Real-Time Water Quality Report
Teck: Duck Pond Operations

East Pond Brook

Deployment Period
August 23, 2023 to October 26, 2023

Newfoundland Labrador

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 real-time water quality monitoring station at TECK Duck Pond: East Pond Brook below East Pond, for the duration of August 23, 2023 through to October 26, 2023.

This station is a part of the Real-Time Water Quality Network. The station is 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 (Real Time Water Quality Monitoring Program - Environment and Climate Change (gov.nl.ca)).

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

	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

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.

The sonde from East Pond Brook was removed and replaced on August 23rd, 2023. This deployment report will include data from August 23rd until October 26th.

Table 2 Instrument performance rankings

Station	Date	Action	Comparison Ranking				
			Temp	pH	Sp. Cond.	DO	Turbidity
East Pond Brook below East Pond	August 23, 2023	Deployment	Excellent	Excellent	Good	Excellent	Excellent
	October 26, 2023	Removal	Excellent	Excellent	Excellent	Excellent	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 East Pond Brook a temperature range of 5.63°C to 24.40°C was recorded during this deployment period (Table 3). Daily fluctuations are observed with higher temperatures during the day and lower temperatures at night. Temperature data 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 East Pond Brook from August 23, 2023 to October 26, 2023.

Station	Max	Min	Median	Mean
East Pond Brook	24.40	5.63	13.80	13.86

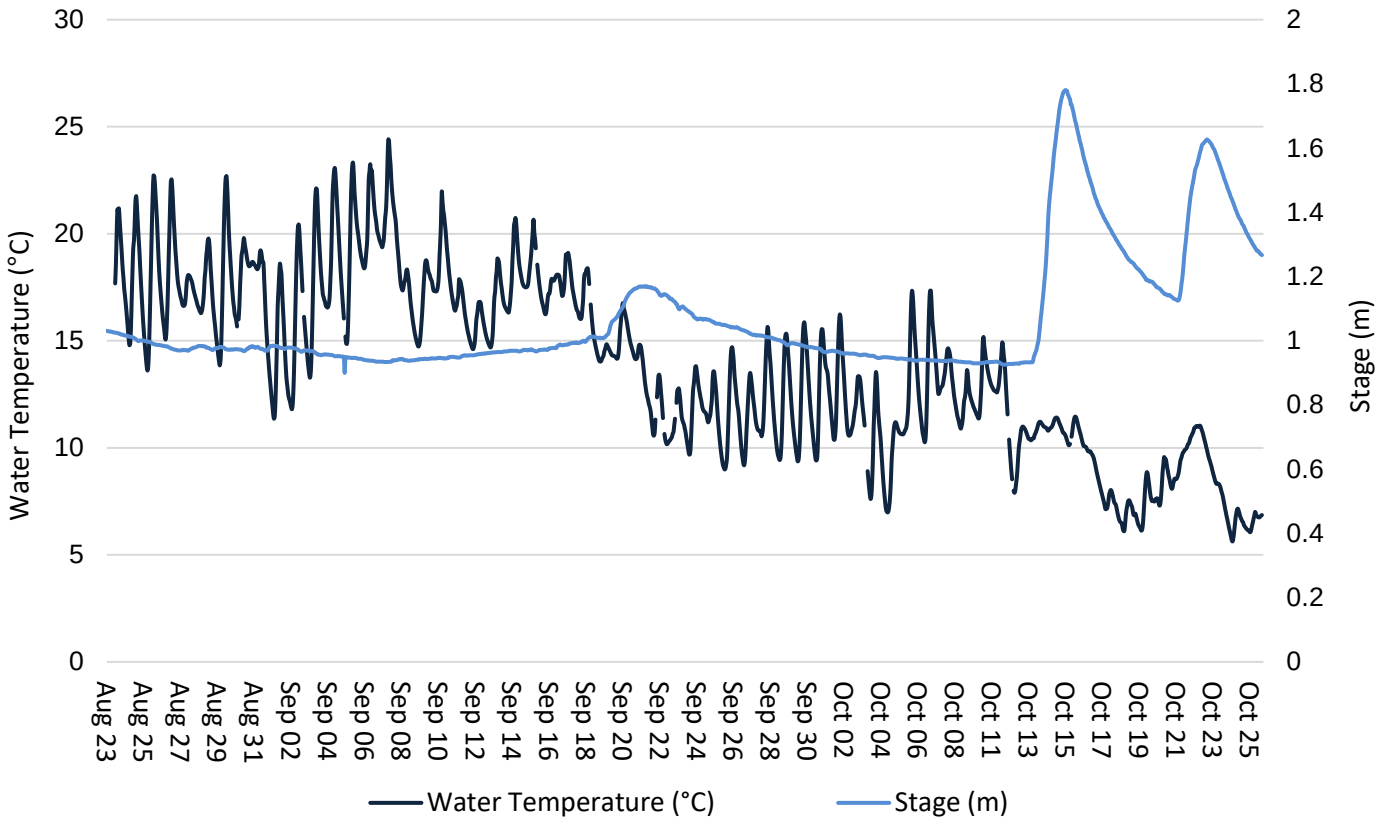

Figure 1 Water Temperature and Stage Level at East Pond Brook.

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. pH at East Pond Brook ranged from 4.76 pH units to 7.12 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. East Pond Brook pH remained within the CCME guidelines for the first half of deployment, but steadily decreased below the minimum guideline for the second portion of deployment. This may indicate sensor drift.

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 East Pond Brook for August 23, 2023 to October 26, 2023.

Station	Max	Min	Median	Mean
East Pond Brook	7.12	4.76	6.31	6.24

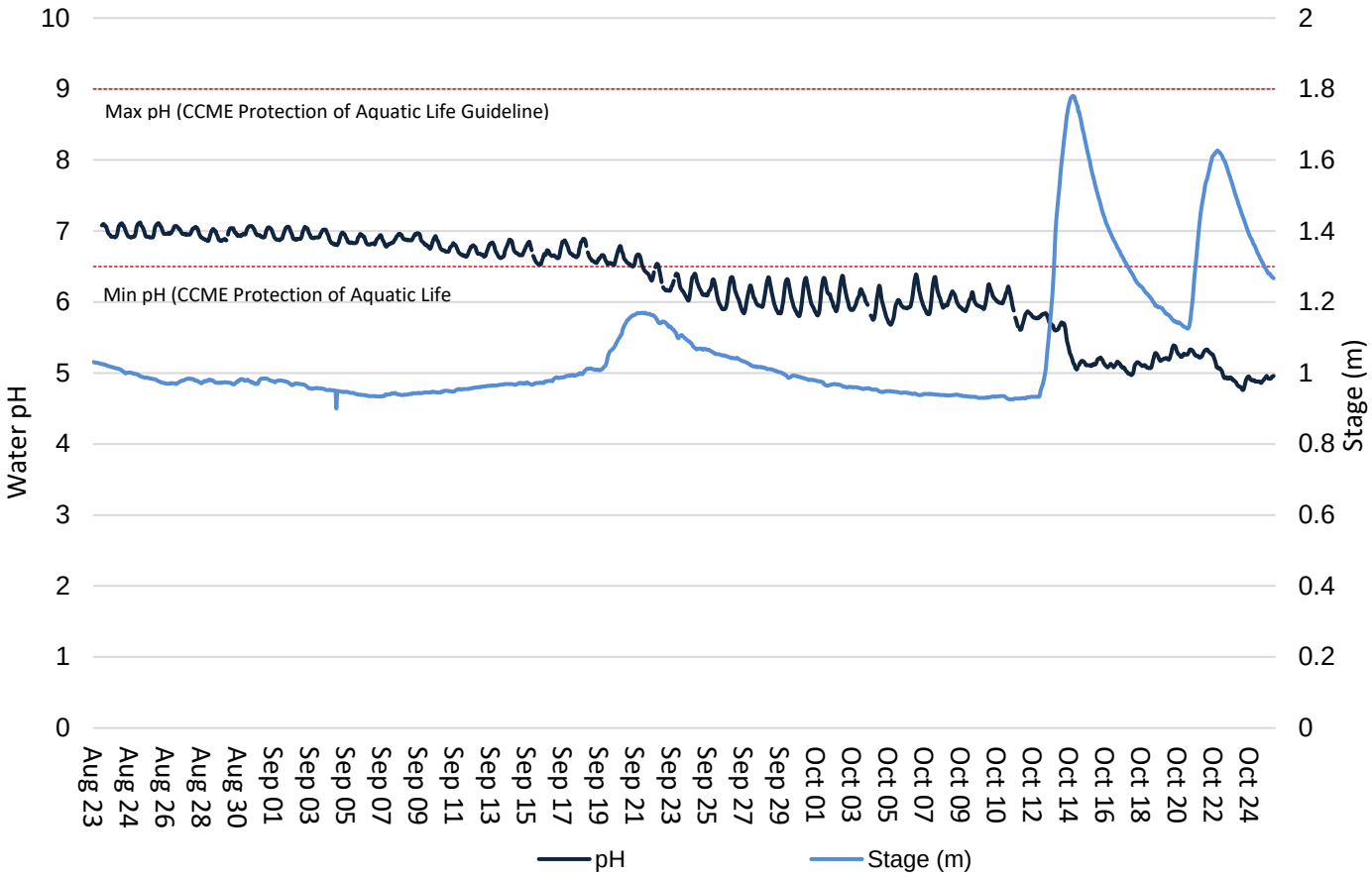

Figure 2. Water pH and Stage at East Pond Brook

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.

Specific conductivity at East Pond Brook ranged from 20.5 µS/cm to 45.3 µS/cm (Table 5). Conductivity showed an increasing trend for the first half of deployment followed by a downward trend for the second half of deployment. The downward trend could be explained by the increased precipitation in the Fall. 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 East Pond Brook for August 23, 2023 to October 26, 2023.

Station	Max	Min	Median	Mean
East Pond Brook	45.3	20.5	35.3	34.2

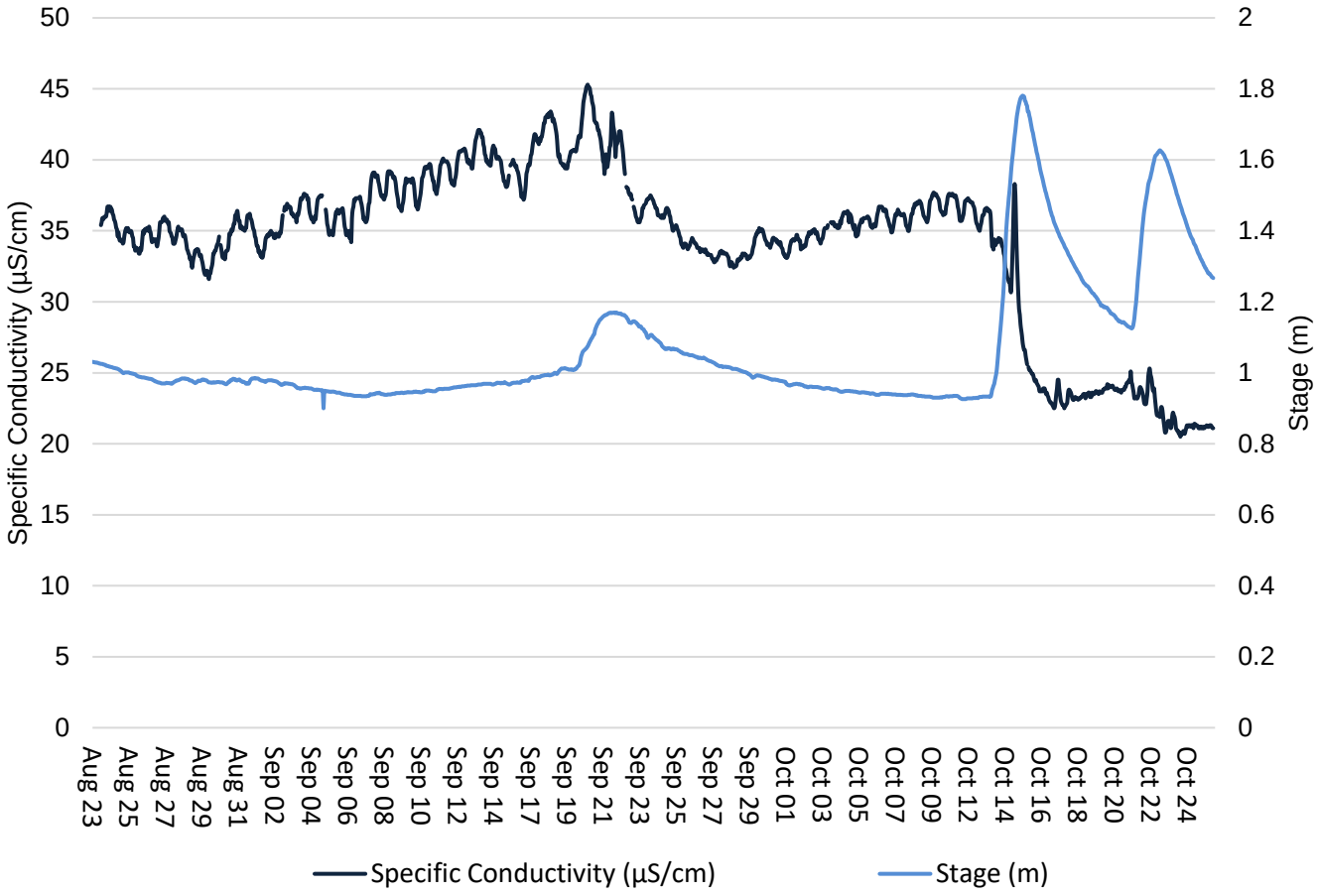

Figure 3. Specific conductivity values at East Pond Brook.

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.

At East Pond brook below East Pond, the dissolved oxygen concentration data ranged from 7.88 mg/L to 12.11 mg/L during this deployment period. Dissolved oxygen levels 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 (Figure 4).

Table 6. Statistical Dissolved Oxygen data for East Pond Brook for August 23, 2023 to October 26, 2023.

Station	Max	Min	Median	Mean
Dissolved Oxygen (mg/L)				
East Pond Brook	12.11	7.88	9.87	9.91
Dissolved Oxygen (%Sat)				
East Pond Brook	100.5	90.1	95.2	95.3

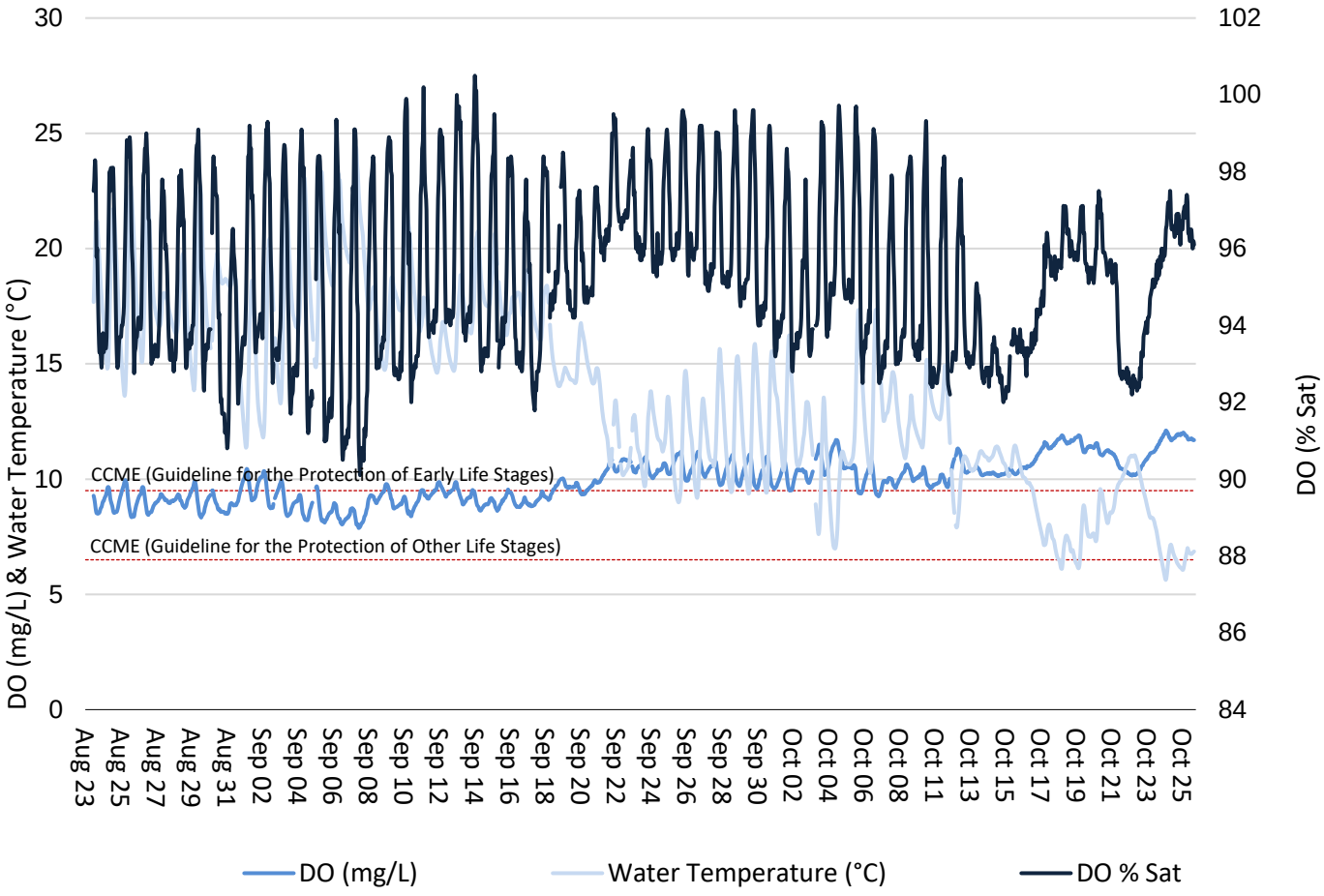

Figure 4. Dissolved oxygen (mg/L & % Sat) and water temperature (°C) values at East Pond Brook

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 at East Pond Brook during this deployment were generally low with some moderate spikes associated with precipitation and associated run-off. An increase in stage October 13th may have caused debris to accumulate around the turbidity sensor, noticeable in the data as persistent higher values for a period of time, before another high stage event around October 23rd cleared the debris from around the sensor, as values returned to baseline.

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 East Pond Brook for August 23, 2023 to October 26, 2023.

Station	Max	Min	Median	Mean
East Pond Brook	38.9	0.0	0.0	0.2

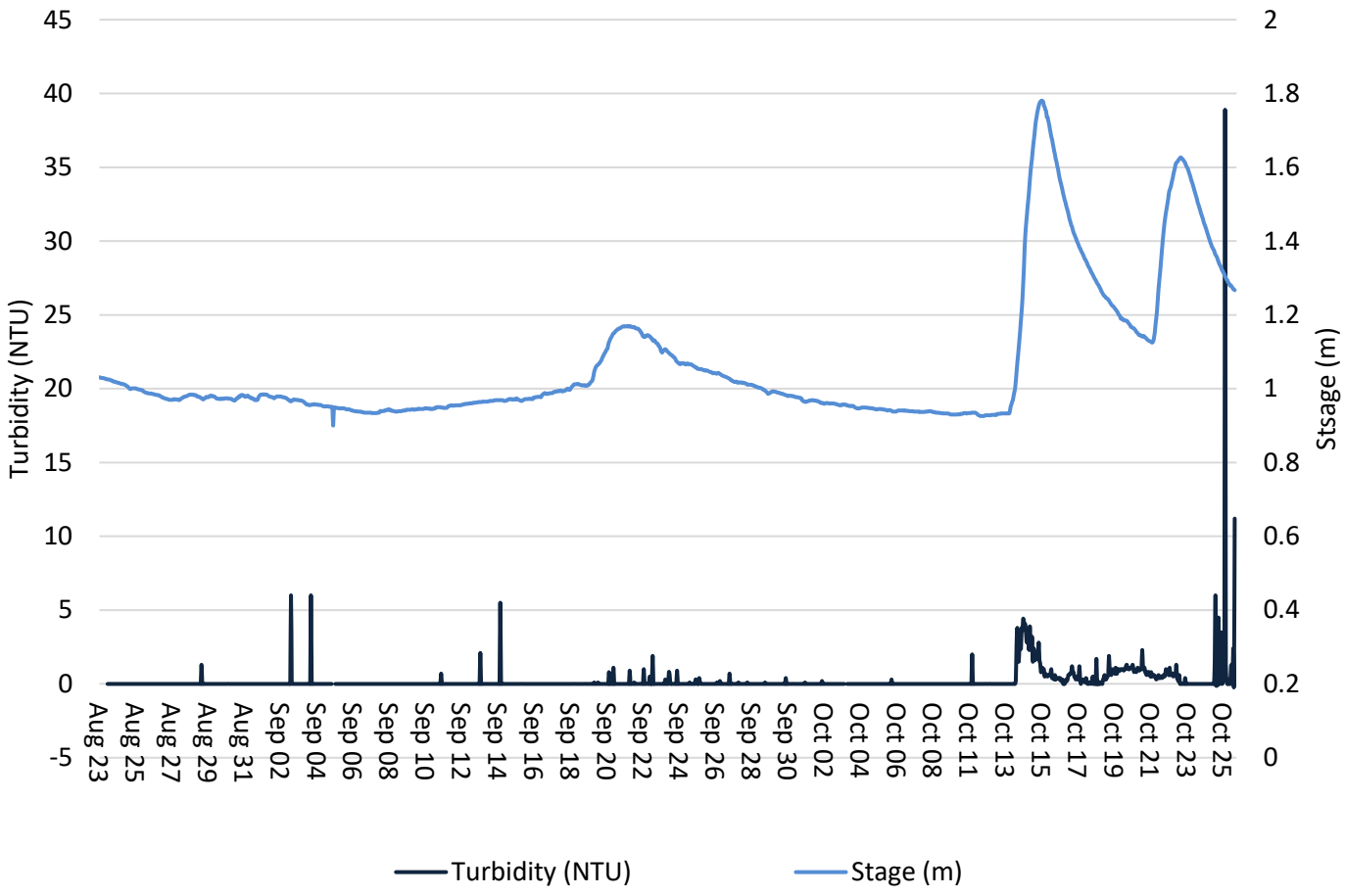

Figure 5. Turbidity (NTU) values at East Pond Brook.

Stage and Total Precipitation

Figure 6, below, shows daily total precipitation data from Millertown weather station and the daily average stage at East Pond Brook.

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.

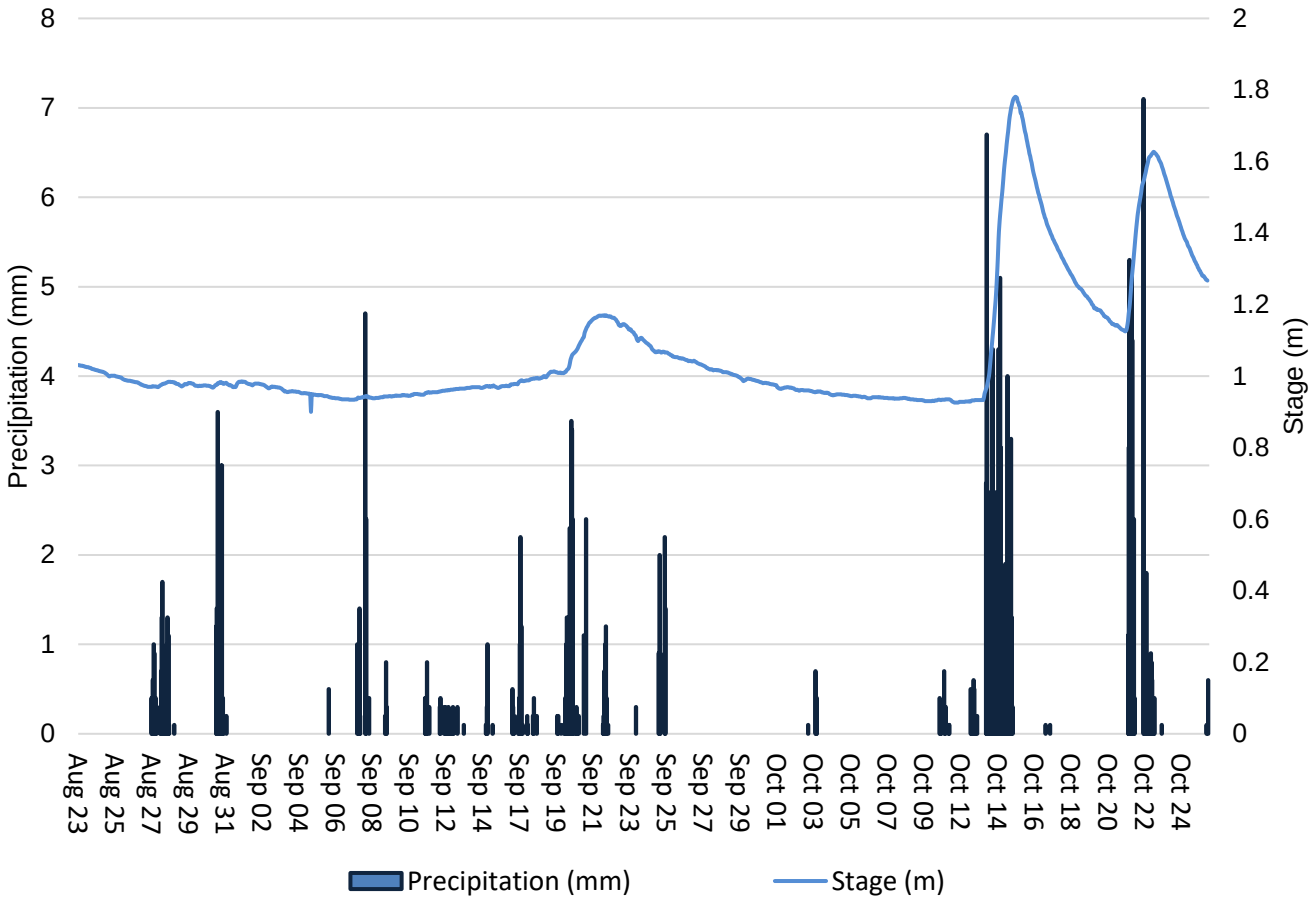

Figure 6. Daily average stage values (m) from East Pond Brook and daily total precipitation values (mm) from Millertown.