Real-Time Water Quality Deployment Report

Lower Churchill River and Lake Melville Stations

June 29 to
August 3, 2011

Newfoundland Labrador

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

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Contents

General

- Department of Environment and Conservation staff monitors the real-time web pages regularly.
- This deployment report discusses water quality related events occurring at stations on the Lower Churchill River at English Point and Lake Melville East of Little River.
- On June 29/30, 2011, real-time water quality monitoring instruments were deployed at stations on the Lower Churchill River at English Point and Lake Melville East of Little River. Instruments were deployed for a period of 34-35 days. Instruments were removed on August 3.

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 QA/QC Sonde is temporarily deployed along side the Field Sonde. 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 Sonde and QAQC Sonde 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 (oC)	<=+/-0.2	>+/-0.2 to 0.5	>+/-0.5 to 0.8	>+/-0.8 to 1	<+/-1
pH (unit)	<=+/-0.2	>+/-0.2 to 0.5	>+/-0.5 to 0.8	>+/-0.8 to 1	>+/-1
Sp. Conductance (µS/cm)	<=+/-3	>+/-3 to 10	>+/-10 to 15	>+/-15 to 20	>+/-20
Sp. Conductance > 35 µS/cm (%)	<=+/-3	>+/-3 to 10	>+/-10 to 15	>+/-15 to 20	>+/-20
Dissolved Oxygen (mg/L) (% Sat)	<=+/-0.3	>+/-0.3 to 0.5	>+/-0.5 to 0.8	>+/-0.8 to 1	>+/-1
Turbidity <40 NTU (NTU)	<=+/-2	>+/-2 to 5	>+/-5 to 8	>+/-8 to 10	>+/-10
Turbidity > 40 NTU (%)	<=+/-5	>+/-5 to 10	>+/-10 to 15	>+/-15 to 20	>+/-20

- It should be noted that the temperature sensor on any sonde 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 sonde the entire sonde 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 English Point and Lake Melville stations deployed between June 29/30 and August 3, 2011 are summarized in Table 2.

Table 2: Comparison rankings for English Point and Lake Melville stations, June 29/30 - August 3, 2011

Station	Date	Action	Comparison Ranking				
			Temperature	pH	Conductivity	Dissolved Oxygen	Turbidity
English Point	June 29, 2011	Deployment	Excellent	Good	Excellent	Excellent	Excellent
	August 3, 2011	Removal	Excellent	Excellent	Excellent	Good	Excellent
Lake Melville	June 30, 2011	Deployment	Excellent	Excellent	Excellent	Excellent	Good
	August 3, 2011	Removal	Excellent	Excellent	Good	Good	Good

- All parameters ranked ‘good’ or ‘excellent’ at both deployment and removal for both stations on the Churchill River at English Point and Lake Melville East of Little River.

Data Interpretation

- The following graphs and discussion illustrate significant water quality-related events from June 29/30 to August 3 at the stations on the Churchill River at English Point and Lake Melville East of Little River.
- 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.

Churchill River at English Point

- Water temperature ranged from 11.40 to 20.40^{o}C during this deployment period (Figure 1).
- Water temperature is increasing throughout the deployment period. This trend is expected due to the increasing ambient air temperatures in the summer season (Figure 2). Water temperature fluctuates diurnally and with tidal influences.

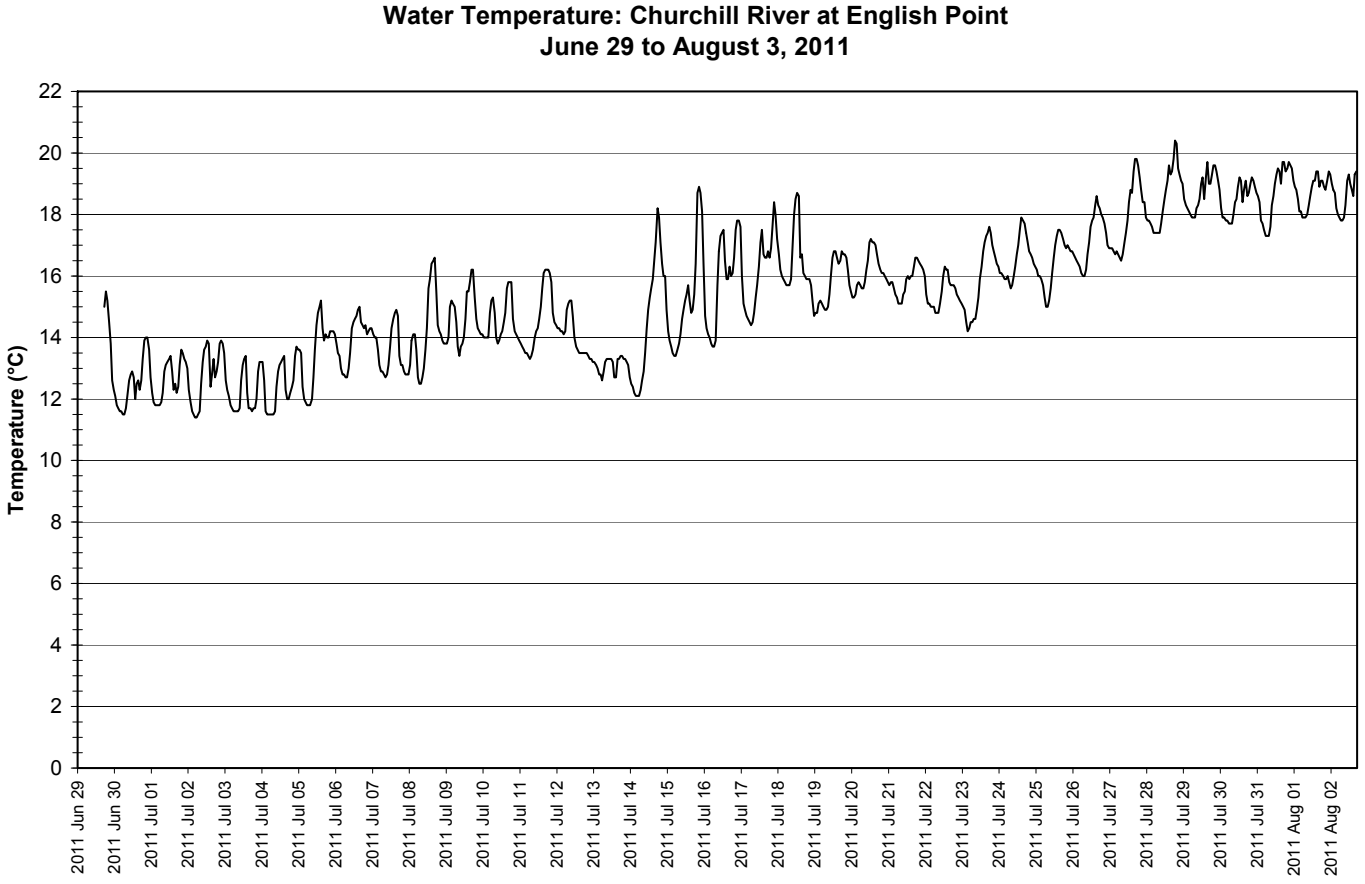

Figure 1: Water temperature at Churchill River at English Point

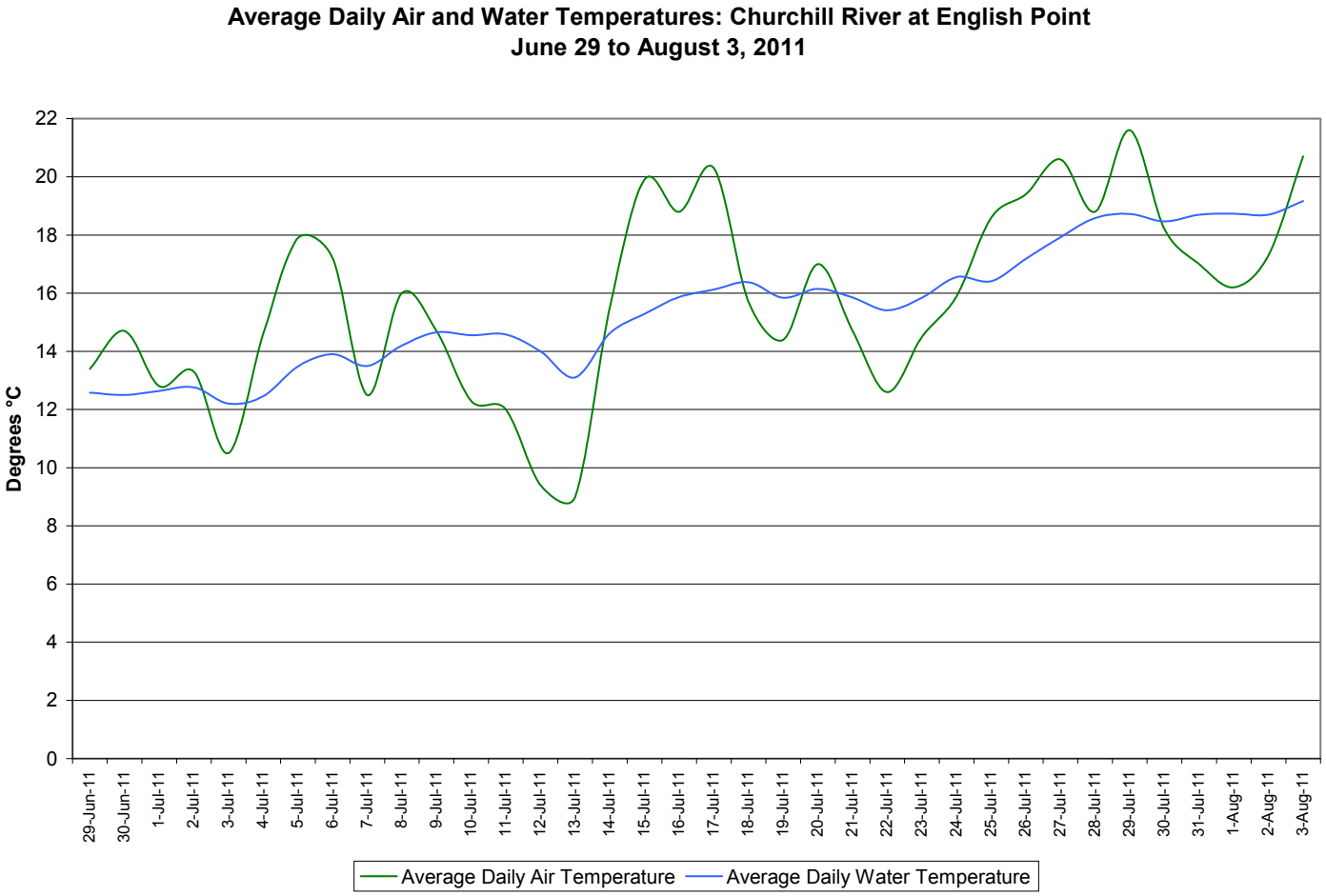

Figure 2: Average daily air and water temperatures at Churchill River at English Point

(weather data collected at Goose Bay)

- pH ranges between 6.41 and 6.97 pH units and decreases slightly throughout the deployment period (Figure 3).
- All values during the deployment are below the maximum CCME Guideline for the Protection of Aquatic Life (9.5). Most values are above the minimum CCME Guideline for Protection of Aquatic Life (6.5). In the latter half of the deployment period, pH values drop to just below the guideline during the night time, and rise again during the day time.

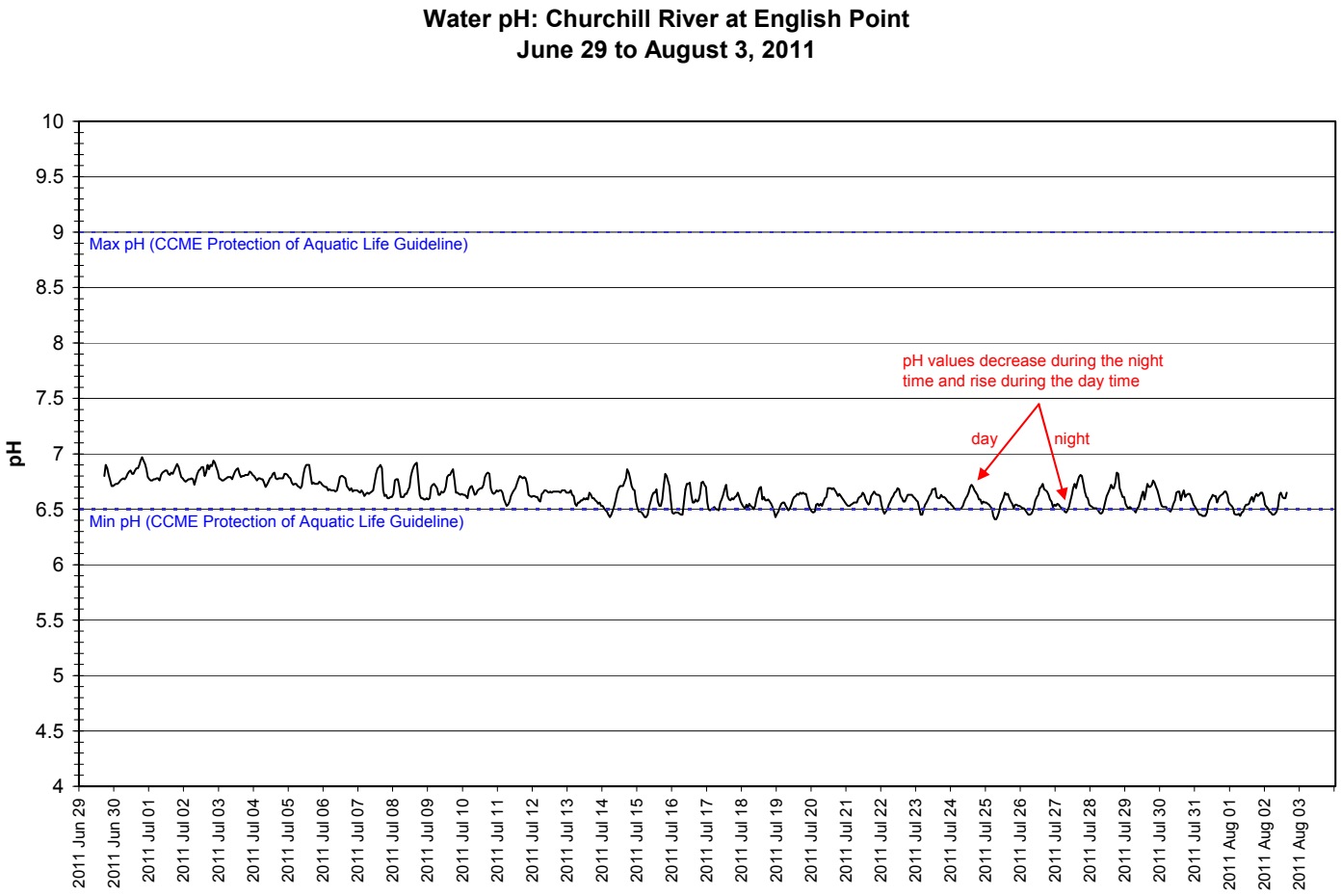

Figure 3: pH at Churchill River at English Point

- Specific conductivity typically ranges between 17.0 to 46.3µS/cm during the deployment period, averaging 28.2µS/cm (Figure 4).
- On 2 separate occasions, specific conductivity spikes higher than normal to 83.9µS/cm and 57.0µS/cm (indicated by red arrows on figure 4). These events are both short lived (~1 hour) and the cause is unknown.
- Specific conductivity fluctuates considerably at this location due to the tidal influences of the Atlantic Ocean. As the tide comes in, the dissolved solids and salinity increase, increasing the specific conductivity and vice versa as the tide goes out. This increase and decrease in specific conductivity and stage occurs twice daily.

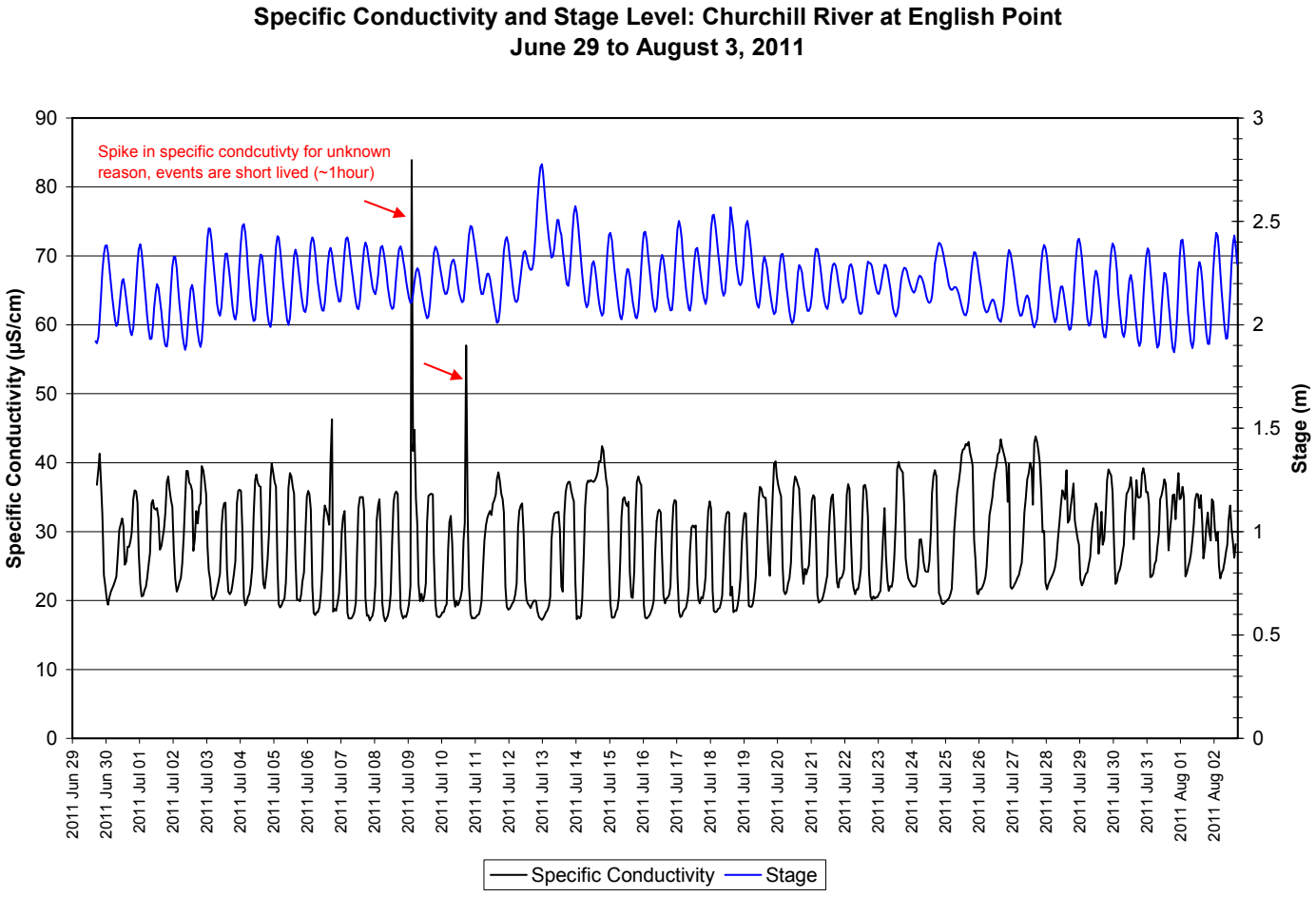

Figure 4: Specific conductivity and stage level at Churchill River at English Point

- The saturation of dissolved oxygen ranged from 90.4 to 111.8% and a range of 9.15 to 11.56mg/l was found in the concentration of dissolved oxygen with a median value of 10.08mg/l (Figure 5).
- All values were above the minimum CCME Guideline for the Protection of Other Life Stage Cold Water Biota of 6.5 mg/l. Most values were above the minimum CCME Guideline for the Protection of Early Life Stage Cold Water Biota value of 9.5 mg/l. The guidelines are indicated in blue on Figure 5.
- Dissolved oxygen content decreases slightly over the deployment period. This trend is expected given the increasing air and water temperatures (Figure 2). Dissolved oxygen content clearly fluctuates diurnally, displaying the inverse relationship to water temperature during the day and night.
- In the last 2 weeks of the deployment period, dissolved oxygen content begins to drop below the guideline during the day when the air and water temperatures are the warmest.

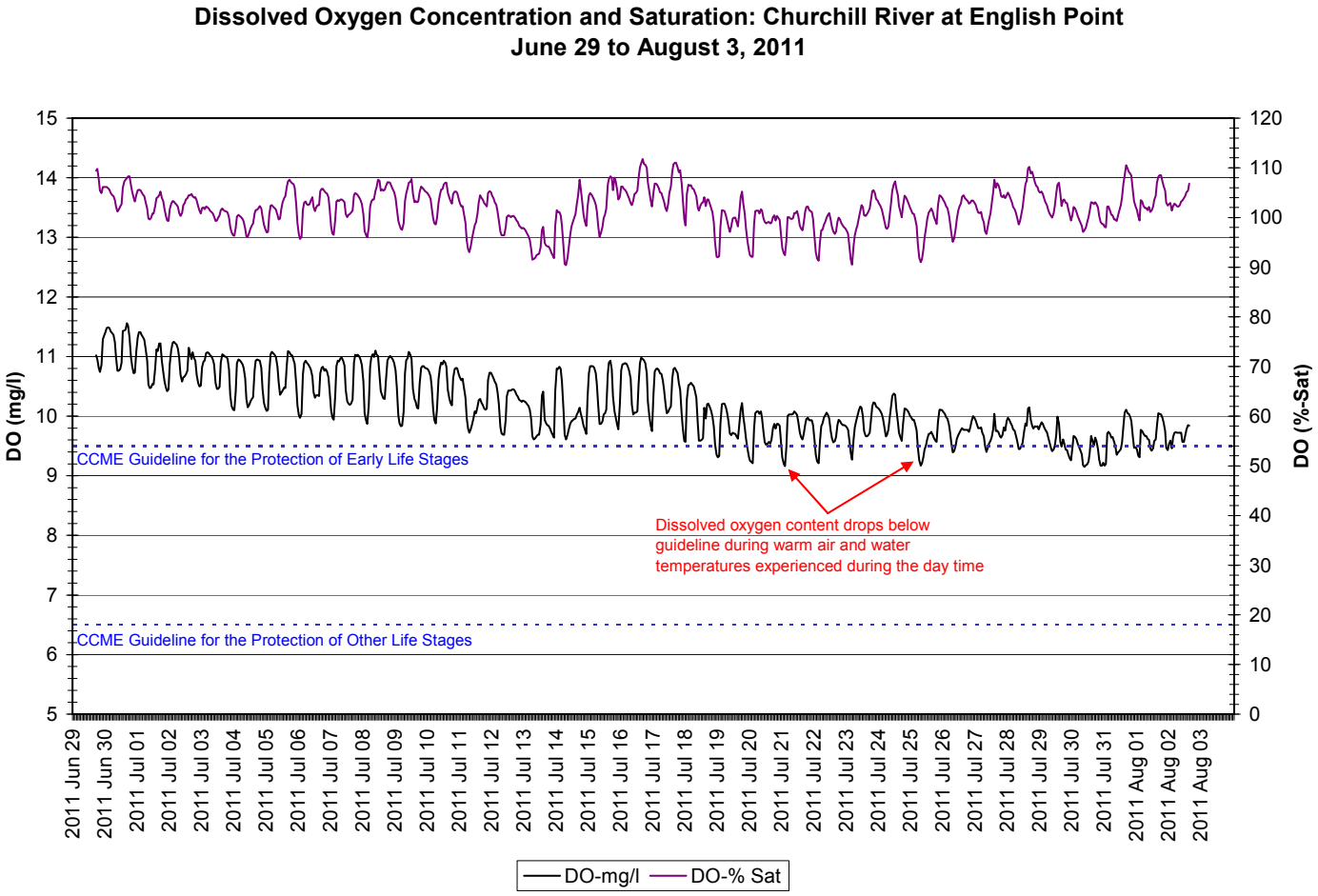

Figure 5: Dissolved oxygen and percent saturation at Churchill River at English Point

- Turbidity values typically ranged between 1.4 and 126.1NTU (Figure 6). A median value of 7.4 NTU indicates there is a natural background turbidity value at this station.
- Over a period of 2 days (July 6-8), turbidity values rise considerably peaking at 3000NTU. This reading is an error reading by the instrument and it often caused when there is something blocking the sensor. These values were not considered in the range or median value calculation. This site is prone to biofouling, especially in warm temperatures which can affect the sensors' performance, causing the error readings.
- There are several spikes in turbidity of lesser magnitude throughout the deployment period. Turbidity values increase over July 12-14 following a rainfall event recorded at the same time. Similarly, rainfall events recorded on July 17-18 correspond with another turbidity increase from July 18-21. Turbidity spikes show typical recovery periods following the events, in some cases up to 2-3 days. Turbidity also fluctuates daily and is most likely related to the increases and decreases in water level with the tidal patterns.

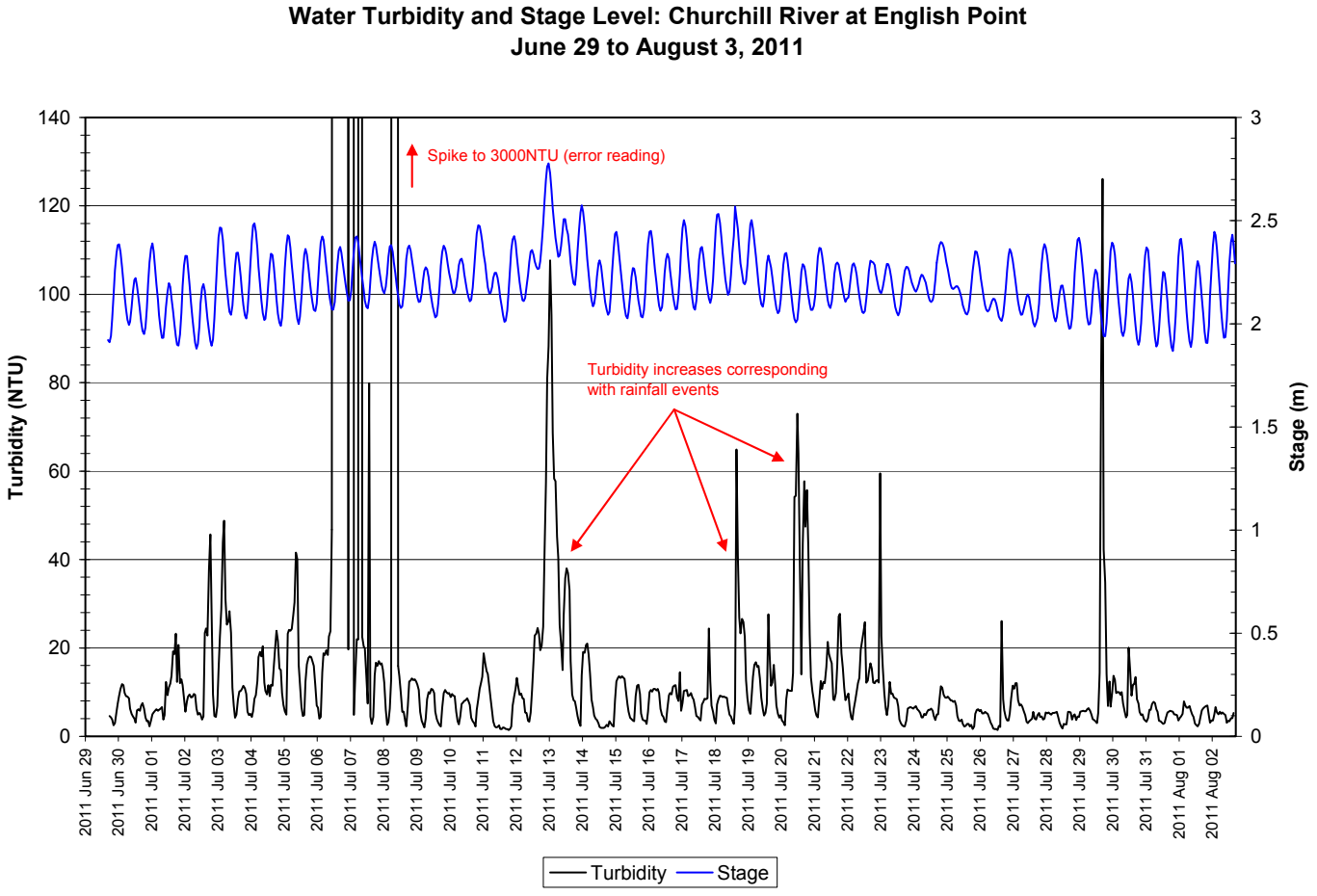

Figure 6: Turbidity and stage level at Churchill River at English Point

- Stage and precipitation are graphed below to show the relationship between rainfall and water level (Figure 7). Stage is generally decreasing throughout the deployment period with varying precipitation records. Averaging stage over 24 hour period reduces the appearance of diurnal variability caused by the tides in the hourly data.
- In some instances, for example, the rainfall events between July 10 and 13, cause the water level in the river to rise in the days following.

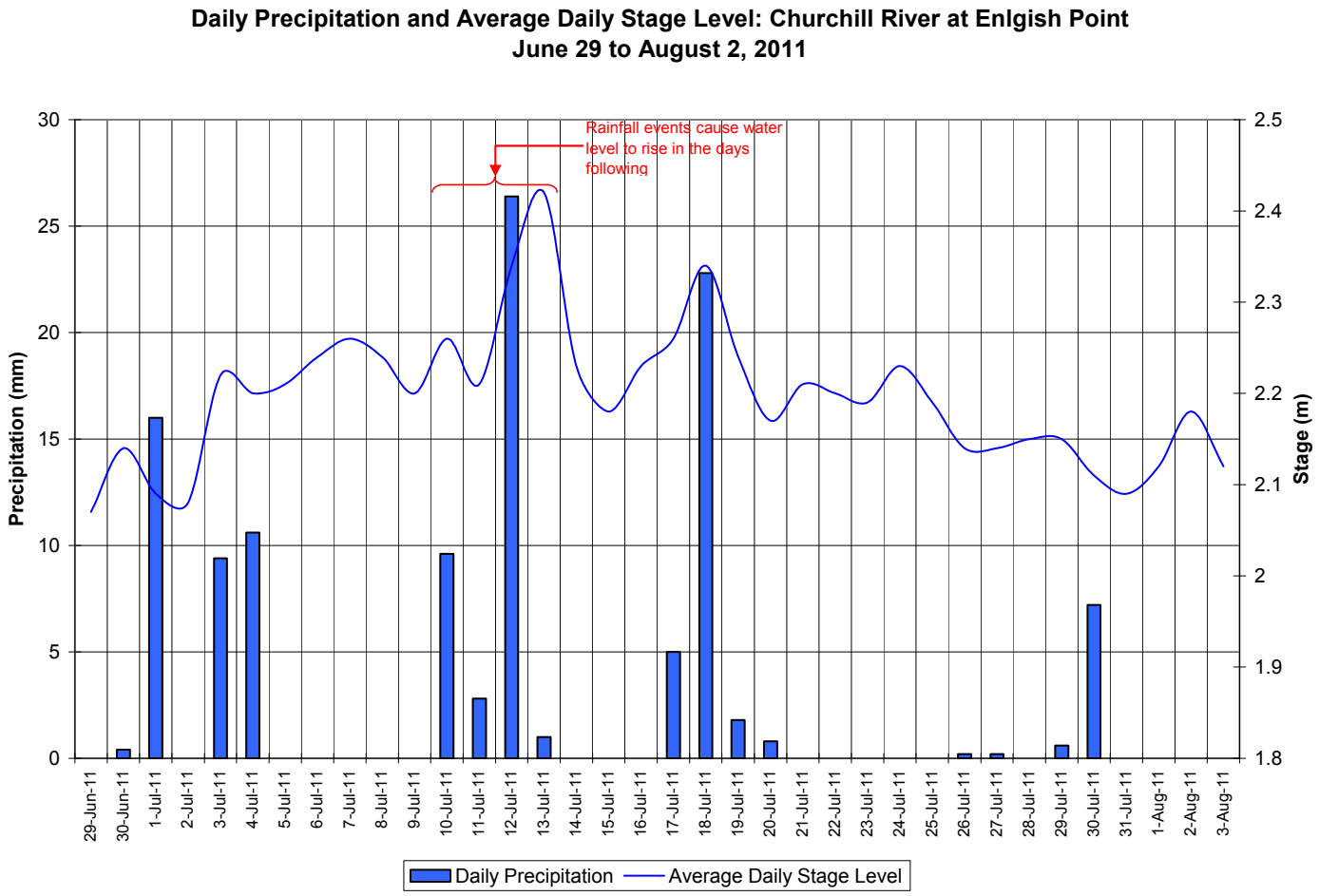

Figure 7: Stage and precipitation at Churchill River at English Point

Lake Melville East of Little River

- On June 7, the station encountered a transmission error where all communication with the station ceased. Environment Canada staff were on site and repaired the station on July 13, 2011. Water quality data measured between June 7 and July 13 was retrieved from the instrument's internal log files upon removal. Water quantity data during this period remains unavailable at this time.
- Water temperature ranges from 7.73 to 21.40^{o}C during this deployment period (Figure 8).
- Water temperature is typically increasing throughout the deployment period. This trend is expected given the increasing ambient air temperature in the summer (Figure 9). Water temperature fluctuates significantly on a daily basis.

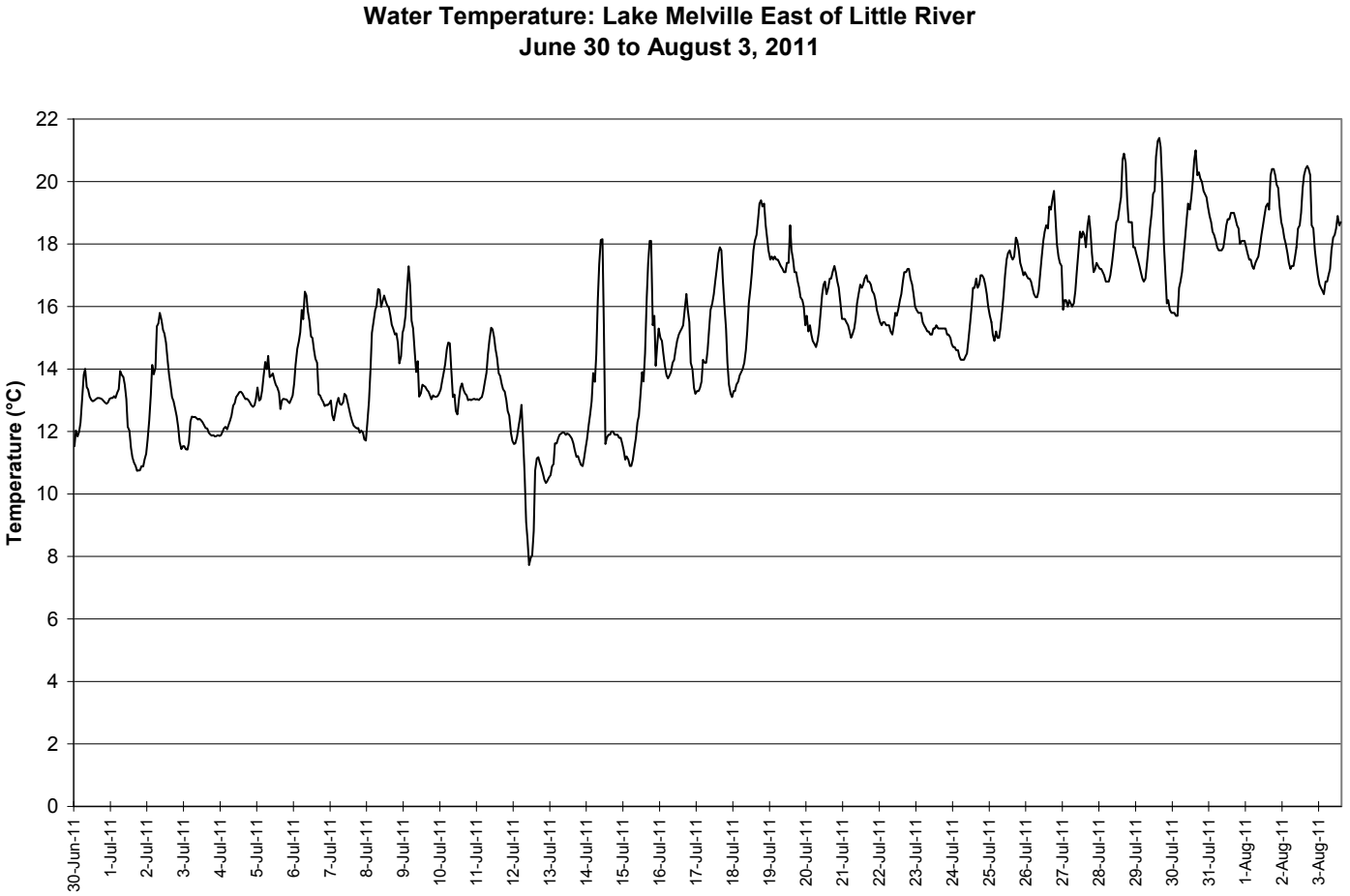

Figure 8: Water temperature at Lake Melville East of Little River

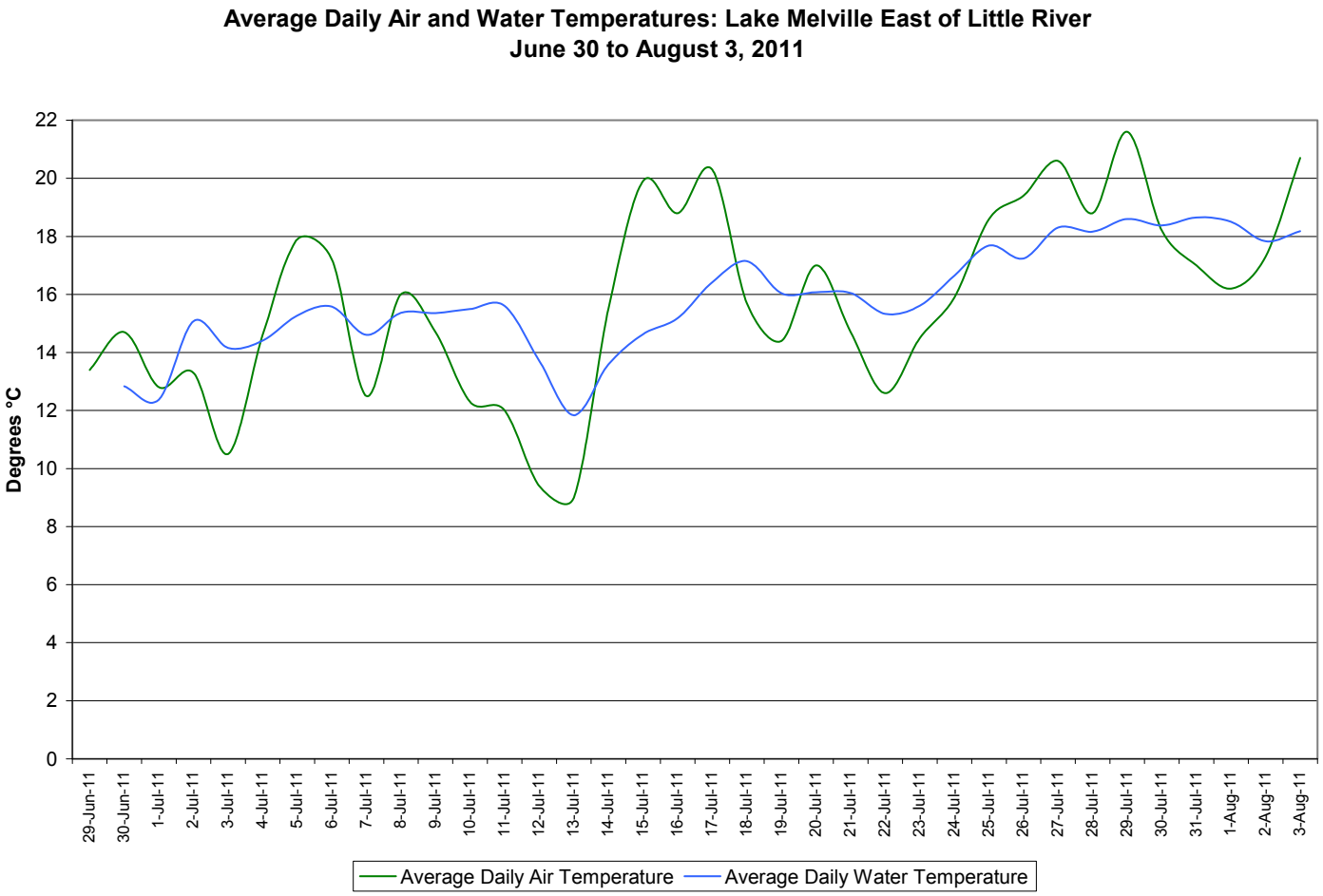

Figure 9: Average daily air and water temperatures at Lake Melville East of Little River (weather data collected at Goose Bay)

- pH ranges between 6.75 and 9.03 pH units (Figure 10). pH fluctuates daily.
- All values are within the recommended range for pH as suggested by the CCME Guidelines for the Protection of Aquatic Life (indicated in blue on Figure 10). These guidelines however, are for freshwater environments. If we consider this to be a 'marine' environment, the minimum and maximum pH guidelines would be then 7.0 and 8.7 respectively (indicated in green on Figure 10). Both the minimum and maximum guidelines for pH in marine environments are exceeded at different times throughout the deployment period but only for short periods of time.

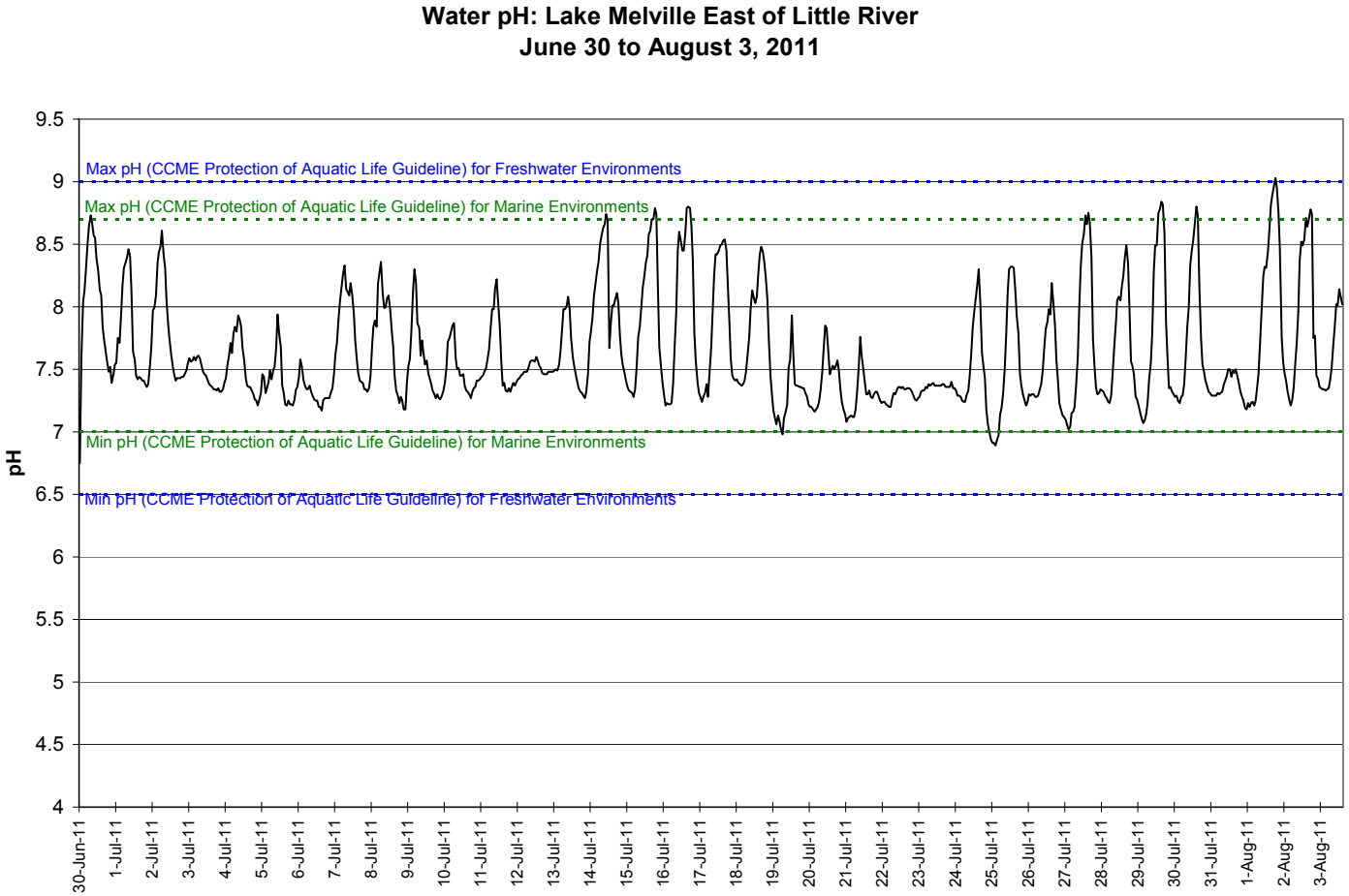

Figure 10: pH at Lake Melville East of Little River

- Specific conductivity typically ranges between 4285 and 11115µS/cm and fluctuates throughout the deployment period (Figure 11).
- On July 12, specific conductivity spikes from around 9000µS/cm up to 21259µS/cm. Specific conductivity returns to expected values after about 8 hours.

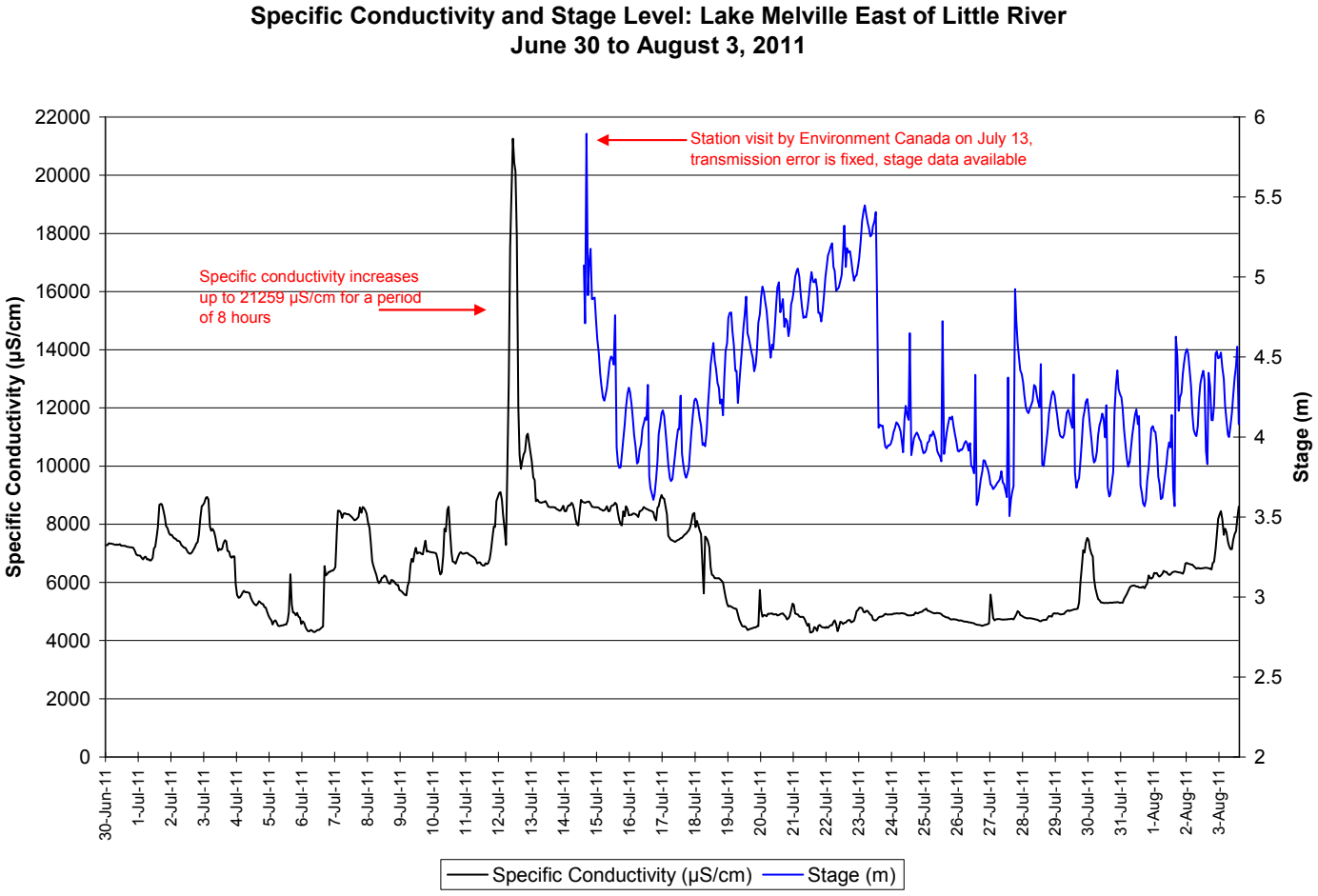

Figure 11: Specific conductivity at Lake Melville East of Little River

- The saturation of dissolved oxygen ranged from 86.8 to 144.6% and a range of 8.29 to 13.57mg/l was found in the concentration of dissolved oxygen with a median value of 9.86mg/l (Figure 12).
- Dissolved oxygen content is decreasing slightly throughout the deployment period. This trend is expected given the increasing air and water temperatures (Figure 9). Dissolved oxygen content fluctuates daily reflecting its inverse relationship with water temperature.
- All values were above the minimum CCME Guideline for the Protection of Other Life Stage Cold Water Biota of 6.5 mg/l. Most values were above the minimum CCME Guideline for the Protection of Early Life Stage Cold Water Biota value of 9.5 mg/l. The guidelines are indicated in blue on Figure 12.
- During the last 2 weeks of the deployment period, dissolved oxygen content begins to drop below the guideline during the day when the air and water temperatures are at a maximum. It is important to note that these guidelines are for freshwater environments. If this environment is considered a marine environment, the minimum CCME Guideline for the Protection of Aquatic Life is 8.0mg/l (indicated in green on Figure 12). All values are above this guideline.

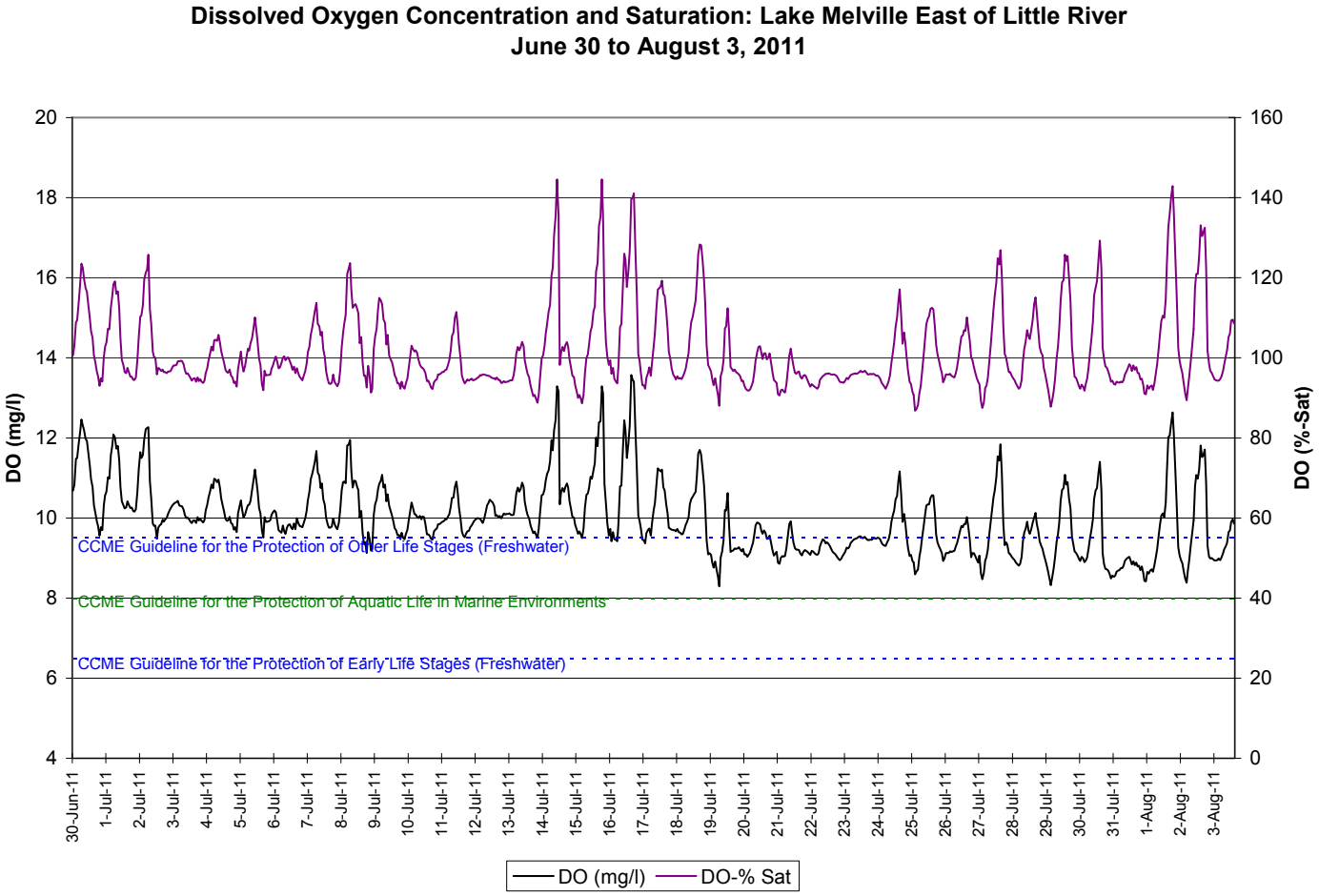

Figure 12: Dissolved oxygen and percent saturation at Lake Melville East of Little River

- A range of 0.0 to 271.7NTU was recorded for turbidity for this deployment period (Figure 13). A median value of 11.6 NTU indicates there is a consistent natural background turbidity value at this station.
- Turbidity spikes occur throughout the deployment period and generally correspond with rainfall events or high winds. This station is particularly susceptible to high winds because the lake environment can cause extreme surf conditions affecting the turbidity and stability of the readings by the instrument. Turbidity events show a typical recovery period, in some cases 2-3 days, before returning to background levels (~11NTU).

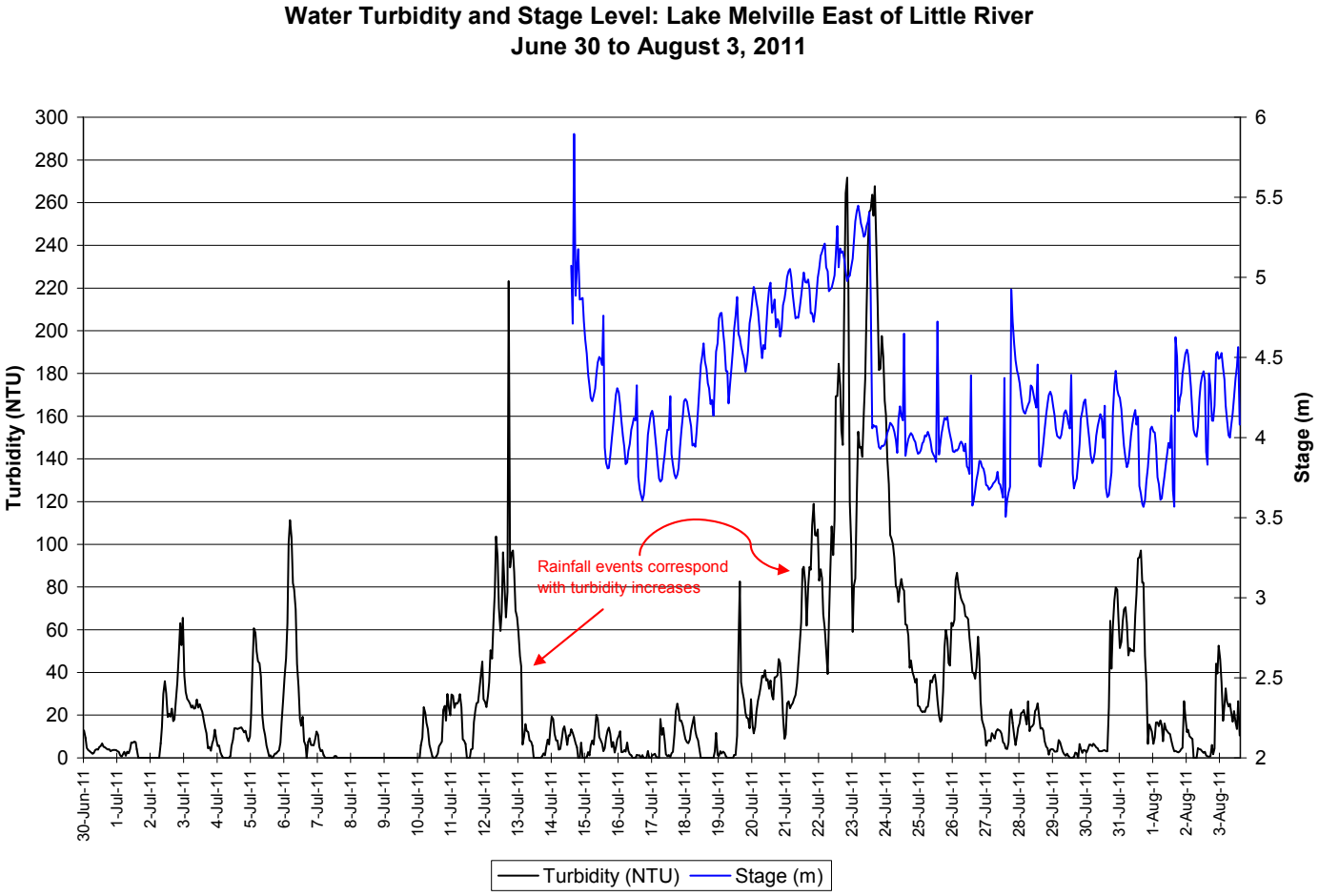

Figure 13: Turbidity at Lake Melville East of Little River

- Stage and precipitation are graphed below to show the relationship between rainfall and water level (Figure 14). The station only successfully transmitted data from July 13 onward after the site visit by Environment Canada. Precipitation events vary throughout the deployment period.
- In some instances, for example, the rainfall events between July 17 and 20, cause the water level in the river to rise in the days following.

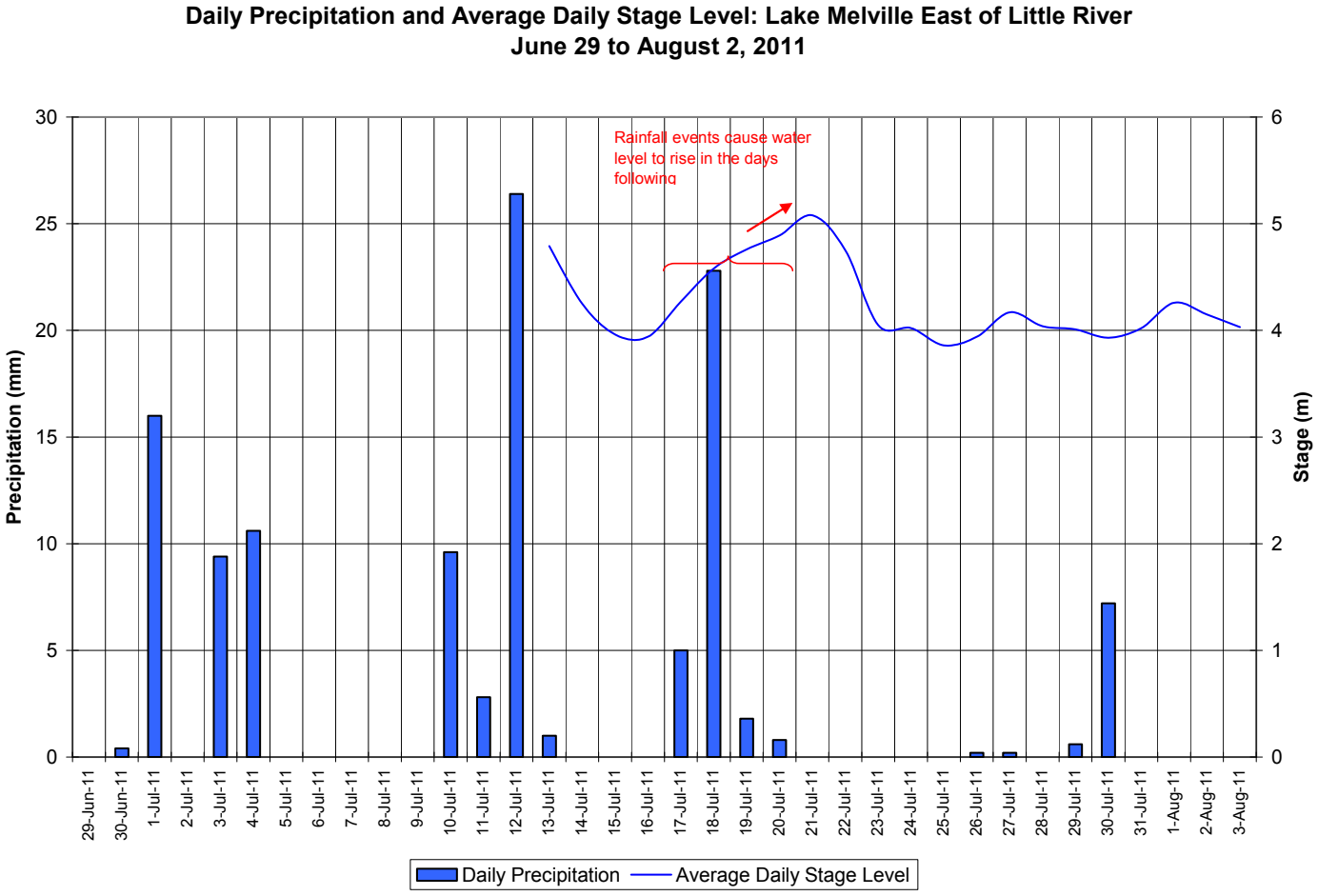

Figure 14: Stage and precipitation at Lake Melville East of Little River

Conclusions

- Instruments at water quality monitoring stations on the Lower Churchill River at English Point and on Lake Melville East of Little River were deployed on June 29/30 and removed on August 3.
- These stations are an extension of the existing RTWQ Network on the Lower Churchill River, established to protect ambient water resources and catch emerging water quality issues. The data from these 2 stations augment the data collected from the existing stations on the Lower Churchill River.
- A transmission error at the station on Lake Melville prevented data from being transmitted in real time between June 7 and July 13. Data was retrieved from the instruments internal log files.
- No significant water quality events were captured during this time. In most cases, weather related events or increase/decreases in water level could be used to explain the fluctuations.
- Most values recorded were within ranges as suggested by the CCME Guidelines for the Protection of Aquatic Life for pH and dissolved oxygen. Events which exceeded the CCME Guidelines were for the most part short lived and not of great magnitude beyond the guideline.
- Water temperature generally was increasing at both stations due to the warming ambient air temperatures in the region.
- pH values were generally with in the recommended CCME Guidelines for the Protection of Aquatic Life for either freshwater or marine environments depending on the station. Events which exceeded the CCME Guidelines were for the most part short lived and not of great magnitude beyond the guideline.
- Specific conductance fluctuated inversely to the changing stage level. In most cases, as specific conductivity increased, stage decreased and vice versa.
- Similarly, dissolved oxygen content fluctuated inversely to water temperature. Dissolved oxygen content generally decreased through out the deployment period at both stations as the water temperature was rising.
- There is a natural background turbidity values at both of these stations. These stations are susceptible to turbidity increases during rainfall and weather events. Recovery periods for turbidity events range depending on the size of the disturbance however generally last 3-4 days during this deployment period.

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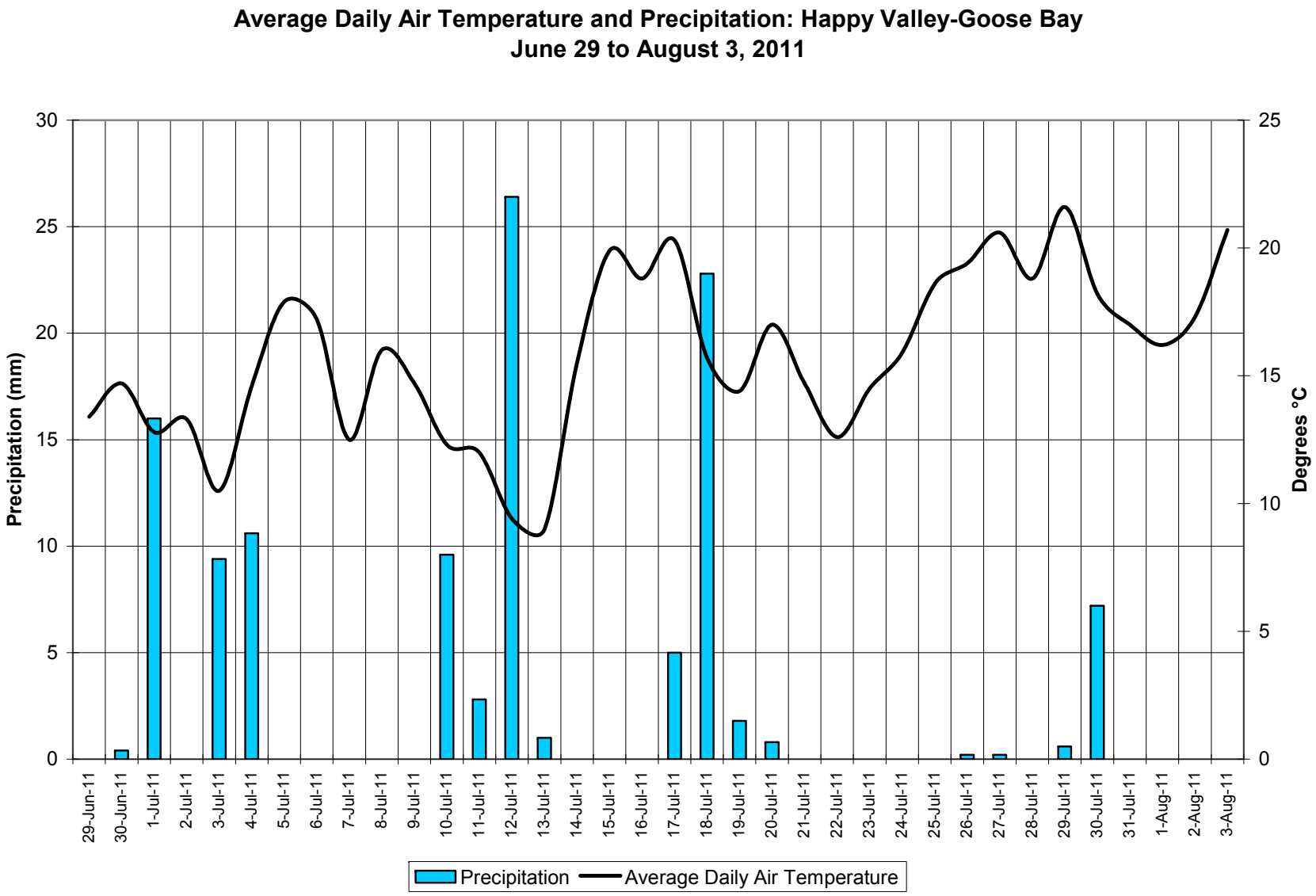
Appendix 1


Average Daily Air Temperature and Precipitation: Happy Valley-Goose Bay
June 29 to August 3, 2011
Precipitation (mm)
Degrees °C
30
25
20
15
10
5
0
25
20
15
10
5
0
29-Jun-11
30-Jun-11
1-Jul-11
2-Jul-11
3-Jul-11
4-Jul-11
5-Jul-11
6-Jul-11
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9-Jul-11
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25-Jul-11
26-Jul-11
27-Jul-11
28-Jul-11
29-Jul-11
30-Jul-11
31-Jul-11
1-Aug-11
2-Aug-11
3-Aug-11
Precipitation
Average Daily Air Temperature