



Real-Time Water Quality Deployment Report

Lower Churchill River and Lake Melville Stations

September 1 to
October 5, 2011



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

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General

- Department of Environment and Conservation staff monitors the real-time web pages regularly.
- This deployment report discusses water quality related events occurring at the station on the Lower Churchill River at English Point.
- On September 1, 2011, a real-time water quality monitoring instruments was deployed at the station on the Lower Churchill River at English Point. The instrument was deployed for a period of 35 days. The instrument was removed on October 5.
- At the station on Lake Melville east of Little River, upon removal of the instrument deployed between August 3 and September 2, the casing which encloses and protects the instrument had been lost. The instrument had been heavily damaged in high surf conditions. No replacement instrument was deployed.

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. 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 QA/QC 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

Parameter	Rank				
	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 station deployed between September 1 and October 5, 2011 are summarized in Table 2.

Table 2: Comparison rankings for Churchill River at English Point station, September 1- October 5, 2011

Station	Date	Action	Comparison Ranking				
			Temperature	pH	Conductivity	Dissolved Oxygen	Turbidity
English Point	Aug 3, 2011	Deployment	Excellent	Good	Excellent	Excellent	Poor
	Sep 1, 2011	Removal	Excellent	Excellent	Poor	Excellent	Fair

- At Churchill River at English Point at deployment, temperature, pH, specific conductivity, and dissolved oxygen all ranked either ‘good’ or excellent’ while turbidity ranked ‘poor’. The field instrument read a value of 0.0NTU and the QA/QC instrument read a value of 13.7NTU. Zero turbidity readings are common at this station throughout the deployment period. This discrepancy is likely caused by a calibration error with the QA/QC instrument which resulted in higher than expected values for turbidity throughout the day at numerous sampling stations. At removal, temperature, pH, and dissolved oxygen ranked ‘excellent’ while specific conductivity ranked ‘poor’ and turbidity ranked ‘fair’. For specific conductivity, the field instrument read a value of 36.0µS/cm while the QA/QC instrument read a value of 44.7µS/cm, a difference >20%. When specific conductivity is >35uS/cm, the ranking criteria dictate a percentage difference be used to classify data. If data is examined on a numerical difference, the difference is 8.7uS/cm, which yields a ranking of ‘good’. Considering the values in comparison are just above 35uS/cm, the ‘poor’ ranking should be judged with caution. For turbidity, the field instrument read a value of 12.7NTU while the QA/QC instrument read a value of 19.0NTU. This discrepancy may be explained in part due to the positioning of the instruments side by side in the river and the amount of time allowed for stabilization.

Data Interpretation

- The following graphs and discussion illustrate water quality-related events from September 1 to October 5 at the station on the Churchill River at English Point.
- 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 QA/QC protocol. Water Survey of Canada is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.

Churchill River at English Point

- Water temperature ranged from 8.70 to 19.00°C during this deployment period (Figure 1).
- Water temperature is decreasing throughout the deployment period. This trend is expected due to the cooling ambient air temperatures in the fall season (Figure 2). Water temperature fluctuates diurnally and with tidal influences.

**Water Temperature: Churchill River at English Point
September 1 to October 5, 2011**

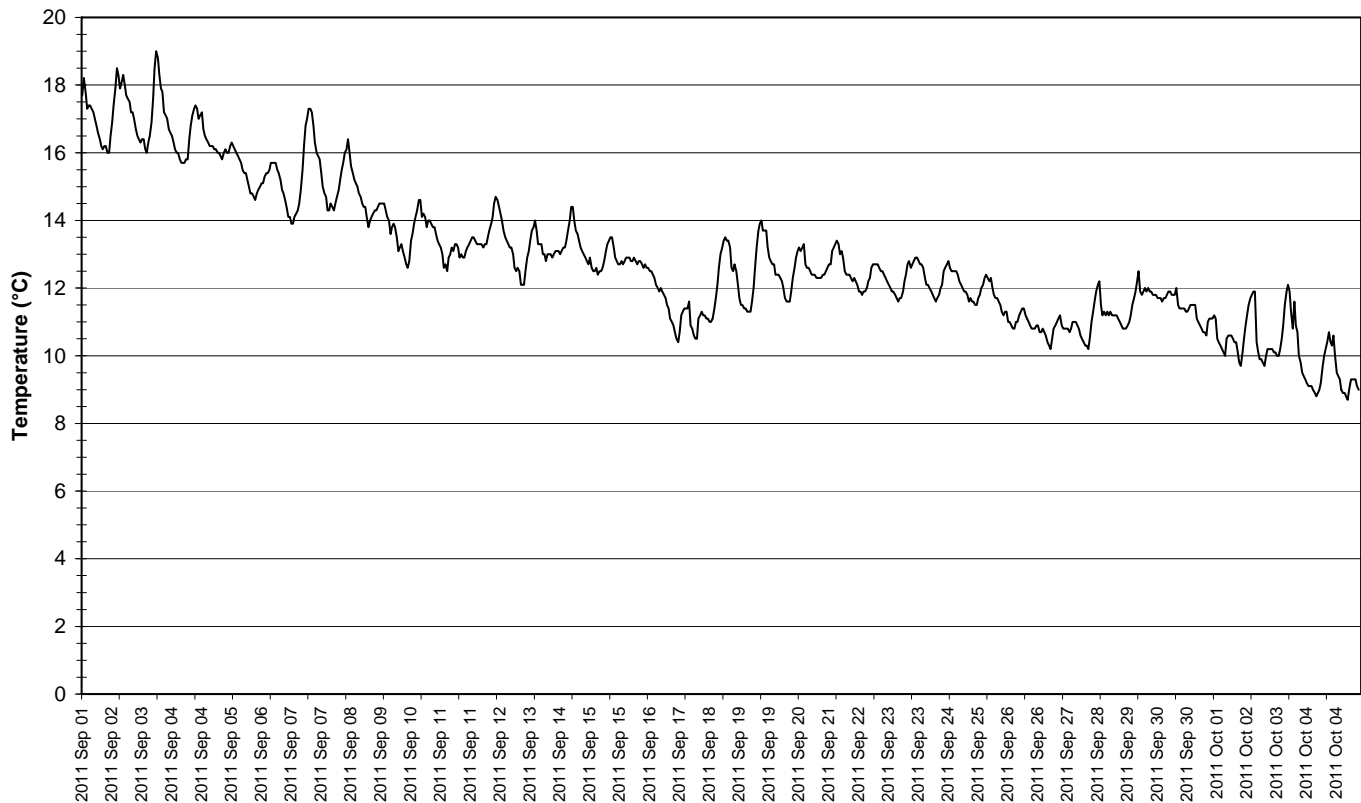
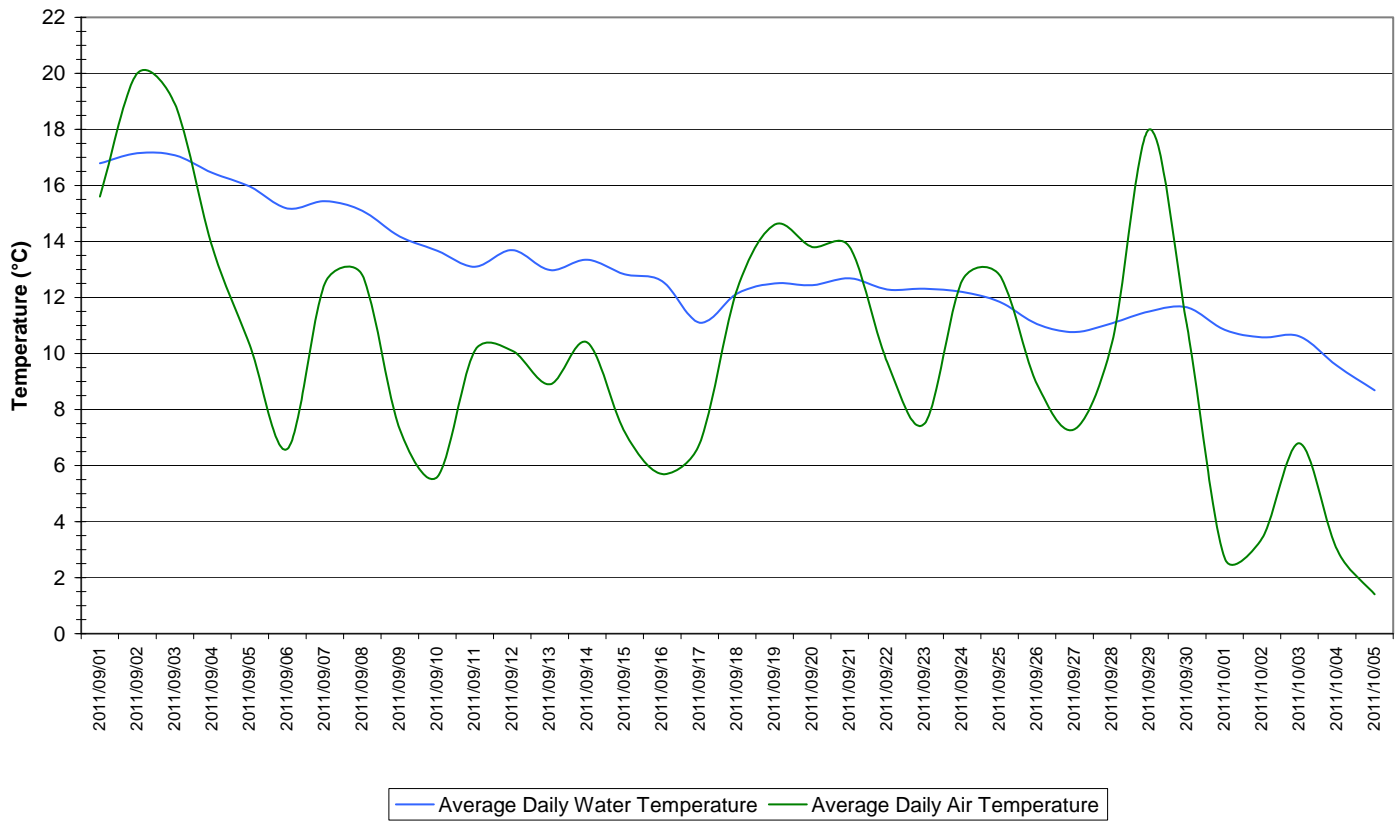


Figure 1: Water temperature at Churchill River at English Point

**Average Daily Air and Water Temperatures: Churchill River at English Point
August 3 to September 1, 2011**



**Figure 2: Average daily air and water temperatures at Churchill River at English Point
(weather data collected at Goose Bay)**

- pH ranges between 6.77 and 7.72 pH units (Figure 3). pH values fluctuate diurnally and with tidal influences.
- All values during the deployment are within the minimum and maximum CCME Guidelines for the Protection of Aquatic Life (>6.5 and <9.5).
- pH is increasing slightly through the beginning of the deployment period and then begins to decrease for the latter half. This decrease may be a result of sensor drift.

**Water pH: Churchill River at English Point
September 1 to October 5, 2011**

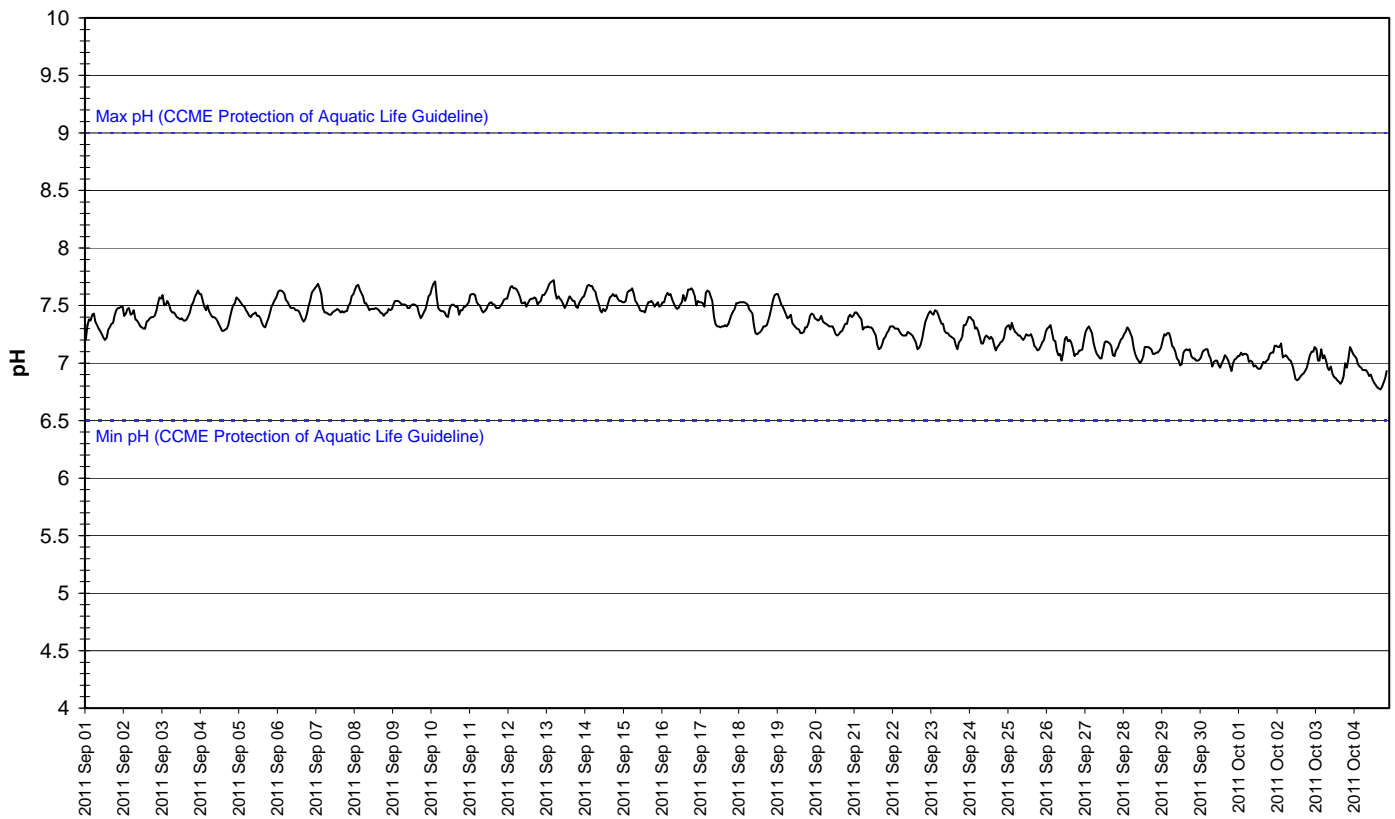


Figure 3: pH at Churchill River at English Point

- Specific conductivity typically ranges between 15.9 to 55.7 $\mu\text{S}/\text{cm}$ during the deployment period, averaging 31.3 $\mu\text{S}/\text{cm}$ (Figure 4).
- 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 consistent throughout the deployment period.

**Specific Conductivity of Water and Stage Level: Churchill River at English Point
September 1 to October 5, 2011**

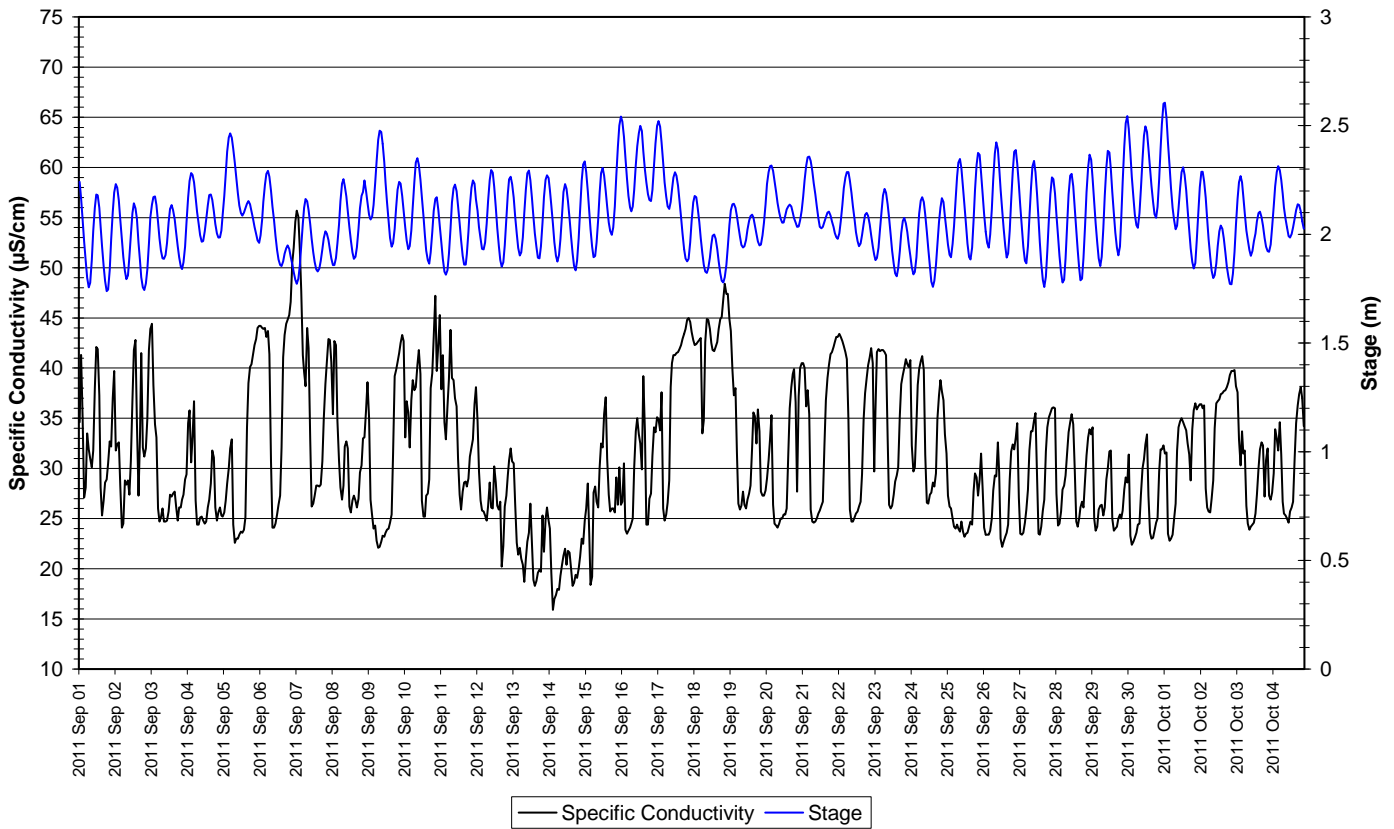


Figure 4: Specific conductivity and stage level at Churchill River at English Point

- The saturation of dissolved oxygen ranged from 87.1 to 107.3% and a range of 9.12 to 11.69mg/l was found in the concentration of dissolved oxygen with a median value of 10.25mg/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. For the first week of the deployment period, dissolved oxygen values are at or just below the minimum CCME Guideline for the Protection of Aquatic Life at Early Life Stages. As the water temperature cools, dissolved oxygen content increases and remains above the guideline for the remainder of the deployment period. The guidelines are indicated in blue on Figure 5.
- Dissolved oxygen content is generally increasing throughout the deployment period and clearly fluctuates diurnally, displaying the inverse relationship to water temperature during the day and night. This trend is expected given the cooling air and water temperatures in the fall season (Figure 2).

**Dissolved Oxygen Concentration and Saturation: Churchill River at English Point
September 1 to October 5, 2011**

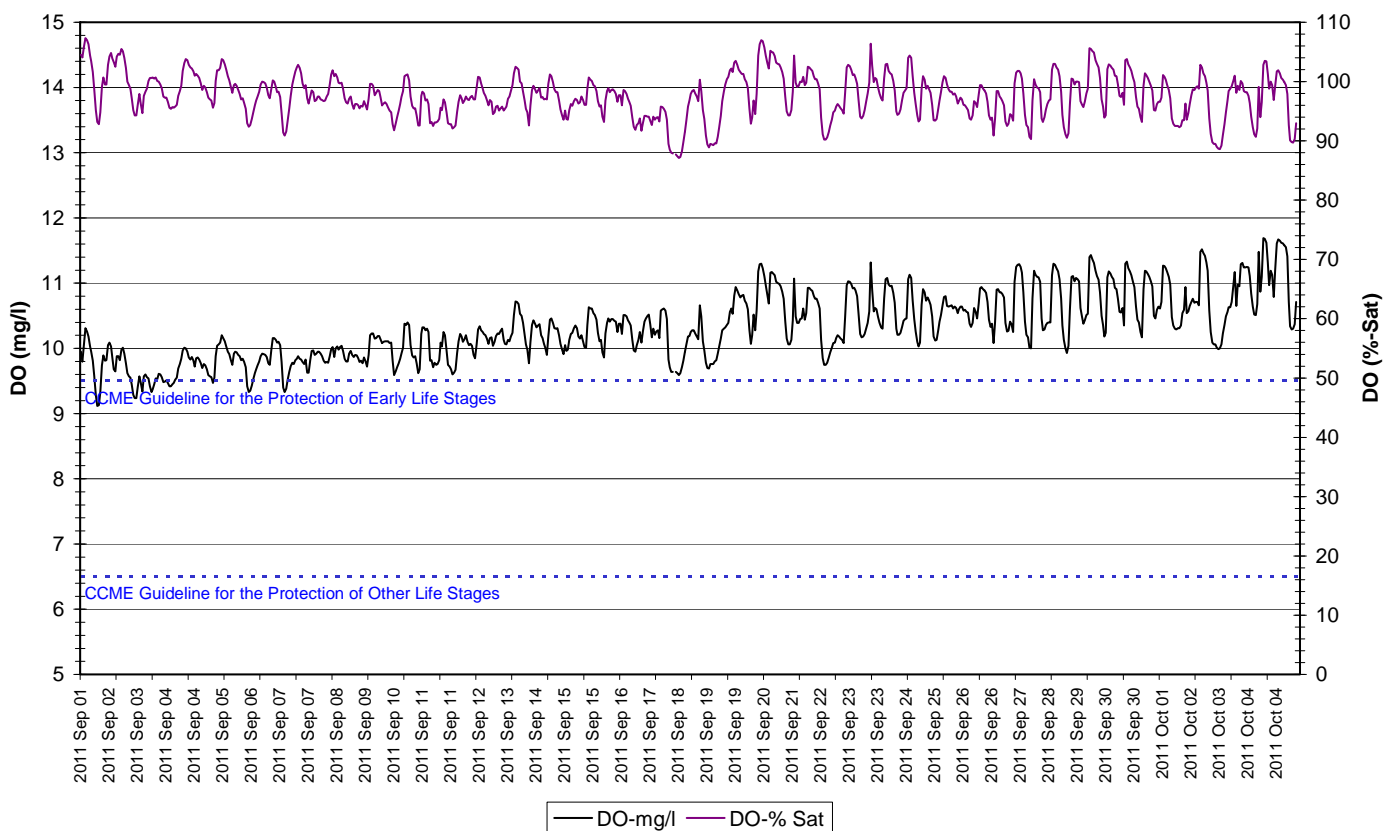


Figure 5: Dissolved oxygen and percent saturation at Churchill River at English Point

- Turbidity values ranged between 0.0 and 153.2NTU (Figure 6). A median value of 0.0 NTU indicates there no apparent natural background turbidity value at this station however this station is susceptible to frequent turbidity increases. Average turbidity at this station is 4.7NTU.
- The largest turbidity spike occurred on September 17 (>150NTU). This increase corresponds with a significant rainfall event over September 16-18. Most of the turbidity increases during the deployment period occur without explanation or corresponding weather events.

**Water Turbidity: Churchill River at English Point
September 1 to October 5, 2011**

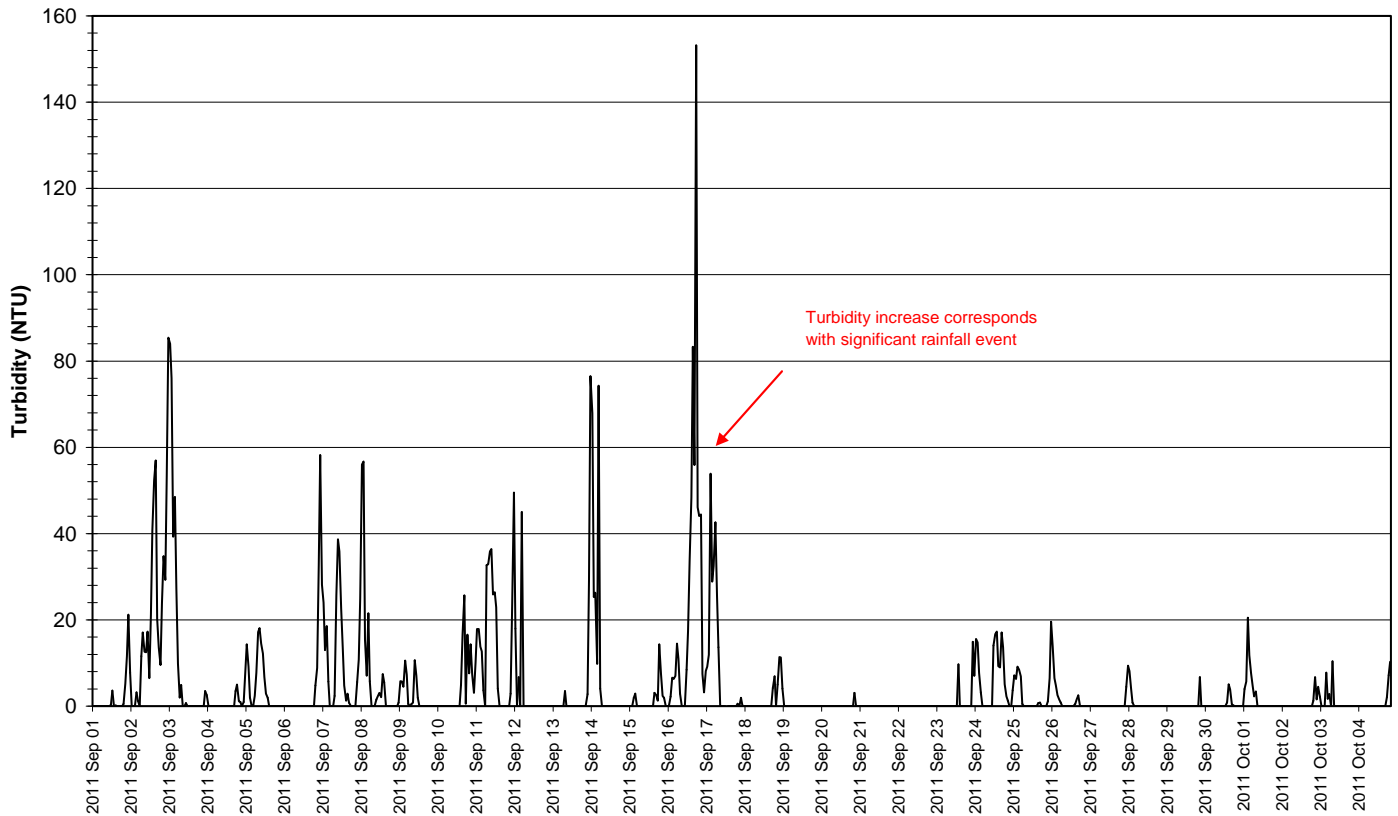


Figure 6: Turbidity at Churchill River at English Point

- Stage and precipitation are graphed below to show the relationship between rainfall and water level (Figure 7). Stage fluctuates 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.

**Daily Precipitation and Average Daily Stage Level: Churchill River at English Point
August 3 to September 1, 2011**

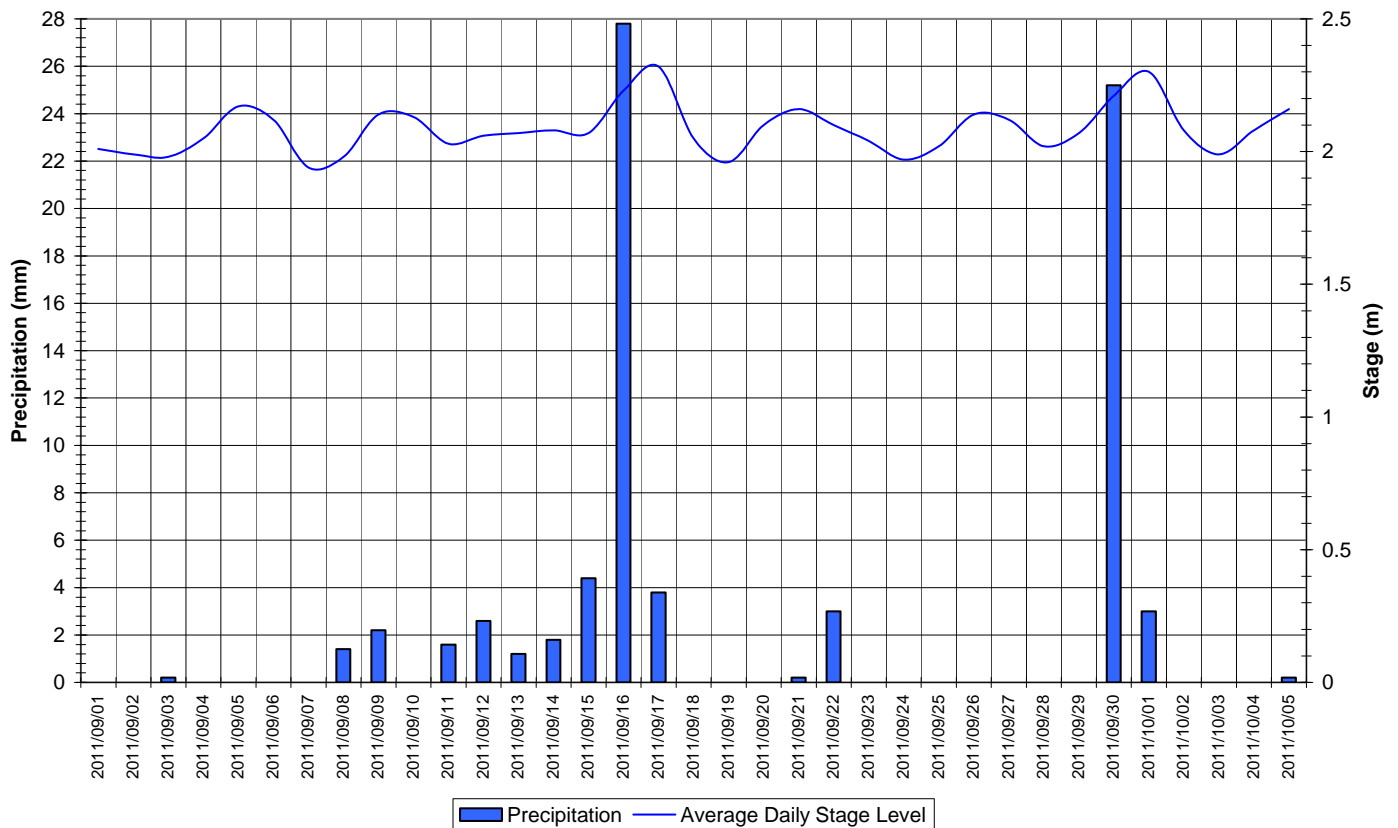


Figure 7: Stage and precipitation at Churchill River at English Point

Lake Melville East of Little River

- No instrument was deployed at this station for the month of September. Upon removal of the instrument deployed on August 3, the protective casing that protects the instrument had been lost. The instrument was heavily damaged by rocky bottom at the lake shore station. No replacement instrument was deployed.



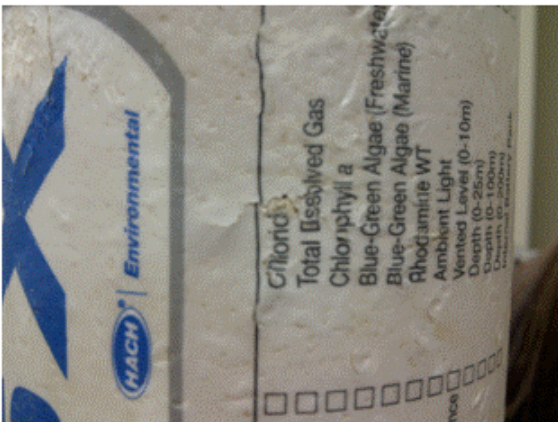
Protective casing for instrument



Instrument upon removal without protective casing



High surf conditions on at Lake Melville east of Little River on September 2, 2011



Damage resulting after instrument casing was lost. Hydrolab casing was cracked and dented potentially compromising future use.

Conclusions

- A water quality monitoring instrument at the station on the Lower Churchill River at English Point was deployed on September 1 and removed on October 5, a period of 35 days. No instrument was deployed during this time at the station on Lake Melville east of Little River.
- 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 two stations augment the data collected from the existing stations on the Lower Churchill River.
- At Churchill River at English Point, in most cases, weather related events or increase/decreases in water level could be used to explain the fluctuations. In some cases, the cause of the disturbance remains unknown. Water temperature was decreasing throughout the period while dissolved oxygen was generally increasing. Specific conductivity fluctuated regularly with changes in stage level and is highly influenced by the tides in the Atlantic Ocean. pH increases near the beginning of the deployment period and may have been subject to sensor drift during the latter half of the deployment when values were decreasing. Turbidity fluctuated throughout the deployment period. Stage and precipitation also varied.
- Most values recorded were within ranges as suggested by the CCME Guidelines for the Protection of Aquatic Life for pH and dissolved oxygen.
- At the station on Lake Melville at Little River, no instrument was deployed on September 2 due to the loss of the protective casing in high surf conditions. The instrument removed on September 2 was heavily damaged.

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Appendix 1

Average Daily Air Temperature and Daily Precipitation: Happy Valley Goose Bay, NL
September 1 to October 5, 2011

