



Real-Time Water Quality Deployment Report

Lower Churchill River Network

July 6/7/19 to
August 25/26, 2022



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

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Real Time Water Quality Monitoring

- Staff with the Department of Environment and Climate Change monitor real-time water quality data on a regular basis.
- This deployment report discusses water quality related events occurring at four stations on the Lower Churchill River: Churchill River below Metchin River, Churchill River above Grizzle Rapids, Churchill River below Muskrat Falls and Churchill River at English Point.
- Real-time water quality monitoring instruments were deployed at Churchill River above Grizzle Rapids and Churchill River below Muskrat Falls on July 6th. An instrument was deployed at Churchill River at English Point on July 7th, and an instrument was deployed at Churchill River below Metchin River on July 19th.
- Instruments at Churchill River below Muskrat Falls and Churchill River at English Point were removed on August 25th for deployment periods of 50 and 49 days, respectively. The instruments at Churchill River below Metchin River and Churchill River above Grizzle Rapids were removed on August 26th for deployment periods of 38 and 51 days, respectively.

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 alongside 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 on the data quality (Table 1).

Table 1: Instrument Performance Ranking classifications for deployment and removal

Parameter	Rank				
	Excellent	Good	Fair	Marginal	Poor
Temperature (C)	<=+/-0.2	>+/-0.2 to 0.5	>+/-0.5 to 0.8	>+/-0.8 to 1	<+/-1
pH (unit)	<=+/-0.2	>+/-0.2 to 0.5	>+/-0.5 to 0.8	>+/-0.8 to 1	>+/-1
Sp. Conductance (µS/cm)	<=+/-3	>+/-3 to 10	>+/-10 to 15	>+/-15 to 20	>+/-20
Sp. Conductance > 35µS/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 Lower Churchill River stations deployed from July 6/7/19 to August 25/26, 2022 are summarized in Table 2.

Table 2: Comparison rankings for Lower Churchill River stations July 6/7/19 to August 25/26, 2022

Churchill River Station	Date	Action	Comparison Ranking				
			Temperature	pH	Conductivity	Dissolved Oxygen	Turbidity
Below Metchin River	July 19, 2022	Deployment	Excellent	Excellent	Excellent	Excellent	Poor
	August 26, 2022	Removal	Excellent	Marginal	Poor	Excellent	Poor
Above Grizzle Rapids	July 6, 2022	Deployment	Excellent	Good	Excellent	Fair	Excellent
	August 26, 2022	Removal	Excellent	Excellent	Excellent	Good	Poor
Below Muskrat Falls	July 6, 2022	Deployment	Good	Excellent	Excellent	Good	Excellent
	August 25, 2022	Removal	Good	Excellent	Excellent	Good	Excellent
At English Point	July 7, 2022	Deployment	Excellent	Excellent	Excellent	Good	Excellent
	August 25, 2022	Removal	Good	Excellent	Excellent	Good	Poor

- Churchill River below Metchin River**

- At deployment, all parameters ranked as ‘excellent’ with the exception of turbidity, which ranked as ‘poor’. This discrepancy may be due to the field sonde not being given sufficient time to acclimate; this is supported by a better ranking between the QA/QC sonde and the grab sample.
- At removal, temperature and dissolved oxygen were ‘excellent’, pH was ‘marginal’, while conductivity and turbidity were ‘poor’. These discrepancies are likely due to the instrument being located in very little water at the time of removal, with significant sediment build-up around the sensors.

- Churchill River above Grizzle Rapids**

- At deployment, all parameters ranked as either ‘excellent’ or ‘good’ with the exception of dissolved oxygen, which ranked as ‘fair’.
- At removal, all parameters ranked as either ‘excellent’ or ‘good’ with the exception of turbidity, which ranked as ‘poor’. This discrepancy may have been due to sediment build-up around the turbidity sensor.

- **Churchill River below Muskrat Falls**
 - At deployment, all parameters ranked as either 'excellent' or 'good'.
 - At removal, all parameters again ranked as either 'excellent' or 'good'.

- **Churchill River at English Point**
 - At deployment, all parameters ranked as either 'excellent' or 'good'.
 - At removal, all parameters ranked as either 'excellent' or 'good' with the exception of turbidity, which ranked as 'poor'. This discrepancy may have been due to sediment build-up around the turbidity sensor.

Data Interpretation

- The following graphs and discussion illustrate water quality related events occurring from July 6/7/19 to August 25/26, 2022 on the Lower Churchill River Network.
- With the exception of water quantity data (stage & 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.

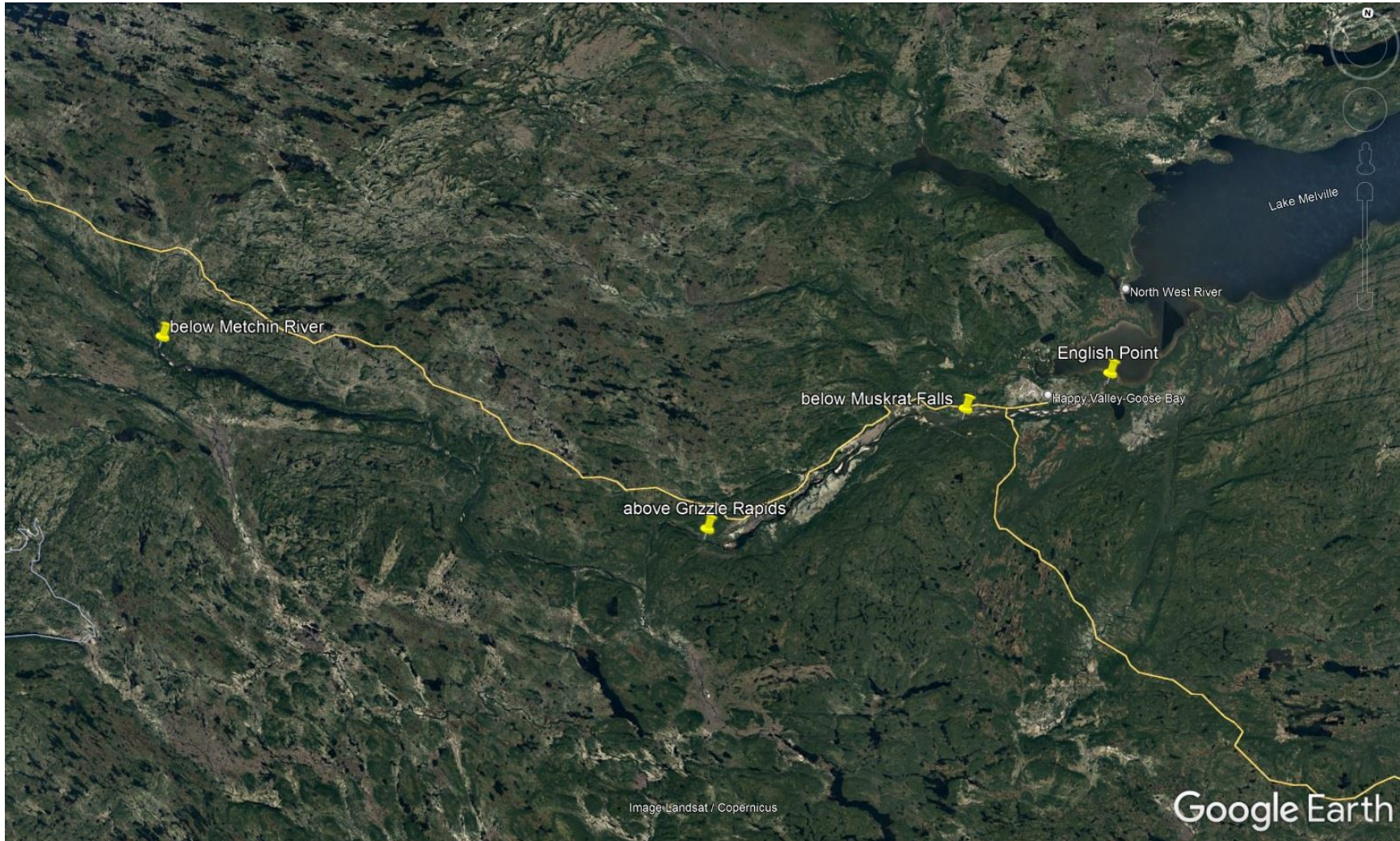


Figure 1: Lower Churchill Network of Real-Time Water Quality Stations

Churchill River below Metchin River

Water Temperature

- Over the deployment period, water temperature ranged from 12.2°C to 22.3°C, with a median value of 16.1°C (Figure 2). Air temperature data was obtained from the Metchin River near TLH Weather Station.
- Water temperature was slightly increasing over the course of deployment, which is to be expected as air temperatures were also slowly increasing across the summer season. Water temperature data exhibits a diurnal pattern as expected, and closely correlates with ambient air temperatures.
- Greater fluctuations in water temperature towards the end of the deployment period can be attributed to the instrument being located in very little water due to decreasing stage levels.
- Water Survey of Canada (Environment and Climate Change Canada) is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.

Churchill River below Metchin River: Water and Air Temperature & Stage

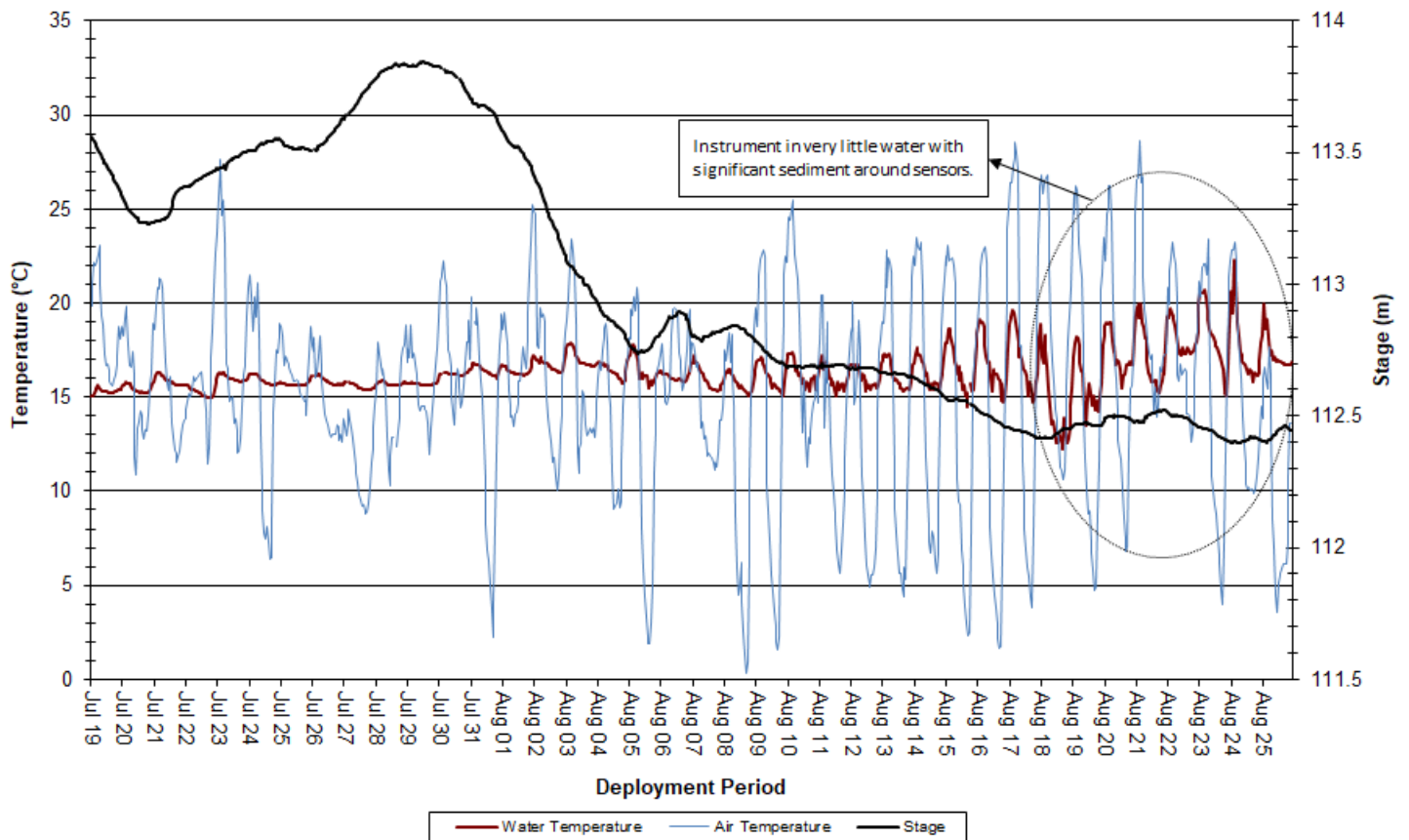


Figure 2: Water and Air Temperature & Stage at Churchill River below Metchin River

pH

- Over the deployment period, pH values ranged from 3.17 to 6.97 pH units, with a median value of 4.96 (Figure 3).
- pH values were quite low over the course of deployment, remaining below the CCME's Guidelines for the Protection of Aquatic Life for the duration of deployment. Decreases in pH correlated with increases in stage, and greater fluctuations towards the end of the deployment period can be attributed to the instrument being located in very little water with sediment build-up around the sensors.
- Photosynthesis uses up hydrogen molecules; this causes the concentration of hydrogen ions to decrease, which in turn causes pH to increase. For this reason, pH may be higher during daylight hours and during the growing season when photosynthesis is at a maximum. This is illustrated by the diurnal fluctuations in pH values (Figure 3).
- Water Survey of Canada (Environment and Climate Change Canada) is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.

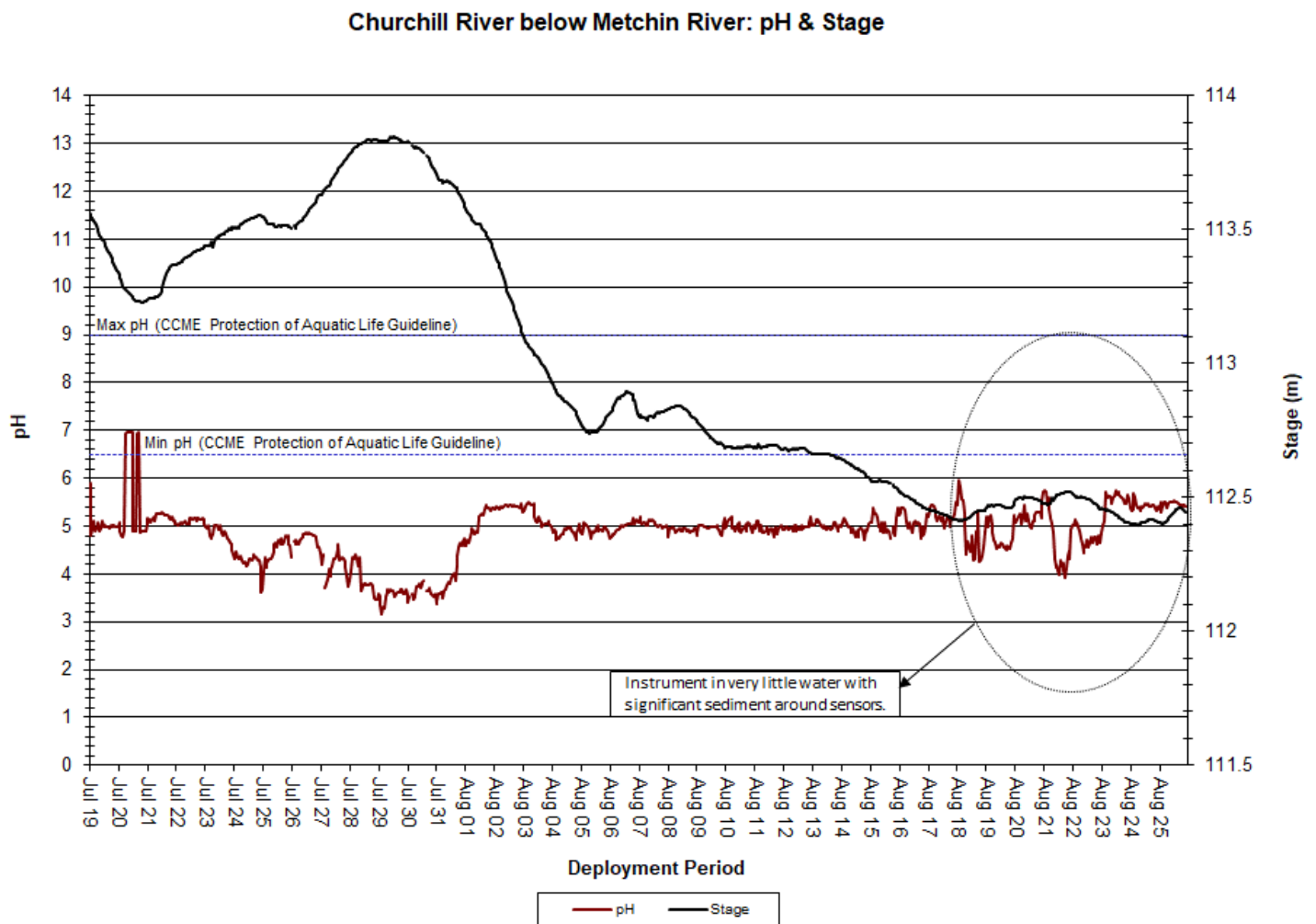


Figure 3: pH & Stage at Churchill River below Metchin River

Specific Conductivity

- Over the deployment period, specific conductivity ranged from 10.5 μ S/cm to 62.7 μ S/cm, with a median value of 20.9 μ S/cm (Figure 4).
- The relationship between conductivity and stage is generally inverted. When stage levels increase, specific conductivity levels decrease as the increased amount of water in the river system dilutes solids that are present. This relationship is somewhat evident in the graph below (Figure 4).
- Increases and large fluctuations in conductivity towards the end of the deployment period can be attributed to the instrument being located in very little water due to decreasing stage levels.
- Water Survey of Canada (Environment and Climate Change Canada) is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.

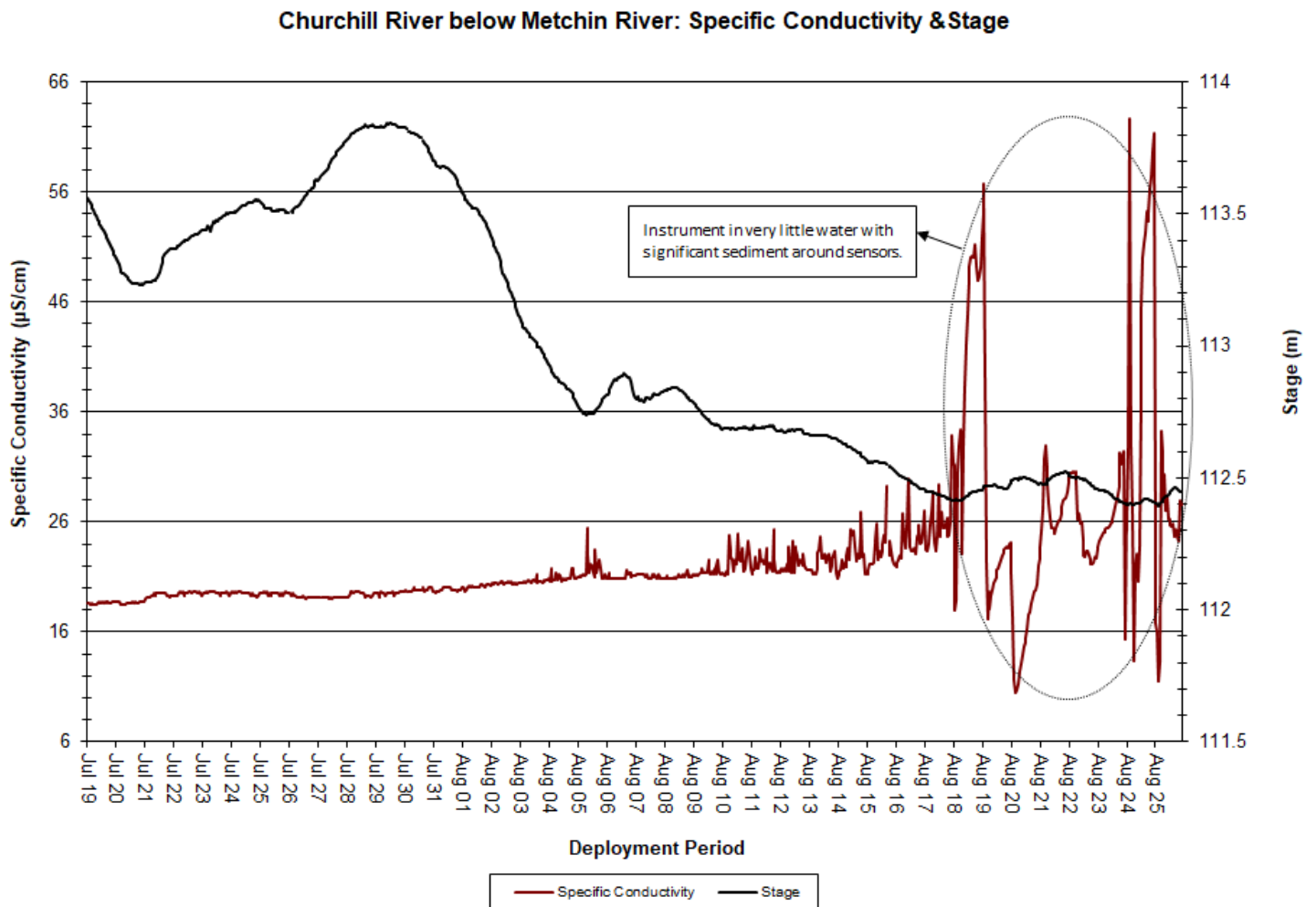


Figure 4: Specific Conductivity & Stage at Churchill River below Metchin River

Dissolved Oxygen

- Over the deployment period, dissolved oxygen content ranged from 0mg/L to 10.11mg/L, with a median value of 9.31mg/L. Saturation of dissolved oxygen ranged from 0% to 105.6%, with a median value of 94.4% (Figure 5).
- There is an evident relationship between water temperature and dissolved oxygen. Over the deployment period, dissolved oxygen levels were slowly decreasing as water temperatures were slowly increasing. Dissolved oxygen also follows a diurnal pattern as water temperatures rise and fall under the influence of ambient air temperatures. Generally, dissolved oxygen levels are higher in a waterbody during cooler temperatures.
- Dissolved oxygen levels were below the CCME's Guideline for the Protection of Early Life Stages for the majority of deployment, which is to be expected. Dissolved oxygen levels remained above the CCME's Guideline for the Protection of Other Life Stages for the majority of deployment.
- Large fluctuations in dissolved oxygen towards the end of the deployment period can be attributed to the instrument being located in very little water due to decreasing stage levels.

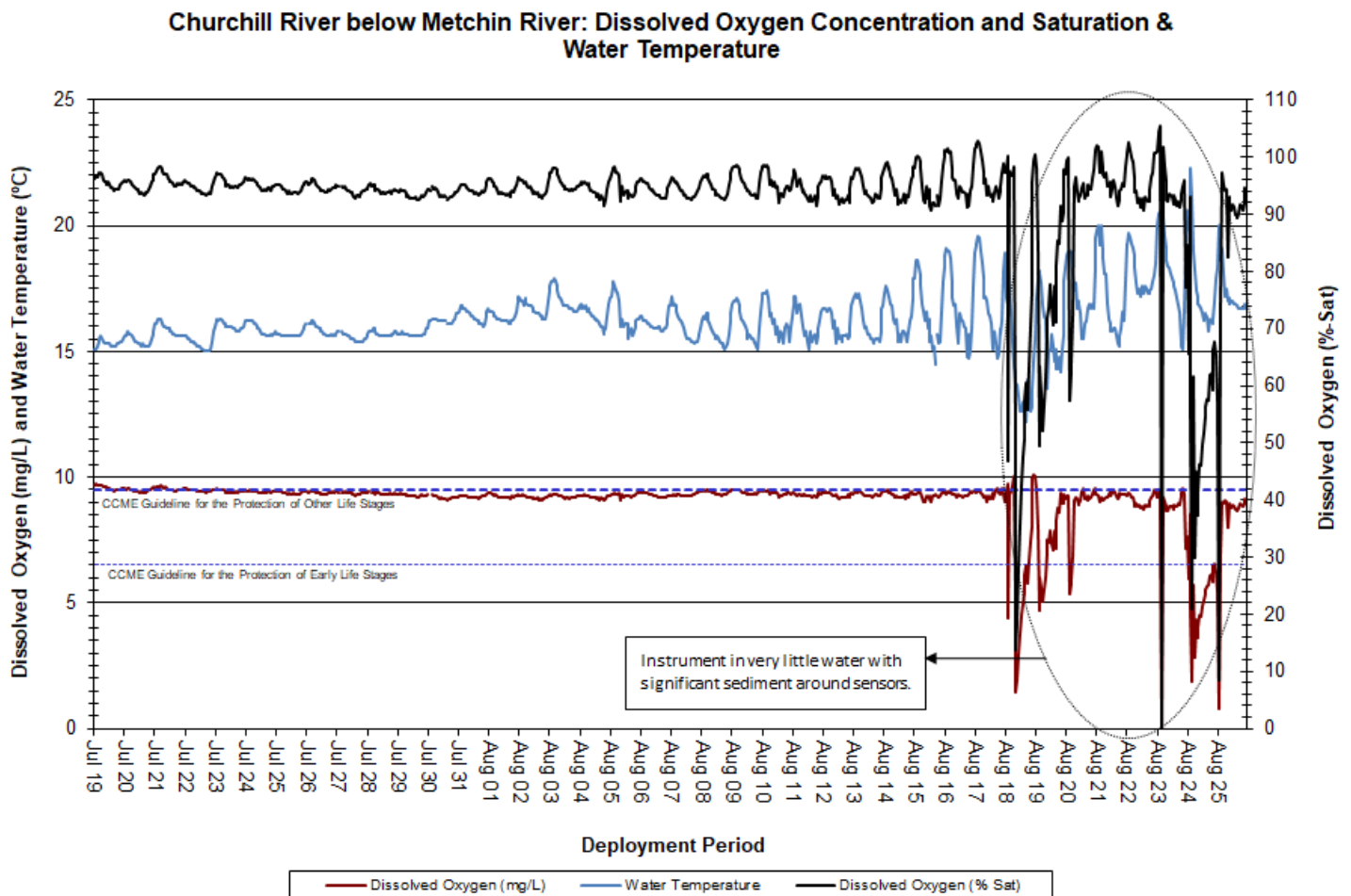


Figure 5: Dissolved Oxygen & Water Temperature at Churchill River below Metchin River

Turbidity

- Over the deployment period, turbidity ranged from 1.9NTU to 2510NTU, with a median value of 24.6NTU (Figure 6). A median value of 24.6NTU indicates a low level of natural background turbidity in the waterbody. Precipitation data was obtained from the Metchin River near TLH Weather Station.
- This station is located at a wide and deep section of the Churchill River and therefore turbidity levels are typically less susceptible to precipitation events as compared to other areas; however, it is unusual that turbidity levels remained elevated for the duration of deployment. This is being attributed to the instrument being located in very little water with significant sediment build-up around the sensors towards the end of the deployment period.
- Water Survey of Canada (Environment and Climate Change Canada) is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.

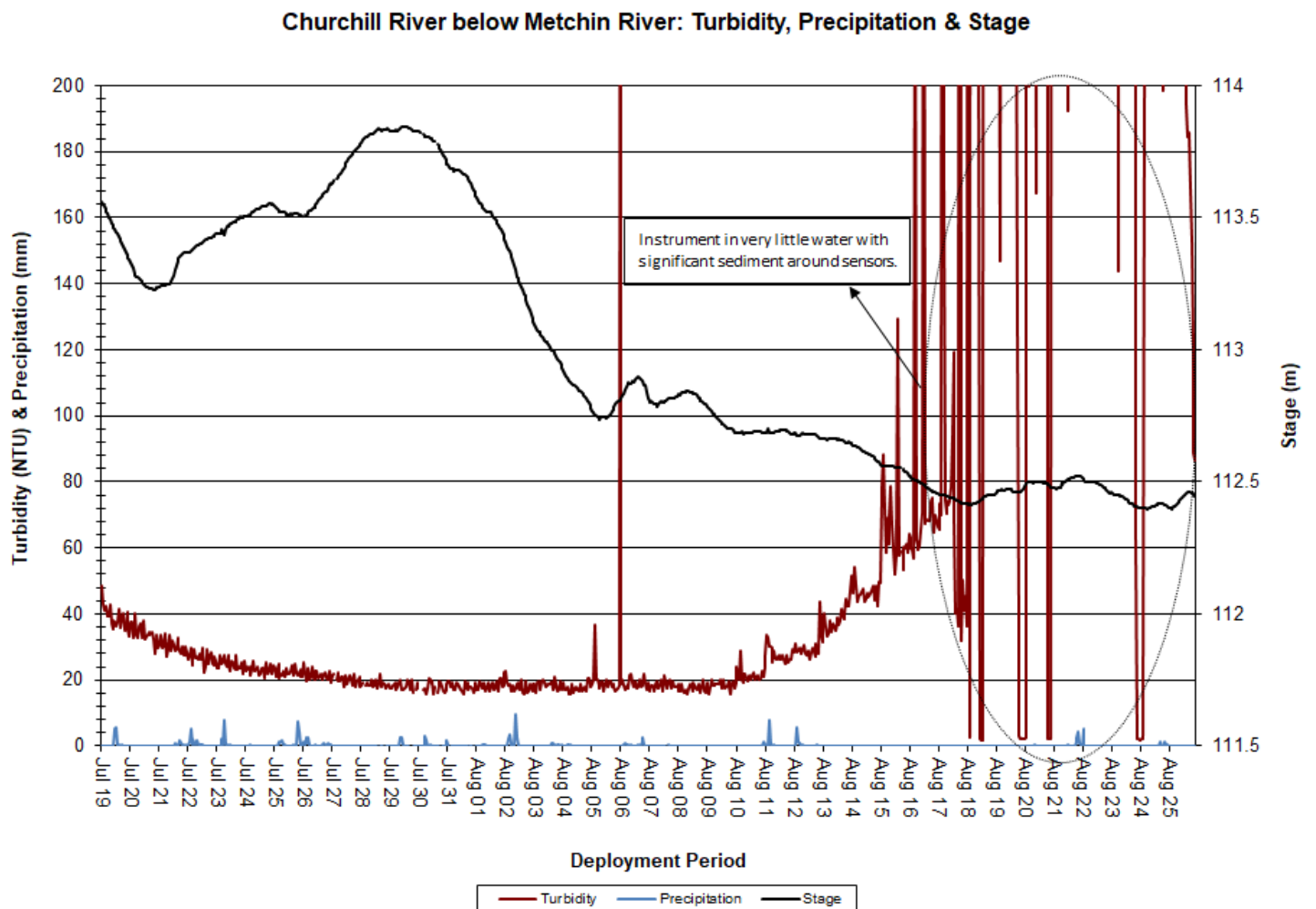


Figure 6: Turbidity, Precipitation & Stage at Churchill River below Metchin River

Stage and Flow

- Over the deployment period, stage levels ranged from 112.395m to 113.845m, with a median value of 112.808m. Flow ranged from 1063.986m³/s to 1478.849m³/s, with a median value of 1207.153m³/s (Figure 7). Precipitation data was obtained from the Metchin River near TLH Weather Station.
- Stage and flow were decreasing over the course of deployment. Precipitation events across the same period generally correlate with increases in both stage and flow (Figure 8).
- Water Survey of Canada (Environment and Climate Change Canada) is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.

Churchill River below Metchin River: Stage & Flow

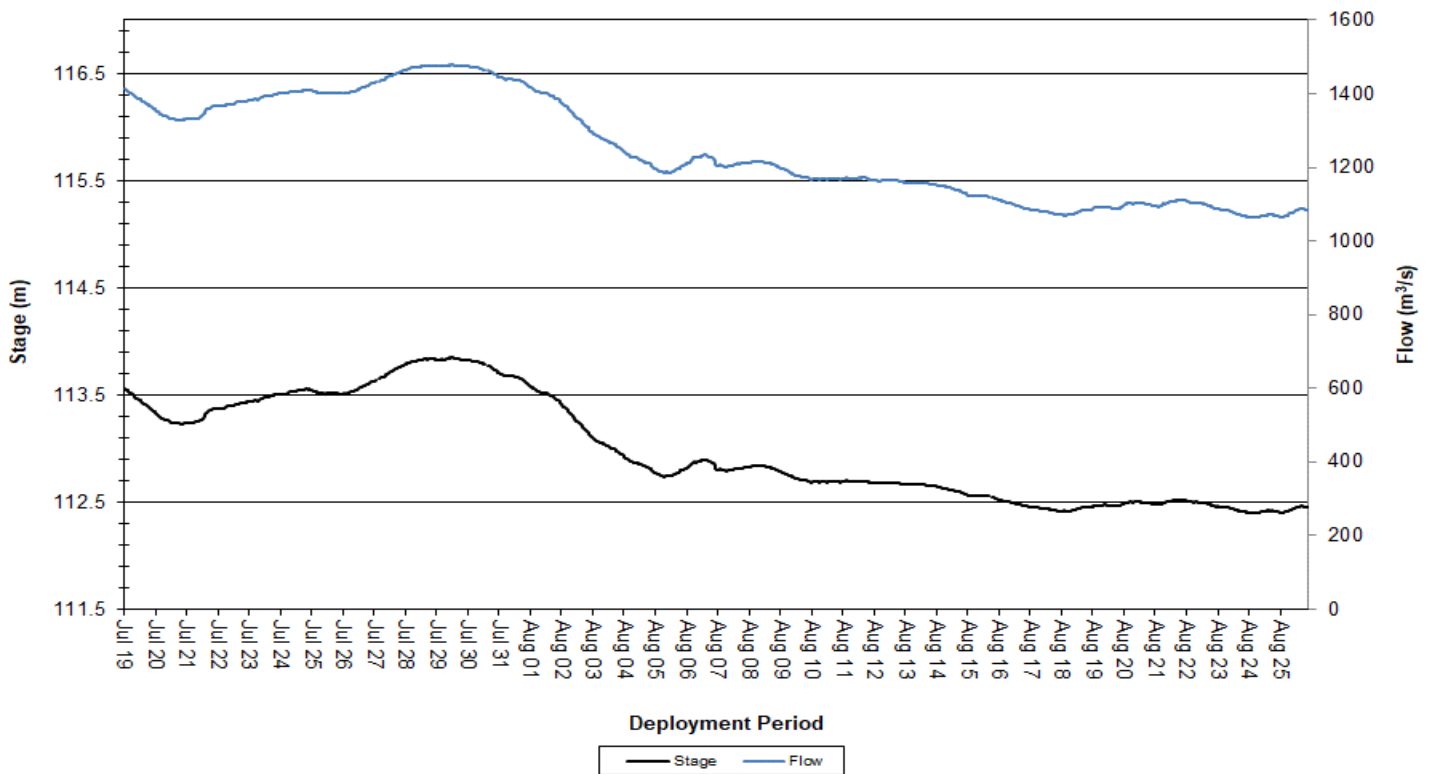


Figure 7: Stage & Flow at Churchill River below Metchin River

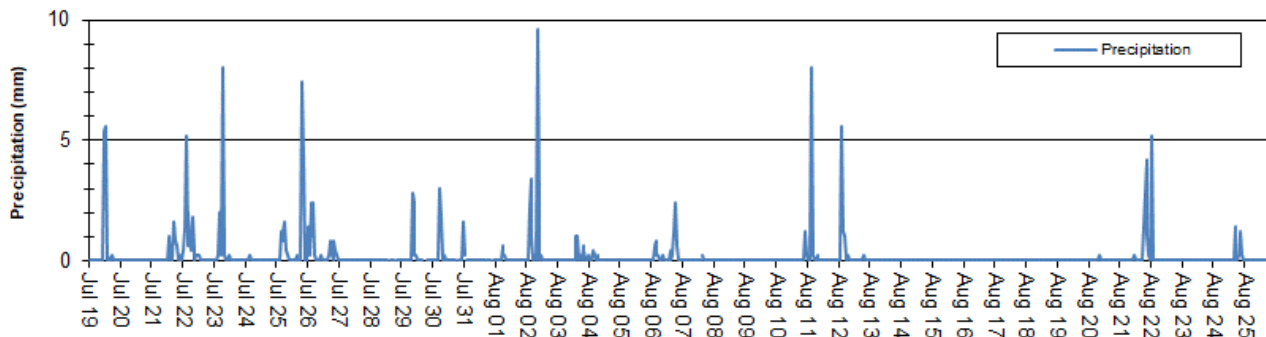


Figure 8: Precipitation at Churchill River below Metchin River

Churchill River above Grizzle Rapids

Water Temperature

- Over the deployment period, water temperature ranged from 12.3°C to 18.9°C, with a median value of 16.5°C (Figure 9). Air temperature data was obtained from the Metchin River near TLH Weather Station.
- Water temperature slowly increased across the deployment period. This trend is to be expected as air temperatures also increased through the summer season. Water temperature data exhibits a diurnal pattern, and closely correlates with ambient air temperatures.
- Water Survey of Canada (Environment and Climate Change Canada) is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.

Churchill River above Grizzle Rapids: Water & Air Temperature and Stage

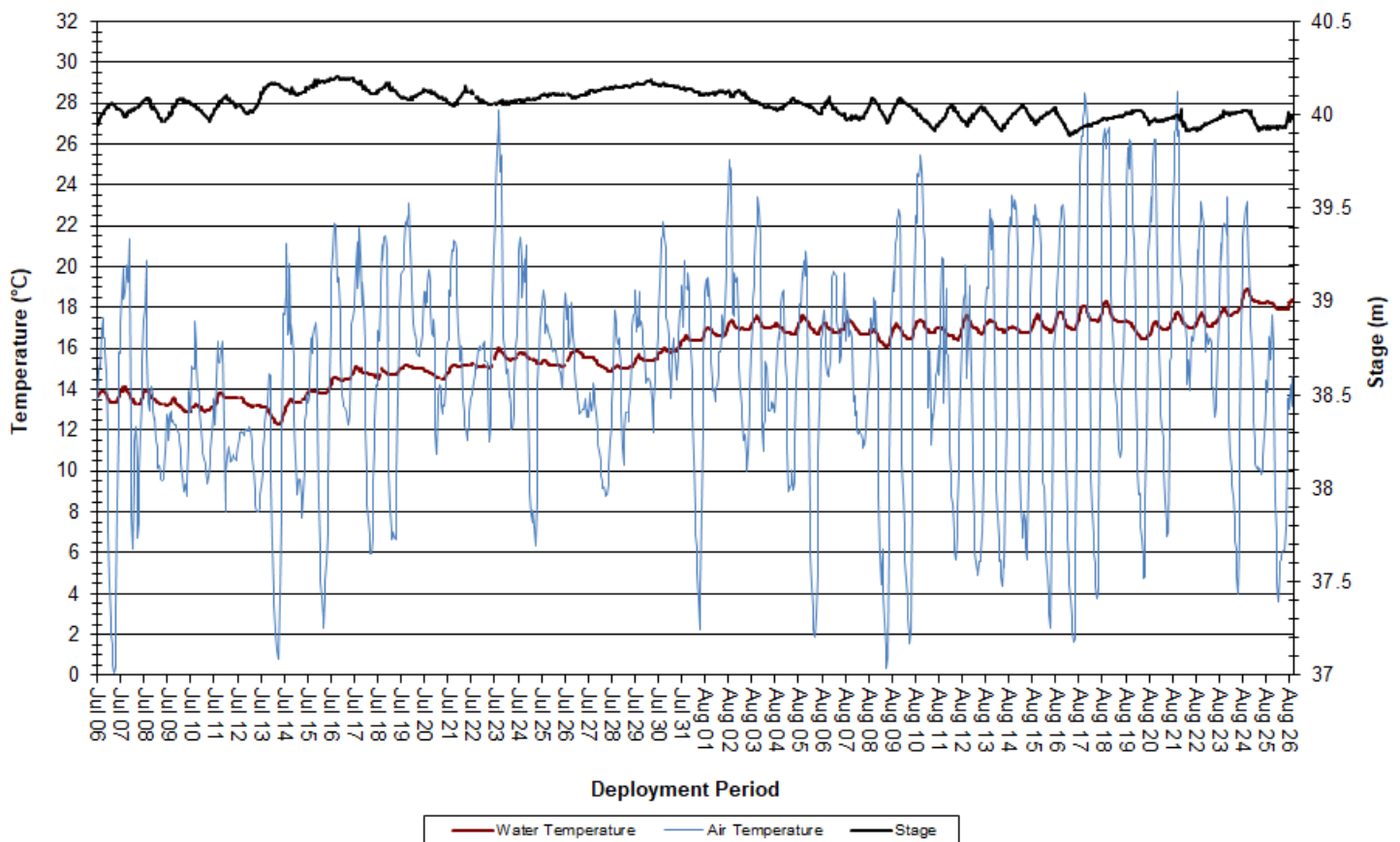


Figure 9: Water and Air Temperature & Stage at Churchill River above Grizzle Rapids

pH

- Over the deployment period, pH values ranged from 6.58 pH units to 7.05 pH units, with a median value of 6.86 (Figure 10).
- pH values were quite stable and remained within the CCME’s Guidelines for the Protection of Aquatic Life for the duration of deployment.
- Photosynthesis uses up hydrogen molecules; this causes the concentration of hydrogen ions to decrease, which in turn causes pH to increase. For this reason, pH may be higher during daylight hours and during the growing season when photosynthesis is at a maximum. This is illustrated by the diurnal fluctuations in pH values (Figure 10).
- Water Survey of Canada (Environment and Climate Change Canada) is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.

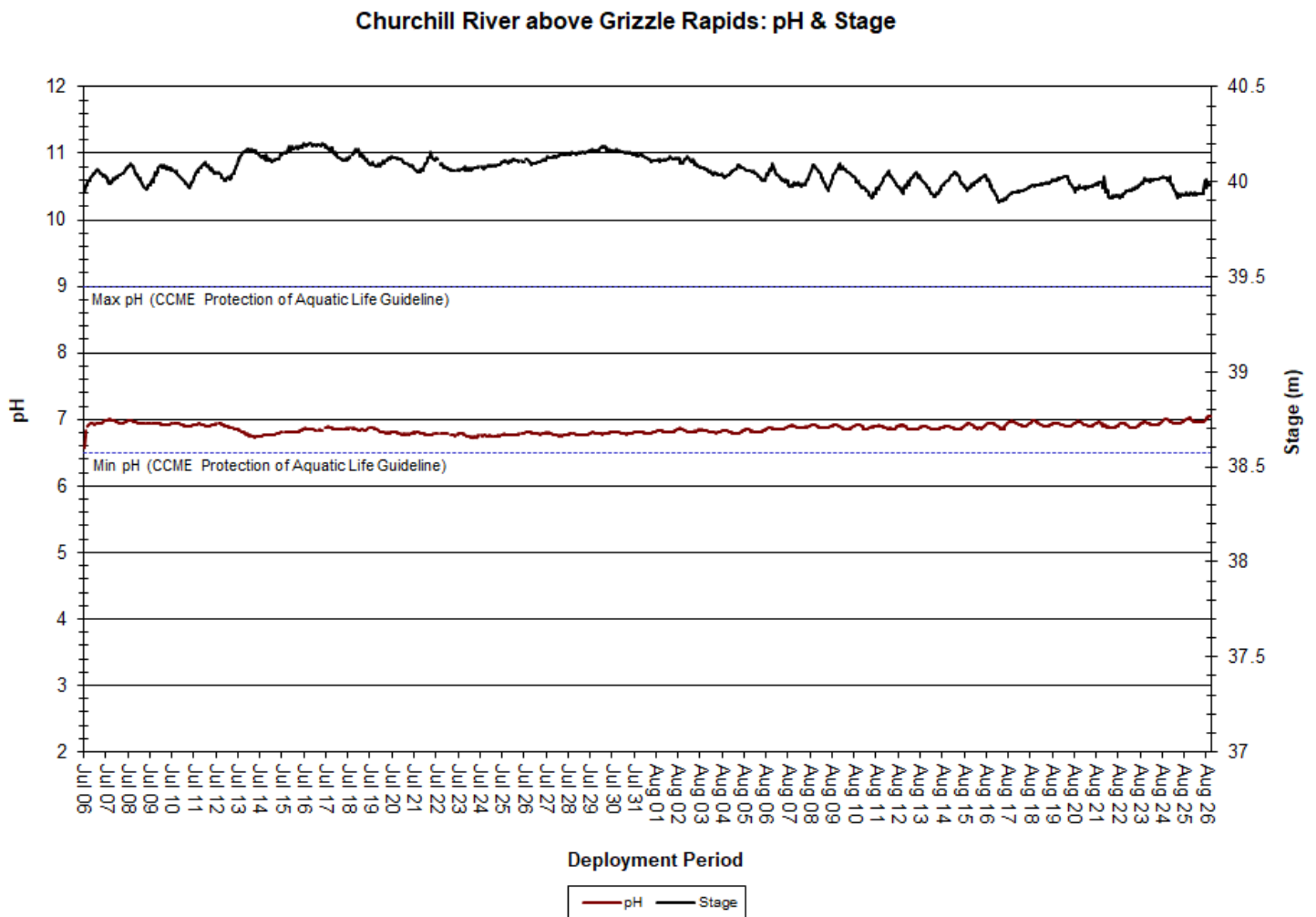


Figure 10: pH & Stage at Churchill River above Grizzle Rapids

Specific Conductivity

- Over the deployment period, specific conductivity ranged from 14.5 μ S/cm to 20.2 μ S/cm, with a median of 16.7 μ S/cm (Figure 11).
- The relationship between conductivity and stage is generally inverted. When stage levels increase, specific conductivity levels generally decrease as the increased amount of water in the river system dilutes solids that are present. This relationship is only somewhat evident in the graph below, likely because this station is located at a deep and wide section of the Churchill River and other factors in the water column influence conductivity levels.
- Water Survey of Canada (Environment and Climate Change Canada) is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.

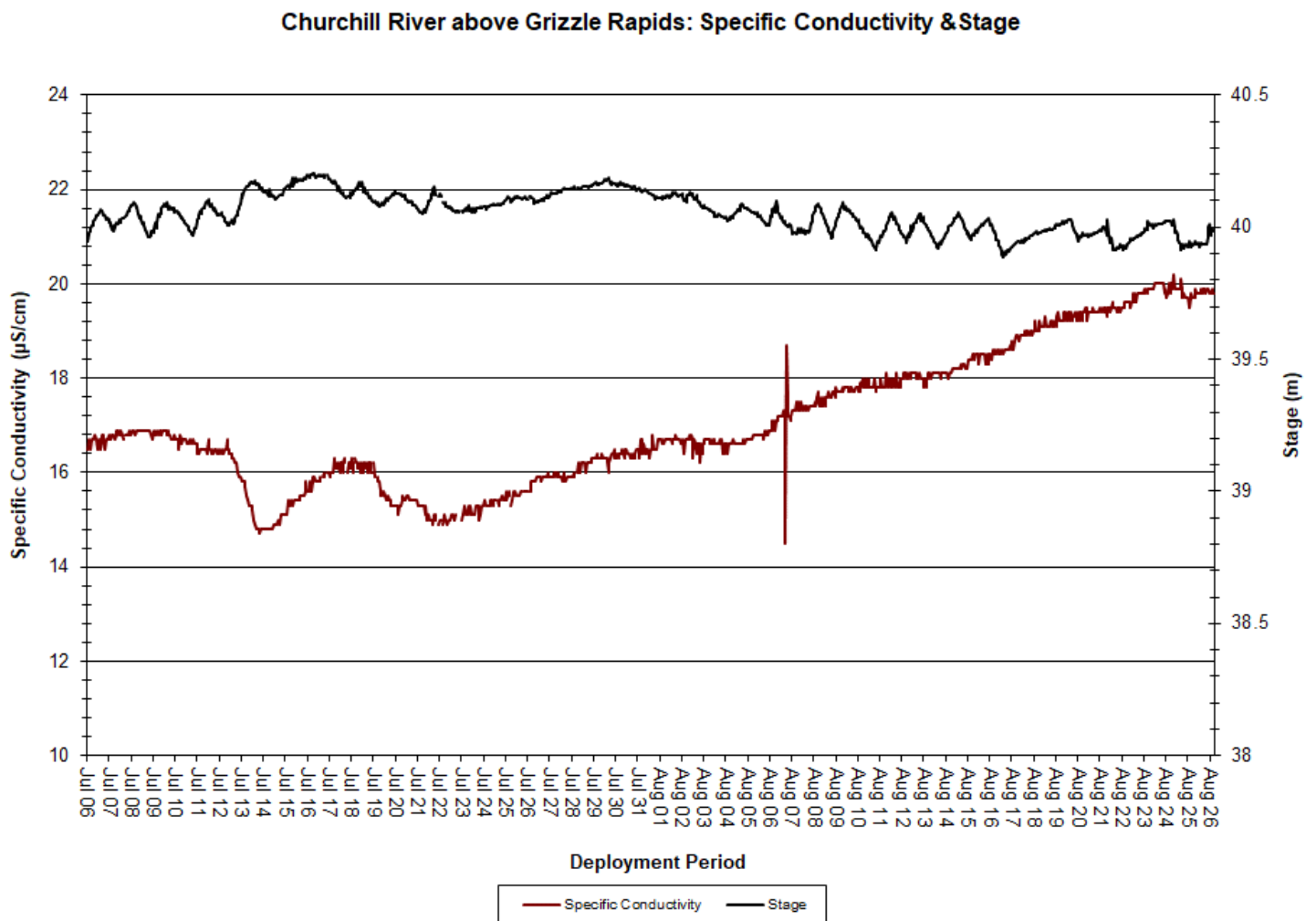


Figure 11: Specific Conductivity & Stage at Churchill River above Grizzle Rapids

Dissolved Oxygen

- Over the deployment period, dissolved oxygen content ranged from 9.35mg/L to 10.65mg/L, with a median value of 9.74mg/L. Saturation of dissolved oxygen ranged from 97.7% saturation to 103.7% saturation, with a median value of 99.7% (Figure 12).
- There is an evident relationship between water temperature and dissolved oxygen. Over the deployment period, dissolved oxygen levels gradually decreased as water temperatures increased through the summer. Dissolved oxygen also follows a diurnal pattern as water temperatures rise and fall under the influence of ambient air temperatures. Generally, dissolved oxygen levels are higher in a waterbody during cooler temperatures.
- Dissolved oxygen levels were above the CCME's Guideline for the Protection of Early Life Stages for the majority of deployment, dipping slightly below the guideline at the end of August when water temperatures were highest. Dissolved oxygen levels were above the CCME's Guideline for the Protection of Other Life Stages for the duration of deployment.

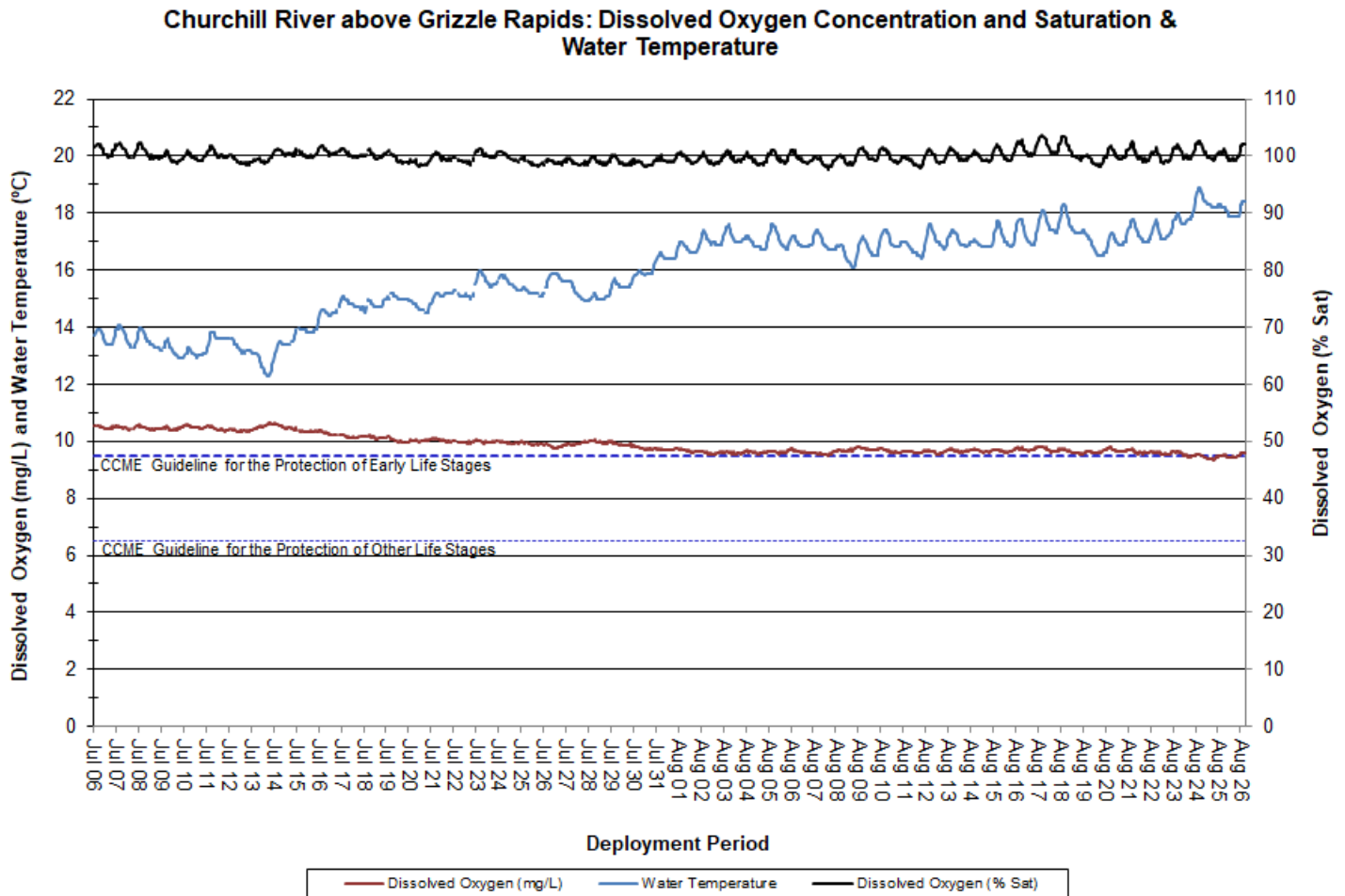


Figure 12: Dissolved Oxygen & Water Temperature at Churchill River above Grizzle Rapids

Turbidity

- Over the deployment period, turbidity ranged from 0NTU to 300NTU, with a median value of 210.2NTU (Figure 13). A median value of 210.2NTU indicates a significant level of natural background turbidity in the waterbody. Precipitation data was obtained from the Metchin River at TLH Weather Station.
- While it is not uncommon to see levels of background turbidity at this station, the fact that turbidity levels remained so high for the duration of deployment is unusual and likely not representative of the true water quality conditions. Given the sandy nature of the river bed at this site, it is more likely that sediment built up around the turbidity sensor, yielding inaccurate readings.
- Water Survey of Canada (Environment and Climate Change Canada) is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.

Churchill River above Grizzle Rapids: Turbidity, Precipitation & Stage

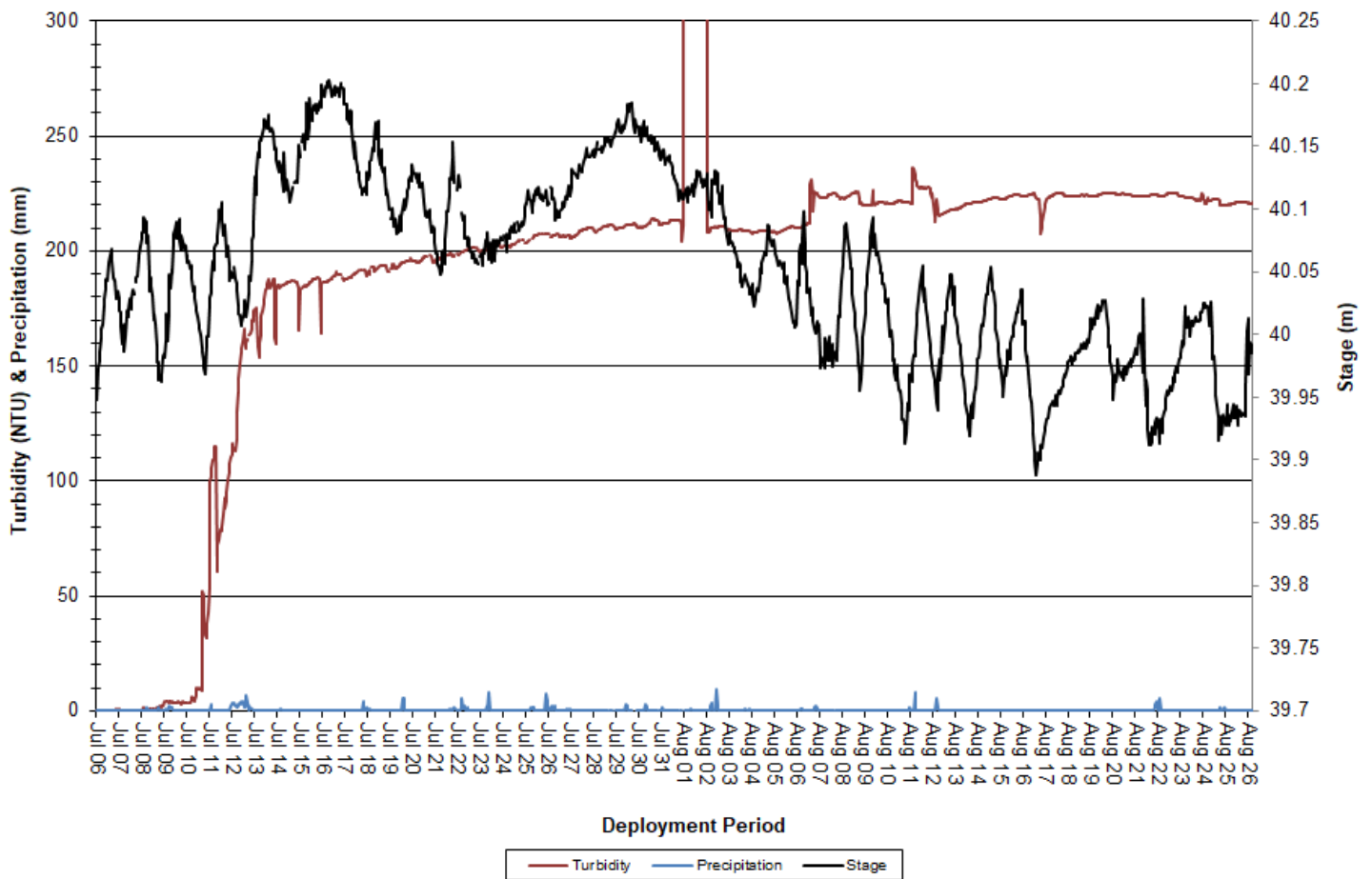


Figure 13: Turbidity, Precipitation & Stage at Churchill River above Grizzle Rapids

Stage

- Over the deployment period, stage ranged from 39.888m to 40.203m, with a median value of 40.054m (Figure 14). Precipitation data was obtained from the Metchin River near TLH Weather Station.
- Stage was somewhat variable across the deployment period, with precipitation events often correlating with increases in stage (Figure 14).
- Water Survey of Canada (Environment and Climate Change Canada) is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.

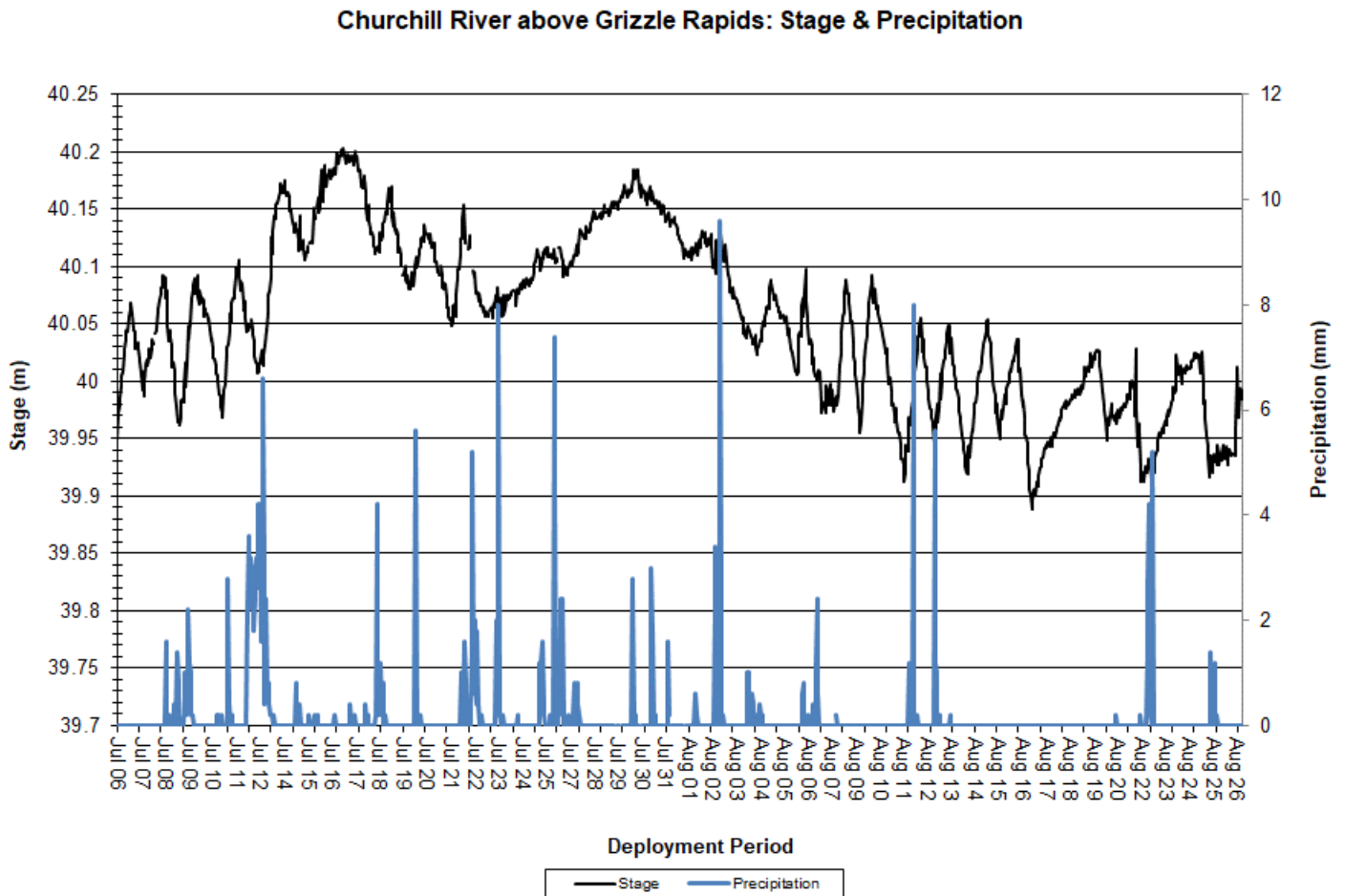


Figure 14: Stage & Precipitation at Churchill River above Grizzle Rapids

Churchill River below Muskrat Falls

Water Temperature

- Over the deployment period, water temperature ranged from 12.3°C to 19.0°C, with a median value of 16.0°C (Figure 15). Air temperature data was obtained from the Churchill River at End of Mud Lake Road Weather Station.
- Water temperature slowly increased over the course of the deployment period. This is to be expected as ambient air temperatures also increased through July and August. Water temperatures closely correlate with ambient air temperatures, fluctuating to a much lesser extent.
- Water Survey of Canada (Environment and Climate Change Canada) is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.

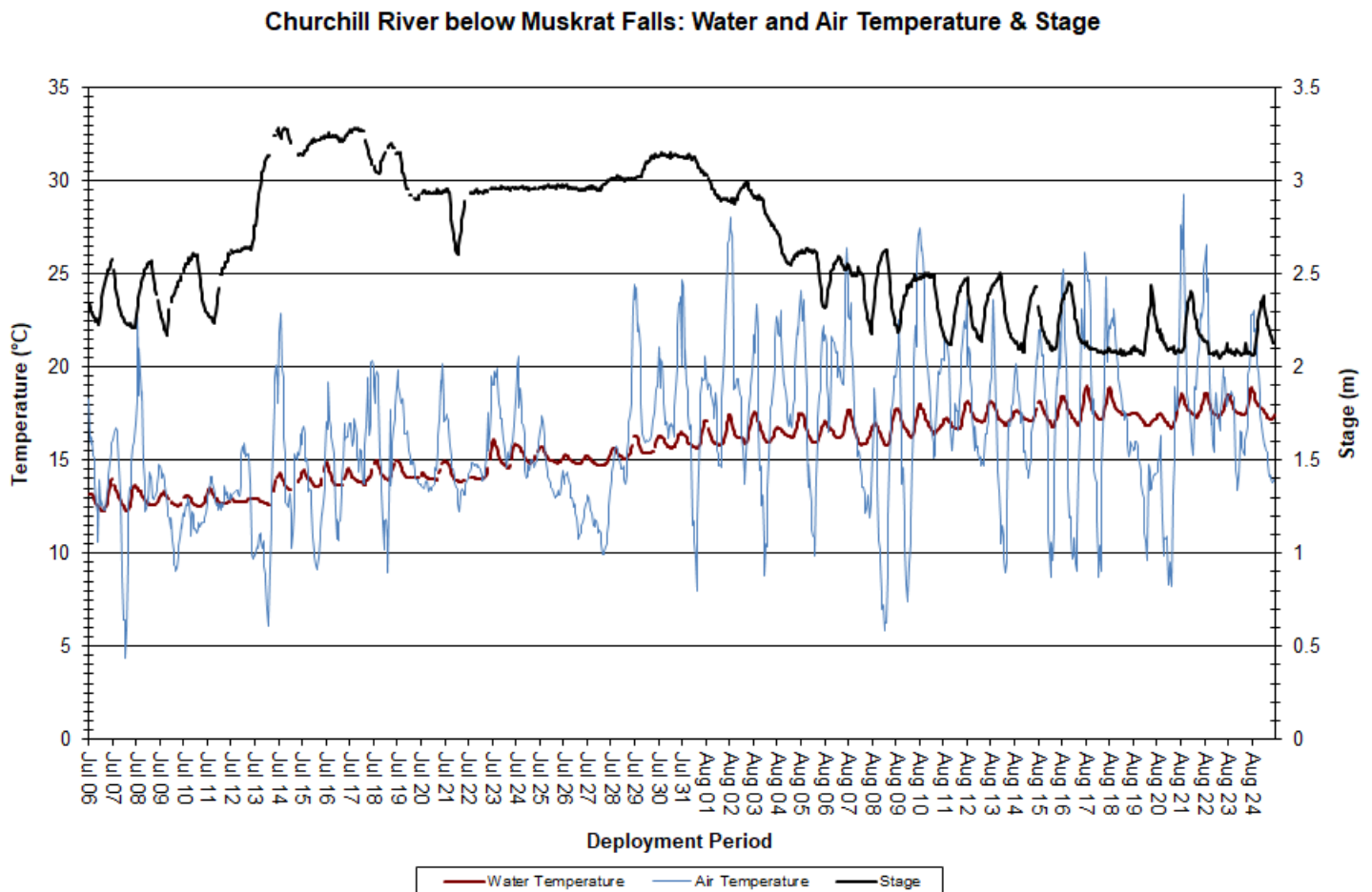


Figure 15: Water and Air Temperature & Stage at Churchill River below Muskrat Falls

pH

- Over the deployment period, pH ranged from 6.54 pH units to 6.78 pH units, with a median value of 6.62 (Figure 16).
- pH values were stable over the course of deployment, and remained within the CCME’s Guidelines for the Protection of Aquatic Life for the duration of the deployment period (Figure 16).
- Water Survey of Canada (Environment and Climate Change Canada) is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.

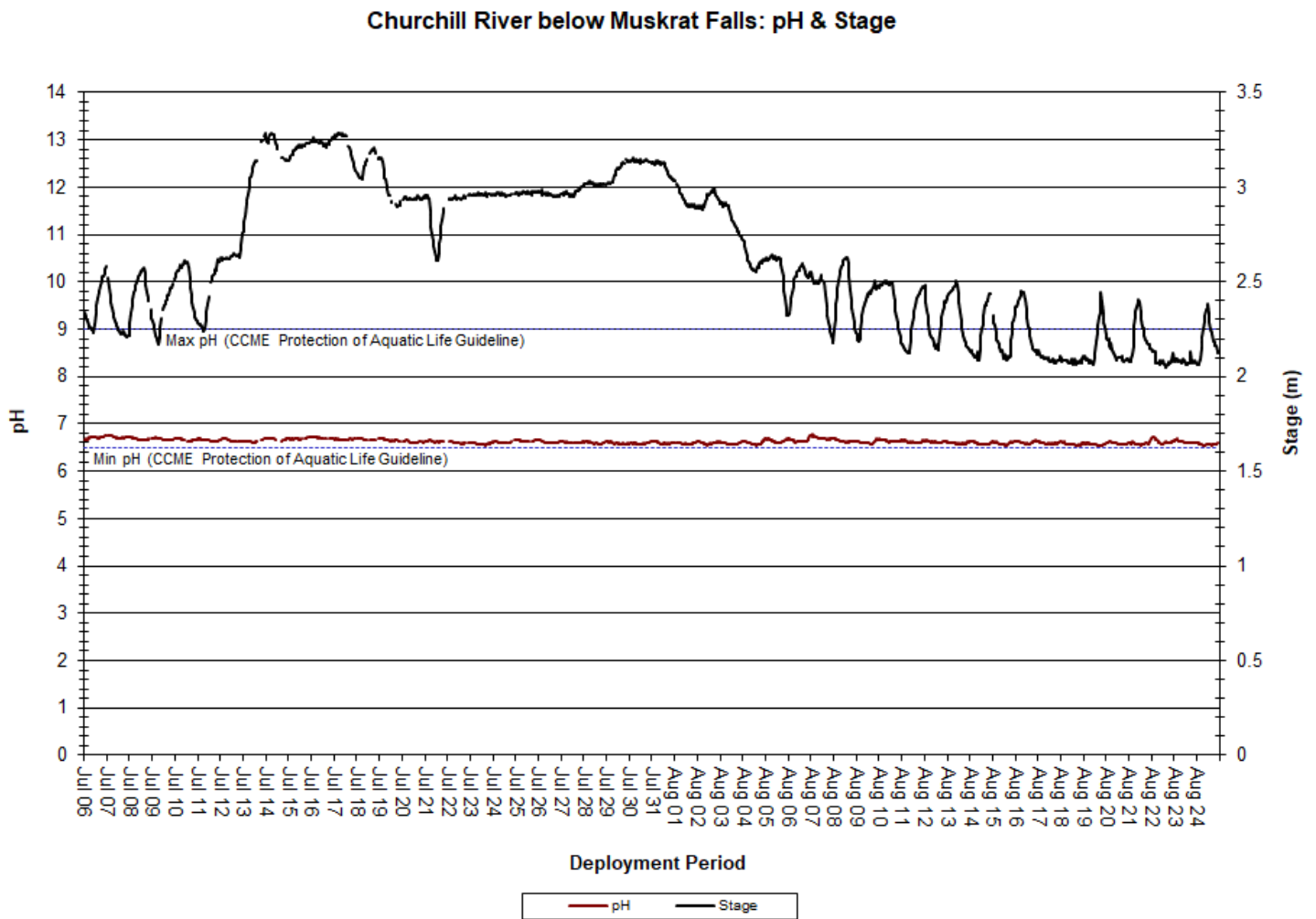


Figure 16: pH & Stage at Churchill River below Muskrat Falls

Specific Conductivity

- Over the deployment period, specific conductivity ranged from 15.2 μ S/cm to 18.8 μ S/cm, with a median value of 16.4 μ S/cm (Figure 17).
- The relationship between conductivity and stage is generally inversed. When stage decreases, specific conductivity increases as the decreased amount of water in the river system concentrates solids that are present, and vice versa. This relationship is only somewhat evident in the graph below, likely because this station is located at a deep and wide section of the Churchill River and other factors in the water column influence conductivity levels (Figure 17).
- Water Survey of Canada (Environment and Climate Change Canada) is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.

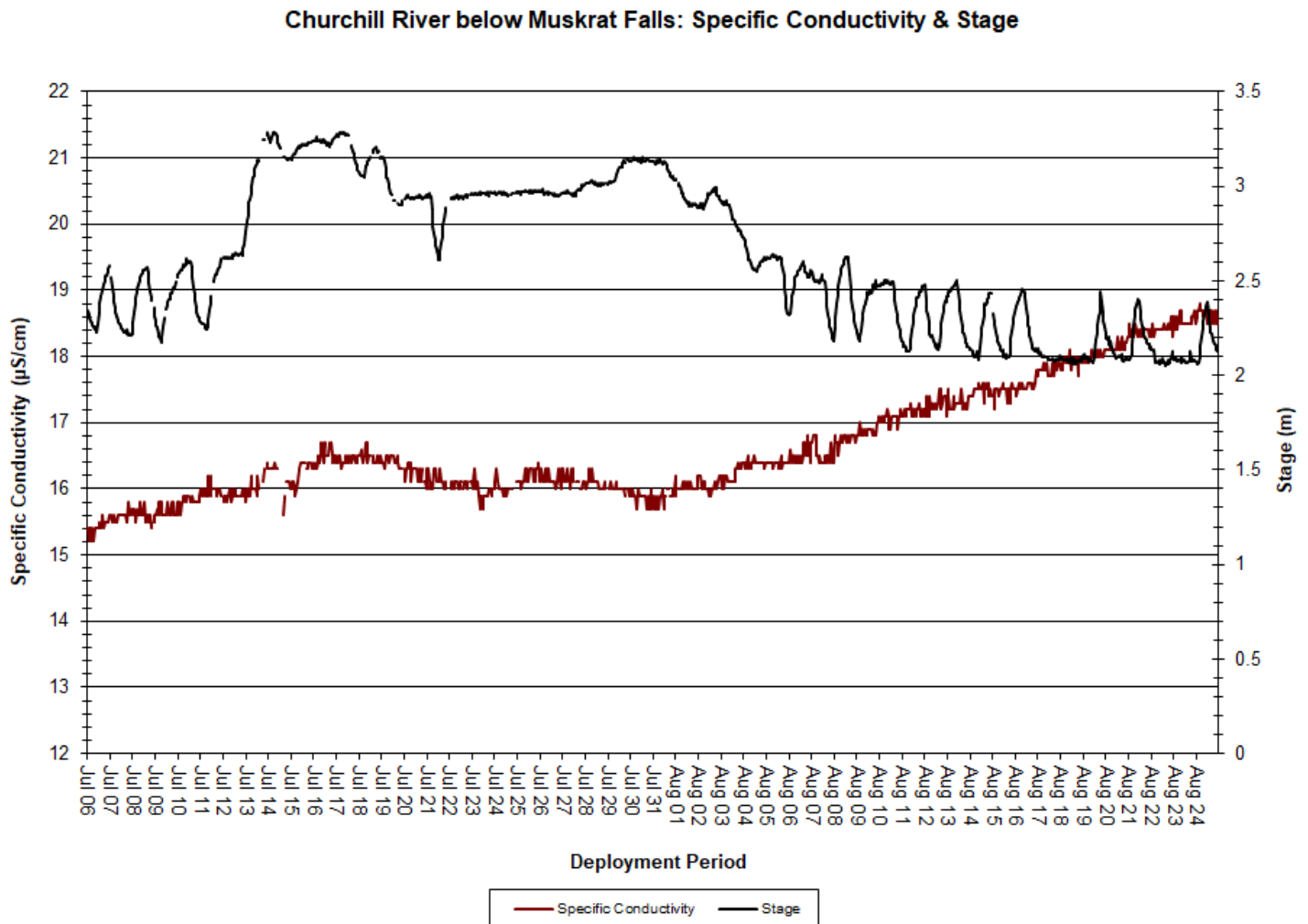


Figure 17: Specific Conductivity & Stage at Churchill River below Muskrat Falls

Dissolved Oxygen

- Over the deployment period, dissolved oxygen concentration ranged from 8.70mg/L to 10.81mg/L, with a median value of 9.95mg/L. Saturation of dissolved oxygen ranged from 90.8% to 104.9%, with a median value of 99.0% (Figure 18).
- Dissolved oxygen and water temperature exhibit an inverse relationship: as one parameter increases, the other decreases, and vice versa. Dissolved oxygen levels slowly decreased over the course of deployment. This is to be expected since water temperatures were slowly increasing over the same period. Dissolved oxygen also follows a diurnal pattern as water temperatures rise and fall under the influence of ambient air temperatures.
- Dissolved oxygen levels remained above the CCME’s Guideline for the Protection of Early Life Stages until August 8. Dissolved oxygen levels remained above the CCME’s Guideline for the Protection of Other Life Stages for the duration of deployment.

Churchill River below Muskrat Falls: Dissolved Oxygen Concentration and Saturation & Water Temperature

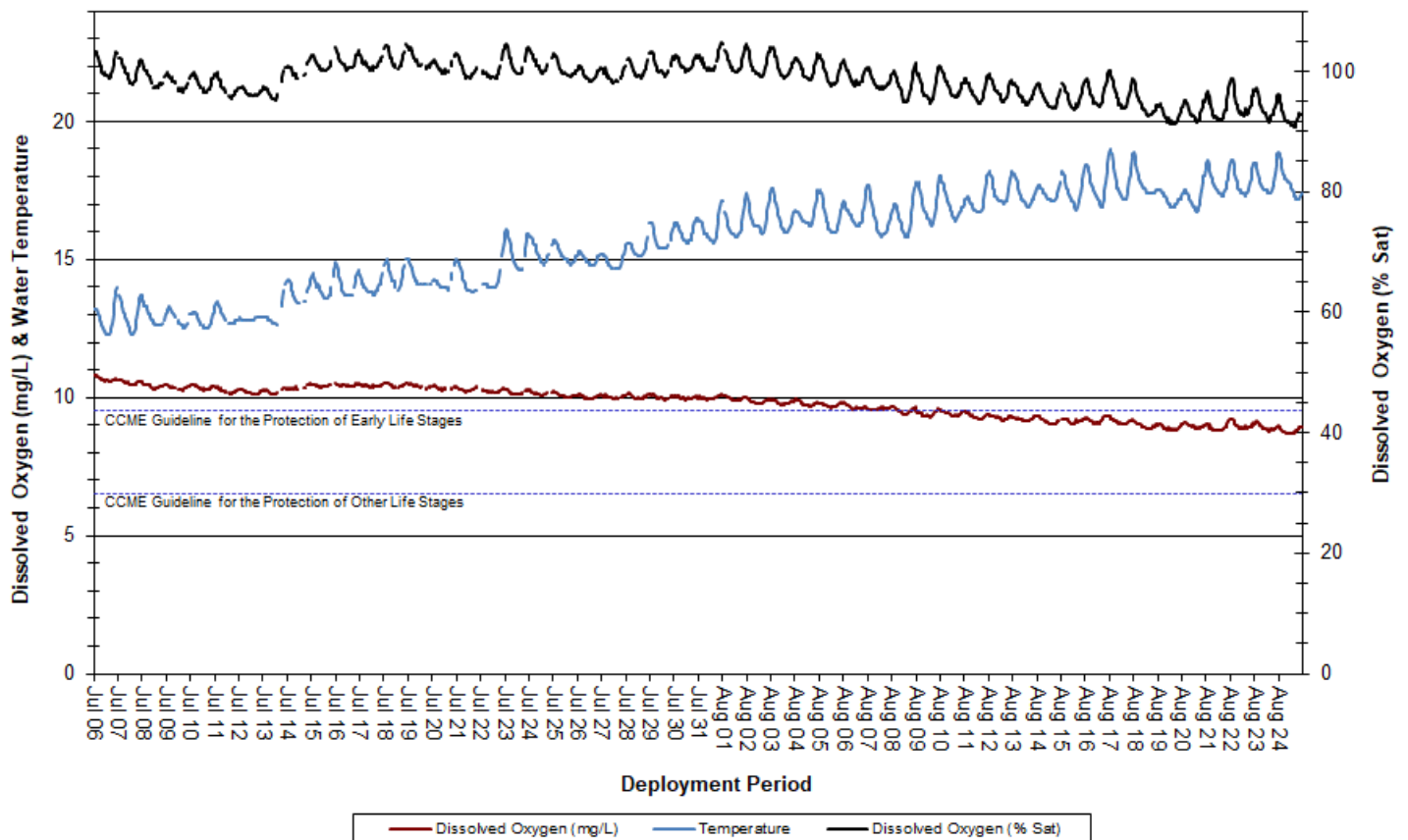


Figure 18: Dissolved Oxygen & Water Temperature at Churchill River below Muskrat Falls

Turbidity

- Over the deployment period, turbidity ranged from 0 NTU to 34.5 NTU, with a median value of 1.0 NTU. A median value of 1.0 NTU indicates a small amount of natural background turbidity in the waterbody, which is typical of this station. Precipitation data was obtained from the Churchill River at End of Mud Lake Road Weather Station.
- There was some correlation between turbidity events and precipitation events across the deployment period (Figure 19). Turbidity levels are often quite variable at this station, and do not always correlate with precipitation events given that this station is located on a wide and deep section of the Churchill River.
- Water Survey of Canada (Environment and Climate Change Canada) is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.

Churchill River below Muskrat Falls: Turbidity, Stage & Precipitation

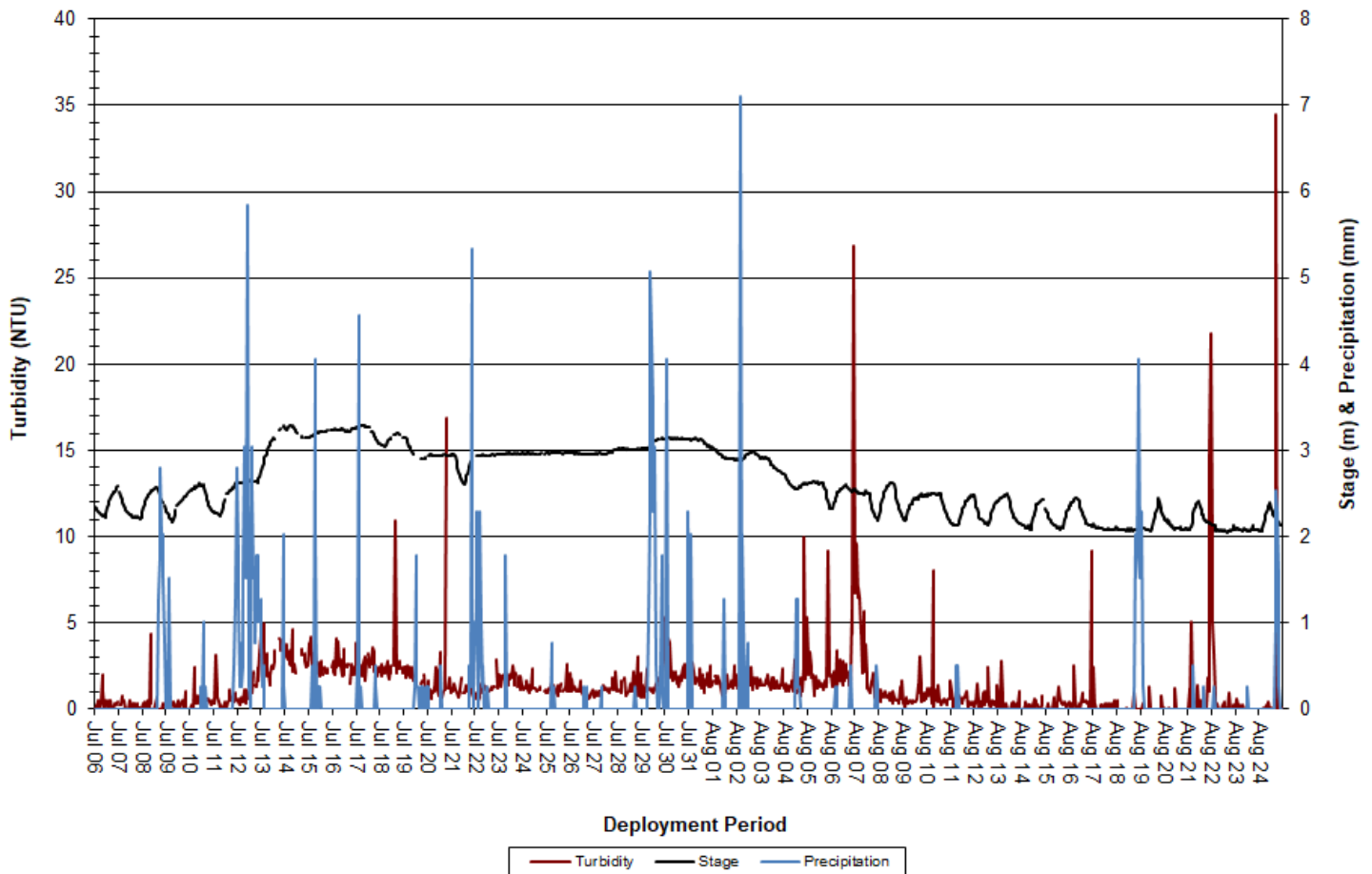


Figure 19: Turbidity, Precipitation & Stage at Churchill River below Muskrat Falls

Stage & Flow

- Over the deployment period, stage ranged from 2.05m to 3.288m, with a median value of 2.572m. Flow ranged from 1073.775m³/s to 2324.598m³/s, with a median value of 1553.156m³/s (Figure 20). Precipitation data was obtained from the Churchill Falls at End of Mud Lake Road Weather Station.
- Stage and flow were variable over the course of deployment, and somewhat correlated with precipitation events. This is partly related to the fact that this station is located on a very wide section of the Churchill River and therefore not as easily influenced by smaller precipitation events. Stage and flow at this station are also influenced by upstream activities at the Muskrat Falls hydroelectric project.
- Water Survey of Canada (Environment and Climate Change Canada) is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.

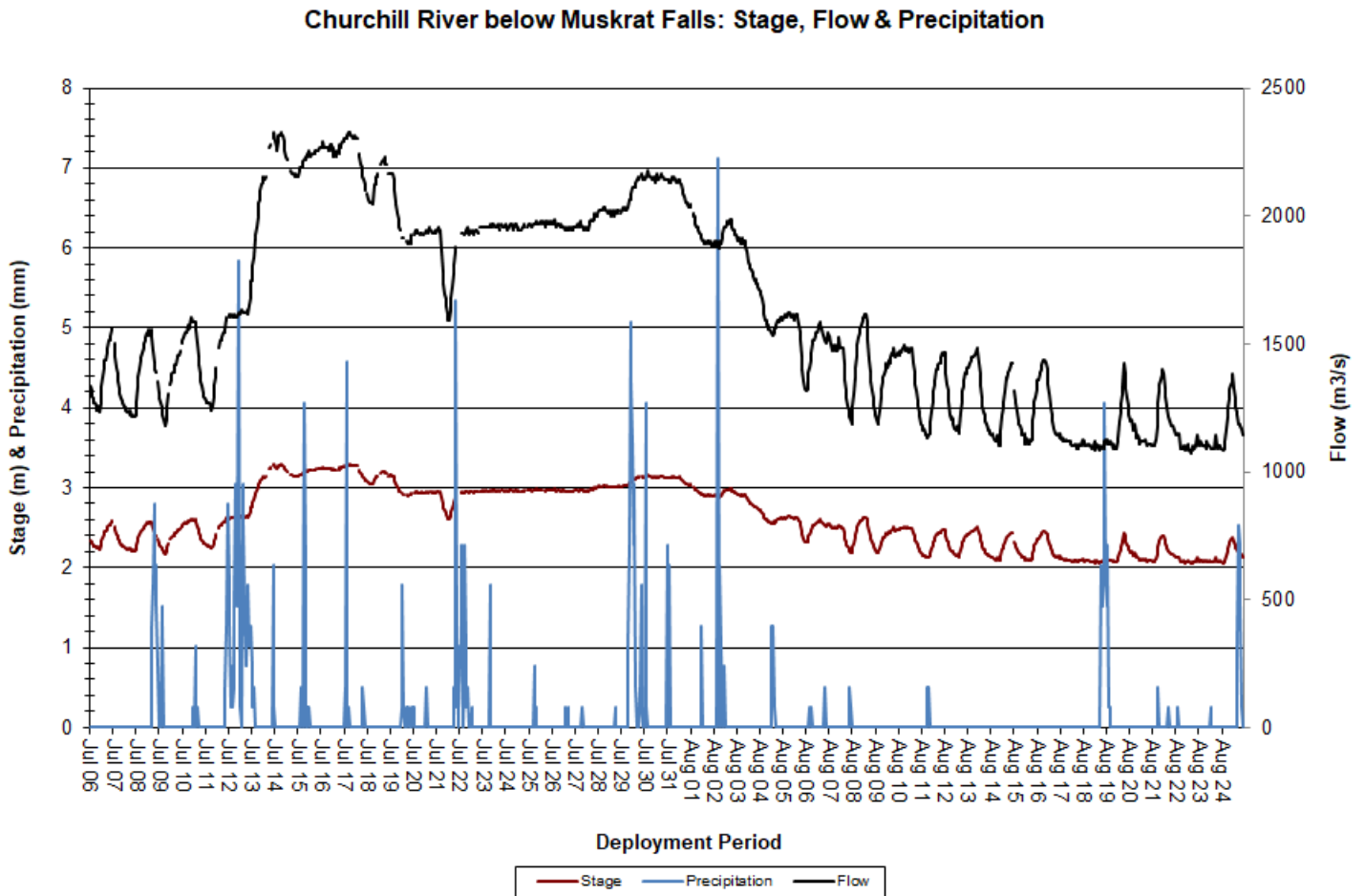


Figure 20: Stage, Flow & Precipitation at Churchill River below Muskrat Falls

Churchill River at English Point

Water Temperature

- Water temperature ranged from 12.4°C to 20.9°C, with a median value of 17.2°C (Figure 21). Air temperature data was obtained from the Churchill River at End of Mud Lake Road Weather Station.
- Water temperature increased slowly across the deployment period. Water temperatures closely correlated with ambient air temperatures, which followed a similar trend across the same period.
- Water Survey of Canada (Environment and Climate Change Canada) is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.

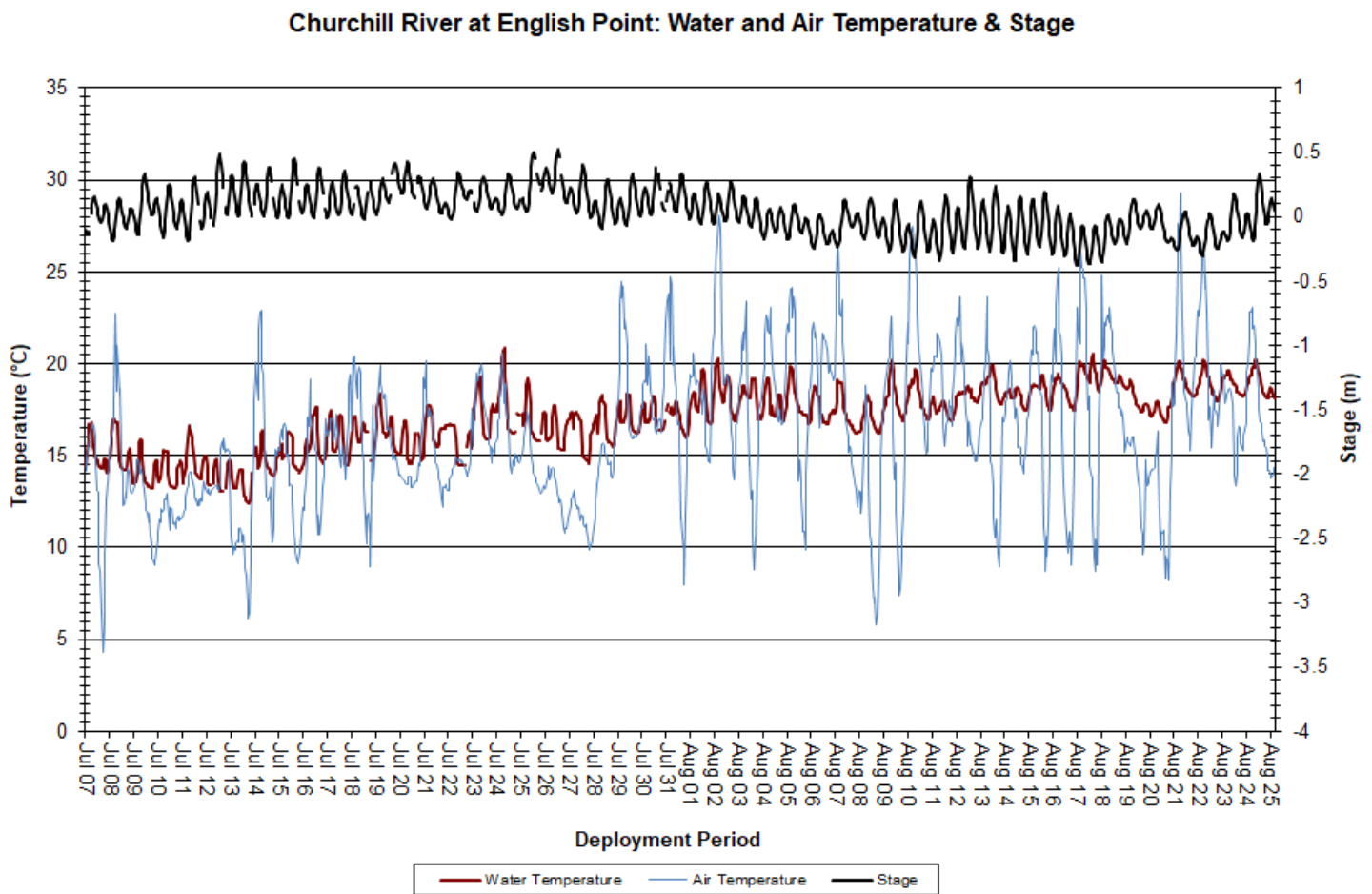


Figure 21: Water and Air Temperature & Stage at Churchill River at English Point

pH

- Over the deployment period, pH ranged from 6.41 pH units to 6.95 pH units, with a median value of 6.62 (Figure 22).
- pH values were relatively stable over the course of deployment. pH values were within the CCME's Guidelines for the Protection of Aquatic Life for the majority of deployment.
- Water Survey of Canada (Environment and Climate Change Canada) is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.

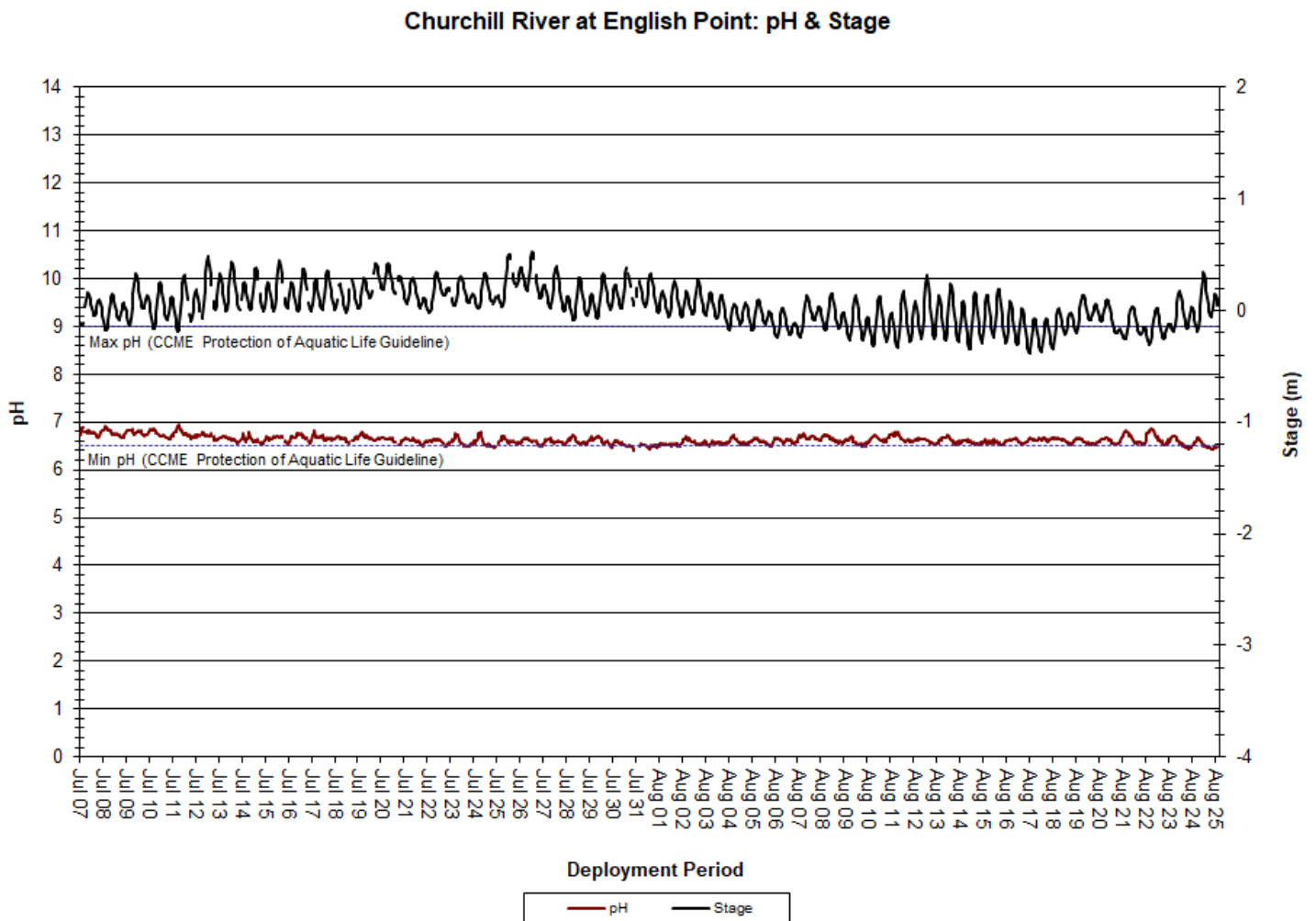


Figure 22: pH & Stage at Churchill River at English Point

Specific Conductivity

- Over the deployment period, specific conductivity ranged from 17.6 μ S/cm to 48.3 μ S/cm, with a median value of 27.9 μ S/cm (Figure 23).
- Specific conductivity fluctuates considerably at this location due to the tidal influences of the Atlantic Ocean on Lake Melville. As the tide comes in, specific conductivity increases as dissolved solids and salinity increase, and vice versa as the tide goes out. This increase and decrease in specific conductivity and stage occurs twice daily. This pattern is generally consistent throughout the deployment period (Figure 23).
- Water Survey of Canada (Environment and Climate Change Canada) is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.

Churchill River at English Point: Specific Conductivity & Stage

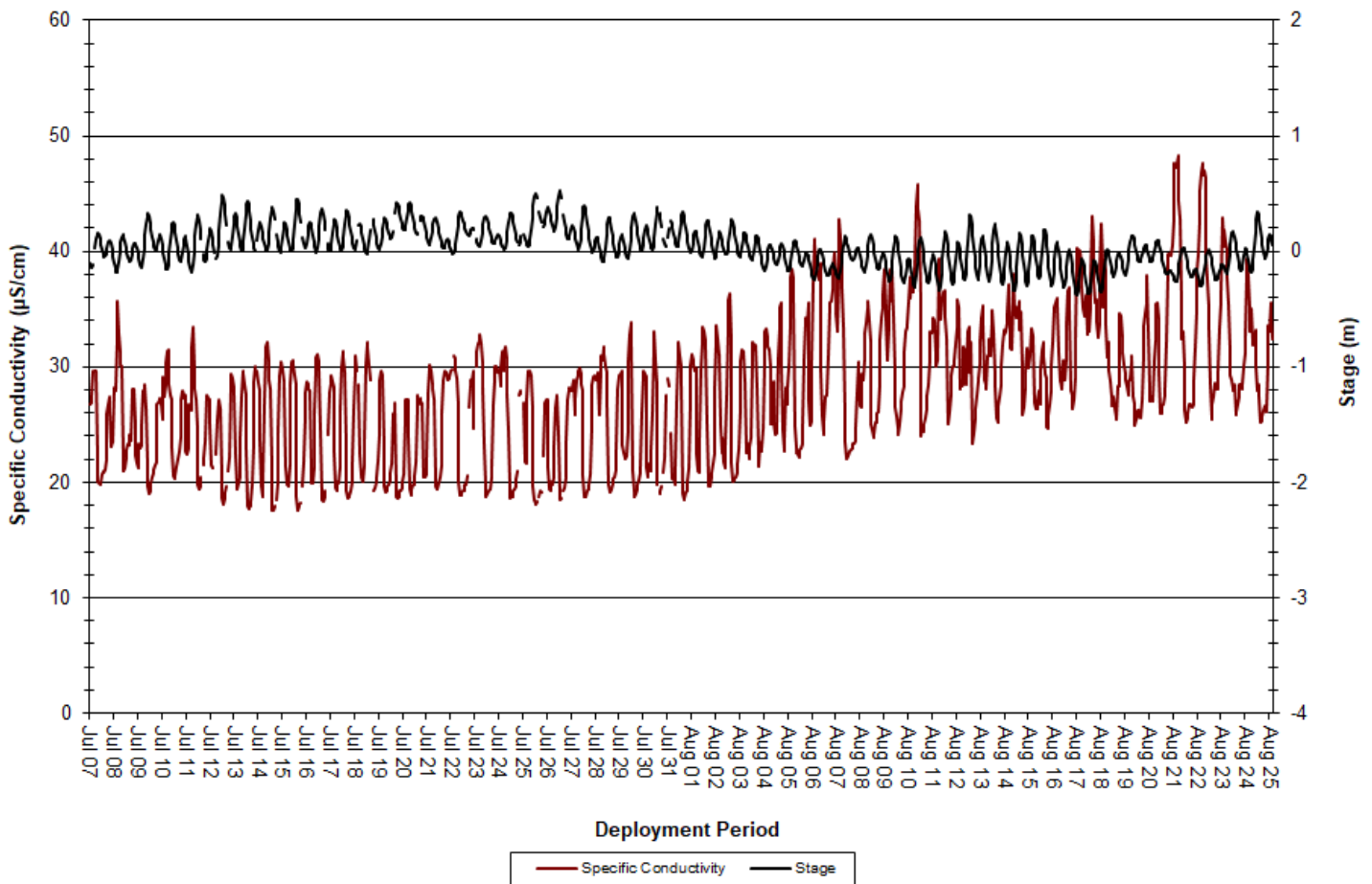


Figure 23: Specific Conductivity & Stage at Churchill River at English Point

Dissolved Oxygen

- Over the deployment period, dissolved oxygen concentration ranged from 8.72mg/L to 10.66mg/L, with a median value of 9.54mg/L. Saturation of dissolved oxygen ranged from 91.2% to 112.1% saturation, with a median value of 99.1% (Figure 24).
- There is an evident relationship between water temperature and dissolved oxygen. As water temperatures increased over the deployment period, dissolved oxygen levels decreased. Dissolved oxygen levels also follow a diurnal pattern as water temperatures rise and fall under the influence of ambient air temperatures. Generally, dissolved oxygen levels are higher in a waterbody during cooler temperatures.
- Dissolved oxygen levels were above the CCME’s Guideline for the Protection of Early Life Stages for the very beginning of deployment, after which they hovered around and then fell below that Guideline. Dissolved oxygen levels were above the CCME’s Guideline for the Protection of Other Life Stages for the duration of deployment (Figure 24).

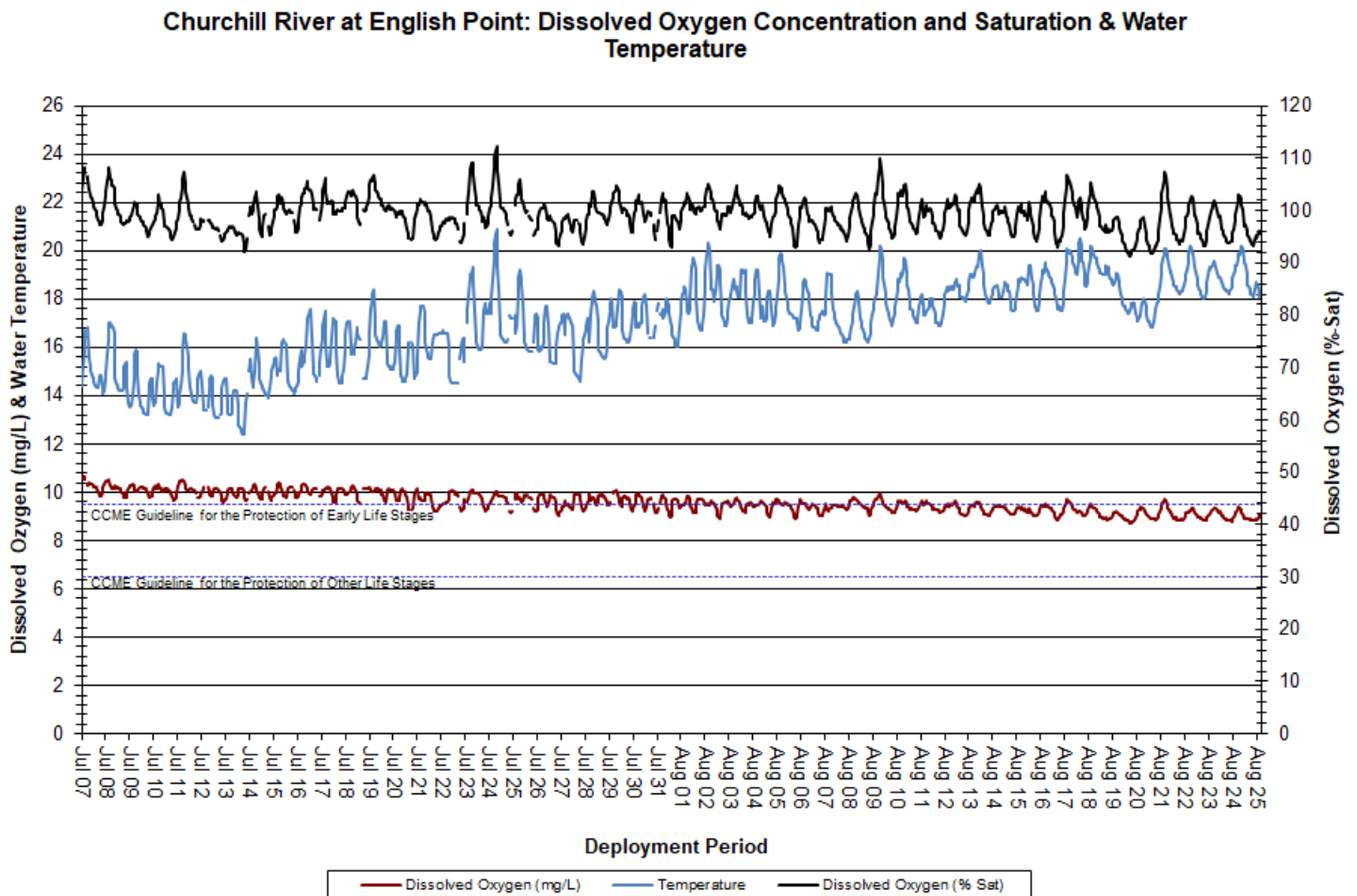


Figure 24: Dissolved Oxygen & Water Temperature at Churchill River at English Point

Turbidity

- Over the deployment period, turbidity ranged from 2.5 NTU to 62.9 NTU, with a median value of 11.2 NTU (Figure 25). A median value of 11.2 NTU indicates a low level of background turbidity; this is to be expected considering the sandy river bed and tidal influences present at this station. Precipitation data was obtained from the Churchill River at End of Mud Lake Road Weather Station.
- Turbidity events generally correlate with precipitation events, as these can increase the presence of suspended material in water. High winds and tidal influences can also contribute to turbidity events at this station by disturbing sediment from the river bed (Figure 25). Wind speed data was also obtained from the Churchill River at End of Mud Lake Road Weather Station.
- Water Survey of Canada (Environment and Climate Change Canada) is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.

Churchill River at English Point: Turbidity, Precipitation & Wind Speed

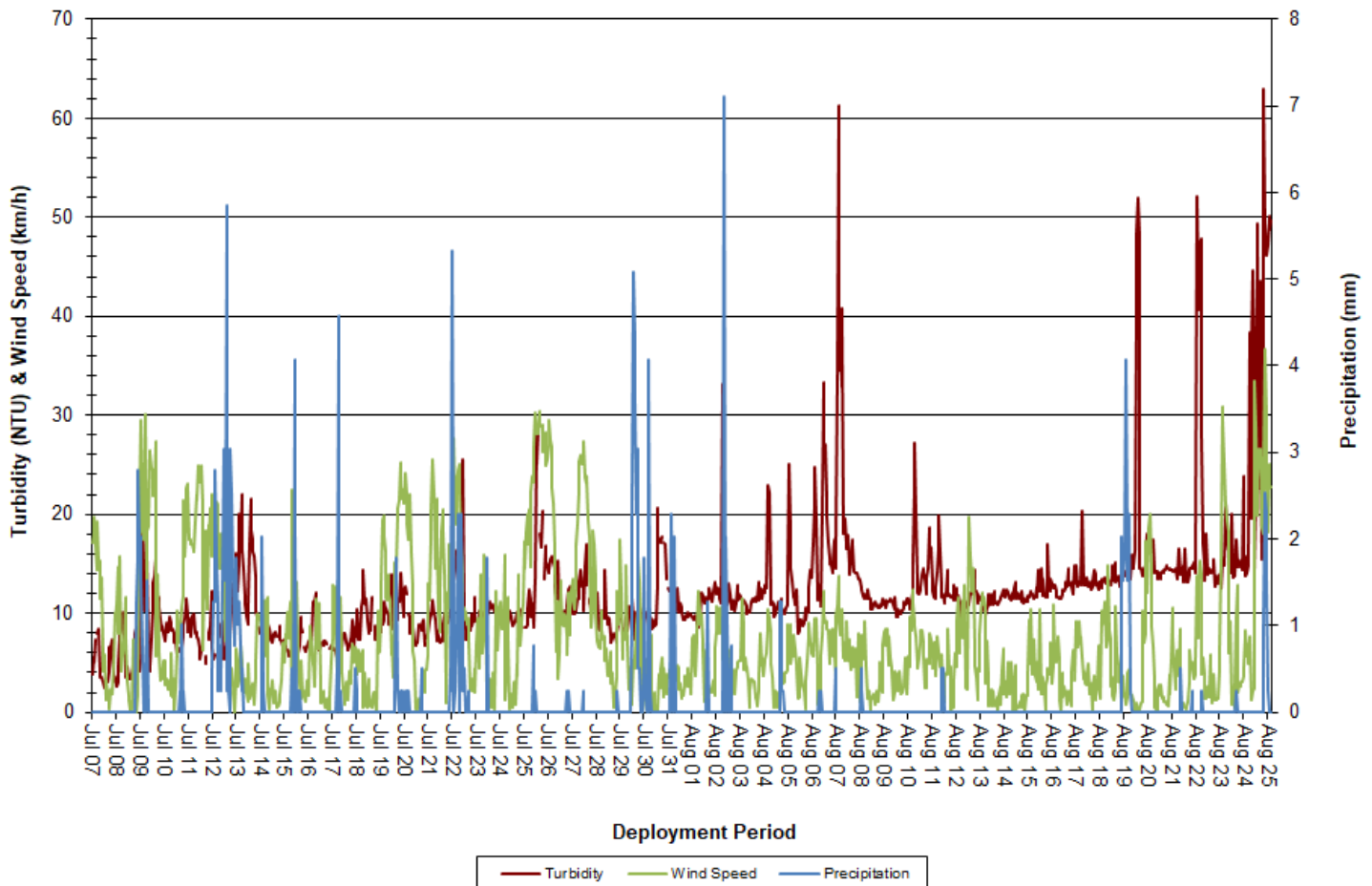


Figure 25: Turbidity, Precipitation & Wind Speed at Churchill River at English Point

Stage

- Over the deployment period, stage ranged from -0.383m to 0.522m, with a median value of 0.037m (Figure 26). Precipitation data was obtained from the Churchill River at End of Mud Lake Road Weather Station.
- Stage fluctuates considerably at this location due to the tidal influences of the Atlantic Ocean. This pattern is consistent over the deployment period. Increases in stage often correlate with precipitation events.
- Water Survey of Canada (Environment and Climate Change Canada) is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.

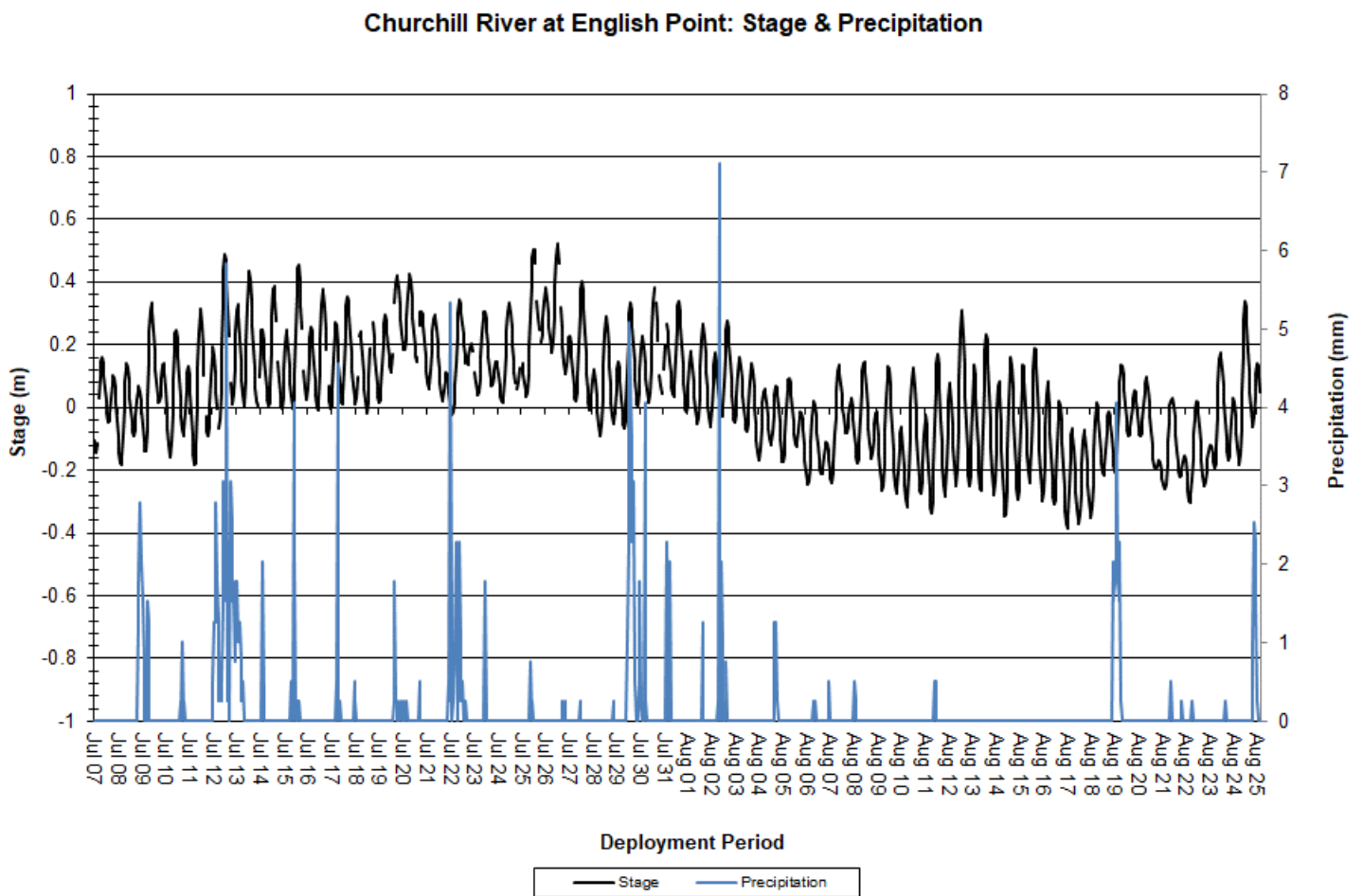


Figure 26: Stage & Precipitation at Churchill River at English Point

Conclusions

- Instruments at four water quality monitoring stations on the Lower Churchill River were deployed from July 6/7/19 through August 25/26, 2022.
- Water temperature increased steadily at all stations over the course of deployment. This is to be expected based on ambient air temperature trends during the same period through July and August.
- pH was relatively stable at all stations over the course of deployment. pH was within the CCME's Guidelines for the Protection of Aquatic Life for the majority of deployment at Churchill River above Grizzle Rapids, below Muskrat Falls and at English Point. pH was well below the minimum Guideline at Churchill River below Metchin River.
- Specific conductivity generally increased over the course of deployment at all stations. Since English Point is influenced by tides in Lake Melville, specific conductivity values at the Churchill River at English Point station had a much wider range, which is comparable to other deployments at this location.
- Dissolved oxygen levels slowly decreased over the course of deployment at all stations as water temperatures increased through the summer. Dissolved oxygen levels are generally higher in water at cooler temperatures. Dissolved oxygen levels eventually fell below the CCME's Guideline for the Protection of Early Life Stages at some point during deployment at all stations. Dissolved oxygen levels were above the CCME's Guideline for the Protection of Other Life Stages for the duration of deployment at all stations.
- Turbidity events occurred at all stations and were generally related to precipitation, wind or tidal events. In most cases, turbidity values returned to background levels following each observed event; however, sediment build-up around the turbidity sensors likely occurred at Churchill River below Metchin River and above Grizzle Rapids, leading to inaccurate readings.

References

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- Fondriest Environmental Inc. (2016a). Fundamentals of Environmental Measurements [Online]. Available at: <http://www.fondriest.com/environmental-measurements/parameters/water-quality/conductivity-salinity-tds/#cond15> [Accessed November 23, 2022].
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- United States Geological Survey. (2017). Water properties: Dissolved oxygen [Online]. Available at: <https://water.usgs.gov/edu/dissolvedoxygen.html> [Accessed November 23, 2022].

APPENDIX A

Water Parameter Description

Water Parameter Description

Dissolved Oxygen - The amount of Dissolved Oxygen (DO) (mg/l or % saturation) in the water is vital to aquatic organisms for their survival. 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 (USGS, 2017).

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 a measure of the relative amount of free hydrogen and hydroxyl ions in water. pH is an important indicator of chemically changing water, and determines the solubility and biological availability of nutrients and heavy metals in the water (USGS, 2017).

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 (Fondriest Environmental Inc, 2016).

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 aquatic processes. 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. In turn, water temperature has an influence on the metabolic rates and biological activity of aquatic organisms (Fondriest Environmental Inc, 2016b).

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 (Swenson 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 (Swenson and Baldwin 1965).

APPENDIX B
Grab Sample Results



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Bureau Veritas Job #: C2L3227
Report Date: 2022/08/11

NL Department of Environment, Climate Change and
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Client Project #: RTWQ
Site Location: LABRADOR
Your P.O. #: 220028978-6

Sample Details/Parameters	A	Result	RDL	UNITS	Extracted	Analyzed	By	Batch
THQ454 CR BELOW MR								
Sampling Date		2022/07/19 13:00						
Matrix		W						
Sample #		2022-6313-00-SI-SP						
Registration #		WS-0-0000						
RESULTS OF ANALYSES OF WATER								
Calculated Parameters								
Hardness (CaCO3)	-	9.3	1.0	mg/L	N/A	2022/08/10		8137781
Nitrate (N)	-	ND	0.050	mg/L	N/A	2022/08/04		8137785
Total dissolved solids (calc., EC)	-	10	1.0	mg/L	N/A	2022/08/03		8137821
Inorganics								
Conductivity	-	18	1.0	uS/cm	N/A	2022/08/02	NGI	8141682
Chloride (Cl-)	-	ND	1.0	mg/L	N/A	2022/08/03	LKH	8144160
Bromide (Br-)	-	ND	1.0	mg/L	N/A	2022/08/03	LKH	8144160
Sulphate (SO4)	-	ND	1.0	mg/L	N/A	2022/08/03	LKH	8144160
Total Alkalinity (Total as CaCO3)	-	8.0	2.0	mg/L	N/A	2022/08/02	NGI	8141684
Colour	-	33	5.0	TCU	N/A	2022/08/04	TGO	8143902
Dissolved Fluoride (F-)	-	ND	0.10	mg/L	N/A	2022/08/03	NGI	8141685
Total Kjeldahl Nitrogen (TKN)	-	0.12	0.10	mg/L	2022/08/04	2022/08/05	RTY	8147915
Nitrate + Nitrite (N)	-	ND	0.050	mg/L	N/A	2022/08/03	TGO	8143904
Nitrite (N)	-	ND	0.010	mg/L	N/A	2022/08/03	TGO	8143905
Nitrogen (Ammonia Nitrogen)	-	ND	0.050	mg/L	N/A	2022/08/02	TGO	8141634
Dissolved Organic Carbon (C)	-	4.9	0.50	mg/L	N/A	2022/08/02	KMC	8138119
Total Organic Carbon (C)	-	4.8	0.50	mg/L	N/A	2022/08/02	KMC	8138114
pH	-	6.97		pH	N/A	2022/08/02	NGI	8141683
Total Phosphorus	-	0.021	0.004	mg/L	2022/08/03	2022/08/05	SSV	8145071
Total Suspended Solids	-	12	1.0	mg/L	2022/07/29	2022/07/29	RMK	8137996
Turbidity	-	3.0	0.10	NTU	N/A	2022/08/03	NGI	8143950
MERCURY BY COLD VAPOUR AA (WATER)								
Metals								
Total Mercury (Hg)	-	ND	0.000013	mg/L	2022/07/29	2022/08/02	FJO	8138417
ELEMENTS BY ICP/MS (WATER)								
Metals								
Total Aluminum (Al)	-	0.29	0.0050	mg/L	2022/08/08	2022/08/09	JHY	8153038
Total Antimony (Sb)	-	ND	0.0010	mg/L	2022/08/08	2022/08/09	JHY	8153038
Total Arsenic (As)	-	ND	0.0010	mg/L	2022/08/08	2022/08/09	JHY	8153038
Total Barium (Ba)	-	0.011	0.0010	mg/L	2022/08/08	2022/08/09	JHY	8153038
Total Boron (B)	-	ND	0.050	mg/L	2022/08/08	2022/08/09	JHY	8153038
Total Cadmium (Cd)	-	ND	0.000010	mg/L	2022/08/08	2022/08/09	JHY	8153038
Total Calcium (Ca)	-	2.3	0.10	mg/L	2022/08/08	2022/08/09	JHY	8153038
Total Chromium (Cr)	-	0.0011	0.0010	mg/L	2022/08/08	2022/08/09	JHY	8153038
Total Copper (Cu)	-	0.0014	0.00050	mg/L	2022/08/08	2022/08/09	JHY	8153038
Total Iron (Fe)	-	0.48	0.050	mg/L	2022/08/08	2022/08/09	JHY	8153038
Total Lead (Pb)	-	ND	0.00050	mg/L	2022/08/08	2022/08/09	JHY	8153038
Total Magnesium (Mg)	-	0.86	0.10	mg/L	2022/08/08	2022/08/09	JHY	8153038



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Bureau Veritas Job #: C2L3227
Report Date: 2022/08/11

NL Department of Environment, Climate Change and
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Client Project #: RTWQ
Site Location: LABRADOR
Your P.O. #: 220028978-6

Sample Details/Parameters	A	Result	RDL	UNITS	Extracted	Analyzed	By	Batch
THQ454 CR BELOW MR								
Sampling Date		2022/07/19 13:00						
Matrix		W						
Sample #		2022-6313-00-SI-SP						
Registration #		WS-0-0000						
ELEMENTS BY ICP/MS (WATER)								
Metals								
Total Manganese (Mn)	-	0.019	0.0020	mg/L	2022/08/08	2022/08/09	JHY	8153038
Total Nickel (Ni)	-	ND	0.0020	mg/L	2022/08/08	2022/08/09	JHY	8153038
Total Phosphorus (P)	-	ND	0.10	mg/L	2022/08/08	2022/08/09	JHY	8153038
Total Potassium (K)	-	0.38	0.10	mg/L	2022/08/08	2022/08/09	JHY	8153038
Total Selenium (Se)	-	ND	0.00050	mg/L	2022/08/08	2022/08/09	JHY	8153038
Total Sodium (Na)	-	0.61	0.10	mg/L	2022/08/08	2022/08/09	JHY	8153038
Total Strontium (Sr)	-	0.011	0.0020	mg/L	2022/08/08	2022/08/09	JHY	8153038
Total Uranium (U)	-	ND	0.00010	mg/L	2022/08/08	2022/08/09	JHY	8153038
Total Zinc (Zn)	-	ND	0.0050	mg/L	2022/08/08	2022/08/09	JHY	8153038



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Bureau Veritas Job #: C2J1370
Report Date: 2022/07/26

NL Department of Environment, Climate Change and
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Client Project #: RTWQ
Site Location: LABRADOR
Your P.O. #: 220028978-6

Sample Details/Parameters	A	Result	RDL	UNITS	Extracted	Analyzed	By	Batch
TCZ020 CR ABOVE GR								
Sampling Date		2022/07/06 11:35						
Matrix		W						
Sample #		2022-6309-00-SI-SP						
RESULTS OF ANALYSES OF WATER								
Calculated Parameters								
Hardness (CaCO3)	-	7.9	1.0	mg/L	N/A	2022/07/26		8101408
Nitrate (N)	-	ND	0.050	mg/L	N/A	2022/07/15		8101411
Total dissolved solids (calc., EC)	-	10	1.0	mg/L	N/A	2022/07/15		8101569
Inorganics								
Conductivity	-	19	1.0	uS/cm	N/A	2022/07/14	NGI	8108371
Chloride (Cl-)	-	ND	1.0	mg/L	N/A	2022/07/15	LKH	8111212
Bromide (Br-)	-	ND	1.0	mg/L	N/A	2022/07/15	LKH	8111212
Sulphate (SO4)	-	ND	1.0	mg/L	N/A	2022/07/15	LKH	8111212
Total Alkalinity (Total as CaCO3)	-	8.4	2.0	mg/L	N/A	2022/07/14	NGI	8108374
Colour	-	29	5.0	TCU	N/A	2022/07/18	MCN	8110906
Dissolved Fluoride (F-)	-	ND	0.10	mg/L	N/A	2022/07/14	NGI	8108375
Total Kjeldahl Nitrogen (TKN)	-	ND	0.10	mg/L	2022/07/19	2022/07/20	MJ1	8117774
Nitrate + Nitrite (N)	-	ND	0.050	mg/L	N/A	2022/07/15	MCN	8110908
Nitrite (N)	-	ND	0.010	mg/L	N/A	2022/07/15	MCN	8110909
Nitrogen (Ammonia Nitrogen)	-	ND	0.050	mg/L	N/A	2022/07/18	MCN	8114367
Dissolved Organic Carbon (C)	-	4.5	0.50	mg/L	N/A	2022/07/15	JHH	8108326
Total Organic Carbon (C)	-	4.4	0.50	mg/L	N/A	2022/07/18	JHH	8114845
pH	-	6.98		pH	N/A	2022/07/14	NGI	8108372
Total Phosphorus	-	ND	0.004	mg/L	2022/07/18	2022/07/20	SSV	8116118
Total Suspended Solids	-	1.2	1.0	mg/L	2022/07/13	2022/07/14	A1M	8106734
Turbidity	-	0.56	0.10	NTU	N/A	2022/07/20	NGI	8119648
MERCURY BY COLD VAPOUR AA (WATER)								
Metals								
Total Mercury (Hg)	-	ND	0.000013	mg/L	2022/07/21	2022/07/21	FJO	8119141
ELEMENTS BY ICP/MS (WATER)								
Metals								
Total Aluminum (Al)	-	0.051	0.0050	mg/L	2022/07/22	2022/07/25	JHY	8124628
Total Antimony (Sb)	-	ND	0.0010	mg/L	2022/07/22	2022/07/25	JHY	8124628
Total Arsenic (As)	-	ND	0.0010	mg/L	2022/07/22	2022/07/25	JHY	8124628
Total Barium (Ba)	-	0.0071	0.0010	mg/L	2022/07/22	2022/07/25	JHY	8124628
Total Boron (B)	-	ND	0.050	mg/L	2022/07/22	2022/07/25	JHY	8124628
Total Cadmium (Cd)	-	ND	0.000010	mg/L	2022/07/22	2022/07/25	JHY	8124628
Total Calcium (Ca)	-	2.1	0.10	mg/L	2022/07/22	2022/07/25	JHY	8124628
Total Chromium (Cr)	-	0.0015	0.0010	mg/L	2022/07/22	2022/07/25	JHY	8124628
Total Copper (Cu)	-	0.00052	0.00050	mg/L	2022/07/22	2022/07/25	JHY	8124628
Total Iron (Fe)	-	0.13	0.050	mg/L	2022/07/22	2022/07/25	JHY	8124628
Total Lead (Pb)	-	ND	0.00050	mg/L	2022/07/22	2022/07/25	JHY	8124628
Total Magnesium (Mg)	-	0.66	0.10	mg/L	2022/07/22	2022/07/25	JHY	8124628
Total Manganese (Mn)	-	0.0078	0.0020	mg/L	2022/07/22	2022/07/25	JHY	8124628



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Bureau Veritas Job #: C2J1370
Report Date: 2022/07/26

NL Department of Environment, Climate Change and
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Client Project #: RTWQ
Site Location: LABRADOR
Your P.O. #: 220028978-6

Sample Details/Parameters	A	Result	RDL	UNITS	Extracted	Analyzed	By	Batch
TCZ020 CR ABOVE GR								
Sampling Date		2022/07/06 11:35						
Matrix		W						
Sample #		2022-6309-00-SI-SP						
ELEMENTS BY ICP/MS (WATER)								
Metals								
Total Nickel (Ni)	-	ND	0.0020	mg/L	2022/07/22	2022/07/25	JHY	8124628
Total Phosphorus (P)	-	ND	0.10	mg/L	2022/07/22	2022/07/25	JHY	8124628
Total Potassium (K)	-	0.28	0.10	mg/L	2022/07/22	2022/07/25	JHY	8124628
Total Selenium (Se)	-	ND	0.00050	mg/L	2022/07/22	2022/07/25	JHY	8124628
Total Sodium (Na)	-	0.70	0.10	mg/L	2022/07/22	2022/07/25	JHY	8124628
Total Strontium (Sr)	-	0.011	0.0020	mg/L	2022/07/22	2022/07/25	JHY	8124628
Total Uranium (U)	-	ND	0.00010	mg/L	2022/07/22	2022/07/25	JHY	8124628
Total Zinc (Zn)	-	ND	0.0050	mg/L	2022/07/22	2022/07/25	JHY	8124628



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Bureau Veritas Job #: C2J1370
Report Date: 2022/07/26

NL Department of Environment, Climate Change and
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Client Project #: RTWQ
Site Location: LABRADOR
Your P.O. #: 220028978-6

Sample Details/Parameters	A	Result	RDL	UNITS	Extracted	Analyzed	By	Batch
TCZ021 CR BELOW MF								
Sampling Date		2022/07/06 14:55						
Matrix		W						
Sample #		2022-6310-00-SI-SP						
RESULTS OF ANALYSES OF WATER								
Calculated Parameters								
Hardness (CaCO3)	-	7.5	1.0	mg/L	N/A	2022/07/26		8101408
Nitrate (N)	-	ND	0.050	mg/L	N/A	2022/07/15		8101411
Total dissolved solids (calc., EC)	-	9.3	1.0	mg/L	N/A	2022/07/15		8101569
Inorganics								
Conductivity	-	17	1.0	uS/cm	N/A	2022/07/14	NGI	8108371
Chloride (Cl-)	-	ND	1.0	mg/L	N/A	2022/07/15	LKH	8111212
Bromide (Br-)	-	ND	1.0	mg/L	N/A	2022/07/15	LKH	8111212
Sulphate (SO4)	-	ND	1.0	mg/L	N/A	2022/07/15	LKH	8111212
Total Alkalinity (Total as CaCO3)	-	4.8	2.0	mg/L	N/A	2022/07/14	NGI	8108374
Colour	-	33	5.0	TCU	N/A	2022/07/18	MCN	8110906
Dissolved Fluoride (F-)	-	ND	0.10	mg/L	N/A	2022/07/14	NGI	8108375
Total Kjeldahl Nitrogen (TKN)	-	ND	0.10	mg/L	2022/07/19	2022/07/20	MJ1	8117774
Nitrate + Nitrite (N)	-	ND	0.050	mg/L	N/A	2022/07/15	MCN	8110908
Nitrite (N)	-	ND	0.010	mg/L	N/A	2022/07/15	MCN	8110909
Nitrogen (Ammonia Nitrogen)	-	ND	0.050	mg/L	N/A	2022/07/18	MCN	8114367
Dissolved Organic Carbon (C)	-	4.5	0.50	mg/L	N/A	2022/07/15	JHH	8108680
Total Organic Carbon (C)	-	4.5	0.50	mg/L	N/A	2022/07/19	JHH	8115151
pH	-	6.97		pH	N/A	2022/07/14	NGI	8108372
Total Phosphorus	-	ND	0.004	mg/L	2022/07/18	2022/07/20	SSV	8116118
Total Suspended Solids	-	3.6	1.0	mg/L	2022/07/13	2022/07/14	A1M	8106734
Turbidity	-	2.7	0.10	NTU	N/A	2022/07/20	NGI	8119648
MERCURY BY COLD VAPOUR AA (WATER)								
Metals								
Total Mercury (Hg)	-	ND	0.000013	mg/L	2022/07/21	2022/07/21	FJO	8119141
ELEMENTS BY ICP/MS (WATER)								
Metals								
Total Aluminum (Al)	-	0.22	0.0050	mg/L	2022/07/22	2022/07/25	JHY	8124628
Total Antimony (Sb)	-	ND	0.0010	mg/L	2022/07/22	2022/07/25	JHY	8124628
Total Arsenic (As)	-	ND	0.0010	mg/L	2022/07/22	2022/07/25	JHY	8124628
Total Barium (Ba)	-	0.0080	0.0010	mg/L	2022/07/22	2022/07/25	JHY	8124628
Total Boron (B)	-	ND	0.050	mg/L	2022/07/22	2022/07/25	JHY	8124628
Total Cadmium (Cd)	-	ND	0.000010	mg/L	2022/07/22	2022/07/25	JHY	8124628
Total Calcium (Ca)	-	1.9	0.10	mg/L	2022/07/22	2022/07/25	JHY	8124628
Total Chromium (Cr)	-	ND	0.0010	mg/L	2022/07/22	2022/07/25	JHY	8124628
Total Copper (Cu)	-	0.00067	0.00050	mg/L	2022/07/22	2022/07/25	JHY	8124628
Total Iron (Fe)	-	0.27	0.050	mg/L	2022/07/22	2022/07/25	JHY	8124628
Total Lead (Pb)	-	ND	0.00050	mg/L	2022/07/22	2022/07/25	JHY	8124628
Total Magnesium (Mg)	-	0.66	0.10	mg/L	2022/07/22	2022/07/25	JHY	8124628
Total Manganese (Mn)	-	0.011	0.0020	mg/L	2022/07/22	2022/07/25	JHY	8124628



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Bureau Veritas Job #: C2J1370
Report Date: 2022/07/26

NL Department of Environment, Climate Change and
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Client Project #: RTWQ
Site Location: LABRADOR
Your P.O. #: 220028978-6

Sample Details/Parameters	A	Result	RDL	UNITS	Extracted	Analyzed	By	Batch
TCZ021 CR BELOW MF								
Sampling Date		2022/07/06 14:55						
Matrix		W						
Sample #		2022-6310-00-SI-SP						
ELEMENTS BY ICP/MS (WATER)								
Metals								
Total Nickel (Ni)	-	ND	0.0020	mg/L	2022/07/22	2022/07/25	JHY	8124628
Total Phosphorus (P)	-	ND	0.10	mg/L	2022/07/22	2022/07/25	JHY	8124628
Total Potassium (K)	-	0.33	0.10	mg/L	2022/07/22	2022/07/25	JHY	8124628
Total Selenium (Se)	-	ND	0.00050	mg/L	2022/07/22	2022/07/25	JHY	8124628
Total Sodium (Na)	-	0.66	0.10	mg/L	2022/07/22	2022/07/25	JHY	8124628
Total Strontium (Sr)	-	0.010	0.0020	mg/L	2022/07/22	2022/07/25	JHY	8124628
Total Uranium (U)	-	ND	0.00010	mg/L	2022/07/22	2022/07/25	JHY	8124628
Total Zinc (Zn)	-	ND	0.0050	mg/L	2022/07/22	2022/07/25	JHY	8124628



BUREAU
VERITAS

Bureau Veritas Job #: C2J1370
Report Date: 2022/07/26

NL Department of Environment, Climate Change and
Municipalities
Client Project #: RTWQ
Site Location: LABRADOR
Your P.O. #: 220028978-6

Sample Details/Parameters	A	Result	RDL	UNITS	Extracted	Analyzed	By	Batch
TCZ023 CR @ EP								
Sampling Date		2022/07/06 11:15						
Matrix		W						
Sample #		2022-6312-00-SI-SP						
RESULTS OF ANALYSES OF WATER								
Calculated Parameters								
Hardness (CaCO3)	-	8.4	1.0	mg/L	N/A	2022/07/26		8101408
Nitrate (N)	-	ND	0.050	mg/L	N/A	2022/07/15		8101411
Total dissolved solids (calc., EC)	-	14	1.0	mg/L	N/A	2022/07/20		8101569
Inorganics								
Conductivity	-	25	1.0	uS/cm	N/A	2022/07/19	NGI	8116685
Chloride (Cl-)	-	2.1	1.0	mg/L	N/A	2022/07/15	LKH	8111212
Bromide (Br-)	-	ND	1.0	mg/L	N/A	2022/07/15	LKH	8111212
Sulphate (SO4)	-	ND	1.0	mg/L	N/A	2022/07/15	LKH	8111212
Total Alkalinity (Total as CaCO3)	-	7.5	2.0	mg/L	N/A	2022/07/19	NGI	8116688
Colour	-	28	25	TCU	N/A	2022/07/18	MCN	8110906
Dissolved Fluoride (F-)	-	ND	0.10	mg/L	N/A	2022/07/19	NGI	8116690
Total Kjeldahl Nitrogen (TKN)	-	0.10	0.10	mg/L	2022/07/19	2022/07/20	MJ1	8117774
Nitrate + Nitrite (N)	-	ND	0.050	mg/L	N/A	2022/07/15	MCN	8110908
Nitrite (N)	-	ND	0.010	mg/L	N/A	2022/07/15	MCN	8110909
Nitrogen (Ammonia Nitrogen)	-	ND	0.050	mg/L	N/A	2022/07/19	MCN	8117092
Dissolved Organic Carbon (C)	-	4.5	0.50	mg/L	N/A	2022/07/19	JHH	8114878
Total Organic Carbon (C)	-	4.7	0.50	mg/L	N/A	2022/07/19	JHH	8114857
pH	-	6.87		pH	N/A	2022/07/19	NGI	8116687
Total Phosphorus	-	0.006	0.004	mg/L	2022/07/18	2022/07/20	SSV	8116118
Total Suspended Solids	-	9.0	1.0	mg/L	2022/07/13	2022/07/14	A1M	8106734
Turbidity	-	7.3	0.10	NTU	N/A	2022/07/15	NGI	8110964
MERCURY BY COLD VAPOUR AA (WATER)								
Metals								
Total Mercury (Hg)	-	ND	0.000013	mg/L	2022/07/21	2022/07/21	FJO	8119141
ELEMENTS BY ICP/MS (WATER)								
Metals								
Total Aluminum (Al)	-	0.29	0.0050	mg/L	2022/07/22	2022/07/25	JHY	8124628
Total Antimony (Sb)	-	ND	0.0010	mg/L	2022/07/22	2022/07/25	JHY	8124628
Total Arsenic (As)	-	ND	0.0010	mg/L	2022/07/22	2022/07/25	JHY	8124628
Total Barium (Ba)	-	0.0085	0.0010	mg/L	2022/07/22	2022/07/25	JHY	8124628
Total Boron (B)	-	ND	0.050	mg/L	2022/07/22	2022/07/25	JHY	8124628
Total Cadmium (Cd)	-	ND	0.000010	mg/L	2022/07/22	2022/07/25	JHY	8124628
Total Calcium (Ca)	-	2.0	0.10	mg/L	2022/07/22	2022/07/25	JHY	8124628
Total Chromium (Cr)	-	ND	0.0010	mg/L	2022/07/22	2022/07/25	JHY	8124628
Total Copper (Cu)	-	0.00084	0.00050	mg/L	2022/07/22	2022/07/25	JHY	8124628
Total Iron (Fe)	-	0.43	0.050	mg/L	2022/07/22	2022/07/25	JHY	8124628
Total Lead (Pb)	-	ND	0.00050	mg/L	2022/07/22	2022/07/25	JHY	8124628
Total Magnesium (Mg)	-	0.82	0.10	mg/L	2022/07/22	2022/07/25	JHY	8124628
Total Manganese (Mn)	-	0.013	0.0020	mg/L	2022/07/22	2022/07/25	JHY	8124628



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VERITAS

Bureau Veritas Job #: C2J1370
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Client Project #: RTWQ
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Your P.O. #: 220028978-6

Sample Details/Parameters	A	Result	RDL	UNITS	Extracted	Analyzed	By	Batch
TCZ023 CR @ EP								
Sampling Date 2022/07/06 11:15								
Matrix W								
Sample # 2022-6312-00-SI-SP								
ELEMENTS BY ICP/MS (WATER)								
Metals								
Total Nickel (Ni)	-	ND	0.0020	mg/L	2022/07/22	2022/07/25	JHY	8124628
Total Phosphorus (P)	-	ND	0.10	mg/L	2022/07/22	2022/07/25	JHY	8124628
Total Potassium (K)	-	0.41	0.10	mg/L	2022/07/22	2022/07/25	JHY	8124628
Total Selenium (Se)	-	ND	0.00050	mg/L	2022/07/22	2022/07/25	JHY	8124628
Total Sodium (Na)	-	1.9	0.10	mg/L	2022/07/22	2022/07/25	JHY	8124628
Total Strontium (Sr)	-	0.013	0.0020	mg/L	2022/07/22	2022/07/25	JHY	8124628
Total Uranium (U)	-	ND	0.00010	mg/L	2022/07/22	2022/07/25	JHY	8124628
Total Zinc (Zn)	-	ND	0.0050	mg/L	2022/07/22	2022/07/25	JHY	8124628