Real-Time Water Quality Deployment Report

Lower Churchill River Network

June 25 to
July 22/23, 2014

Newfoundland Labrador

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

Contents

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Real Time Water Quality Monitoring

- Department of Environment and Conservation staff monitors the real-time web pages regularly.
- This deployment report discusses water quality related events occurring at five stations on the Lower Churchill River: below Metchin River, below Grizzle Rapids, above and below Muskrat Falls and at English Point.
- There was no instrument deployed at the station on Lake Melville east of Little River. Instrument deployments at this station have been suspended until a buoy system can be established at this site.
- On June 25, 2014, real-time water quality monitoring instruments were deployed at the five Lower Churchill River Stations for periods of 27-28 days. On July 8, 2014, the instrument at below Muskrat Falls was removed and replaced as it had become buried in sand. Instruments at all stations were removed on July 22/23, 2014.

Quality Assurance and Quality Control

- As part of the Quality Assurance and Quality Control protocol (QAQC), an assessment of the reliability of data recorded by an instrument is made at the beginning and end of the deployment period. The procedure is based on the approach used by the United States Geological Survey.
  - ► At deployment and removal, a QAQC Instrument is temporarily deployed along side 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 QAQC Instrument at deployment and at removal, a qualitative statement is made on the data quality (Table 1).

Table 1: 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 dependant, 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 June 25 to July 22/23, 2014 are summarized in Table 2.

Table 2: Comparison rankings for Lower Churchill River stations, June 25 to July 22/23, 2014

Churchill River Station and Instrument Number	Date	Action	Comparison Ranking				
			Temperature	pH	Conductivity	Dissolved Oxygen	Turbidity
Below Metchin River (45701)	June 25, 2014	Deployment	Excellent	Good	Excellent	Excellent	Excellent
	July 22, 2014	Removal	Excellent	Excellent	Excellent	Excellent	Excellent
Below Grizzle Rapids (45709)	June 25, 2014	Deployment	Fair	Good	Excellent	Excellent	Excellent
	July 22, 2014	Removal	Good	Excellent	Excellent	Excellent	Excellent
Above Muskrat Falls (45708)	June 25, 2014	Deployment	Excellent	Excellent	Excellent	Excellent	Good
	July 23, 2014	Removal	Excellent	Poor	Excellent	Excellent	Excellent
Below Muskrat Falls (47500)	June 25, 2014*	Deployment	Excellent	Excellent	Excellent	Excellent	Good
	July 23, 2014*	Removal	*	*	*	*	*
At English Point (45699)	June 25, 2014	Deployment	Excellent	Excellent	Excellent	Excellent	Fair
	July 23, 2014	Removal	Excellent	Poor	Excellent	Excellent	Good

* Sonde was removed and 47589 was installed on July 8th, due to the sonde being buried in sand. Removal rankings unavailable as the sonde was again buried in sand during removal on July 23, 2014.

- At the station below Metchin River, temperature, pH, specific conductivity, dissolved oxygen and turbidity all rank either 'good' or 'excellent' at deployment.

  At removal, temperature, pH, specific conductivity, dissolved oxygen and turbidity all rank 'excellent'.

- At the station below Grizzle Rapids, pH, specific conductivity, dissolved oxygen and turbidity all rank either 'good' or 'excellent' at deployment. Temperature ranked 'fair'. The field sonde recorded a value of 12.70°C while the QA/QC sonde recorded 13.41°C. It is likely that the QA/QC temperature sensor was not fully acclimated to the water temperature when the values were recorded.

  At removal, pH, specific conductivity, dissolved oxygen, turbidity and temperature all rank 'excellent' or 'good'.

- At the station above Muskrat Falls, temperature, specific conductivity, pH and dissolved oxygen all rank 'excellent' while turbidity ranks 'good' at deployment.

  At removal, temperature, specific conductivity, dissolved oxygen and turbidity all rank 'excellent' while pH ranks 'poor'. For pH, the field instrument read a value of 6.88 and the QAQC instrument read a value of 5.85. The QAQC instrument is reading unusually low and is likely incorrect. This discrepancy is likely due to the values on the QA/QC sonde being recorded before the sensor had stabilized.

- At the station below Muskrat Falls, temperature, specific conductivity, pH, dissolved oxygen and turbidity all rank either 'good' or 'excellent' at deployment on June 25th.

  At removal, the sensors could not be ranked as the instrument was buried in sand and thus recording invalid measurements.

- At the station at English Point, temperature, pH, specific conductivity and dissolved oxygen all rank 'excellent' and turbidity ranks 'fair' at deployment. For turbidity, the field sonde measured 9.4NTU and the QA/QC measured 3.6NTU. The grab sample taken at this time measured 7NTU, and had a 'good' ranking when compared with the field value. The QA/QC reading is thus inaccurate.

  At removal, temperature, specific conductivity dissolved oxygen and turbidity all rank either 'good' or 'excellent', while pH ranks 'poor'. The field value for pH was 6.64 and the QA/QC value was 5.20. This discrepancy may be due to the QA QC sonde not having stabilized before the value was recorded as pH sensors can be slow to acclimate to conditions.

Data Interpretation

- The following graphs and discussion illustrate water quality related events occurring between June 25 and July 22-23 in the Lower Churchill River Network.
- With the exception of water quantity data (stage), all data used in the preparation of the graphs and subsequent discussion below adhere to this stringent QAQC protocol. Water Survey of Canada is responsible for QAQC of water quantity data. Corrected data can be obtained upon request.
- The below Muskrat Falls station is experiencing issues with the sediment in the area. The sonde hads been repeatedly buried in sand during deployment. This limits the data available for interpretation at this station.

Churchill River below Metchin River

- Water temperature ranges from 12.70°C to 20.40°C during the deployment period (Figure 1).
- Water temperature is generally increasing throughout the deployment period. This trend is expected due to the warming air temperatures into the summer season (Figure 2).

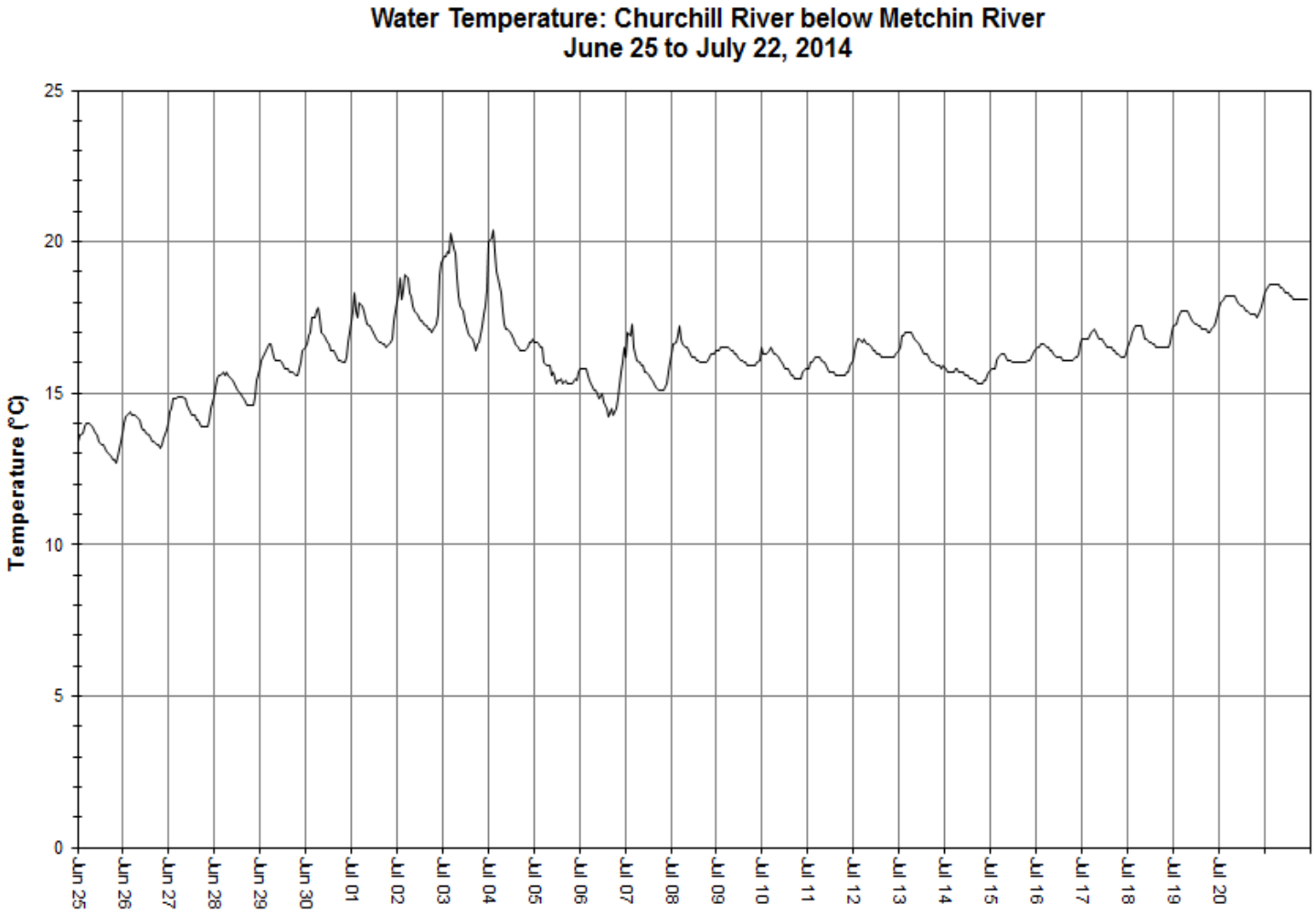


Figure 1: Water temperature at Churchill River below Metchin River

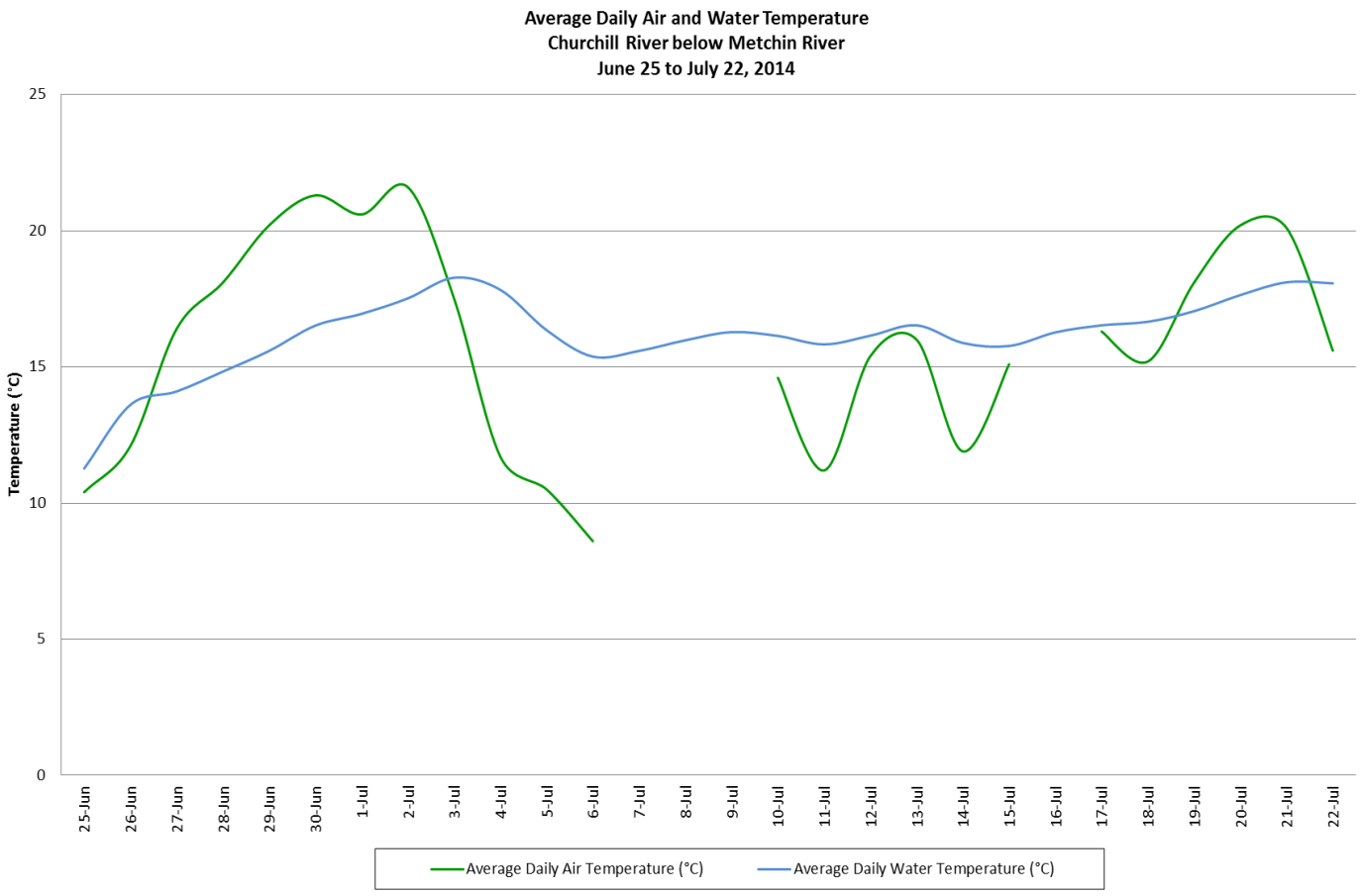


Figure 2: Average daily air and water temperature at Churchill River below Metchin River (weather data recorded at Churchill Falls, NL)

- pH ranges between 6.86 and 7.10 pH units and is very stable throughout the deployment period regardless of the changing stage levels (Figure 3).
- All pH values during the deployment are within the CCME Guidelines for the Protection of Aquatic Life (indicated in blue on Figure 3).

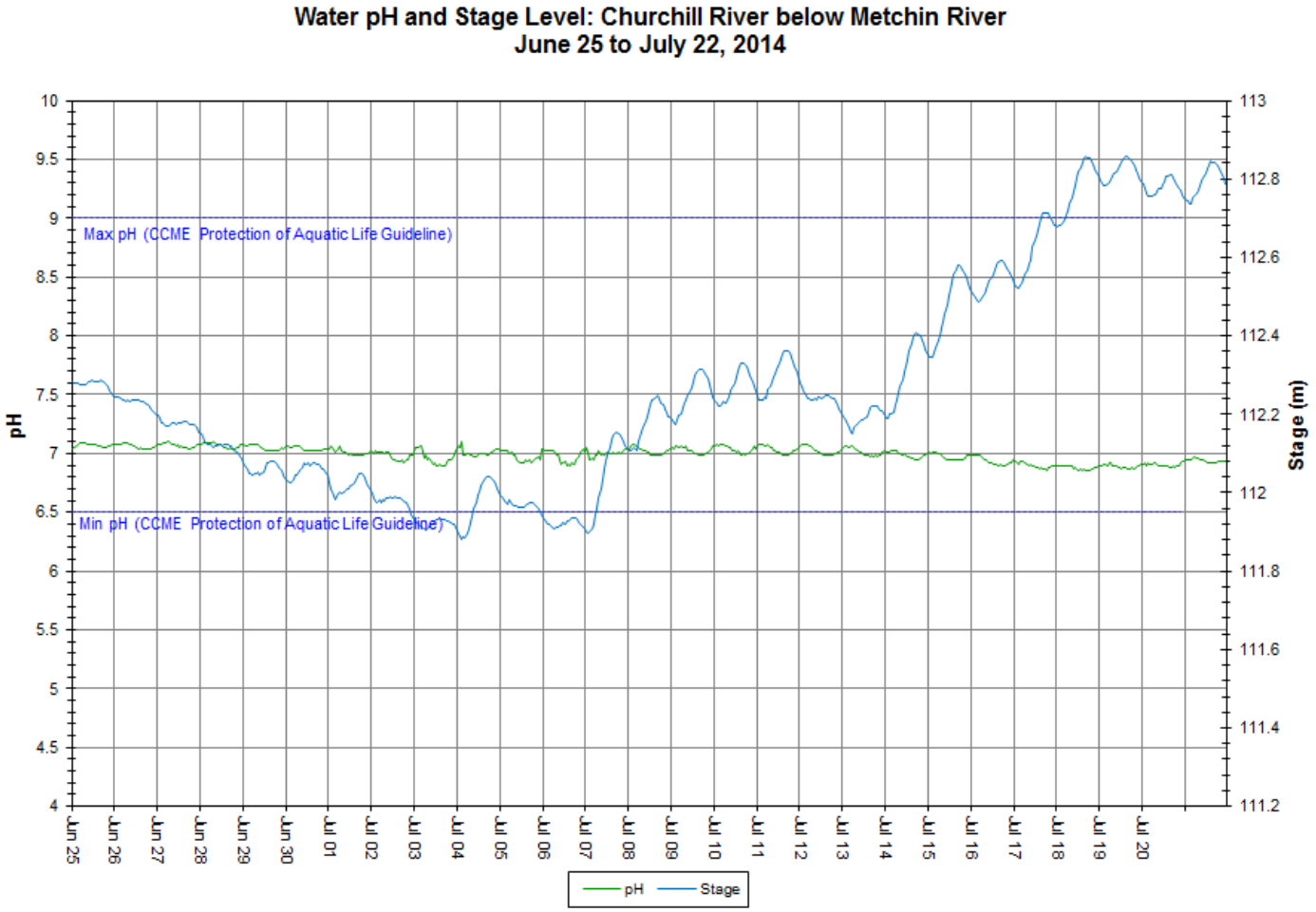


Figure 3: pH and stage level at Churchill River below Metchin River

- Specific conductivity ranges between 16.7µS/cm to 19.6µS/cm during the deployment period, averaging 18.1µS/cm (Figure 4).
- Stage is included in Figure 4 to illustrate the inverse relationship between conductivity and water level. Stage is fluctuating significantly throughout the deployment period. Generally, as stage levels decrease, specific conductivity generally increases due to the increasing concentration of dissolved solids in the water column. Inversely, when stage increases, specific conductivity usually decreases as the concentration of dissolved solids is diluted. This trend is clearly visible in the data collected during the deployment period.

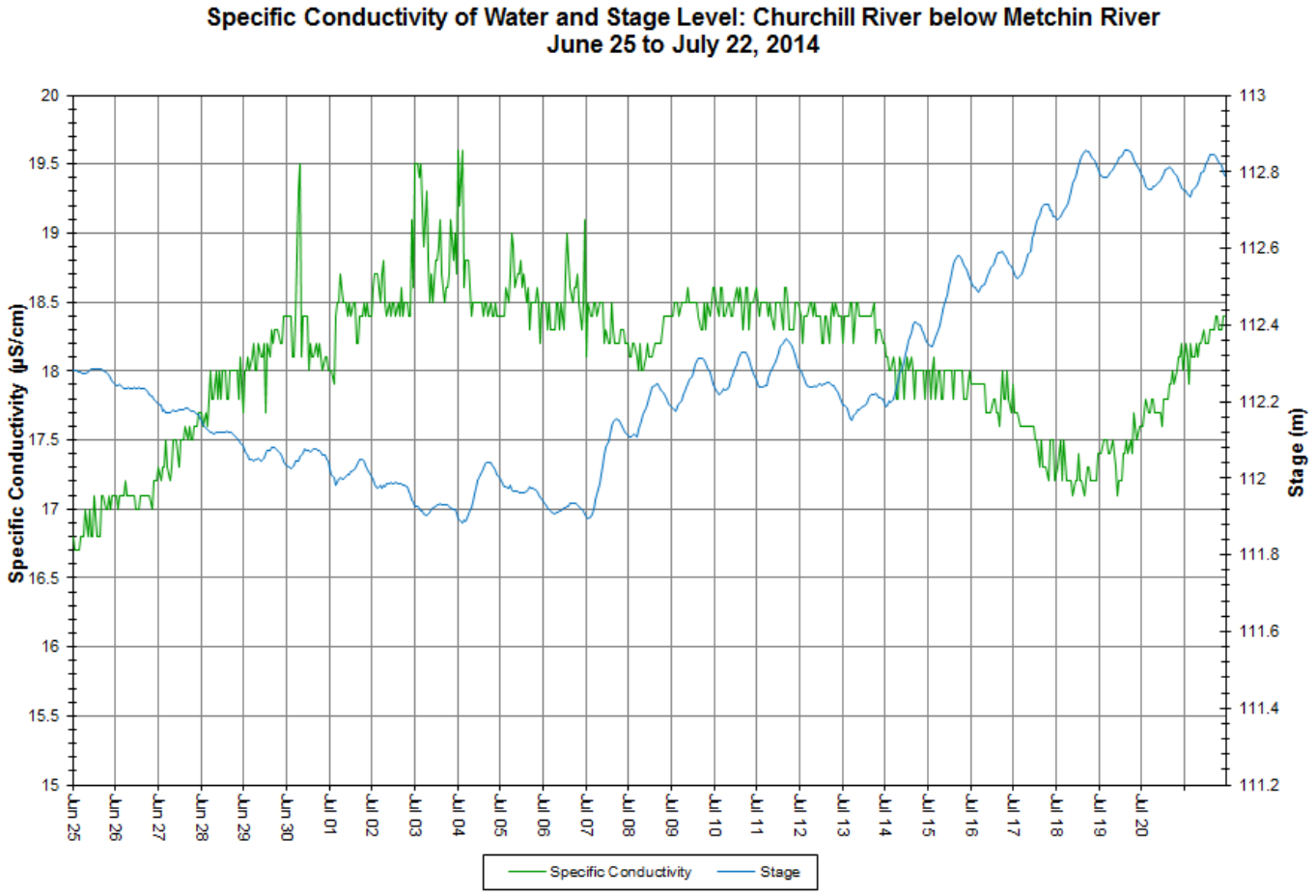


Figure 4: Specific conductivity and stage level at Churchill River below Metchin River

- Dissolved oxygen content ranges between 9.08mg/l and 10.51mg/l. The saturation of dissolved oxygen ranges from 91.8% to 104.6% (Figure 5).
- All values are above the minimum CCME Guideline for the Protection of Cold Water Biota at Other Life Stages of 6.5mg/l. All values recorded during the first week of deployment are above the CCME Guidelines for the Protection of Early Life Stages of 9.5mg/l. The guidelines are indicated in blue on Figure 5.
- Dissolved oxygen content is decreasing throughout the deployment period. This trend is expected given the warming air and water temperatures (Figure 2).

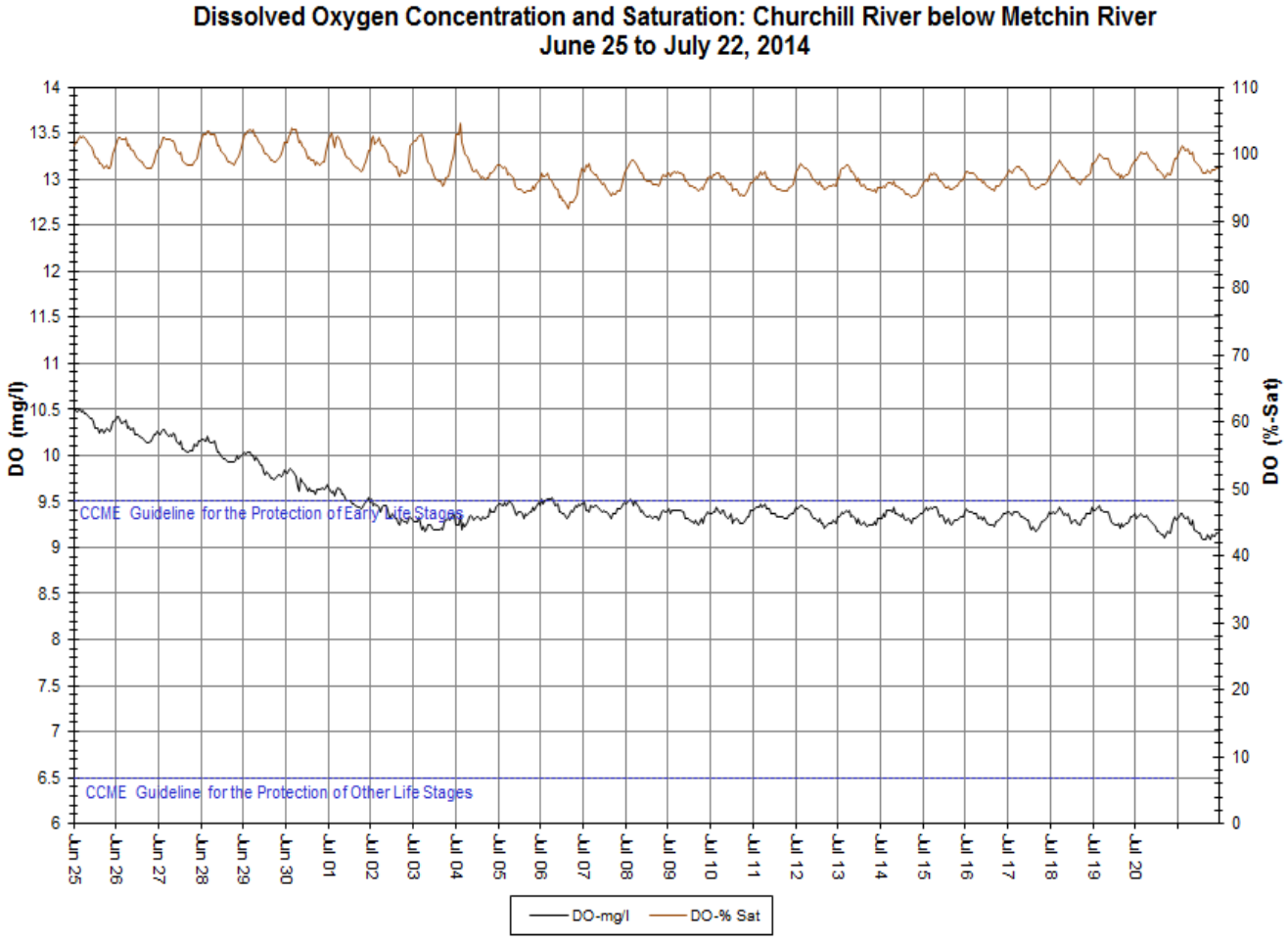


Figure 5: Dissolved oxygen and percent saturation at Churchill River below Metchin River

- Turbidity generally remains at 0NTU for the majority of the deployment period (Figure 6). A median value of 0NTU indicates there is no natural background turbidity value at this station.
- Turbidity frequently increases to values >0NTU. These events are generally low in magnitude and drop again rapidly, likely from debris passing the turbidity sensor. Increases such as those on July 3, 6, 8,11 are associated with precipitation events.

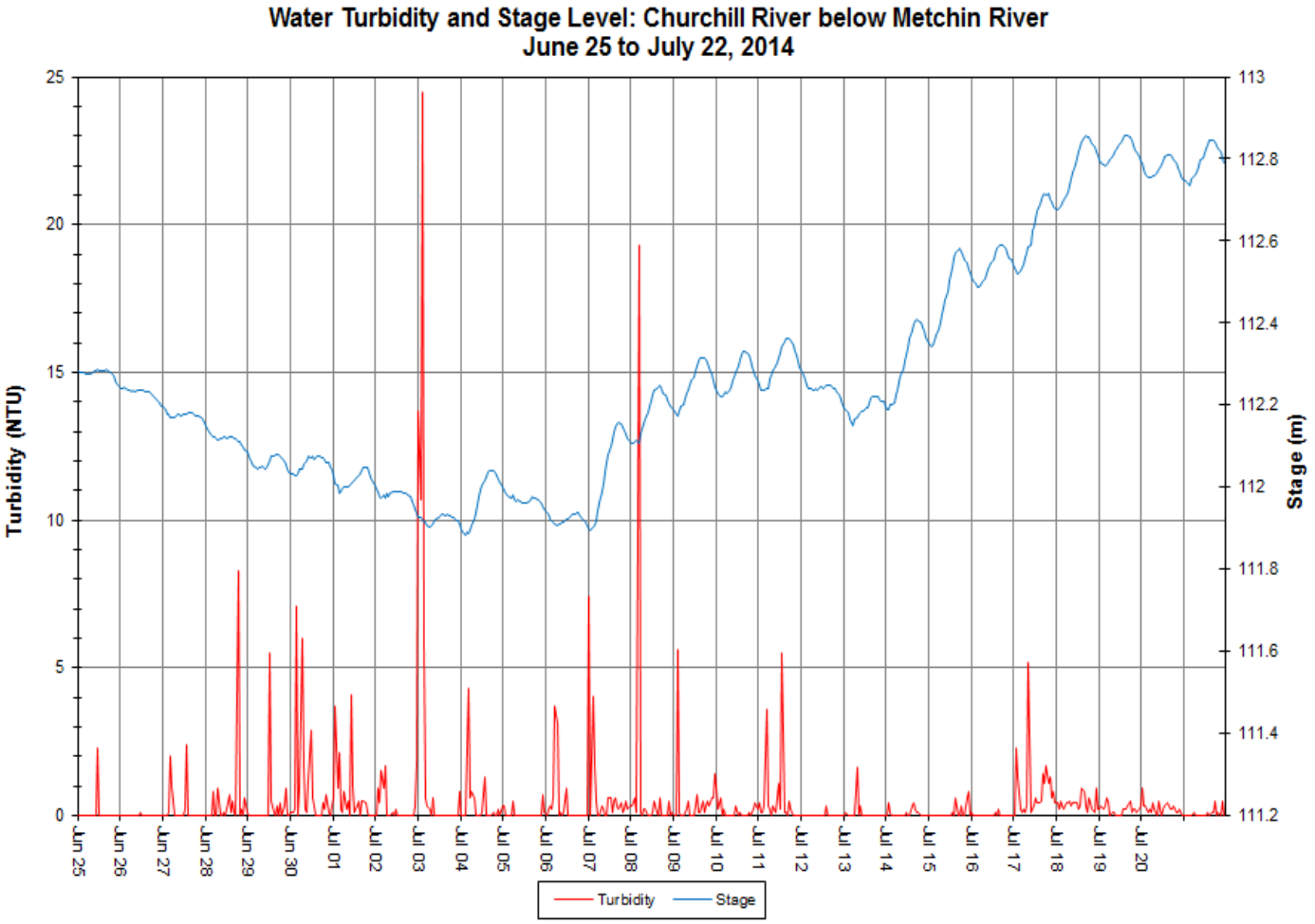


Figure 6: Turbidity and stage level at Churchill River below Metchin River

- Stage and precipitation are graphed below to show the relationship between rainfall and water level (Figure 7). Stage is generally increasing throughout the deployment period. Precipitation occurs on <50% of the days in the deployment period, however, amounts are generally low, peaking at 16.6mm on July 22. Stage ranges between 111.88m and 112.86m, a difference of 0.98m.

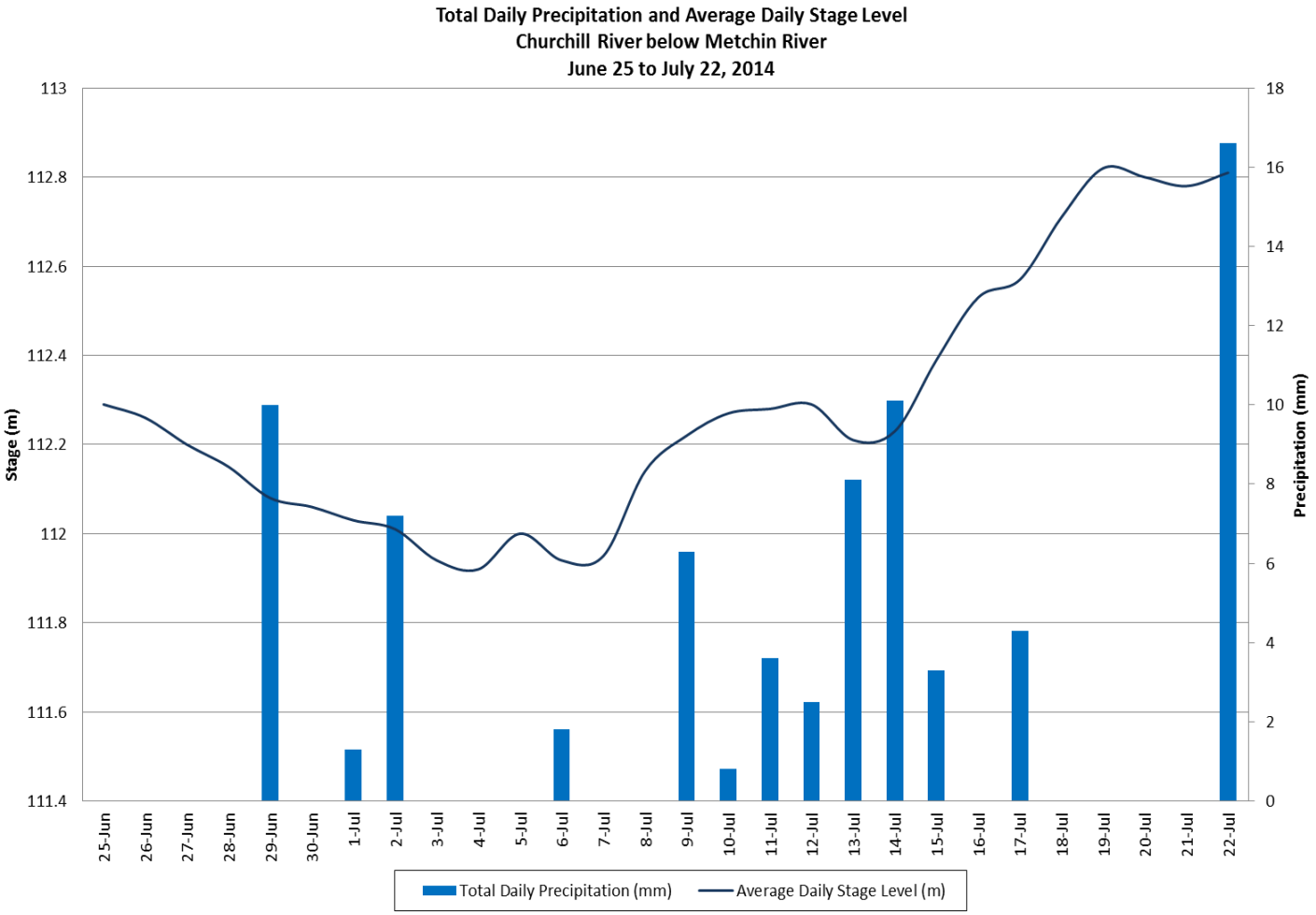


Figure 7: Daily precipitation and average daily stage level at Churchill River below Metchin River (weather data recorded at Churchill Falls)

Churchill River below Grizzle Rapids

- Water temperature ranges from 10.60°C to 19.20°C during the deployment period (Figure 8).
- Water temperature is generally increasing throughout the deployment period. This trend is expected due to the warming ambient air temperatures in the summer season (Figure 9).

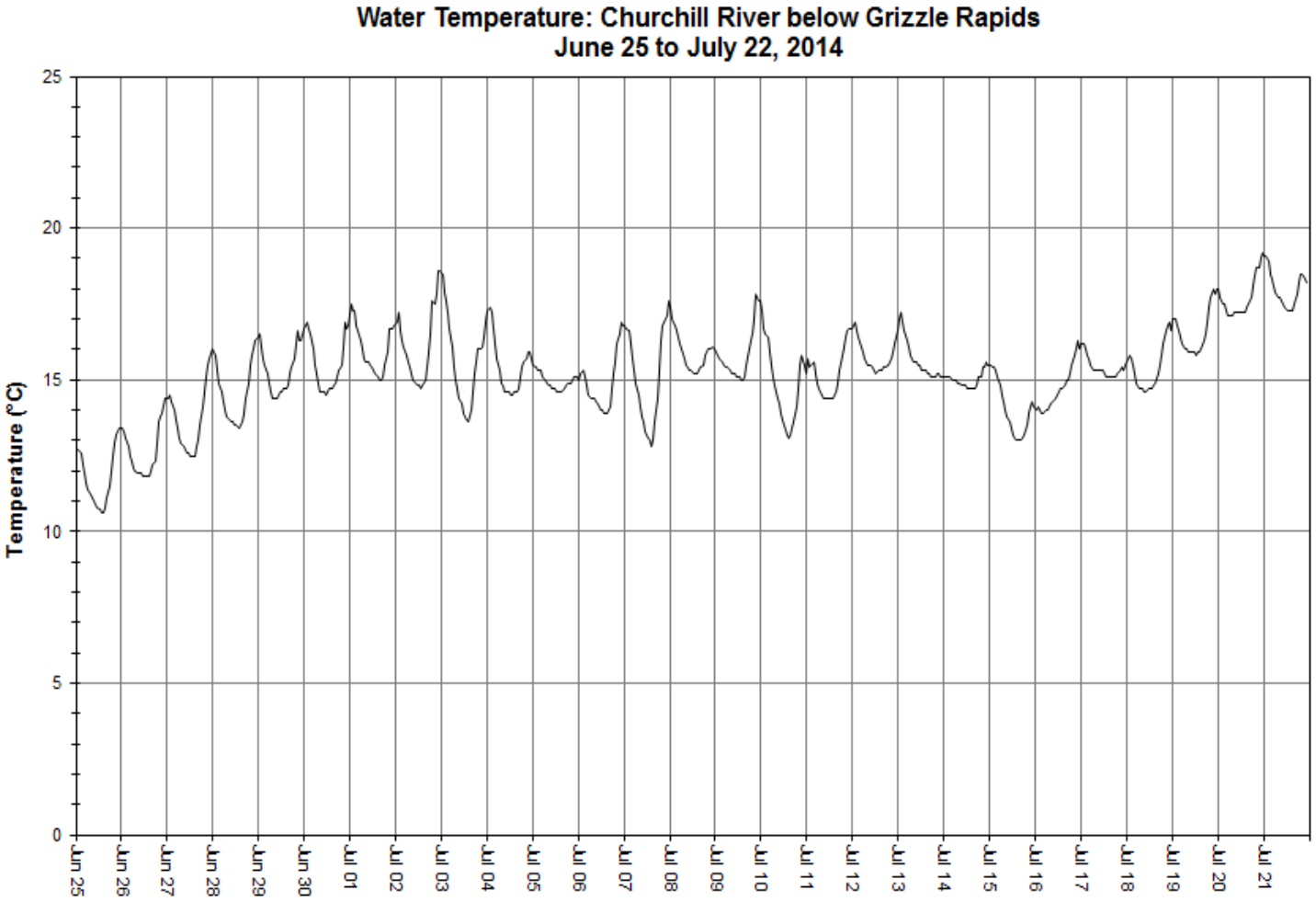


Figure 8: Water temperature at Churchill River below Grizzle Rapids

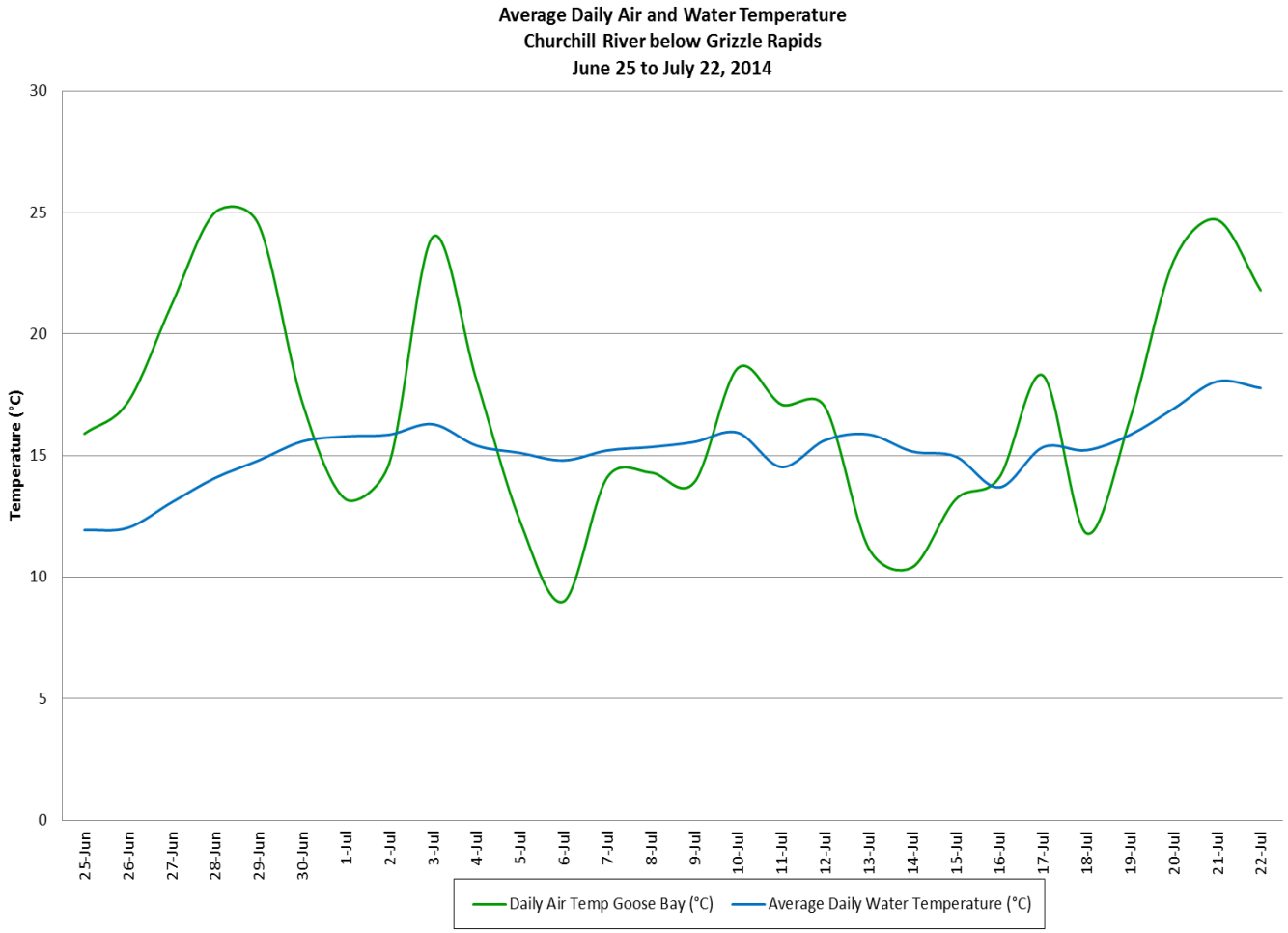


Figure 9: Average daily air and water temperature at Churchill River below Grizzle Rapids (weather data recorded at Goose Bay)

- pH ranges between 6.63 and 7.14 pH units (Figure 10). pH values are very stable throughout the deployment period regardless of changing water levels. pH values generally fluctuate on a daily basis.
- All values during the deployment are within the CCME Guidelines for the Protection of Aquatic Life (indicated in blue on Figure 10).

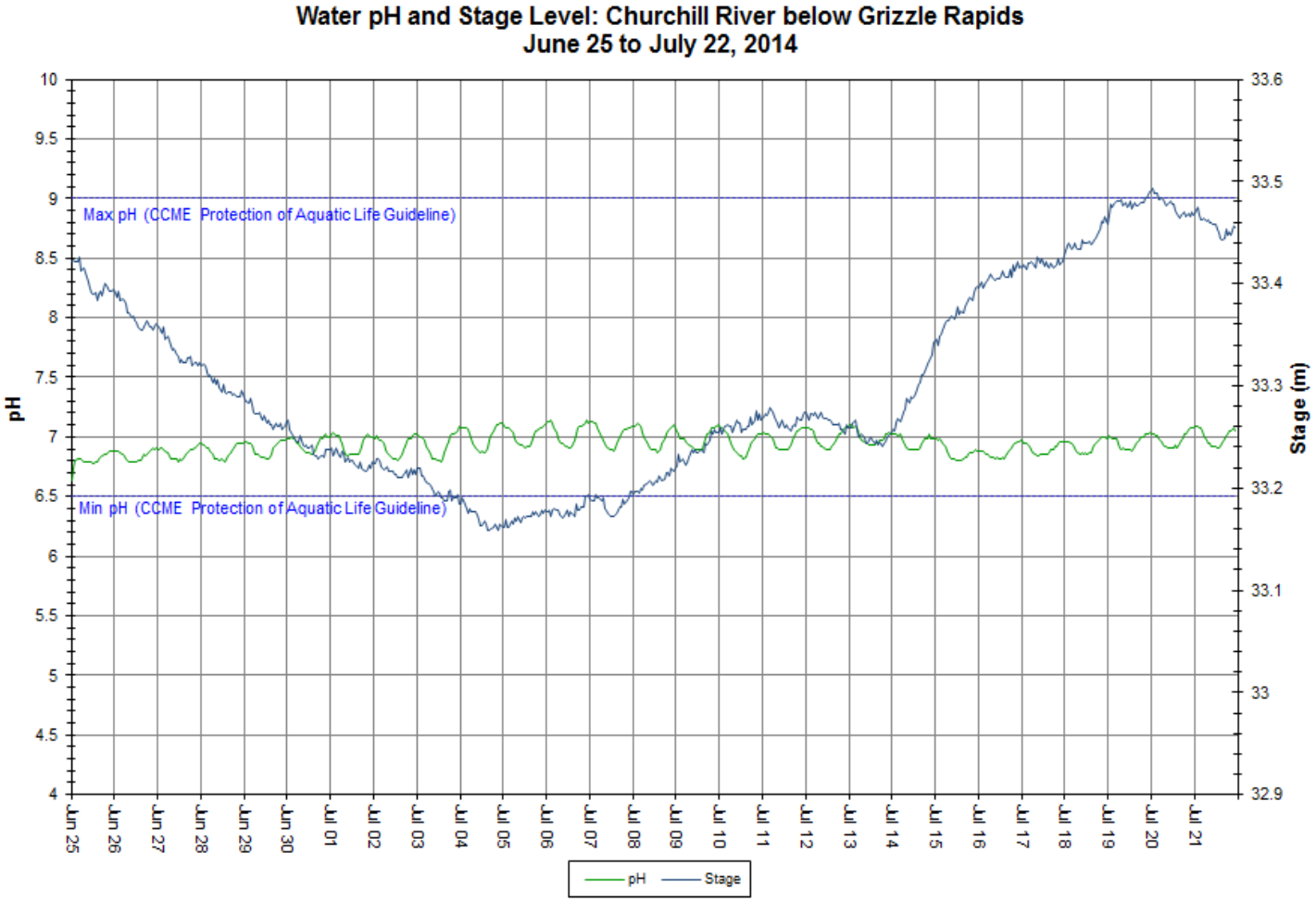


Figure 10: pH and stage level at Churchill River below Grizzle Rapids

- Specific conductivity ranges from 14.4µS/cm to 17.4µS/cm during the deployment period, averaging 16.2µS/cm (Figure 11).
- Stage is included in Figure 11 to illustrate the inverse relationship between conductivity and water level. Generally, as stage levels increase, specific conductivity decreases due to the dilution of dissolved solids in the water column. Inversely, when stage decreases, specific conductivity usually increases as the concentration of dissolved solids is increased. This trend is not clearly visible in the data collected during the deployment period, as specific conductivity is very stable despite changing water levels.

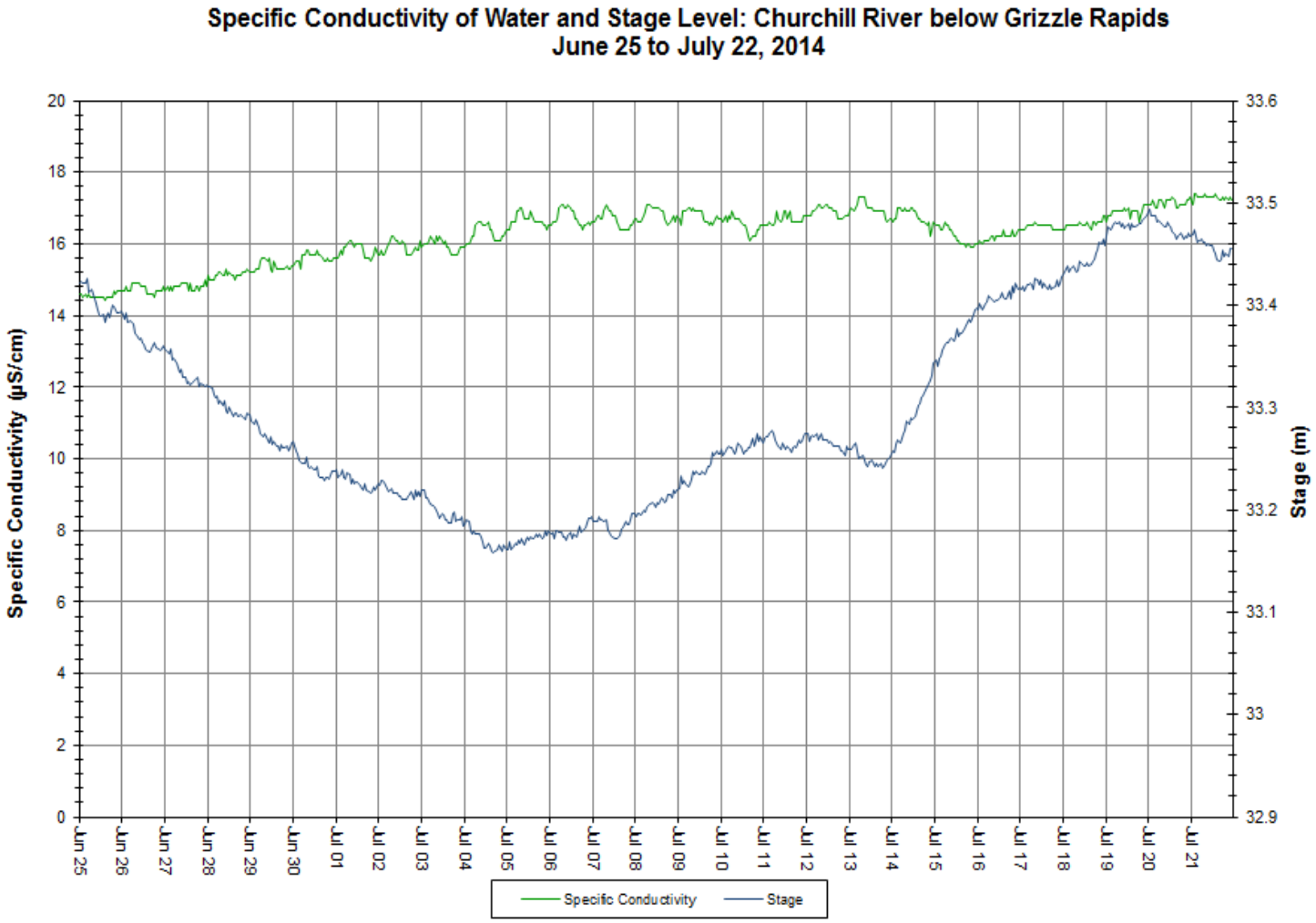


Figure 11: Specific conductivity and stage level at Churchill River below Grizzle Rapids

- Dissolved oxygen content ranges between 9.24mg/l and 10.99mg/l. The saturation of dissolved oxygen ranges from 94.2% to 105.6% (Figure 12).
- All values were above the minimum CCME Guideline for the Protection of Cold Water Biota at Other Life Stages of 6.5mg/l and only a few values dip below the CCME Guideline for the Protection of Early Life Stages of 9.5mg/l. The guidelines are indicated in blue on Figure 12.
- Dissolved oxygen content is decreasing slightly throughout the deployment period. This trend is expected given the warming air and water temperatures into the summer (Figure 9).

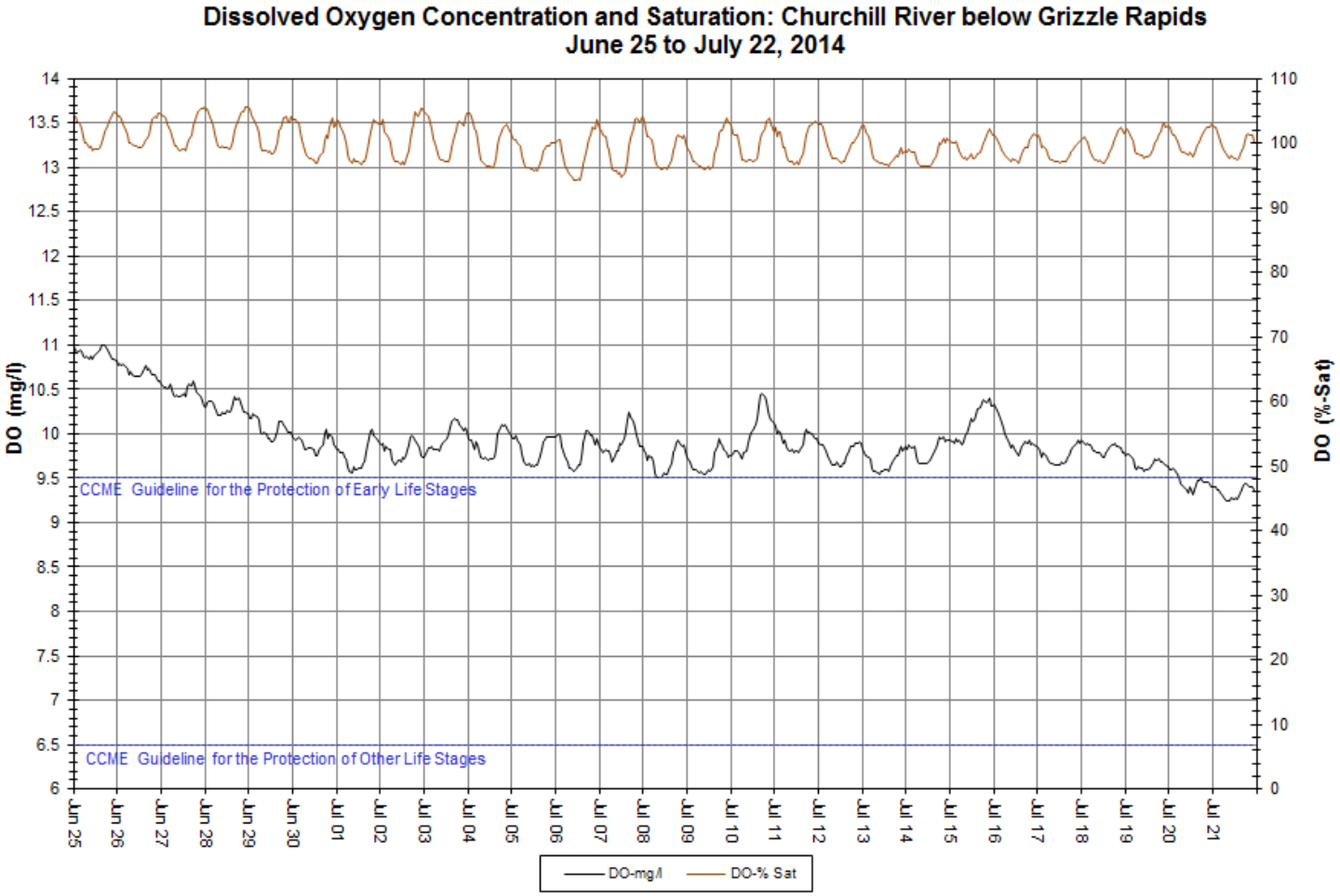


Figure 12: Dissolved oxygen and percent saturation at Churchill River below Grizzle Rapids

- Turbidity values remain at 0NTU for most of the deployment period (Figure 13). A median value of 0NTU at this station indicates there is no natural background turbidity. This trend is typical of this station as the river reach runs clearly and quickly though Grizzle Rapids.
- Turbidity increases up to 16.5NTU near the end of the deployment period on July 22, after a gradual increase July 19-22. This may be due to precipitation events in the preceding days or accumulation of debris on the turbidity sensor.

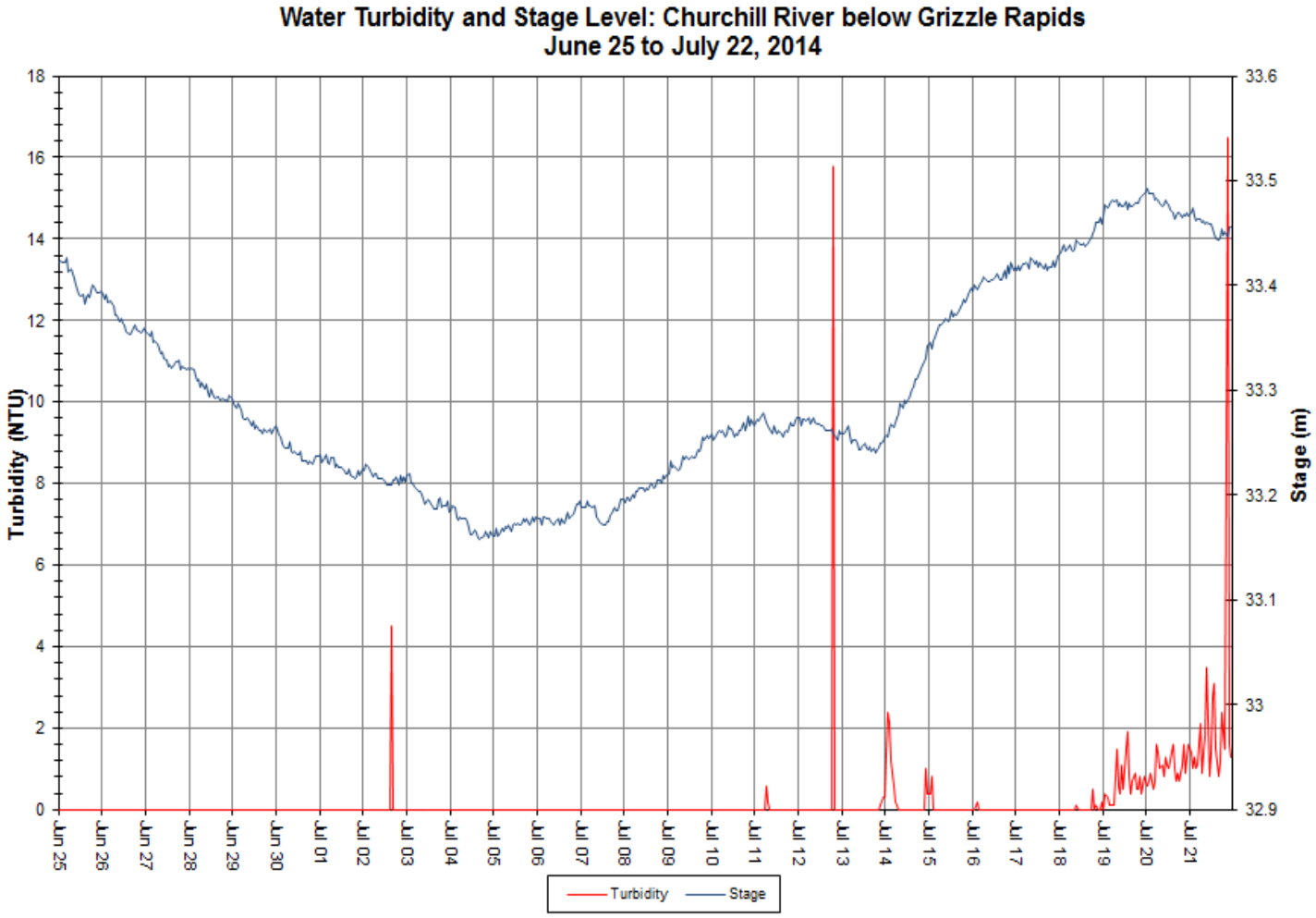


Figure 13: Turbidity and stage level at Churchill River below Grizzle Rapids

- Stage and precipitation are graphed below to show the relationship between rainfall and water level (Figure 14). Stage is decreasing throughout the first two weeks of deployment before steadily increasing in the last two weeks of the deployment period. Precipitation occurs on <50% of the days in the deployment period and amounts are generally low, peaking at 16.6 mm on July 22. Stage ranges between 33.16m and 33.49m, a difference of 0.33m.

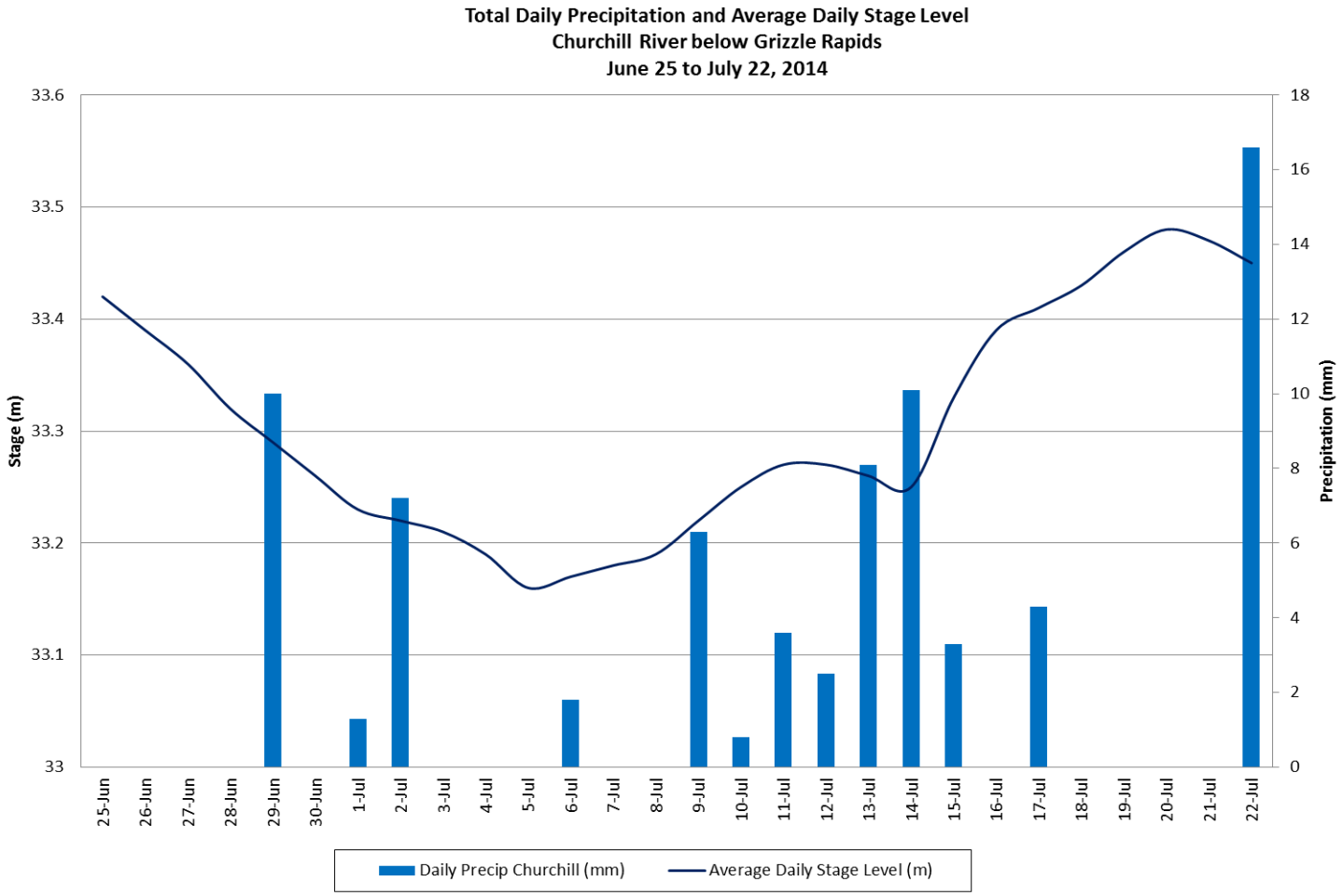


Figure 14: Daily precipitation and average daily stage level at Churchill River below Grizzle Rapids (weather data recorded at Goose Bay)

Churchill River above Muskrat Falls

- Water temperature ranges from 11.92°C to 18.85°C during the deployment period (Figure 15).
- Water temperature is increasing throughout the deployment period. This trend is expected given the warming ambient air temperatures in the summer season (Figure 16).

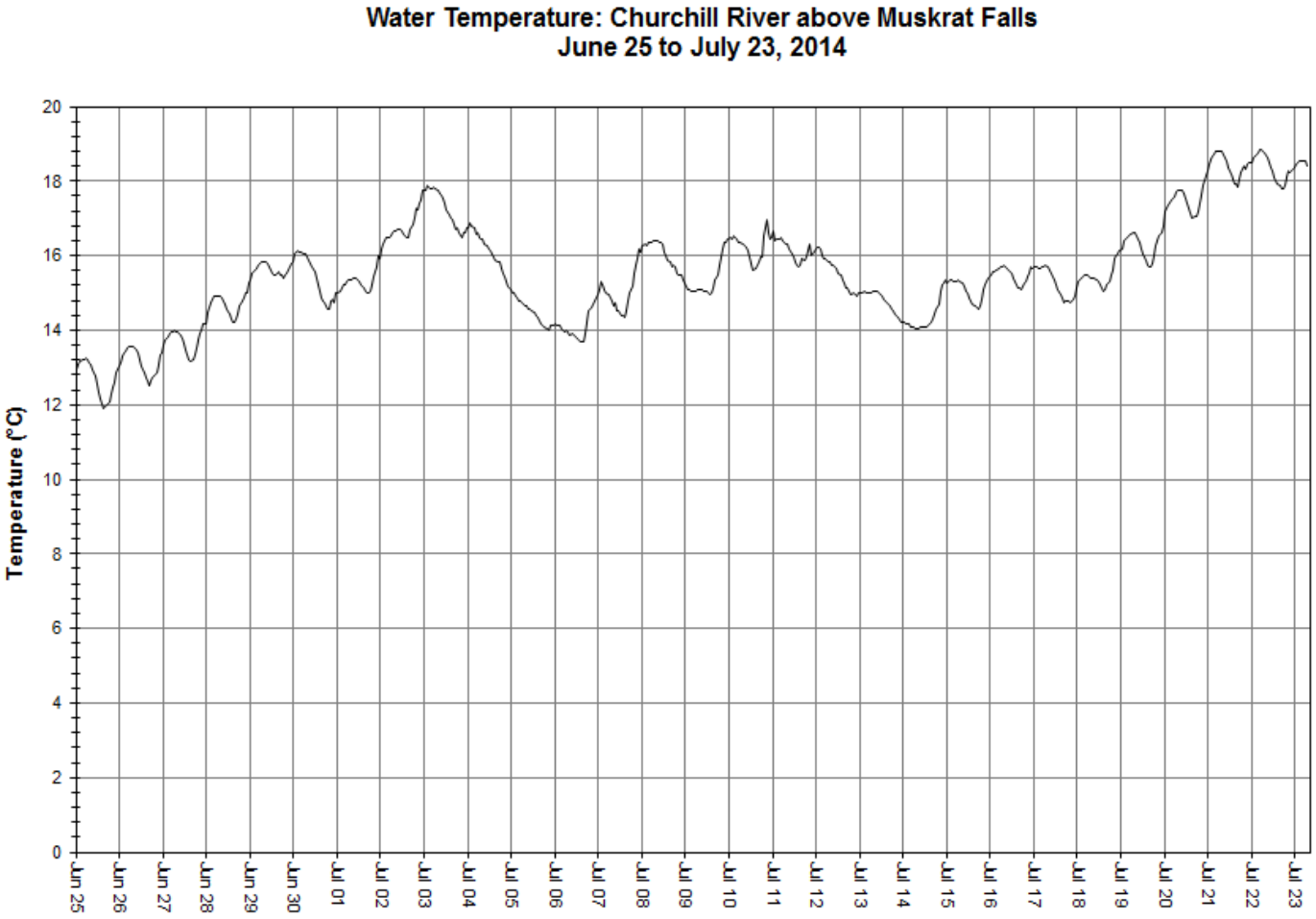


Figure 15: Water temperature at Churchill River above Muskrat Falls

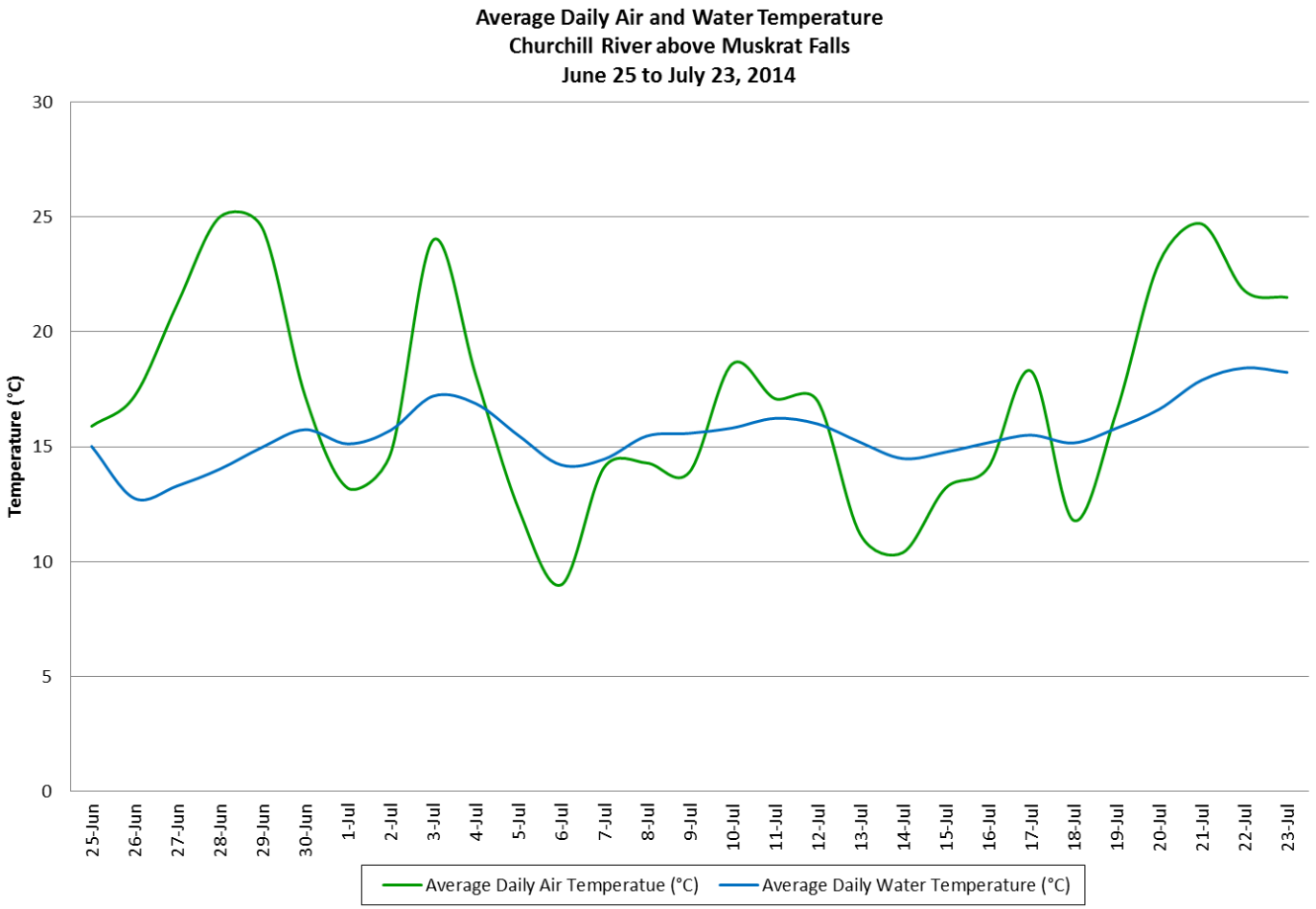


Figure 16: Average daily air and water temperature at Churchill River above Muskrat Falls (weather data recorded at Goose Bay)

- pH ranges between 6.51 and 7.11 pH units (Figure 17). pH values are relatively stable throughout the deployment period, dropping noticeably when stage levels rise due to dilution.
- All pH values recorded are within the CCME Guidelines for the Protection of Aquatic Life (indicated in blue on Figure 17).

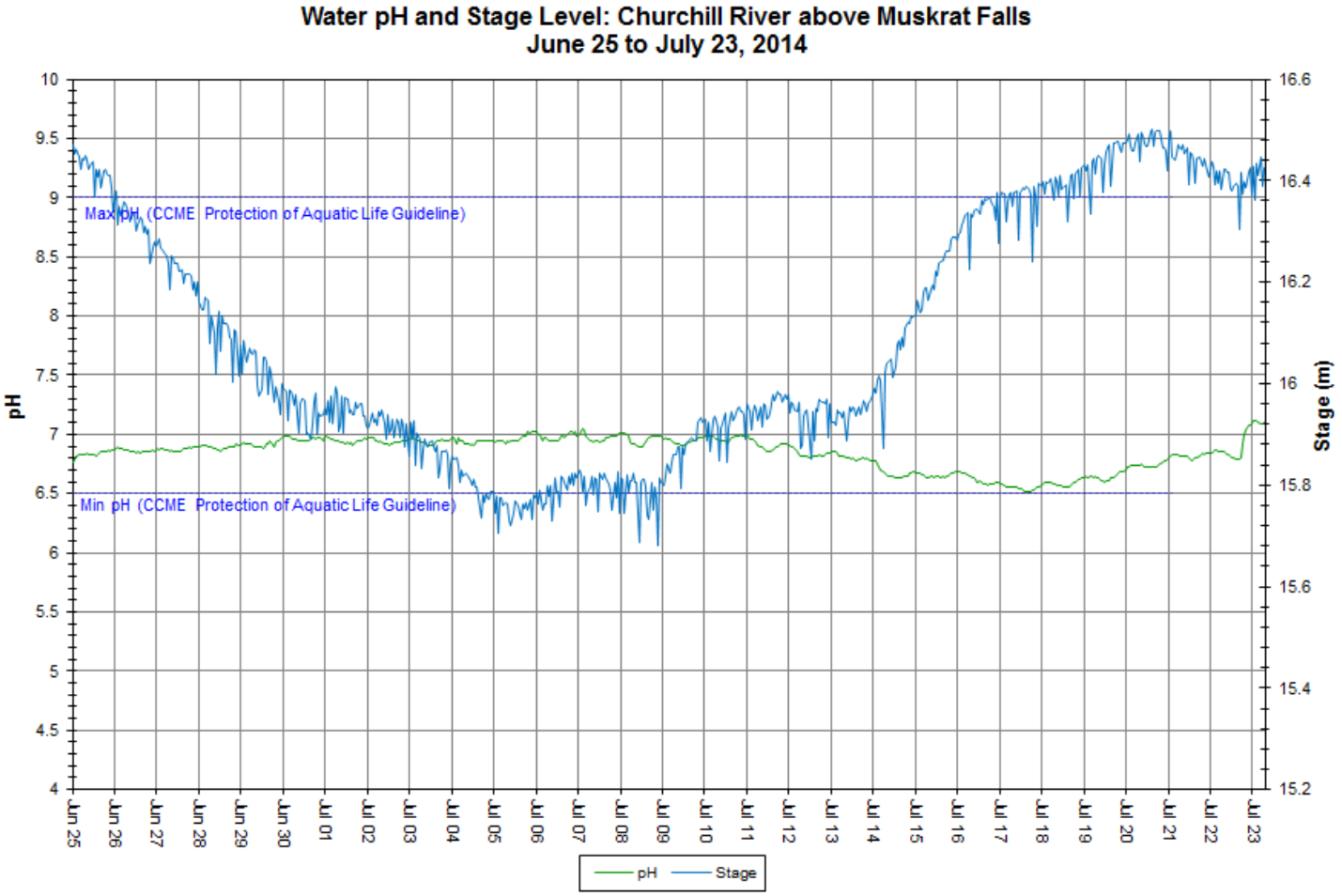


Figure 17: pH and stage at Churchill River above Muskrat Falls

- Specific conductivity ranges from 14.5µS/cm to 18.7µS/cm during the deployment period, averaging 17.1µS/cm. (Figure 18).
- Stage is included in Figure 18 to illustrate the inverse relationship between conductivity and water level. Generally, as stage levels increase, specific conductivity decreases due to the dilution of dissolved solids in the water column. Inversely, when stage decreases, specific conductivity usually increases as the concentration of dissolved solids is increased. This trend is visible in the data collected during the deployment period.

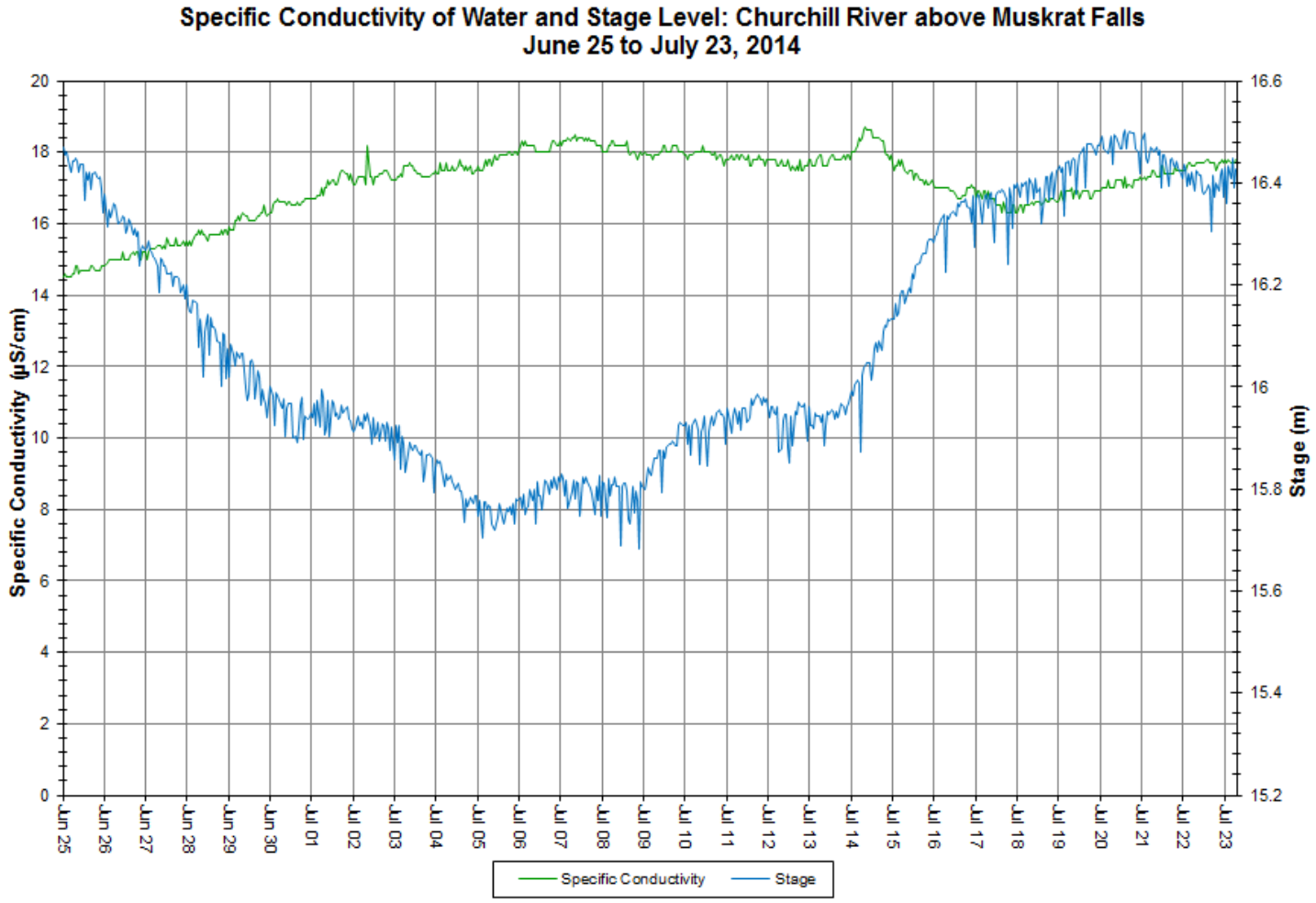


Figure 18: Specific conductivity and stage level at Churchill River above Muskrat Falls

- Dissolved oxygen content ranges between 8.93mg/l and 10.56mg/l. The saturation of dissolved oxygen ranges from 93.4% to 101.6% (Figure 19).
- All values were above the minimum CCME Guideline for the Protection of Cold Water Biota at Other Life Stages of 6.5mg/l, while the majority of values were above the Guideline for Early Life Stages of 9.5mg/l. The guidelines are indicated in blue on Figure 19.
- Dissolved oxygen content is decreasing slightly throughout the deployment period. This trend is expected given the warming air and water temperatures (Figure 16).

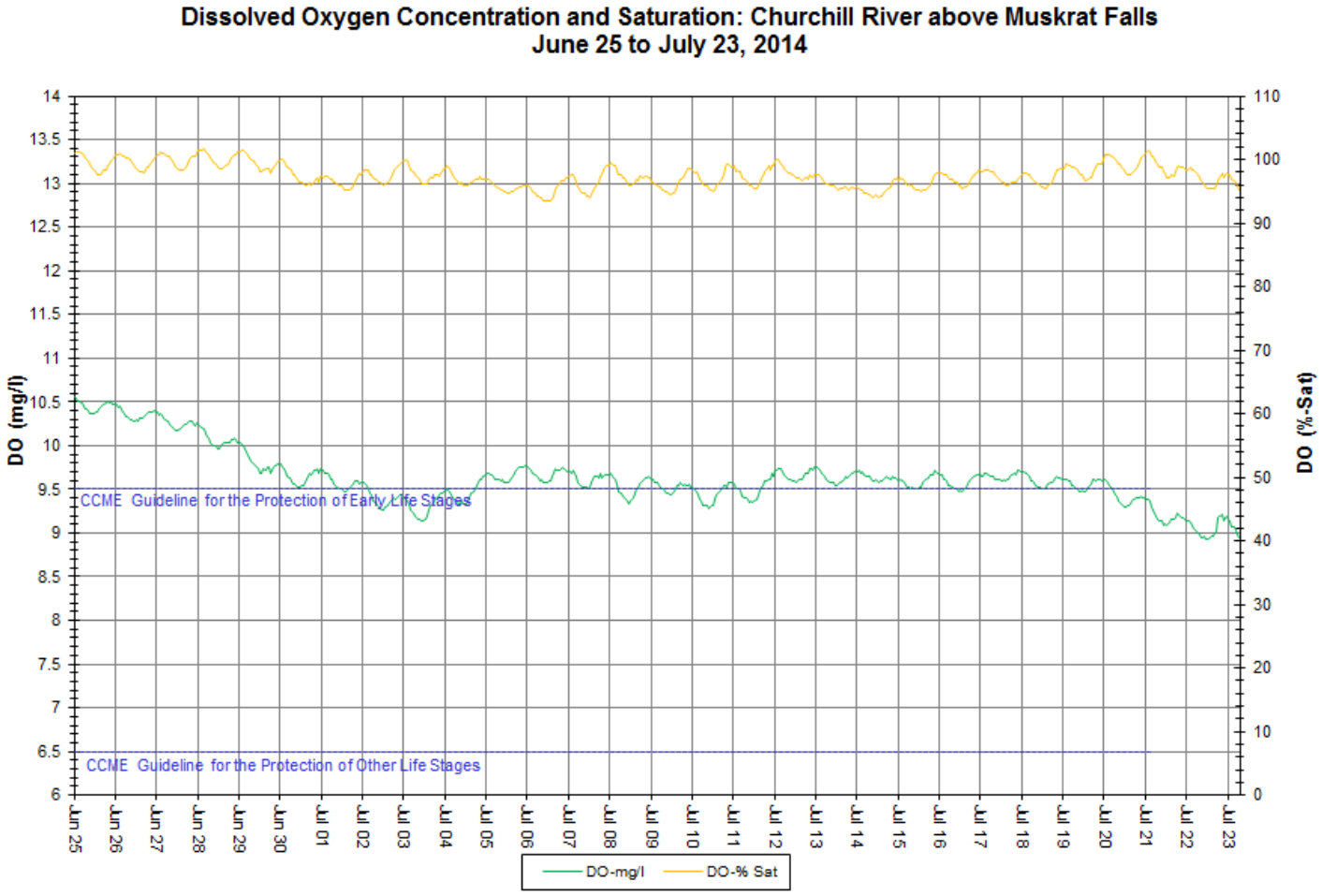


Figure 19: Dissolved oxygen and percent saturation at Churchill River above Muskrat Falls

- Turbidity ranges between 0.3NTU and 234.8NTU, averaging 13.5 NTU during the deployment (Figure 20). A median value of 10.1NTU suggests there is consistent natural background turbidity value. This trend is typical at this station.
- Turbidity increases on June 29/30 and July 6/7 correspond with precipitation events. These events are highlighted in red on Figure 20.

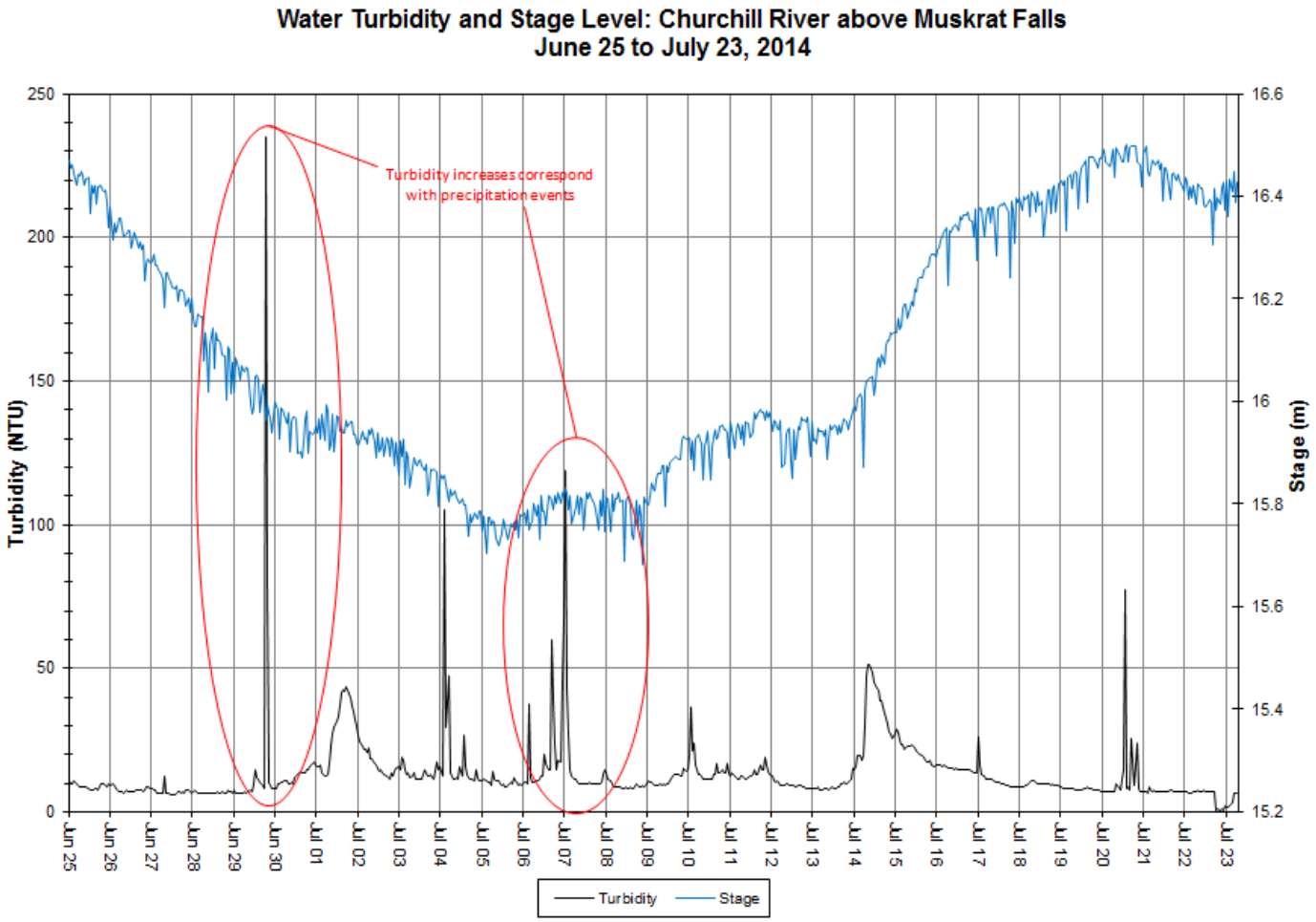


Figure 20: Turbidity and stage level at Churchill River above Muskrat Falls

- Stage and precipitation are graphed below to show the relationship between rainfall and water level (Figure 22). Stage decreases throughout the first 2 weeks of the deployment period. Precipitation events during the second part of deployment caused the stage levels to increase. Precipitation occurs on <50% of the days in the deployment period and amounts are generally small in magnitude. Stage ranges between 15.68m and 16.50m, a difference of 0.82m. Discharge ranges from 1110m^3/s to 1550m^3/s.

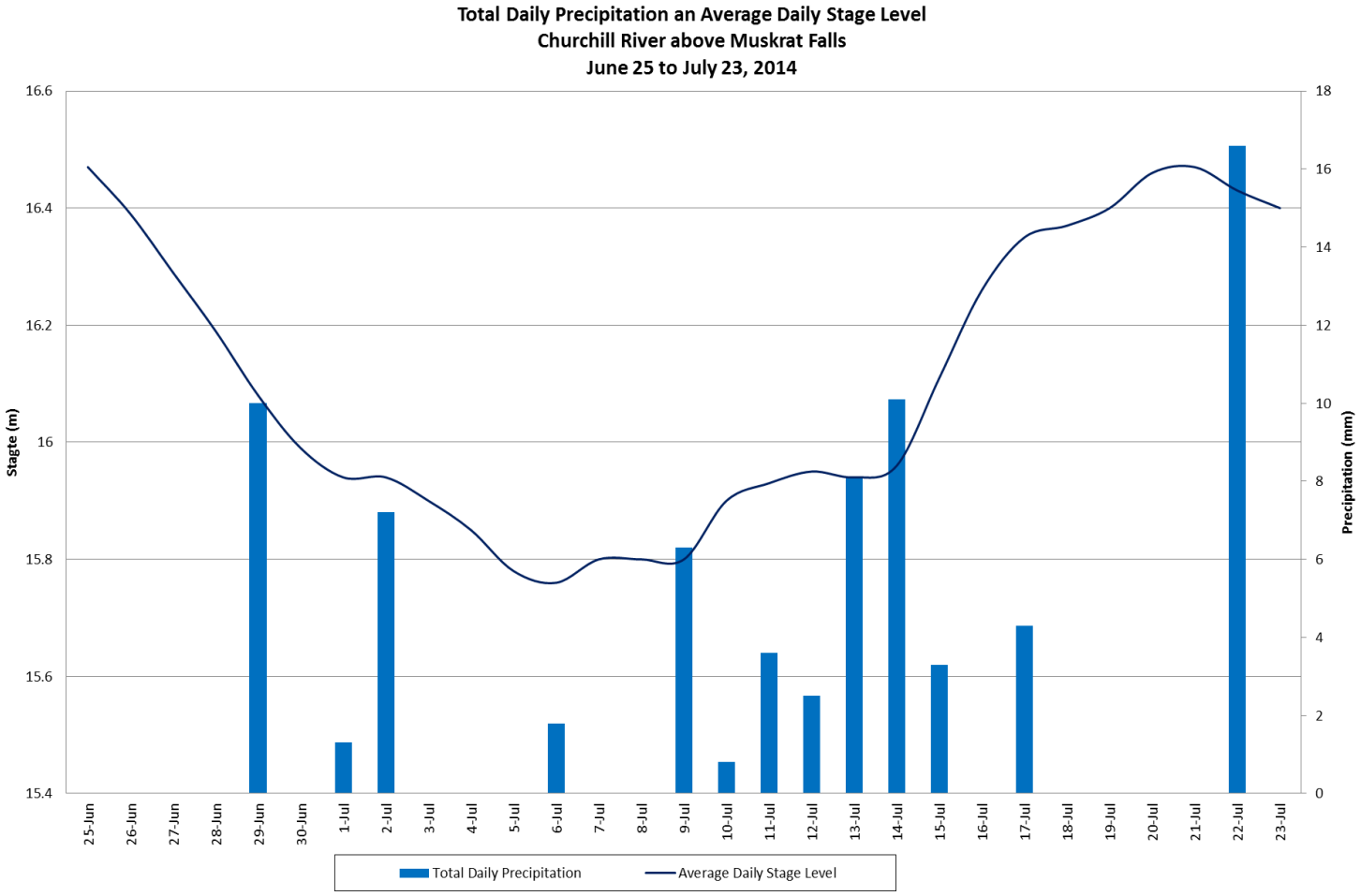


Figure 22: Daily precipitation and average daily stage level at Churchill River above Muskrat Falls (weather data recorded at Goose Bay)

Churchill River below Muskrat Falls

- The sonde located at this station was quickly buried in sand after the initial deployment. The sonde was switched out on July 8th, but was quickly covered in sand again. Thus the majority of the values recorded during this deployment period are inaccurate and have been removed from the dataset.
- For the data which is available, the water temperature ranges from 8.40°C to 14.00°C (Figure 23).
- From the available data, water temperature is increasing throughout the deployment period. This trend is expected given the warming ambient air temperatures in the summer season (Figure 24).

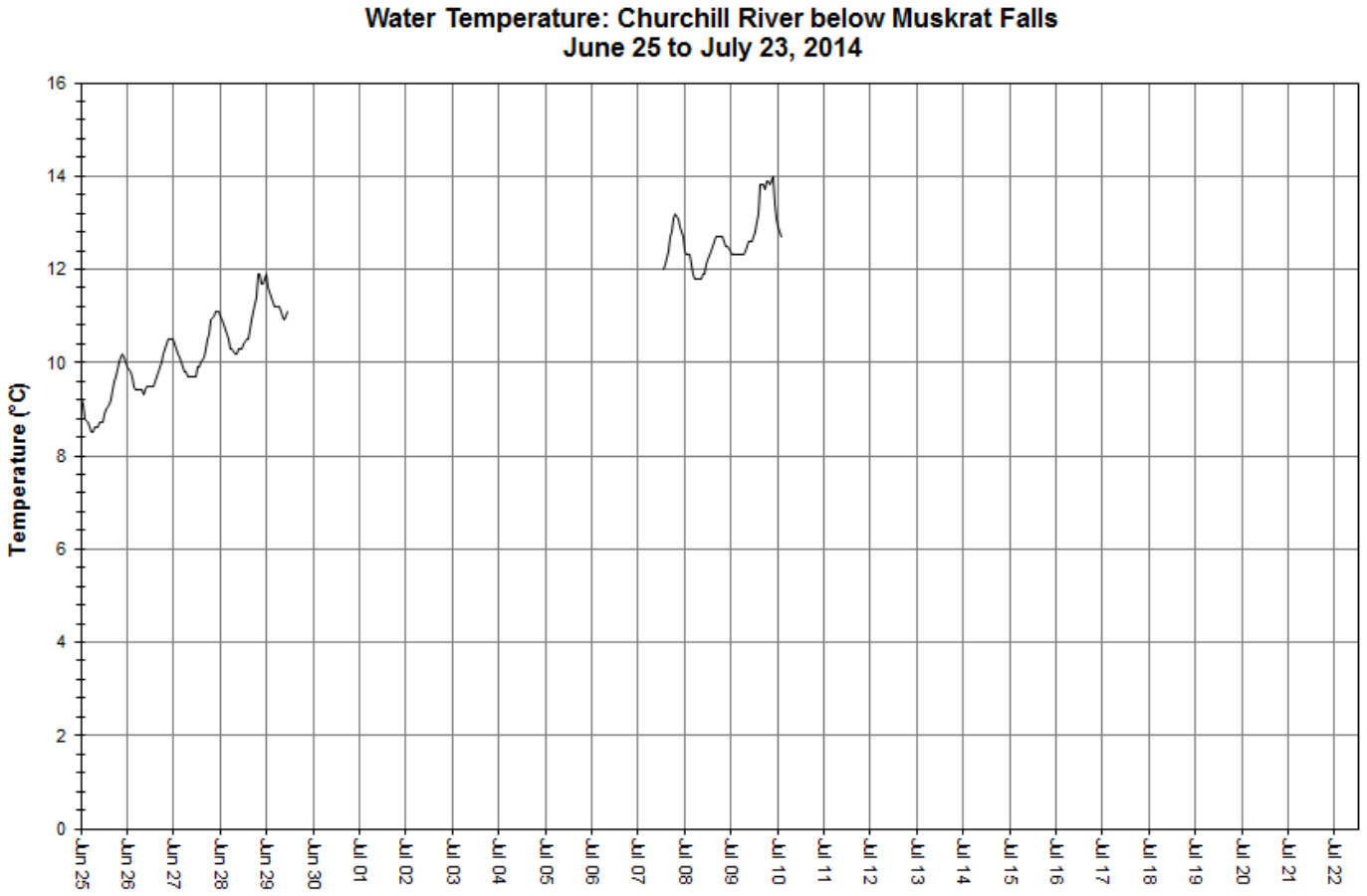


Figure 23: Water temperature at Churchill River below Muskrat Falls

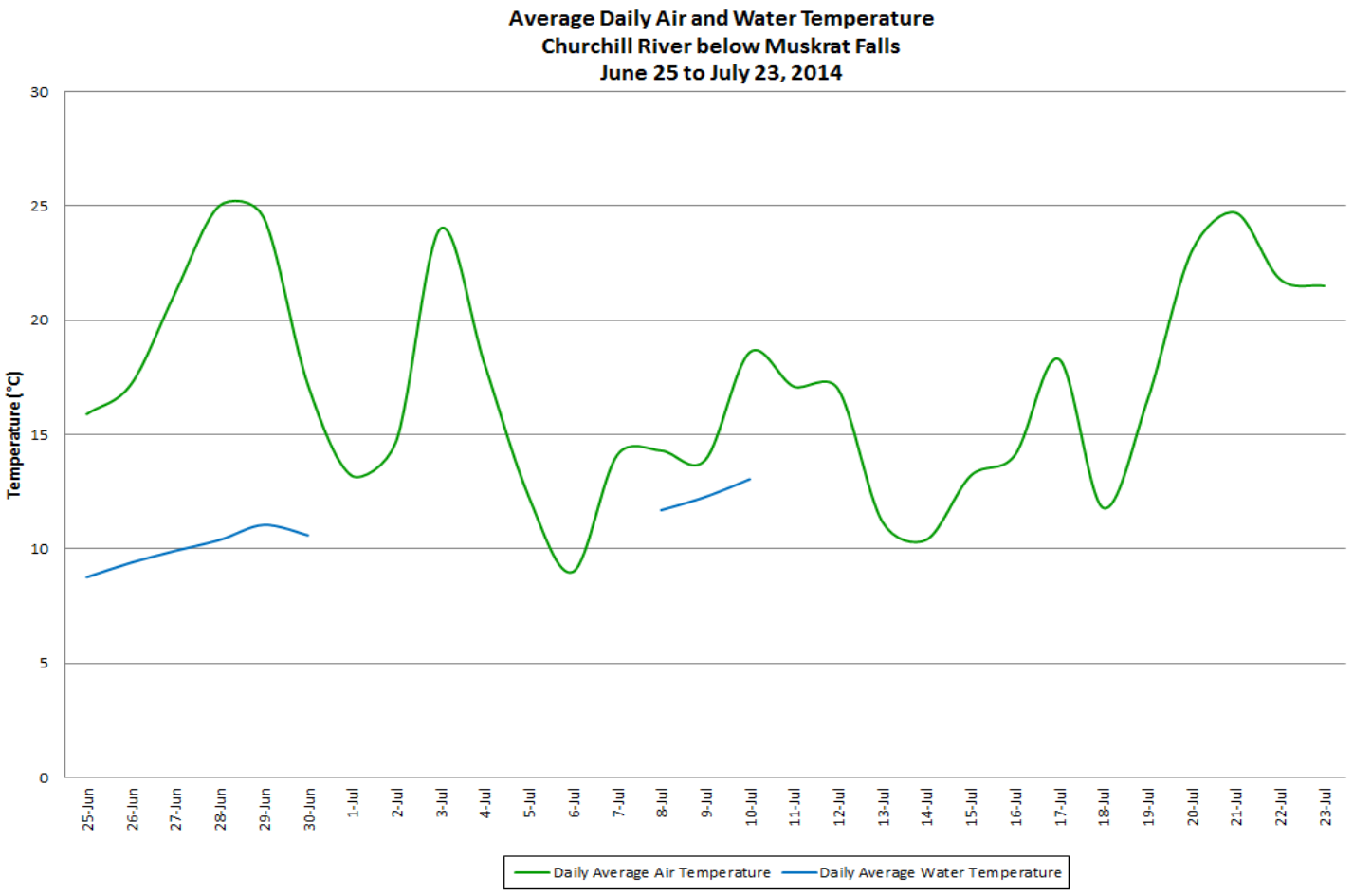


Figure 24: Average daily air and water temperature at Churchill River below Muskrat Falls

(weather data recorded at Goose Bay)

- For the available data, pH ranges between 6.65 and 7.18 pH units (Figure 25).
- All values recorded accurately during the deployment are within the CCME Guidelines for the Protection of Aquatic Life (indicated in blue on Figure 25).

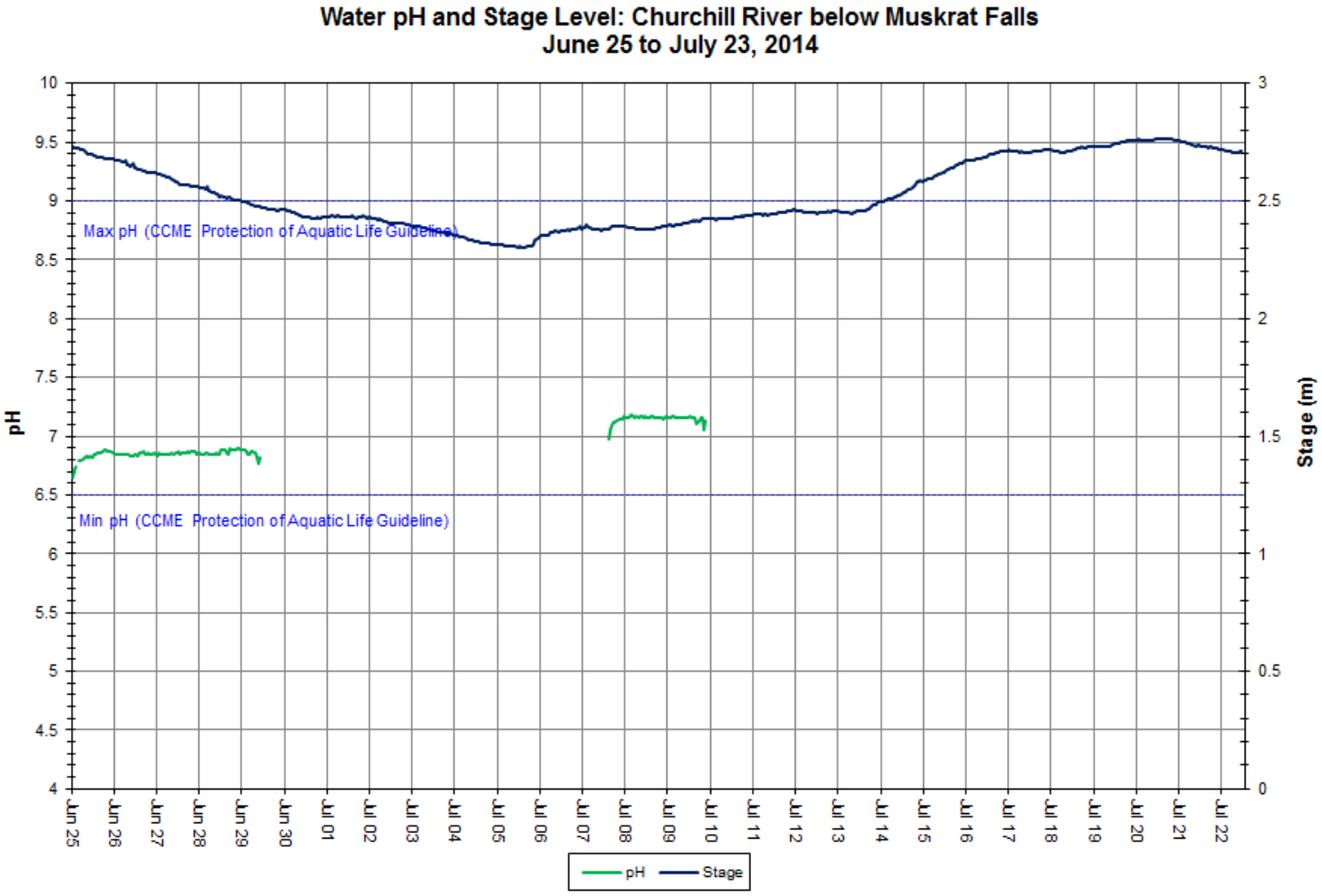


Figure 25: pH and stage level at Churchill River below Muskrat Falls

- Specific conductance ranges between 8.5µS/cm and 16.9µS/cm during the deployment period, averaging 14.7µS/cm (Figure 26).
- Stage is included in Figure 26 to illustrate the inverse relationship between conductivity and water level. Generally, as stage levels increase, specific conductivity decreases due to the dilution of dissolved solids in the water column. Inversely, when stage decreases, specific conductivity usually increases as the concentration of dissolved solids is increased. This trend is visible in the available data as specific conductance was increasing as the stage level decreased during the first week of deployment.
- The rapid drop in specific conductance July 10 may be related to precipitation events which occurred at this time, or may be due to the sonde being buried in sand at this point in time.

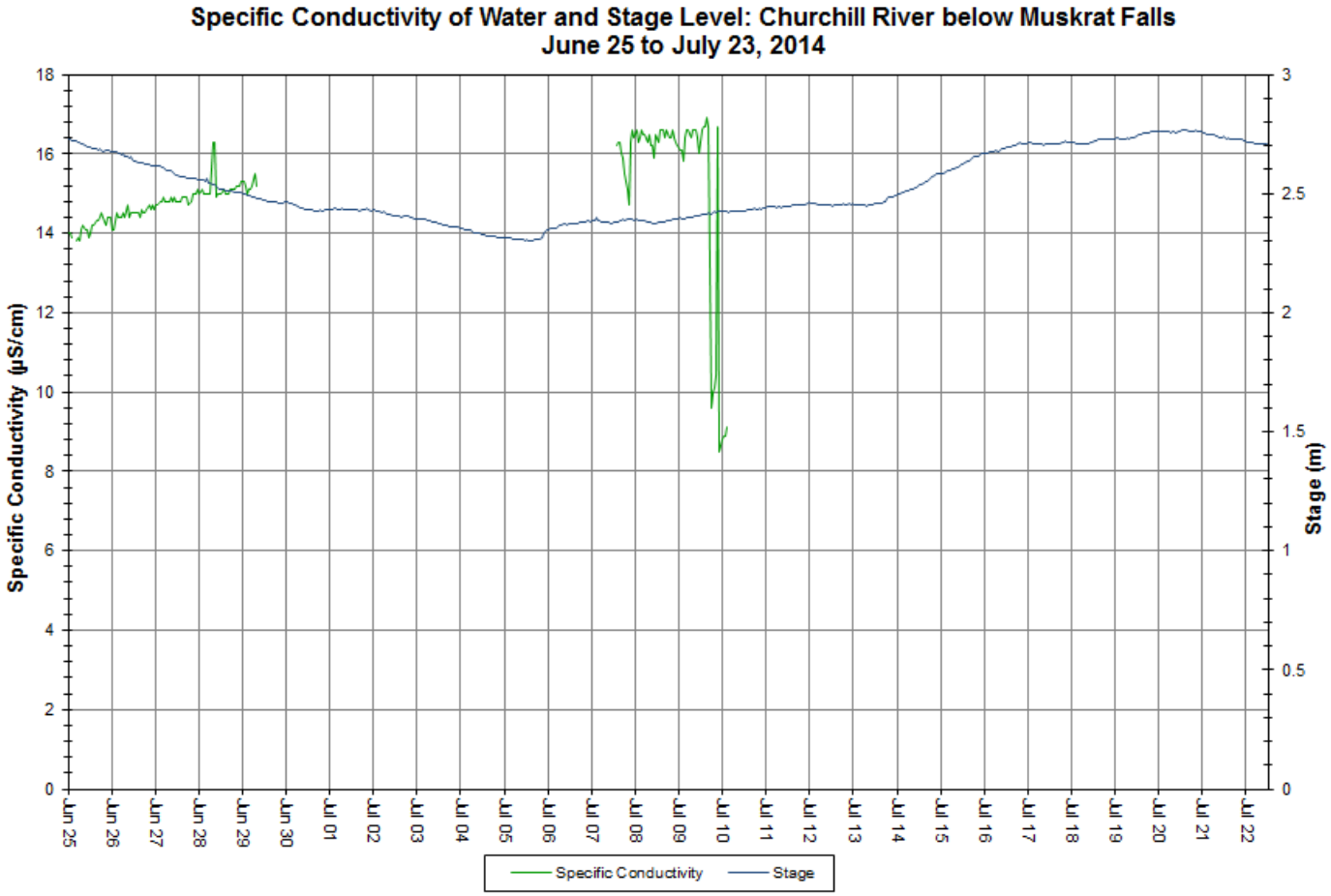


Figure 26: Specific conductivity and stage level at Churchill River below Muskrat Falls

- Dissolved oxygen content ranges between 10.65mg/l and 12.39mg/l. The saturation of dissolved oxygen ranges from 101.3% to 108.7% (Figure 27).
- All values recorded were above both the minimum CCME Guidelines for the Protection of Cold Water Biota at Other Life Stages of 6.5mg/l and at Early Life Stages of 9.5mg/l. The guidelines are indicated in blue on Figure 27.
- Dissolved oxygen content is decreasing over time, according to the available data. This trend is expected given the warming air and water temperatures (Figure 24). Dissolved oxygen is typically higher at this station compared to the other stations further upstream due to the addition of oxygen to the water at Muskrat Falls.

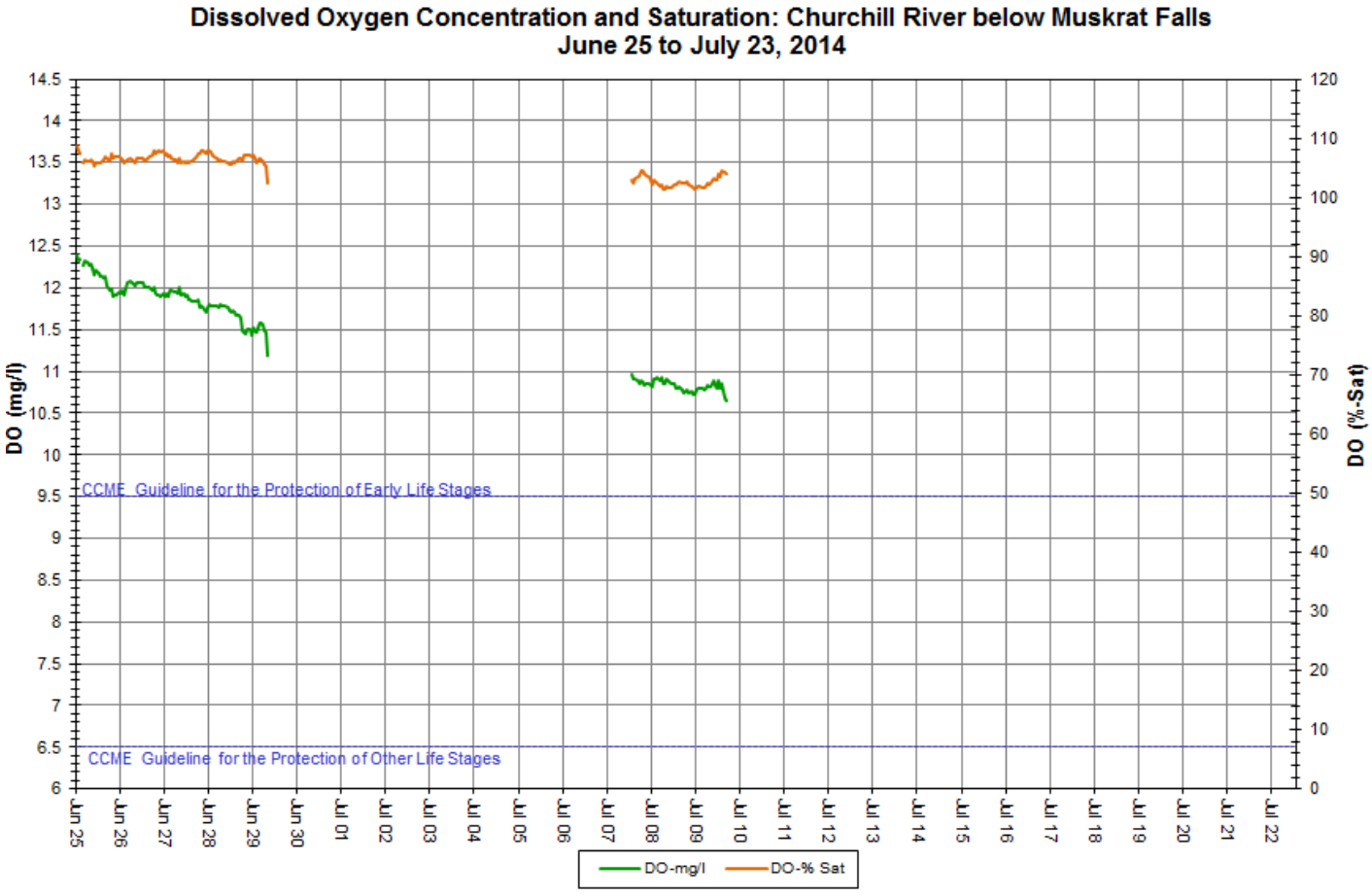


Figure 27: Dissolved oxygen and percent saturation at Churchill River below Muskrat Falls

- Turbidity ranges between 27NTU and 176.1NTU, averaging 45.6NTU (Figure 28). A median value of 41.5NTU during this time indicates there is a consistent natural background turbidity value. This trend is typical at this station.
- Turbidity values increase above background levels on June 29, corresponding with a precipitation event at this time. This event is highlighted in red on Figure 28.

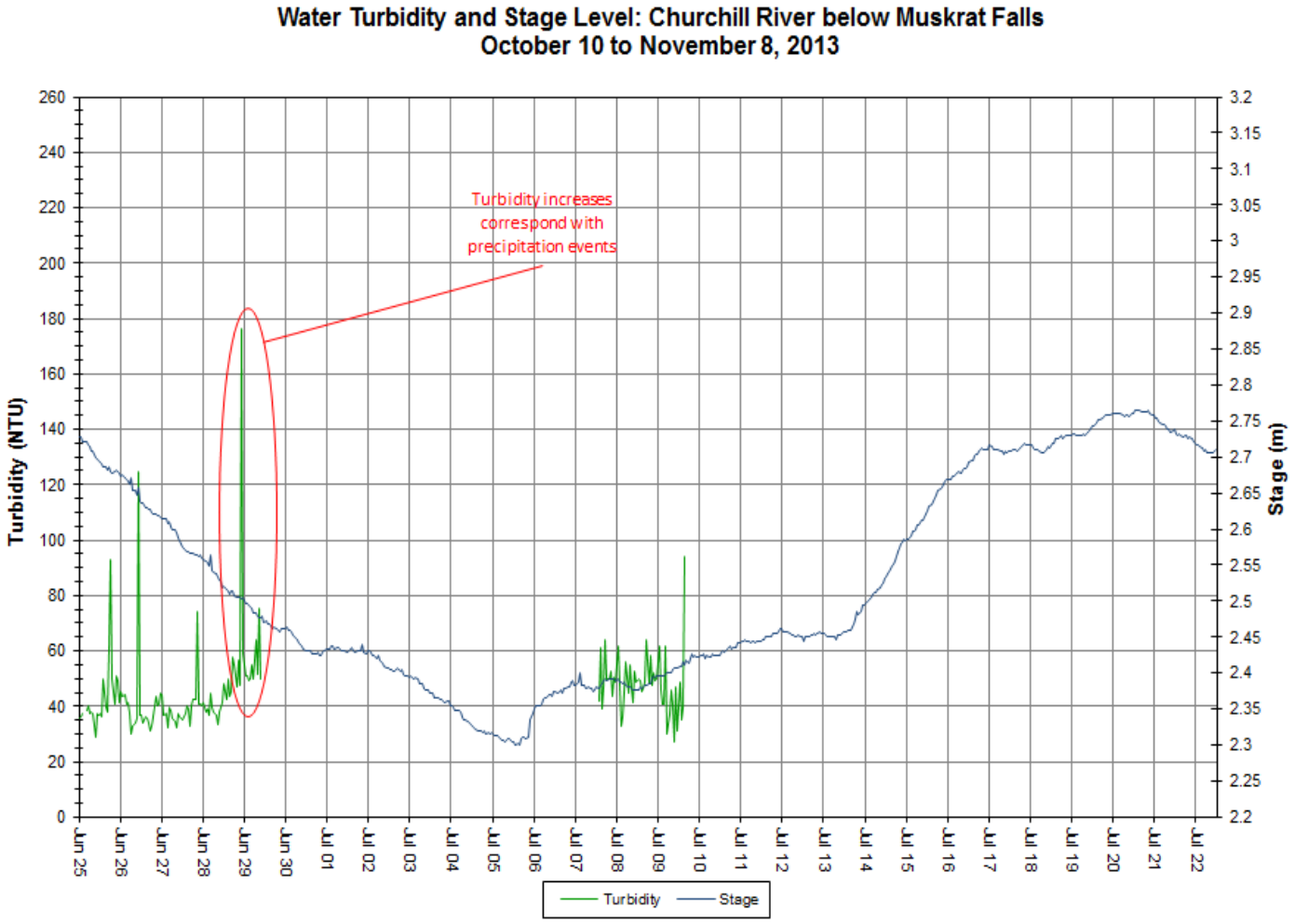


Figure 28: Turbidity and stage level at Churchill River below Muskrat Falls

- Stage and precipitation are graphed below to show the relationship between rainfall and water level (Figure 29). Stage decreases during the first 10 days of deployment, before beginning a steady increase for the remainder of the deployment. Precipitation occurs on <50% of the days in the deployment period and amounts are small in magnitude. Stage ranges between 2.30m and 2.77m, a difference of 0.47m.

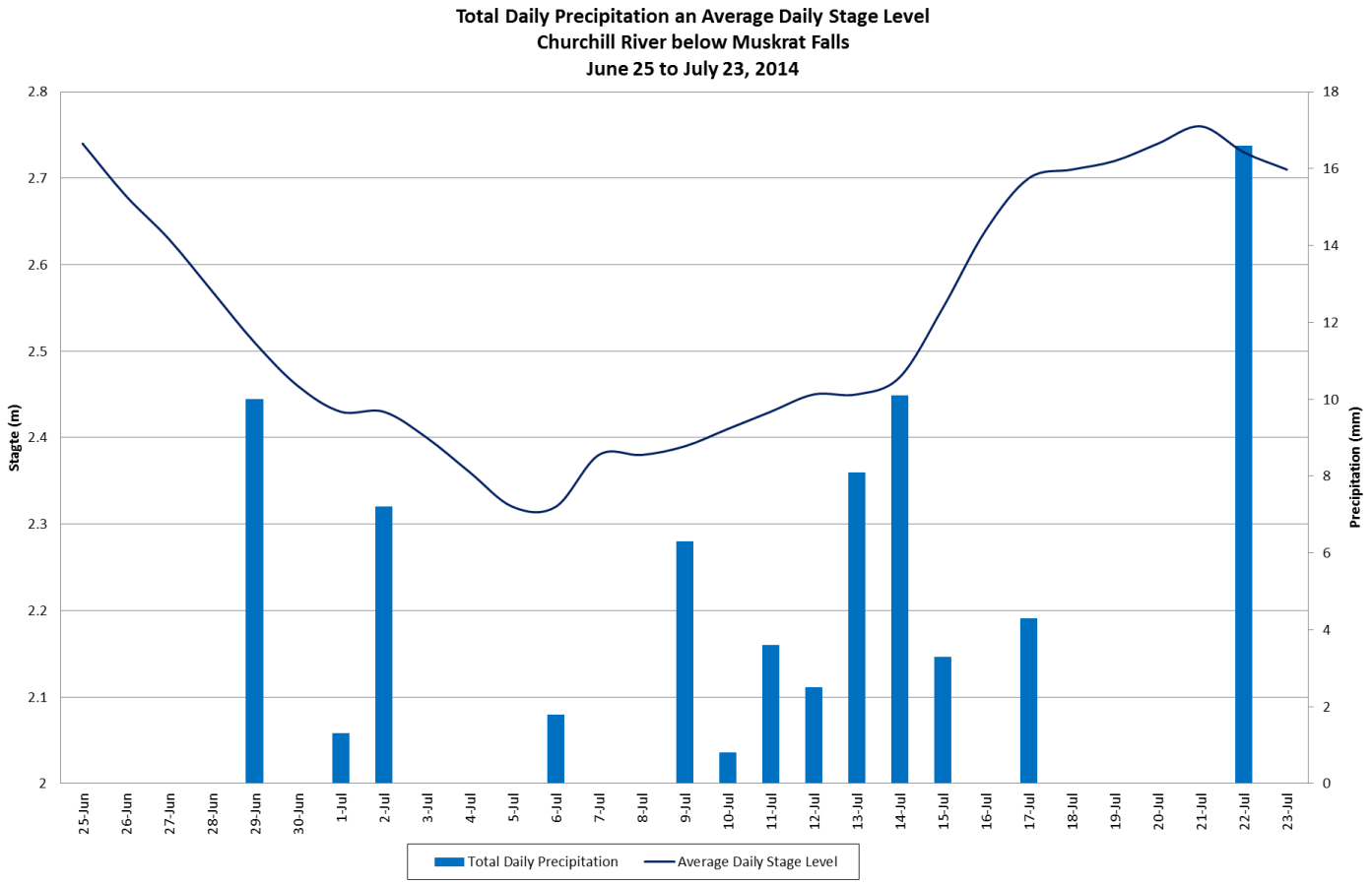


Figure 29: Daily precipitation and average daily stage level at Churchill River below Muskrat Falls (weather data recorded at Goose Bay)

(a) **(b)**

(c) **(d)**

Figure 30: Photographs of the below Lower Muskrat Falls station in 2013 (a-b) and June 2014 (c-d)

Churchill River at English Point

- Water temperature ranges from 10.90°C to 20.70°C during the deployment period (Figure 31).
- Water temperature is increasing throughout this period. This trend is expected given the warming ambient air temperatures in the summer season (Figure 32). Water temperature fluctuates diurnally.

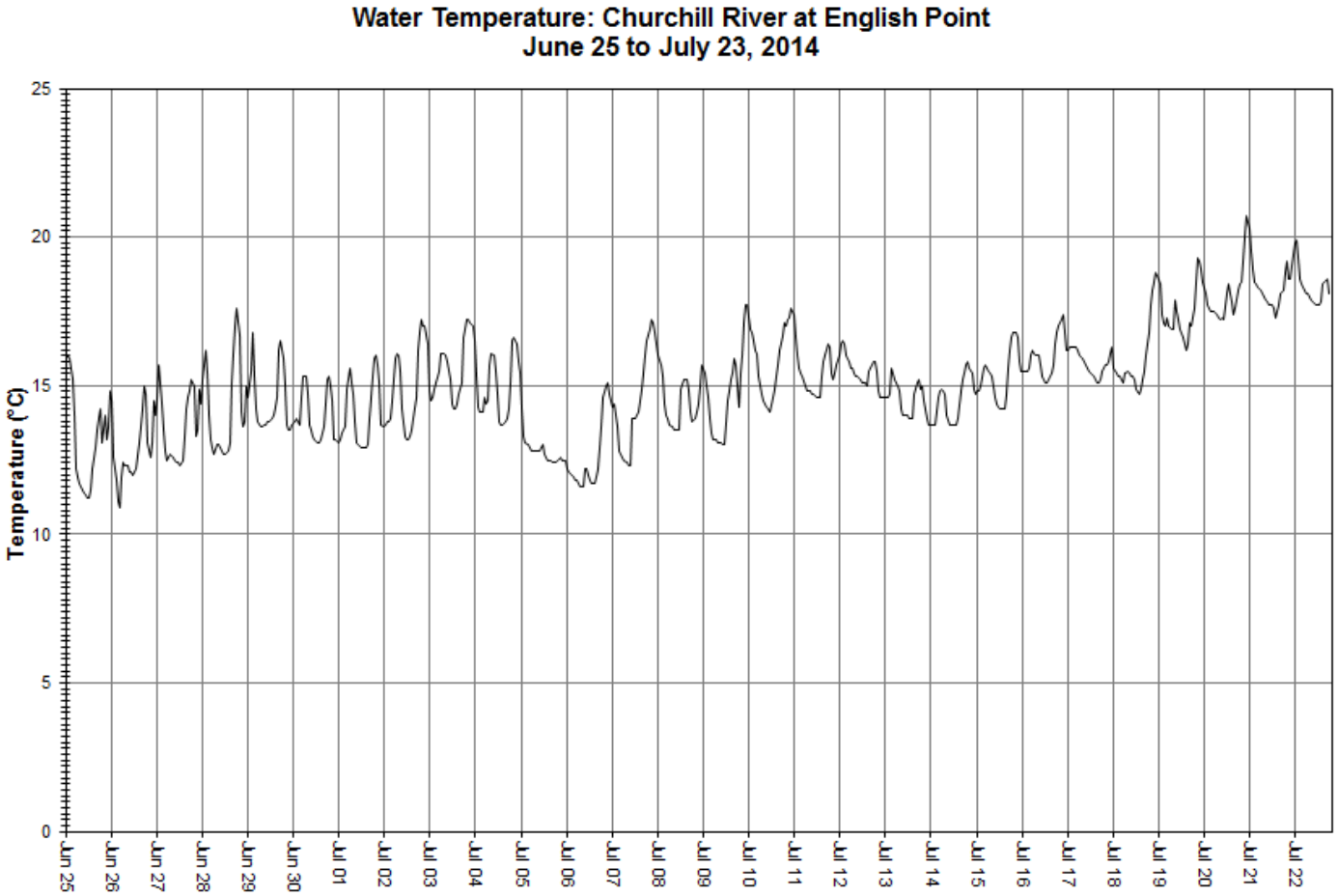


Figure 31: Water temperature at Churchill River at English Point

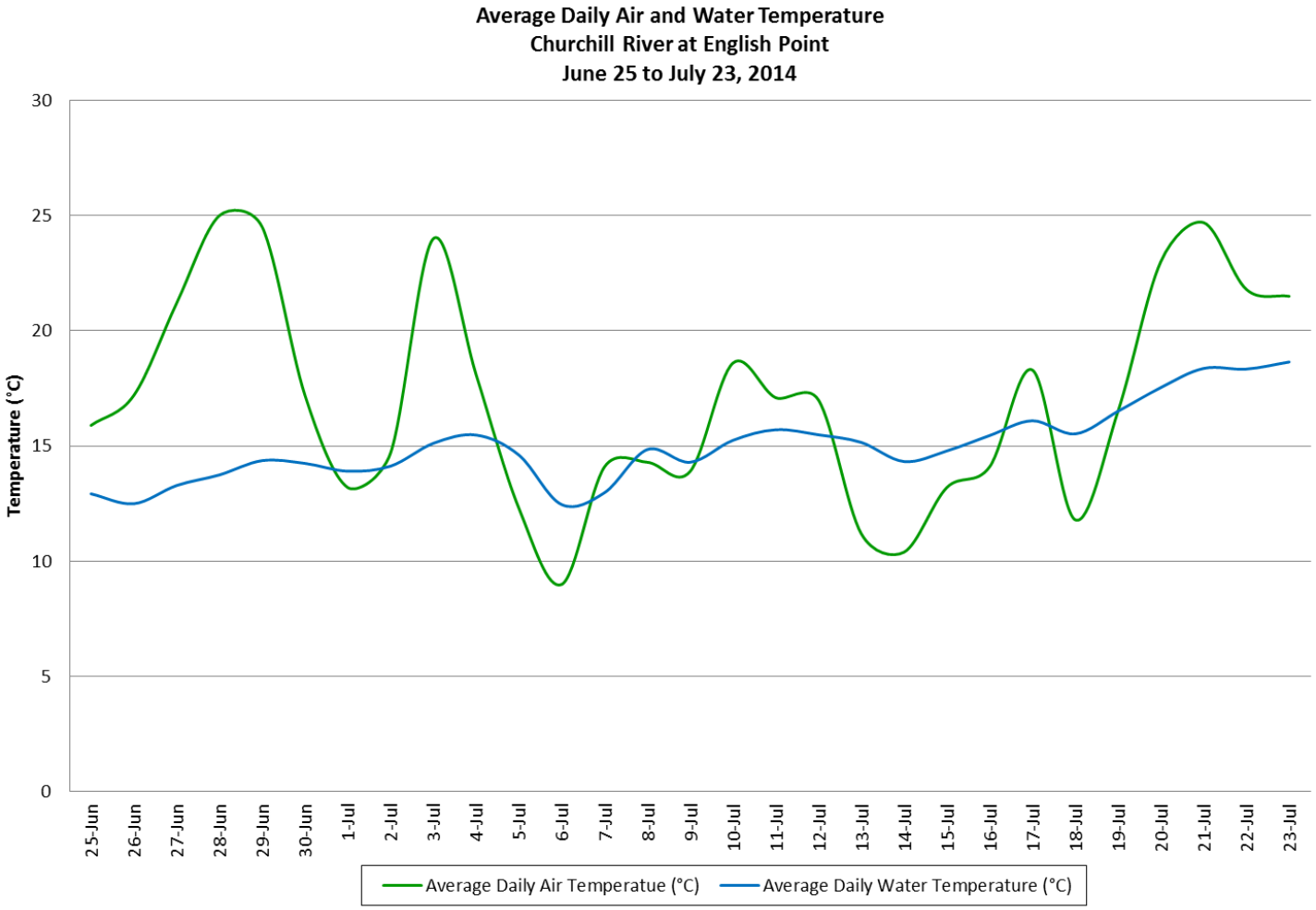


Figure 32: Average daily air and water temperature at Churchill River at English Point

(weather data recorded at Goose Bay)

- pH ranges between 5.92 and 6.99 pH units during the deployment period (Figure 33).
- The majority of values during this period are within the CCME Guidelines for the Protection of Aquatic Life (indicated in blue on Figure 33). The pH values drop below the minimum guideline during the last 10 days of deployment, corresponding to the increase in stage and precipitation events at this time. This is a normal relationship between rising stage levels and falling pH values due to the addition of freshwater into the system.

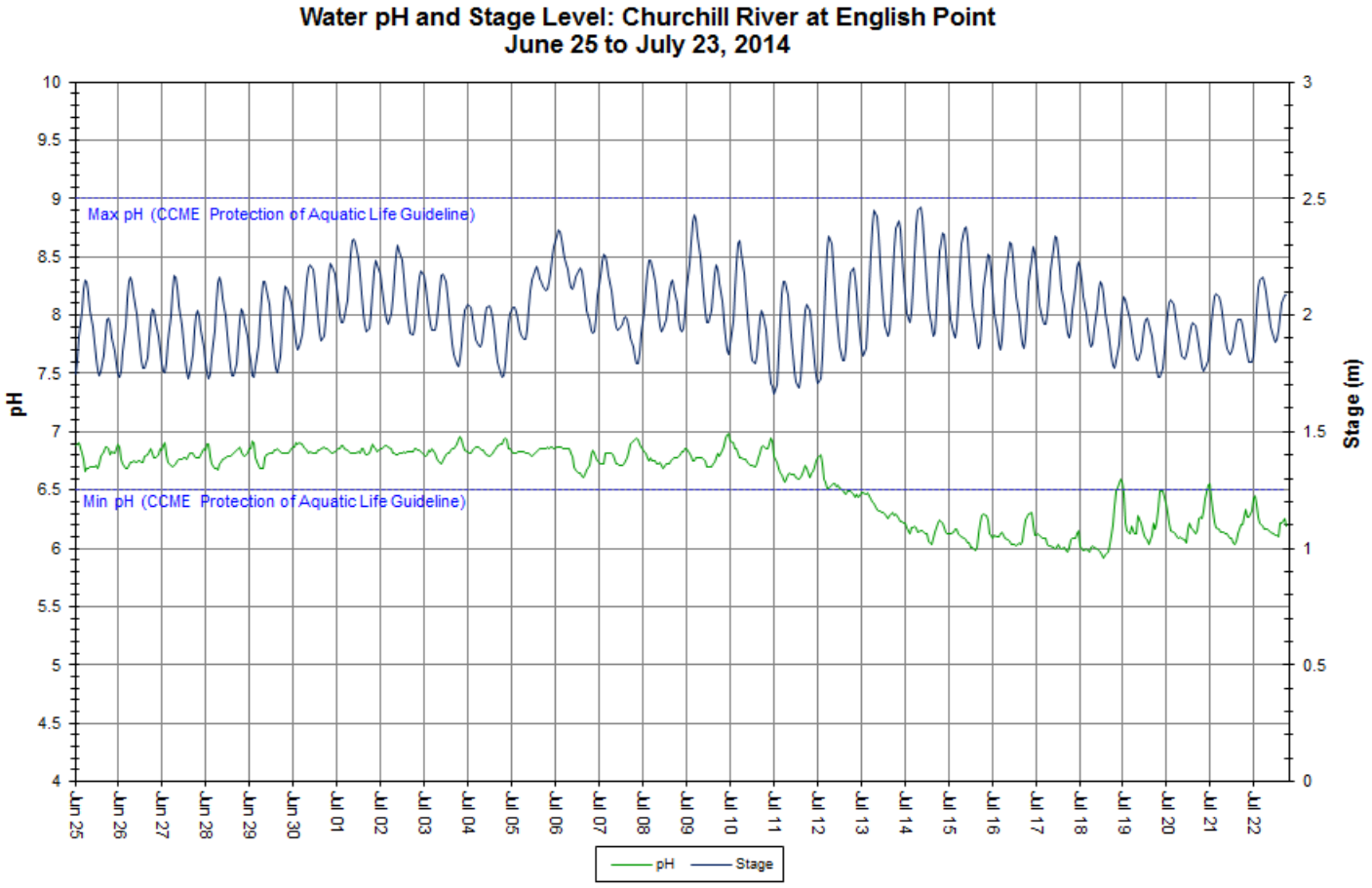


Figure 33: pH and stage level at Churchill River at English Point

- Specific conductance ranged between 18.1µS/cm and 61.8µS/cm during the deployment period, averaging 30.0µS/cm (Figure 34).
- Specific conductivity fluctuates considerably at this location due to the tidal influences of the Atlantic Ocean. As the tide comes in, the specific conductivity increases as the 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. There is a decrease in specific conductivity during a period of high stage level July 5-7. This decrease is highlighted in red on Figure 34.

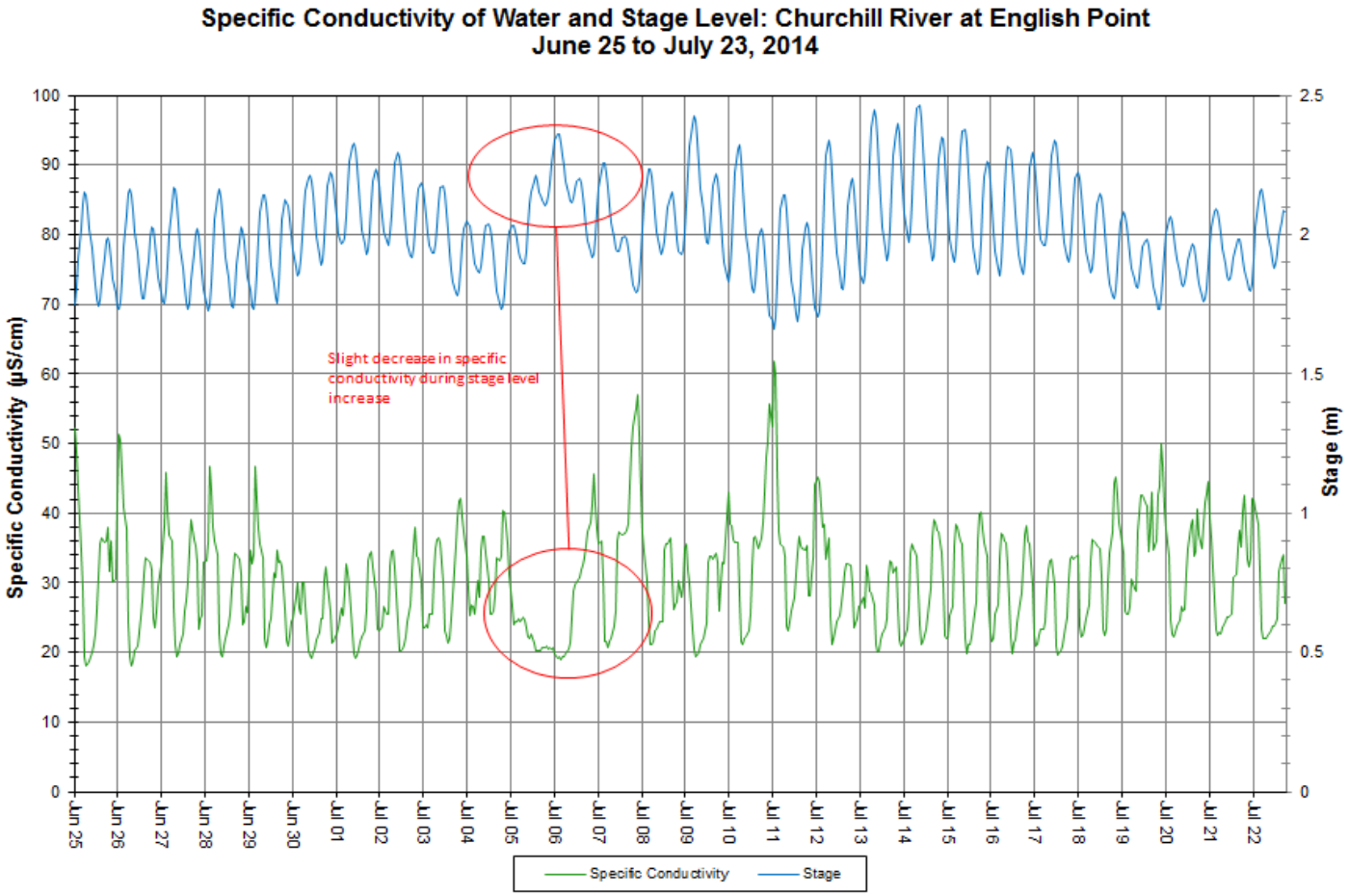


Figure 34: Specific conductivity and stage level at Churchill River at English Point

- Dissolved oxygen content ranges between 9.31mg/l and 11.44mg/l during the deployment period. The saturation of dissolved oxygen ranges from 90.4% to 114.5% (Figure 35).
- The majority of values were above both the minimum CCME Guidelines for the Protection of Cold Water Biota at Other Life Stage of 6.5mg/l and at Early Life Stages of 9.5mg/l. The guidelines are indicated in blue on Figure 35. The values dropped below the Early Life Stages Guideline on only a few occasions.
- Dissolved oxygen content is decreasing slightly throughout the deployment period. This trend is expected given the warming air and water temperatures (Figure 32).

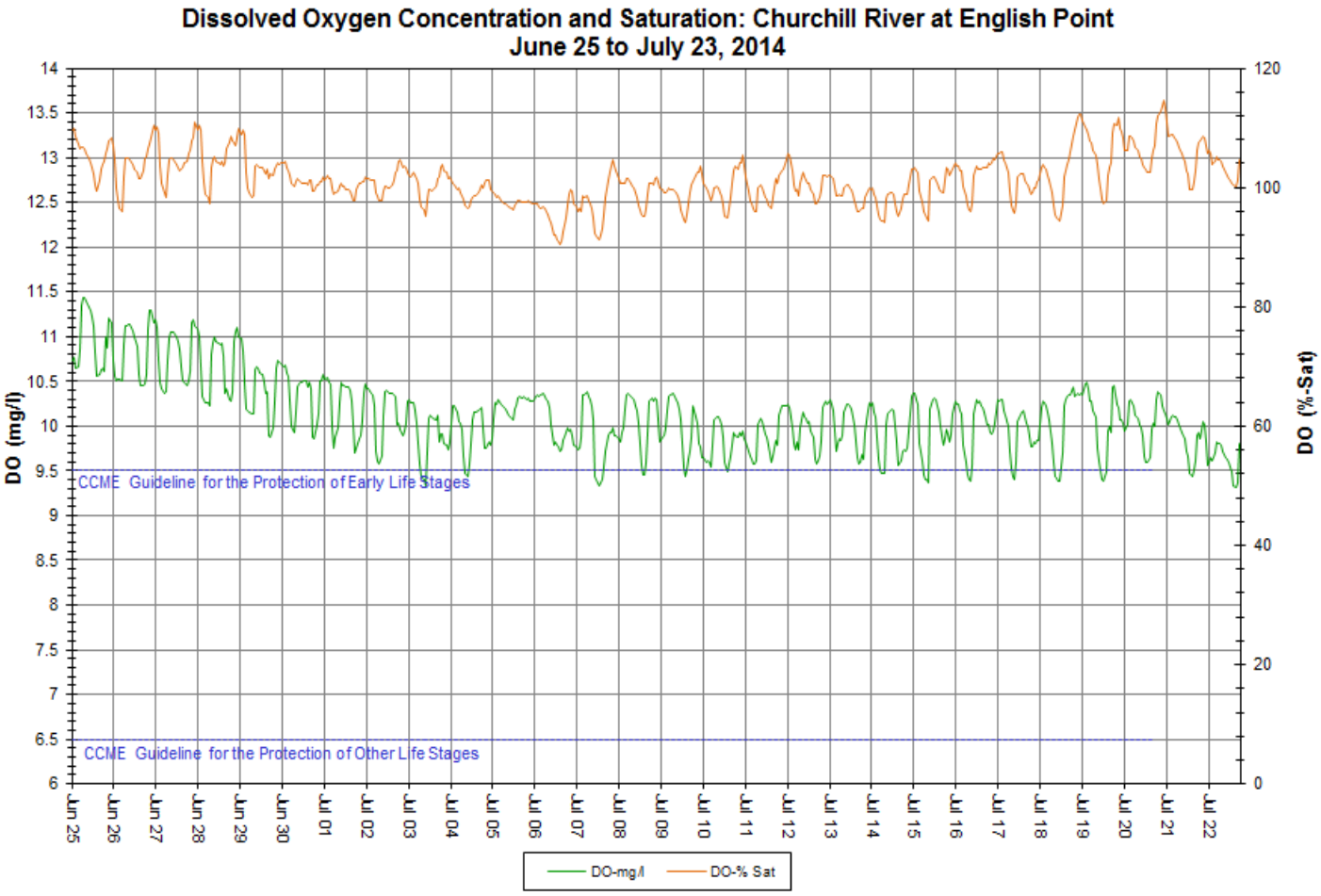


Figure 35: Dissolved oxygen and percent saturation at Churchill River at English Point

- Turbidity ranges from 5.4NTU to 147NTU during the deployment period (Figure 36).
- Turbidity increases on July 6 and July 11 correspond with precipitation events recorded in the region. These events are highlighted in red on Figure 36.

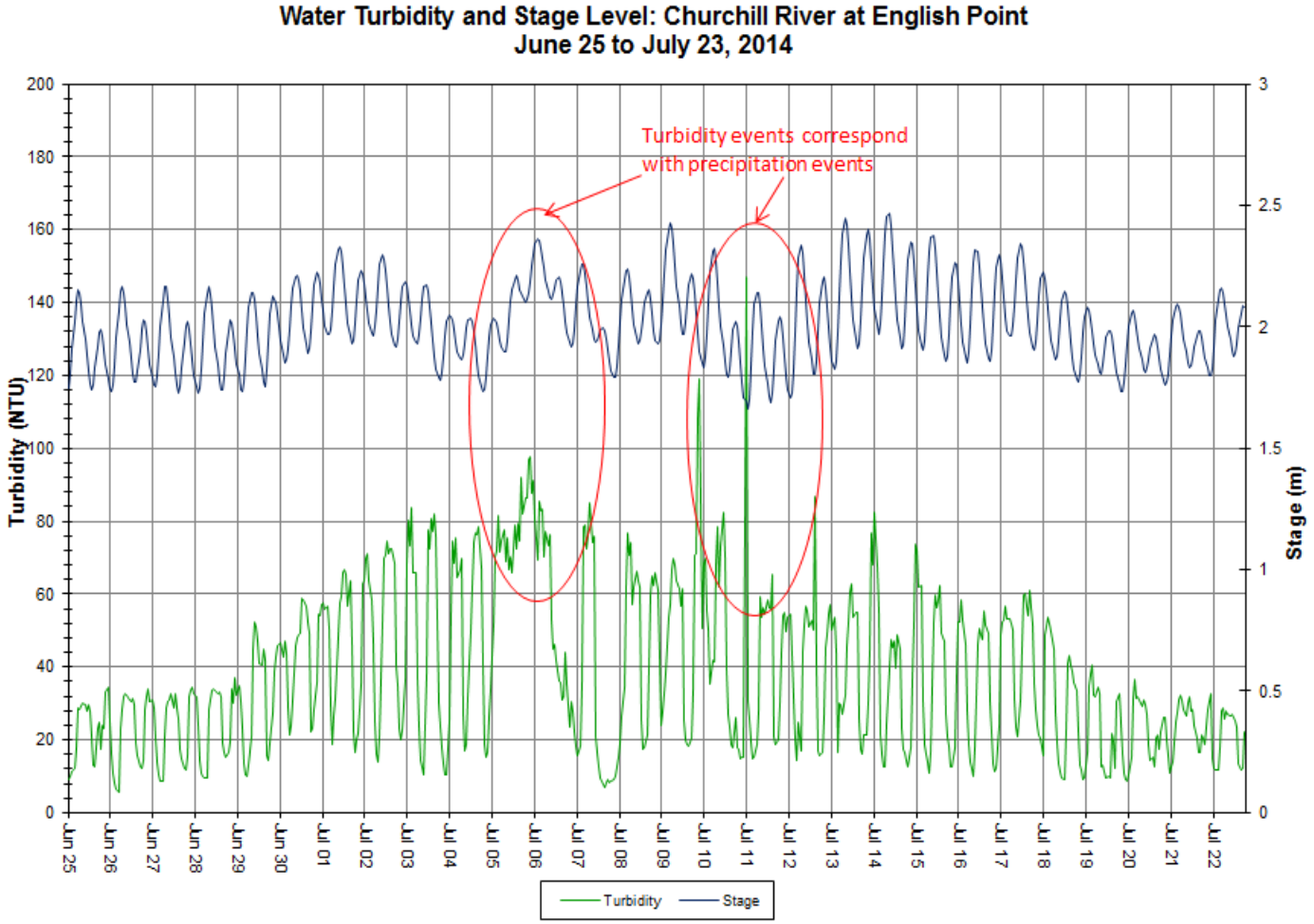


Figure 36: Turbidity and stage level at Churchill River at English Point

- Stage and precipitation are graphed below to show the relationship between rainfall and water level (Figure 37). Stage is fluctuating throughout the deployment period. Precipitation occurs on <50% of the days in the deployment period and amounts are small in magnitude. Stage ranges between 1.66m and 2.47m, a difference of 0.81m.

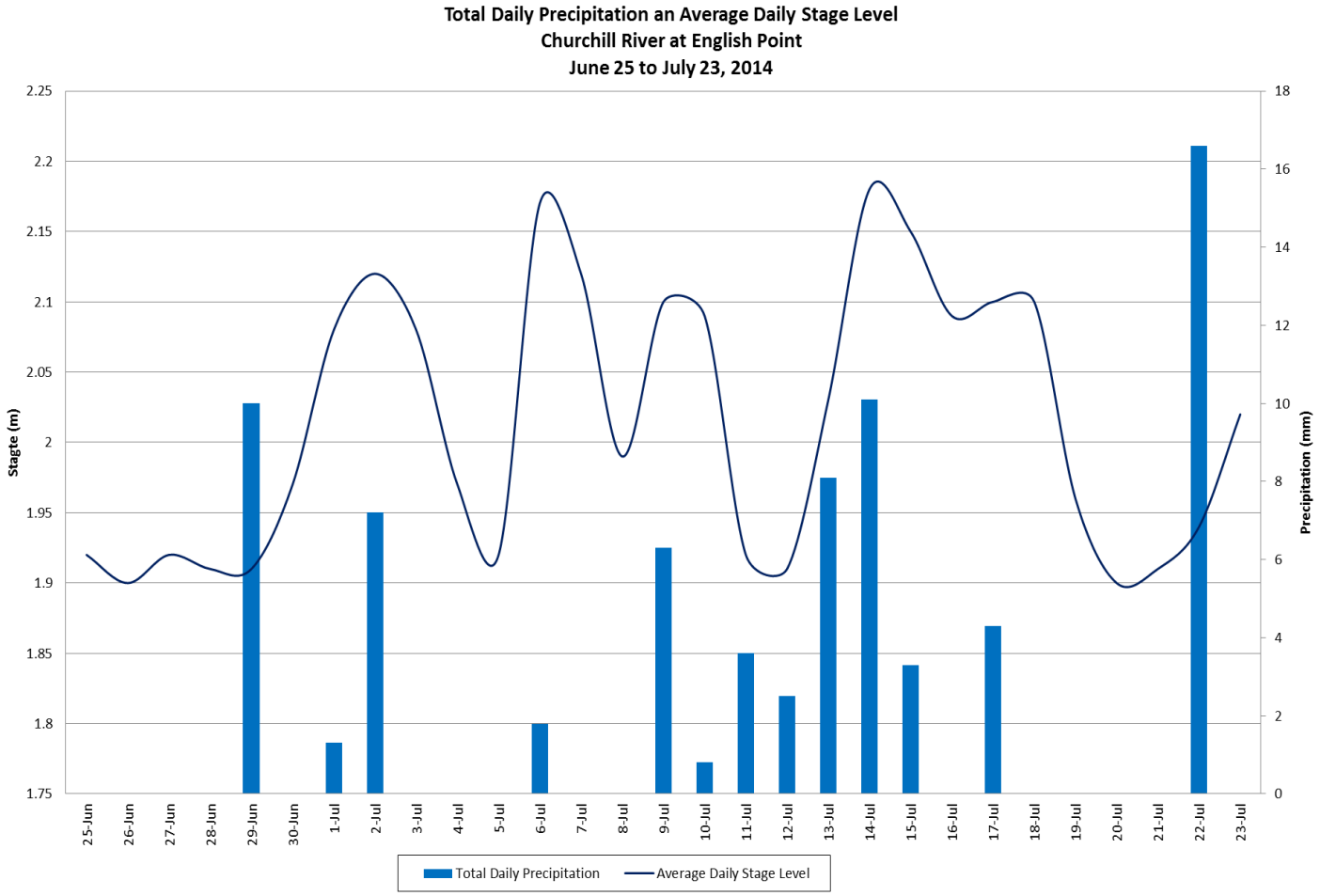
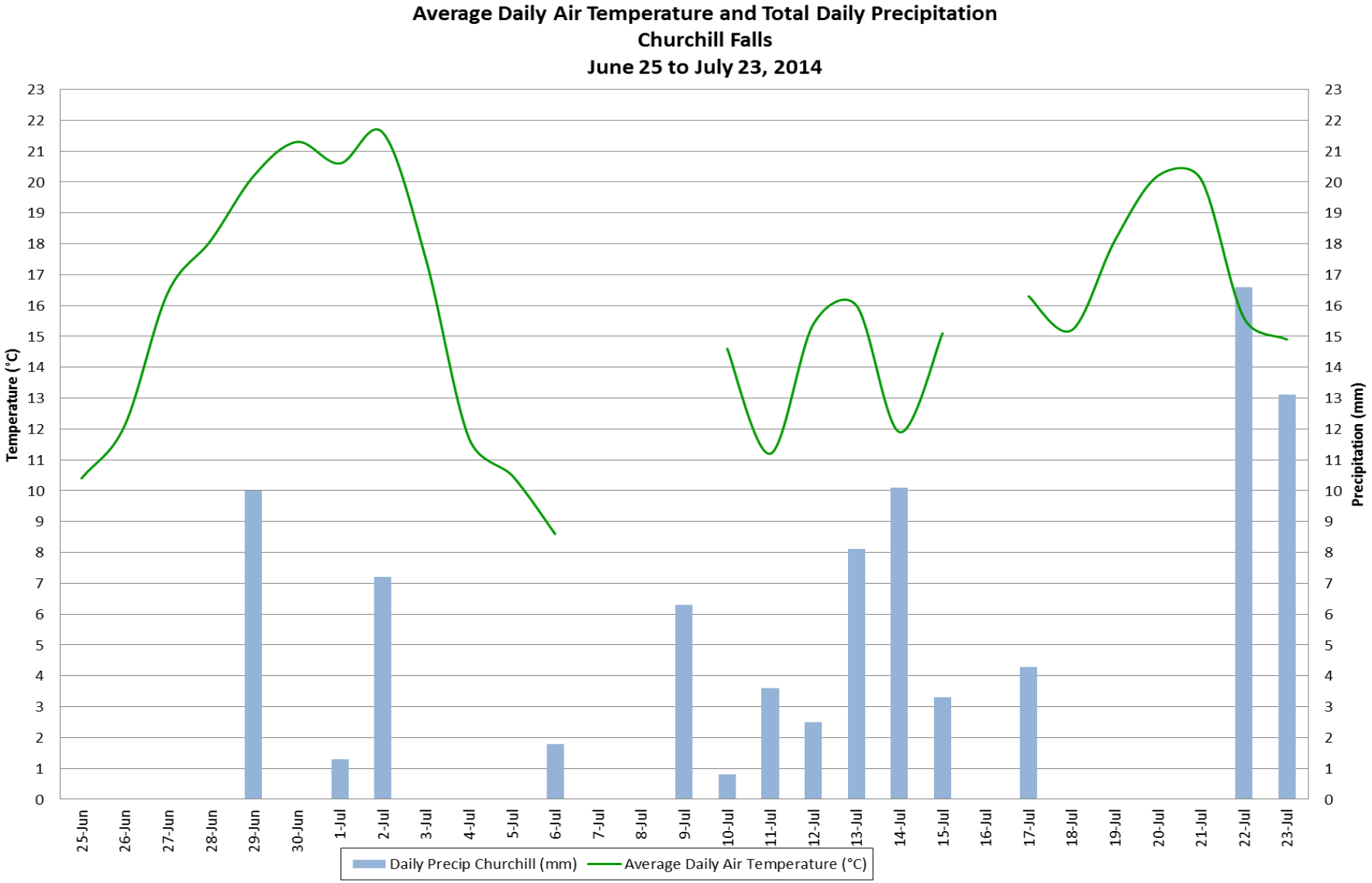


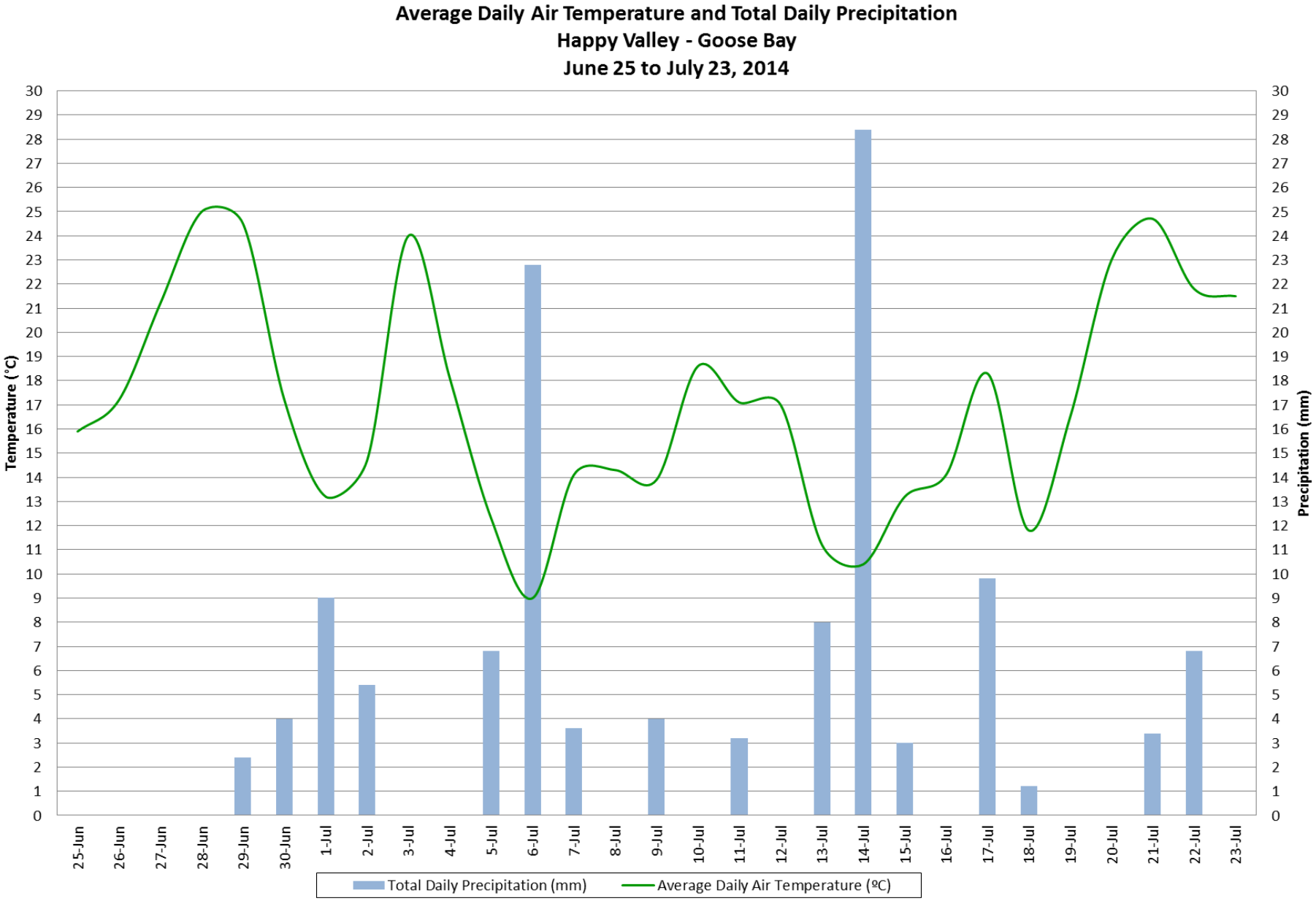
Figure 37: Daily precipitation and average daily stage level at Churchill River at English Point (weather data recorded at Goose Bay)

Conclusions

- Instruments at five water quality monitoring stations on the Lower Churchill River were deployed from June 25 to July 22/23, 2014.
- Stage levels generally decrease at all stations for the first half of deployment before increasing during the second half of deployment as numerous precipitation events cause the stage level to increase. Water level changes at the each of the stations ranged between 0.33m and 0.98m.
- Water temperature was increasing at all stations throughout the deployment period due to the warming ambient air temperatures in the region into the summer season. Water temperature typically ranged between 8.4°C and 20.7°C.
- pH is generally neutral and stable at stations along the Lower Churchill River ranging between 5.92 and 7.18 pH units. All pH values at all stations were within the recommended CCME Guidelines for the Protection of Aquatic Life, with the exception of the final week of deployment at English Point, where the values dropped below the minimum guideline due to the addition of freshwater from precipitation events.
- Specific conductivity was relatively stable at all stations regardless of the fluctuating stage levels. All stations showed little variation in values except at English Point, which is influenced by the tides in Lake Melville. Specific conductivity ranged between 8.5µS/cm and 19.6µS/cm at the stations below Metchin River, below Grizzle Rapids and above and below Muskrat Falls. Specific conductivity values at the station at English Point ranged higher at 18.1µS/cm to 61.8µS/cm .
- Dissolved oxygen content was decreasing throughout the deployment period as it is inversely related to water temperature, which is rising. Values ranged between 8.93mg/l and 12.39mg/l. The majority of values were above both the CCME Guideline for the Protection of Aquatic Life for Cold Water Biota at Other Life Stages at 6.5mg/l and at Early Life Stages of 9.5mg/l. Values occasionally dropped below the Early Life Stages Guideline when water temperatures were high. The station below Muskrat Falls consistently has high dissolved oxygen content due to the location of the Muskrat Falls, 6km upstream.
- Turbidity data at the stations below Metchin River and below Grizzle Rapids remained mostly at 0NTU throughout the deployment period which is typical of these stations. Turbidity values at the stations above and below Muskrat Falls and at English Point were typical for the stations, reporting background values of 10.1NTU, 41.5NTU, and 31.6NTU respectively.

Appendix 1 – Weather Data – Environment Canada Historical Weather and Climate Database




Average Daily Air Temperature and Total Daily Precipitation
Happy Valley - Goose Bay
June 25 to July 23, 2014
Temperature (°C)
Precipitation (mm)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
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26
27
28
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30
25-Jun
26-Jun
27-Jun
28-Jun
29-Jun
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5-Jul
6-Jul
7-Jul
8-Jul
9-Jul
10-Jul
11-Jul
12-Jul
13-Jul
14-Jul
15-Jul
16-Jul
17-Jul
18-Jul
19-Jul
20-Jul
21-Jul
22-Jul
23-Jul
Total Daily Precipitation (mm)
Average Daily Air Temperature (ºC)