Real-Time Water Quality Deployment Report

Voisey's Bay Network

July 4/5 to August 27/28, 2024

Newfoundland Labrador

Government of Newfoundland & Labrador

Department of Environment and Climate Change

Water Resources Management Division

Contents

Prepared by:
Brenda Congram
Environmental Scientist
Water Resources Management Division
Department of Environment and Climate Change
brendacongram@gov.nl.ca

Real Time Water Quality Monitoring

Staff with the Department of Environment and Climate Change monitor the real-time web pages regularly.

This deployment report discusses water quality related events occurring at four stations in the Voisey's Bay Network: Reid Brook at Outlet to Reid Pond; Camp Pond Brook below Camp Pond; Tributary to Reid Brook; and Reid Brook below Tributary.

On July 4 and 5, 2024, ECC staff deployed real-time water quality monitoring instruments at the four real-time stations in the Voisey's Bay network. Instruments were removed by ECC Staff on August 27 and 28, 2024.

The field instruments at Reid Brook at Outlet of Reid Pond, Tributary to Reid Brook and Reid Brook below Tributary all experienced power failures before the end of the deployment period. Due to issues with station equipment, all three instruments were relying on internal battery power for transmission and logging of data. By the time these instruments were removed, the internal batteries were no longer functioning, and therefore data from the field sonde could not be retrieved and comparison rankings are not available. The station at Reid Brook at Outlet of Reid Pond was repaired during the site visit by rewiring some of the equipment. The stations at Tributary to Reid Brook and Reid Brook below Tributary were repaired during the site visit by replacing the field cables.

Quality Assurance and Quality Control

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. This procedure is based on the approach used by the United States Geological Survey.

At deployment and removal, a QA/QC instrument is temporarily deployed adjacent to the field instrument. Values for temperature, pH, conductivity, dissolved oxygen, and turbidity are compared between the two instruments**.** Based on the degree of difference between parameters recorded by the field instrument and QA/QC instrument at deployment and at removal, a qualitative statement is made about the data quality (Table 1).

Table 1: Ranking classifications for deployment and removal

	Rank				
Parameter	**Excellent**	**Good**	**Fair**	**Marginal**	**Poor**
Temperature (oC)	<=+/-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

It should be noted that the temperature sensor on any instrument is the most important. All other parameters can be broken down into three groups: temperature dependent; temperature compensated; and temperature independent. Because the temperature sensor is not isolated from the rest of the instrument, the entire instrument must be at the same temperature before the 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.

Deployment and removal comparison rankings for the Voisey's Bay Network stations are summarized in Table 2.

Table 2: Comparison rankings for Voisey's Bay Network stations

Station Voisey's Bay	Date	Action	Comparison Ranking				
			Temperature	pH	Conductivity	Dissolved Oxygen	Turbidity
Reid Brook at Outlet	July 4	Deployment	Good	Fair	Excellent	Fair	Excellent
	August 27	Removal	Cannot Rank	Cannot Rank	Cannot Rank	Cannot Rank	Cannot Rank
Camp Pond Brook	July 5	Deployment	Excellent	Good	Good	Excellent	Excellent
	August 28	Removal	Excellent	Excellent	Good	Good	Excellent
Reid Brook below Tributary	July 4	Deployment	Fair	Excellent	Good	Good	Poor
	August 28	Removal	Cannot Rank	Cannot Rank	Cannot Rank	Cannot Rank	Cannot Rank
Tributary to Reid Brook	July 4	Deployment	Excellent	Excellent	Good	Good	Excellent
	August 28	Removal	Cannot Rank	Cannot Rank	Cannot Rank	Cannot Rank	Cannot Rank

Reid Brook at Outlet of Reid Pond

- At deployment, conductivity and turbidity were 'excellent', temperature was 'good', while pH and dissolved oxygen were 'fair'.
- Comparison rankings are not available for removal due to missing data from the field sonde.

Camp Pond Brook below Camp Pond

- At deployment, all parameters ranked as either 'excellent' or 'good'.
- At removal, all parameters ranked as either 'excellent' or 'good'.

Reid Brook below Tributary

- At deployment, pH was 'excellent', conductivity and dissolved oxygen were 'good', and temperature was 'fair'. The comparison ranking for turbidity was 'poor', which may be attributable to the QA/QC sonde not being placed in close enough proximity to the field sonde or not being given sufficient time to acclimate; this is supported by an 'excellent' comparison ranking between the field sonde and grab sample.
- Comparison rankings are not available for removal due to missing data from the field sonde.

Tributary to Reid Brook

- At deployment, all parameters ranked as either 'excellent' or 'good'.
- Comparison rankings are not available for removal due to missing data from the field sonde.

It is important to note that, in general, there are several conditions under which a less than ideal QA/QC ranking may be obtained. These include, but are not limited to: placement of the QA/QC sonde in relation to the field sonde; the amount of time each sonde is given to stabilize before readings are recorded; and deteriorating performance of one or more of the sensors.

Data Interpretation

The following graphs and discussion illustrate significant water quality-related events from July 4/5 to August 27/28, 2024 in the Voisey's Bay Real-Time Water Quality Monitoring Network.

With the exception of water quantity data (stage and flow), all data used in the preparation of the graphs and subsequent discussion below adhere to stringent QA/QC protocol. Water Survey of Canada is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.

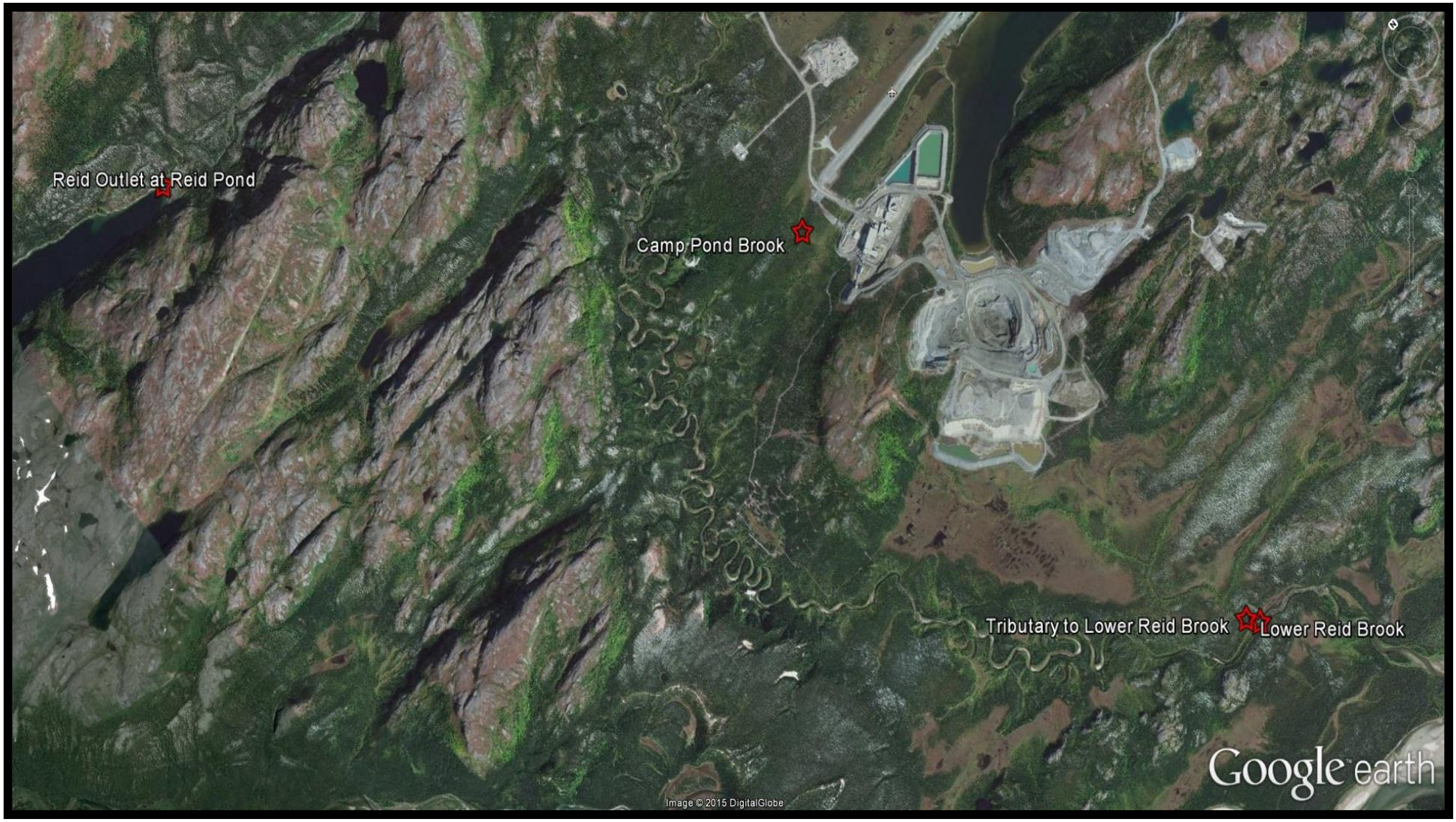

Figure 1: Voisey's Bay Network Station Locations

Reid Brook at Outlet of Reid Pond

Water Temperature

Over the deployment period, water temperature ranged from 10.04°C to 15.26°C, with a median value of 13.08°C (Figure 2). As evidenced in the graph below, air temperature fluctuates to a much greater extent each day compared to water temperature. Air temperature data was obtained from the Voisey's Bay airstrip weather station.

Water temperature was variable over the course of the deployment period, similar to air temperature. This water body takes longer to acclimate to changes in temperature as it has a much larger surface area compared to the brooks at the other RTWQ stations in this network.

Transmission of water quality data did not occur across the deployment period at this station, and data from the instrument's internal log file was only available until August 20.

Please note the stage data used below 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.

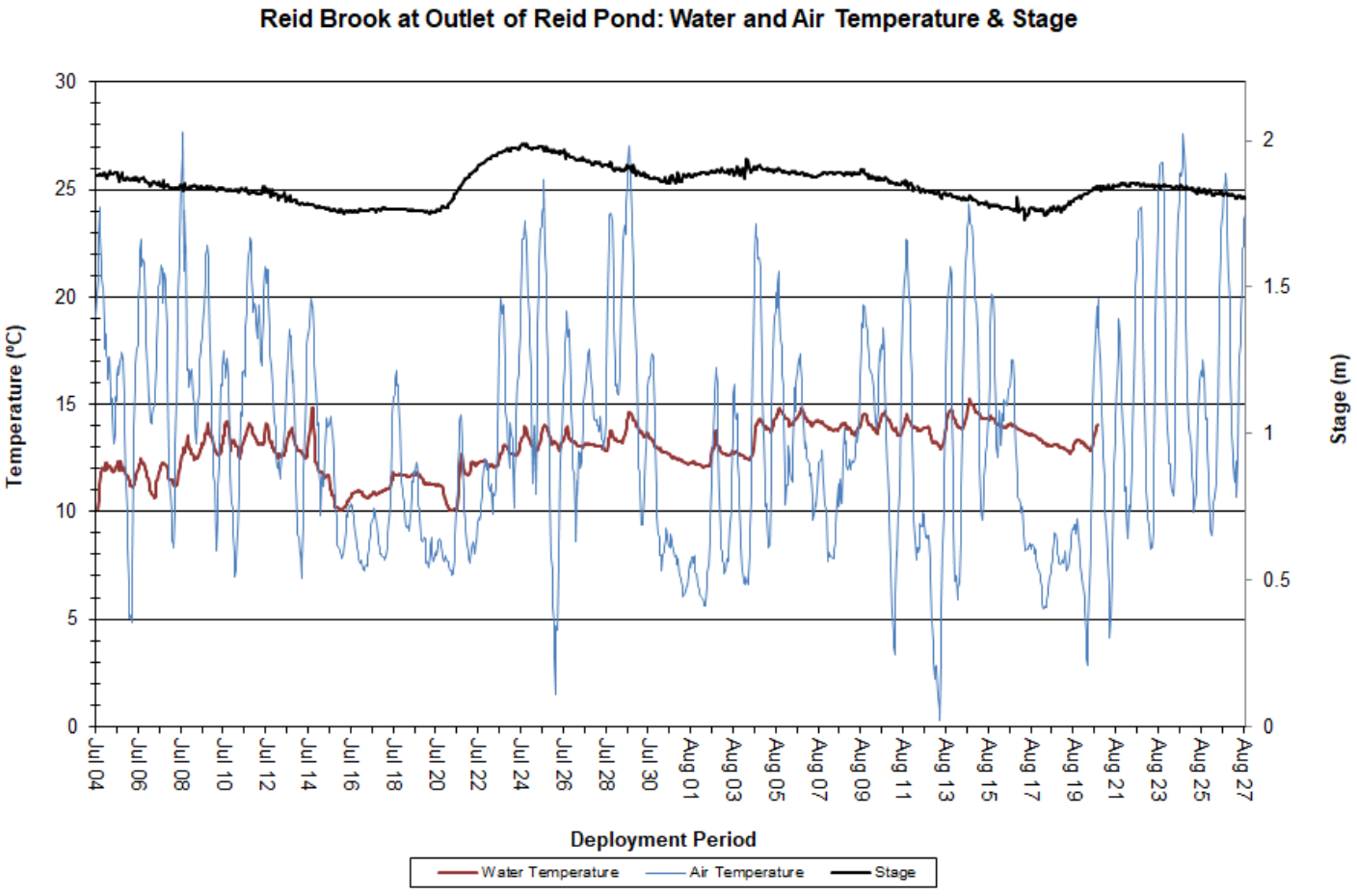

Figure 2: Water and Air Temperature & Stage at Reid Brook at Outlet of Reid Pond

pH

Over the deployment period, pH values ranged from 0 pH units to 12.6 pH units, with a median value of 0 pH units (Figure 3).

pH levels were below the CCME's Guidelines for the Protection of Aquatic Life for the majority of the deployment period. The sudden decrease in pH values on July 6 and subsequent sporadic pH values across the deployment period likely indicate a sensor failure on the field sonde.

Transmission of water quality data did not occur across the deployment period at this station, and data from the instrument's internal log file was only available until August 20.

Please note the stage data used below 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.

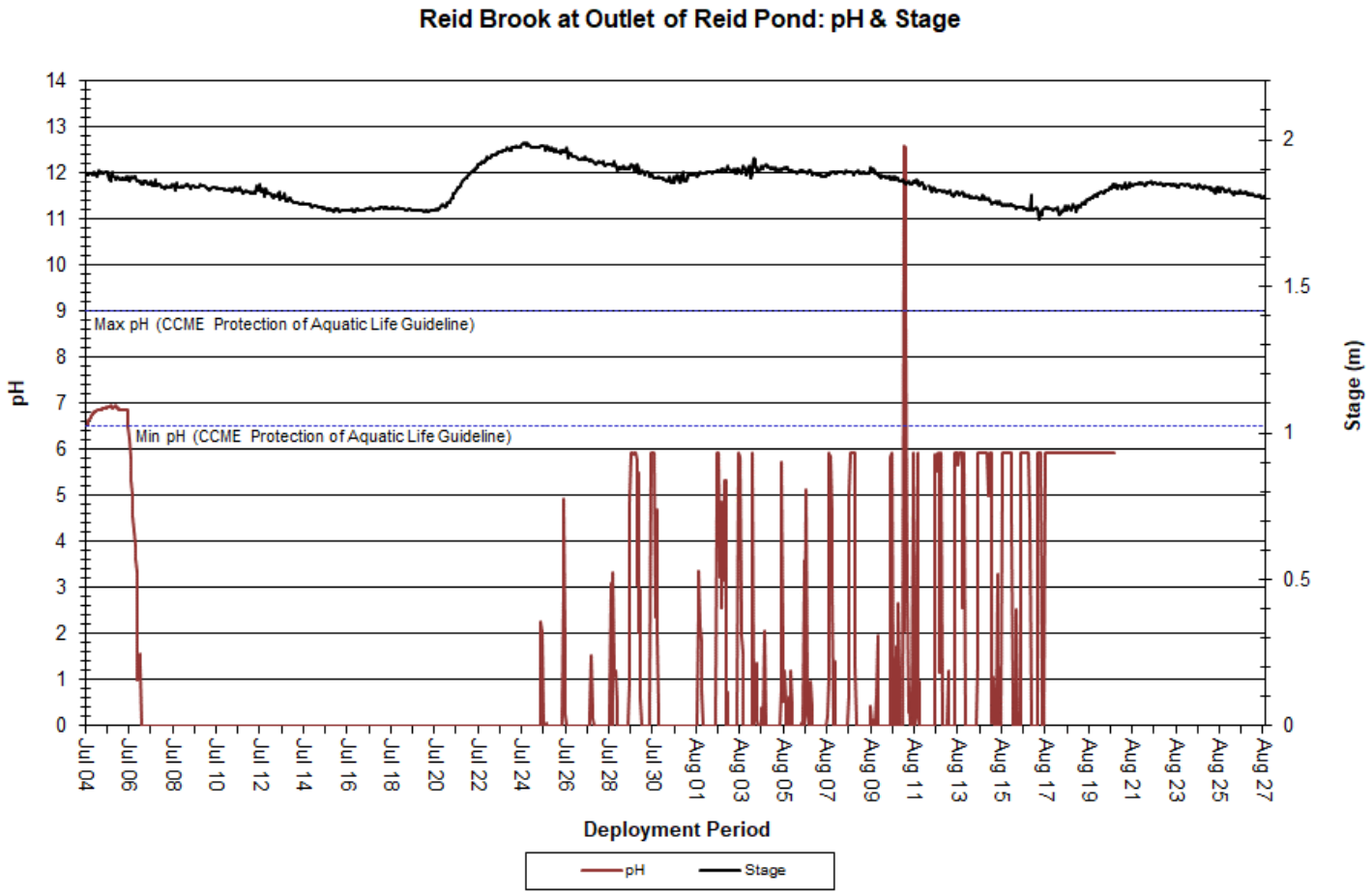

Figure 3: pH & Stage at Reid Brook at Outlet of Reid Pond

Specific Conductivity

Over the deployment period, specific conductivity levels ranged from 11µS/cm to 32µS/cm, with a median value of 17µS/cm. Conductivity at Reid Brook remained somewhat stable across the deployment period. This is to be expected as this water body is pristine in nature and is far removed from any anthropogenic disturbances that could affect water quality.

The relationship between conductivity and stage level is generally inversed. When stage levels decrease, specific conductivity levels increase, as the decreased amount of water in the river system concentrates the solids that are present. Similarly, as stage levels rise, conductivity levels will dip in response. This relationship is not as evident at Reid Brook as it is at other stations in the Voisey's Bay network (Figure 4).

Transmission of water quality data did not occur across the deployment period at this station, and data from the instrument's internal log file was only available until August 20.

Please note the stage data used below 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.

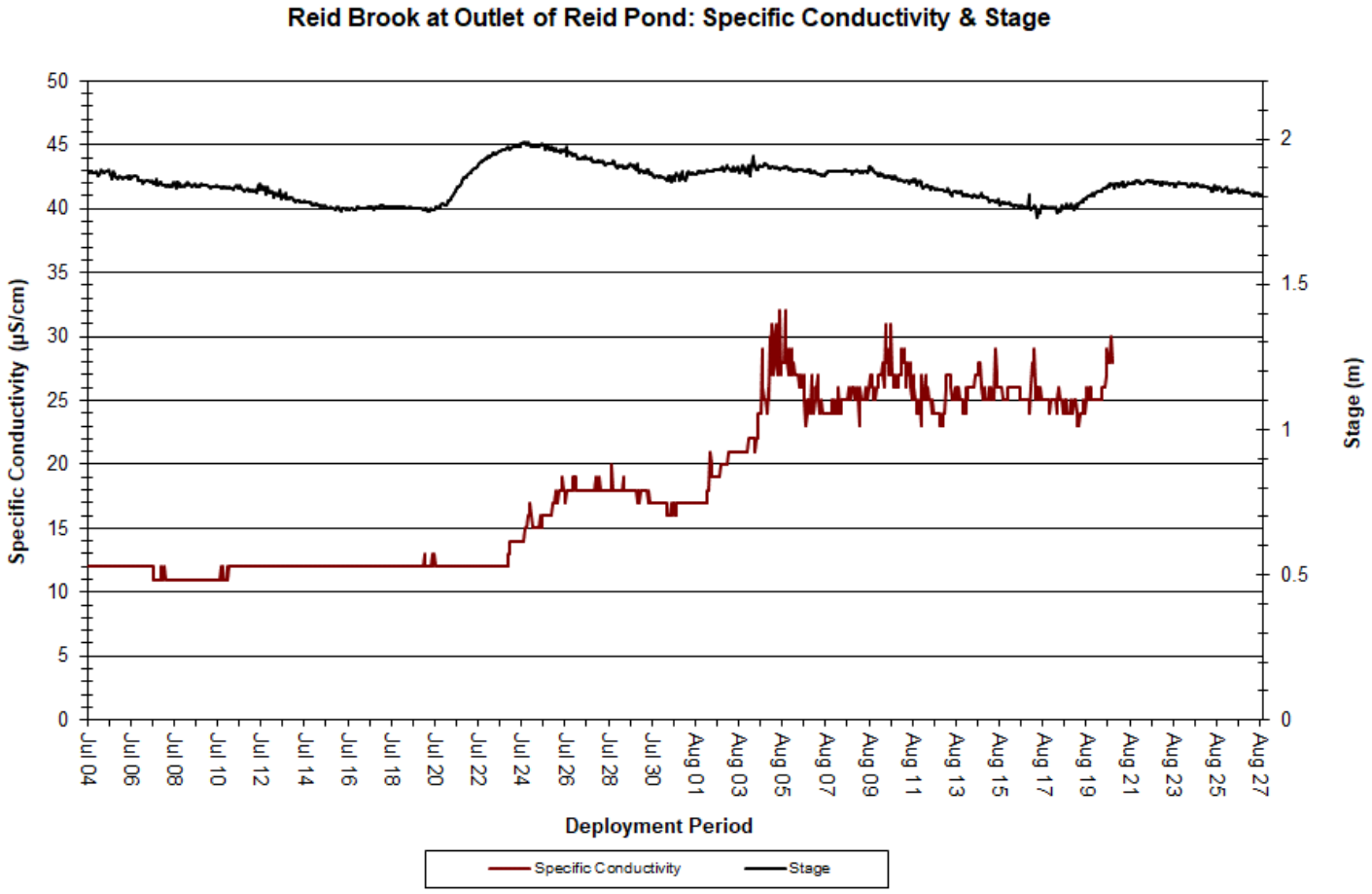

Figure 4: Specific Conductivity & Stage at Reid Brook at Outlet of Reid Pond

Dissolved Oxygen

Over the deployment period, dissolved oxygen concentration levels ranged from 9.64mg/L to 11.38mg/L, with a median value of 10.08mg/L. Percent saturation levels for dissolved oxygen ranged from 92.6% saturation to 103.2% saturation, with a median value of 95.8% saturation (Figure 5).

The water quality instrument measures dissolved oxygen concentration (mg/L) with a dissolved oxygen probe. The instrument then calculates percent saturation (% Sat) taking into account water temperature.

Dissolved oxygen concentration values remained above the CCME's Guidelines for the Protection of Early and Other Life Stages (9.5 mg/L) for the duration of deployment. Dissolved oxygen concentrations were somewhat variable across the deployment period; this is not unexpected given that water temperatures were also variable over the same period. Dissolved oxygen concentrations are generally higher in water at lower temperatures, and vice versa.

Transmission of water quality data did not occur across the deployment period at this station, and data from the instrument's internal log file was only available until August 20.

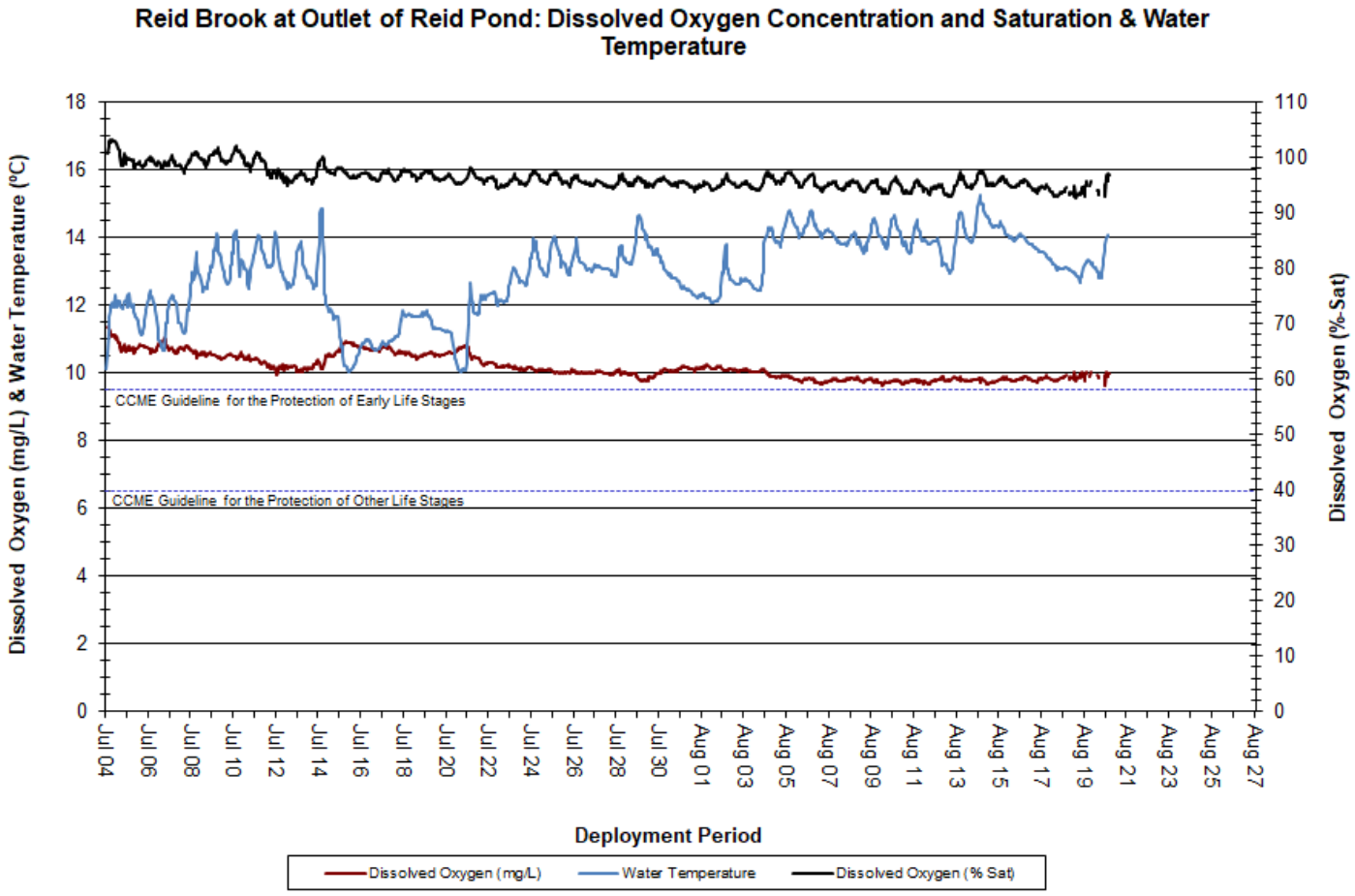

Figure 5: Dissolved Oxygen Concentration and Saturation & Water Temperature at Reid Brook at Outlet of Reid Pond

Turbidity

Over the deployment period, turbidity levels ranged from 0NTU to 652NTU, with a median value of 0NTU (Figure 6). This indicates a very low level of background turbidity at this station during deployment, which is typical of this station. Precipitation data was obtained from the Voisey's Bay Weather Station.

All water bodies have a natural level of turbidity. A significant increase in turbidity is of concern when monitoring water quality. Higher turbidity readings would normally be expected during heavy rainfall or runoff events. Generally, turbidity levels increase for a short period of time and then return to within a baseline range. Turbidity values can also increase when there is a decrease in water level, which causes natural material in the water body to become concentrated.

It is not unusual for this station to see very little variability in turbidity levels, as it is pristine in nature and far removed from anthropogenic influences that may affect water quality.

Transmission of water quality data did not occur across the deployment period at this station, and data from the instrument's internal log file was only available until August 20.

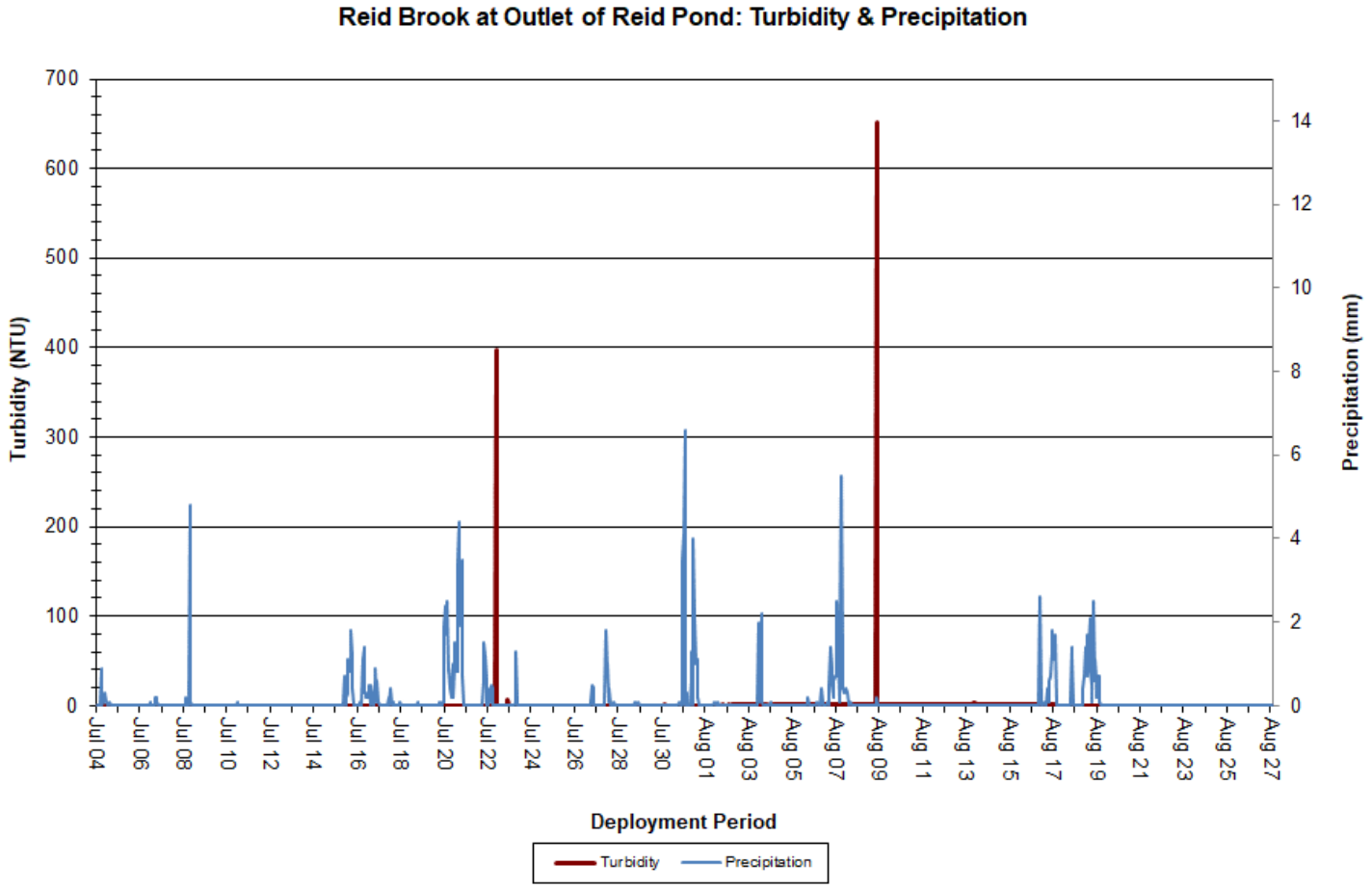

Figure 6: Turbidity & Precipitation at Reid Brook at Outlet of Reid Pond

Stage, Flow & Precipitation

Stage is an important parameter, as it provides an estimate of water level at a station and can explain some of the events that are occurring with other parameters (e.g. specific conductivity, DO, and turbidity). Stage will generally increase during rainfall events (Figure 7) and during any surrounding snow or ice melt; however, direct snowfall will not cause a significant increase in stage.

Over the deployment period, stage values ranged from 1.729m to 1.99m, with a median value of 1.846m. Flow values ranged from 0.977m^3/s to 3.264m^3/s, with a median value of 1.75m^3/s. Precipitation data was obtained from the Voisey's Bay Weather Station (Figure 7).

Please note the stage and flow data used below 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.

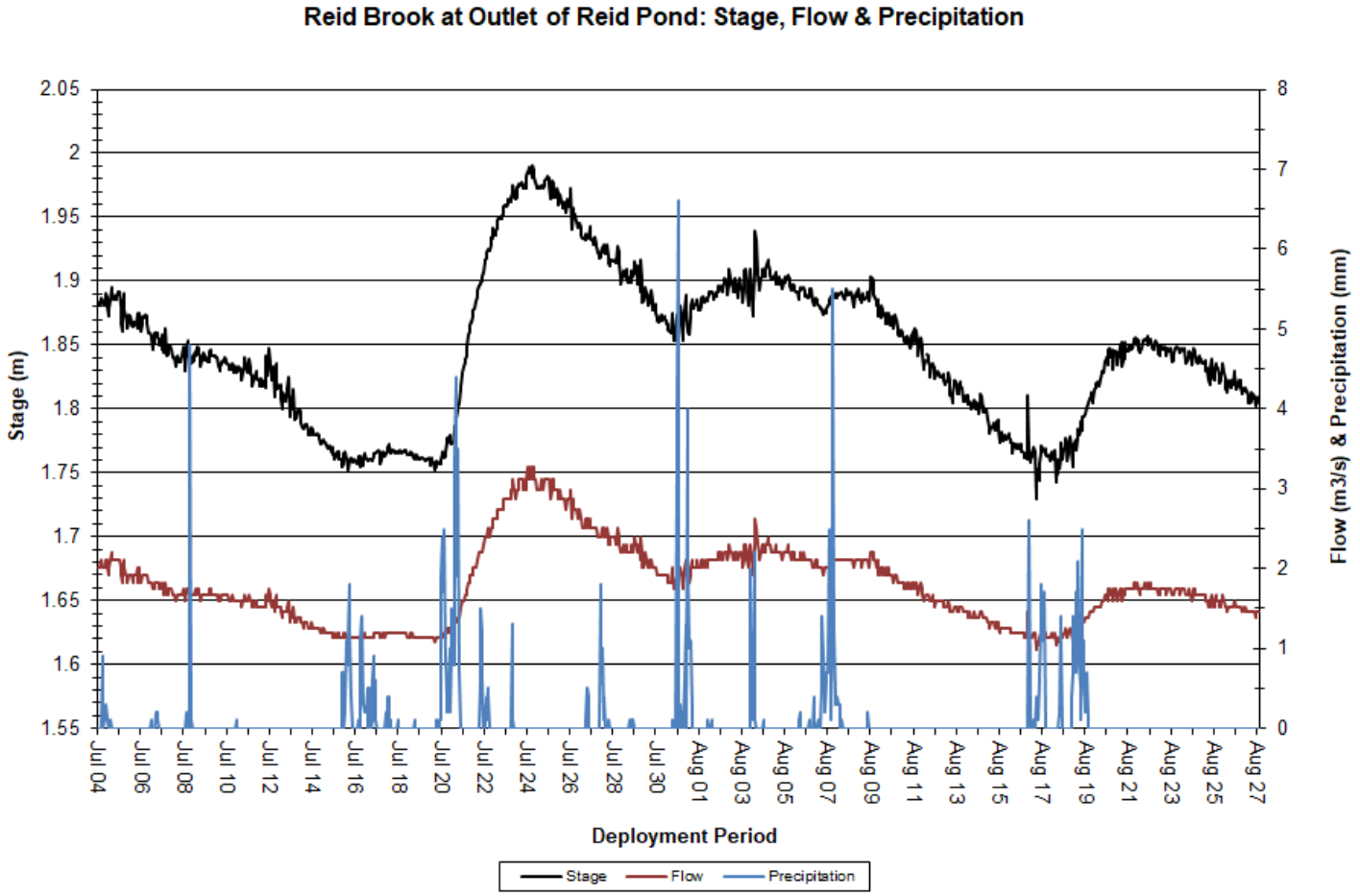

Figure 7: Stage, Flow & Precipitation at Reid Brook at Outlet of Reid Pond

Camp Pond Brook below Camp Pond

Water Temperature

Over the deployment period, water temperature ranged from 10.56°C to 19.37°C, with a median value of 15.58°C (Figure 8).

Water temperature at this station displays diurnal variations. Water temperature was variable over the course of deployment and correlated closely with air temperatures across the same period (Figure 8). Air temperature data was obtained from the Voisey's Bay Weather Station.

Camp Pond Brook is sensitive to changes in ambient air temperature and fluctuates considerably depending on the weather and time of day. This station typically has the highest water temperatures and greatest fluctuations when compared to the other stations in the network.

Please note the stage data used below 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.

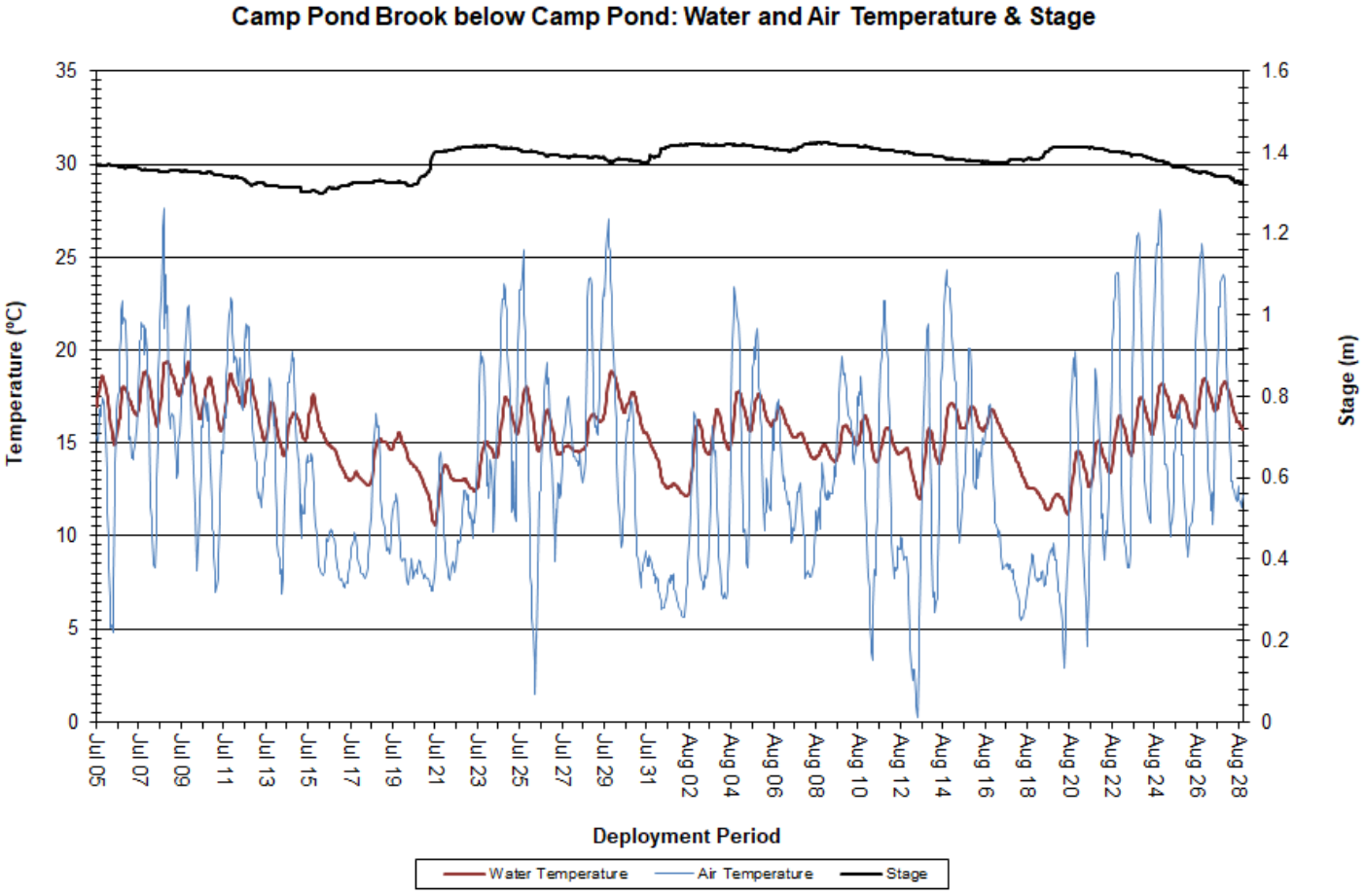

Figure 8: Water and Air Temperature & Stage at Camp Pond Brook below Camp Pond

pH

Over the deployment period, pH values ranged from 5.97 pH units to 6.87 pH units, with a median value of 6.68 pH units (Figure 9).

pH levels were relatively stable over the course of deployment, remaining within the CCME's Guidelines for the Protection of Aquatic Life for the majority of the deployment period.

Natural events such as rainfall and snow melt will alter the pH of a brook for a period of time - pH levels will decrease slightly during and after high stage levels. This is a natural process.

Please note the stage data used below 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.

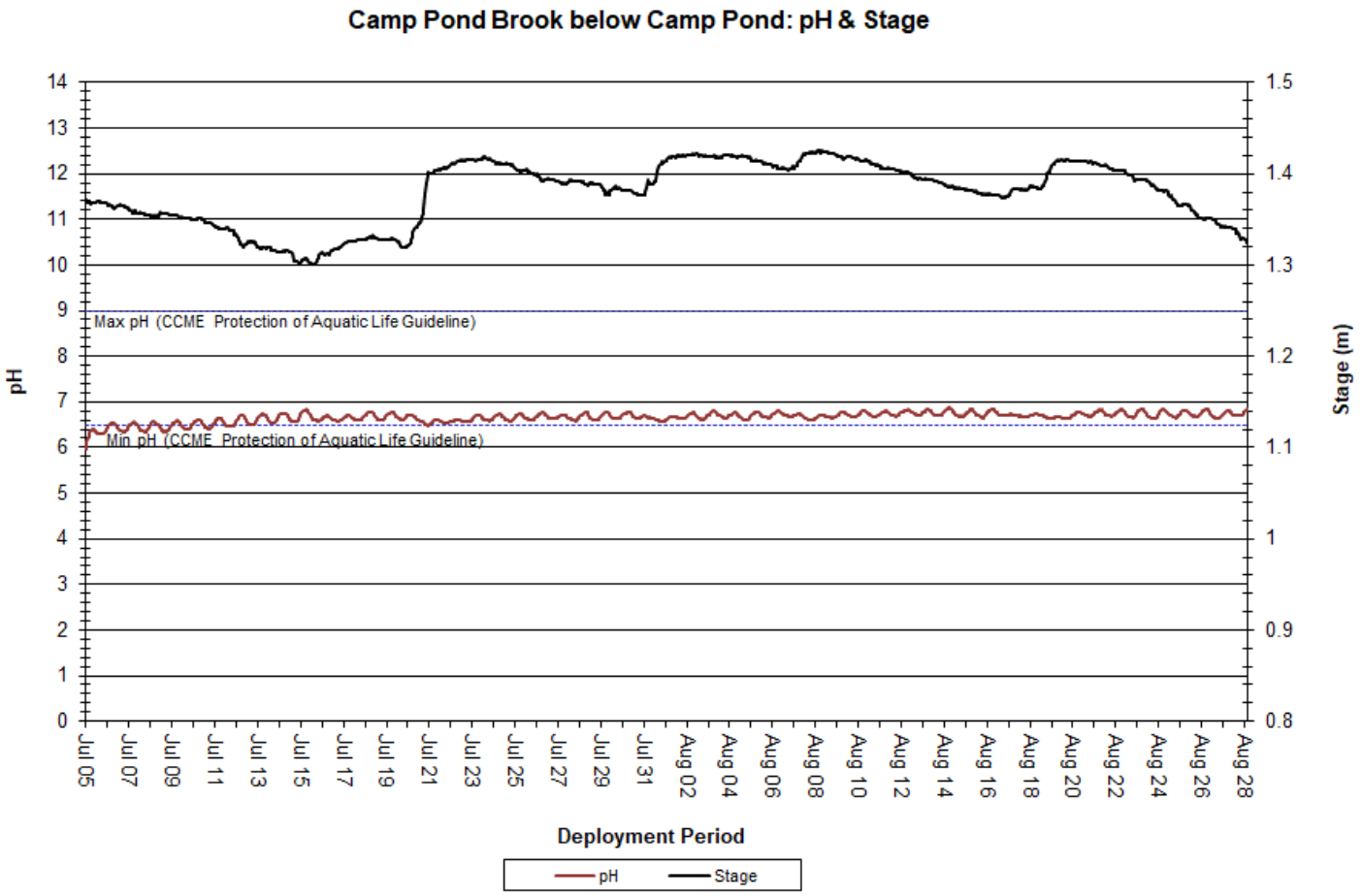

Figure 9: pH & Stage at Camp Pond Brook below Camp Pond

Specific Conductivity

Over the deployment period, specific conductivity ranged from 44µS/cm to 80µS/cm, with a median value of 46µS/cm (Figure 10).

Conductivity levels were variable but relatively stable across the deployment period as stage was similarly variable but stable. A decrease in water level generally serves to concentrate suspended materials in the water column, in turn increasing specific conductivity (Figure 10). Sudden increases in stage also typically correspond with sudden temporary increases in specific conductivity at this station, which is evident in the graph below.

Please note the stage data used below 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.

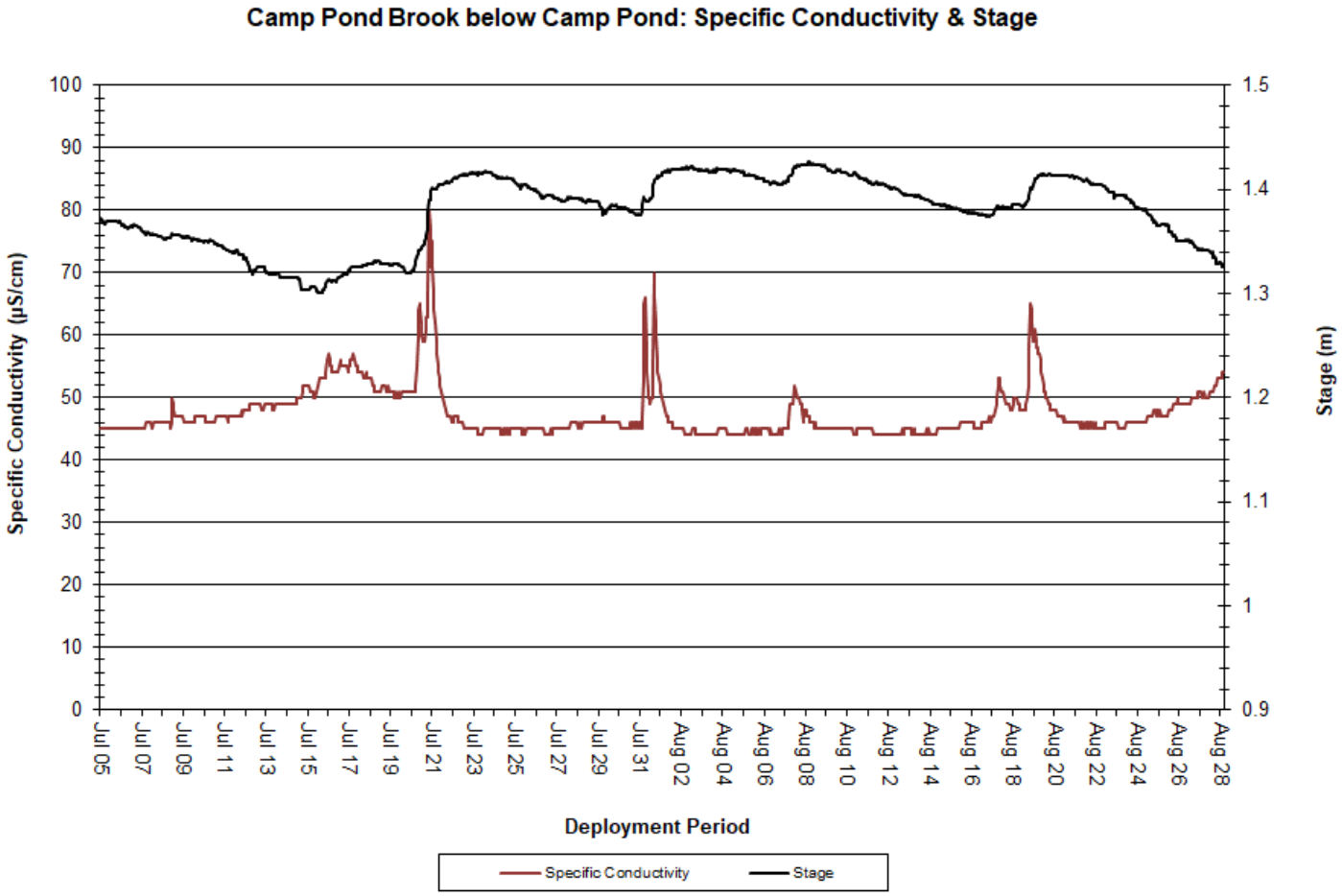

Figure 10: Specific Conductivity & Stage at Camp Pond Brook below Camp Pond

Dissolved Oxygen

Over the deployment period, dissolved oxygen concentration ranged from 8.14mg/L to 9.98mg/L, with a median value of 9.07mg/L. Saturation of dissolved oxygen ranged from 85.4% saturation to 97.7% saturation, with a median value of 90.7% (Figure 11).

Dissolved oxygen concentrations were variable across the deployment period, as water temperatures followed a similar, but opposite, trend. This observation is to be expected as water temperature directly influences the level of dissolved oxygen present in the water column; as water temperatures increase, dissolved oxygen concentrations decrease, and vice versa.

Dissolved oxygen concentrations were below the CCME's Guideline for the Protection of Early Life Stages for much of the deployment period. Instances where dissolved oxygen concentrations rose above the Guideline correlated closely with periods of cooler water temperatures, which is to be expected. Dissolved oxygen concentrations remained above the CCME's Guideline for the Protection of Other Life Stages for the duration of deployment (Figure 11).

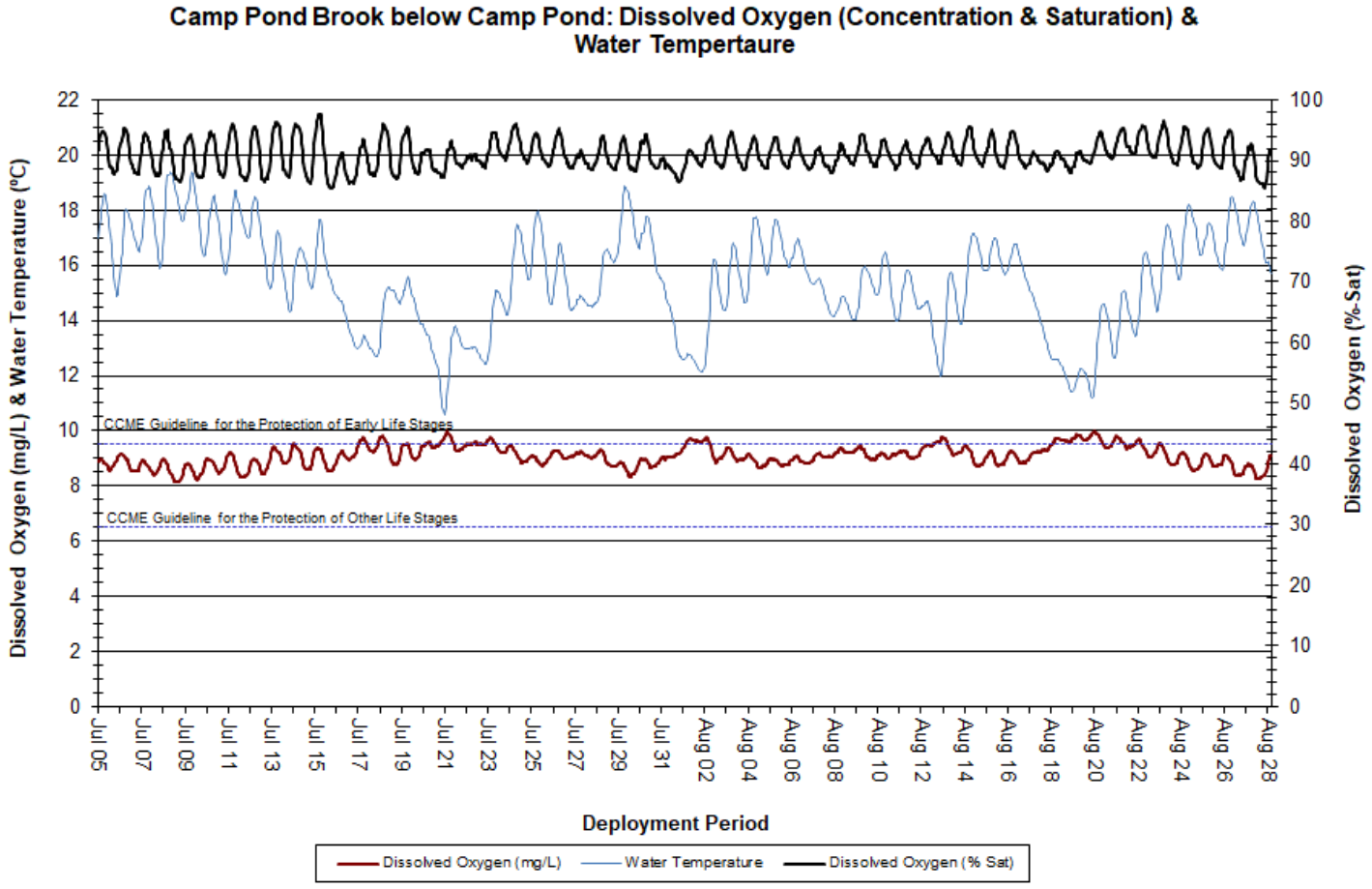

Figure 11: Dissolved Oxygen & Water Temperature at Camp Pond Brook below Camp Pond

Turbidity

Over the deployment period, turbidity ranged from 0NTU to 68.9NTU, with a median value of 0.2NTU (Figure 12). A median value of 0.2NTU indicates that there was a very low level of natural background turbidity at this station.

Variable turbidity levels are commonly observed at this station and are typically attributable to precipitation events and subsequent runoff entering Camp Pond Brook, which is evident in the graph below (Figure 12). Precipitation data was obtained from the Voisey's Bay Weather Station.

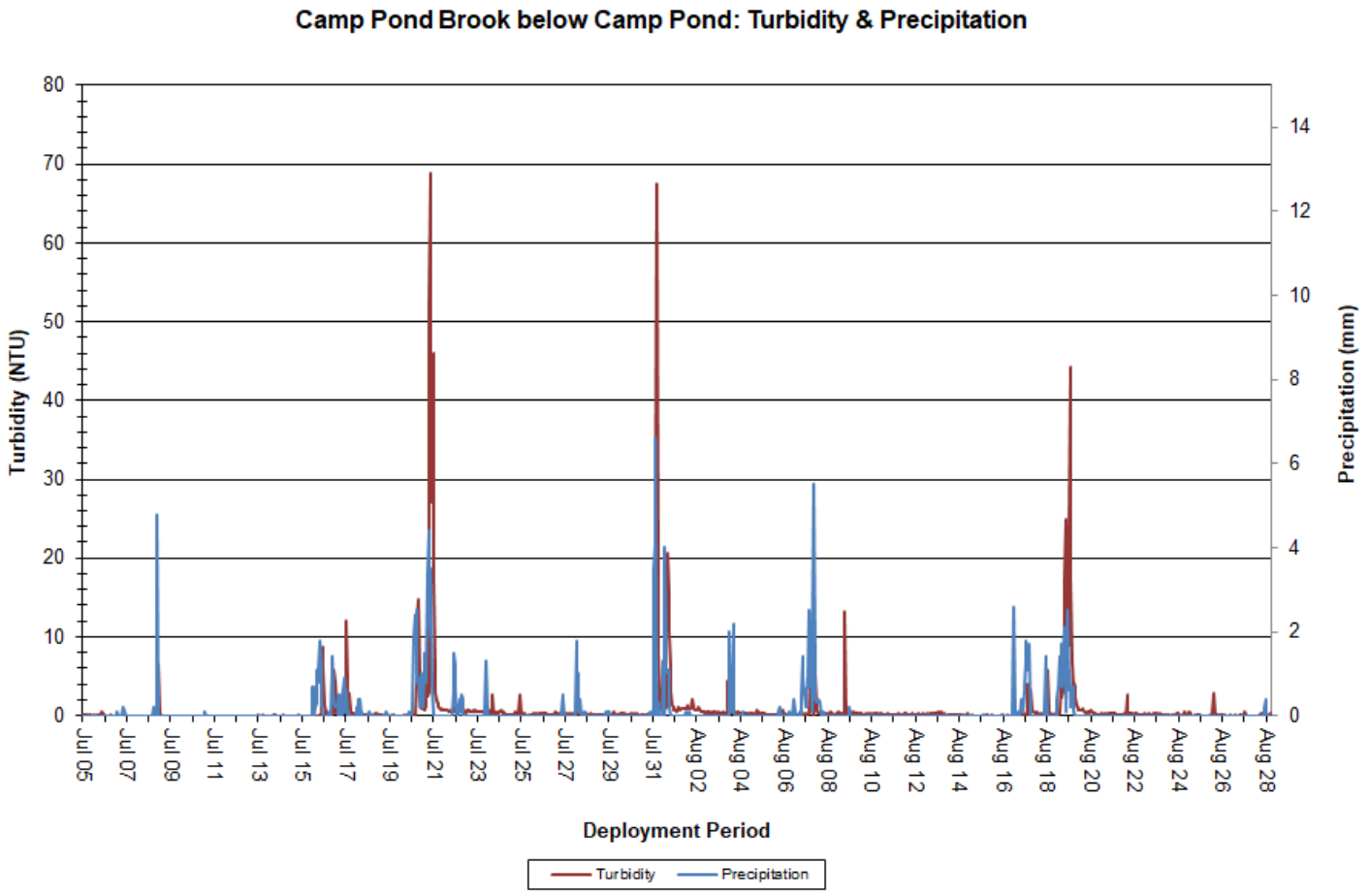

Figure 12: Turbidity & Precipitation at Camp Pond Brook below Camp Pond

Stage, Flow and Precipitation

Over the deployment period, stage values ranged from 1.301m to 1.426m, with a median value of 1.39m. Stream flow values ranged from 0.128m^3/s to 0.563m^3/s, with a median value of 0.369m^3/s. Precipitation data was obtained from the Voisey's Bay Weather Station (Figure 13).

Stage was variable across the deployment period. Many increases in stage were observed across the deployment period and can be attributed to observed rainfall events, as evidenced in the graph below (Figure 13).

Please note the stage and flow data used below 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.

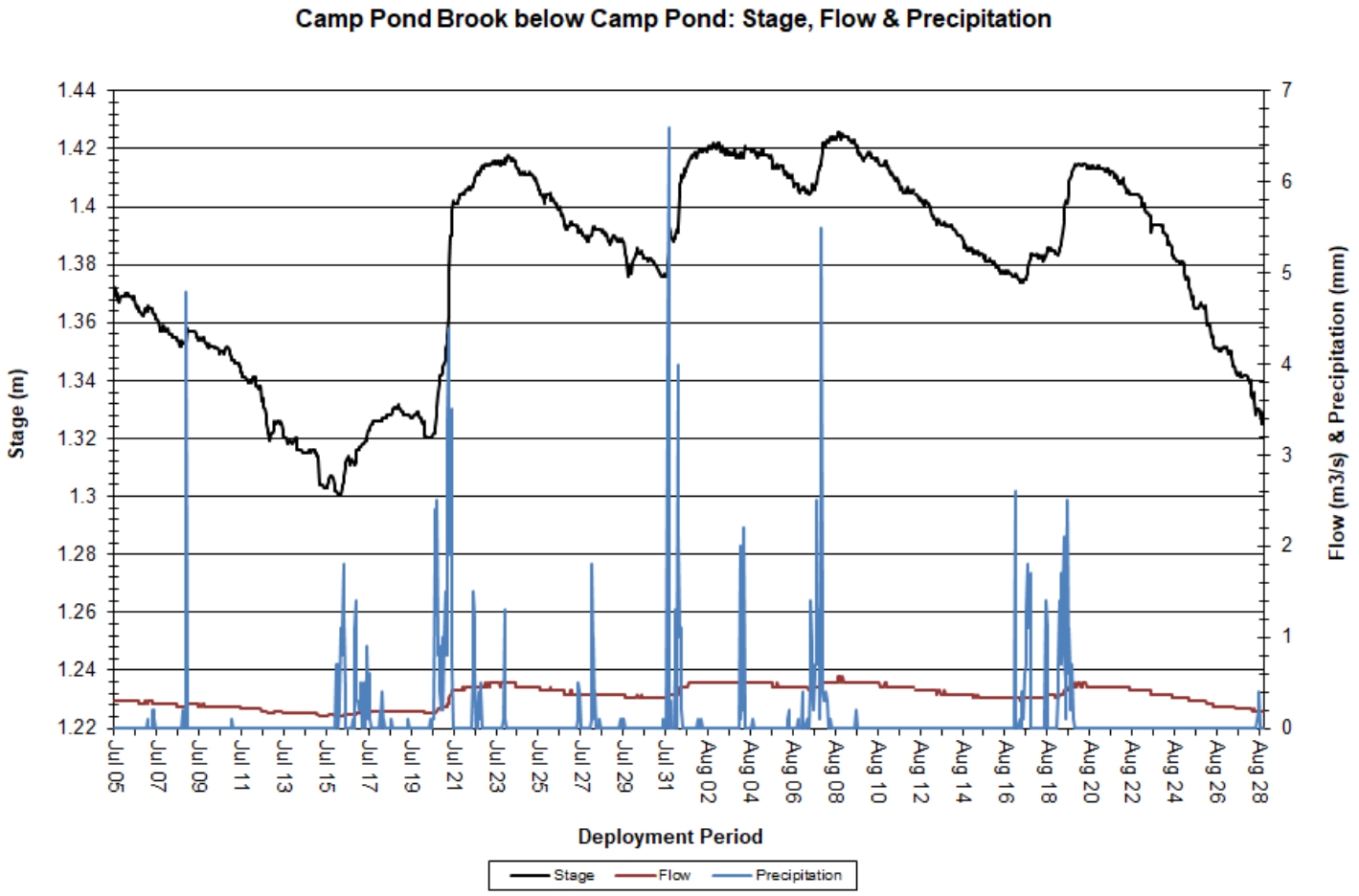

Figure 13: Stage, Flow & Precipitation at Camp Pond Brook below Camp Pond

Reid Brook below Tributary

Water Temperature

Over the deployment period, water temperature ranged from 8.65°C to 16.62°C, with a median value of 13.05°C (Figure 14).

Water temperature at this station displays diurnal variations and was variable across the deployment period. This is to be expected as air temperatures exhibited a similar trend (Figure 14). Air temperature data was obtained from the Voisey's Bay Weather Station.

Water temperature data is not available from August 6 onwards due to decreased power to the field sonde.

Please note the stage and flow data used below 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.

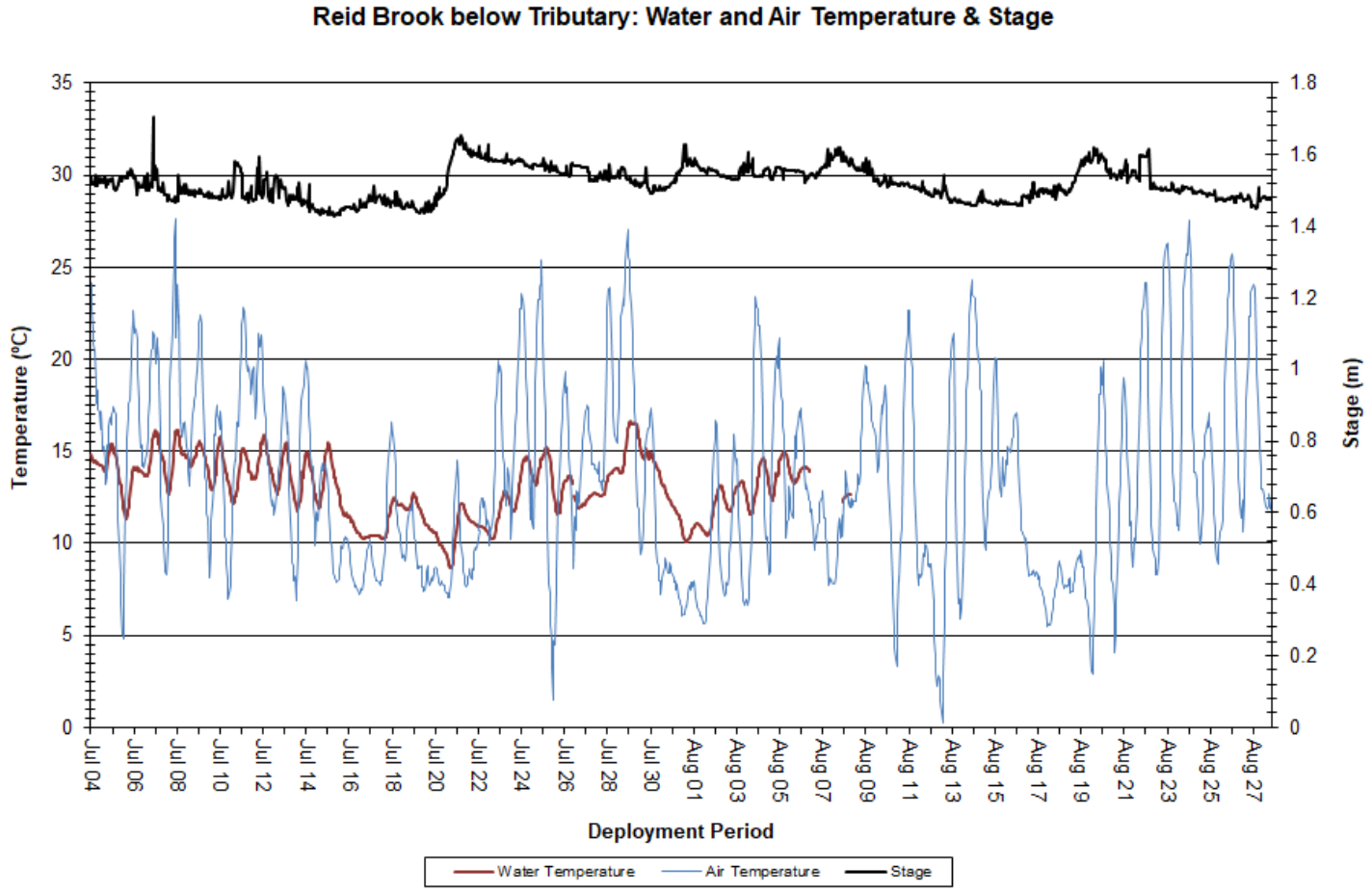

Figure 14: Water and Air Temperature & Stage at Reid Brook below Tributary

pH

Over the deployment period, pH ranged from 6.47 pH units to 7.14 pH units, with a median value of 6.95 (Figure 15).

pH was within the CCME's Guidelines for the Protection of Aquatic Life for the majority of the deployment period.

pH data is not available from August 6 onwards due to decreased power to the field sonde.

Please note the stage and flow data used below 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.

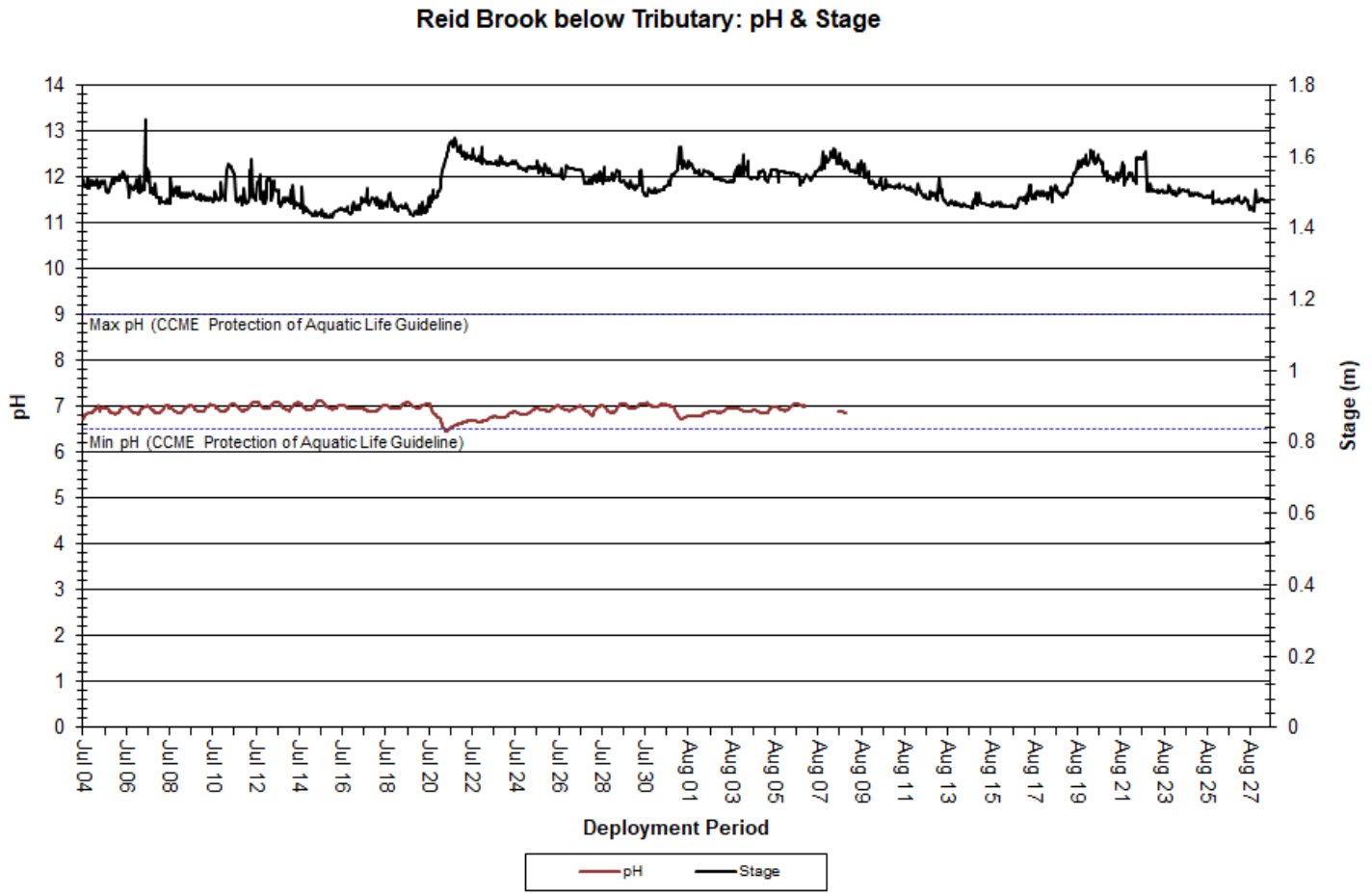

Figure 15: pH & Stage at Reid Brook below Tributary

Specific Conductivity

Over the deployment period, specific conductivity ranged from 28.8µS/cm to 48.6µS/cm, with a median value of 40.3µS/cm (Figure 16).

Specific conductivity was variable but stable over the course of the deployment period. Specific conductivity and stage generally exhibit an inverse relationship: as one parameter increases, the other decreases. This relationship is somewhat evident in the graph below (Figure 16).

Specific conductivity data is not available from August 6 onwards due to decreased power to the field sonde.

Please note the stage and flow data used below 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.

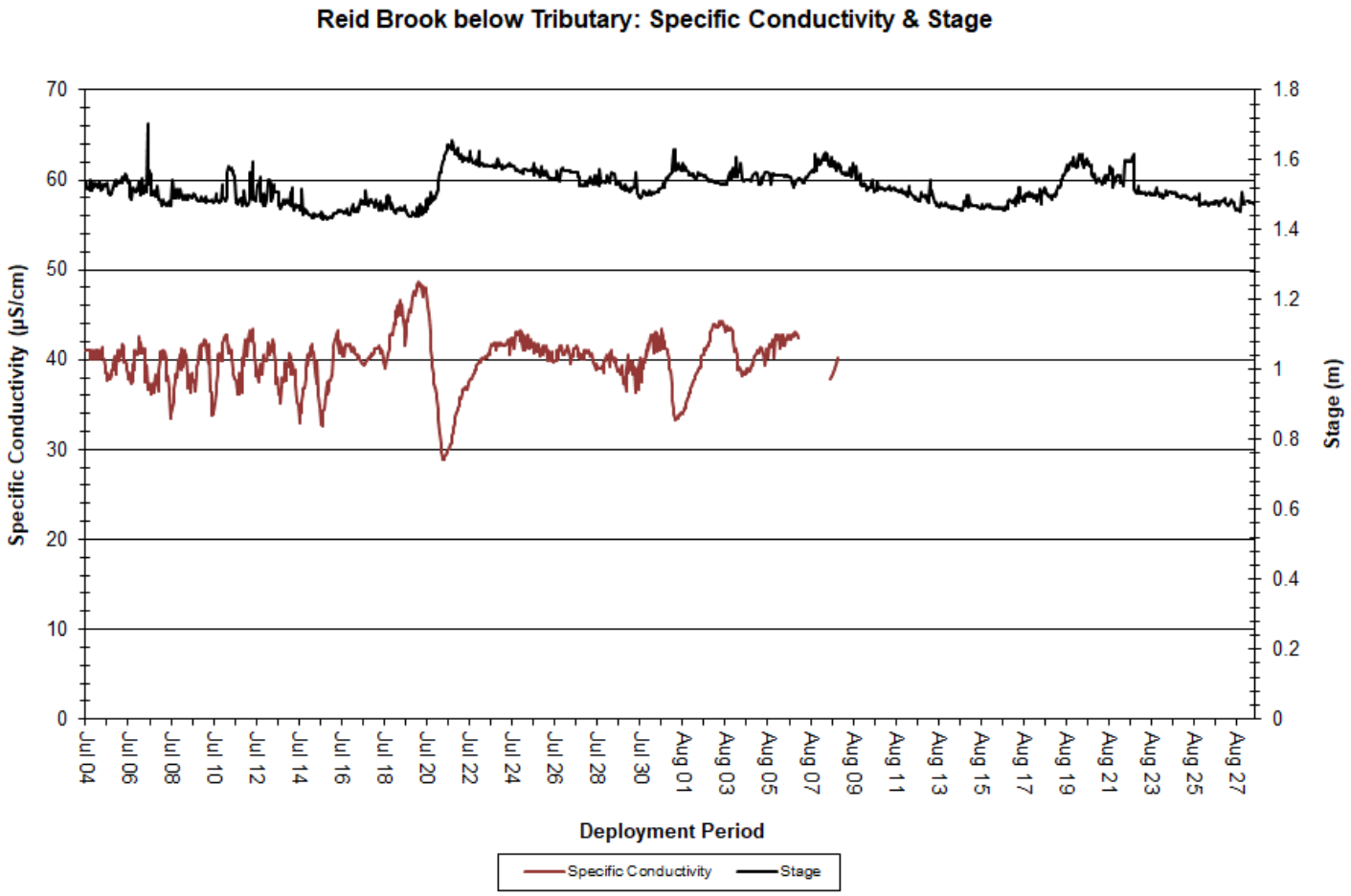

Figure 16: Specific Conductivity & Stage at Reid Brook below Tributary

Dissolved Oxygen

Over the deployment period, dissolved oxygen concentration ranged from 9.18mg/L to 11.14mg/L, with a median value of 10.08mg/L. The saturation of dissolved oxygen ranged from 93.0% saturation to 101.2% saturation, with a median value of 95.6% (Figure 17).

Dissolved oxygen concentrations remained above the CCME's Guideline for the Protection of Early Life Stages for the majority of deployment; instances where dissolved oxygen concentrations fell below the Guideline correspond closely with higher water temperatures. Water temperature and dissolved oxygen concentration generally exhibit an inverse relationship. Dissolved oxygen concentrations remained above the CCME's Guideline for the Protection of Other Life Stages for the duration of deployment.

Dissolved oxygen data is not available from August 6 onwards due to decreased power to the field sonde.

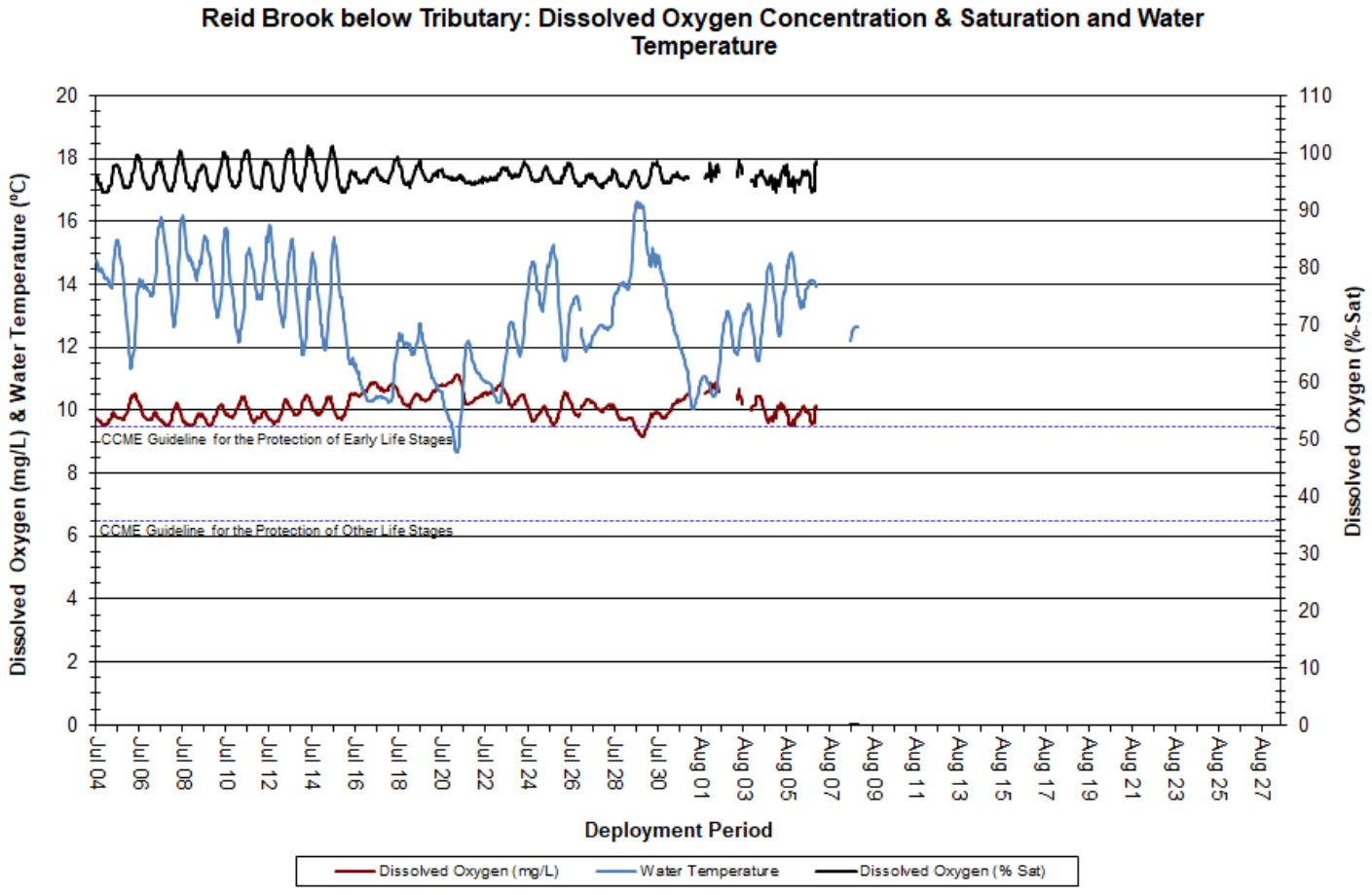

Figure 17: Dissolved Oxygen & Water Temperature at Reid Brook below Tributary

Turbidity

Over the deployment period, turbidity ranged from 0NTU to 24NTU, with a median value of 6NTU (Figure 18). A median value of 6NTU indicates a low level of background turbidity, which is typical of this station due to the sandy nature of the riverbed.

The majority of the turbidity events observed at this station correlated closely with rainfall events (Figure 18), which can cause mixing of solids in the water column. Precipitation data was obtained from the Voisey's Bay Weather Station.

Turbidity data is not available from August 6 onwards due to decreased power to the field sonde.

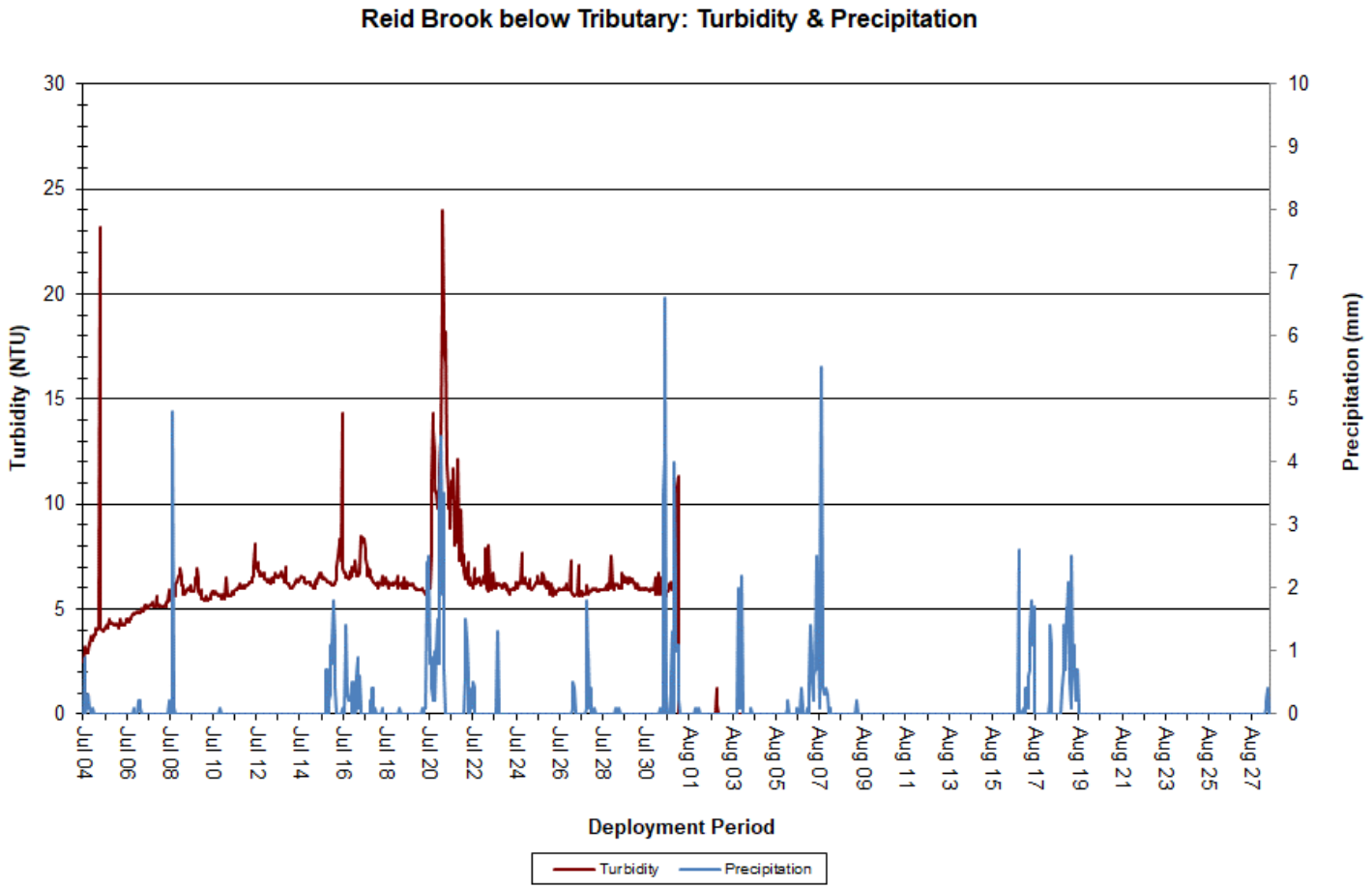

Figure 18: Turbidity & Precipitation at Reid Brook below Tributary

Stage and Flow

Over the deployment period, stage values ranged from 1.43m to 1.705m, with a median value of 1.515m. Stream flow values ranged from 1.299m^3/s to 8.233m^3/s, with a median value of 2.645m^3/s. Precipitation data was obtained from the Voisey's Bay Weather Station (Figure 19).

Stage and flow were variable, but generally stable, across the deployment period. Increases in both stage and flow were generally attributable to observed rainfall events (Figure 19).

Please note the stage and flow data used below 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.

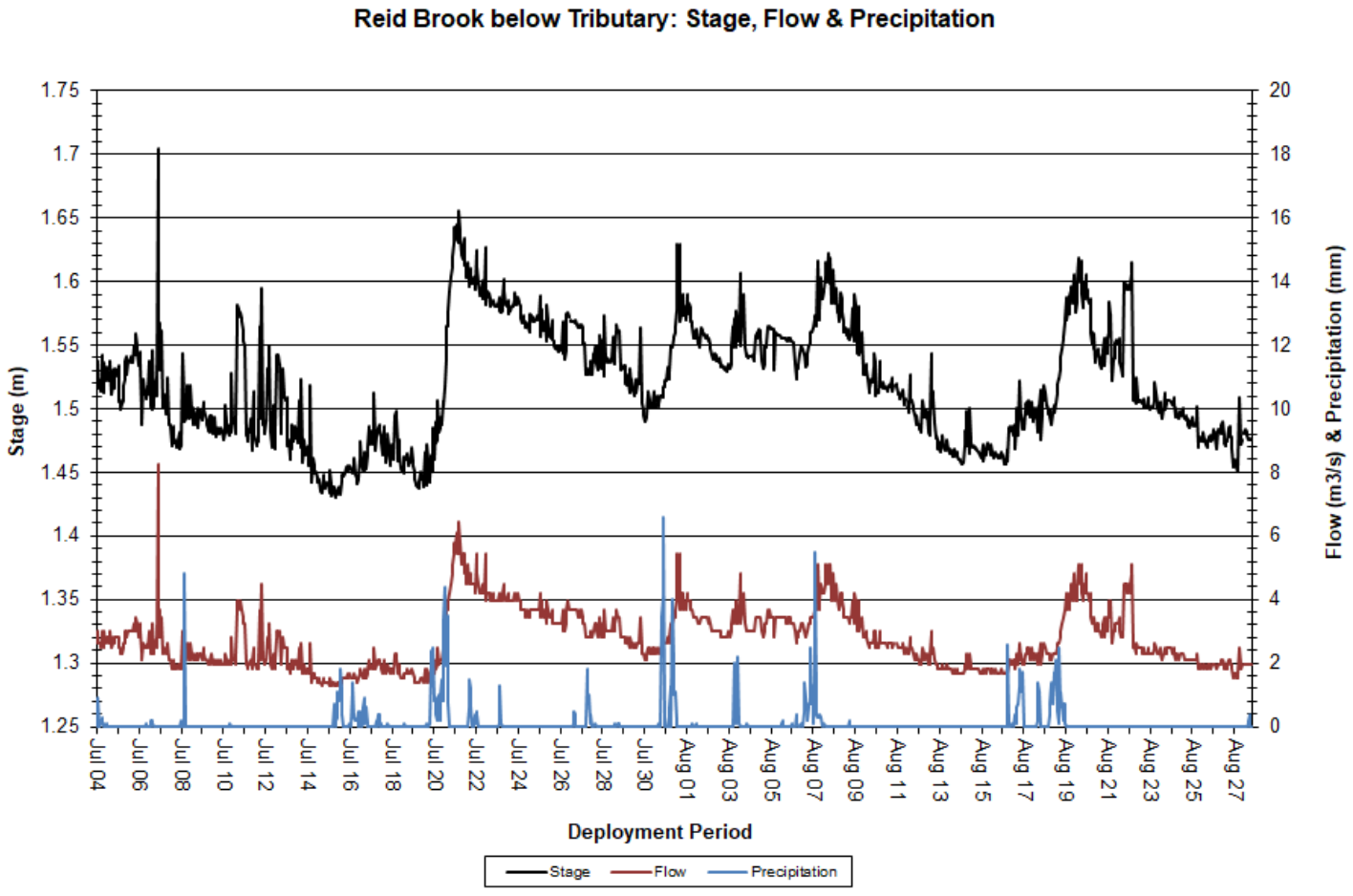

Figure 19: Stage, Flow & Precipitation at Reid Brook below Tributary

Tributary to Reid Brook

Water Temperature

Over the deployment period, water temperature ranged from 8.5°C to 16.06°C, with a median value of 12.505°C (Figure 20). Streams and brooks are sensitive to changes in the ambient air temperature, thus water temperature will fluctuate considerably depending on the weather and the time of day. Air temperature fluctuates to a greater extent compared to water temperature. Air temperature data was obtained from the Voisey's Bay Weather Station.

Water temperature data displays a natural diurnal pattern. Water temperatures were variable but generally increasing over the course of deployment and correlated closely with ambient air temperatures.

Water temperature data is not available from August 13 onwards due to decreased power to the field sonde.

Please note the stage and flow data used below 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.

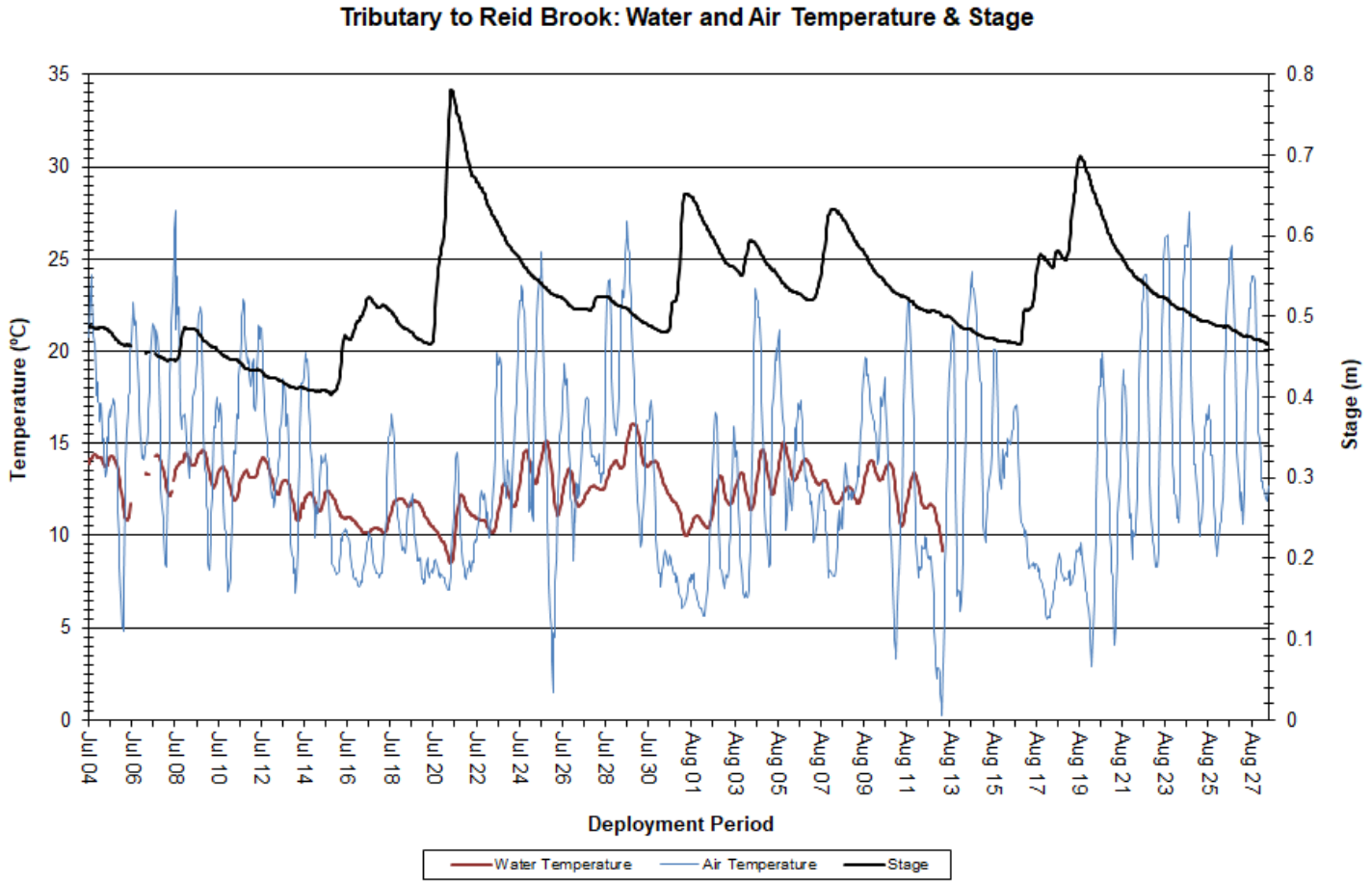

Figure 20: Water and Air Temperature & Stage at Tributary to Reid Brook

pH

Over the deployment period, pH ranged from 6.86 pH units to 8.04 pH units, with a median value of 7.79 (Figure 21).

pH values were within the CCME's Guidelines for the Protection of Aquatic Life for the duration of the deployment period.

pH data is not available from August 13 onwards due to decreased power to the field sonde.

Please note the stage and flow data used below 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.

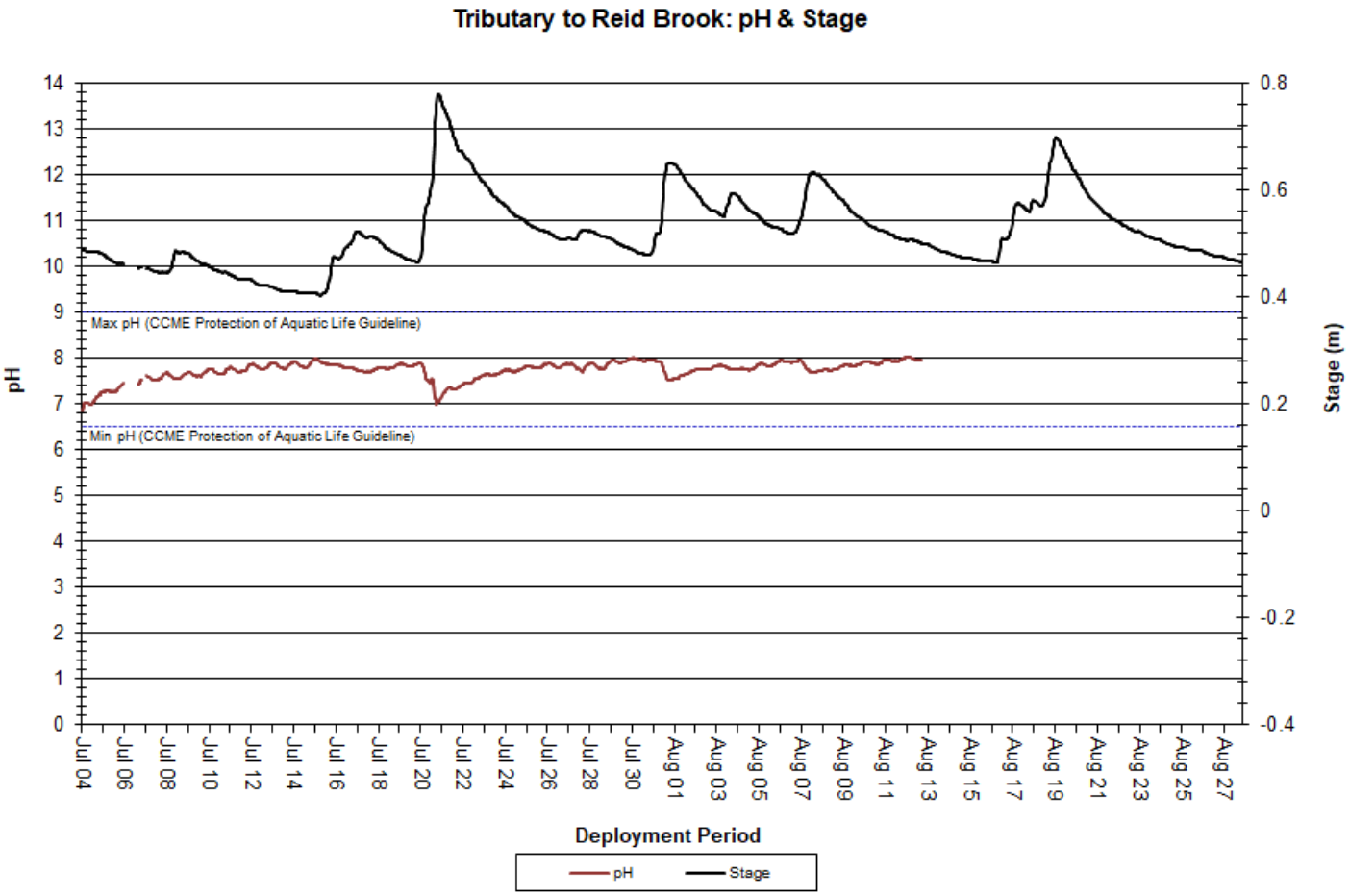

Figure 21: pH & Stage at Tributary to Reid Brook

Specific Conductivity

Over the deployment period, specific conductivity ranged from 28.3µS/cm to 51.0µS/cm, with a median value of 45.2µS/cm (Figure 22).

Specific conductivity and stage generally exhibit an inverse relationship: as one parameter increases, the other decreases. This relationship is clearly evident in the graph below.

Specific conductivity data is not available from August 13 onwards due to decreased power to the field sonde.

Please note the stage and flow data used below 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.

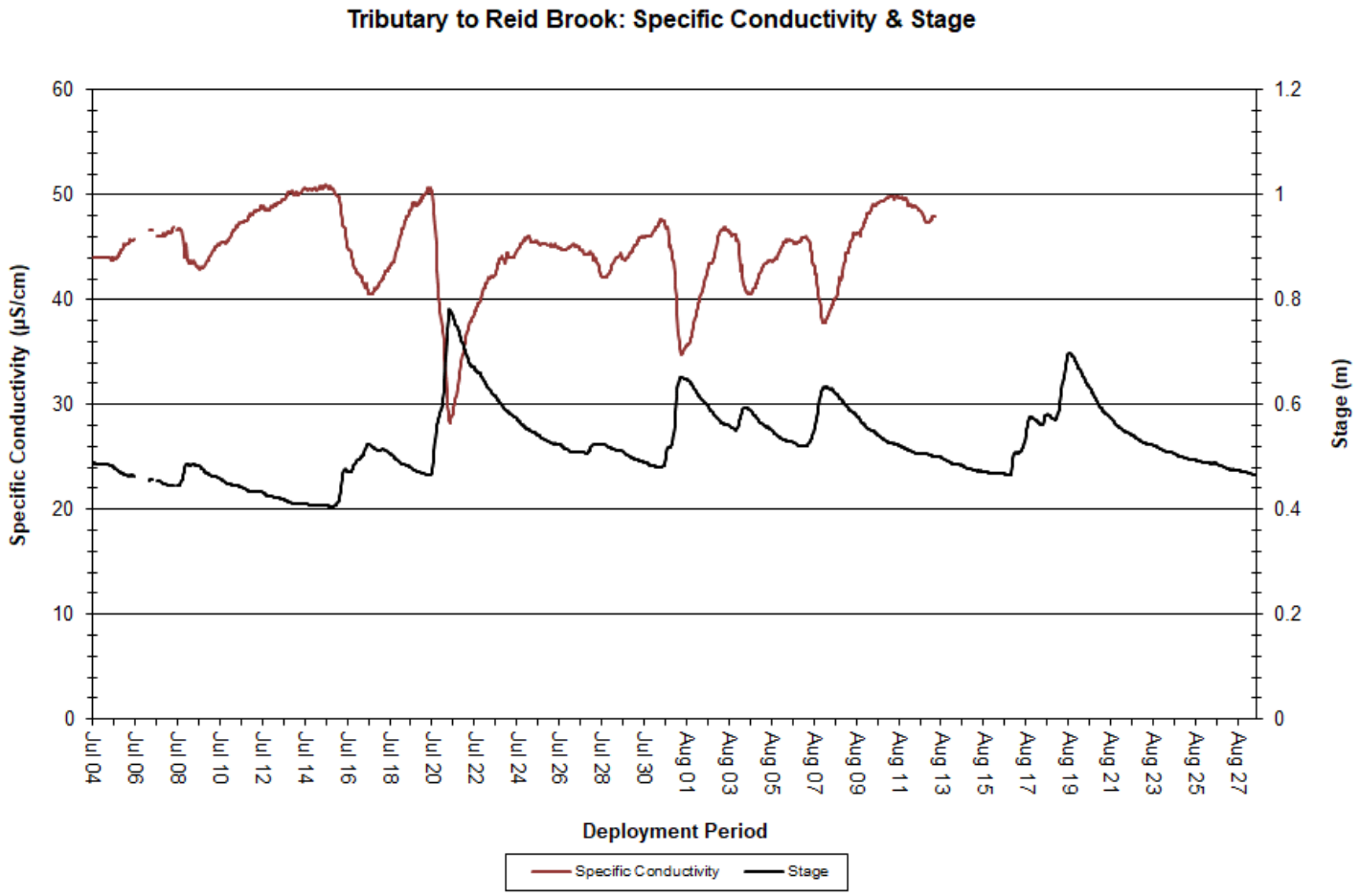

Figure 22: Specific Conductivity & Stage at Tributary to Reid Brook

Dissolved Oxygen

Over the deployment period, dissolved oxygen concentration ranged from 9.13mg/L to 10.90mg/L, with a median value of 9.99mg/L. The saturation of dissolved oxygen ranged from 91.3% saturation to 97.4% saturation, with a median value of 93.6% (Figure 23).

Dissolved oxygen levels remained above the CCME's Guideline for the Protection of Early Life Stages for the majority of the deployment period; instances where dissolved oxygen concentrations fell below the Guideline correlate closely with warmer water temperatures, which is to be expected. Dissolved oxygen levels remained above the CCME's Guideline for the Protection of Other Life Stages for the duration of deployment.

Dissolved oxygen concentration displays a diurnal pattern. During nightfall, dissolved oxygen levels are higher as cooler temperatures allow for more DO to be stored in the water column. During the day, dissolved oxygen levels are lower. This is a result of warmer water temperatures and photosynthesis by aquatic plants, which decrease dissolved oxygen levels in the water column.

Dissolved oxygen data is not available from August 13 onwards due to decreased power to the field sonde.

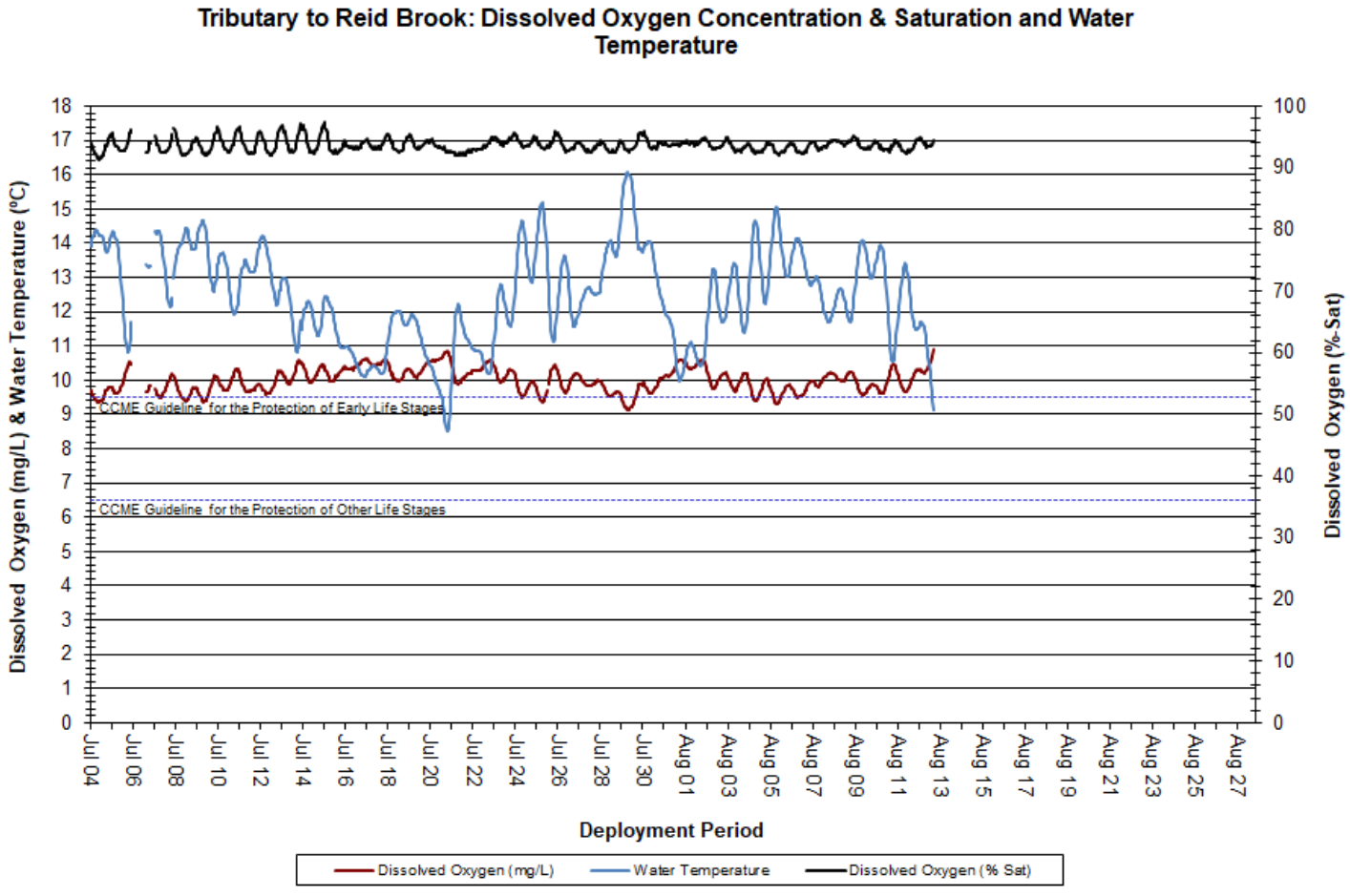

Figure 23: Dissolved Oxygen & Water Temperature at Tributary to Reid Brook

Turbidity

Over the deployment period, turbidity ranged from 0NTU to 36.5NTU, with a median value of 0.7NTU (Figure 24). A median value of 0.7NTU indicates that there was a very low level of background turbidity at this station.

This site is particularly prone to variable turbidity as it has a sandy-clay bottom that is easily disturbed by precipitation events. Turbidity events correlated closely with observed rainfall events, and turbidity returned to baseline levels following each temporary increase (Figure 24). Precipitation data was obtained from the Voisey's Bay Weather Station.

Turbidity data is not available from August 13 onwards due to decreased power to the field sonde.

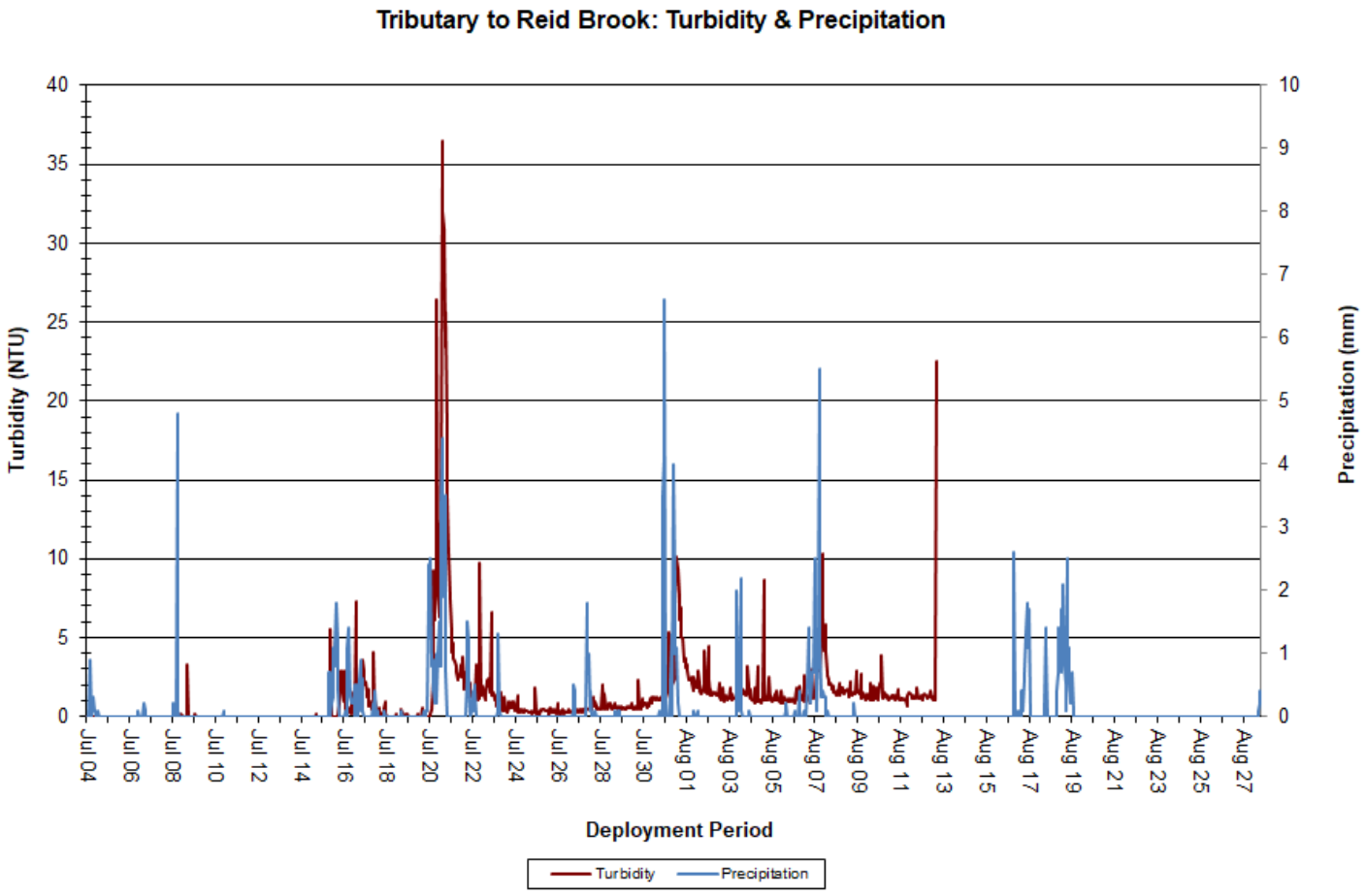

Figure 24: Turbidity & Precipitation at Tributary to Reid Brook

Stage and Flow

Over the deployment period, stage values ranged from 0.404m to 0.781m, with a median value of 0.512m. Stream flow values ranged from 0.067m^3/s to 1.231m^3/s, with a median value of 0.145m^3/s. Precipitation data was obtained from the Voisey's Bay Weather Station (Figure 25).

Stage and flow were variable across the deployment period. Increases in both stage and flow were generally attributable to observed rainfall events (Figure 25).

Please note the stage and flow data used below 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.

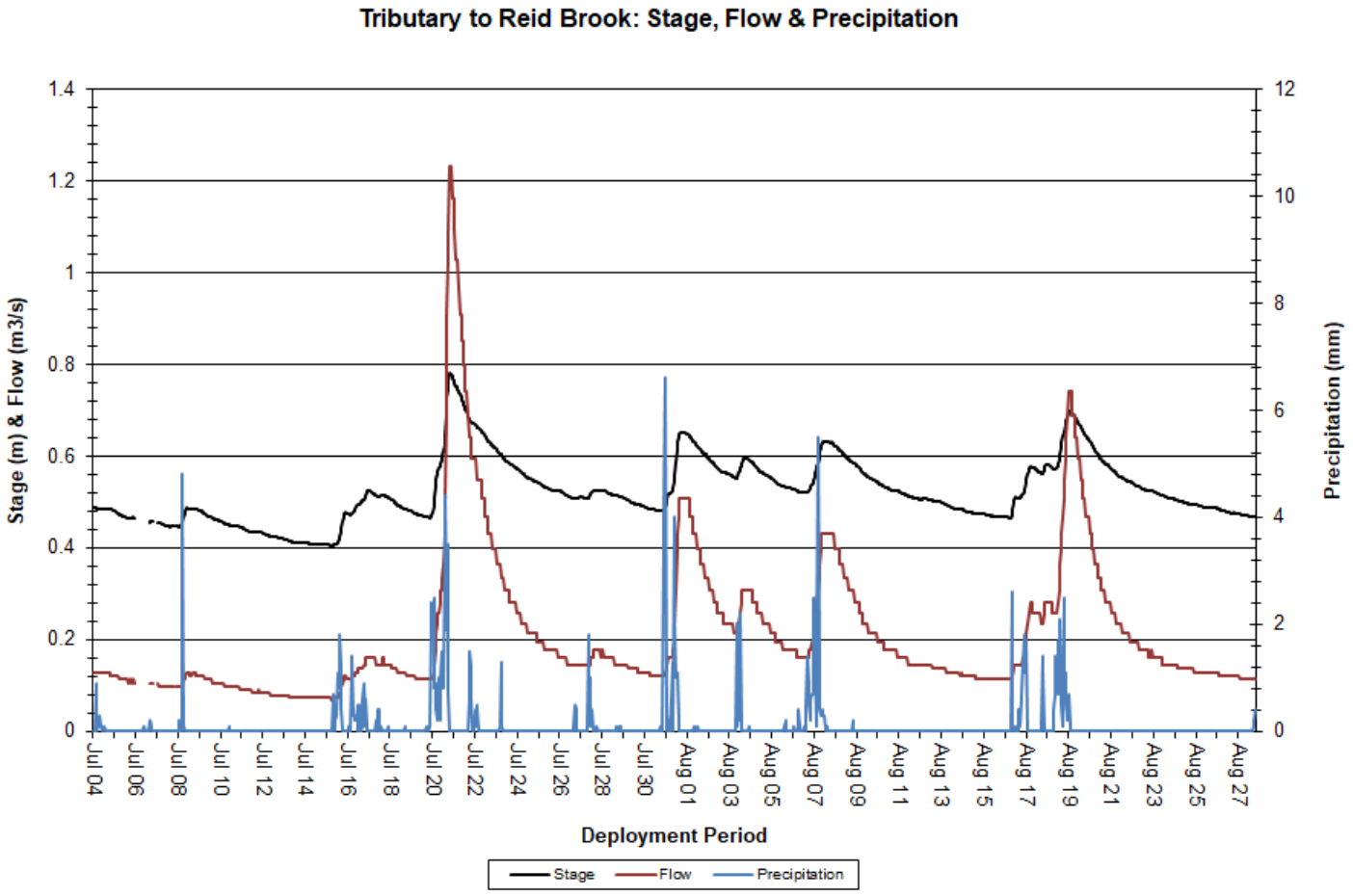

Figure 25: Stage, Flow & Precipitation at Tributary to Reid Brook

Conclusions

Water temperatures across all stations ranged from a minimum of 8.5°C at Tributary to Reid Brook to a maximum of 19.37°C at Camp Pond Brook below Camp Pond. Overall, water temperature was increasing across the network. Stations at Camp Pond Brook, Tributary to Reid Brook, and Reid Brook below Tributary are more sensitive to changes in ambient air temperatures as these sites are brooks with continuously moving water. In contrast, Reid Brook at Outlet of Reid Pond is a large pond with a high surface area and deeper, slower-moving water.

pH values across all stations ranged from a minimum of 0pH units to 12.6pH units, both at Reid Brook at Outlet of Reid Pond, which is likely attributable to a sensor failure. pH values at all others stations were relatively consistent across the deployment period.

Specific conductivity across all stations ranged from a minimum of 11µS/cm at Reid Brook at Outlet of Reid Pond to a maximum of 80.0µS/cm at Camp Pond Brook below Camp Pond. Conductivity values at Reid Brook at Outlet of Reid Pond were the lowest across the network. Camp Pond Brook below Camp Pond had the highest median value at 46.0µS/cm.

Dissolved oxygen levels across all stations ranged from a minimum of 8.14mg/L at Camp Pond Brook below Camp Pond to a maximum of 11.38mg/L at Reid Brook at Outlet of Reid Pond. Dissolved oxygen is generally decreasing at this time of year and varies diurnally as water temperature is greatly affected by ambient air temperature. Dissolved oxygen levels remained above the CCME's Guideline for the Protection of Other Life Stages at all stations for the duration of deployment. Instances where dissolved oxygen concentrations fell below the CCME's Guideline for the Protection of Early Life Stages correlated closely with warmer water temperatures.

Turbidity levels across all stations ranged from a minimum of 0 NTU at all stations to a maximum of 652 NTU at Reid Brook at Outlet of Reid Pond. Turbidity levels showed natural increases and decreases generally corresponding to precipitation events at all stations.

Overall, the changes in water quality parameters over the course of this deployment can be explained by natural events. Camp Pond Brook below Camp Pond does have the potential for anthropogenic influences as the site is the closest to the inhabited area. It is important to note that during a change (a decrease or increase) in water quality, change only occurs for a short period of time and then water quality parameters return to baseline.

References

Canadian Council of Ministers of the Environment. (2014) "Canadian water quality guidelines for the protection of aquatic life" Canadian Council of Ministers of the Environment. Retrieved from: http://www.ccme.ca/en/resources/canadian_environmental_quality_guidelines/index.html

Canadian Council of Ministers of the Environment. (2014) "Water Quality Guidelines for the Protection of Aquatic Life" Canadian Council of Ministers of the Environment. Retrieved from: http://st-ts.ccme.ca/en/index.html?chems=162&chapters=1

OTT Hydromet (2017) "Hydrolab" Retrieved from: http://www.ott.com/en-us/products/water-quality-2/hydrolab-ds5x-multiparameter-data-sonde-855/

Mike Sader (2017) "Turbidity Measurement: A Simple, Effective Indicator of Water Quality Change". OTT Hydromet. Retrieved from http://www.ott.com/en-us/products/download/turbidity-white-paper/

Swanson, H.A., and Baldwin, H.L., (1965) "A Primer on Water Quality" U.S. Geological Survey. Retrieved from: http://ga.water.usgs.gov/edu/characteristics.html

APPENDIX A: Comparison Graphs

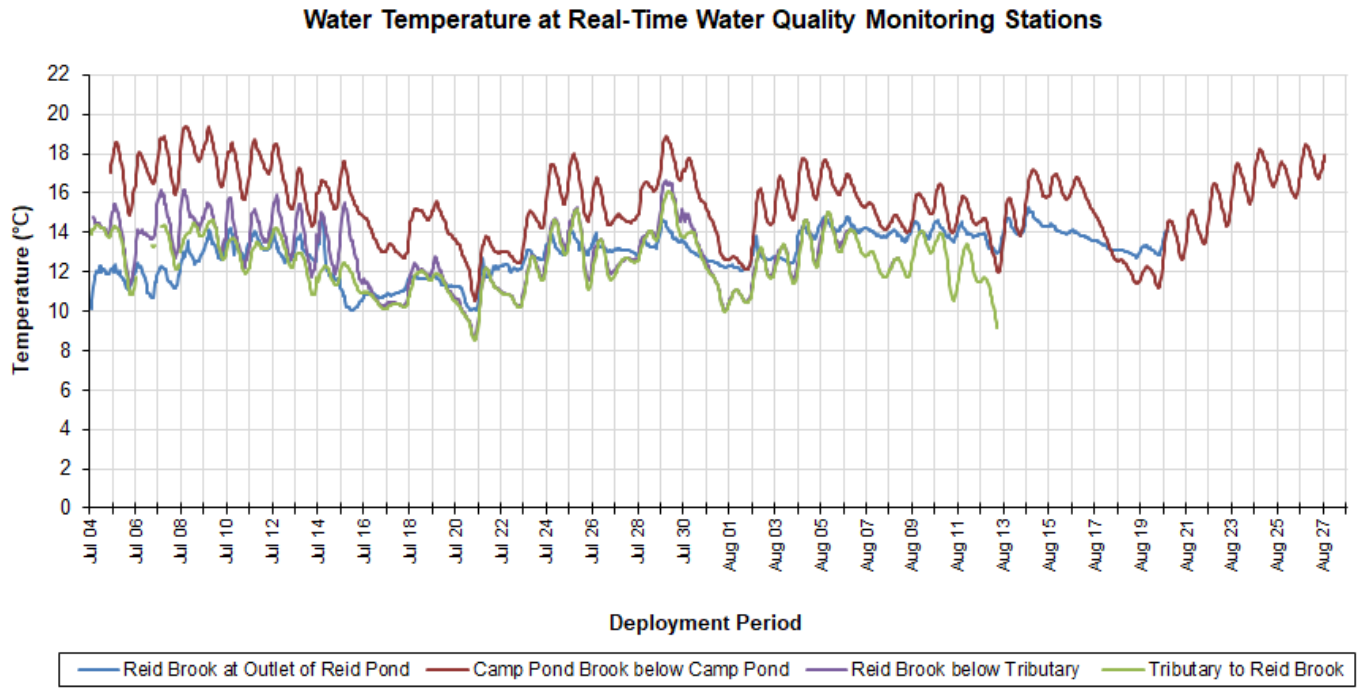

Figure A1: Comparison of Water Temperature (^{0}C) between all Real-Time Stations in Voisey's Bay.

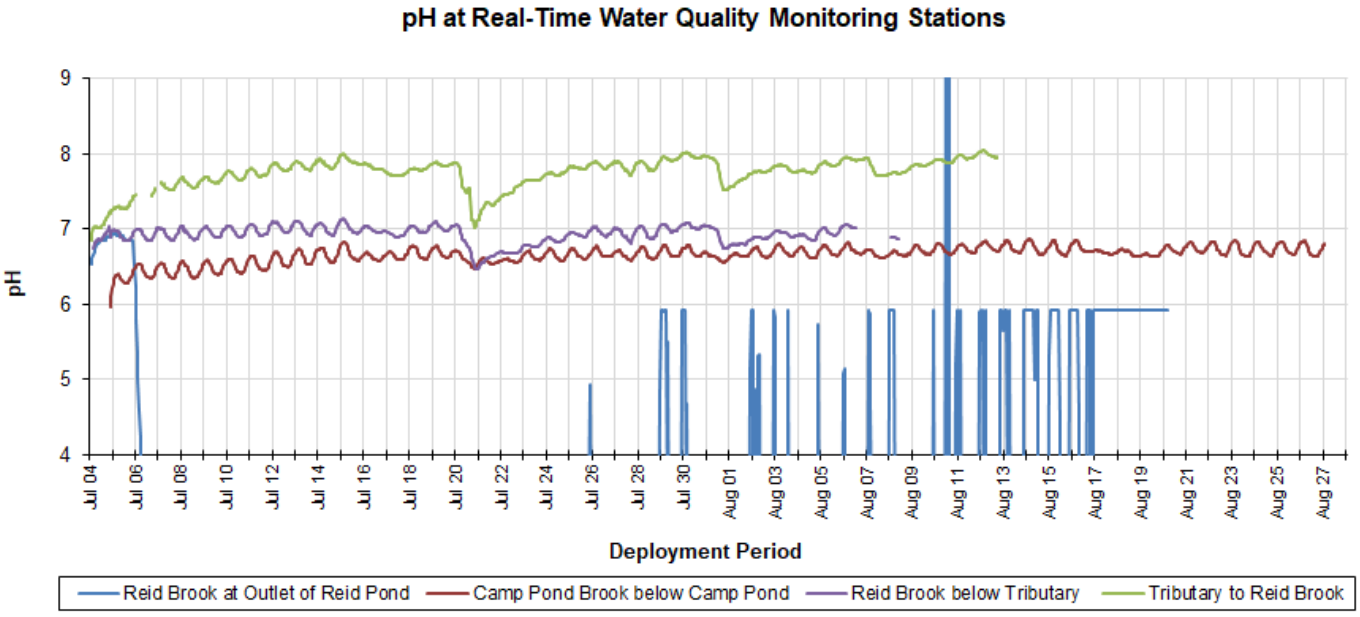

Figure A2: Comparison of pH between all Real-Time Stations in Voisey's Bay.

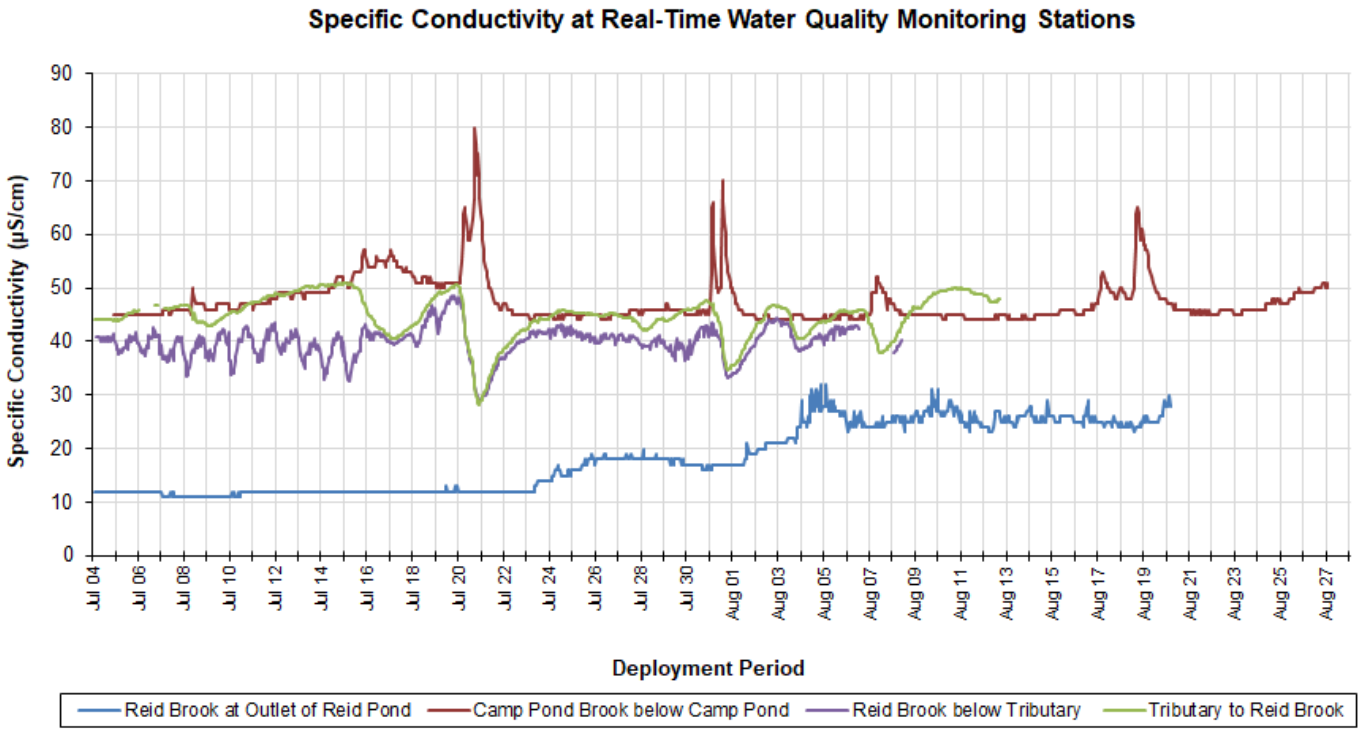

Figure A3: Comparison of Specific Conductivity (µS/cm) between all Real-Time Stations in Voisey's Bay.

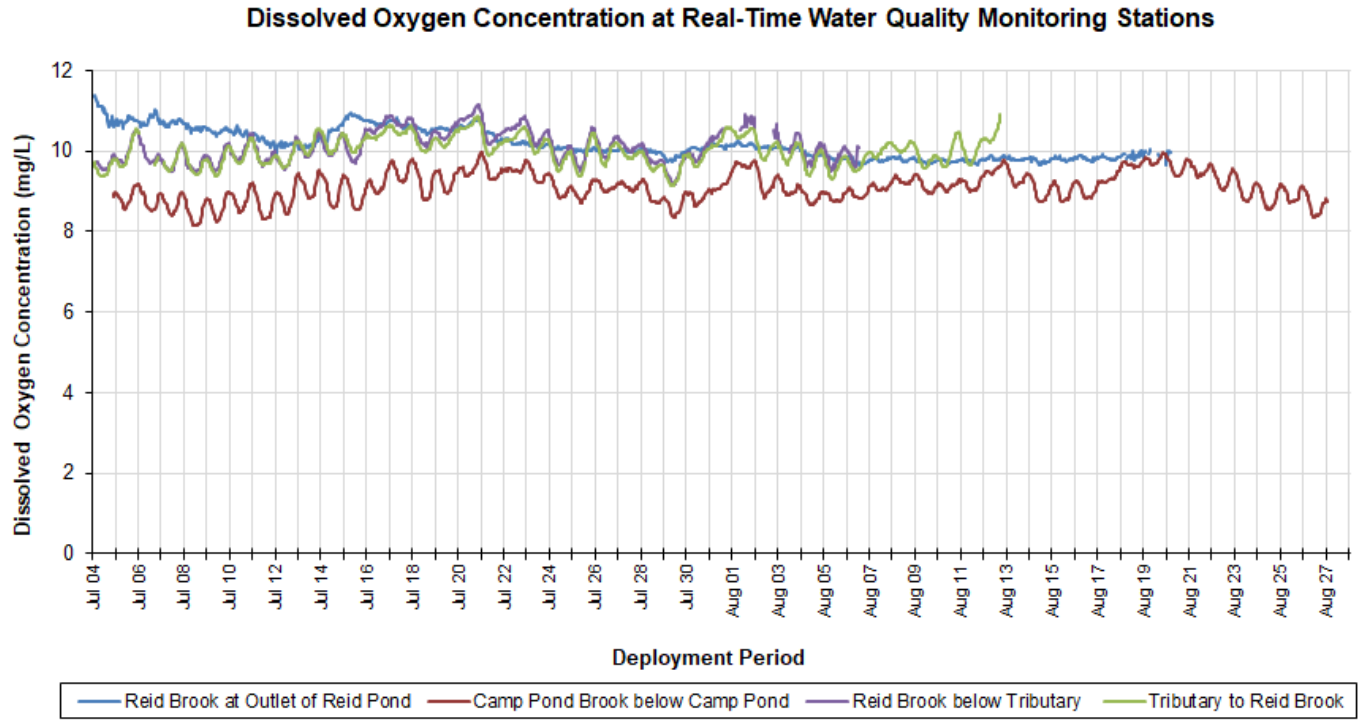

Figure A4: Comparison of Dissolved Oxygen (mg/L) between all Real-Time Stations in Voisey's Bay.

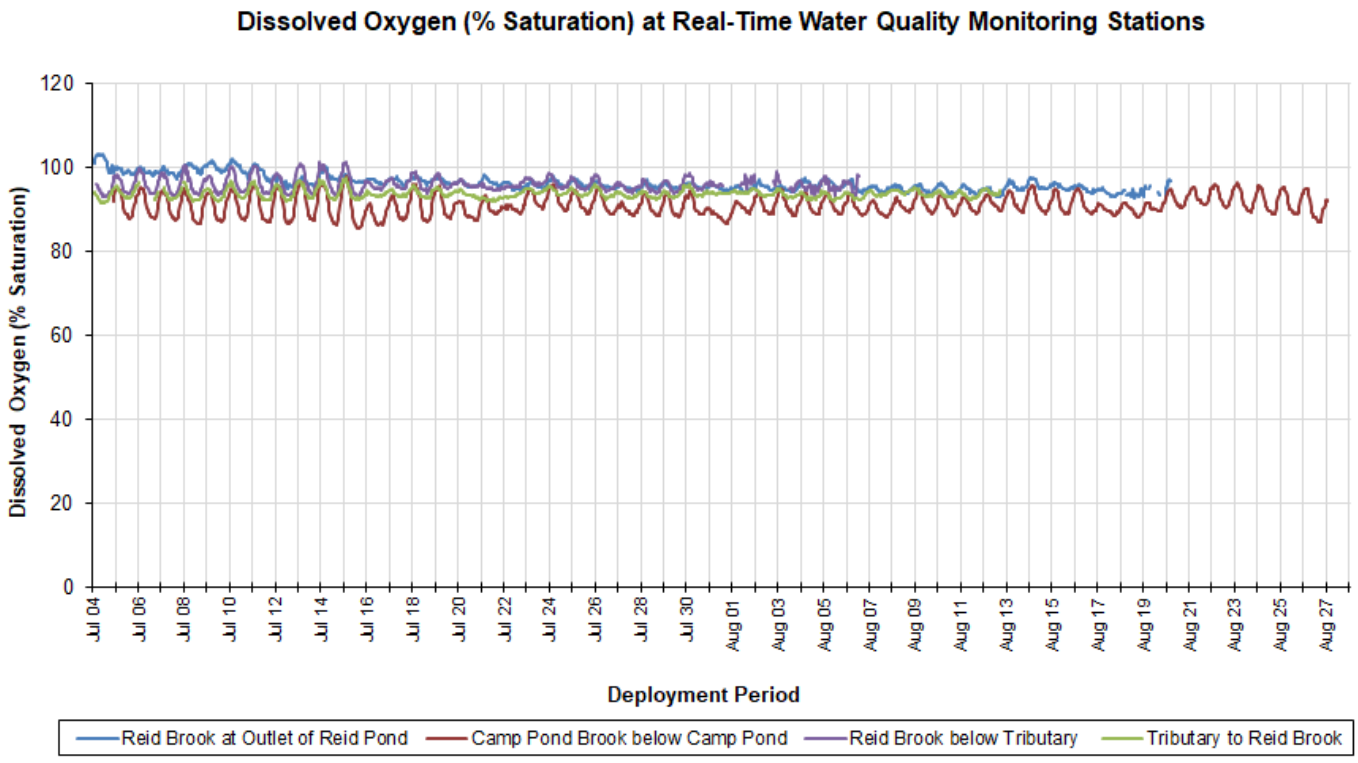

Figure A5: Comparison of Dissolved Oxygen (% Sat) between all Real-Time Stations in Voisey's Bay.

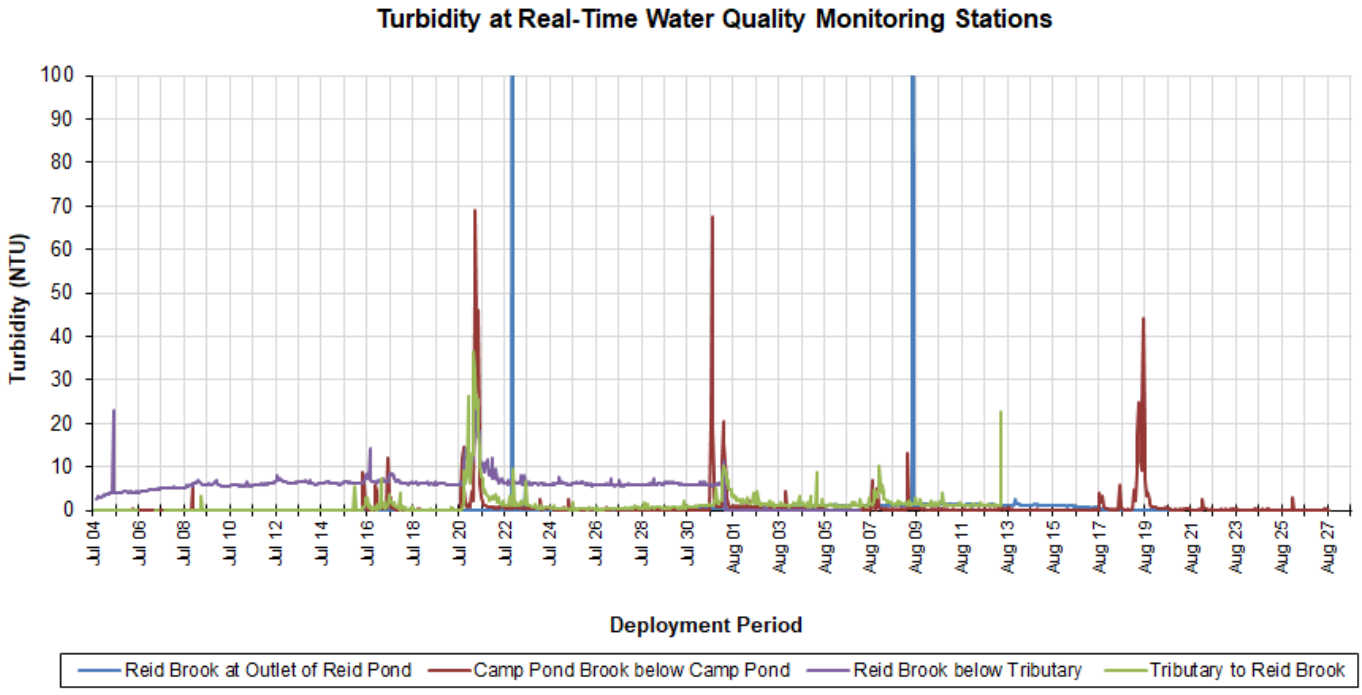

Figure A6: Comparison of Turbidity (NTU) between all Real-Time Stations in Voisey's Bay.

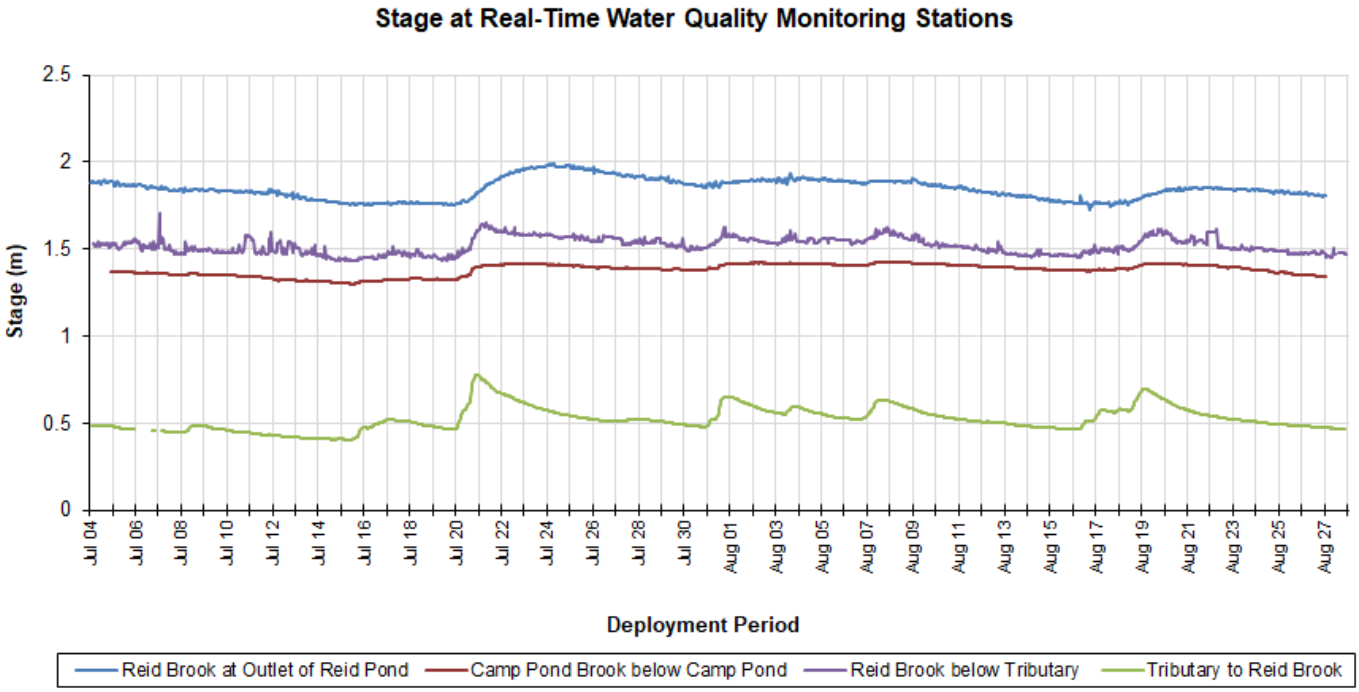

Figure A7: Comparison of Stage (m) between all Real-Time Stations in Voisey's Bay. Please note that stage data is raw data. It has not been corrected for backwater effect. WSC is responsible for QA/QC of water quantity data.

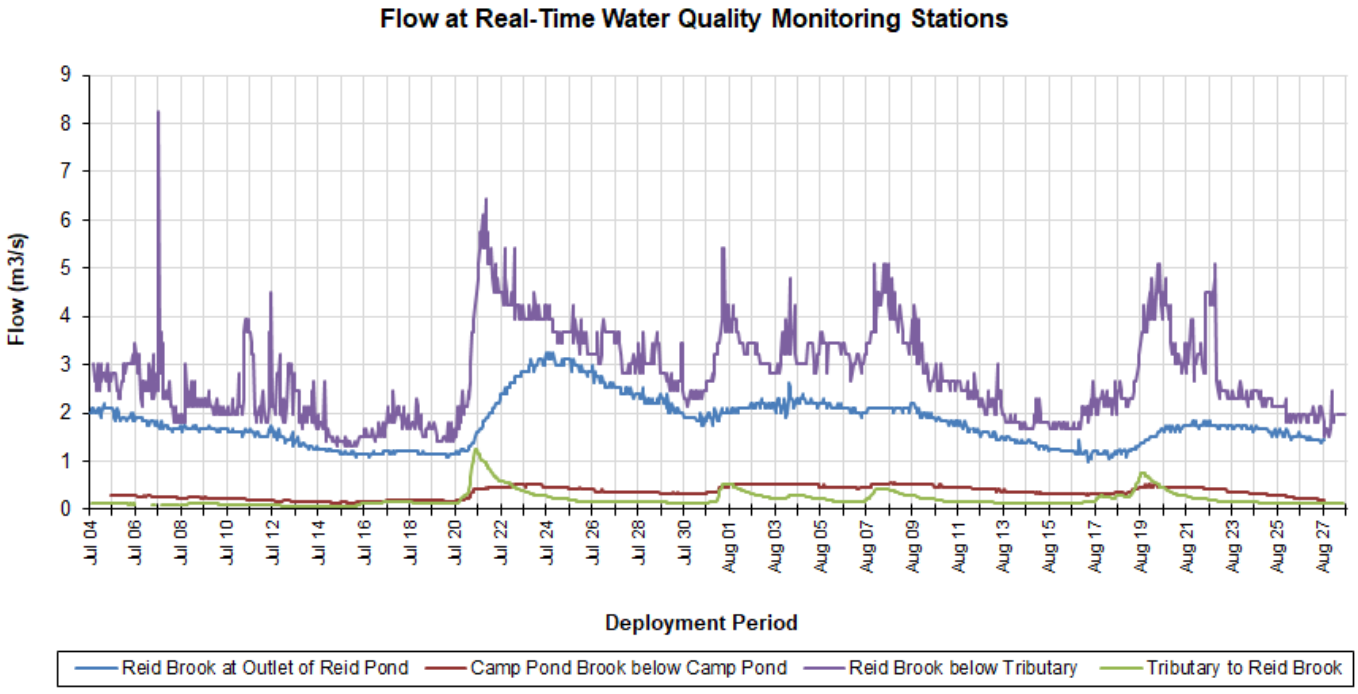

Figure A8: Comparison of Flow (m^3/s) between all Real-Time Stations in Voisey's Bay. Please note that flow data is raw data. It has not been corrected for backwater effect. WSC is responsible for QA/QC of water quantity data.

APPENDIX B: Water Parameter Description

Dissolved Oxygen: The amount of Dissolved Oxygen (DO) (mg/L or % saturation) in the water is vital to the survival of aquatic organisms. The concentration of DO is affected by such things as water temperature, water depth and flow (e.g., aeration by rapids, riffles etc.), consumption by aerobic organisms, consumption by inorganic chemical reactions, consumption by plants during darkness, and production by plants during the daylight (CCME 2014).

Flow: Flow (m3/s) is a measure of how quickly a volume of water is displaced in streams, rivers, and other channels.

pH: pH is the measure of hydrogen ion activity and affects: (i) the availability of nutrients to aquatic life; (ii) the concentration of biochemical substances dissolved in water; (iii) the efficiency of hemoglobin in the blood of vertebrates; and (iv) the toxicity of pollutants. Changes in pH can be attributed to industrial effluence, saline inflows or aquatic organisms involved in the photosynthetic cycling of CO_2 (CCME 2014).

Specific conductivity: Specific conductivity (µS/cm) is a measure of water's ability to conduct electricity, with values normalized to a water temperature of 25°C. Specific conductance indicates the concentration of dissolved solids (such as salts) in the water, which can affect the growth and reproduction of aquatic life. Specific conductivity is affected by rainfall events, the composition of inflowing tributaries and their associated geology, saline inflow (e.g., road salt), agricultural run-off and industrial inputs (Swanson and Baldwin 1965).

Stage: Stage (m) is the elevation of the water surface and is often used as a surrogate for the more difficult to measure flow.

Temperature: Essential to the measurement of most water quality parameters, temperature (°C) controls most processes and dynamics of limnology. Water temperature is influenced by such things as ambient air temperature, solar radiation, meteorological events, industrial effluence, wastewater, inflowing tributaries, as well as water body size and depth (OTT Hydromet 2017).

Total Dissolved Solids: Total Dissolved Solids (TDS) (g/l) is a measure of alkaline salts dissolved in water or in fine suspension and can affect the growth and reproduction of aquatic life. It is affected by rainfall events, the composition of inflowing tributaries and their associated geology, saline inflow (e.g., road salt), agricultural run-off and industrial inputs (CCME 2014; Swanson and Baldwin 1965).

Turbidity: Turbidity (NTU) is a measure of the translucence of water and indicates the amount of suspended material in the water. Turbidity is caused by any substance that makes water cloudy (e.g., soil erosion, micro-organisms, vegetation, chemicals, etc.) and can correspond to precipitation events, high stage, and floating debris near the sensor (Sadar, 2017).

APPENDIX C: Grab Sample Results

Bureau Veritas Job #: C4K8899
Report Date: 2024/07/18

NL Department of Environment, Climate Change and Municipalities
Your P.O. #: 220028978-13
Sampler Initials: BC

Sample Details/Parameters	A	Result	RDL	UNITS	Extracted	Analyzed	By	Batch
ZRG171 REID BROOK AT OUTLET Sampling Date 2024/07/04 13:20 Matrix DR Sample # 2024-6401-00-SI-SP Registration # SA-0000								
RESULTS OF ANALYSES OF DRINKING WATER								
Calculated Parameters								
Hardness (CaCO3)	-	4.6	1.0	mg/L	N/A	2024/07/12		9504926
Nitrate (N)	-	0.057	0.050	mg/L	N/A	2024/07/17		9504929
Total dissolved solids (calc., EC)	-	8.1	1.0	mg/L	N/A	2024/07/16		9505919
Inorganics								
Conductivity	-	15	1.0	uS/cm	N/A	2024/07/15	LJV	9514101
Chloride (Cl-)	-	ND	1.0	mg/L	N/A	2024/07/15	LKH	9512652
Bromide (Br-)	-	ND	1.0	mg/L	N/A	2024/07/15	LKH	9512652
Sulphate (SO4)	-	ND	1.0	mg/L	N/A	2024/07/15	LKH	9512652
Total Alkalinity (Total as CaCO3)	-	5.0	2.0	mg/L	N/A	2024/07/15	LJV	9514102
Colour	-	6.5	5.0	TCU	N/A	2024/07/16	EMT	9514299
Dissolved Fluoride (F-)	-	ND	0.10	mg/L	N/A	2024/07/15	LJV	9514100
Total Kjeldahl Nitrogen (TKN)	-	0.10	0.10	mg/L	2024/07/17	2024/07/18	RTY	9520074
Nitrate + Nitrite (N)	-	0.057	0.050	mg/L	N/A	2024/07/16	EMT	9514301
Nitrite (N)	-	ND	0.010	mg/L	N/A	2024/07/16	EMT	9514302
Nitrogen (Ammonia Nitrogen)	-	ND	0.050	mg/L	N/A	2024/07/11	MCN	9507877
Dissolved Organic Carbon (C)	-	2.1	0.50	mg/L	N/A	2024/07/12	MKY	9511105
Total Organic Carbon (C)	-	2.0	0.50	mg/L	N/A	2024/07/11	MKY	9507981
pH	-	6.78		pH	N/A	2024/07/15	LJV	9514099
Total Phosphorus	-	ND	0.004	mg/L	2024/07/17	2024/07/17	SPC	9519537
Total Suspended Solids	-	ND	1.0	mg/L	2024/07/11	2024/07/16	DME	9507819
Turbidity	-	0.66	0.10	NTU	N/A	2024/07/16	LJV	9516517
MERCURY BY COLD VAPOUR AA (DRINKING WATER)								
Metals								
Total Mercury (Hg)	-	ND	0.000013	mg/L	2024/07/12	2024/07/15	JEP	9510752
Dup.Total Mercury (Hg)	-	ND	0.000013	mg/L	2024/07/12	2024/07/15	JEP	9510752
ELEMENTS BY ICP/MS (DRINKING WATER)								
Metals								
Total Aluminum (Al)	-	0.042	0.0050	mg/L	2024/07/11	2024/07/11	MTZ	9507631
Total Antimony (Sb)	-	ND	0.0010	mg/L	2024/07/11	2024/07/11	MTZ	9507631
Total Arsenic (As)	-	ND	0.0010	mg/L	2024/07/11	2024/07/11	MTZ	9507631
Total Barium (Ba)	-	0.0022	0.0010	mg/L	2024/07/11	2024/07/11	MTZ	9507631
Total Boron (B)	-	ND	0.050	mg/L	2024/07/11	2024/07/11	MTZ	9507631
Total Cadmium (Cd)	-	ND	0.000010	mg/L	2024/07/11	2024/07/11	MTZ	9507631
Total Calcium (Ca)	-	1.4	0.10	mg/L	2024/07/11	2024/07/11	MTZ	9507631
Total Chromium (Cr)	-	ND	0.0010	mg/L	2024/07/11	2024/07/11	MTZ	9507631
Total Copper (Cu)	-	ND	0.00050	mg/L	2024/07/11	2024/07/11	MTZ	9507631
Total Iron (Fe)	-	ND	0.050	mg/L	2024/07/11	2024/07/11	MTZ	9507631
Total Lead (Pb)	-	ND	0.00050	mg/L	2024/07/11	2024/07/11	MTZ	9507631

Bureau Veritas 200 Bluewater Rd, Suite 105, Bedford, Nova Scotia Canada B4B 1G9 Tel: 902-420-0203 Toll-free: 800-565-7227 Fax: 902-420-8612 www.bvna.com

Bureau Veritas Job #: C4K8899
Report Date: 2024/07/18

NL Department of Environment, Climate Change and Municipalities
Your P.O. #: 220028978-13
Sampler Initials: BC

Sample Details/Parameters	A	Result	RDL	UNITS	Extracted	Analyzed	By	Batch
ZRG171 REID BROOK AT OUTLET Sampling Date 2024/07/04 13:20 Matrix DR Sample # 2024-6401-00-SI-SP Registration # SA-0000								
ELEMENTS BY ICP/MS (DRINKING WATER)								
Metals								
Total Magnesium (Mg)	-	0.27	0.10	mg/L	2024/07/11	2024/07/11	MTZ	9507631
Total Manganese (Mn)	-	ND	0.0020	mg/L	2024/07/11	2024/07/11	MTZ	9507631
Total Nickel (Ni)	-	ND	0.0020	mg/L	2024/07/11	2024/07/11	MTZ	9507631
Total Phosphorus (P)	-	ND	0.10	mg/L	2024/07/11	2024/07/11	MTZ	9507631
Total Potassium (K)	-	ND	0.10	mg/L	2024/07/11	2024/07/11	MTZ	9507631
Total Selenium (Se)	-	ND	0.00050	mg/L	2024/07/11	2024/07/11	MTZ	9507631
Total Sodium (Na)	-	0.81	0.10	mg/L	2024/07/11	2024/07/11	MTZ	9507631
Total Strontium (Sr)	-	0.0051	0.0020	mg/L	2024/07/11	2024/07/11	MTZ	9507631
Total Uranium (U)	-	ND	0.00010	mg/L	2024/07/11	2024/07/11	MTZ	9507631
Total Zinc (Zn)	-	ND	0.0050	mg/L	2024/07/11	2024/07/11	MTZ	9507631

Bureau Veritas 200 Bluewater Rd, Suite 105, Bedford, Nova Scotia Canada B4B 1G9 Tel: 902-420-0203 Toll-free: 800-565-7227 Fax: 902-420-8612 www.bvna.com

Sample Details/Parameters	A	Result	RDL	UNITS	Extracted	Analyzed	By	Batch
ZRG170 CAMP POND BROOK Sampling Date 2024/07/05 09:40 Matrix DR Sample # 2024-6400-00-SI-SP Registration # SA-0000								
RESULTS OF ANALYSES OF DRINKING WATER								
Calculated Parameters								
Hardness (CaCO3)	-	15	1.0	mg/L	N/A	2024/07/12		9504926
Nitrate (N)	-	ND	0.050	mg/L	N/A	2024/07/17		9504929
Total dissolved solids (calc., EC)	-	26	1.0	mg/L	N/A	2024/07/16		9505919
Inorganics								
Conductivity	-	47	1.0	uS/cm	N/A	2024/07/15	LJV	9514095
Chloride (Cl-)	-	4.0	1.0	mg/L	N/A	2024/07/15	LKH	9513746
Bromide (Br-)	-	ND	1.0	mg/L	N/A	2024/07/15	LKH	9513746
Sulphate (SO4)	-	17	1.0	mg/L	N/A	2024/07/15	LKH	9513746
Total Alkalinity (Total as CaCO3)	-	9.9	2.0	mg/L	N/A	2024/07/15	LJV	9514097
Colour	-	18	5.0	TCU	N/A	2024/07/16	EMT	9514299
Dissolved Fluoride (F-)	-	ND	0.10	mg/L	N/A	2024/07/15	LJV	9514098
Total Kjeldahl Nitrogen (TKN)	-	0.13	0.10	mg/L	2024/07/17	2024/07/18	RTY	9520074
Nitrate + Nitrite (N)	-	ND	0.050	mg/L	N/A	2024/07/16	EMT	9514301
Nitrite (N)	-	ND	0.010	mg/L	N/A	2024/07/16	EMT	9514302
Nitrogen (Ammonia Nitrogen)	-	ND	0.050	mg/L	N/A	2024/07/11	MCN	9507879
Dissolved Organic Carbon (C)	-	3.6	0.50	mg/L	N/A	2024/07/13	MKY	9511125
Total Organic Carbon (C)	-	3.6	0.50	mg/L	N/A	2024/07/11	MKY	9507985
Dup.Total Organic Carbon (C)	-	3.6	0.50	mg/L	N/A	2024/07/11	MKY	9507985
pH	-	7.12		pH	N/A	2024/07/15	LJV	9514094
Total Phosphorus	-	0.007	0.004	mg/L	2024/07/17	2024/07/17	SPC	9519537
Total Suspended Solids	-	ND	1.0	mg/L	2024/07/11	2024/07/16	DME	9507819
Turbidity	-	0.63	0.10	NTU	N/A	2024/07/16	LJV	9516518
MERCURY BY COLD VAPOUR AA (DRINKING WATER)								
Metals								
Total Mercury (Hg)	-	ND	0.000013	mg/L	2024/07/12	2024/07/15	JEP	9510723
ELEMENTS BY ICP/MS (DRINKING WATER)								
Metals								
Total Aluminum (Al)	-	0.055	0.0050	mg/L	2024/07/11	2024/07/11	MTZ	9507703
Total Antimony (Sb)	-	ND	0.0010	mg/L	2024/07/11	2024/07/11	MTZ	9507703
Total Arsenic (As)	-	ND	0.0010	mg/L	2024/07/11	2024/07/11	MTZ	9507703
Total Barium (Ba)	-	0.0070	0.0010	mg/L	2024/07/11	2024/07/11	MTZ	9507703
Total Boron (B)	-	ND	0.050	mg/L	2024/07/11	2024/07/11	MTZ	9507703
Total Cadmium (Cd)	-	0.000013	0.000010	mg/L	2024/07/11	2024/07/11	MTZ	9507703
Total Calcium (Ca)	-	4.2	0.10	mg/L	2024/07/11	2024/07/11	MTZ	9507703
Total Chromium (Cr)	-	0.0012	0.0010	mg/L	2024/07/11	2024/07/11	MTZ	9507703
Total Copper (Cu)	-	0.0031	0.00050	mg/L	2024/07/11	2024/07/11	MTZ	9507703
Total Iron (Fe)	-	0.23	0.050	mg/L	2024/07/11	2024/07/11	MTZ	9507703
Total Lead (Pb)	-	ND	0.00050	mg/L	2024/07/11	2024/07/11	MTZ	9507703

Bureau Veritas 200 Bluewater Rd, Suite 105, Bedford, Nova Scotia Canada B4B 1G9 Tel: 902-420-0203 Toll-free: 800-565-7227 Fax: 902-420-8612 www.bvna.com

Bureau Veritas Job #: C4K8899
Report Date: 2024/07/18

NL Department of Environment, Climate Change and Municipalities
Your P.O. #: 220028978-13
Sampler Initials: BC

Sample Details/Parameters	A	Result	RDL	UNITS	Extracted	Analyzed	By	Batch
ZRG170 CAMP POND BROOK Sampling Date 2024/07/05 09:40 Matrix DR Sample # 2024-6400-00-SI-SP Registration # SA-0000								
ELEMENTS BY ICP/MS (DRINKING WATER)								
Metals								
Total Magnesium (Mg)	-	1.2	0.10	mg/L	2024/07/11	2024/07/11	MTZ	9507703
Total Manganese (Mn)	-	0.016	0.0020	mg/L	2024/07/11	2024/07/11	MTZ	9507703
Total Nickel (Ni)	-	0.017	0.0020	mg/L	2024/07/11	2024/07/11	MTZ	9507703
Total Phosphorus (P)	-	ND	0.10	mg/L	2024/07/11	2024/07/11	MTZ	9507703
Total Potassium (K)	-	0.65	0.10	mg/L	2024/07/11	2024/07/11	MTZ	9507703
Total Selenium (Se)	-	ND	0.00050	mg/L	2024/07/11	2024/07/11	MTZ	9507703
Total Sodium (Na)	-	2.5	0.10	mg/L	2024/07/11	2024/07/11	MTZ	9507703
Total Strontium (Sr)	-	0.023	0.0020	mg/L	2024/07/11	2024/07/11	MTZ	9507703
Total Uranium (U)	-	ND	0.00010	mg/L	2024/07/11	2024/07/11	MTZ	9507703
Total Zinc (Zn)	-	ND	0.0050	mg/L	2024/07/11	2024/07/11	MTZ	9507703

Bureau Veritas 200 Bluewater Rd, Suite 105, Bedford, Nova Scotia Canada B4B 1G9 Tel: 902-420-0203 Toll-free: 800-565-7227 Fax: 902-420-8612 www.bvna.com

Sample Details/Parameters	A	Result	RDL	UNITS	Extracted	Analyzed	By	Batch
ZRG172 REID BROOK BELOW TRIBUTARY Sampling Date 2024/07/04 15:33 Matrix DR Sample # 2024-6402-00-SI-SP Registration # SA-0000								
RESULTS OF ANALYSES OF DRINKING WATER								
Calculated Parameters								
Hardness (CaCO3)	-	12	1.0	mg/L	N/A	2024/07/12		9504926
Nitrate (N)	-	ND	0.050	mg/L	N/A	2024/07/17		9504929
Total dissolved solids (calc., EC)	-	24	1.0	mg/L	N/A	2024/07/16		9505919
Inorganics								
Conductivity	-	43	1.0	uS/cm	N/A	2024/07/15	LJV	9514101
Chloride (Cl-)	-	3.6	1.0	mg/L	N/A	2024/07/15	LKH	9512652
Bromide (Br-)	-	ND	1.0	mg/L	N/A	2024/07/15	LKH	9512652
Sulphate (SO4)	-	3.0	1.0	mg/L	N/A	2024/07/15	LKH	9512652
Total Alkalinity (Total as CaCO3)	-	8.7	2.0	mg/L	N/A	2024/07/15	LJV	9514102
Colour	-	27	5.0	TCU	N/A	2024/07/16	EMT	9514299
Dissolved Fluoride (F-)	-	ND	0.10	mg/L	N/A	2024/07/15	LJV	9514100
Total Kjeldahl Nitrogen (TKN)	-	0.10	0.10	mg/L	2024/07/16	2024/07/17	RTY	9518168
Nitrate + Nitrite (N)	-	ND	0.050	mg/L	N/A	2024/07/16	EMT	9514301
Nitrite (N)	-	ND	0.010	mg/L	N/A	2024/07/16	EMT	9514302
Nitrogen (Ammonia Nitrogen)	-	ND	0.050	mg/L	N/A	2024/07/11	MCN	9507879
Dissolved Organic Carbon (C)	-	3.6	0.50	mg/L	N/A	2024/07/15	MKY	9514151
Total Organic Carbon (C)	-	3.6	0.50	mg/L	N/A	2024/07/11	MKY	9507981
pH	-	6.96		pH	N/A	2024/07/15	LJV	9514099
Total Phosphorus	-	ND	0.004	mg/L	2024/07/17	2024/07/17	SPC	9519537
Total Suspended Solids	-	ND	1.0	mg/L	2024/07/11	2024/07/16	DME	9507819
Turbidity	-	1.2	0.10	NTU	N/A	2024/07/16	LJV	9516517
MERCURY BY COLD VAPOUR AA (DRINKING WATER)								
Metals								
Total Mercury (Hg)	-	ND	0.000013	mg/L	2024/07/12	2024/07/15	JEP	9510752
ELEMENTS BY ICP/MS (DRINKING WATER)								
Metals								
Total Aluminum (Al)	-	0.060	0.0050	mg/L	2024/07/11	2024/07/11	MTZ	9507703
Total Antimony (Sb)	-	ND	0.0010	mg/L	2024/07/11	2024/07/11	MTZ	9507703
Total Arsenic (As)	-	ND	0.0010	mg/L	2024/07/11	2024/07/11	MTZ	9507703
Total Barium (Ba)	-	0.0059	0.0010	mg/L	2024/07/11	2024/07/11	MTZ	9507703
Total Boron (B)	-	ND	0.050	mg/L	2024/07/11	2024/07/11	MTZ	9507703
Total Cadmium (Cd)	-	0.000012	0.000010	mg/L	2024/07/11	2024/07/11	MTZ	9507703
Total Calcium (Ca)	-	3.4	0.10	mg/L	2024/07/11	2024/07/11	MTZ	9507703
Total Chromium (Cr)	-	ND	0.0010	mg/L	2024/07/11	2024/07/11	MTZ	9507703
Total Copper (Cu)	-	0.00087	0.00050	mg/L	2024/07/11	2024/07/11	MTZ	9507703
Total Iron (Fe)	-	0.27	0.050	mg/L	2024/07/11	2024/07/11	MTZ	9507703
Total Lead (Pb)	-	ND	0.00050	mg/L	2024/07/11	2024/07/11	MTZ	9507703
Total Magnesium (Mg)	-	0.93	0.10	mg/L	2024/07/11	2024/07/11	MTZ	9507703

Bureau Veritas 200 Bluewater Rd, Suite 105, Bedford, Nova Scotia Canada B4B 1G9 Tel: 902-420-0203 Toll-free: 800-565-7227 Fax: 902-420-8612 www.bvna.com

Bureau Veritas Job #: C4K8899
Report Date: 2024/07/18

NL Department of Environment, Climate Change and Municipalities
Your P.O. #: 220028978-13
Sampler Initials: BC

Sample Details/Parameters	A	Result	RDL	UNITS	Extracted	Analyzed	By	Batch
ZRG172 REID BROOK BELOW TRIBUTARY Sampling Date 2024/07/04 15:33 Matrix DR Sample # 2024-6402-00-SI-SP Registration # SA-0000								
ELEMENTS BY ICP/MS (DRINKING WATER)								
Metals								
Total Manganese (Mn)	-	0.0062	0.0020	mg/L	2024/07/11	2024/07/11	MTZ	9507703
Total Nickel (Ni)	-	0.0070	0.0020	mg/L	2024/07/11	2024/07/11	MTZ	9507703
Total Phosphorus (P)	-	ND	0.10	mg/L	2024/07/11	2024/07/11	MTZ	9507703
Total Potassium (K)	-	0.38	0.10	mg/L	2024/07/11	2024/07/11	MTZ	9507703
Total Selenium (Se)	-	ND	0.00050	mg/L	2024/07/11	2024/07/11	MTZ	9507703
Total Sodium (Na)	-	2.4	0.10	mg/L	2024/07/11	2024/07/11	MTZ	9507703
Total Strontium (Sr)	-	0.021	0.0020	mg/L	2024/07/11	2024/07/11	MTZ	9507703
Total Uranium (U)	-	ND	0.00010	mg/L	2024/07/11	2024/07/11	MTZ	9507703
Total Zinc (Zn)	-	ND	0.0050	mg/L	2024/07/11	2024/07/11	MTZ	9507703

Bureau Veritas 200 Bluewater Rd, Suite 105, Bedford, Nova Scotia Canada B4B 1G9 Tel: 902-420-0203 Toll-free: 800-565-7227 Fax: 902-420-8612 www.bvna.com

Sample Details/Parameters	A	Result	RDL	UNITS	Extracted	Analyzed	By	Batch
ZRG173 TRIBUTARY TO REID BROOK Sampling Date 2024/07/04 15:40 Matrix DR Sample # 2024-6403-00-SI-SP Registration # SA-0000								
RESULTS OF ANALYSES OF DRINKING WATER								
Calculated Parameters								
Hardness (CaCO3)	-	15	1.0	mg/L	N/A	2024/07/12		9504926
Nitrate (N)	-	ND	0.050	mg/L	N/A	2024/07/17		9504929
Total dissolved solids (calc., EC)	-	26	1.0	mg/L	N/A	2024/07/16		9505919
Inorganics								
Conductivity	-	47	1.0	uS/cm	N/A	2024/07/15	LJV	9514101
Chloride (Cl-)	-	3.7	1.0	mg/L	N/A	2024/07/15	LKH	9513746
Bromide (Br-)	-	ND	1.0	mg/L	N/A	2024/07/15	LKH	9513746
Sulphate (SO4)	-	2.9	1.0	mg/L	N/A	2024/07/15	LKH	9513746
Total Alkalinity (Total as CaCO3)	-	9.1	2.0	mg/L	N/A	2024/07/15	LJV	9514102
Colour	-	32	5.0	TCU	N/A	2024/07/16	EMT	9514299
Dissolved Fluoride (F-)	-	ND	0.10	mg/L	N/A	2024/07/15	LJV	9514100
Total Kjeldahl Nitrogen (TKN)	-	0.11	0.10	mg/L	2024/07/16	2024/07/17	RTY	9518168
Nitrate + Nitrite (N)	-	ND	0.050	mg/L	N/A	2024/07/16	EMT	9514301
Nitrite (N)	-	ND	0.010	mg/L	N/A	2024/07/16	EMT	9514302
Nitrogen (Ammonia Nitrogen)	-	ND	0.050	mg/L	N/A	2024/07/11	MCN	9507879
Dup.Nitrogen (Ammonia Nitrogen)	-	ND	0.050	mg/L	N/A	2024/07/11	MCN	9507879
Dissolved Organic Carbon (C)	-	4.2	0.50	mg/L	N/A	2024/07/15	MKY	9514151
Total Organic Carbon (C)	-	3.7	0.50	mg/L	N/A	2024/07/11	MKY	9507985
pH	-	7.07		pH	N/A	2024/07/15	LJV	9514099
Total Phosphorus	-	0.007	0.004	mg/L	2024/07/17	2024/07/17	SPC	9519537
Total Suspended Solids	-	2.6	1.0	mg/L	2024/07/11	2024/07/16	DME	9507819
Turbidity	-	1.2	0.10	NTU	N/A	2024/07/16	LJV	9516526
MERCURY BY COLD VAPOUR AA (DRINKING WATER)								
Metals								
Total Mercury (Hg)	-	ND	0.000013	mg/L	2024/07/12	2024/07/15	JEP	9510752
ELEMENTS BY ICP/MS (DRINKING WATER)								
Metals								
Total Aluminum (Al)	-	0.072	0.0050	mg/L	2024/07/11	2024/07/11	MTZ	9507703
Total Antimony (Sb)	-	ND	0.0010	mg/L	2024/07/11	2024/07/11	MTZ	9507703
Total Arsenic (As)	-	ND	0.0010	mg/L	2024/07/11	2024/07/11	MTZ	9507703
Total Barium (Ba)	-	0.0072	0.0010	mg/L	2024/07/11	2024/07/11	MTZ	9507703
Total Boron (B)	-	ND	0.050	mg/L	2024/07/11	2024/07/11	MTZ	9507703
Total Cadmium (Cd)	-	0.000014	0.000010	mg/L	2024/07/11	2024/07/11	MTZ	9507703
Total Calcium (Ca)	-	4.0	0.10	mg/L	2024/07/11	2024/07/11	MTZ	9507703
Total Chromium (Cr)	-	ND	0.0010	mg/L	2024/07/11	2024/07/11	MTZ	9507703
Total Copper (Cu)	-	0.0011	0.00050	mg/L	2024/07/11	2024/07/11	MTZ	9507703
Total Iron (Fe)	-	0.34	0.050	mg/L	2024/07/11	2024/07/11	MTZ	9507703
Total Lead (Pb)	-	ND	0.00050	mg/L	2024/07/11	2024/07/11	MTZ	9507703

Bureau Veritas 200 Bluewater Rd, Suite 105, Bedford, Nova Scotia Canada B4B 1G9 Tel: 902-420-0203 Toll-free: 800-565-7227 Fax: 902-420-8612 www.bvna.com

Bureau Veritas Job #: C4K8899
Report Date: 2024/07/18

NL Department of Environment, Climate Change and Municipalities
Your P.O. #: 220028978-13
Sampler Initials: BC

Sample Details/Parameters	A	Result	RDL	UNITS	Extracted	Analyzed	By	Batch
ZRG173 TRIBUTARY TO REID BROOK Sampling Date 2024/07/04 15:40 Matrix DR Sample # 2024-6403-00-SI-SP Registration # SA-0000								
ELEMENTS BY ICP/MS (DRINKING WATER)								
Metals								
Total Magnesium (Mg)	-	1.1	0.10	mg/L	2024/07/11	2024/07/11	MTZ	9507703
Total Manganese (Mn)	-	0.0069	0.0020	mg/L	2024/07/11	2024/07/11	MTZ	9507703
Total Nickel (Ni)	-	0.0094	0.0020	mg/L	2024/07/11	2024/07/11	MTZ	9507703
Total Phosphorus (P)	-	ND	0.10	mg/L	2024/07/11	2024/07/11	MTZ	9507703
Total Potassium (K)	-	0.41	0.10	mg/L	2024/07/11	2024/07/11	MTZ	9507703
Total Selenium (Se)	-	ND	0.00050	mg/L	2024/07/11	2024/07/11	MTZ	9507703
Total Sodium (Na)	-	2.8	0.10	mg/L	2024/07/11	2024/07/11	MTZ	9507703
Total Strontium (Sr)	-	0.025	0.0020	mg/L	2024/07/11	2024/07/11	MTZ	9507703
Total Uranium (U)	-	ND	0.00010	mg/L	2024/07/11	2024/07/11	MTZ	9507703
Total Zinc (Zn)	-	ND	0.0050	mg/L	2024/07/11	2024/07/11	MTZ	9507703

Bureau Veritas 200 Bluewater Rd, Suite 105, Bedford, Nova Scotia Canada B4B 1G9 Tel: 902-420-0203 Toll-free: 800-565-7227 Fax: 902-420-8612 www.bvna.com