Real-Time Water Quality Deployment Report

Duck Pond Network

May 26, 2016 to July 6, 2016

Newfoundland Labrador

Government of Newfoundland & Labrador
Department of Environment and Climate Change
Water Resources Management Division
St. John's, NL, A1B 4J6 Canada

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2016-05-26 to 2016-07-06

General

- Department of Environment and Climate Change staff monitors the real-time web pages consistently.
- The Duck Pond Network consists of two surface water stations: East Pond Brook below East Pond and Tributary to Gills Pond Brook. In this report, they will be abbreviated as EPB and TGPB, respectively. Additionally, a groundwater monitoring well is located down gradient of the tailings retention dam. Due to the relatively slow rate of change in groundwater, this data will be addressed in the annual report.
- Daily discharge data is provided on a monthly basis and is complete up to the end of June 2016. Four substantial discharge periods greater than 5000 m^3/day are identified: May 26 – May 29, June 7 – June 12, June 13 – June 17, and June 20 – June 24.
- Effluent discharge from Teck Duck Pond Operations (DPO) into Tributary to Gills Pond Brook is included as a violet trace on flow diagrams throughout the report. This data is calculated from total daily discharge volumes provided by Teck DPO on a monthly basis. Data may not be complete and is provided for visual purposes only.
- Hydrometric data included in this report is provisional and used only for illustrative purposes. Corrected and finalized data may be retrieved from the Water Survey of Canada website (http://www.ec.gc.ca/rhc-wsc/)*.

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.

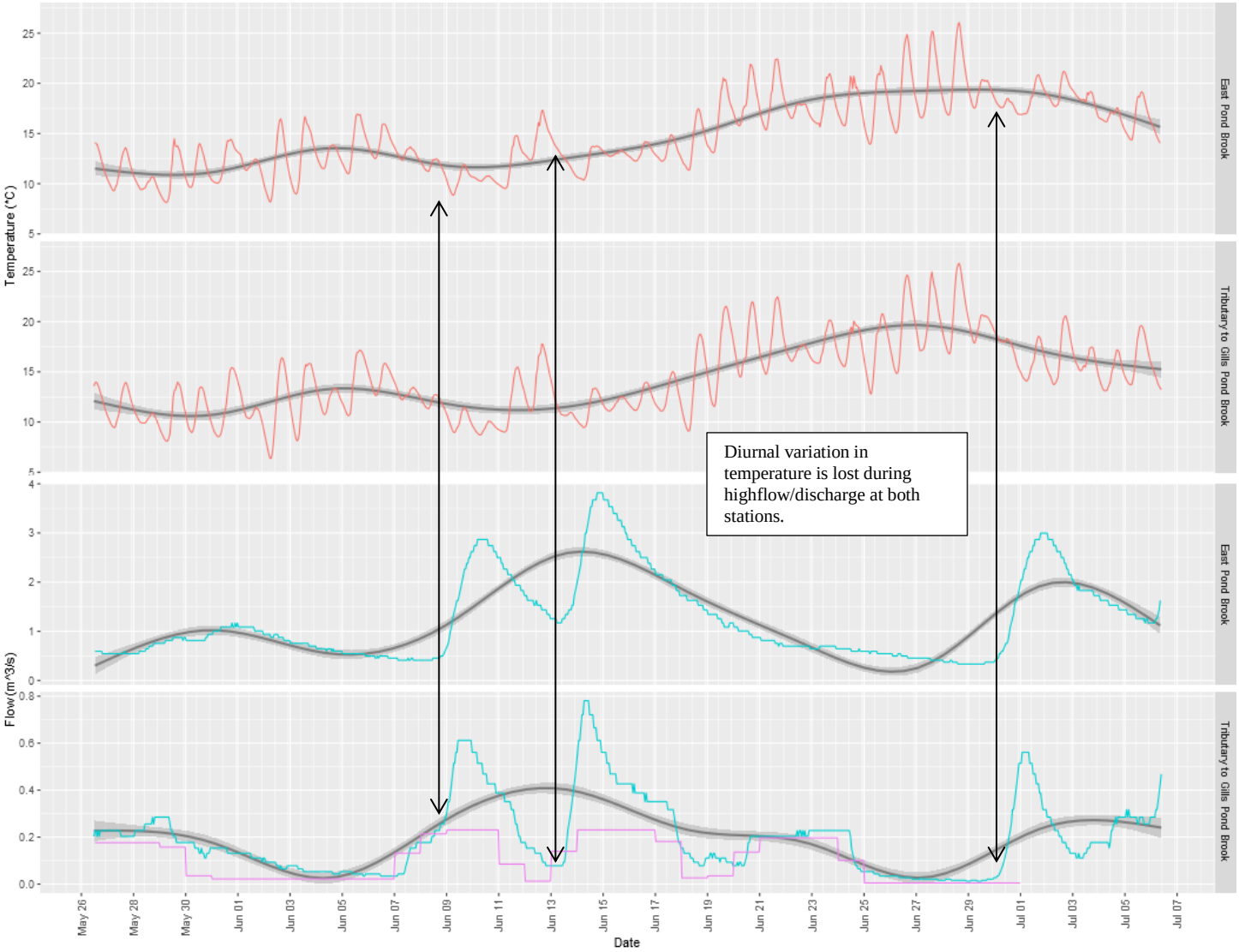
Table 1: Qualitative QAQC Ranking

Station	Date	Action	Comparison Ranking				
			Temperature	pH	Conductivity	Dissolved Oxygen	Turbidity
East Pond Brook below East Pond	2016-05-26	Deployment	Excellent	Good	Excellent	Excellent	Excellent
	2016-07-06	Removal	Excellent	Fair	Excellent	Excellent	Excellent
Tributary to Gills Pond Brook	2016-05-26	Deployment	Excellent	Excellent	Excellent	Excellent	Good
	2016-07-06	Removal	Excellent	Good	Good	Excellent	Good

Data Interpretation

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.



Station	Mean	Median	Min	Max
East Pond Brook	14.89	14.18	8.14	26.06
Tributary to Gills Pond Brook	14.41	13.93	6.38	25.81

- Water temperature increased throughout the deployment period at both EPB and TGPB stations. EPB was marginally warmer than TGPB.

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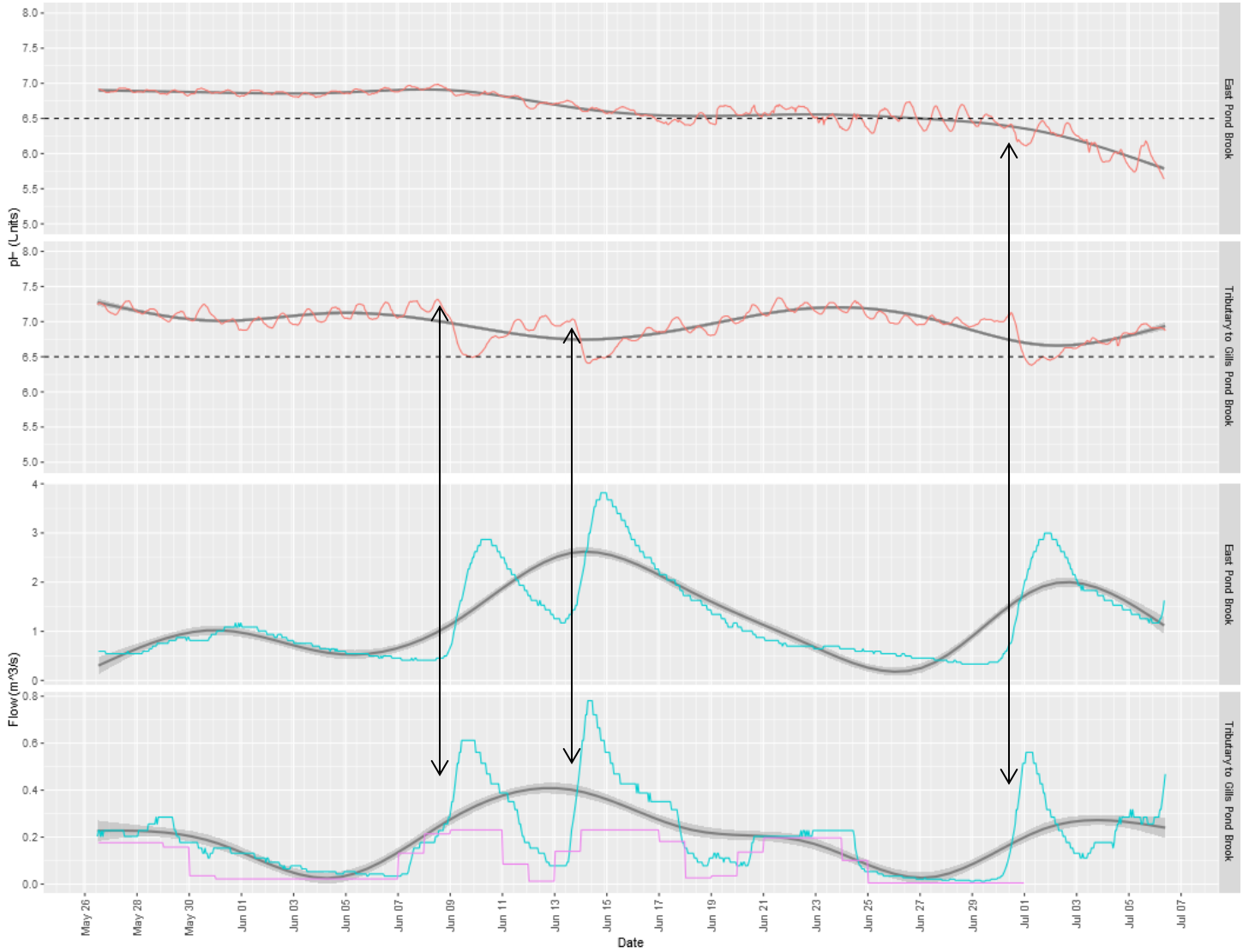
pH

pH is used to give an indication of the acidity or basicity of a solution. A pH of 7 denotes a neutral solution while lower values are acidic and higher values are basic. Technically, the pH of a solution indicates the availability of protons to react with molecules dissolved in water. Such reactions can affect how molecules function chemically and metabolically.



Station	Mean	Median	Min	Max
East Pond Brook	6.62	6.65	5.64	6.99
Tributary to Gills Pond Brook	6.97	7.01	6.38	7.34

- Dashed lines in the figure above indicate the lower bound of the CCME pH guidelines of 6.5 to 9.5. Most values were found to be within these guidelines.
- pH levels declined throughout the deployment period at both stations, although this is more pronounced at EPB station. Higher alkalinity at TGPB provides for extra buffering capacity compared to EPB.
- Some transient drops were observed in pH and are associated with precipitation events (see arrows in the above figure).

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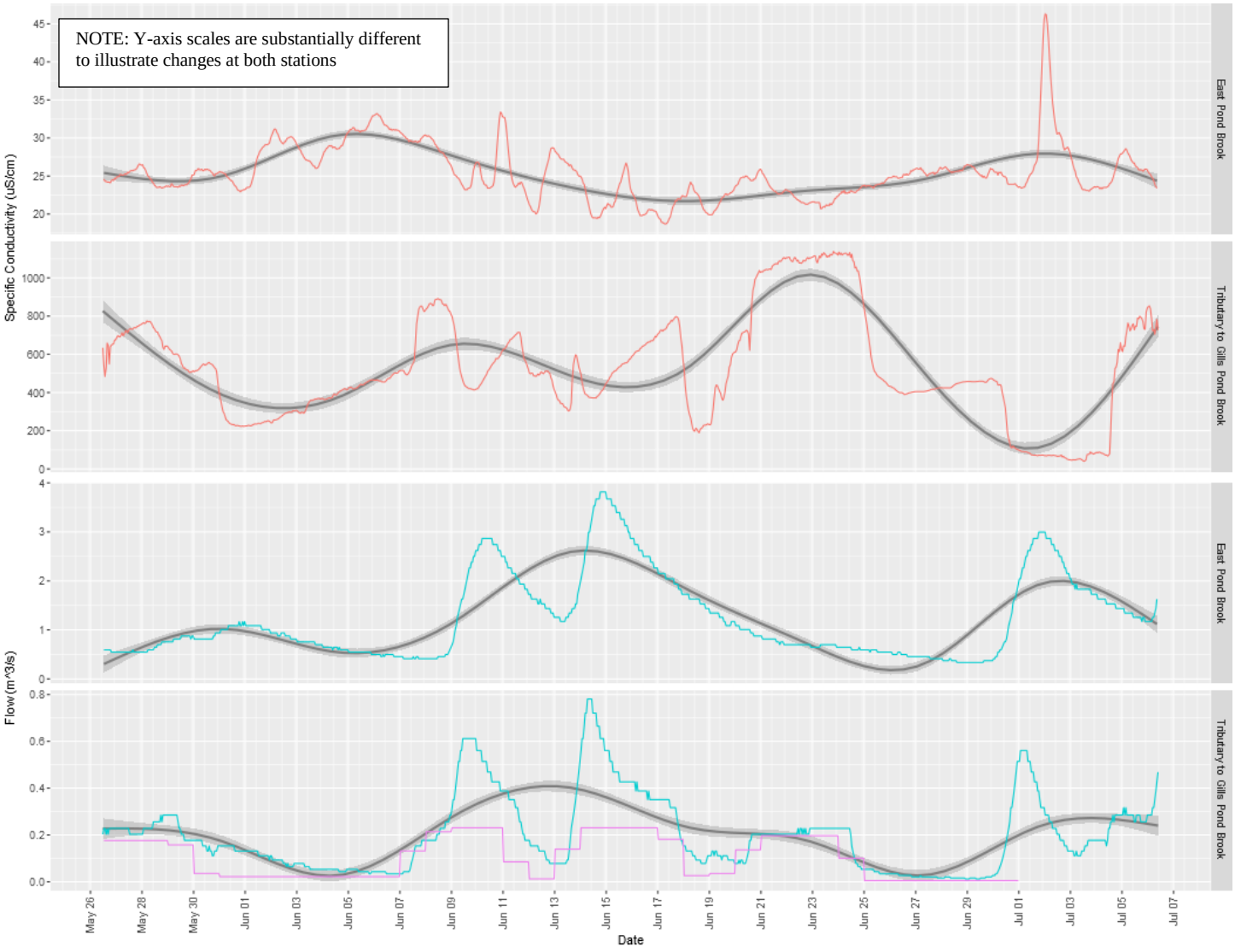
Specific Conductivity

Conductivity relates to the ease of passing an electric charge – or resistance – 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.



Station	Mean	Median	Min	Max
East Pond Brook	25.4	25.0	18.7	46.3
Tributary to Gills Pond Brook	527.7	484.0	39.5	1139.0

- Due to the high levels of dissolved solids in the treated effluent released to TGPB, specific conductivity is highly variable and undergoes drastic changes. EPB, meanwhile, is generally stable and with low variation. The range of values observed at TGPB was 1099.5 uS/cm while it was merely 27.6 uS/cm at EPB.

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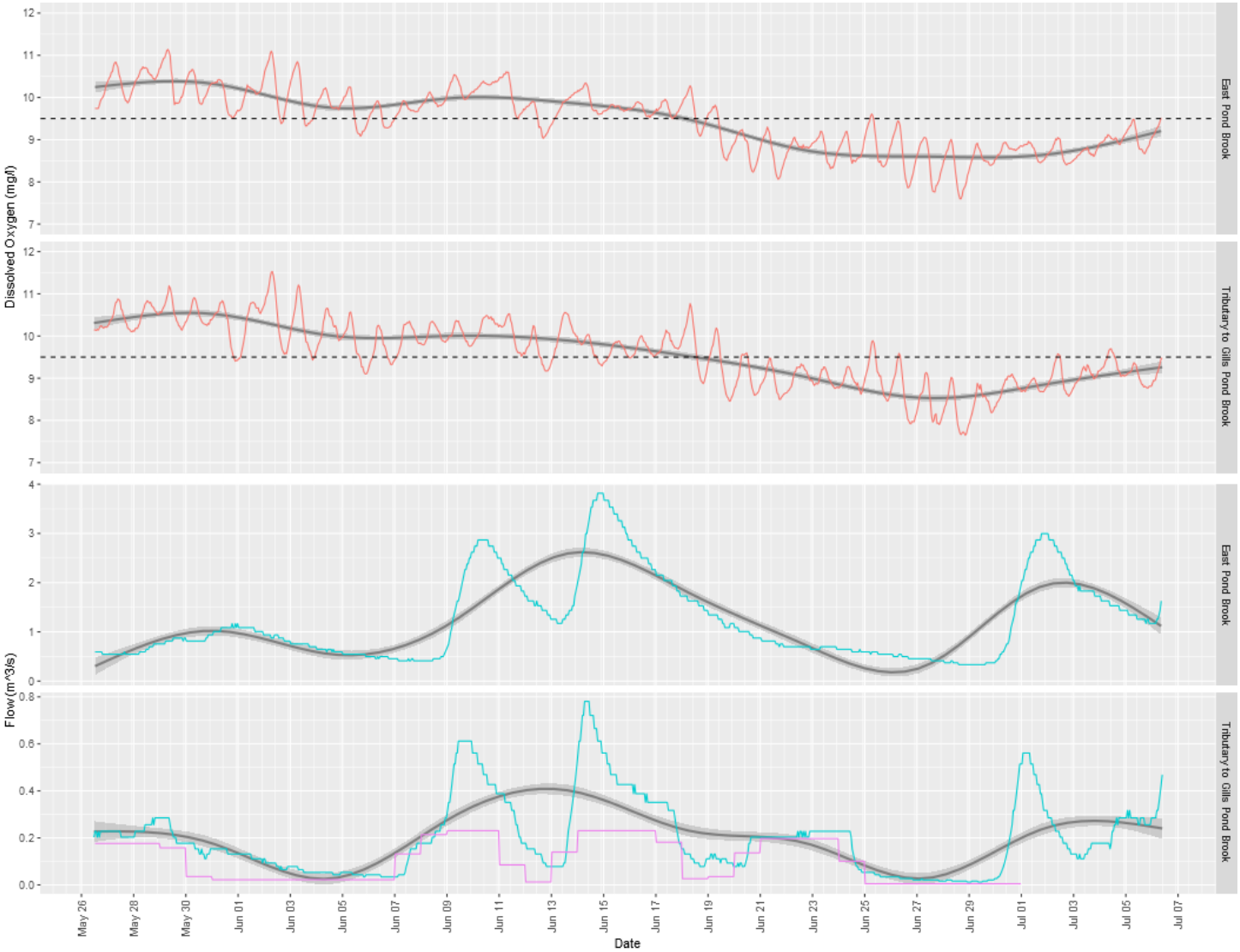
Dissolved Oxygen

Dissolved oxygen is a metabolic requirement of aquatic plants and animals. The concentration of oxygen in water depends on many factors, especially temperature – the saturation of oxygen in water is inversely proportional to water temperature. 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.



Station	Mean	Median	Min	Max
East Pond Brook	9.46	9.56	7.60	11.14
Tributary to Gills Pond Brook	9.57	9.58	7.65	11.53

- The concentration of dissolved oxygen in water is highly dependent on water temperature. As such, there is little difference between EPB and TGPB during this deployment.
- On June 18th, DO concentrations consistently fall below the CCME Guideline of 9.5 mg/l (dashed line) established for the protection of early life stages. This is expected as water temperature rises.

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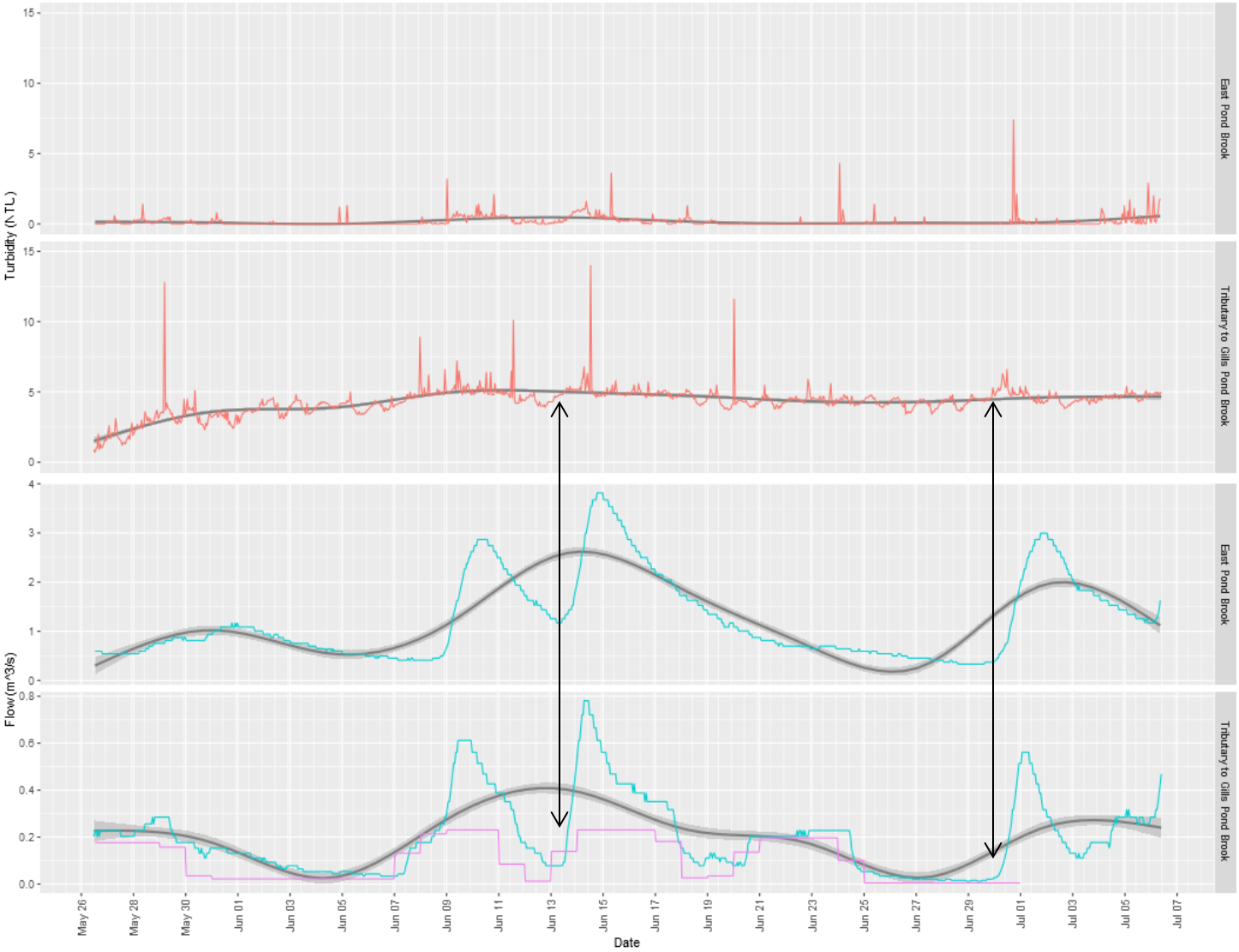
Turbidity

Turbidity 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.



Station	Mean	Median	Min	Max
East Pond Brook	0.2	0.0	0.0	7.4
Tributary to Gills Pond Brook	4.3	4.4	0.7	14.0

- Turbidity levels at EPB were very low throughout the deployment period while TGPB saw low-level turbidity consistently from May 26 to July 6. This difference could be attributed to several variables, including flow pattern (EPB tends to exhibit a smooth laminar flow while TGPB is turbulent), discharge of effluent into TGPB and the water sources.
- At TGPB, turbidity increased from May 26 to early-mid June. In the above figure, additional peaks in turbidity are shown following rainfall events.

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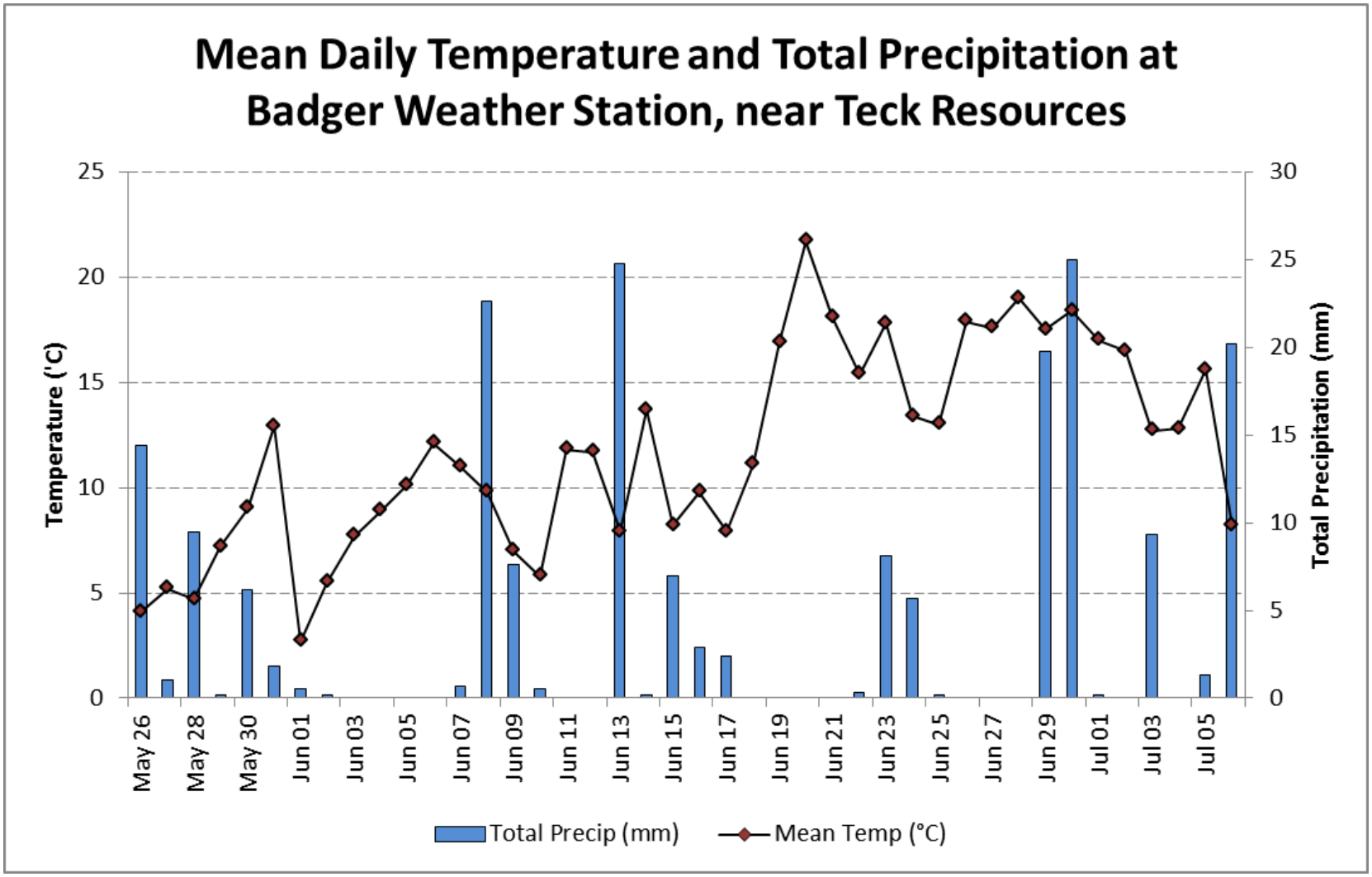
Appendix


Mean Daily Temperature and Total Precipitation at Badger Weather Station, near Teck Resources
Temperature (°C)
Total Precipitation (mm)
25
20
15
10
5
0
30
25
20
15
10
5
0
May 26
May 28
May 30
Jun 01
Jun 03
Jun 05
Jun 07
Jun 09
Jun 11
Jun 13
Jun 15
Jun 17
Jun 19
Jun 21
Jun 23
Jun 25
Jun 27
Jun 29
Jul 01
Jul 03
Jul 05
Total Precip (mm)
Mean Temp (°C)