Real-Time Water Quality Report
Leary's Brook at Prince Philip Drive

Deployment Period
June 8th to July 19th, 2022

Newfoundland Labrador

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

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Table of Contents

Table of Figures

General

The Water Resources Management Division, in partnership with Environment and Climate Change Canada (ECCC), maintains a real-time water quality and water quantity monitoring station at Leary's Brook, adjacent to Prince Phillip Drive in St. John's, Newfoundland.

The real-time station allows for assessment and management of the water body. This deployment report discusses water quality related events occurring at the Leary's Brook station.

The purpose of this real-time station is to monitor, process, and publish hydrometric (water quantity) and real-time water quality data at the station. Leary's Brook is an urban stream which flows through industrial and commercial areas and is adjacent to a major roadway.

This report covers the period between the June 8th, 2022 deployment and July 19th, 2022 removal.

Figure 1 Leary's Brook Real-Time Water Quality and Quantity Station

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 Leary's Brook for this period are summarized in Table 2.

Table 2 Instrument performance rankings for Leary's Brook

Station	**Date**	**Action**	**Comparison Ranking**				
			Temperature	**pH**	**Conductivity**	**Dissolved Oxygen**	**Turbidity**
Leary's Brook	April 22, 2022	Deployment	Excellent	Excellent	Fair	Excellent	Excellent
	June 8, 2022	Removal	Excellent	Excellent	Excellent	Excellent	Excellent

At the time of deployment, temperature, pH, dissolved oxygen, and turbidity ranked "Excellent;" and conductivity ranked "Fair." At the time of removal, all of the sensors ranked "Excellent." When the sensor was removed on June 8th, the stage level in Leary's Brook was very low. Part of the cage surrounding the sensor was no longer submerged.

Data Interpretation

The following graphs and discussion illustrate water quality-related events from June 8th, 2022 to July 19th, 2022 at the Leary's Brook station.

With the exception of water quantity data (stage) and precipitation data, all data used in the preparation of the graphs and subsequent discussion below adhere to this stringent QA/QC protocol. Water Survey of Canada (WSC) is responsible for QA/QC of water quantity data. Corrected and finalized data may be retrieved from the WSC website (http://www.ec.gc.ca/rhc-wsc/). Precipitation data from the deployment period was retrieved from the ECCC weather station at St. John's International Airport.

Results

Water Temperature

- Water temperature ranged from 8.11°C to 20.70°C during this deployment period, with a median value of 15.4°C and a mean value of 15.11°C.
- The water temperature data displayed in Figure 2, is typical of shallow streams and ponds. Water temperatures in shallow streams respond quickly to changes in air temperature. Water temperatures usually fall overnight and rise during daylight hours. As seen in Figure 2, water temperature is also impacted by stage. Temperatures in Leary's Brook typically rise when warmer runoff enters the system. A warming trend is observable throughout the deployment. This is a result of seasonal variability as air temperature increases during spring and early summer.
- 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.

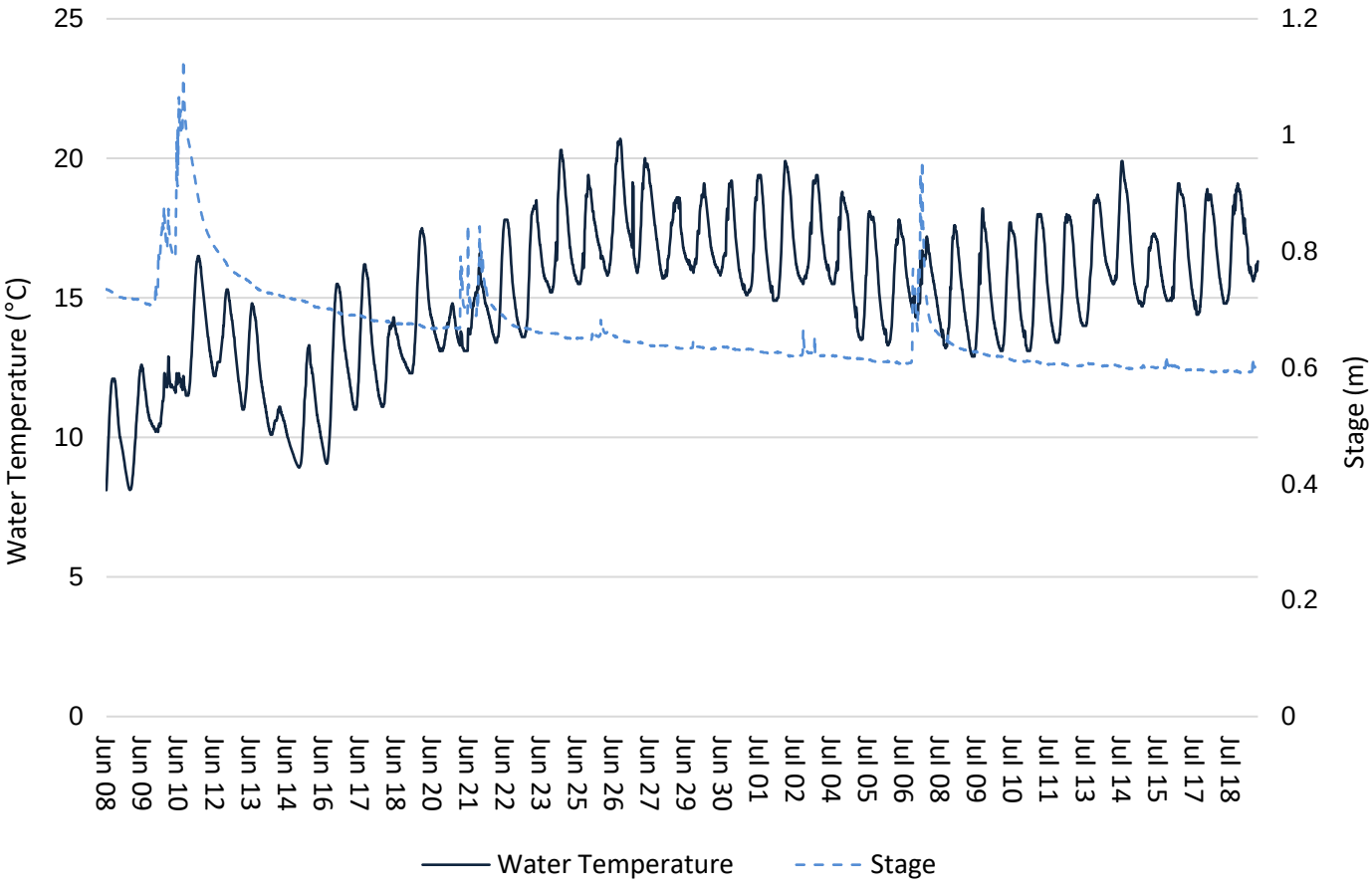

Figure 2 Water Temperature and Stage Level at Leary's Brook

pH

- Throughout the deployment period, the pH at Leary's Brook Station ranged from 6.56 to 7.13.
- The CCME (Canadian Council of Ministers of the Environment) Freshwater Aquatic Life guideline provides a basis by which to judge the overall health of the brook. Naturally, all streams and brooks are different. The median and mean pH at Leary's Brook were both 6.90 for this deployment period. The pH at Leary's Brook falls between the guidelines throughout this deployment.
- Figure 3, below, illustrates a slight dip in pH in Leary's Brook (the water becomes more acidic) when stage increases. In general, precipitation entering Leary's Brook has a lower pH than local surface water causing a small reduction in the pH of the brook. Daily fluctuations can be caused by respiration and photosynthesis of aquatic plants and algae.

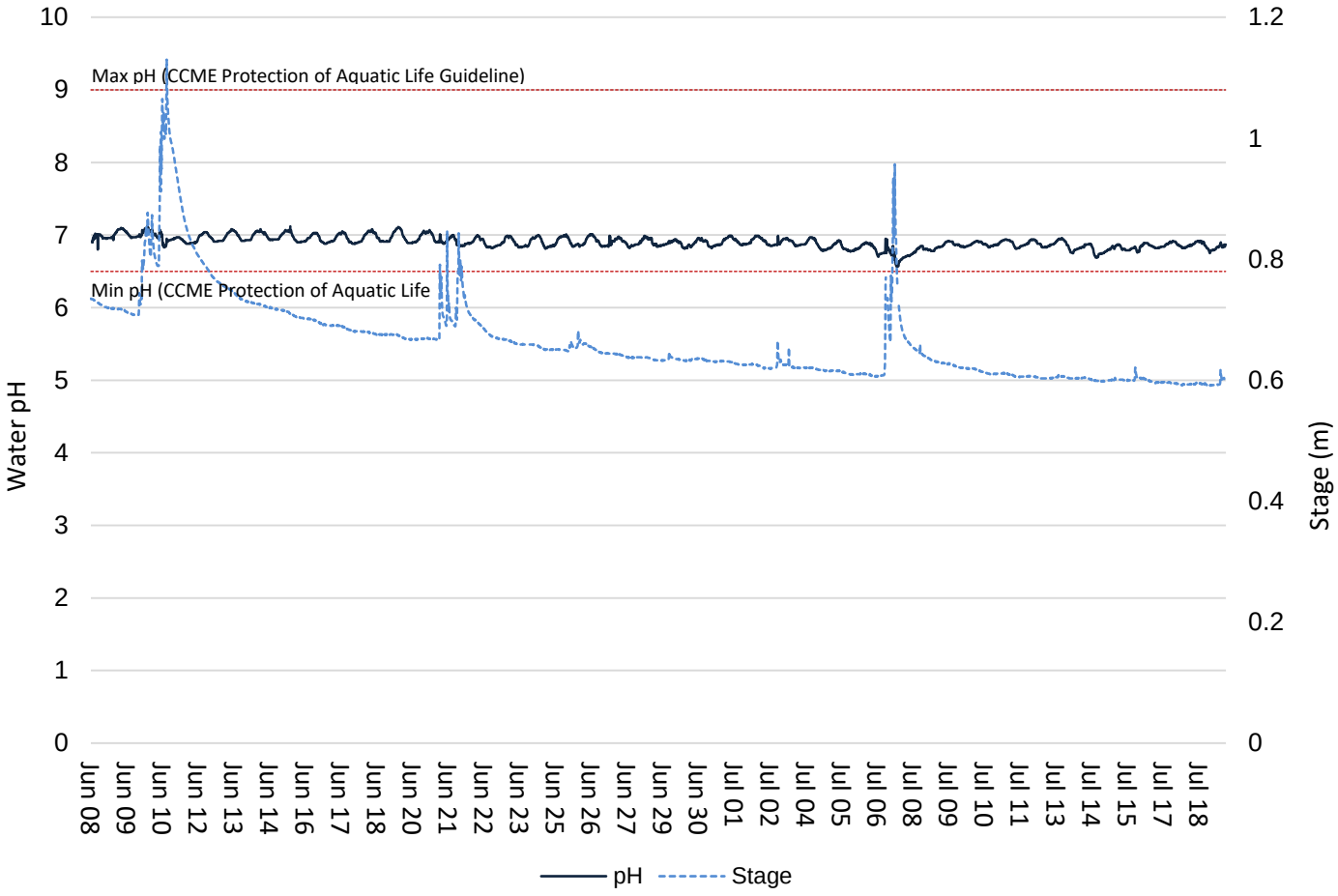

Figure 3 Water pH and Stage at Leary's Brook

Specific Conductivity

- The conductivity levels ranged from 230 µS/cm to 1167 µS/cm during this deployment period. The median and mean specific conductivities were 848 µS/cm and 851.8 µS/cm respectively.
- Figure 4 illustrates how specific conductivity decreases during spring months when water levels increase as a result of precipitation. Rain water has a lower specific conductivity than Leary's Brook, resulting in a temporary decrease in conductivity as the system is diluted. During this deployment the specific conductivity has an increasing trend. This may be a result of the very low levels of precipitation during the months of June and July.

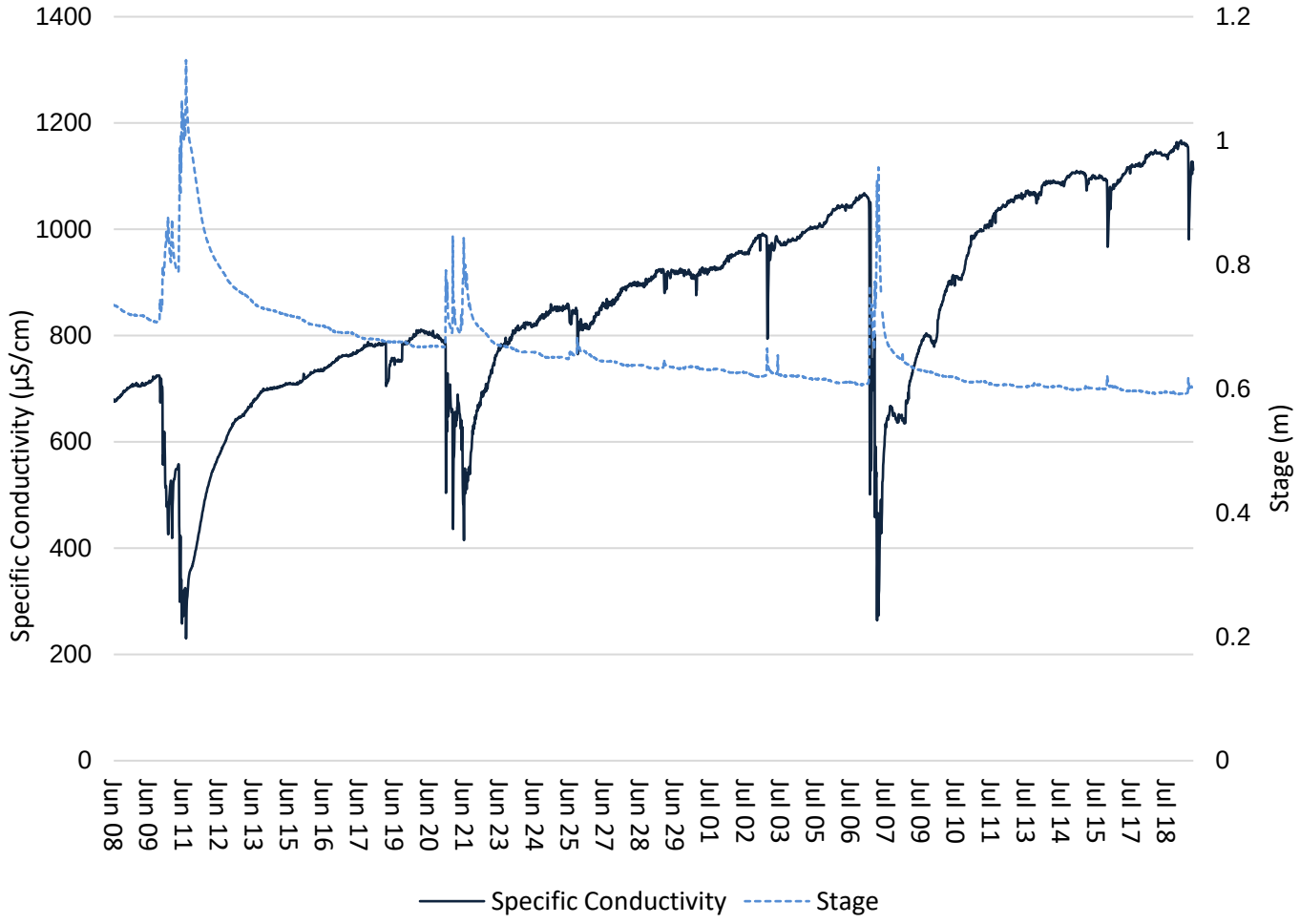

Figure 4 Specific conductivity values at Leary's Brook Station.

Total Dissolved Solids

- The values for total dissolved solids (TDS) ranged from 0.7450 g/mL to 0.1470 g/mL during this deployment period. The median and mean for TDS were 0.5340 g/mL and 0.5408 g/mL respectively.
- TDS is calculated from the conductivity and temperate probes. Pure water has low conductivity. Electrical currents are conducted by ions in solution, so increases in TDS will result in an increase in conductivity. Figure 5, below, illustrates how an increase to stage can lead to a decrease in TDS during the spring months.

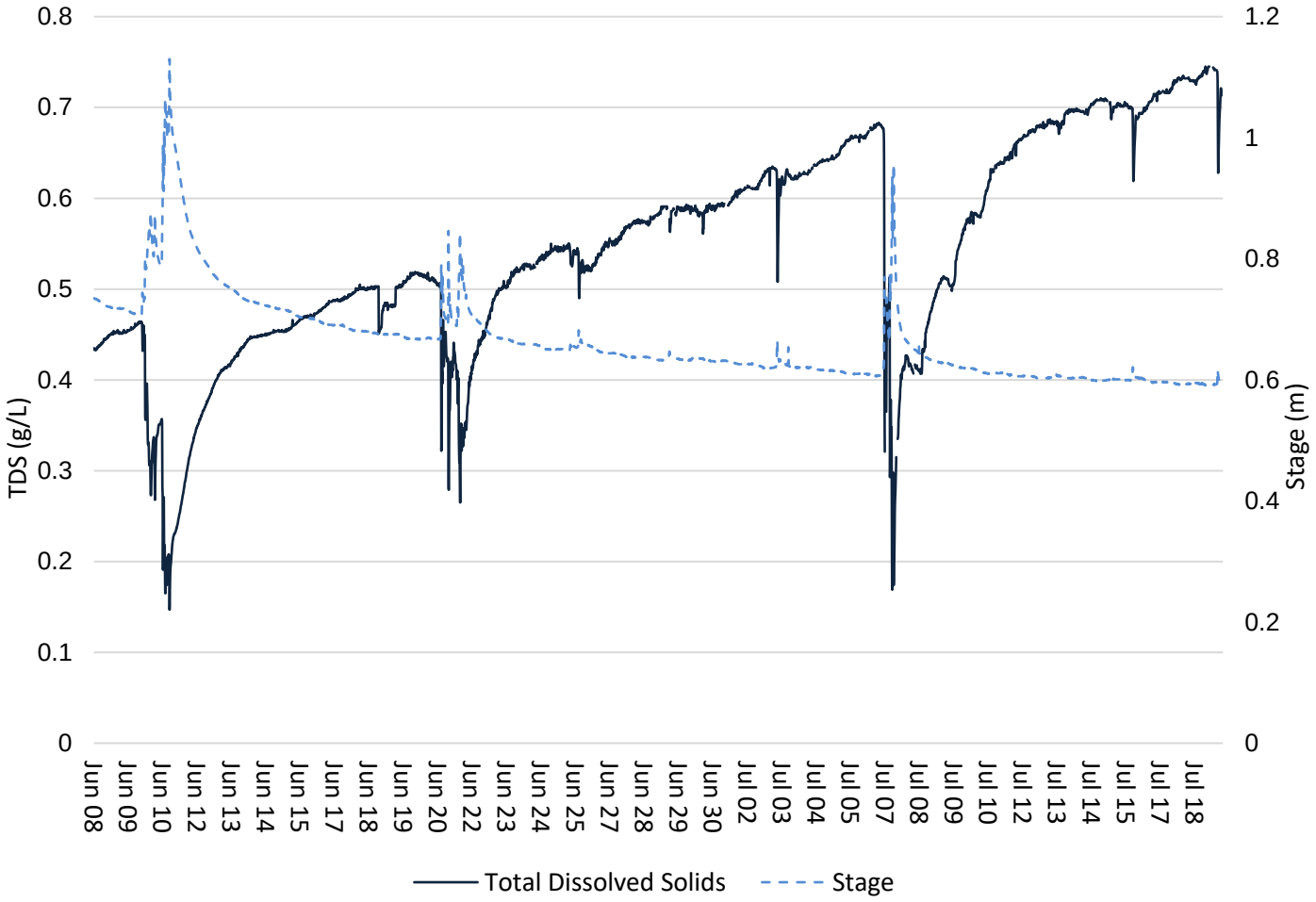

Figure 5 Total Dissolved Solids in Water and Stage Level at Leary's Brook.

Dissolved Oxygen

- The sonde measures dissolved oxygen (DO) (mg/L) and then calculates the percent saturation (% Sat) using the dissolved oxygen and temperature sensors.
- The DO % sat levels during the deployment period ranged from 75.1% to 104.5%, with a median and mean value of 96.4% and 96.0% respectively. Dissolved oxygen (mg/L) measured from 6.85 mg/L to 11.89 mg/L, with a median and mean value of 9.43 mg/L and 9.54 mg/L respectively. The dissolved oxygen (mg/L) values were above the minimum dissolved oxygen CCME Guidelines for the protection of other life stages throughout the deployment period; however, as water temperatures increased, the dissolved oxygen levels dropped below the CCME guideline for the protection of early stage life.
- Small decreases in available oxygen are associated with increases in water temperature, because warm water can hold less dissolved oxygen than cold water.

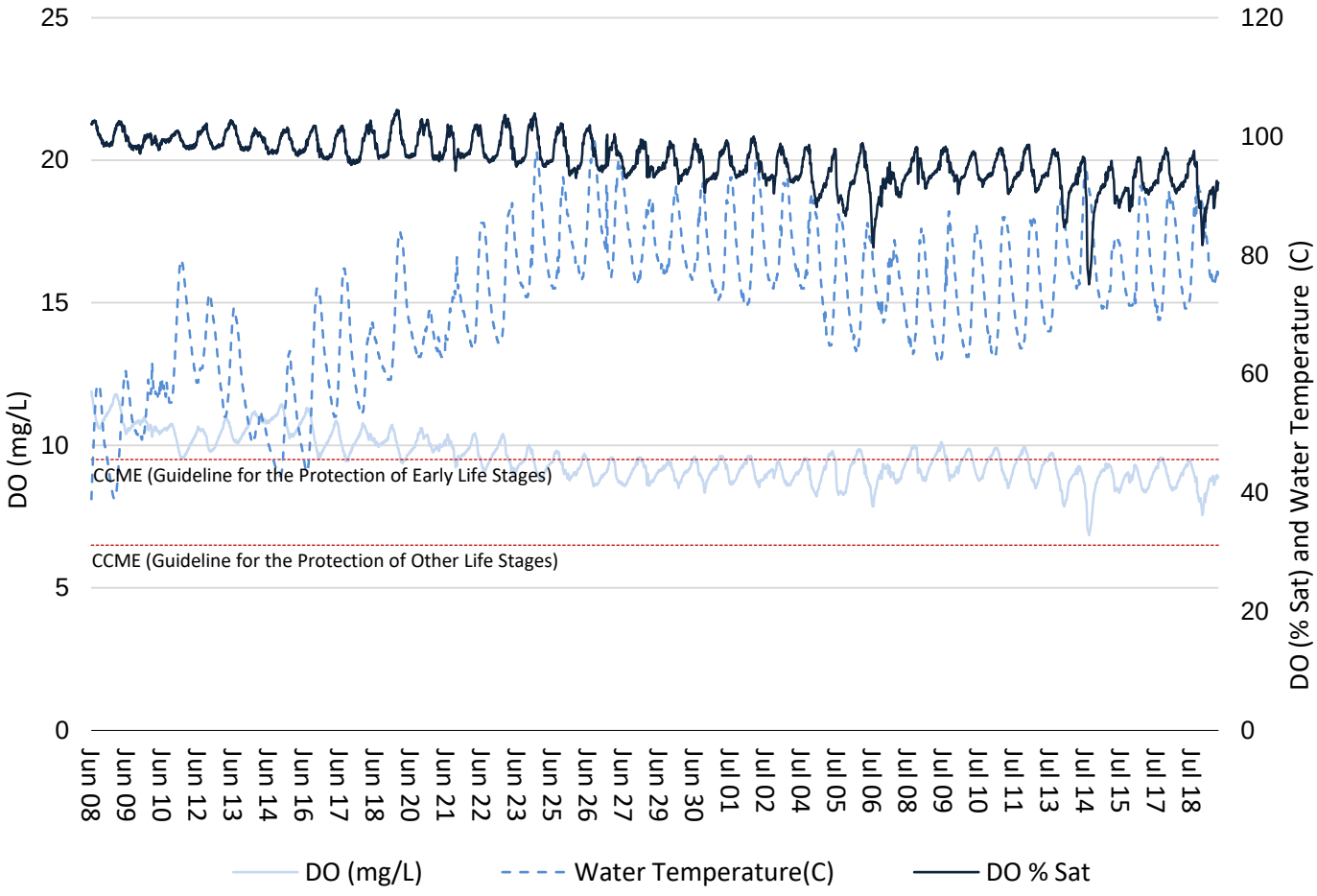

Figure 6 Dissolved oxygen (mg/L & % Sat) and water temperature (°C) values at Leary's Brook Station.

Turbidity

- The turbidity readings during this deployment ranged between 0.0 NTU to 101.6 NTU with median and mean values of 0.0 NTU and 3.4 NTU respectively.
- Increases in turbidity (cloudiness) are usually caused by increased runoff during precipitation events. Runoff carries silt and other debris into Leary's Brook. Upstream construction and the inadequate control of silt-laden runoff can also cause turbidity to increase. As shown in figure 7, most turbidity increases during this period correlate with runoff from precipitation events. Construction occurred upstream and downstream of Leary's Brook station during this deployment period, which may have contributed to turbidity levels.

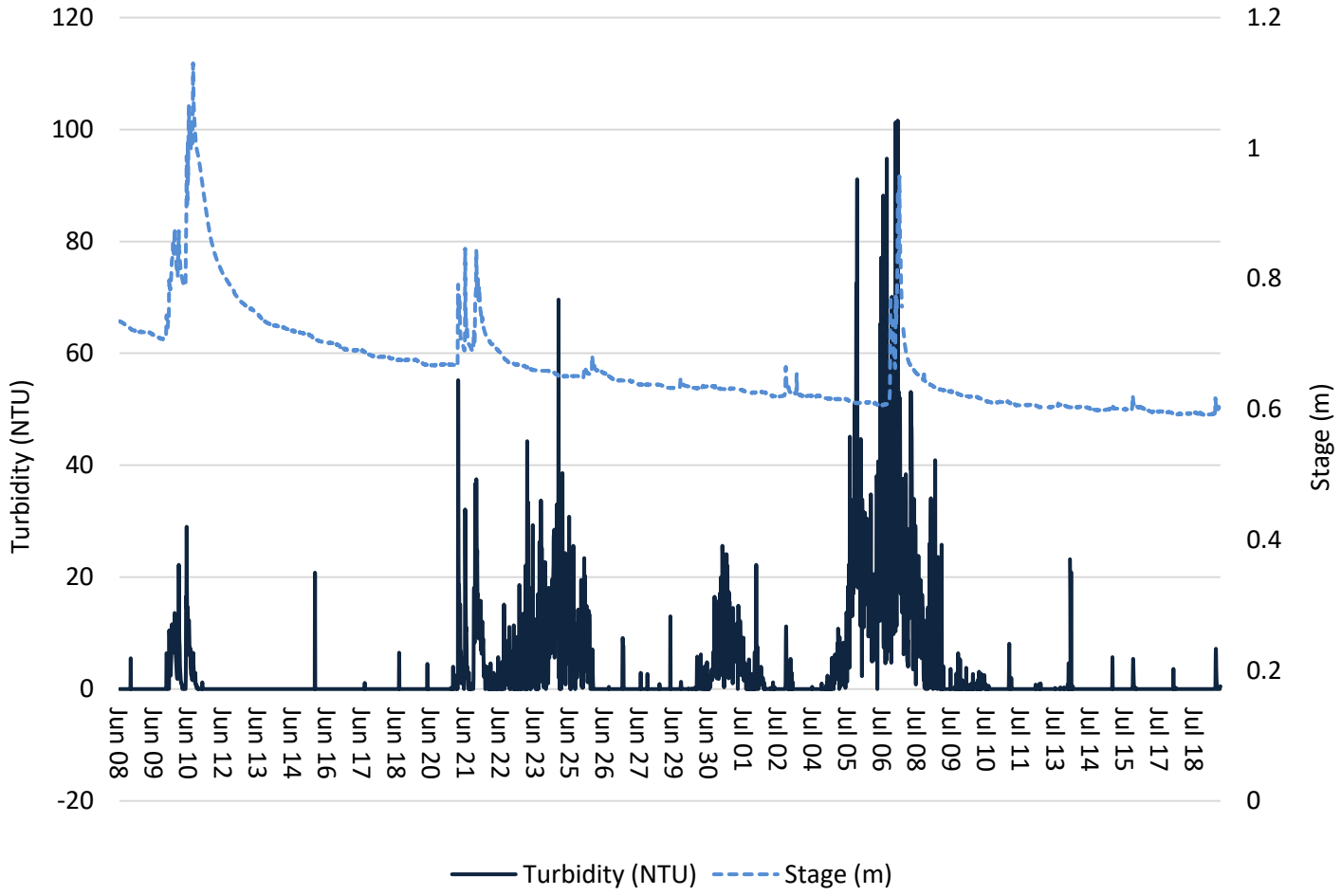

Figure 7 Turbidity (NTU) values at Leary's Brook Station

Stage and Total Precipitation

- Figure 8, below, shows daily total precipitation data from the Pippy Park weather station and the daily average stage. Limited precipitation events during this deployment led to a general decrease in stage levels.
- 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.
- Stage (and streamflow) usually varies significantly throughout a deployment period in Leary's Brook. As it is a largely urban stream with quick runoff, the river is considered 'flashy', increasing and decreasing quickly.

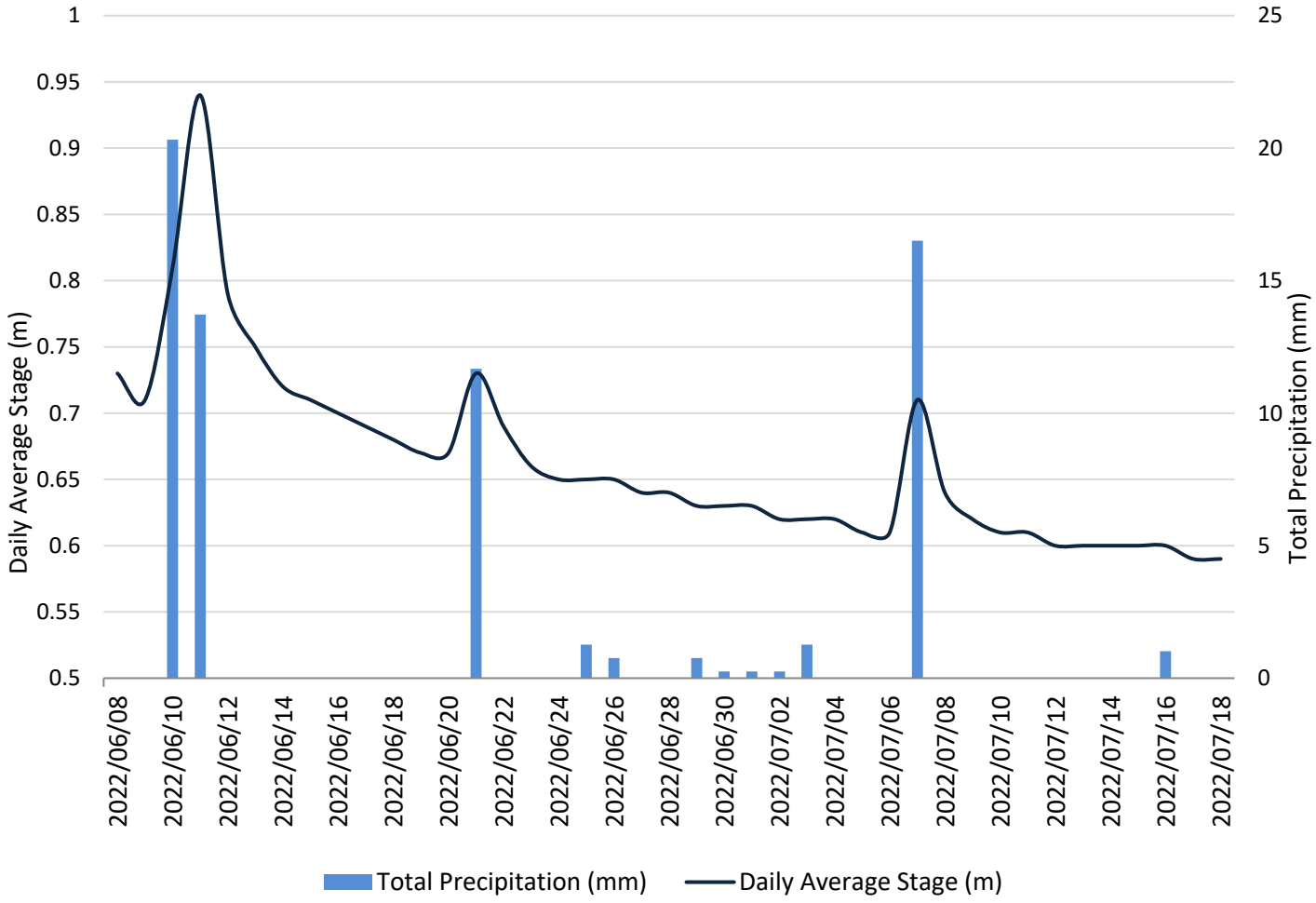

Figure 8 Daily average stage values (m) from Leary's Brook and daily total precipitation values (mm) from Pippy Park weather station.

Conclusions

In both natural and developed environments, climate and weather conditions can contribute to variations in water quality. Leary's Brook is an urban stream surrounded by heavily developed land, so it is expected that observed and recorded changes in Leary's Brook water quality are related to anthropogenic disturbances or effects.

Precipitation and runoff events during the deployment period led to expected increases in stage, thus influencing the water temperature, DO, turbidity, pH, specific conductance, and TDS. The stage data series has a decreasing trend during the deployment period; the months of June and July were very dry; resulting in very low stage levels towards the end of the deployment period. During this deployment period, the median water temperature at the Leary's Brook station was 15.4°C. The median pH for Leary's Brook Station was 6.9. The pH level generally decreases slightly at this station during rainfall events and increases during dry periods. Increased turbidity levels can periodically be associated with upstream disturbances and construction, although most often they are caused by precipitation runoff. Runoff can carry sediments into the brook overland and via storm drains. Specific conductivity had a median value of 848 µS/cm. TDS had a median value of 0.534 g/mL during the deployment period. Dissolved Oxygen at Leary's Brook had a median of 96.4% saturation and 9.43 mg/L during the deployment period. Small decreases in DO (mg/L and % Sat) correspond with increases in water temperatures. Dissolved oxygen levels were above the CCME Aquatic Life guidelines for the protection of early and other life stages during this deployment period.