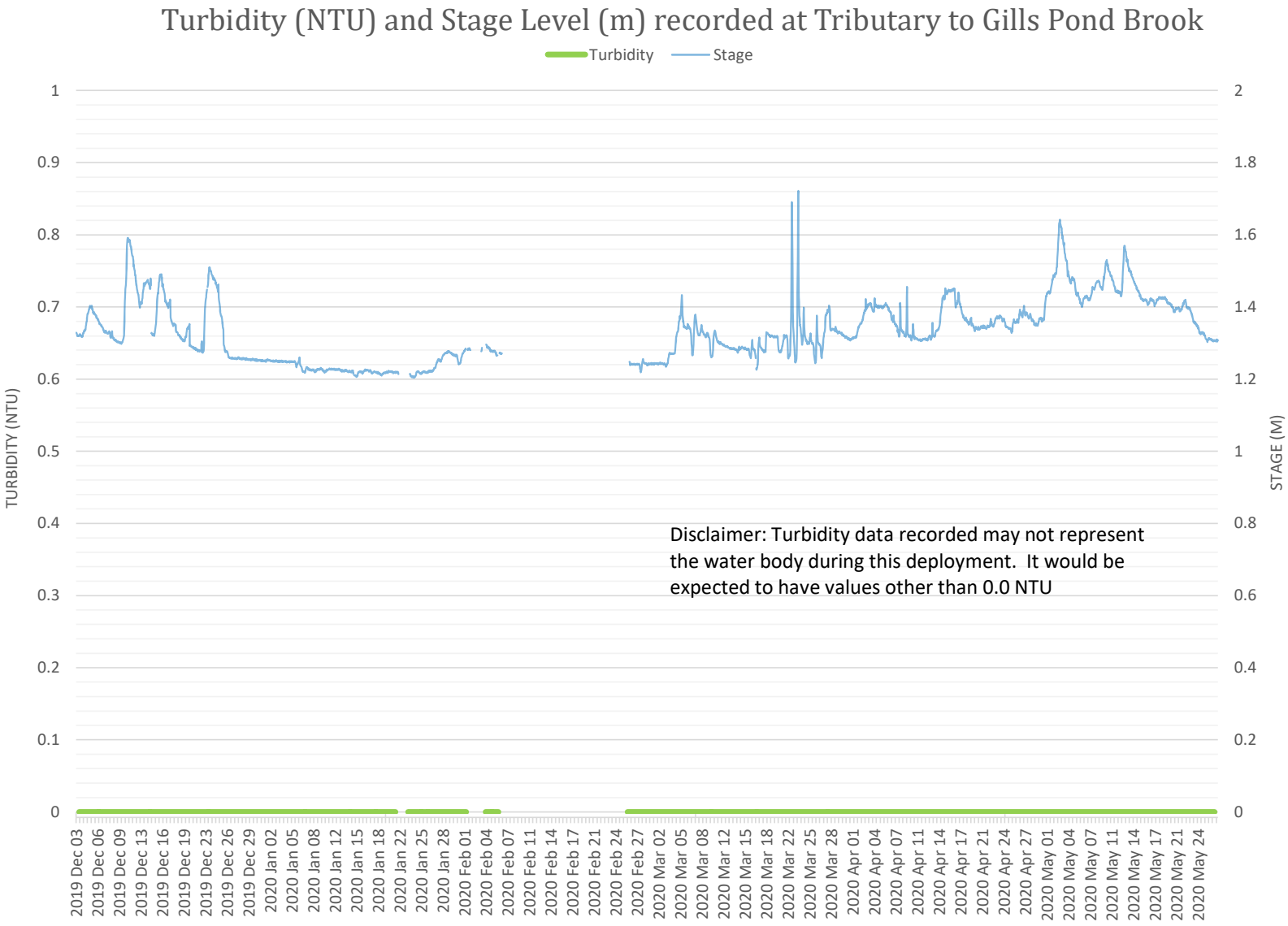
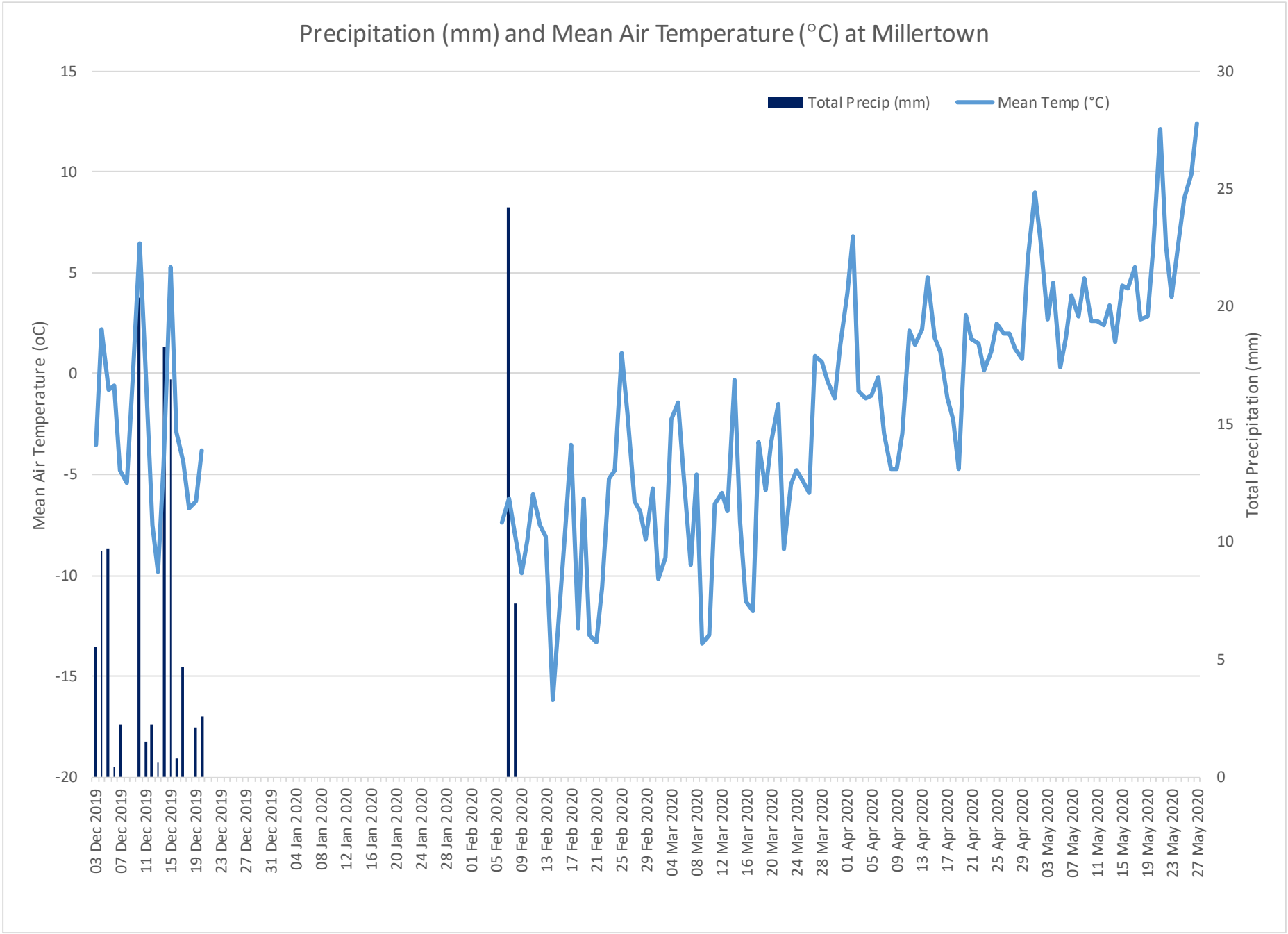
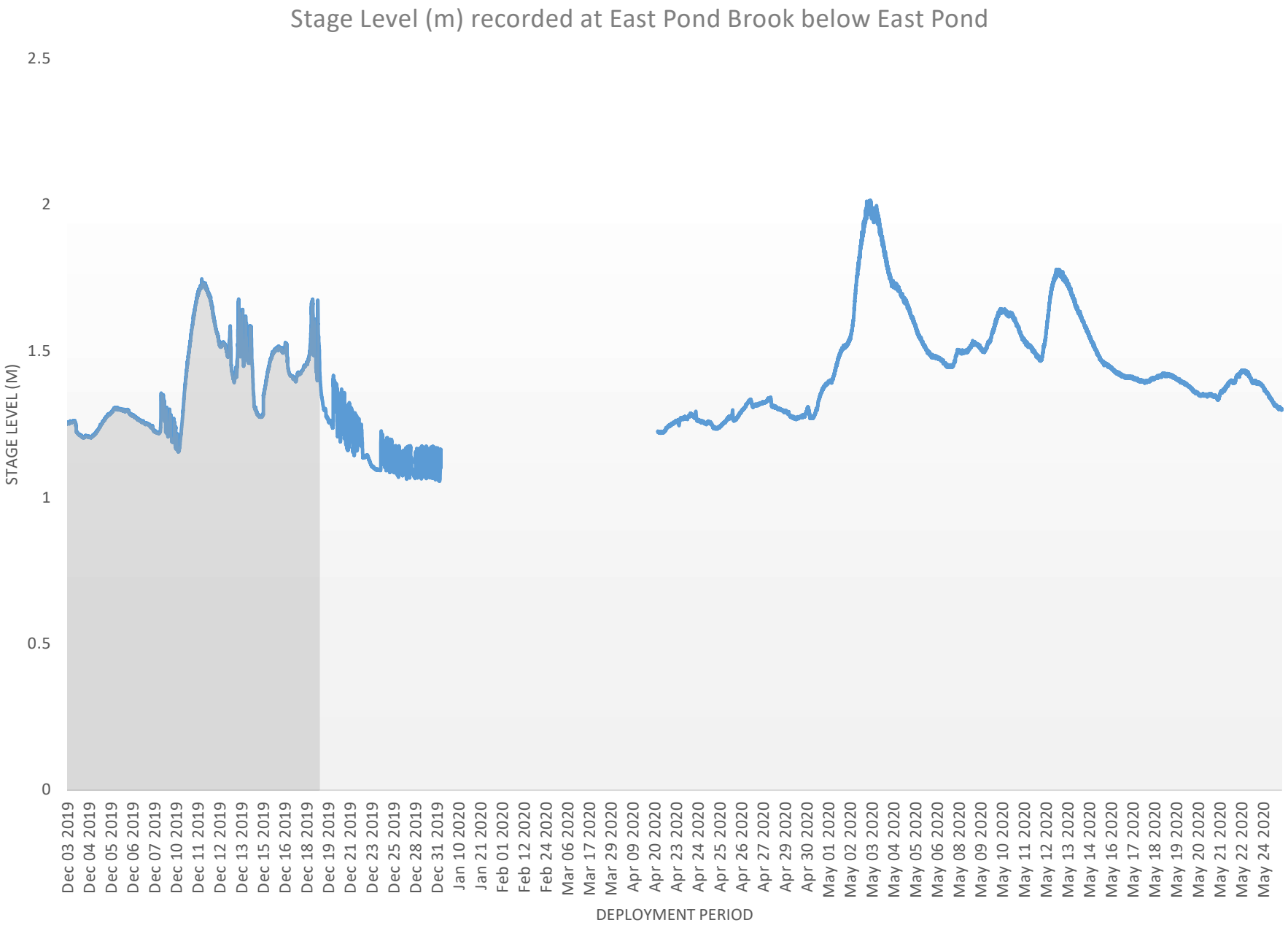



**Figure 11. Turbidity (NTU) and Stage Level (m) at Tributary to Gills Pond Brook**

APPENDIX I


Precipitation (mm) and Mean Air Temperature (°C) at Millertown
Total Precip (mm)
Mean Temp (°C)
Mean Air Temperature (oC)
Total Precipitation (mm)
15
10
5
0
-5
-10
-15
-20
30
25
20
15
10
5
0
03 Dec 2019
07 Dec 2019
11 Dec 2019
15 Dec 2019
19 Dec 2019
23 Dec 2019
27 Dec 2019
31 Dec 2019
04 Jan 2020
08 Jan 2020
12 Jan 2020
16 Jan 2020
20 Jan 2020
24 Jan 2020
28 Jan 2020
01 Feb 2020
05 Feb 2020
09 Feb 2020
13 Feb 2020
17 Feb 2020
21 Feb 2020
25 Feb 2020
29 Feb 2020
04 Mar 2020
08 Mar 2020
12 Mar 2020
16 Mar 2020
20 Mar 2020
24 Mar 2020
28 Mar 2020
01 Apr 2020
05 Apr 2020
09 Apr 2020
13 Apr 2020
17 Apr 2020
21 Apr 2020
25 Apr 2020
29 Apr 2020
03 May 2020
07 May 2020
11 May 2020
15 May 2020
19 May 2020
23 May 2020
27 May 2020

APPENDIX II


Stage Level (m) recorded at East Pond Brook below East Pond
STAGE LEVEL (M)
2.5
2
1.5
1
0.5
0
Dec 03 2019
Dec 04 2019
Dec 05 2019
Dec 06 2019
Dec 07 2019
Dec 10 2019
Dec 11 2019
Dec 12 2019
Dec 13 2019
Dec 15 2019
Dec 16 2019
Dec 18 2019
Dec 19 2019
Dec 21 2019
Dec 23 2019
Dec 25 2019
Dec 28 2019
Dec 31 2019
Jan 10 2020
Jan 21 2020
Feb 01 2020
Feb 12 2020
Feb 24 2020
Mar 06 2020
Mar 17 2020
Mar 29 2020
Apr 09 2020
Apr 20 2020
Apr 23 2020
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May 01 2020
May 02 2020
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May 16 2020
May 17 2020
May 18 2020
May 19 2020
May 20 2020
May 21 2020
May 22 2020
May 24 2020
DEPLOYMENT PERIOD