# Real-Time Water Quality Deployment Report

## Lower Churchill River Network

**August 17/18 to**
**September 28, 2021**

Newfoundland Labrador

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

## Contents



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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 below Muskrat Falls on August 17th. An instrument was deployed at Churchill River at English Point on August 18th.
- The instrument at Churchill River at English Point was removed on September 28th for deployment period of 41 days.
- The instruments at Churchill River above Grizzle Rapids and below Muskrat Falls were not removed from the water due to poor weather preventing access to these sites; however, for the purposes of this report, data from these stations will be reported as if the instruments had been removed on September 28th, for a deployment period of 42 days.
- The instrument at Churchill River below Metchin River was also not removed from the water due to poor weather preventing access to this site; however, for the purposes of this report, data from this station will be reported as if it had been deployed on August 18th and removed on September 28th, for a deployment period of 41 days.
- The station at Churchill River above Muskrat Falls was not able to be deployed during this deployment period. This station was relocated in October 2016 as it was situated in the flood zone of the Muskrat Falls Reservoir and needed to be moved back to ensure the station did not flood as the reservoir water levels were raised. Even at raised water levels, the above Muskrat Falls station is situated quite far from the water, making it impractical to install monitoring equipment. Additionally, safety requirements with regards to working in and around the reservoir for the Muskrat Falls project further hindered the ability to deploy the instrument at this station.

## 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**

| | **Rank** | | | | |
|---|---|---|---|---|---|
| **Parameter** | **Excellent** | **Good** | **Fair** | **Marginal** | **Poor** |
| Temperature (C) | <=+/-0.2 | >+/-0.2 to 0.5 | >+/-0.5 to 0.8 | >+/-0.8 to 1 | <+/-1 |
| pH (unit) | <=+/-0.2 | >+/-0.2 to 0.5 | >+/-0.5 to 0.8 | >+/-0.8 to 1 | >+/-1 |
| Sp. Conductance (µS/cm) | <=+/-3 | >+/-3 to 10 | >+/-10 to 15 | >+/-15 to 20 | >+/-20 |
| Sp. Conductance > 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 August 17/18 to September 28, 2021 are summarized in Table 2.

**Table 2: Comparison rankings for Lower Churchill River stations August 17/18 to September 28, 2021**

| Churchill River Station | Date | Action | Comparison Ranking | | | | |
|---|---|---|---|---|---|---|---|
| | | | Temperature | pH | Conductivity | Dissolved Oxygen | Turbidity |
| Below Metchin River | August 18, 2021 | Deployment | N/A | N/A | N/A | N/A | N/A |
| | September 28, 2021 | Removal | N/A | N/A | N/A | N/A | N/A |
| Above Grizzle Rapids | August 17, 2021 | Deployment | Excellent | Good | Excellent | Excellent | Excellent |
| | September 28, 2021 | Removal | N/A | N/A | N/A | N/A | N/A |
| Below Muskrat Falls | August 17, 2021 | Deployment | Excellent | Good | Excellent | Excellent | Excellent |
| | September 28, 2021 | Removal | N/A | N/A | N/A | N/A | N/A |
| At English Point | August 18, 2021 | Deployment | Excellent | Good | Good | Excellent | Excellent |
| | September 28, 2021 | Removal | Good | Excellent | Excellent | Excellent | Excellent |
| Above Muskrat Falls | Not deployed | Deployment | N/A | N/A | N/A | N/A | N/A |
| | Not deployed | Removal | N/A | N/A | N/A | N/A | N/A |

- **Churchill River below Metchin River**
    - Comparison rankings are not available for deployment or removal since this instrument was not physically deployed or removed on the dates in question due to poor weather preventing access to the site.
- **Churchill River above Grizzle Rapids**
    - At deployment, all parameters ranked as either ‘excellent’ or ‘good’.
    - Comparison rankings are not available for removal since this instrument was not physically removed from the water on the date in question.
- **Churchill River below Muskrat Falls**
    - At deployment, all parameters ranked as either ‘excellent’ or ‘good’.
    - Comparison rankings are not available for removal since this instrument was not physically removed from the water on the date in question.

- **Churchill River at English Point**
    - At deployment, all parameters ranked as either 'excellent' or 'good'.
    - At removal, all parameters again ranked as either 'excellent' or 'good'.

## Data Interpretation

- The following graphs and discussion illustrate water quality related events occurring from August 17/18 to September 28, 2021 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.

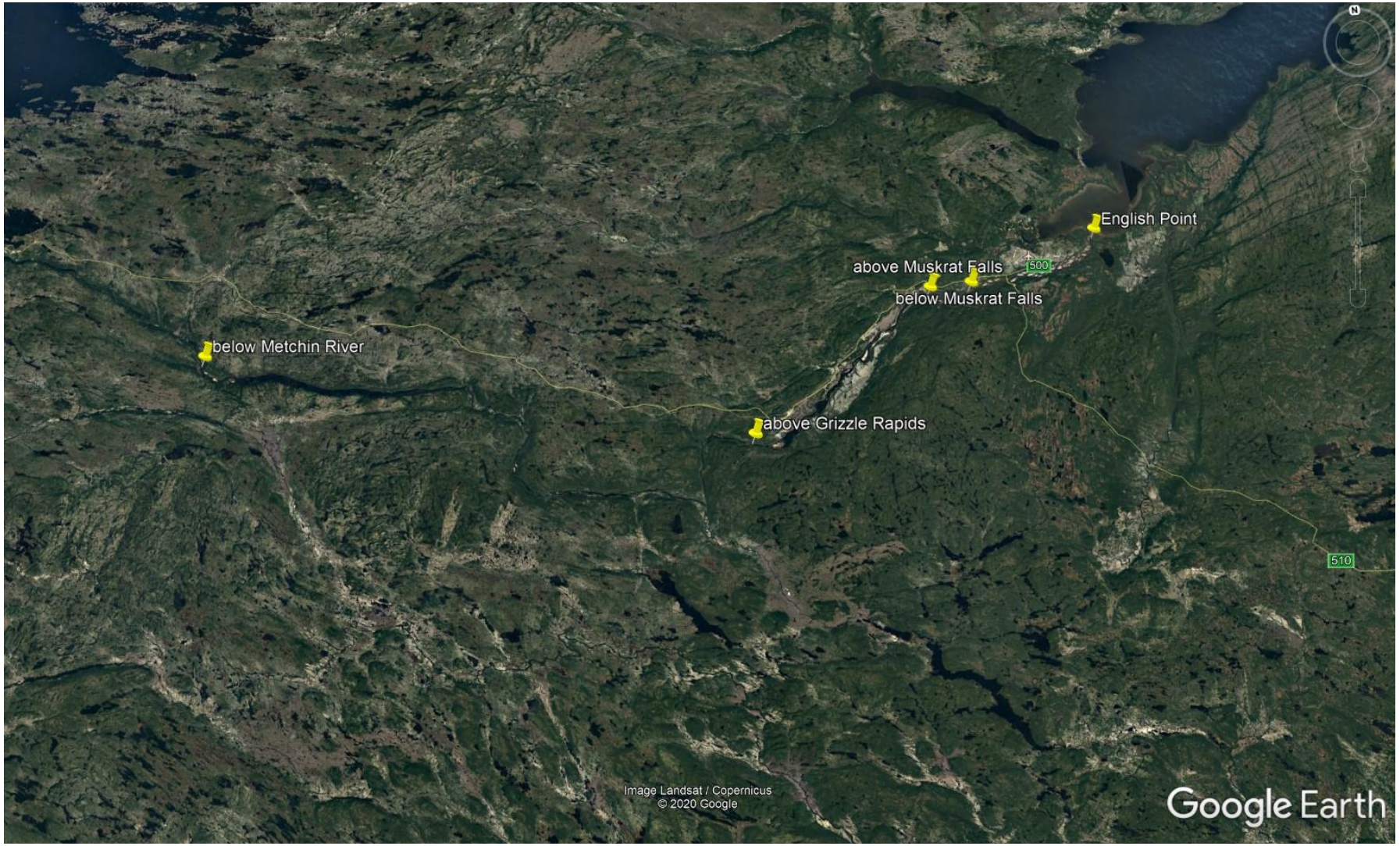


**Figure 1: Lower Churchill Network of Real-Time Water Quality Stations**

## Churchill River below Metchin River

### Water Temperature

- Over the deployment period, water temperature ranged from 10.6°C to 18.9°C, with a median value of 13.7°C (Figure 2). Air temperature data was obtained from the Metchin River near TLH Weather Station.
- Water temperature was slowly decreasing over the course of deployment, which is to be expected as air temperatures were also slowly decreasing into the fall season. Water temperature data exhibits a diurnal pattern as expected, 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.

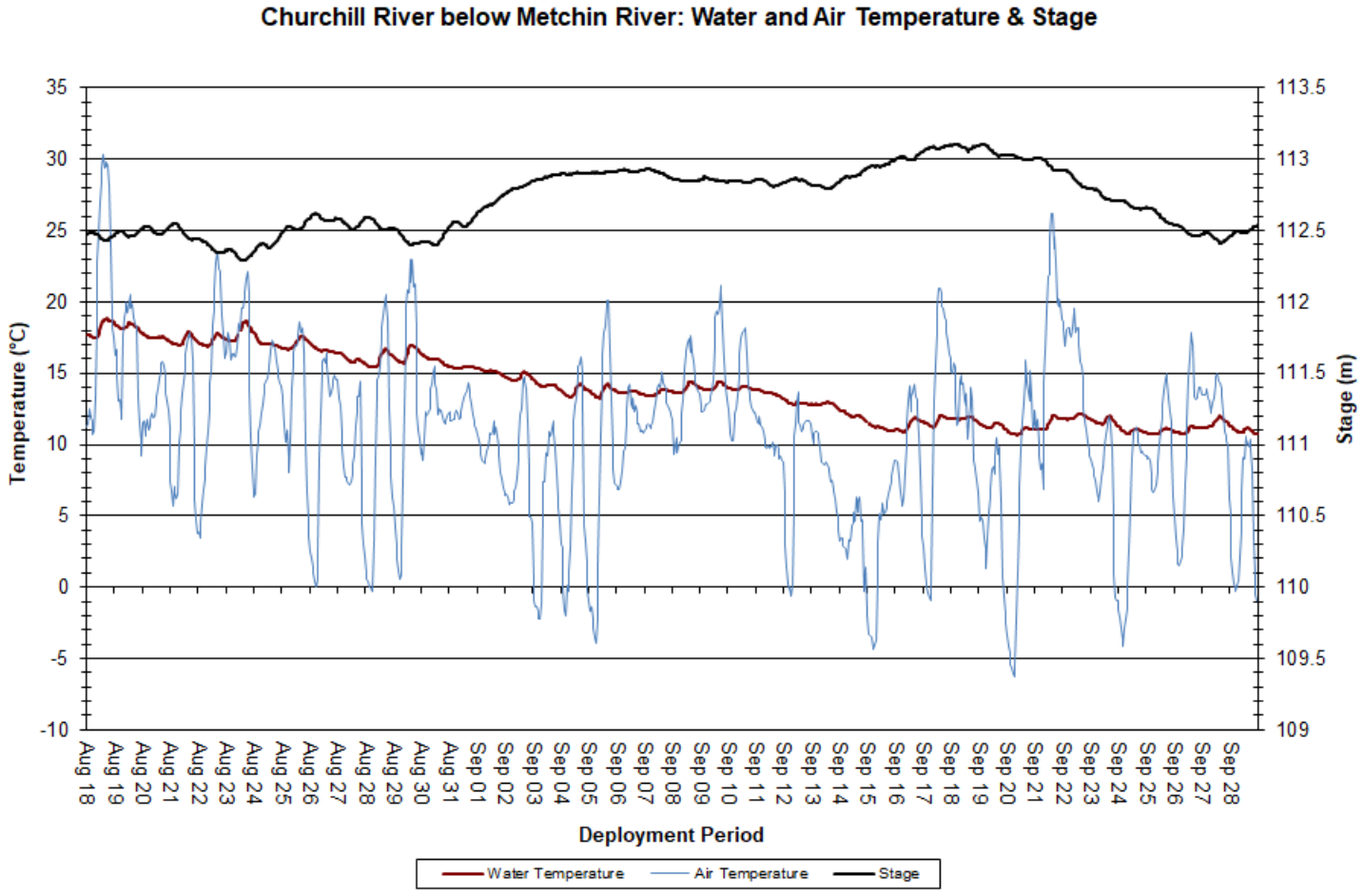


**Figure 2: Water and Air Temperature & Stage at Churchill River below Metchin River**

**pH**

- Over the deployment period, pH values ranged from 5.91 to 7.12 pH units, with a median value of 6.93 (Figure 3).
- pH values were quite stable over the majority of deployment, remaining within the CCME's Guidelines for the Protection of Aquatic Life until mid-September. After this, pH values fell below the CCME's Minimum Guideline, an occurrence which may be attributed to higher stage levels, sensor drift, or a combination of the two.
- 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.

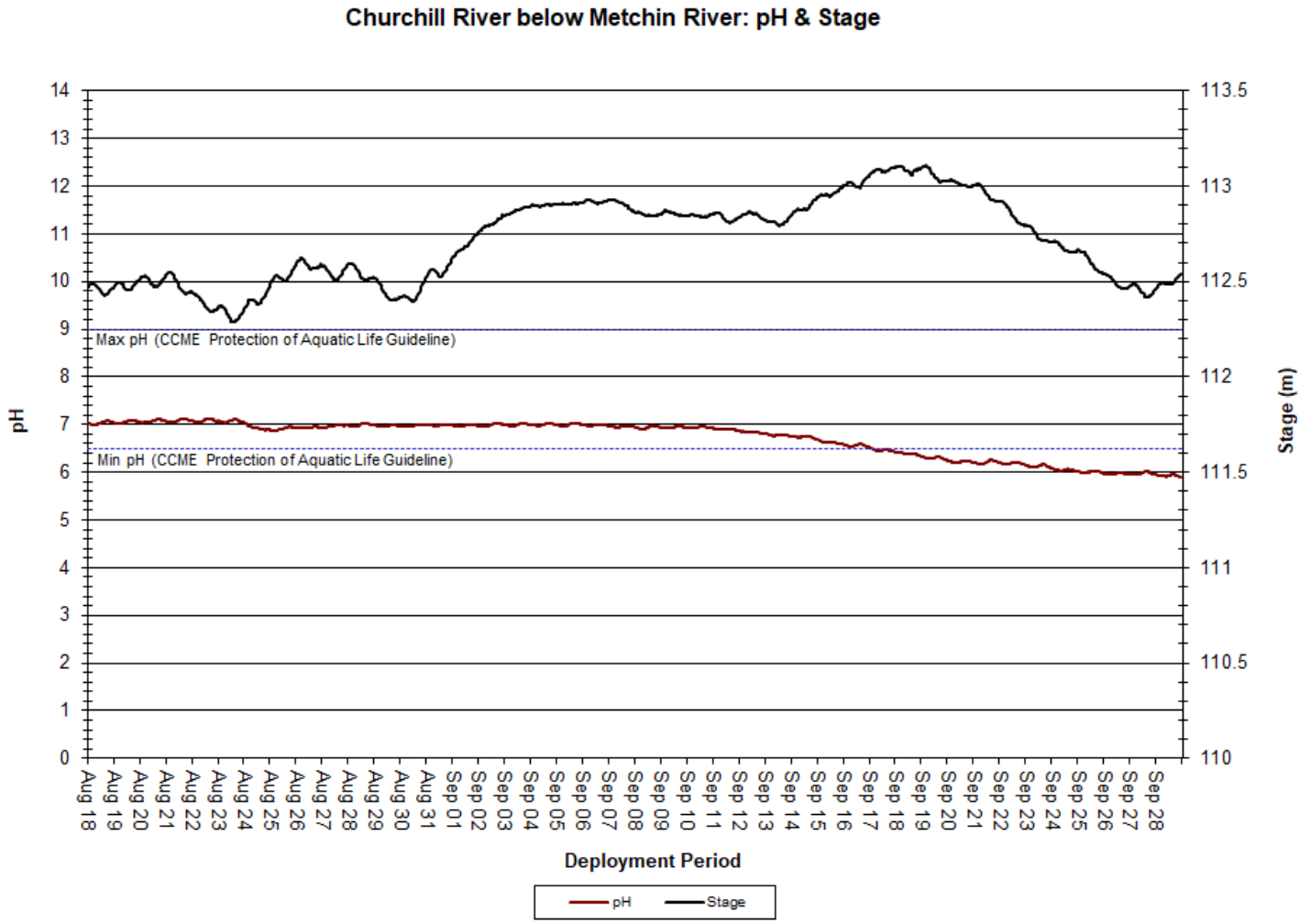


**Figure 3: pH & Stage at Churchill River below Metchin River**

**Specific Conductivity**

- Over the deployment period, specific conductivity ranged from 18.0µS/cm to 25.2µS/cm, with a median value of 19.6µS/cm (Figure 4).
- The relationship between conductivity and stage is generally inversed. 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).
- 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.

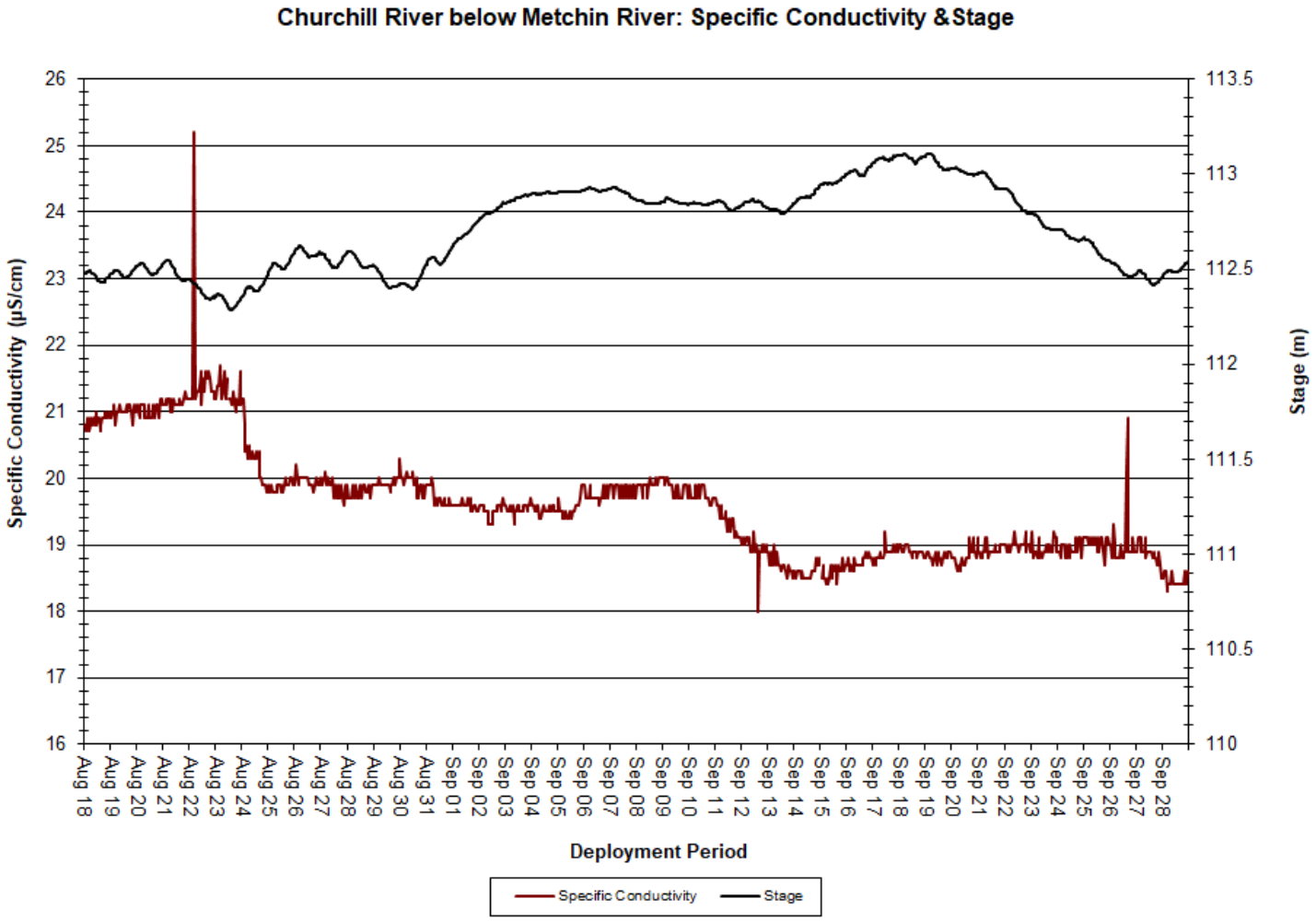


**Figure 4: Specific Conductivity & Stage at Churchill River below Metchin River**

**Dissolved Oxygen**

- Over the deployment period, dissolved oxygen content ranged from 8.96mg/L to 10.58mg/L, with a median value of 9.67mg/L. Saturation of dissolved oxygen ranged from 91.4% to 99.7%, with a median value of 94.1% (Figure 5).
- There is an evident relationship between water temperature and dissolved oxygen. Over the deployment period, dissolved oxygen levels were steadily increasing, as water temperatures were steadily decreasing. 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 beginning of deployment, which is to be expected as water temperatures were higher across the same period. Dissolved oxygen levels rose above the CCME's Guidelines for the Protection of Early Life Stages on September 2nd, and stayed there for the remainder of deployment as water temperatures continued to decrease. Dissolved oxygen levels remained above the CCME's Guideline for the Protection of Other Life Stages for the duration of deployment.

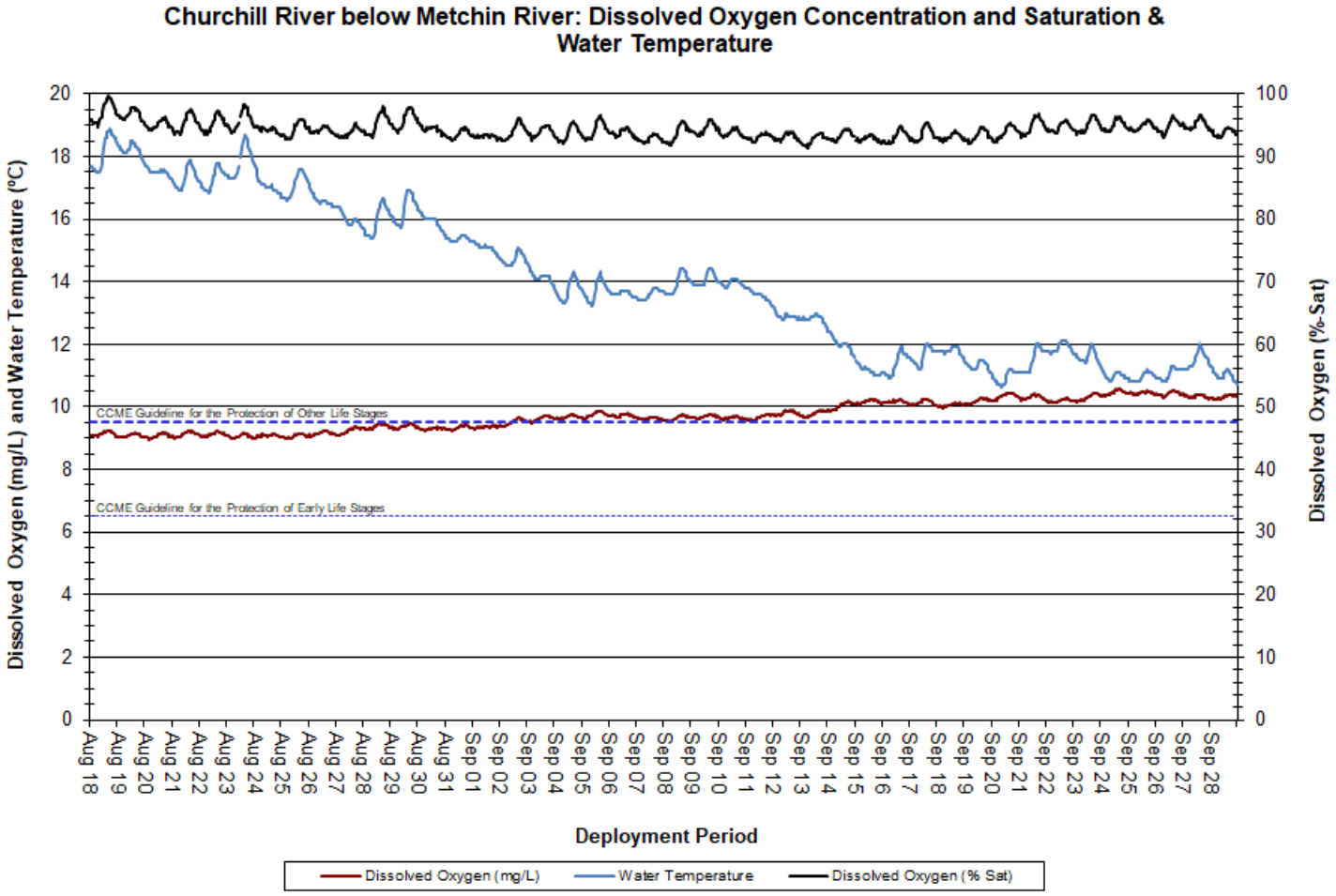


**Figure 5: Dissolved Oxygen & Water Temperature at Churchill River below Metchin River**

**Turbidity**

- Over the deployment period, turbidity ranged from 0.0NTU to 17.7NTU, with a median value of 14.0NTU (Figure 6). A median value of 14.0NTU 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 with very few spikes. This may be due to a slight calibration error, or may be due to sediment build-up around the sensor given the sandy nature of the riverbed at this site.
- 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.

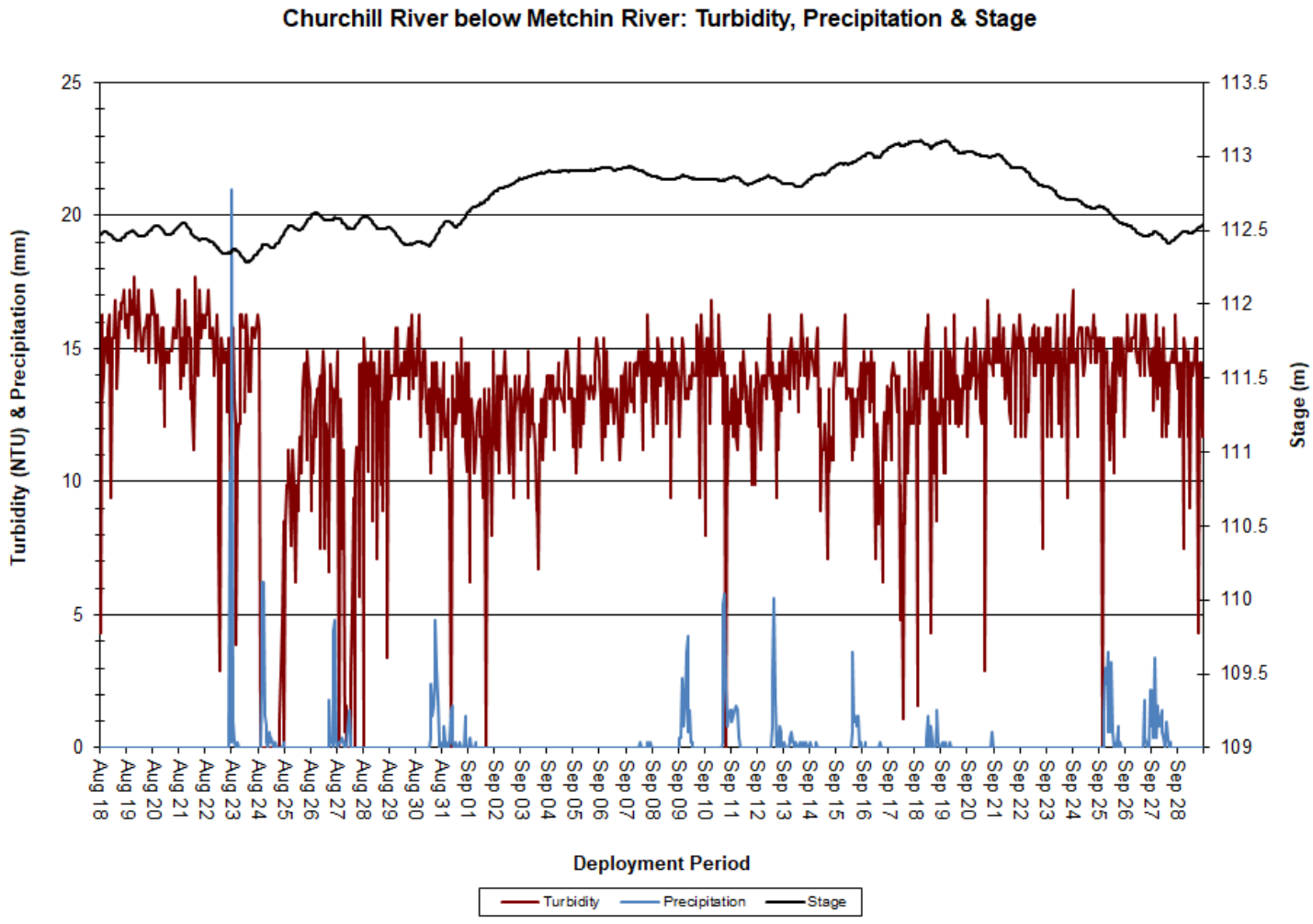


**Figure 6: Turbidity, Precipitation & Stage at Churchill River below Metchin River**

## Stage and Flow

- Over the deployment period, stage levels ranged from 112.287m to 113.107m, with a median value of 112.785m. Flow ranged from 920.764m$^3$/s to 1240.693m$^3$/s, with a median value of 1136.620m$^3$/s (Figure 7). Precipitation data was obtained from the Metchin River near TLH Weather Station.
- Stage and flow were relatively low and stable, but gradually increased, 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.

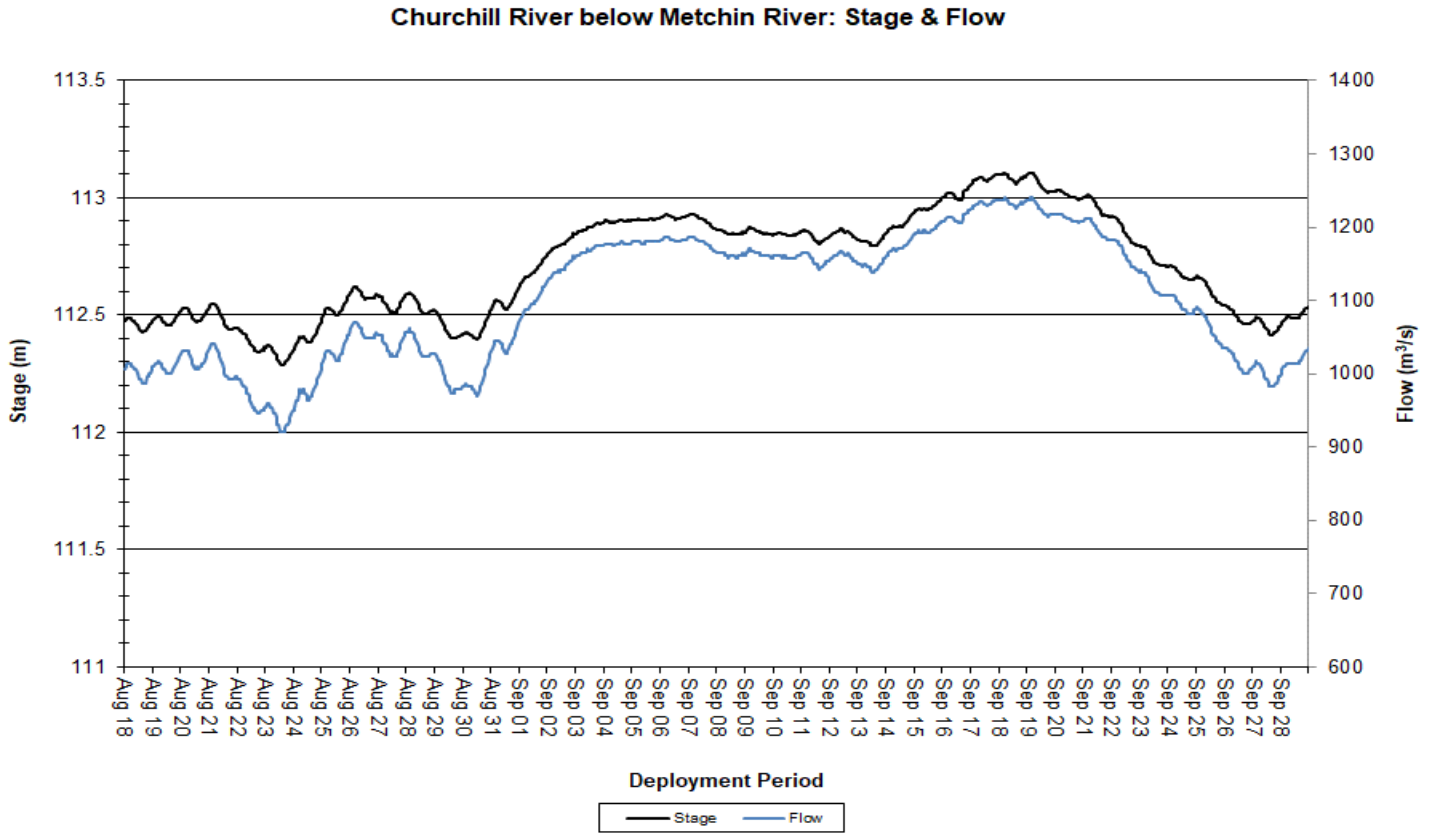


**Figure 7: Stage & Flow at Churchill River below Metchin River**

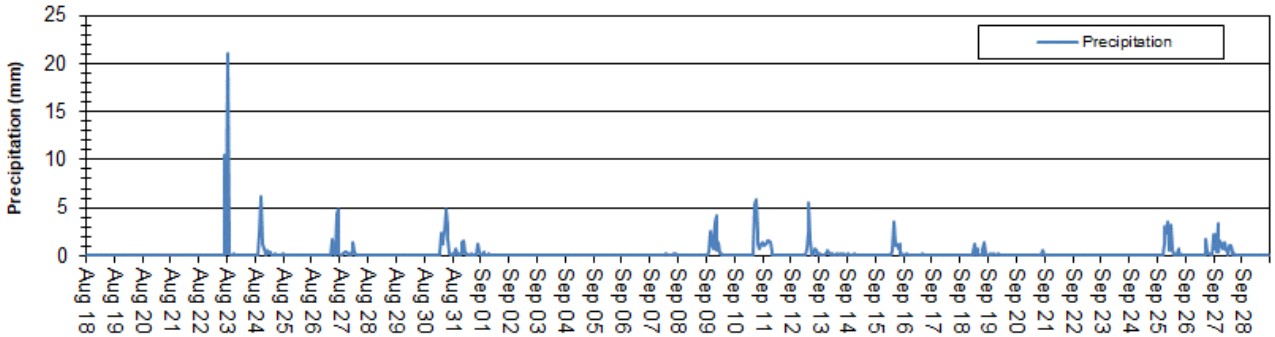


**Figure 8: Precipitation at Churchill River below Metchin River**

## Churchill River above Grizzle Rapids

### Water Temperature

- Over the deployment period, water temperature ranged from 11.0°C to 19.2°C, with a median value of 14.4°C (Figure 9). Air temperature data was obtained from the Muskrat Falls MET Station.
- Water temperature slowly decreased across the deployment period. This trend is to be expected as air temperatures also decreased into the fall 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.

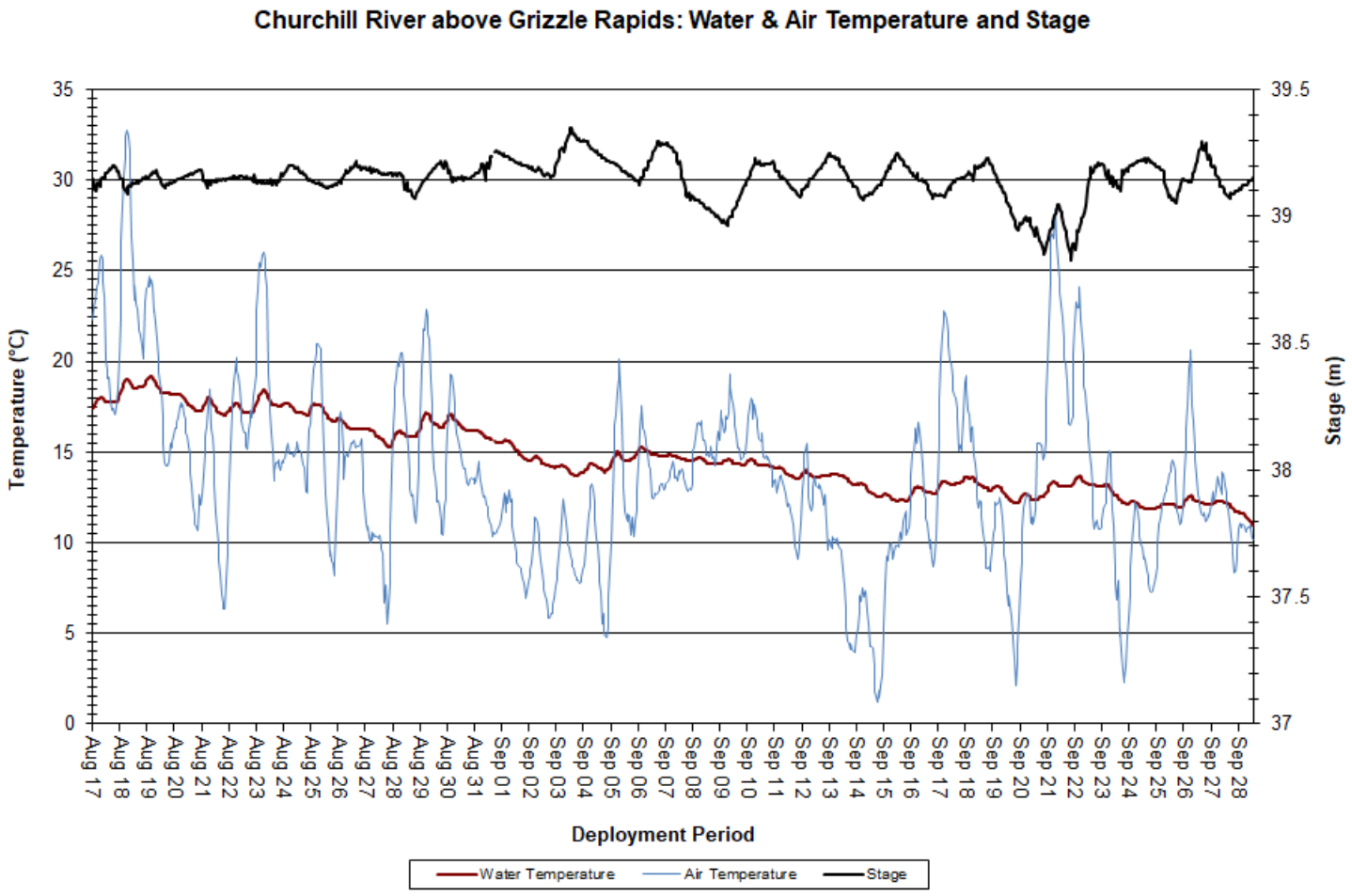


**Figure 9: Water and Air Temperature & Stage at Churchill River above Grizzle Rapids**

**pH**

- Over the deployment period, pH values ranged from 6.98 pH units to 7.26 pH units, with a median value of 7.08 (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.

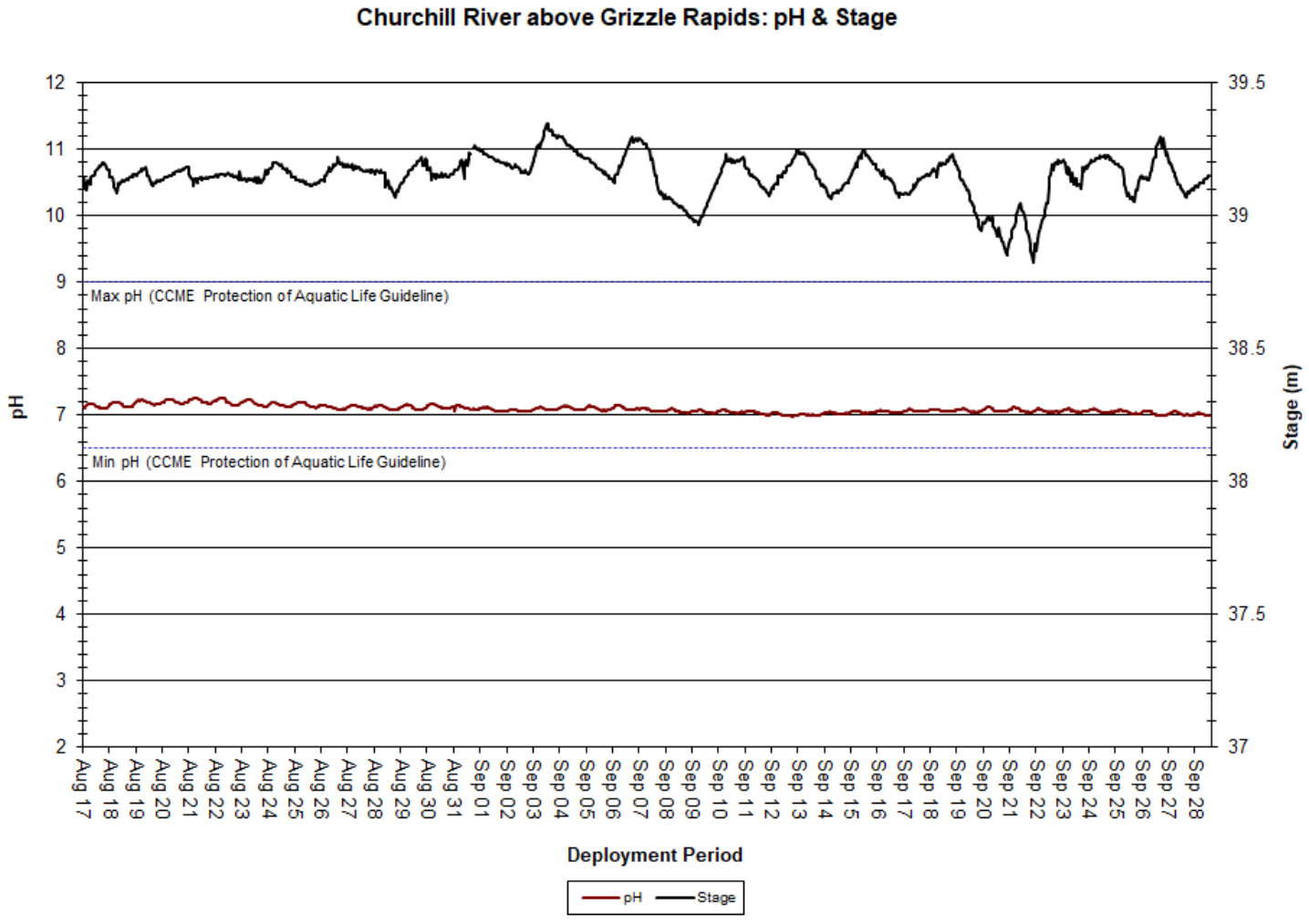


**Figure 10: pH & Stage at Churchill River above Grizzle Rapids**

### Specific Conductivity

- Over the deployment period, specific conductivity ranged from 19.4µS/cm to 21.3µS/cm, with a median of 20.4µS/cm (Figure 11).
- The relationship between conductivity and stage is generally inversed. 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.

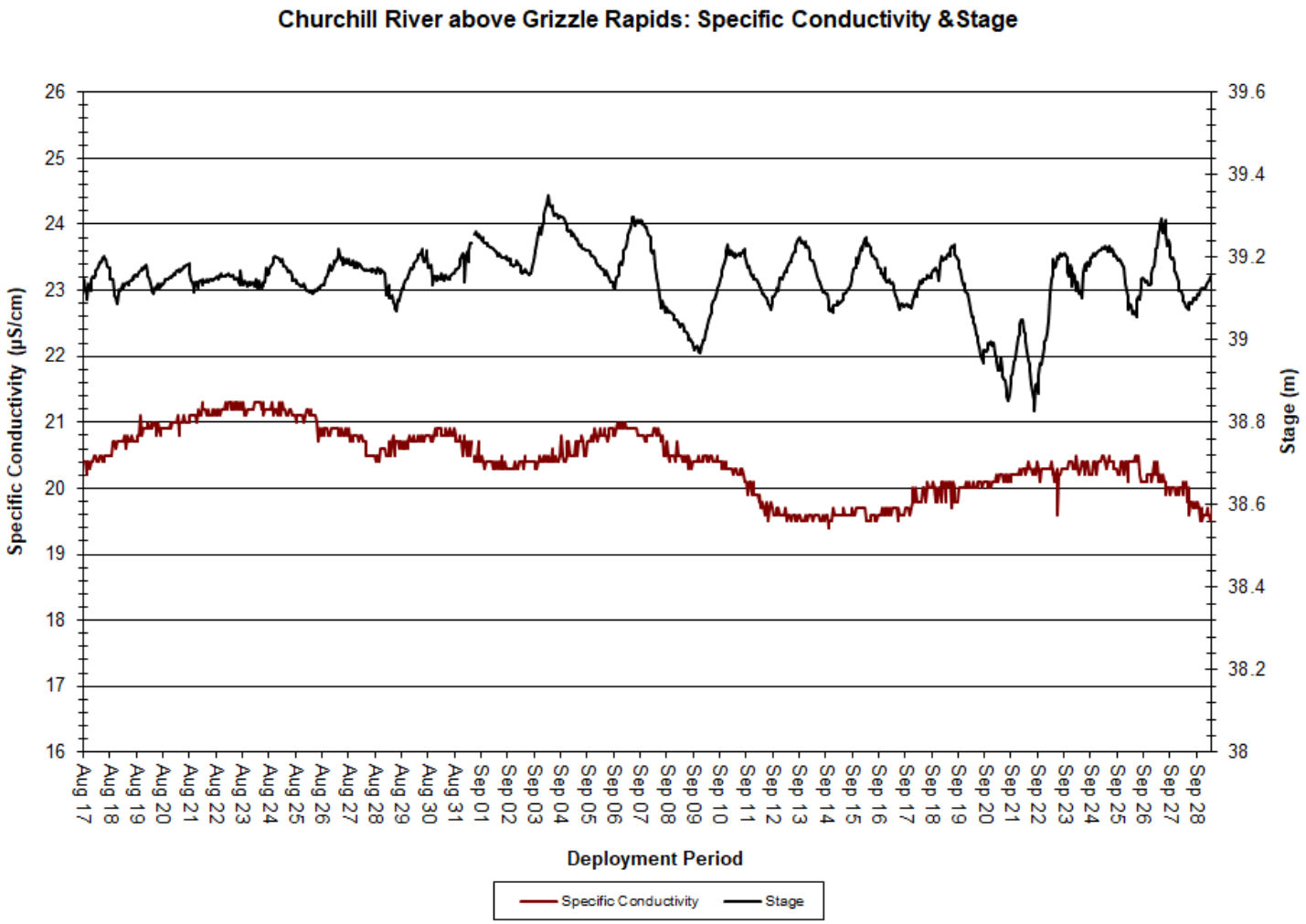


**Figure 11: Specific Conductivity & Stage at Churchill River above Grizzle Rapids**

**Dissolved Oxygen**

- Over the deployment period, dissolved oxygen content ranged from 9.18mg/L to 10.66mg/L, with a median value of 9.91mg/L. Saturation of dissolved oxygen ranged from 93.5% saturation to 101.3% saturation, with a median value of 97.3% (Figure 12).
- There is an evident relationship between water temperature and dissolved oxygen. Over the deployment period, dissolved oxygen levels gradually increased as water temperatures decreased into the fall. 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 hovered around the CCME's Guideline for the Protection of Early Life Stages for the very beginning of deployment, but rose above the Guideline by September 1st and stayed there for the remainder of the deployment period. Dissolved oxygen levels were above the CCME's Guideline for the Protection of Other Life Stages for the duration of deployment.

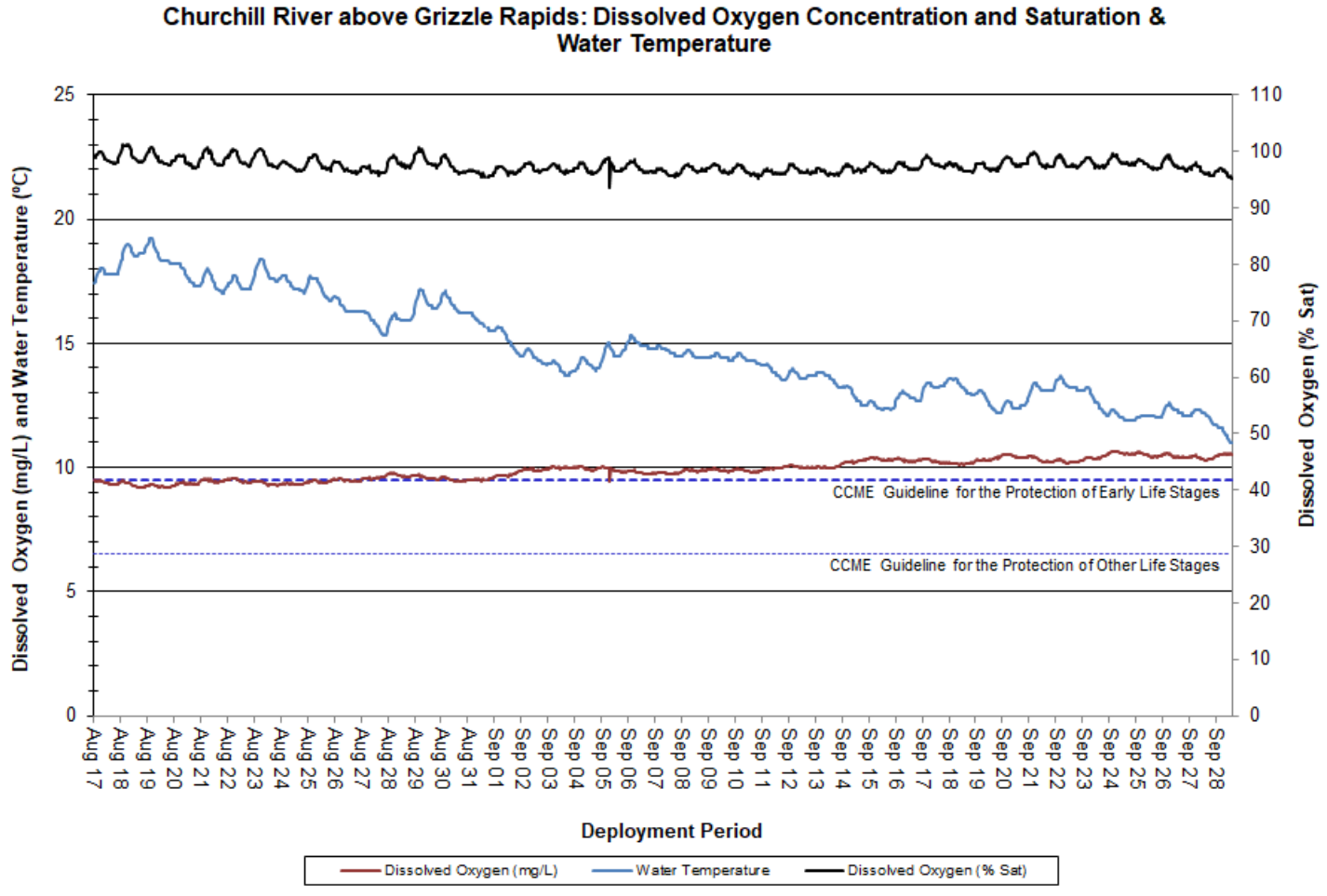


**Figure 12: Dissolved Oxygen & Water Temperature at Churchill River above Grizzle Rapids**

**Turbidity**

- Over the deployment period, turbidity ranged from 0.0NTU to 1.1NTU, with a median value of 0.0NTU (Figure 13). A median value of 0.0NTU indicates a very low level of natural background turbidity in the waterbody. Precipitation data was obtained from the Muskrat Falls MET Station.
- Turbidity spikes observed over the deployment period somewhat correlate with precipitation events (Figure 13). This station is located at a wide and deep section of the Churchill River and therefore turbidity levels are likely less susceptible to precipitation events as compared to other areas. Turbidity levels returned to background levels following each observed increase.
- 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.

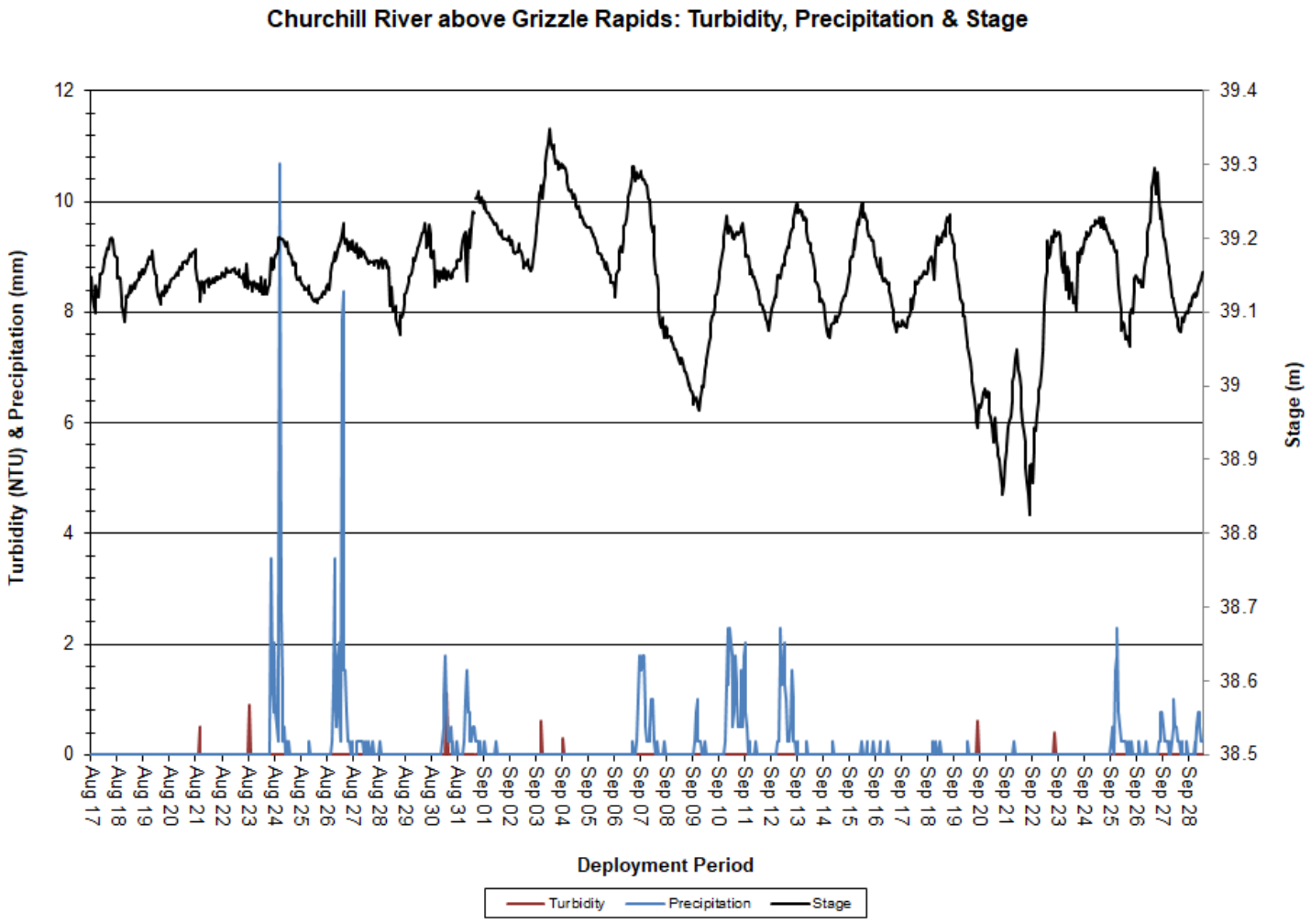


**Figure 13: Turbidity, Precipitation & Stage at Churchill River above Grizzle Rapids**

## Stage

- Over the deployment period, stage ranged from 38.826m to 39.349m, with a median value of 39.156m (Figure 14). Precipitation data was obtained from the Muskrat Falls MET Station.
- Stage was quite stable across the deployment period, with precipitation events often correlating with slight 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.

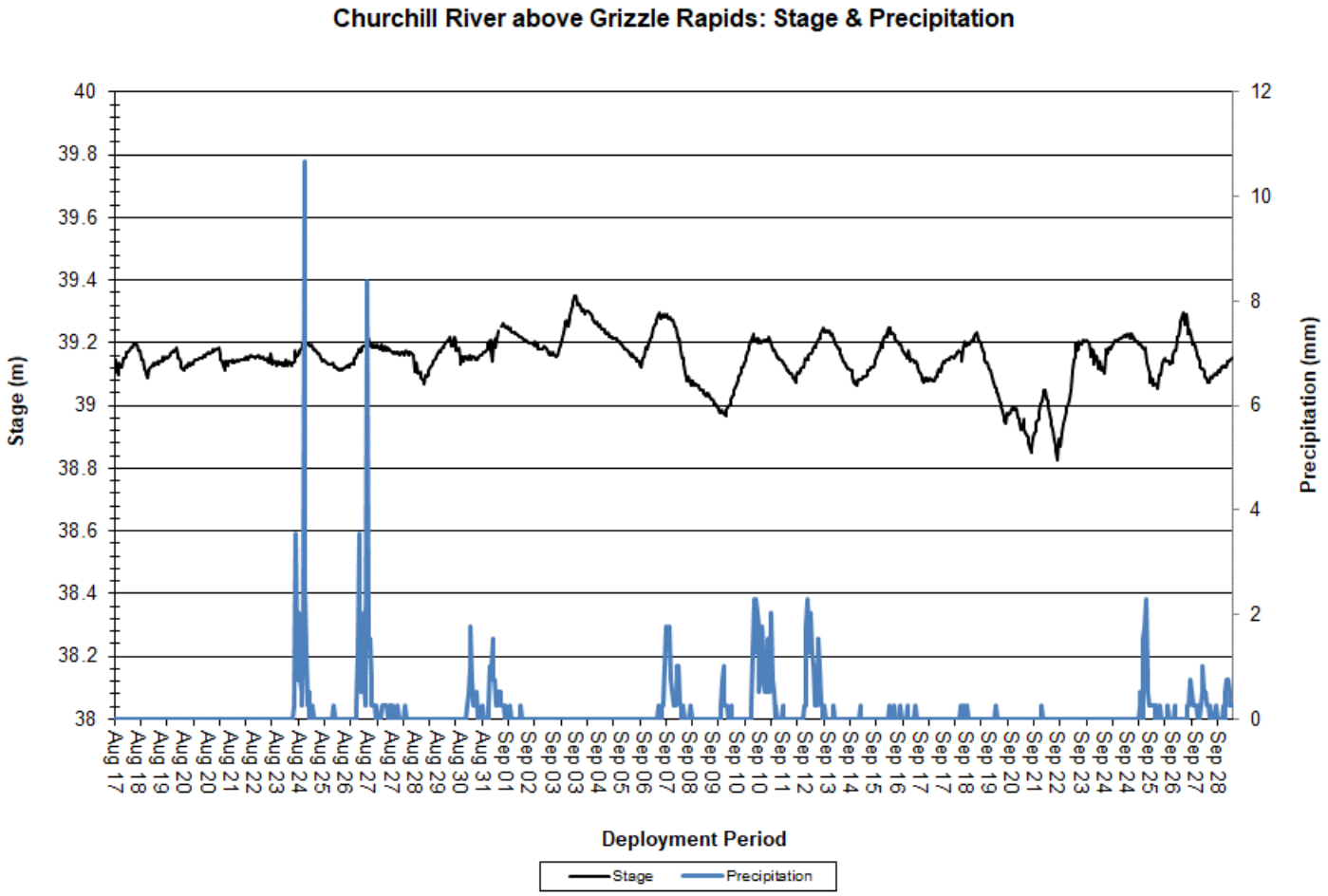


**Figure 14: Stage & Precipitation at Churchill River above Grizzle Rapids**

## Churchill River below Muskrat Falls

### Water Temperature

- Over the deployment period, water temperature ranged from 11.4°C to 19.9°C, with a median value of 15.7°C (Figure 15). Air temperature data was obtained from the Muskrat Falls MET Station.
- Water temperature slowly decreased over the course of the deployment period. This is to be expected as ambient air temperatures also decreased through August and September. Water temperatures closely correlate with ambient air temperatures; however, the brief occurrence on September 22nd where water temperature almost exactly matches air temperature indicates that the instrument was out of water for a short period of time.
- 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.

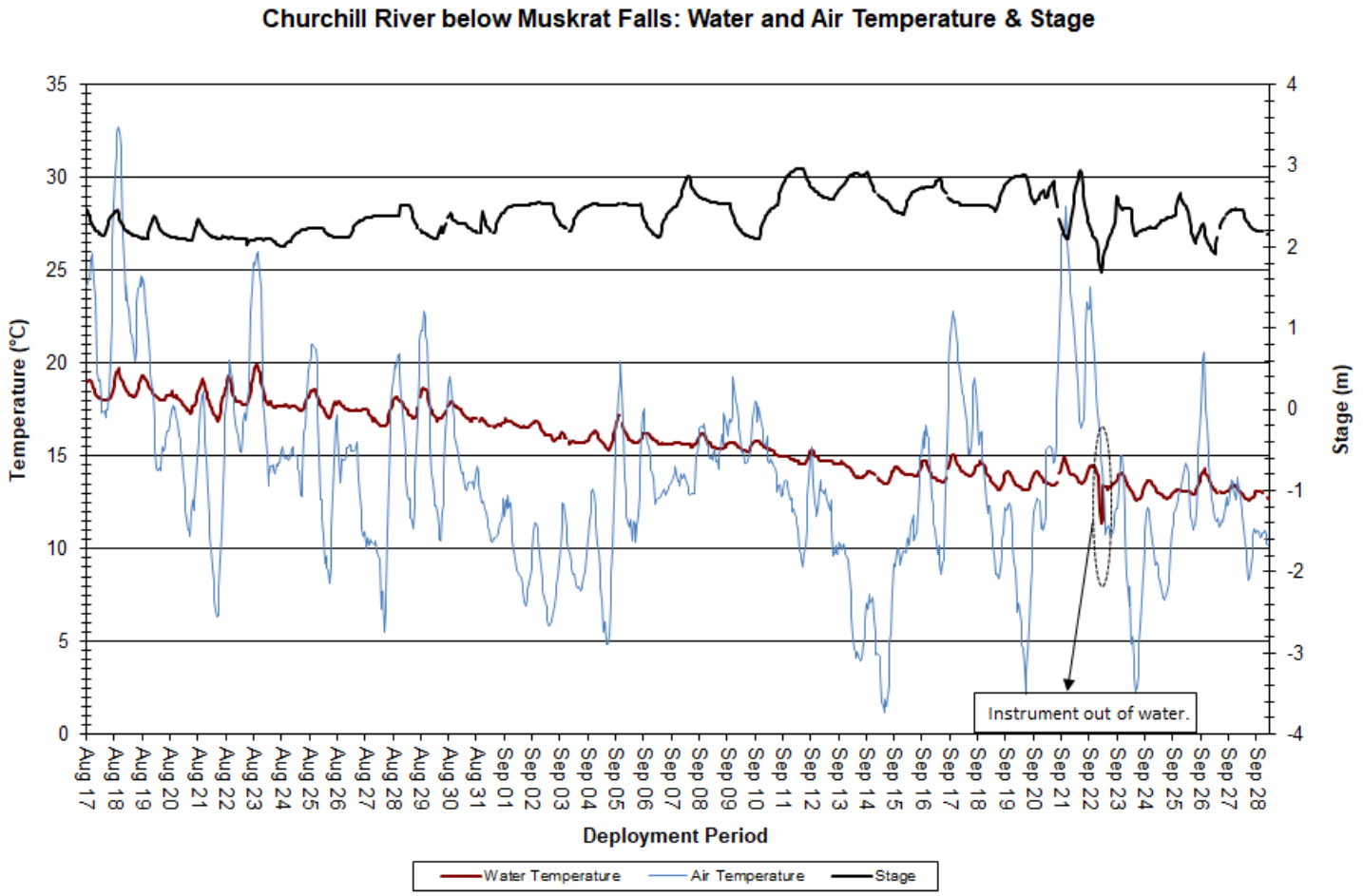


**Figure 15: Water and Air Temperature & Stage at Churchill River below Muskrat Falls**

**pH**

- Over the deployment period, pH ranged from 0 pH units to 7.19 pH units, with a median value of 6.94 (Figure 16).
- pH values were quite stable over the course of deployment, and remained within the CCME's Guidelines for the Protection of Aquatic Life for the majority of the deployment period (Figure 16). The brief drop in pH readings observed on September 22nd is due to the instrument being out of water for a short period of time.
- 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.

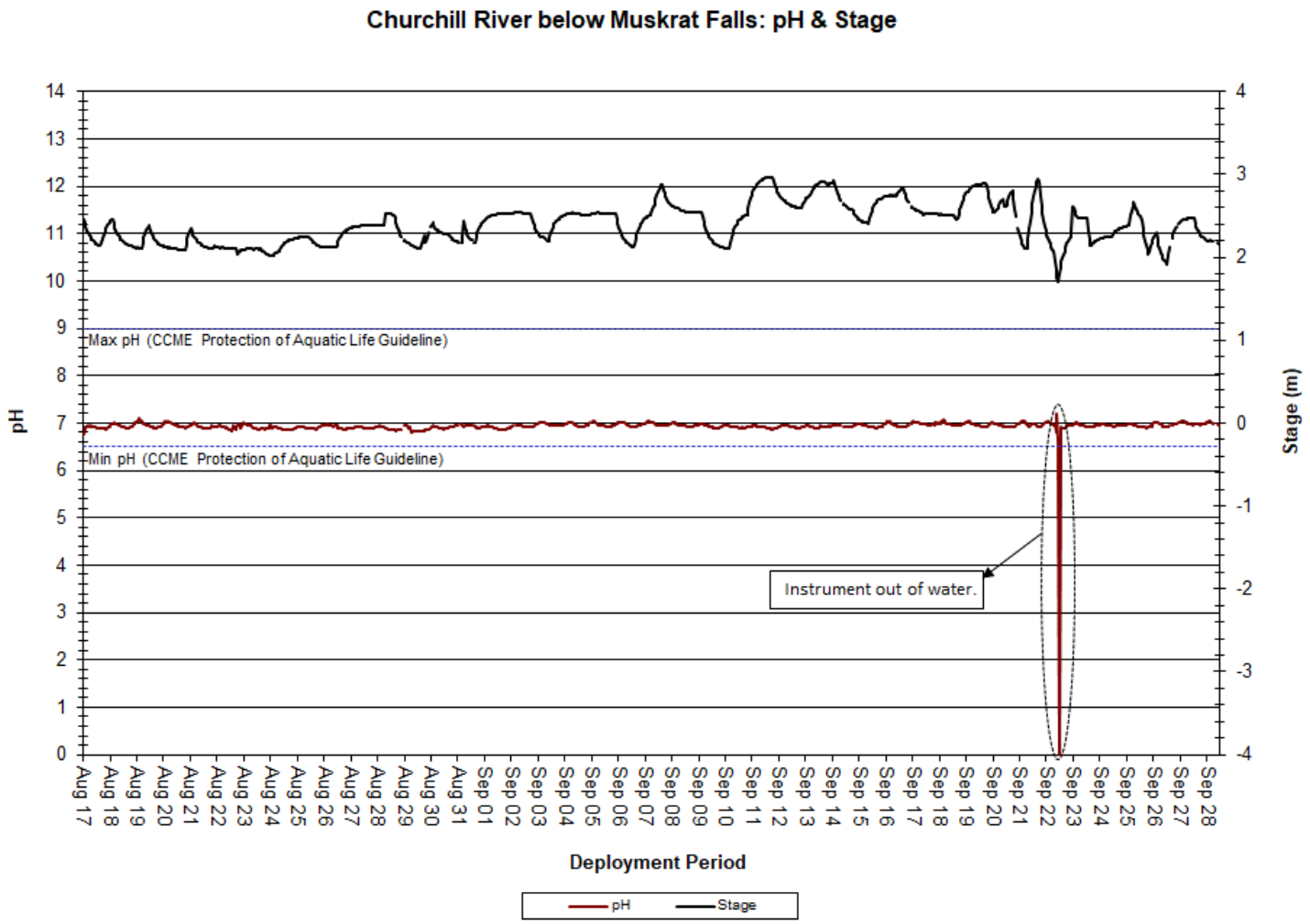


**Figure 16: pH & Stage at Churchill River below Muskrat Falls**

**Specific Conductivity**

- Over the deployment period, specific conductivity ranged from 0µS/cm to 21.5µS/cm, with a median value of 20.1µS/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).
- The brief period of decreased specific conductivity readings observed on September 22nd is due to the instrument being out of water for a short period of time.
- 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.

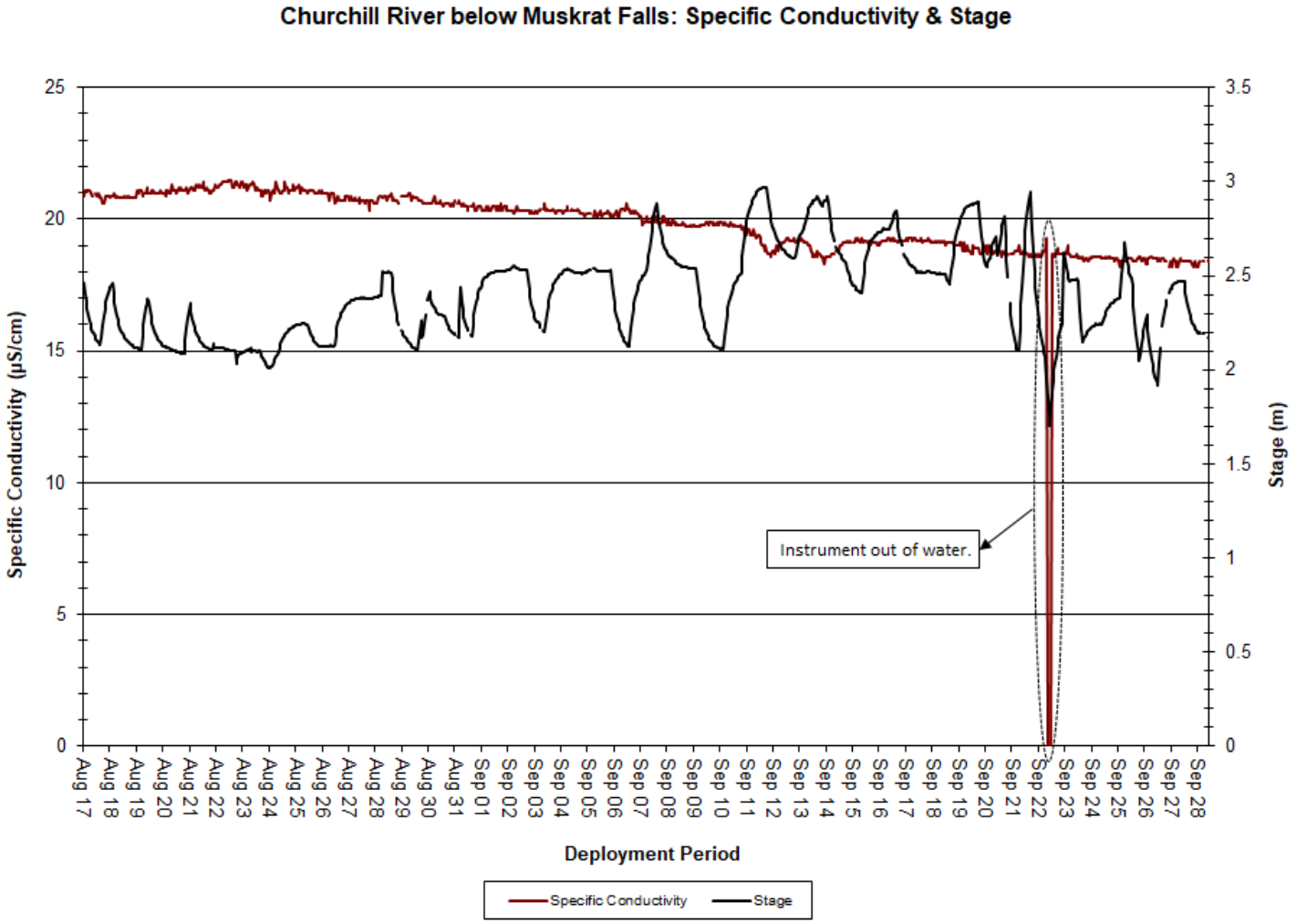


**Figure 17: Specific Conductivity & Stage at Churchill River below Muskrat Falls**

**Dissolved Oxygen**

- Over the deployment period, dissolved oxygen concentration ranged from 8.55mg/L to 10.77mg/L, with a median value of 9.44mg/L. Saturation of dissolved oxygen ranged from 90.1% to 103.8%, with a median value of 95.8% (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 increased over the course of deployment. This is to be expected since water temperatures were slowly decreasing 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 were below the CCME's Guidelines for the Protection of Early Life Stages for the beginning of deployment until mid-September, after which levels rose above the Guideline and stayed there for the remainder of deployment. Dissolved oxygen levels were above the CCME's Guidelines for the Protection of Other Life Stages for the duration of the deployment period.

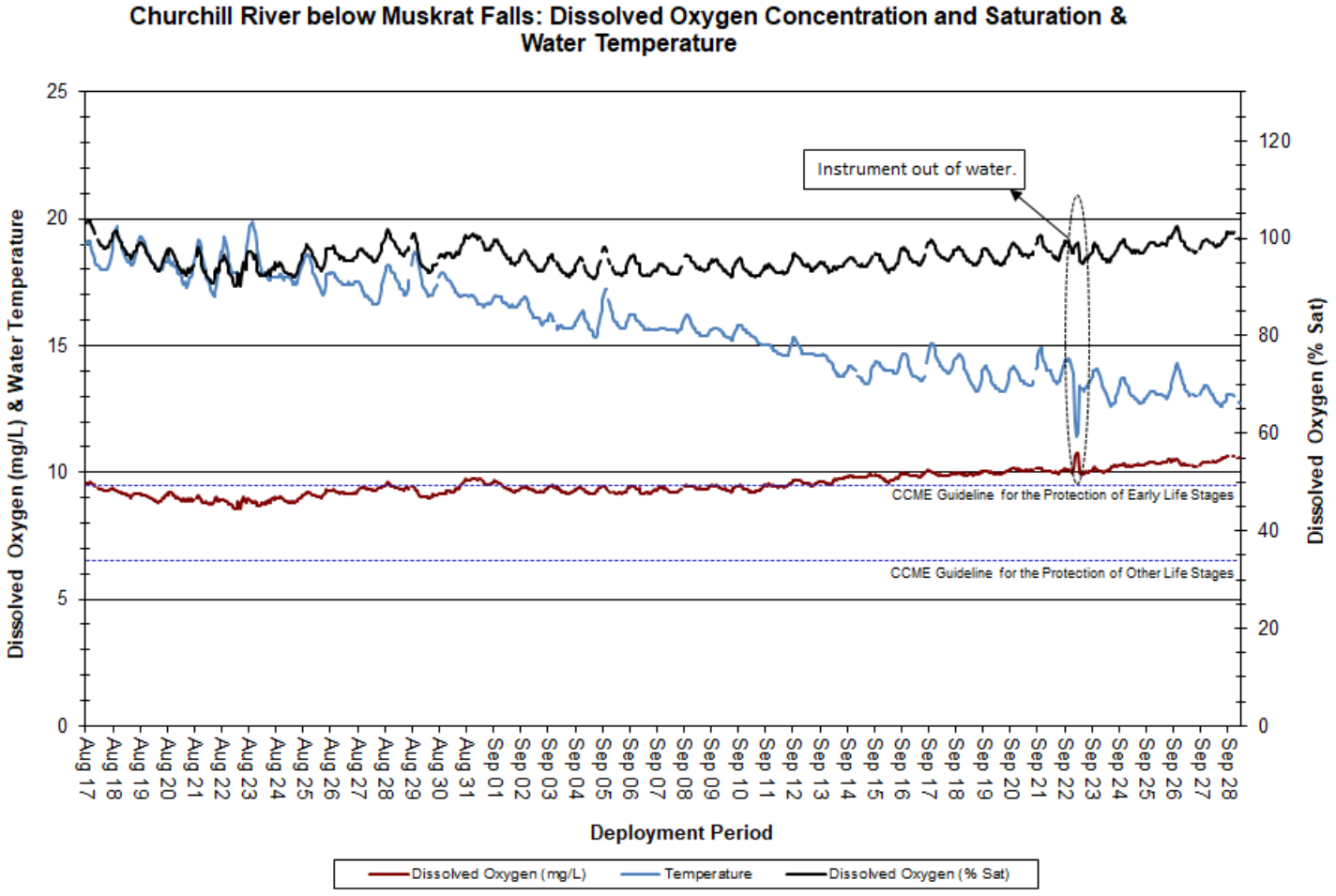


**Figure 18: Dissolved Oxygen & Water Temperature at Churchill River below Muskrat Falls**

**Turbidity**

- Over the deployment period, turbidity ranged from 0 NTU to 67.3 NTU, with a median value of 0 NTU. A median value of 0 NTU indicates a very small amount of natural background turbidity in the waterbody, which is typical of this station. Precipitation data was obtained from the Muskrat Falls MET Station.
- There was relatively good 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.

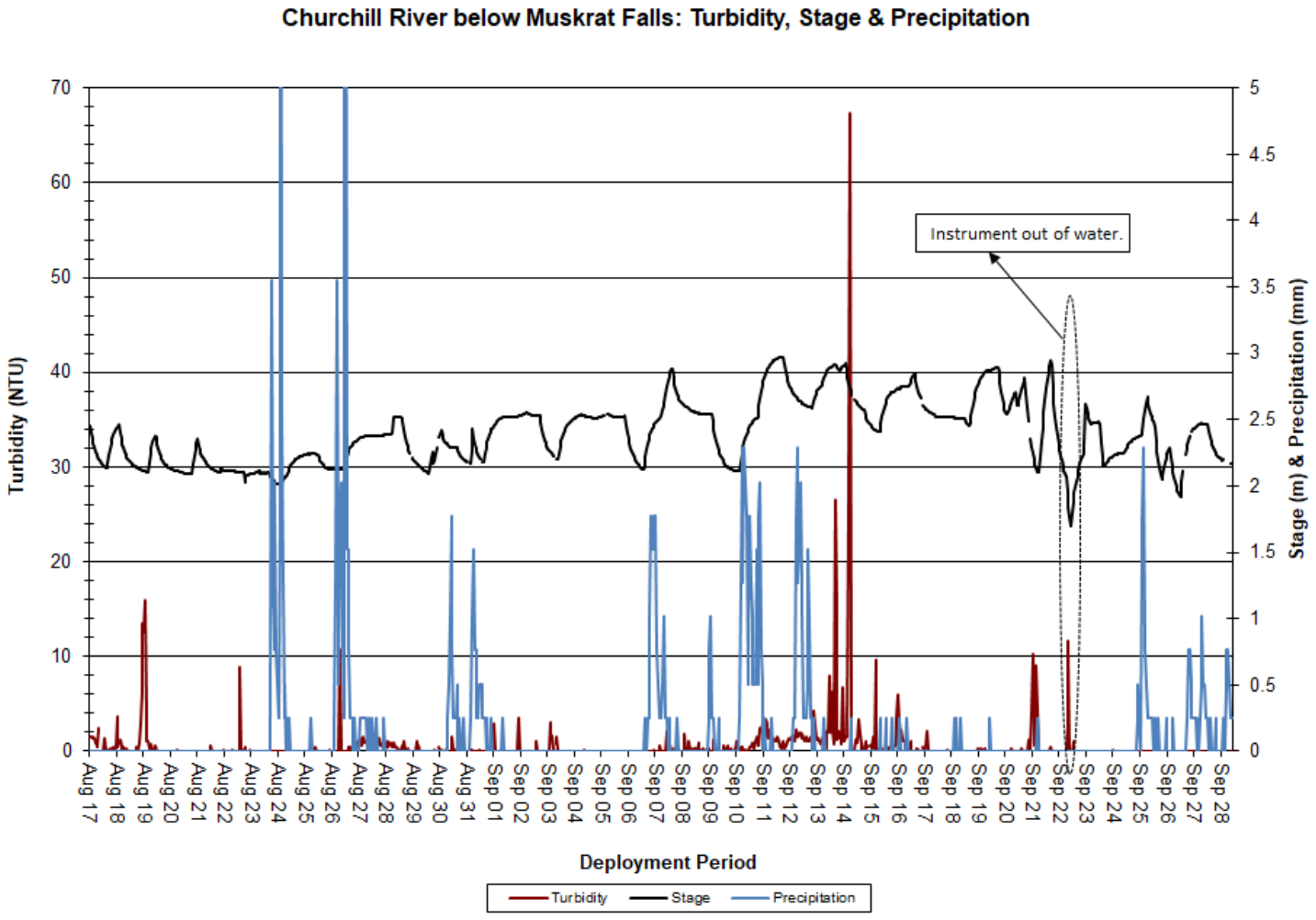


**Figure 19: Turbidity, Precipitation & Stage at Churchill River below Muskrat Falls**

### Stage & Flow

- Over the deployment period, stage ranged from 1.70m to 2.97m, with a median value of 2.382m. Flow ranged from 894.698m$^3$/s to 2002.798m$^3$/s, with a median value of 1402.399m$^3$/s (Figure 20). Precipitation data was obtained from the Muskrat Falls MET Station.
- Stage and flow were variable but stable over the course of deployment, and only 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 is 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.

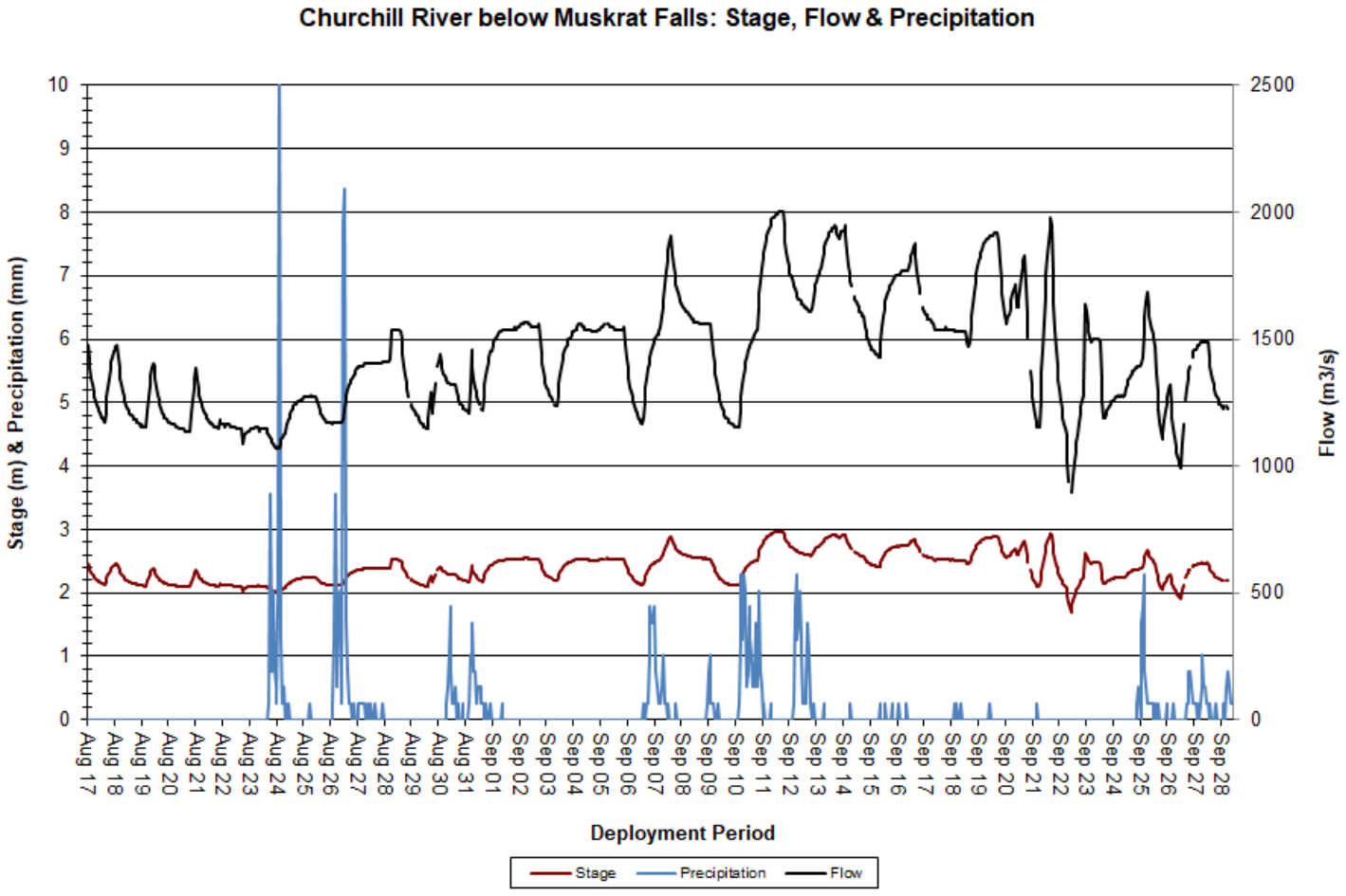


**Figure 20: Stage, Flow & Precipitation at Churchill River below Muskrat Falls**

## Churchill River at English Point

### Water Temperature

- Water temperature ranged from 11.3°C to 22.1°C, with a median value of 14.8°C (Figure 21). Air temperature data was obtained from the End of Mud Lake Road Weather Station.
- Water temperature decreased 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.

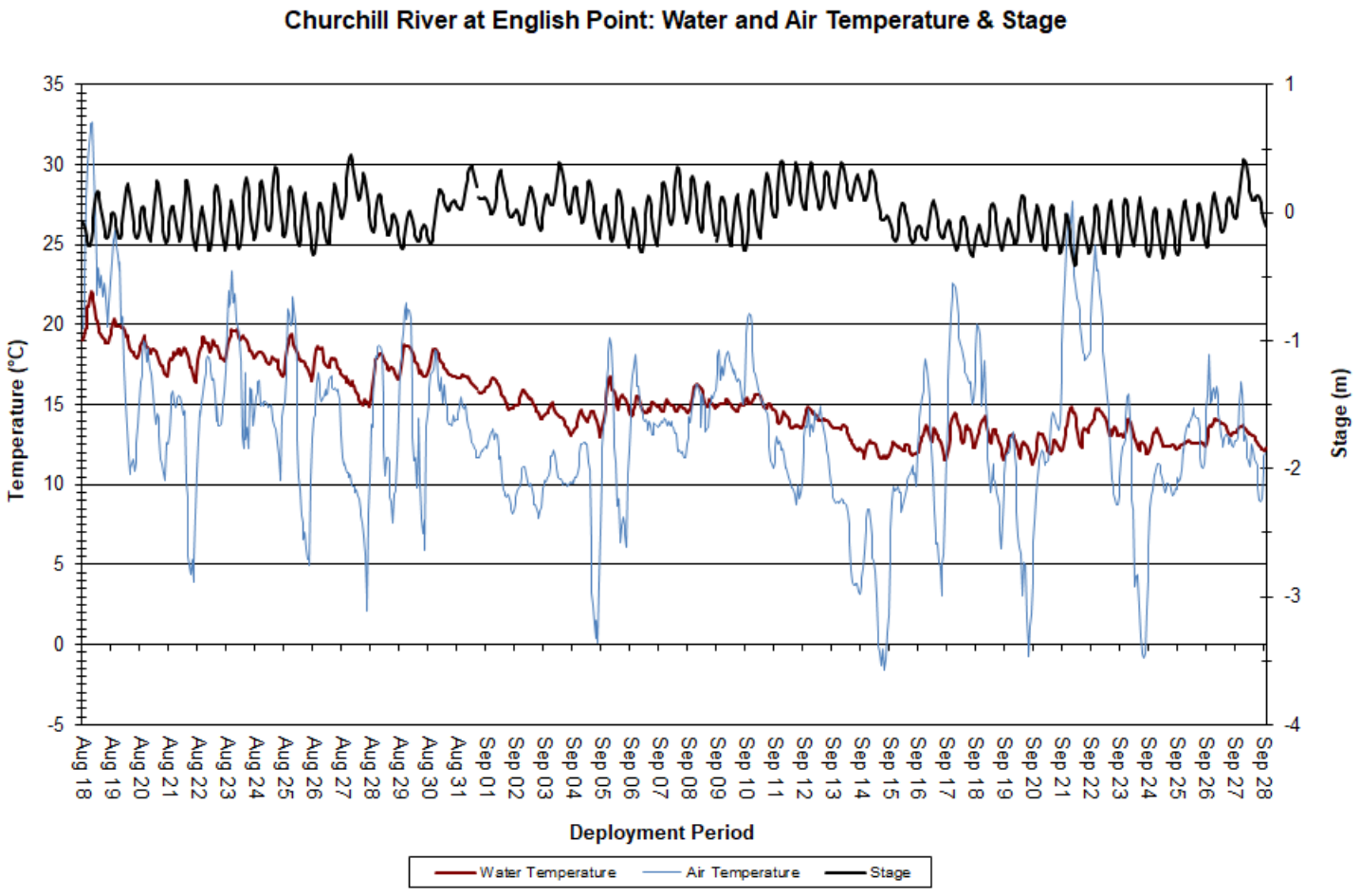


**Figure 21: Water and Air Temperature & Stage at Churchill River at English Point**

**pH**

- Over the deployment period, pH ranged from 6.38 pH units to 7.38 pH units, with a median value of 6.76 (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, except for a short period in mid-September correlating closely with a period of higher 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.

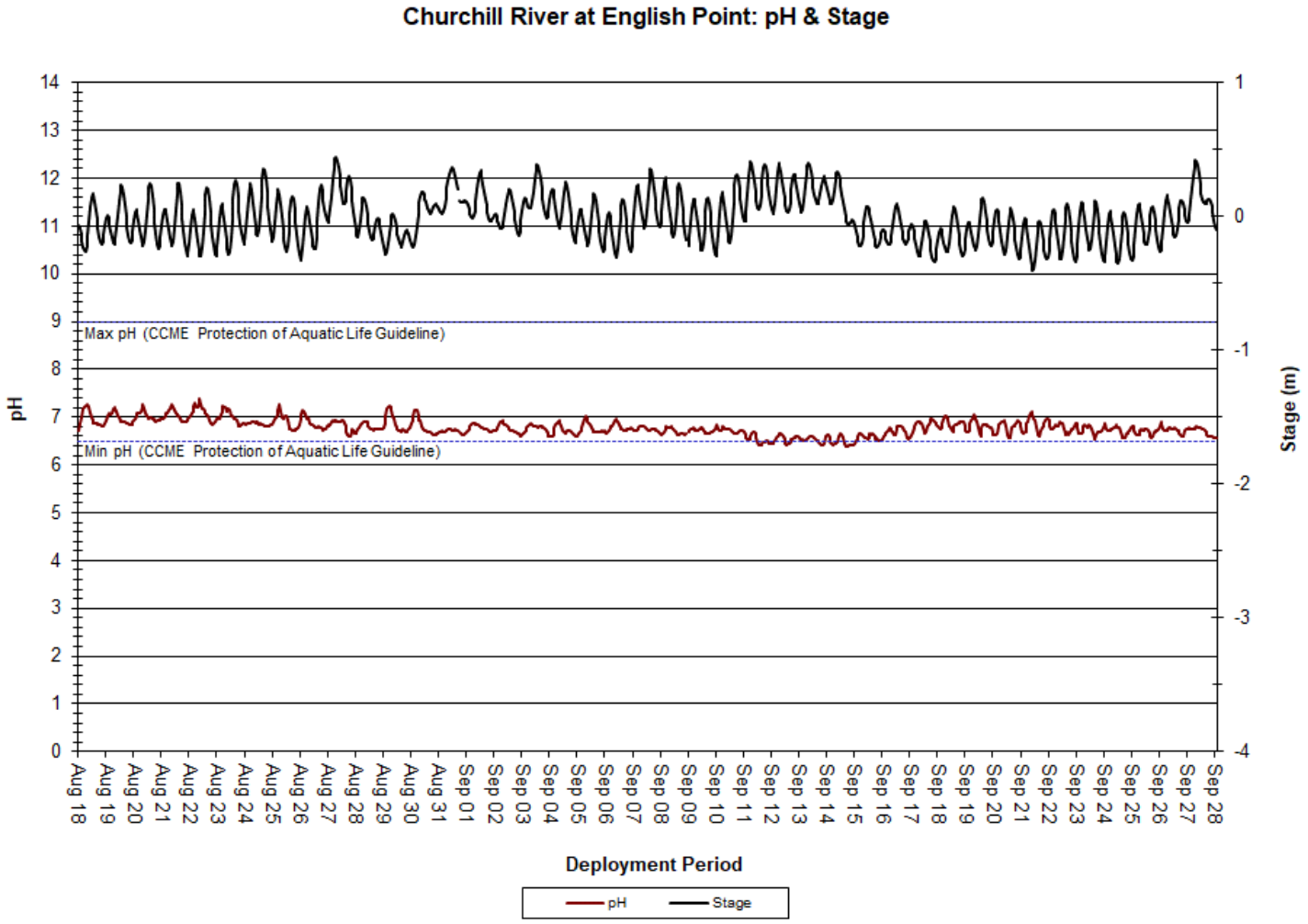


**Figure 22: pH & Stage at Churchill River at English Point**

**Specific Conductivity**

- Over the deployment period, specific conductivity ranged from 19.7µS/cm to 58.8µs/cm, with a median value of 32.2µS/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.

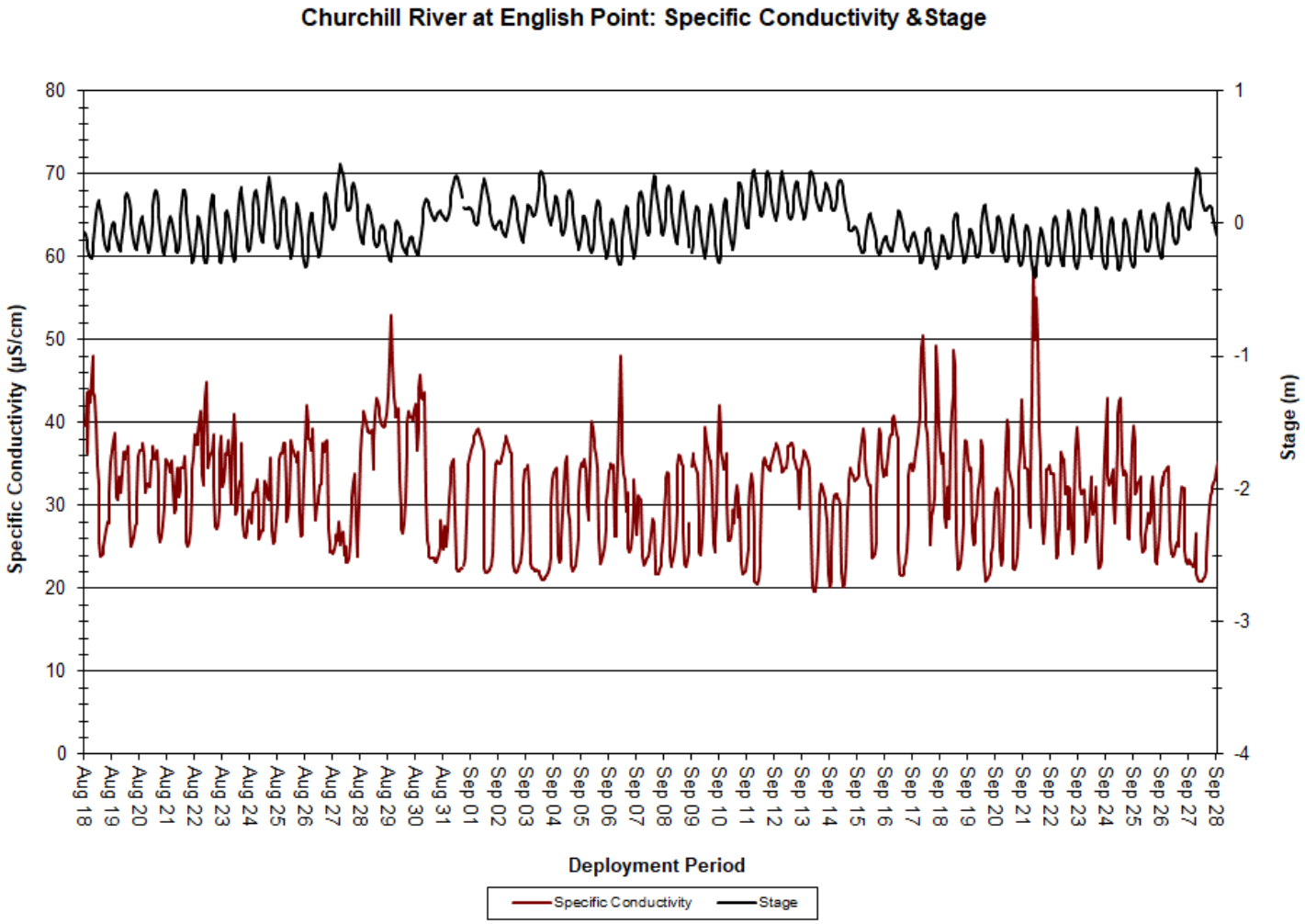


**Figure 23: Specific Conductivity & Stage at Churchill River at English Point**

**Dissolved Oxygen**

- Over the deployment period, dissolved oxygen concentration ranged from 8.67mg/L to 10.57mg/L, with a median value of 9.62mg/L. Saturation of dissolved oxygen ranged from 87.0% to 107.4% saturation, with a median value of 95.7% (Figure 24).
- There is an evident relationship between water temperature and dissolved oxygen. As water temperatures decreased over the deployment period, dissolved oxygen levels increased. 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 below the CCME's Guideline for the Protection of Early Life Stages for the beginning of deployment, after which they hovered around and then rose above that Guideline as water temperatures decreased through September. Dissolved oxygen levels were above the CCME's Guidelines for the Protection of Other Life Stages for the duration of deployment (Figure 24).

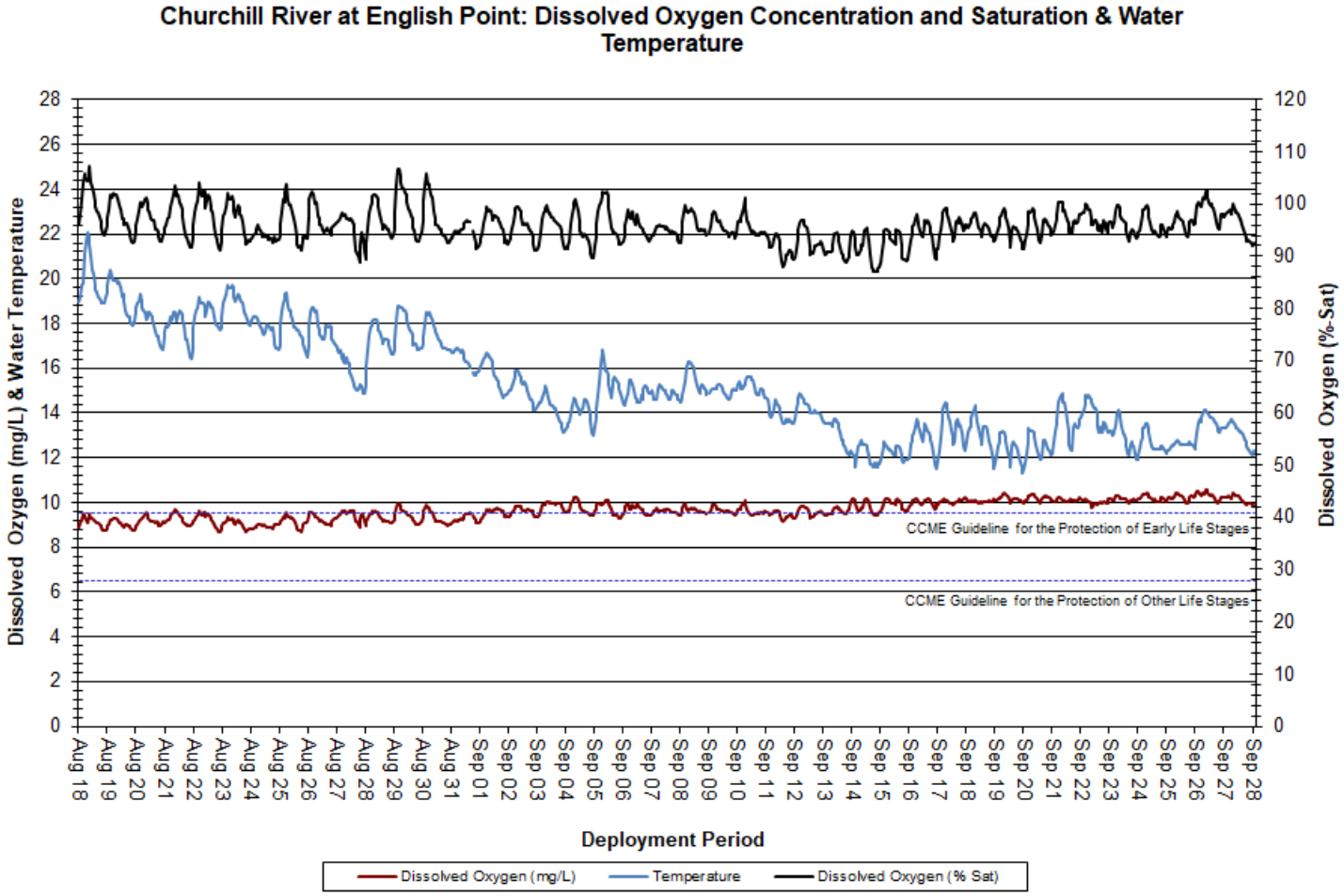


**Figure 24: Dissolved Oxygen & Water Temperature at Churchill River at English Point**

**Turbidity**

- Over the deployment period, turbidity ranged from 2.5 NTU to 205.7 NTU, with a median value of 9.7 NTU (Figure 25). A median value of 9.7 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 End of Mud Lake Road Weather Station.
- Turbidity events often correlate with precipitation events, as these can increase the presence of suspended material in water. High winds and tidal influences also contribute to turbidity events at this station by disturbing sediment from the river bed (Figure 25). Wind speed data was obtained from the 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.

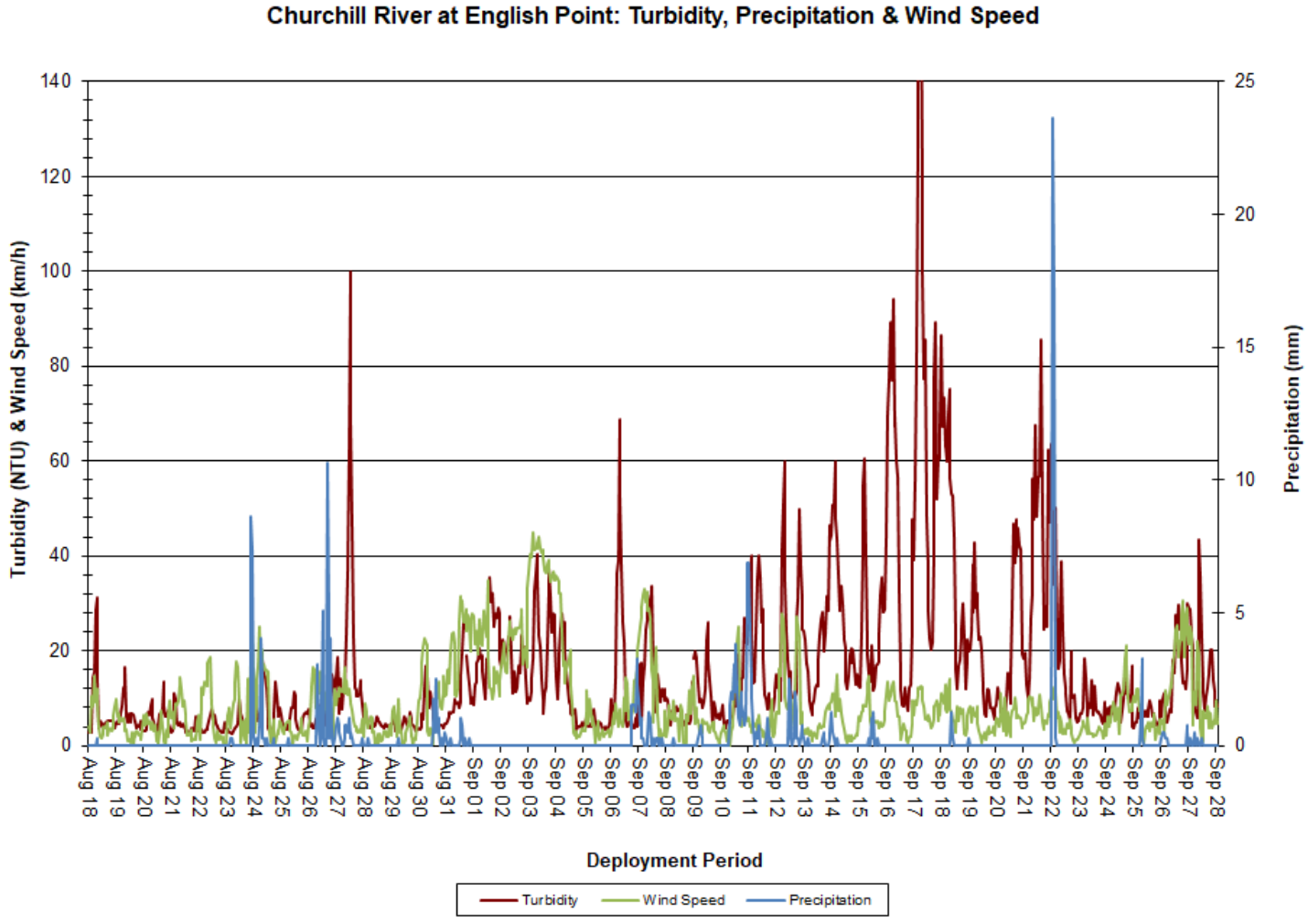


**Figure 25: Turbidity, Precipitation & Wind Speed at Churchill River at English Point**

## Stage

- Over the deployment period, stage ranged from -0.41m to 0.448m, with a median value of -0.017m (Figure 26). Precipitation data was obtained from the 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.

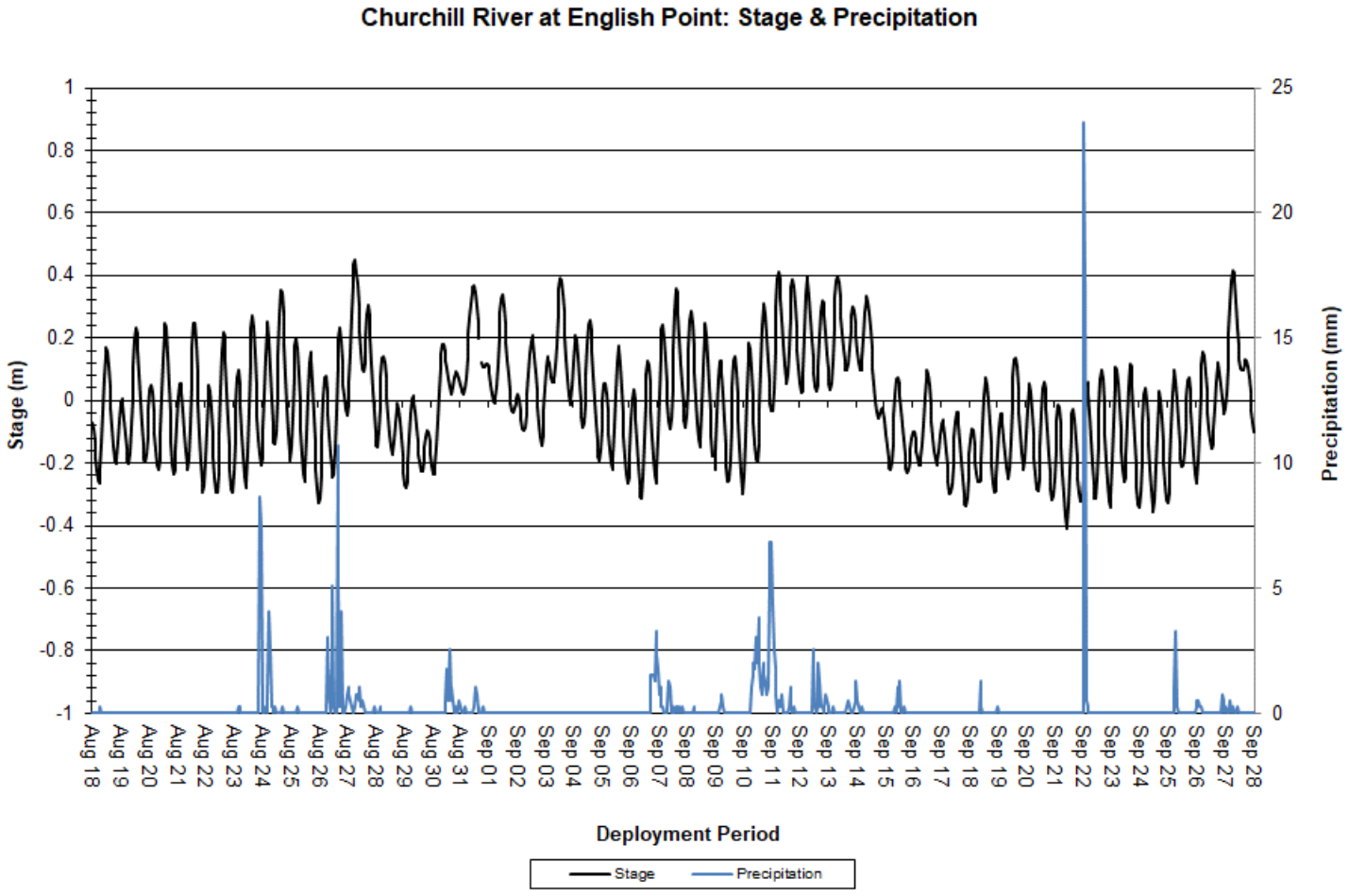


**Figure 26: Stage & Precipitation at Churchill River at English Point**

## Conclusions

- Instruments at four water quality monitoring stations on the Lower Churchill River were deployed from August 17/18 through September 28, 2021.
- Water temperature decreased 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 August and September.
- 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 duration of deployment at Churchill River above Grizzle Rapids and below Muskrat Falls (except while the instrument was briefly out of water), while pH remained within the Guidelines for the majority of deployment at both Churchill River below Metchin River and at English Point.
- Specific conductivity was generally stable 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 increased over the course of deployment at all stations as water temperatures decreased into the fall. Dissolved oxygen levels are generally higher in water at cooler temperatures. Dissolved oxygen levels eventually rose above 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.

## References

Canadian Council of Ministers of the Environment. 2007. Canadian water quality guidelines for the protection of aquatic life: Summary table. Updated December, 2007. In: Canadian environmental quality guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg. Available at: http://st-ts.ccme.ca/en/index.html?chems=154,162&chapters=1 [Accessed December 12, 2017].

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Fondriest Environmental Inc. (2016b). Fundamentals of Environmental Measurements [Online]. Available at: http://www.fondriest.com/environmental-measurements/parameters/water-quality/water-temperature/#watertemp1 [Accessed December 12, 2017].

Swenson, H.A., and Baldwin, H.L. (1965). A Primer on Water Quality, U.S. Geological Survey. Available at: https://pubs.usgs.gov/gip/7000057/report.pdf [Accessed December 12, 2017].

United States Geological Survey. (2017). Water properties: Dissolved oxygen [Online]. Available at: https://water.usgs.gov/edu/dissolvedoxygen.html [Accessed December 12, 2017].

# 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

BV Labs Job #: C1N8978
Report Date: 2021/08/30

NL Department of Environment, Climate Change and Municipalities
Your P.O. #: 220028978-5

| Sample Details/Parameters | A | Result | RDL | UNITS | Extracted | Analyzed | By | Batch |
|---|---|---|---|---|---|---|---|---|
| QLG091 CR ABOVE GR | | | | | | | | |
| Sampling Date 2021/08/17 10:10 | | | | | | | | |
| Matrix W | | | | | | | | |
| Sample # 2021-6324-00-SI-SP | | | | | | | | |
| Registration # WS-S-0000 | | | | | | | | |
| **RESULTS OF ANALYSES OF WATER** | | | | | | | | |
| **Calculated Parameters** | | | | | | | | |
| Hardness (CaCO3) | - | 10 | 1.0 | mg/L | N/A | 2021/08/27 | | 7535152 |
| Nitrate (N) | - | ND | 0.050 | mg/L | N/A | 2021/08/26 | | 7535153 |
| Total dissolved solids (calc., EC) | - | 11 | 1.0 | mg/L | N/A | 2021/08/25 | | 7535300 |
| **Inorganics** | | | | | | | | |
| Conductivity | - | 20 | 1.0 | uS/cm | N/A | 2021/08/25 | SHW | 7539882 |
| Chloride (Cl-) | - | ND | 1.0 | mg/L | N/A | 2021/08/26 | FD | 7543744 |
| Bromide (Br-) | - | ND | 1.0 | mg/L | N/A | 2021/08/26 | FD | 7543744 |
| Sulphate (SO4) | - | ND | 1.0 | mg/L | N/A | 2021/08/26 | FD | 7543744 |
| Total Alkalinity (Total as CaCO3) | - | 11 | 5.0 | mg/L | N/A | 2021/08/25 | MCN | 7539854 |
| Colour | - | 34 | 5.0 | TCU | N/A | 2021/08/25 | MCN | 7539855 |
| Dissolved Fluoride (F-) | - | ND | 0.10 | mg/L | N/A | 2021/08/25 | SHW | 7539884 |
| Total Kjeldahl Nitrogen (TKN) | - | 0.10 | 0.10 | mg/L | 2021/08/26 | 2021/08/27 | MJ1 | 7543520 |
| Nitrate + Nitrite (N) | - | ND | 0.050 | mg/L | N/A | 2021/08/25 | MCN | 7539857 |
| Nitrite (N) | - | ND | 0.010 | mg/L | N/A | 2021/08/25 | MCN | 7539858 |
| Nitrogen (Ammonia Nitrogen) | - | ND | 0.050 | mg/L | N/A | 2021/08/25 | EMT | 7539942 |
| Dissolved Organic Carbon (C) | - | 4.3 | 0.50 | mg/L | N/A | 2021/08/25 | NGI | 7539929 |
| Total Organic Carbon (C) | - | 4.6 | 0.50 | mg/L | N/A | 2021/08/25 | NGI | 7539913 |
| pH | - | 7.03 | | pH | N/A | 2021/08/25 | SHW | 7539883 |
| Total Phosphorus | - | 0.025 | 0.004 | mg/L | 2021/08/26 | 2021/08/27 | SSV | 7543344 |
| Total Suspended Solids | - | 26 | 2.0 | mg/L | 2021/08/24 | 2021/08/26 | MKX | 7538304 |
| Turbidity | - | 3.8 | 0.10 | NTU | N/A | 2021/08/25 | SHW | 7539937 |
| **MERCURY BY COLD VAPOUR AA (WATER)** | | | | | | | | |
| **Metals** | | | | | | | | |
| Total Mercury (Hg) | - | ND | 0.000013 | mg/L | 2021/08/25 | 2021/08/25 | NHU | 7537662 |
| **ELEMENTS BY ICP/MS (WATER)** | | | | | | | | |
| **Metals** | | | | | | | | |
| Total Aluminum (Al) | - | 0.33 | 0.0050 | mg/L | 2021/08/27 | 2021/08/27 | MLB | 7545400 |
| Total Antimony (Sb) | - | ND | 0.0010 | mg/L | 2021/08/24 | 2021/08/26 | MLB | 7538734 |
| Total Arsenic (As) | - | ND | 0.0010 | mg/L | 2021/08/24 | 2021/08/26 | MLB | 7538734 |
| Total Barium (Ba) | - | 0.011 | 0.0010 | mg/L | 2021/08/24 | 2021/08/26 | MLB | 7538734 |
| Total Boron (B) | - | ND | 0.050 | mg/L | 2021/08/24 | 2021/08/26 | MLB | 7538734 |
| Total Cadmium (Cd) | - | ND | 0.000010 | mg/L | 2021/08/24 | 2021/08/26 | MLB | 7538734 |
| Total Calcium (Ca) | - | 2.5 | 0.10 | mg/L | 2021/08/24 | 2021/08/26 | MLB | 7538734 |
| Total Chromium (Cr) | - | ND | 0.0010 | mg/L | 2021/08/24 | 2021/08/26 | MLB | 7538734 |
| Total Copper (Cu) | - | 0.00092 | 0.00050 | mg/L | 2021/08/24 | 2021/08/26 | MLB | 7538734 |
| Total Iron (Fe) | - | 0.84 | 0.050 | mg/L | 2021/08/24 | 2021/08/26 | MLB | 7538734 |
| Total Lead (Pb) | - | ND | 0.00050 | mg/L | 2021/08/24 | 2021/08/26 | MLB | 7538734 |
| Total Magnesium (Mg) | - | 0.93 | 0.10 | mg/L | 2021/08/24 | 2021/08/26 | MLB | 7538734 |
| Total Manganese (Mn) | - | 0.029 | 0.0020 | mg/L | 2021/08/24 | 2021/08/26 | MLB | 7538734 |
| Total Nickel (Ni) | - | ND | 0.0020 | mg/L | 2021/08/24 | 2021/08/26 | MLB | 7538734 |



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BV Labs Job #: C1N8978
Report Date: 2021/08/30

NL Department of Environment, Climate Change and Municipalities
Your P.O. #: 220028978-5

| Sample Details/Parameters | A | Result | RDL | UNITS | Extracted | Analyzed | By | Batch |
|---|---|---|---|---|---|---|---|---|
| QLG091 CR ABOVE GR<br>Sampling Date 2021/08/17 10:10<br>Matrix W<br>Sample # 2021-6324-00-SI-SP<br>Registration # WS-S-0000<br>**ELEMENTS BY ICP/MS (WATER)**<br>**Metals** | | | | | | | | |
| Total Phosphorus (P) | - | ND | 0.10 | mg/L | 2021/08/24 | 2021/08/26 | MLB | 7538734 |
| Total Selenium (Se) | - | ND | 0.00050 | mg/L | 2021/08/24 | 2021/08/26 | MLB | 7538734 |
| Total Sodium (Na) | - | 0.55 | 0.10 | mg/L | 2021/08/24 | 2021/08/26 | MLB | 7538734 |
| Total Strontium (Sr) | - | 0.012 | 0.0020 | mg/L | 2021/08/24 | 2021/08/26 | MLB | 7538734 |
| Total Uranium (U) | - | ND | 0.00010 | mg/L | 2021/08/24 | 2021/08/26 | MLB | 7538734 |
| Total Zinc (Zn) | - | ND | 0.0050 | mg/L | 2021/08/24 | 2021/08/26 | MLB | 7538734 |



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BV Labs Job #: C1N8978
Report Date: 2021/08/30

NL Department of Environment, Climate Change and Municipalities
Your P.O. #: 220028978-5

| Sample Details/Parameters | A | Result | RDL | UNITS | Extracted | Analyzed | By | Batch |
|---|---|---|---|---|---|---|---|---|
| QLG092 CR BELOW MF | | | | | | | | |
| Sampling Date 2021/08/17 13:05 | | | | | | | | |
| Matrix W | | | | | | | | |
| Sample # 2021-6325-00-SI-SP | | | | | | | | |
| Registration # WS-S-0000 | | | | | | | | |
| **RESULTS OF ANALYSES OF WATER** | | | | | | | | |
| **Calculated Parameters** | | | | | | | | |
| Hardness (CaCO3) | - | 10 | 1.0 | mg/L | N/A | 2021/08/26 | | 7535152 |
| Nitrate (N) | - | ND | 0.050 | mg/L | N/A | 2021/08/26 | | 7535153 |
| Total dissolved solids (calc., EC) | - | 12 | 1.0 | mg/L | N/A | 2021/08/25 | | 7535300 |
| **Inorganics** | | | | | | | | |
| Conductivity | - | 22 | 1.0 | uS/cm | N/A | 2021/08/25 | SHW | 7539882 |
| Chloride (Cl-) | - | ND | 1.0 | mg/L | N/A | 2021/08/26 | FD | 7543744 |
| Bromide (Br-) | - | ND | 1.0 | mg/L | N/A | 2021/08/26 | FD | 7543744 |
| Sulphate (SO4) | - | ND | 1.0 | mg/L | N/A | 2021/08/26 | FD | 7543744 |
| Total Alkalinity (Total as CaCO3) | - | 12 | 5.0 | mg/L | N/A | 2021/08/25 | MCN | 7539854 |
| Colour | - | 25 | 5.0 | TCU | N/A | 2021/08/25 | MCN | 7539855 |
| Dissolved Fluoride (F-) | - | ND | 0.10 | mg/L | N/A | 2021/08/25 | SHW | 7539884 |
| Total Kjeldahl Nitrogen (TKN) | - | ND | 0.10 | mg/L | 2021/08/26 | 2021/08/27 | MJ1 | 7543520 |
| Nitrate + Nitrite (N) | - | ND | 0.050 | mg/L | N/A | 2021/08/25 | MCN | 7539857 |
| Nitrite (N) | - | ND | 0.010 | mg/L | N/A | 2021/08/25 | MCN | 7539858 |
| Nitrogen (Ammonia Nitrogen) | - | ND | 0.050 | mg/L | N/A | 2021/08/25 | EMT | 7539942 |
| Dissolved Organic Carbon (C) | - | 3.6 | 0.50 | mg/L | N/A | 2021/08/25 | NGI | 7539929 |
| Total Organic Carbon (C) | - | 3.6 | 0.50 | mg/L | N/A | 2021/08/25 | NGI | 7539913 |
| pH | - | 7.07 | | pH | N/A | 2021/08/25 | SHW | 7539883 |
| Total Phosphorus | - | 0.011 | 0.004 | mg/L | 2021/08/26 | 2021/08/27 | SSV | 7543344 |
| Total Suspended Solids | - | 8.2 | 1.0 | mg/L | 2021/08/24 | 2021/08/26 | MKX | 7538304 |
| Turbidity | - | 7.3 | 0.10 | NTU | N/A | 2021/08/25 | SHW | 7539937 |
| **MERCURY BY COLD VAPOUR AA (WATER)** | | | | | | | | |
| **Metals** | | | | | | | | |
| Total Mercury (Hg) | - | ND | 0.000013 | mg/L | 2021/08/25 | 2021/08/25 | NHU | 7537662 |
| **ELEMENTS BY ICP/MS (WATER)** | | | | | | | | |
| **Metals** | | | | | | | | |
| Total Aluminum (Al) | - | 0.18 | 0.0050 | mg/L | 2021/08/24 | 2021/08/25 | MLB | 7538734 |
| Total Antimony (Sb) | - | ND | 0.0010 | mg/L | 2021/08/24 | 2021/08/25 | MLB | 7538734 |
| Total Arsenic (As) | - | ND | 0.0010 | mg/L | 2021/08/24 | 2021/08/25 | MLB | 7538734 |
| Total Barium (Ba) | - | 0.0099 | 0.0010 | mg/L | 2021/08/24 | 2021/08/25 | MLB | 7538734 |
| Total Boron (B) | - | ND | 0.050 | mg/L | 2021/08/24 | 2021/08/25 | MLB | 7538734 |
| Total Cadmium (Cd) | - | ND | 0.000010 | mg/L | 2021/08/24 | 2021/08/25 | MLB | 7538734 |
| Total Calcium (Ca) | - | 2.6 | 0.10 | mg/L | 2021/08/24 | 2021/08/25 | MLB | 7538734 |
| Total Chromium (Cr) | - | ND | 0.0010 | mg/L | 2021/08/24 | 2021/08/25 | MLB | 7538734 |
| Total Copper (Cu) | - | 0.00080 | 0.00050 | mg/L | 2021/08/24 | 2021/08/25 | MLB | 7538734 |
| Total Iron (Fe) | - | 0.28 | 0.050 | mg/L | 2021/08/24 | 2021/08/25 | MLB | 7538734 |
| Total Lead (Pb) | - | ND | 0.00050 | mg/L | 2021/08/24 | 2021/08/25 | MLB | 7538734 |
| Total Magnesium (Mg) | - | 0.90 | 0.10 | mg/L | 2021/08/24 | 2021/08/25 | MLB | 7538734 |
| Total Manganese (Mn) | - | 0.011 | 0.0020 | mg/L | 2021/08/24 | 2021/08/25 | MLB | 7538734 |
| Total Nickel (Ni) | - | ND | 0.0020 | mg/L | 2021/08/24 | 2021/08/25 | MLB | 7538734 |



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BV Labs Job #: C1N8978
Report Date: 2021/08/30

NL Department of Environment, Climate Change and Municipalities
Your P.O. #: 220028978-5

| Sample Details/Parameters | A | Result | RDL | UNITS | Extracted | Analyzed | By | Batch |
|---|---|---|---|---|---|---|---|---|
| QLG092 CR BELOW MF<br>Sampling Date 2021/08/17 13:05<br>Matrix W<br>Sample # 2021-6325-00-SI-SP<br>Registration # WS-S-0000 | | | | | | | | |
| **ELEMENTS BY ICP/MS (WATER)** | | | | | | | | |
| **Metals** | | | | | | | | |
| Total Phosphorus (P) | - | ND | 0.10 | mg/L | 2021/08/24 | 2021/08/25 | MLB | 7538734 |
| Total Selenium (Se) | - | ND | 0.00050 | mg/L | 2021/08/24 | 2021/08/25 | MLB | 7538734 |
| Total Sodium (Na) | - | 0.65 | 0.10 | mg/L | 2021/08/24 | 2021/08/25 | MLB | 7538734 |
| Total Strontium (Sr) | - | 0.013 | 0.0020 | mg/L | 2021/08/24 | 2021/08/25 | MLB | 7538734 |
| Total Uranium (U) | - | ND | 0.00010 | mg/L | 2021/08/24 | 2021/08/25 | MLB | 7538734 |
| Total Zinc (Zn) | - | ND | 0.0050 | mg/L | 2021/08/24 | 2021/08/25 | MLB | 7538734 |



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BV Labs Job #: C1N8978
Report Date: 2021/08/30

NL Department of Environment, Climate Change and Municipalities
Your P.O. #: 220028978-5

| Sample Details/Parameters | A | Result | RDL | UNITS | Extracted | Analyzed | By | Batch |
|---|---|---|---|---|---|---|---|---|
| QLG094 CR @ EP | | | | | | | | |
| Sampling Date 2021/08/18 09:35 | | | | | | | | |
| Matrix W | | | | | | | | |
| Sample # 2021-6327-00-SI-SP | | | | | | | | |
| Registration # WS-S-0000 | | | | | | | | |
| **RESULTS OF ANALYSES OF WATER** | | | | | | | | |
| **Calculated Parameters** | | | | | | | | |
| Hardness (CaCO3) | - | 9.6 | 1.0 | mg/L | N/A | 2021/08/26 | | 7535152 |
| Nitrate (N) | - | ND | 0.050 | mg/L | N/A | 2021/08/27 | | 7535153 |
| Total dissolved solids (calc., EC) | - | 22 | 1.0 | mg/L | N/A | 2021/08/25 | | 7535300 |
| **Inorganics** | | | | | | | | |
| Conductivity | - | 40 | 1.0 | uS/cm | N/A | 2021/08/25 | SHW | 7539882 |
| Chloride (Cl-) | - | 6.0 | 1.0 | mg/L | N/A | 2021/08/26 | FD | 7543744 |
| Bromide (Br-) | - | ND | 1.0 | mg/L | N/A | 2021/08/26 | FD | 7543744 |
| Sulphate (SO4) | - | 1.1 | 1.0 | mg/L | N/A | 2021/08/26 | FD | 7543744 |
| Total Alkalinity (Total as CaCO3) | - | 8.8 | 5.0 | mg/L | N/A | 2021/08/27 | MCN | 7542641 |
| Colour | - | 46 | 5.0 | TCU | N/A | 2021/08/27 | MCN | 7542654 |
| Dissolved Fluoride (F-) | - | ND | 0.10 | mg/L | N/A | 2021/08/25 | SHW | 7539884 |
| Total Kjeldahl Nitrogen (TKN) | - | ND | 0.10 | mg/L | 2021/08/26 | 2021/08/27 | MJ1 | 7543520 |
| Nitrate + Nitrite (N) | - | ND | 0.050 | mg/L | N/A | 2021/08/26 | MCN | 7542686 |
| Nitrite (N) | - | ND | 0.010 | mg/L | N/A | 2021/08/26 | MCN | 7542687 |
| Nitrogen (Ammonia Nitrogen) | - | ND | 0.050 | mg/L | N/A | 2021/08/25 | EMT | 7539942 |
| Dissolved Organic Carbon (C) | - | 4.8 | 0.50 | mg/L | N/A | 2021/08/25 | NGI | 7539929 |
| Total Organic Carbon (C) | - | 5.0 | 0.50 | mg/L | N/A | 2021/08/25 | NGI | 7539913 |
| pH | - | 7.02 | | pH | N/A | 2021/08/25 | SHW | 7539883 |
| Total Phosphorus | - | 0.011 | 0.004 | mg/L | 2021/08/26 | 2021/08/27 | SSV | 7543344 |
| Total Suspended Solids | - | 4.0 | 1.0 | mg/L | 2021/08/25 | 2021/08/27 | MKX | 7539988 |
| Turbidity | - | 3.6 | 0.10 | NTU | N/A | 2021/08/25 | SHW | 7539937 |
| **MERCURY BY COLD VAPOUR AA (WATER)** | | | | | | | | |
| **Metals** | | | | | | | | |
| Total Mercury (Hg) | - | ND | 0.000013 | mg/L | 2021/08/25 | 2021/08/25 | NHU | 7537662 |
| **ELEMENTS BY ICP/MS (WATER)** | | | | | | | | |
| **Metals** | | | | | | | | |
| Total Aluminum (Al) | - | 0.15 | 0.0050 | mg/L | 2021/08/24 | 2021/08/25 | MLB | 7538734 |
| Total Antimony (Sb) | - | ND | 0.0010 | mg/L | 2021/08/24 | 2021/08/25 | MLB | 7538734 |
| Total Arsenic (As) | - | ND | 0.0010 | mg/L | 2021/08/24 | 2021/08/25 | MLB | 7538734 |
| Total Barium (Ba) | - | 0.0086 | 0.0010 | mg/L | 2021/08/24 | 2021/08/25 | MLB | 7538734 |
| Total Boron (B) | - | ND | 0.050 | mg/L | 2021/08/24 | 2021/08/25 | MLB | 7538734 |
| Total Cadmium (Cd) | - | ND | 0.000010 | mg/L | 2021/08/24 | 2021/08/25 | MLB | 7538734 |
| Total Calcium (Ca) | - | 2.1 | 0.10 | mg/L | 2021/08/24 | 2021/08/25 | MLB | 7538734 |
| Total Chromium (Cr) | - | ND | 0.0010 | mg/L | 2021/08/24 | 2021/08/25 | MLB | 7538734 |
| Total Copper (Cu) | - | 0.0010 | 0.00050 | mg/L | 2021/08/24 | 2021/08/25 | MLB | 7538734 |
| Total Iron (Fe) | - | 0.44 | 0.050 | mg/L | 2021/08/24 | 2021/08/25 | MLB | 7538734 |
| Total Lead (Pb) | - | ND | 0.00050 | mg/L | 2021/08/24 | 2021/08/25 | MLB | 7538734 |
| Total Magnesium (Mg) | - | 1.1 | 0.10 | mg/L | 2021/08/24 | 2021/08/25 | MLB | 7538734 |
| Total Manganese (Mn) | - | 0.011 | 0.0020 | mg/L | 2021/08/24 | 2021/08/25 | MLB | 7538734 |
| Total Nickel (Ni) | - | ND | 0.0020 | mg/L | 2021/08/24 | 2021/08/25 | MLB | 7538734 |



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BV Labs Job #: C1N8978
Report Date: 2021/08/30

NL Department of Environment, Climate Change and Municipalities
Your P.O. #: 220028978-5

| Sample Details/Parameters | A | Result | RDL | UNITS | Extracted | Analyzed | By | Batch |
|---|---|---|---|---|---|---|---|---|
| QLG094 CR @ EP<br>Sampling Date 2021/08/18 09:35<br>Matrix W<br>Sample # 2021-6327-00-SI-SP<br>Registration # WS-S-0000<br>**ELEMENTS BY ICP/MS (WATER)**<br>**Metals** | | | | | | | | |
| Total Phosphorus (P) | - | ND | 0.10 | mg/L | 2021/08/24 | 2021/08/25 | MLB | 7538734 |
| Total Selenium (Se) | - | ND | 0.00050 | mg/L | 2021/08/24 | 2021/08/25 | MLB | 7538734 |
| Total Sodium (Na) | - | 4.1 | 0.10 | mg/L | 2021/08/24 | 2021/08/25 | MLB | 7538734 |
| Total Strontium (Sr) | - | 0.016 | 0.0020 | mg/L | 2021/08/24 | 2021/08/25 | MLB | 7538734 |
| Total Uranium (U) | - | ND | 0.00010 | mg/L | 2021/08/24 | 2021/08/25 | MLB | 7538734 |
| Total Zinc (Zn) | - | ND | 0.0050 | mg/L | 2021/08/24 | 2021/08/25 | MLB | 7538734 |



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