



Real-Time Water Quality Report Teck: Duck Pond Operations

Deployment Period
August 24, 2022 to November 15, 2022



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

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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 August 24, 2022 through to November 15, 2022.

These stations are a part of the Real-Time Water Quality Network. The stations are maintained by the Department of Environment and Climate Change, 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 (<https://www.gov.nl.ca/ecc/waterres/rti/rtwq/>).

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/>.

Quality Assurance and Quality Control

To ensure the effectiveness and reliability of the real time water quality monitoring program, quality assurance, quality control, and quality assessment procedures have been implemented. 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).

Table 1 Instrument Performance Ranking classifications for deployment and removal

Parameter	Rank				
	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

The most important sensor on any sonde is the temperature sensor. 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 device 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. The deployment and removal instrument performance rankings for this period are summarized in Table 2.

Sondes from Tributary to Gill's Pond Brook and East Pond Brook were removed and replaced on August 24th, 2022. On October 18th, 2022, the sonde at Tributary to Gills Pond Brook was replaced; however, the water levels at East Pond Brook were too high to safely swap out the device. This deployment report will include data from August 24th until November 15th, which includes data from two deployment periods at Tributary to Gill's Pond Brook.

Table 2 Instrument performance rankings

Station	Date	Action	Comparison Ranking				
			Temp	pH	Sp. Cond.	DO	Turbidity
Tributary to Gill's Pond Brook	August 24, 2022	Deployment	Excellent	Excellent	Excellent	Excellent	Excellent
	October 10, 2022	Removal	Excellent	Good	Fair	Good	Excellent
Tributary to Gill's Pond Brook	October 10, 2022	Deployment	Excellent	Fair	Good	Good	Excellent
	November 15, 2022	Removal	Excellent	Excellent	Excellent	Excellent	Excellent
East Pond Brook below East Pond	August 24, 2022	Deployment	Excellent	Excellent	Good	Excellent	Excellent
	November 15, 2022	Removal	Excellent	Good	Good	Fair	Excellent

Results

Water Temperature

Water Temperature is a crucial 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.

At Tributary to Gills Pond Brook a temperature range of 0.83°C to 24.19°C was recorded during this deployment period. The water temperature at East Pond Brook ranged from 0.50°C to 25.10°C (Table 3). Daily fluctuations are observed at both stations with higher temperatures during the day and lower temperatures at night. Both stations showed a downward trend as air temperatures dropped throughout late summer and the fall.

Please note, the stage data is raw data that is published on the ECCC web page. 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.

Table 3. Statistical temperature data for Tributary to Gills Pond Brook and East Pond Brook from August 24, 2022 to November 15, 2022.

Station	Max	Min	Median	Mean
Tributary to Gills Pond Brook	24.19	0.83	11.19	11.54
East Pond Brook	25.10	0.50	11.48	11.81

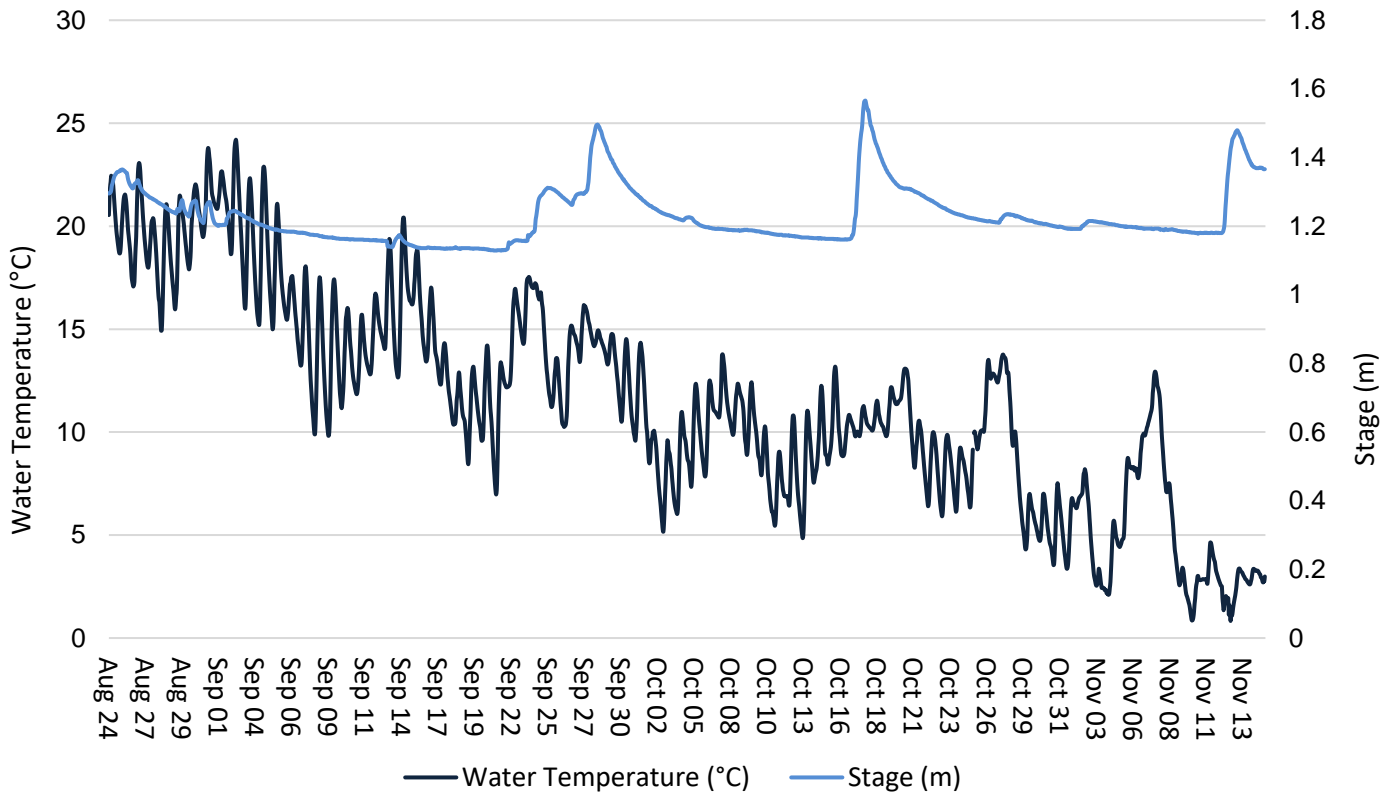


Figure 1 Water Temperature and Stage Level at Tributary to Gills Pond Brook.

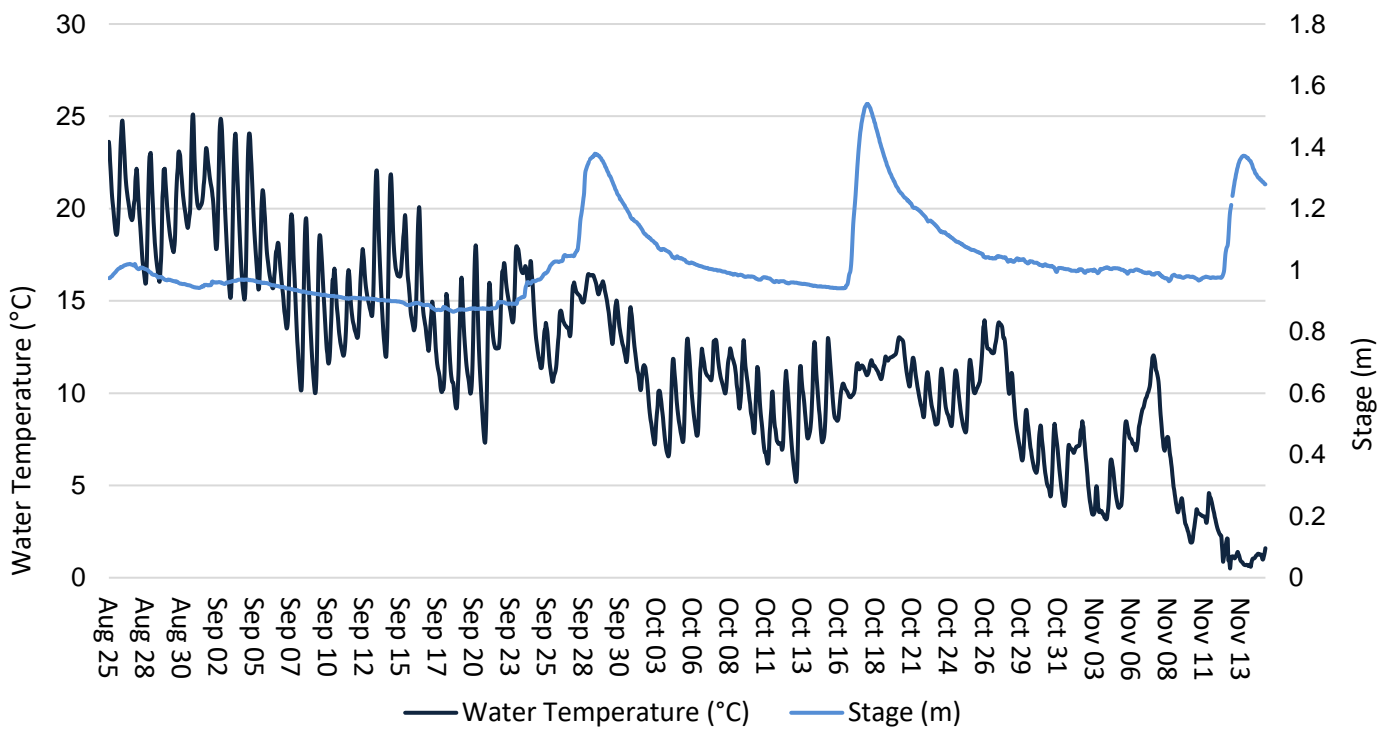


Figure 2 Water Temperature and Stage Level at East Pond Brook.

pH

pH indicates the acidity or alkalinity of a solution. A value of 7.00 pH units denotes a neutral solution, lower values are acidic, and higher values are basic. The pH levels at Tributary to Gills Pond Brook ranged from 5.48 pH units to a maximum of 7.61 pH units (Table 4). pH at East Pond Brook ranged from 6.15 pH units to 7.31 pH units at this time.

pH is influenced by precipitation runoff and tends to decrease as stage increases. During periods of drier or colder weather, water levels decline and pH increases slightly as dissolved ions are not as diluted. pH levels at both locations fluctuated daily and during stage events. Daily fluctuations can be caused by the respiration and photosynthesis of aquatic plants and algae, which become more abundant during the spring and summer seasons.

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. Both stations remained within the guidelines except during major precipitation events when they briefly dipped below the minimum pH guideline for protection of aquatic life.

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 4. Statistical pH data for Tributary to Gills Pond Brook and East Pond Brook for August 24, 2022 to November 15, 2022.

Station	Max	Min	Median	Mean
Tributary to Gills Pond Brook	7.61	5.48	7.17	7.10
East Pond Brook	7.31	6.15	6.70	6.78

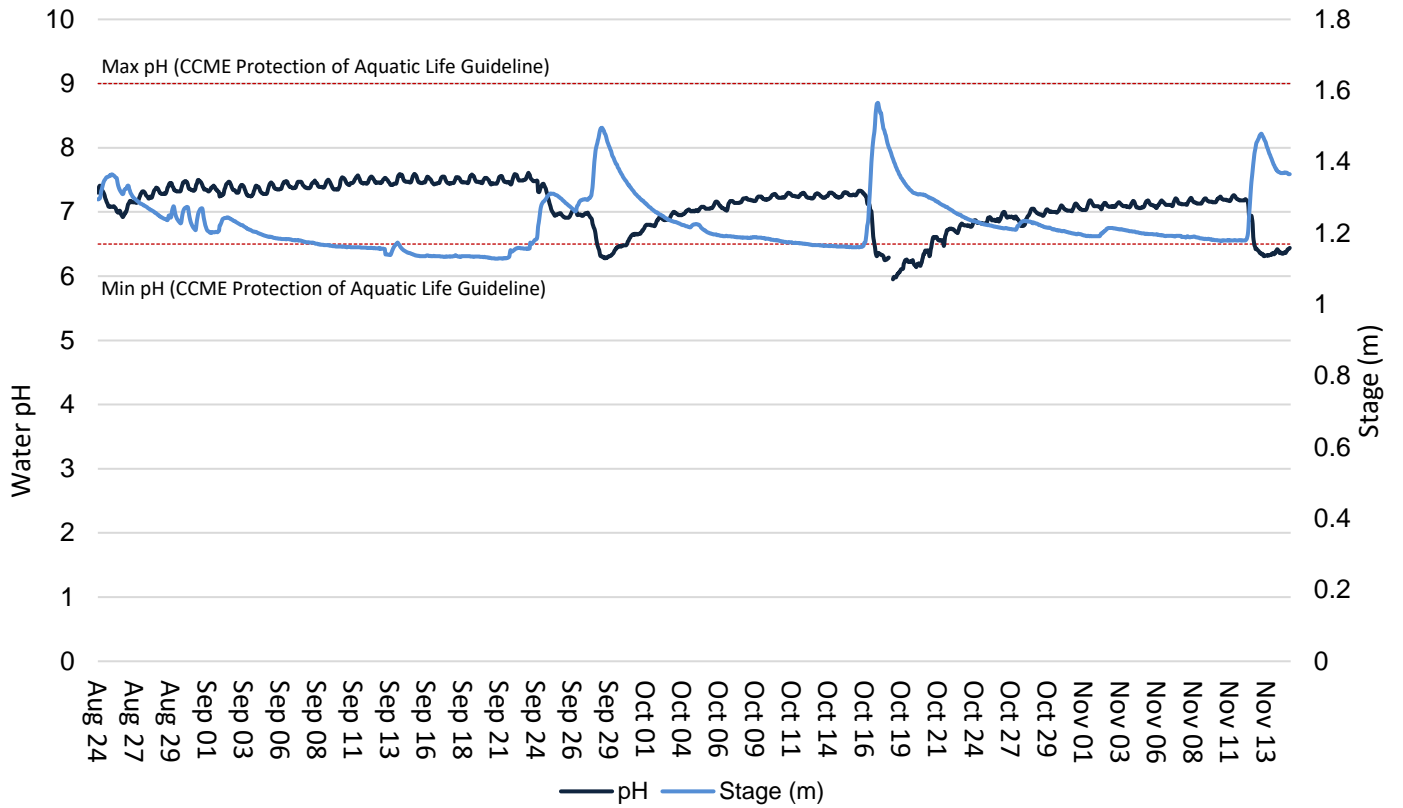


Figure 3 Water pH and Stage at Tributary to Gills Pond Brook.

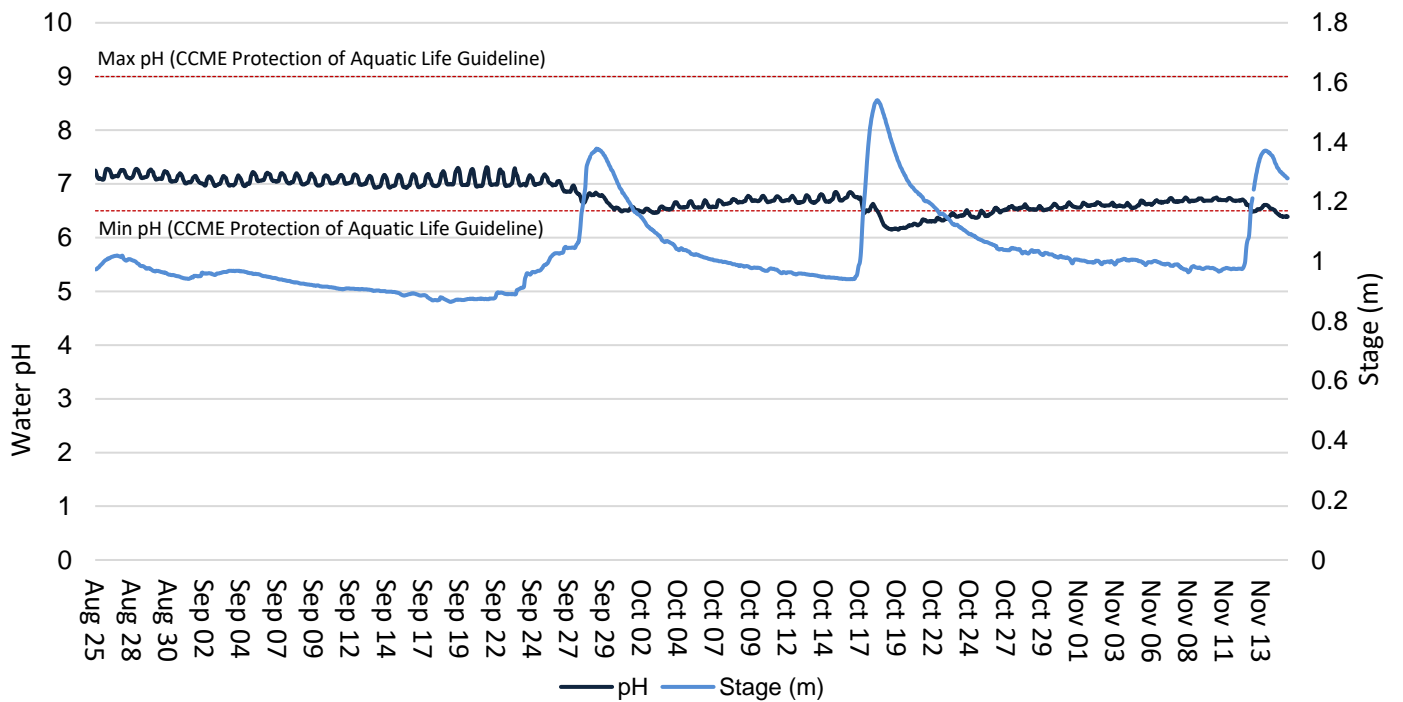


Figure 4. Water pH and Stage at East Pond Brook

Specific Conductivity

Conductivity relates to the ability of an electric charge 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°C to allow comparison across variable temperatures.

Conductivity was variable throughout the deployment. The conductivity at the end of the summer and early fall was overall higher than the rest of the deployment at Tributary to Gills Pond Brook. East Pond Brook was much more consistent throughout the deployment; however, the conductivity dropped throughout the deployment. The downward trend at both stations could be explained by the increased precipitation in the fall. Conductivity at Tributary to Gill's Pond Brook ranged from 21.7 $\mu\text{S}/\text{cm}$ to 669.0 $\mu\text{S}/\text{cm}$ (Table 5). Specific conductivity at East Pond Brook ranged from 23.2 $\mu\text{S}/\text{cm}$ to 47.4 $\mu\text{S}/\text{cm}$ (Table 5). An increase in stage corresponded to a decrease in specific conductivity, because rainwater has low specific conductivity and the system becomes diluted.

Stage Level data is raw data. 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 5. Statistical conductivity data for Tributary to Gills Pond Brook and East Pond Brook for August 24, 2022 to November 15, 2022.

Station	Max	Min	Median	Mean
Tributary to Gills Pond Brook	669.0	21.7	59.3	126.7
East Pond Brook	47.4	23.2	33.5	34.3

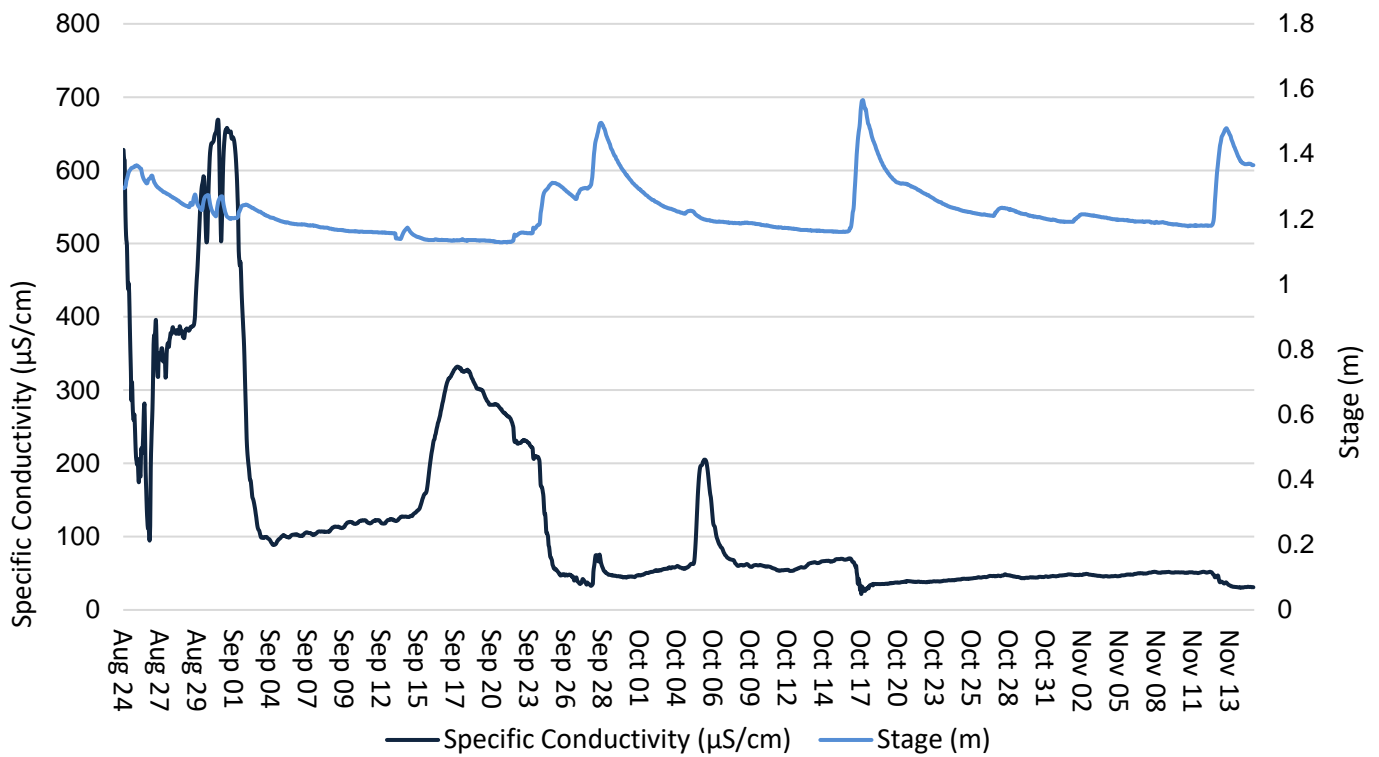


Figure 5. Specific conductivity values at Tributary to Gills Pond Brook.

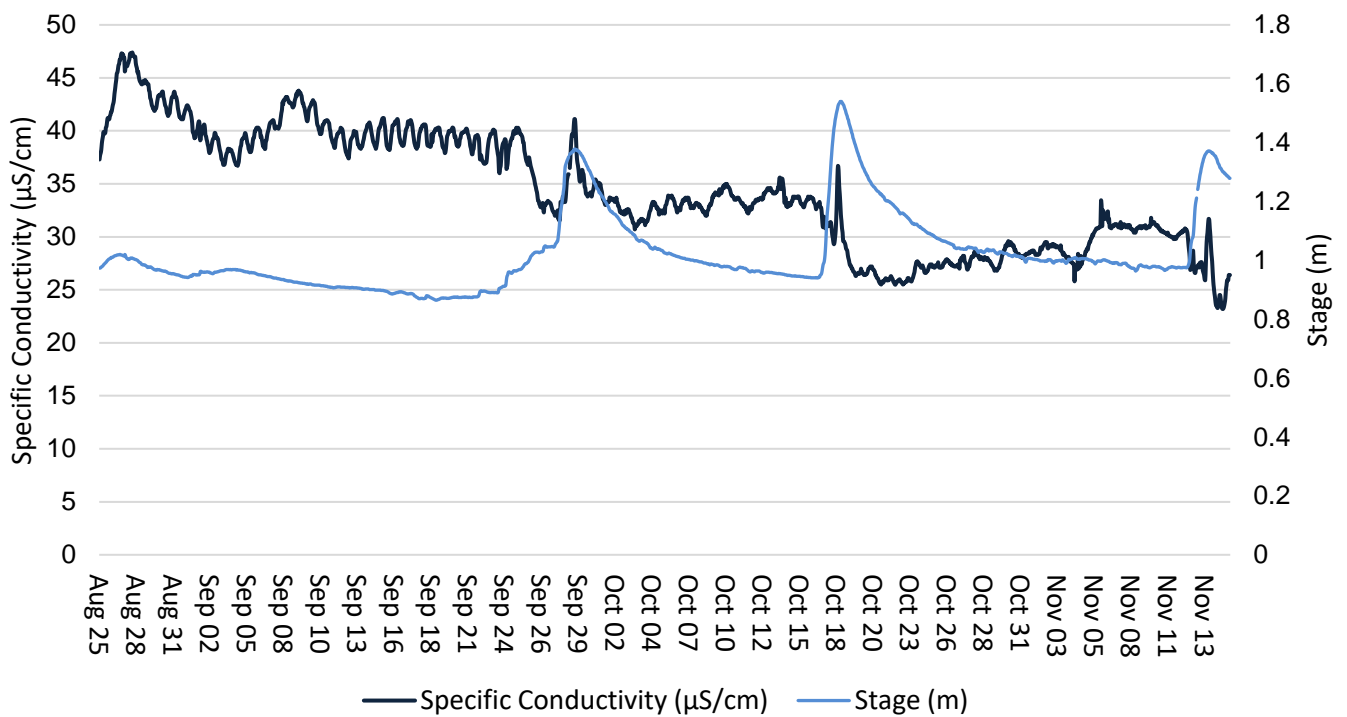


Figure 6. Specific conductivity values at East Pond Brook.

Dissolved Oxygen

Dissolved oxygen is a metabolic requirement of aquatic plants and animals. The amount of dissolved 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. Cooler water can hold more dissolved oxygen. Oxygen concentrations also tend to be higher in flowing water compared to still, lake environments or riverine pools. Low oxygen concentrations can give an indication of excessive decomposition of organic matter or the presence of oxidizing materials.

Tributary to Gill's Pond Brook had a minimum dissolved oxygen concentration of 8.33 mg/L, and it had a maximum dissolved oxygen concentration of 12.60 mg/L. At East Pond brook below East Pond, the dissolved oxygen concentration data ranged from 7.69 mg/L to 13.10 mg/L.

Dissolved oxygen levels at both stations were below the CCME guidelines for the protection of early life stages at the start of the deployment; however, as temperatures cooled, DO values increased at both sites (Figure 7 & 8).

Table 6. Statistical Dissolved Oxygen data for Tributary to Gills Pond Brook and East Pond Brook for August 24, 2022 to November 15, 2022.

Station	Max	Min	Median	Mean
Dissolved Oxygen (mg/L)				
Tributary to Gills Pond Brook	12.60	8.33	10.31	10.32
East Pond Brook	13.10	7.69	9.91	9.94
Dissolved Oxygen (%Sat)				
Tributary to Gills Pond Brook	102.9	82.0	95.9	94.2
East Pond Brook	98.6	84.2	91.2	91.2

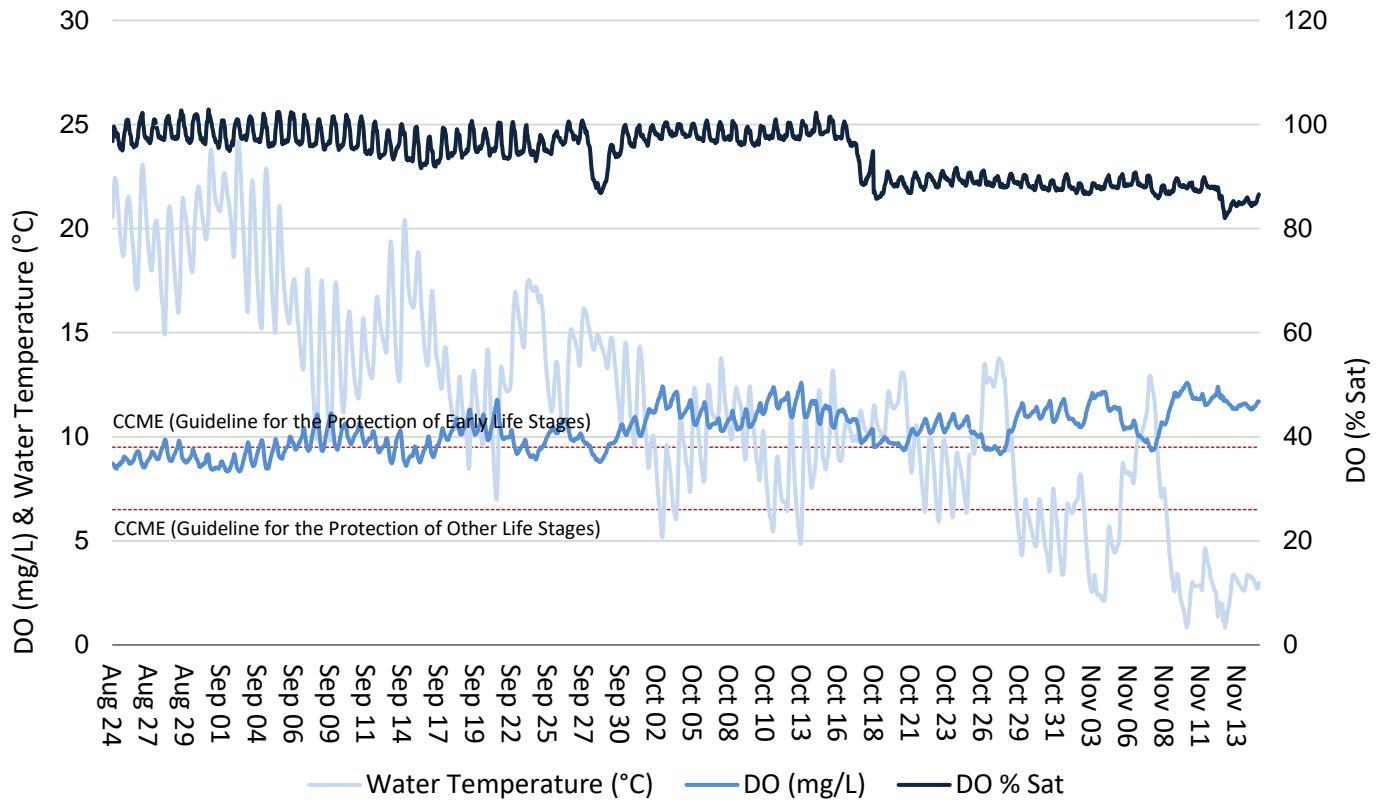


Figure 7. Dissolved oxygen (mg/L & % Sat) and water temperature (°C) values at Tributary to Gills Pond Brook.

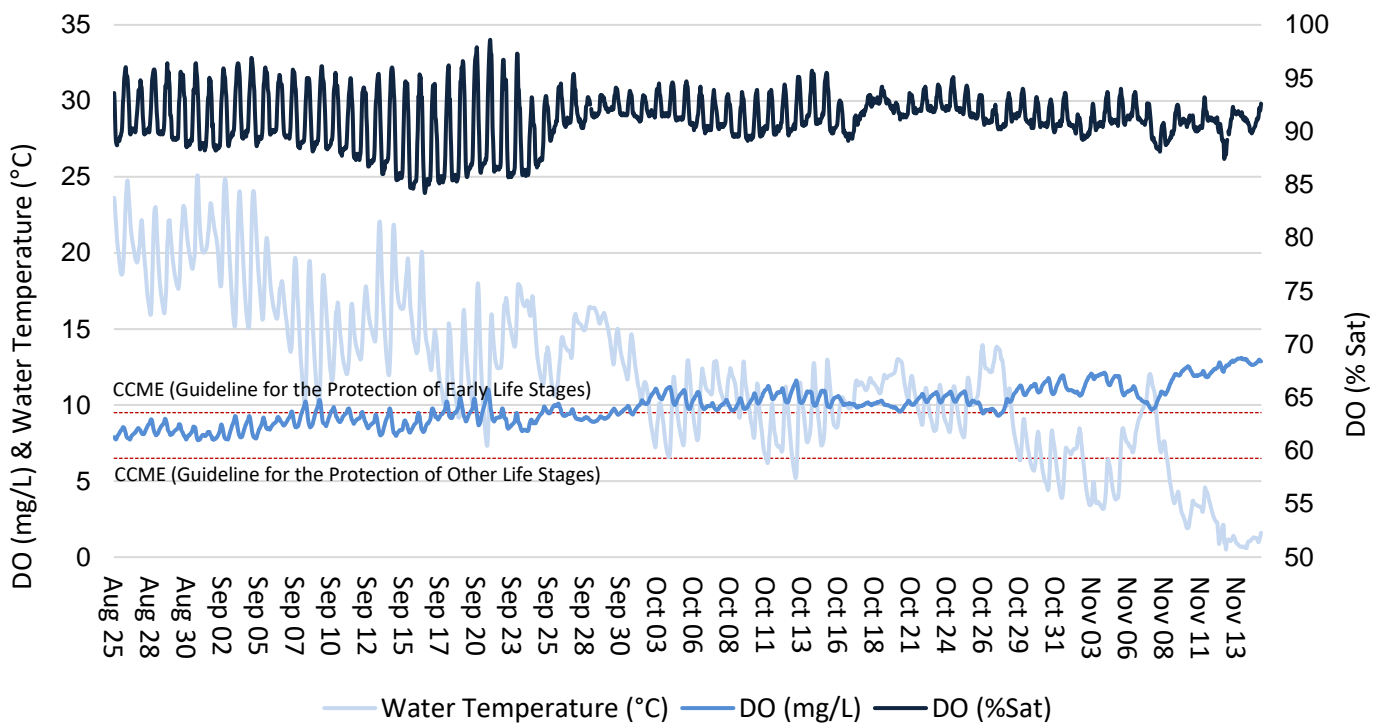


Figure 8 Dissolved oxygen (mg/L & % Sat) and water temperature (°C) values at East Pond Brook

Turbidity

Turbid or cloudy 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, harming plant and phytoplankton growth. High turbidity can also damage the delicate respiratory organs of aquatic animals and sediment can cover critical spawning areas.

Turbidity levels are generally low at Tributary to Gills Pond Brook and are influenced by precipitation and associated runoff as well as effluent discharges. As seen in figure 9, spikes are generally associated with precipitation events. Turbidity levels at East Pond Brook during this deployment were also generally low; however, some of the spikes were unexpectedly high. The spikes seen at East Pond Brook may be a result of debris becoming stuck in the sensor rather than extremely high turbidity levels in the water column; because of this, the statistics for East Pond Brook may not accurately reflect the conditions in the river during the deployment period.

Stage Level data is raw data. 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 7. Statistical turbidity data for Tributary to Gills Pond Brook and East Pond Brook for August 24, 2022 to November 15, 2022.

Station	Max	Min	Median	Mean
Tributary to Gills Pond Brook	29.2	0.0	0.0	0.1
East Pond Brook	2851.0	0.0	4.4	59.2

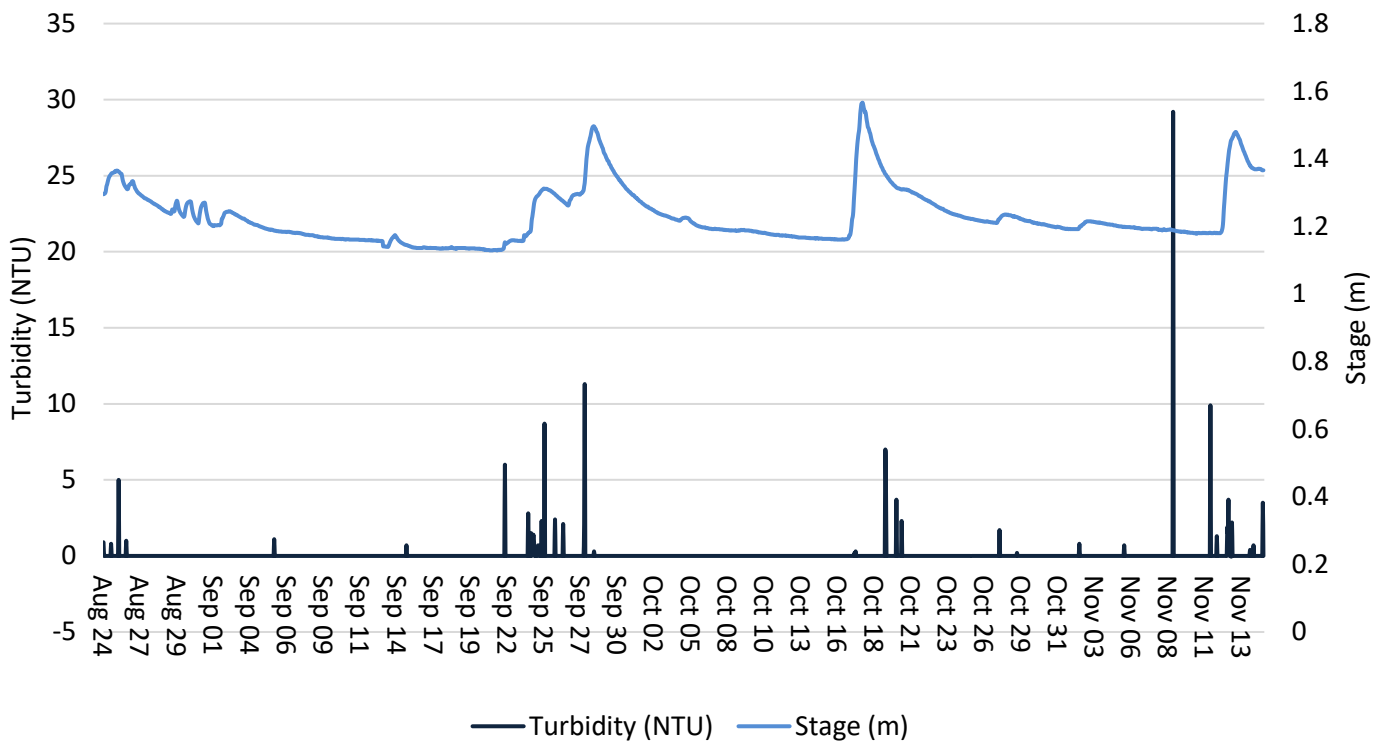


Figure 9. Turbidity (NTU) values at Tributary to Gills Pond Brook.

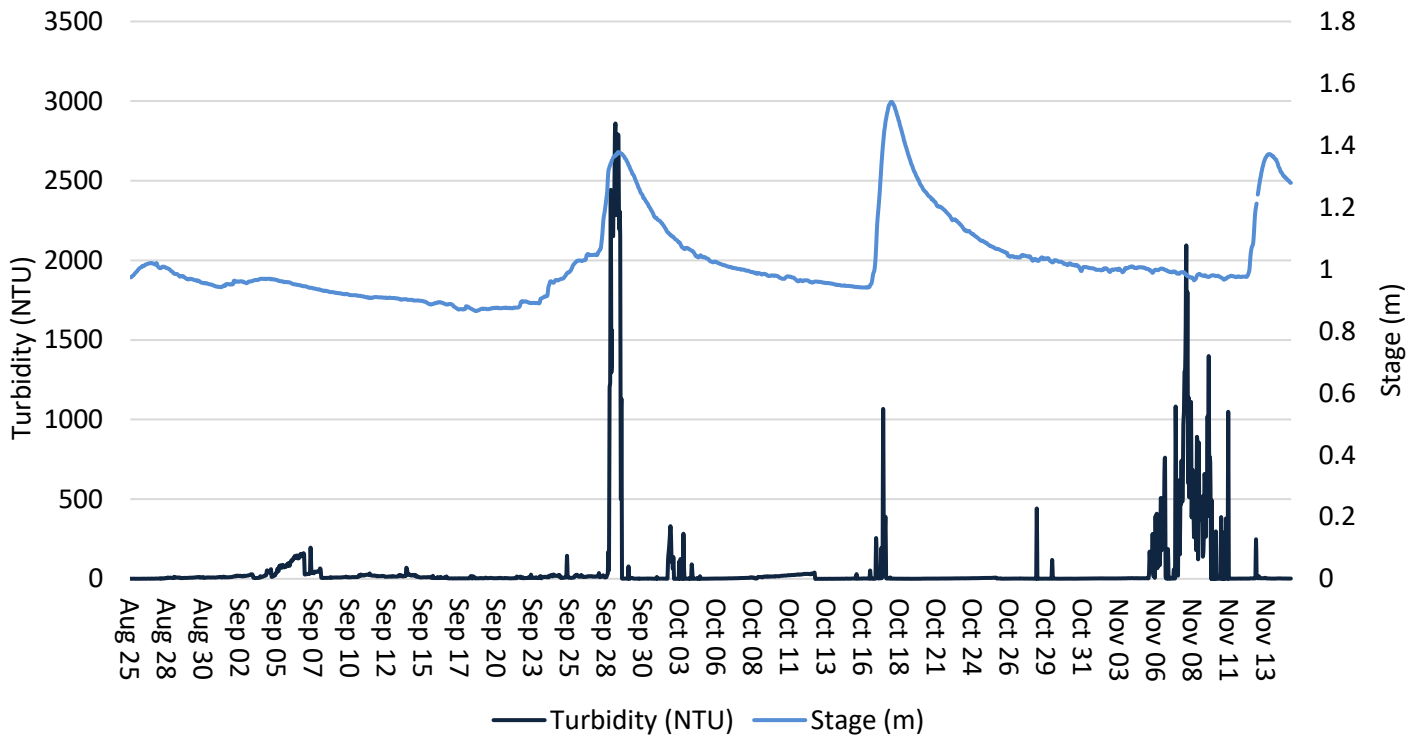


Figure 10. Turbidity (NTU) values at East Pond Brook.

Stage and Total Precipitation

Figure 11, below, shows daily total precipitation data from Millertown weather station and the daily average stage at each site. There is no precipitation data available from the start of the deployment until October 27th, 2022.

Please note that the stage data 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.

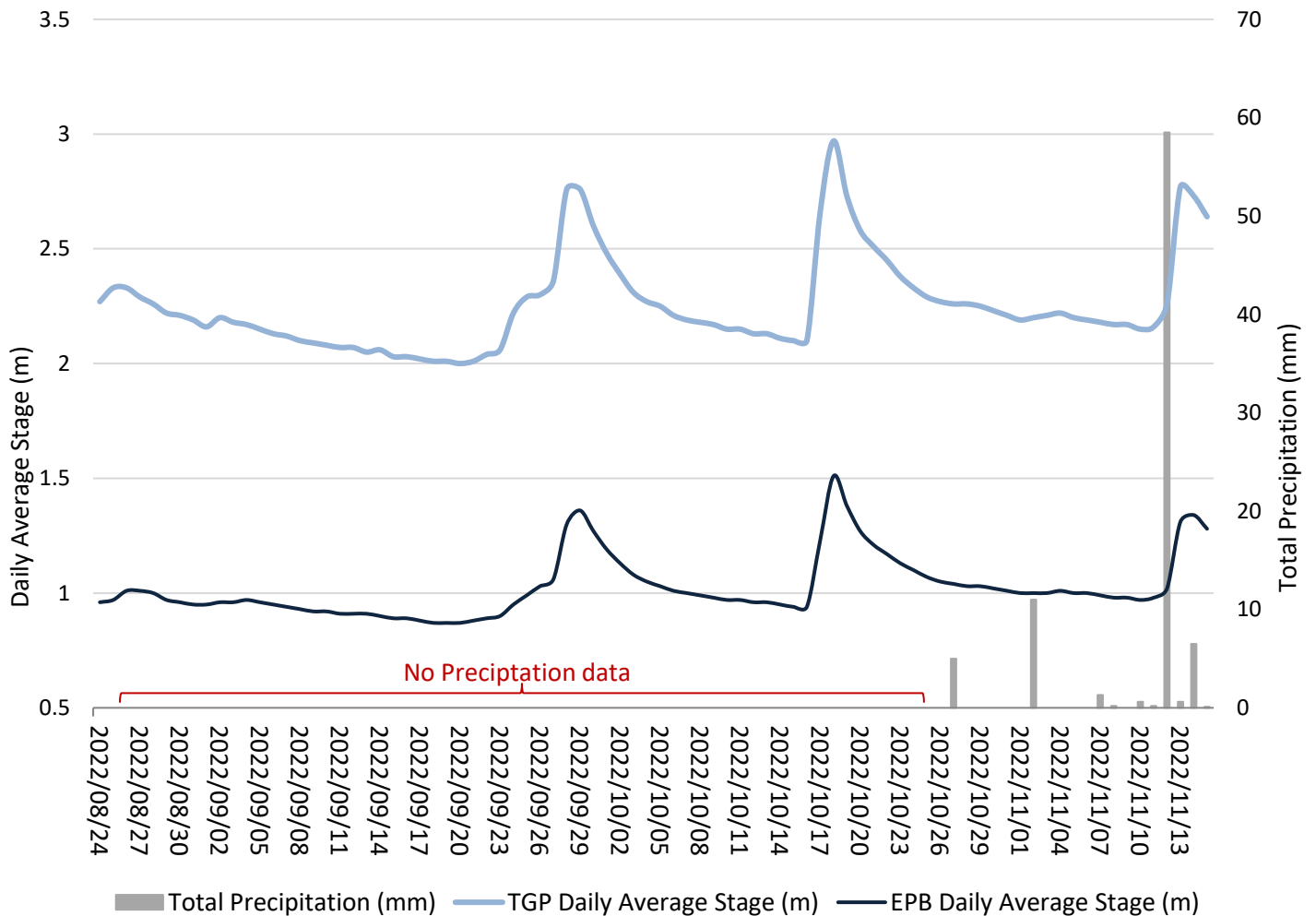


Figure 11 Daily average stage values (m) from Tributary to Gills Pond and East Pond Brook and daily total precipitation values (mm) from Millertown.