Real-Time Water Quality Deployment Report

Rattling Brook Network

August 13, 2010 to September 15, 2010

Government of Newfoundland & Labrador
Department of Environment and Conservation
Water Resources Management Division
St. John's, NL, A1B 4J6 Canada

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General

- Department of Environment and Conservation staff monitors the real-time web pages consistently.
- This monthly deployment period illustrates and discusses water quality related events from August 13th, 2010 to September 15th, 2010; a period of 32 days.
- On July 29th, 2010 an emergency maintenance trip was made to Long Harbour to replace the malfunctioning Hydrolab at Rattling Brook below Bridge. S/n 43679 was kept at this station from August 13th to September 15th while S/n 44604 was being repaired.

Maintenance and Calibration of Instrument

- 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.
  - Upon deployment, a QA/QC Sonde is temporarily deployed along side the Field Sonde. Values for temperature and dissolved oxygen are compared between the two instruments. A grab sample is taken to compare with the Field Sonde for specific conductivity, pH and turbidity parameters. Based on the degree of difference between parameters recorded by the Field Sonde, QAQC Sonde and grab sample a qualitative statement is made on the data quality in Table 1 upon Deployment.
  - At the end of a deployment period, readings are taken in the water body from the Field Sonde before and after a thorough cleaning in order to assess the degree of biofouling. During calibration in the laboratory, an assessment of calibration drift is made and the two error values are combined to give Total Error (T_e). If T_e exceeds a predetermined data correction criterion, a correction based on T_e is applied to the dataset using linear interpolation. Based on the value for T_e, a qualitative statement is also made on the data quality in Table 1 upon Removal.

Station	Date	Action	Comparison Ranking				
			Temperature	pH	Conductivity	Dissolved Oxygen	Turbidity
Rattling Brook Big Pond	August 13, 2010	Deployment	Excellent	Poor	Fair	Excellent	Excellent
	September 15, 2010	Removal	Excellent	Excellent	Excellent	Excellent	Excellent
Rattling Brook below Bridge	August 13, 2010	Deployment	Good	Good	Excellent	Excellent	Excellent
	September 15, 2010	Removal	Poor	Excellent	Excellent	Excellent	Excellent
Rattling Brook below Plant Discharge	August 13, 2010	Deployment	Excellent	Excellent	Good	Good	Excellent
	September 15, 2010	Removal	Excellent	Excellent	Excellent	Excellent	Excellent

- Note: On August 13th during the deployment of s/n 47904 at Rattling Brook Big Pond, the pH sensor was ranked as "Poor" in comparison to the grab sample taken. The Hydrolab pH was recorded as 6.27 while the grab sample indicated 7.33, a difference of 1.06 pH units. This difference may be due to insufficient time for the Hydrolab to equilibrate to its surroundings.

- Note: On September 15th during the removal of s/n 43679 from Rattling Brook below Bridge, the temperature sensor on the QAQC sonde recorded 16.57°C before field cleaning and 15.61°C after field cleaning while the temperature recorded by the Field sonde changed by only 0.09°C. Such a drastic change in the QAQC sonde temperature appears anomalous, however it is retained since there is no solid evidence to merit disqualification of the resulting temperature correction.

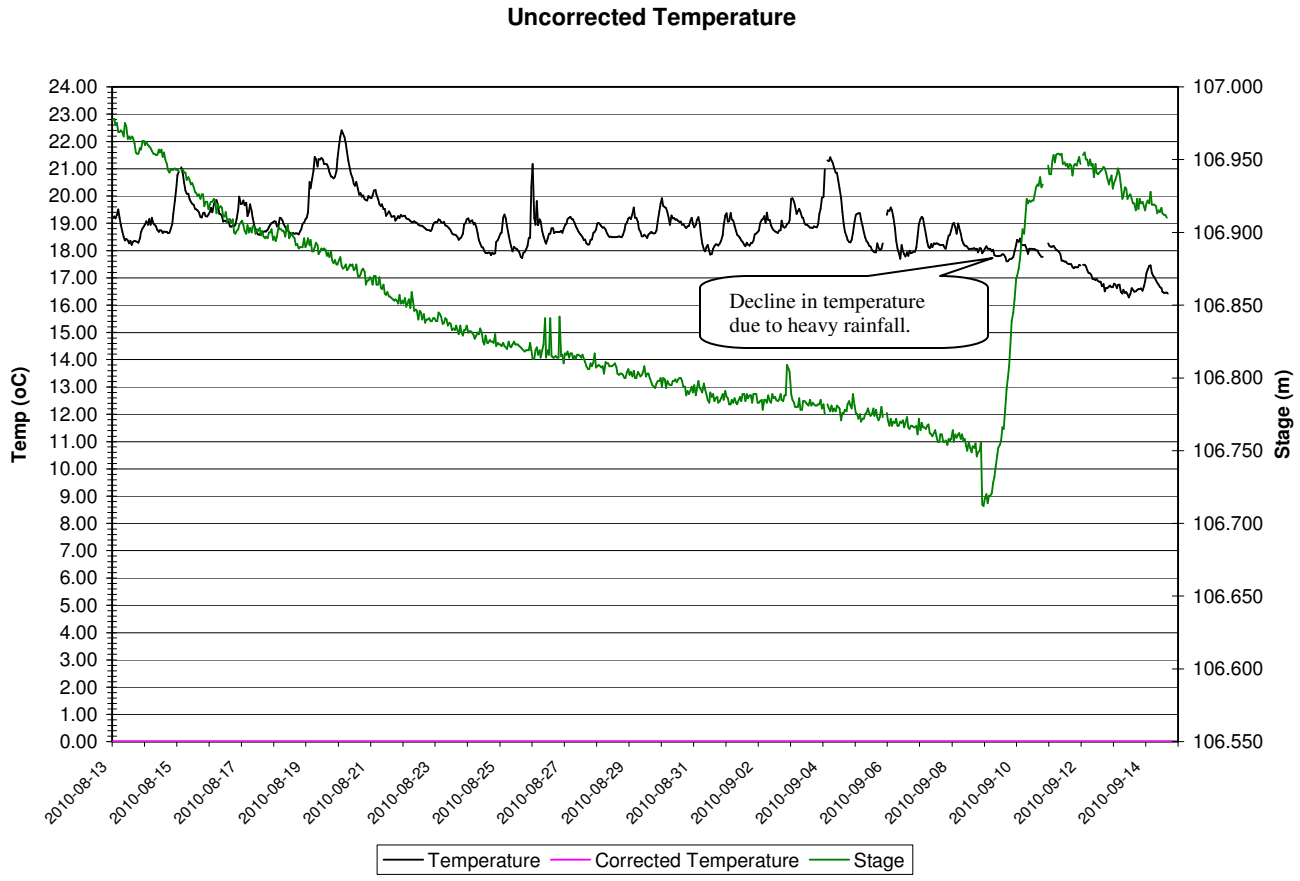
Data Interpretation

- The following graphs and discussion illustrate significant water quality-related events in the Rattling Brook Network.

Rattling Brook Big Pond

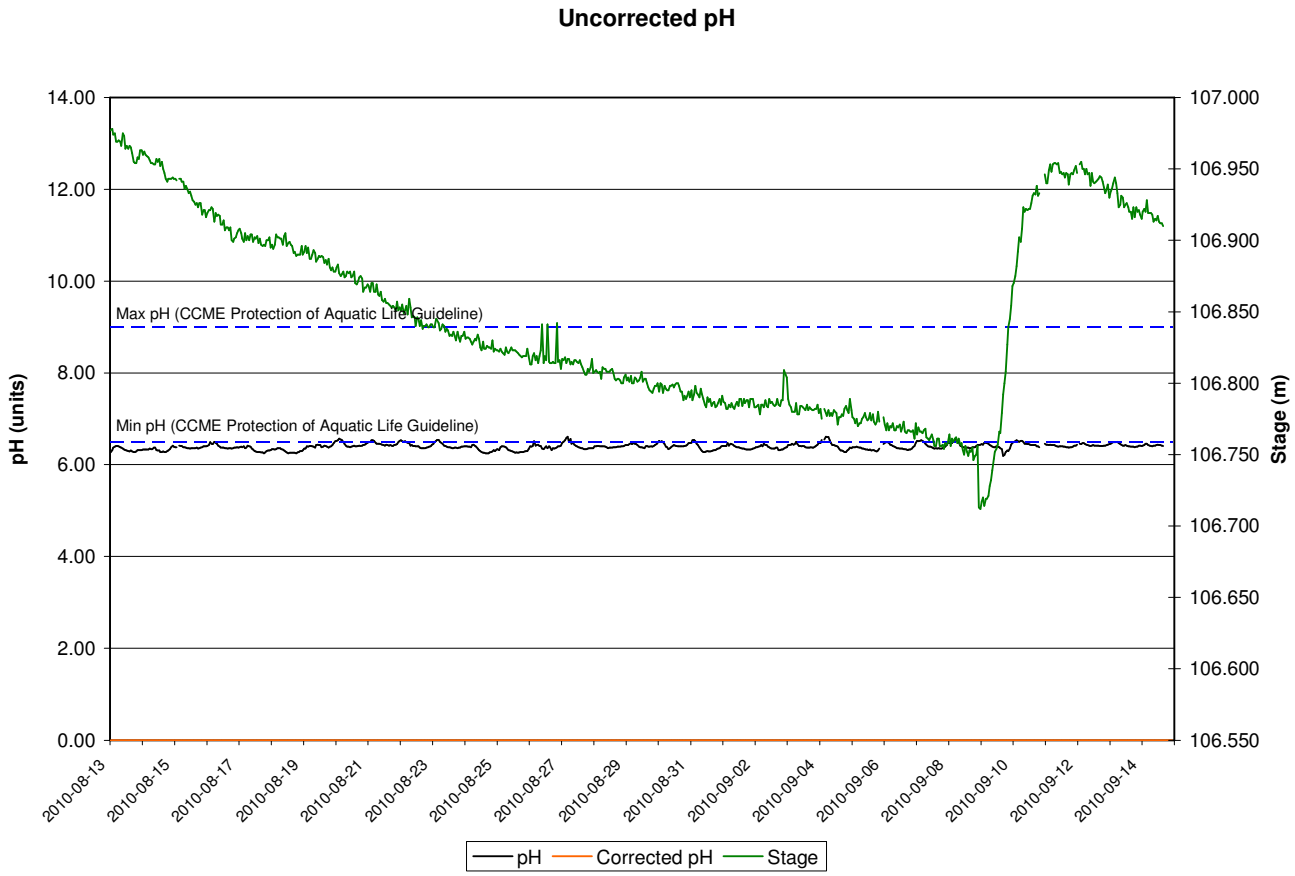
- No correction was made to water temperature at this station.
- Water temperature ranged from 22.4 to 16.28°C during this deployment period.
- A downward trend in temperature is observed towards the end of the deployment, especially following the large rise in stage level occurring on September 9th that resulted from 51.9 mm of precipitation.

Figure 1: Water temperature at Rattling Brook Big Pond



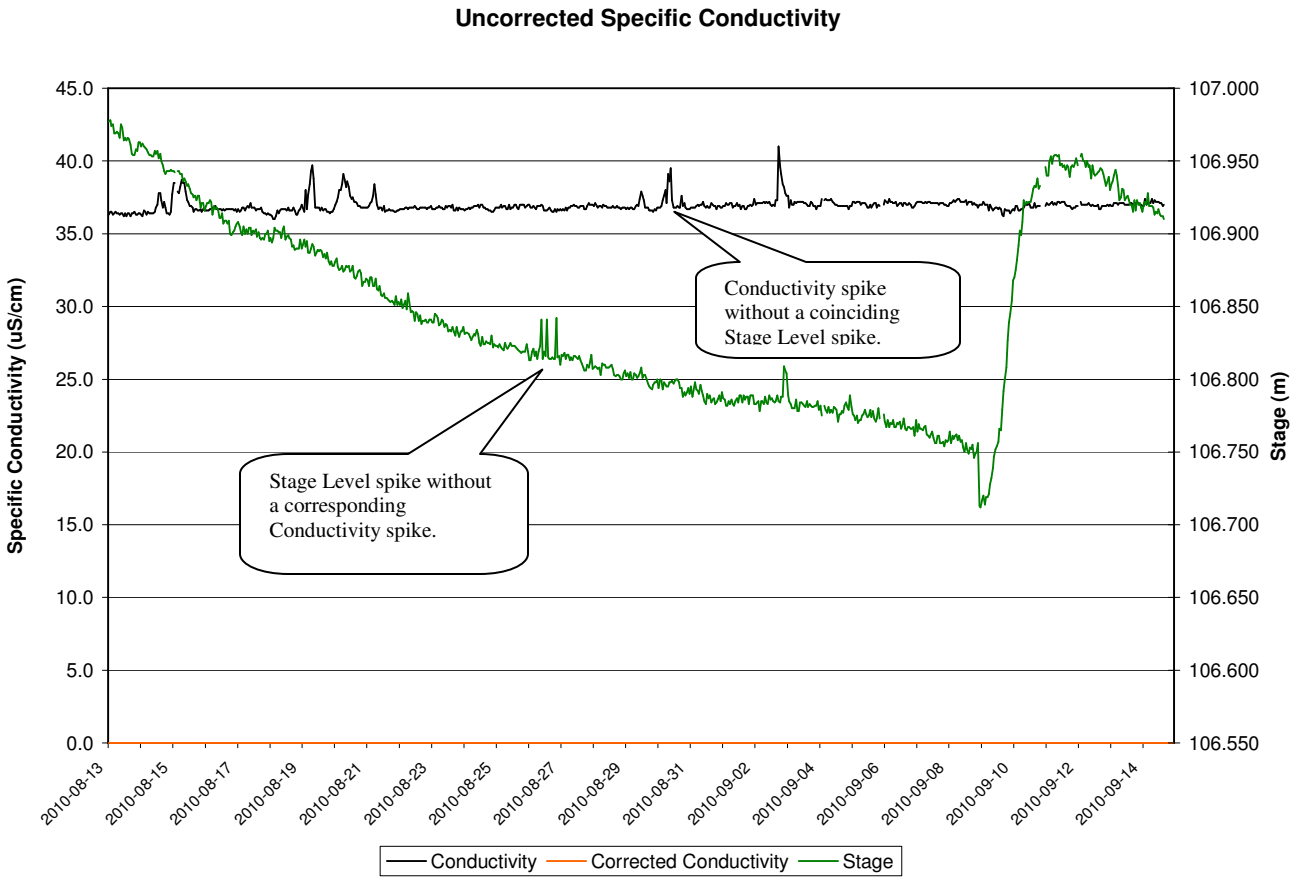
- pH was not corrected at this station due to a lack of significant biofouling or calibration drift; total error did not exceed the data correction criterion.
- A trend was not recognized in this data. pH appears to be resistant to fluctuation even during the heavy rainfall on September 9th. Values ranged from 6.19 to 6.61 with a median of 6.39, indicating that most recordings are below the CCME Guideline of 6.5 for the Protection of Aquatic Life.

Figure 2: pH at Rattling Brook Big Pond



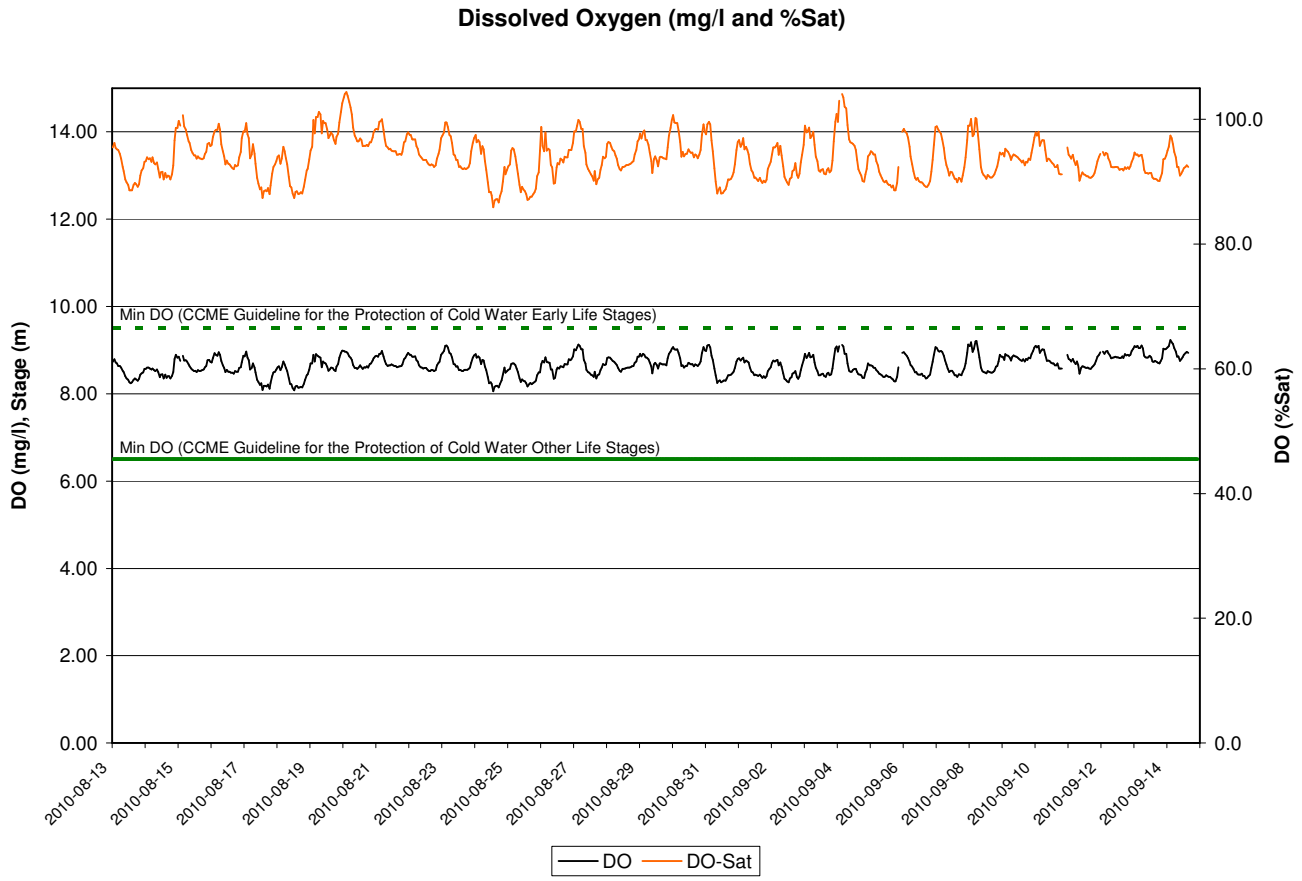
- No correction to specific conductivity was required since the total error did not exceed the data correction criterion.
- Specific conductivity ranged from 36.0 to 41.0 µS/cm with a median of 36.9 µS/cm for this deployment. Variation in conductivity is erratic and does not always appear to fluctuate with precipitation. In the figure below, there are incidents where conductivity and stage level spikes occur in conjunction as well as conductivity and stage level spikes that do not appear to relate to one another.

Figure 3: Specific conductivity at Rattling Brook Big Pond



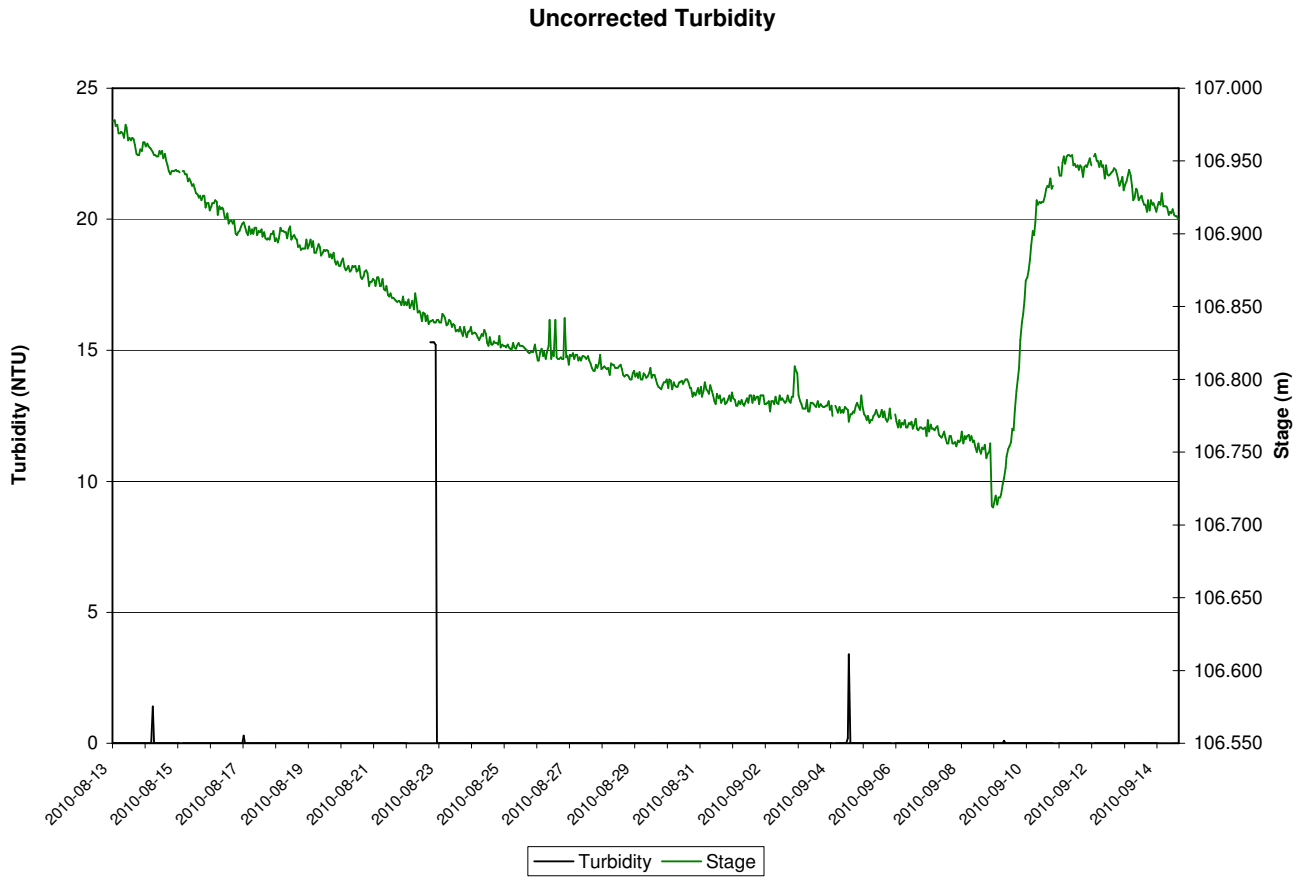
- A correction was not applied to dissolved oxygen since the total error was calculated to be 1%. The data presented below is raw.
- The saturation of dissolved oxygen ranged from 104.8 to 85.9% with a median of 93.7%.
- A range of 8.06 to 9.23 mg/l was found in the concentration of dissolved oxygen with a median value of 8.65 mg/l. This indicates that all values were above the CCME Guideline for the Protection of Other Life Stage Cold Water Biota of 6.5 mg/l but all values were below the CCME Guideline for the Protection of Early Life Stage Cold Water Biota value of 9.5 mg/l.
- No significant events occurred during this deployment that would indicate any serious problems.

Figure 4: Dissolved Oxygen at Rattling Brook Big Pond



- No correction was applied to the turbidity record for this month since the total error was not sufficient for a correction.
- A range of 0.0 to 15.3 NTU was recorded for turbidity for this deployment period. A median value of 0.0 NTU indicates that turbidity for this deployment period was very low with only a few occurrences of short-term turbidity spikes.

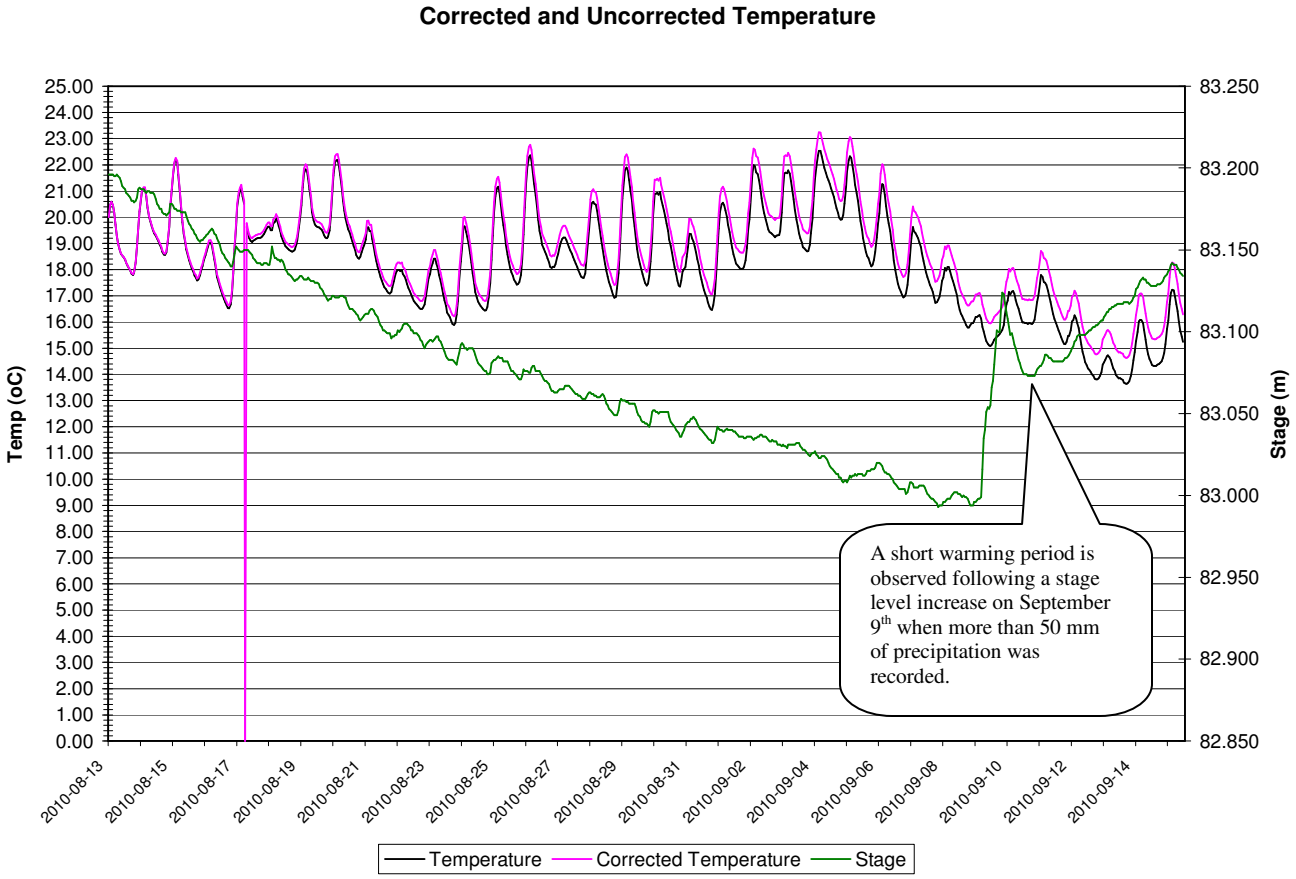
Figure 5: Turbidity at Rattling Brook Big Pond



Rattling Brook below Bridge

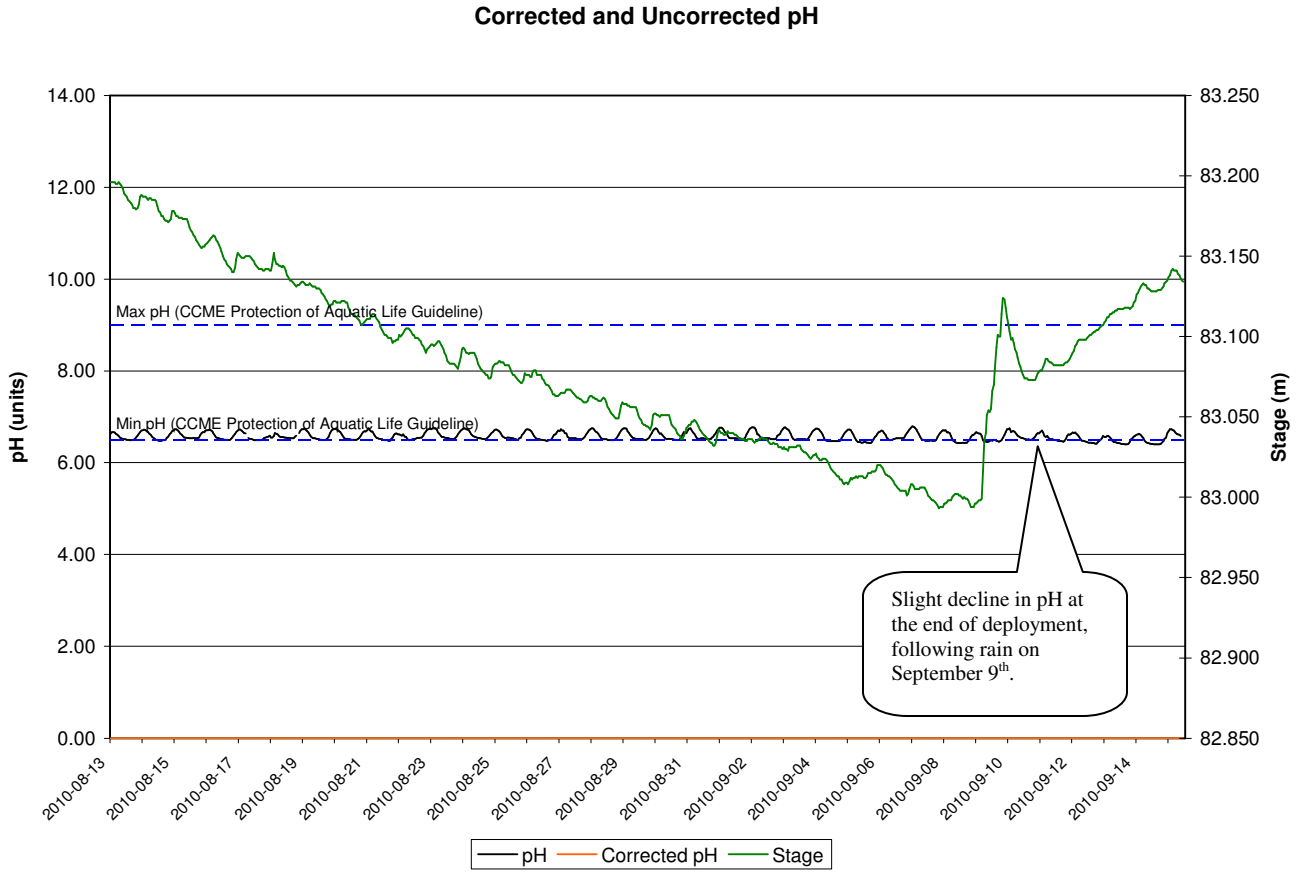
- A correction of 1.05°C was applied to water temperature during this deployment. This correction may not necessarily be warranted since the QAQC sonde used during removal indicated a change in temperature of 0.96°C over a period of less than five minutes. This is considered unusual for Rattling Brook.
- Corrected water temperature for this deployment ranged from 23.23 to 14.63°C with a notable downward trend beginning in early September. This trend is likely to continue its decline into the annual low of winter.

Figure 6: Water temperature at Rattling Brook below Bridge



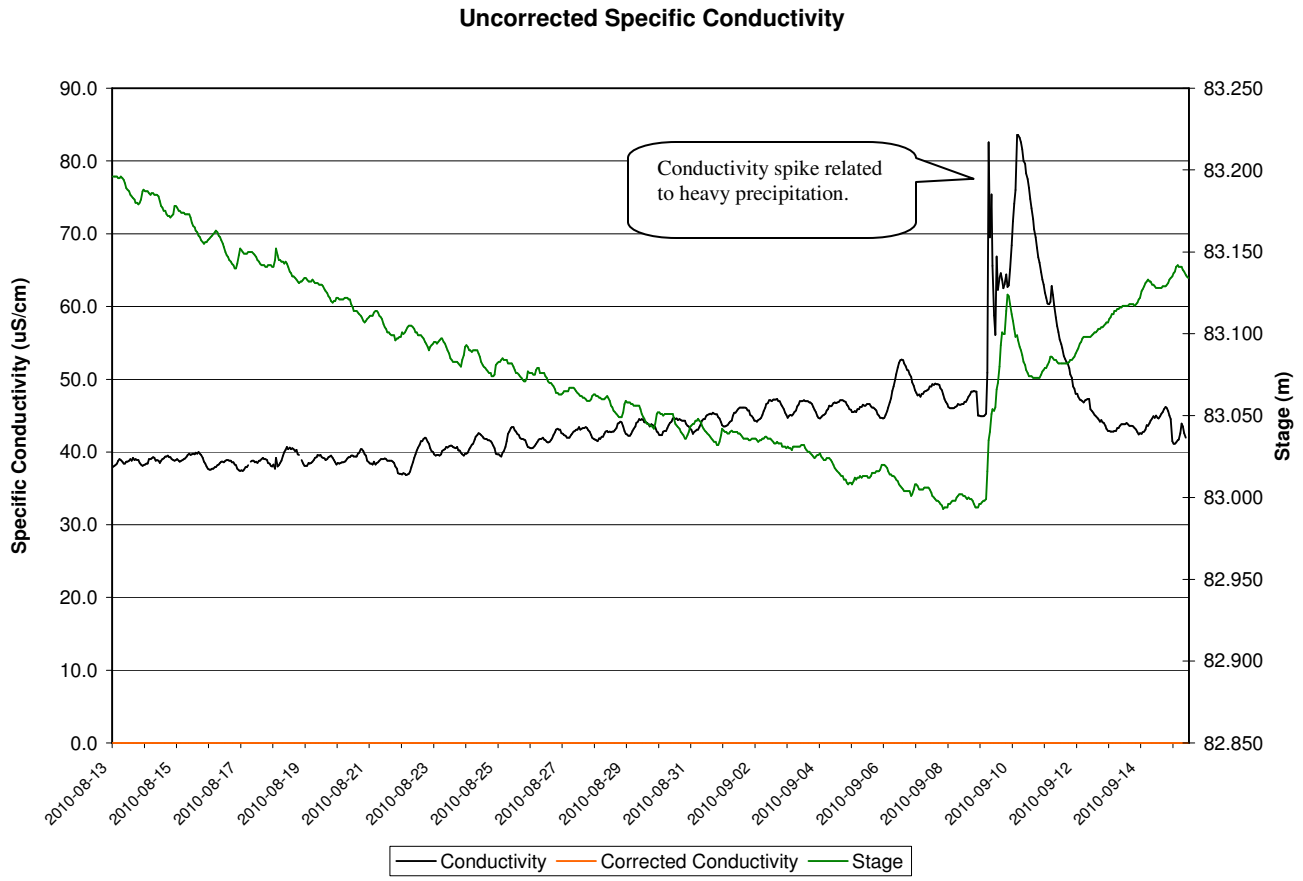
- pH showed a very narrow range for the deployment period of interest and no correction was deemed necessary.
- pH ranged from 6.79 to 6.40 with a median value of 6.55, indicating that more than 50% of values were greater than the CCME Guideline value of 6.5 for the Protection of Aquatic Life. A marginal decline is observed near the end of deployment, possibly in relation to the acidifying effect of heavy rainfall on September 9th.

Figure 7: pH at Rattling Brook below Bridge



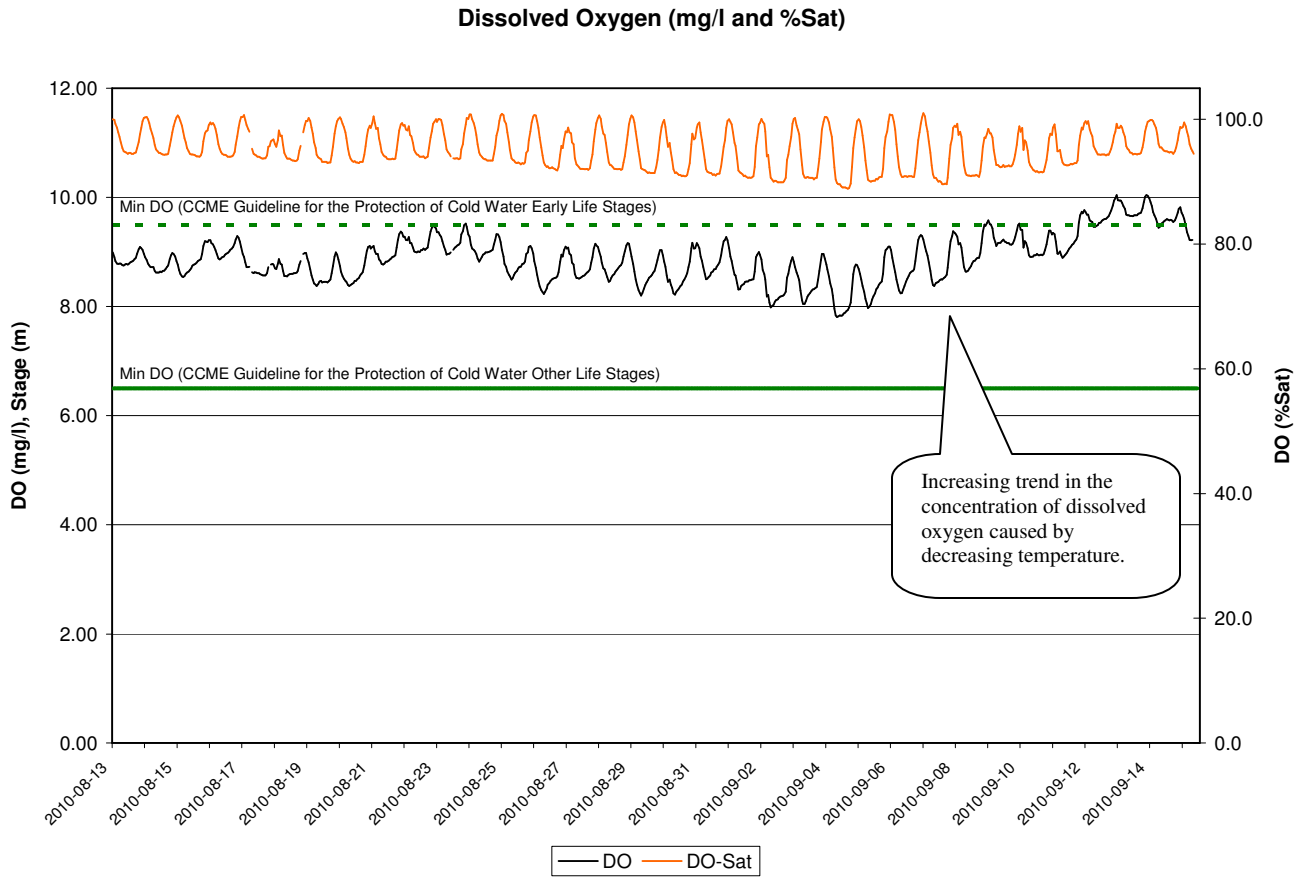
- No correction was applied to conductivity for this deployment and the data presented in the figure below are raw values.
- A steady increase in conductivity occurs throughout the deployment period as the stage level descends. On September 9th, a large fluctuation in conductivity is preceded by a decline in conductivity as stage level once again begins to rise.
- Conductivity ranged from 36.8 to 52.7 µS/cm prior to the heavy rainfall at which point conductivity rose to 83.6 µS/cm.

Figure 8: Specific conductivity at Rattling Brook below Bridge



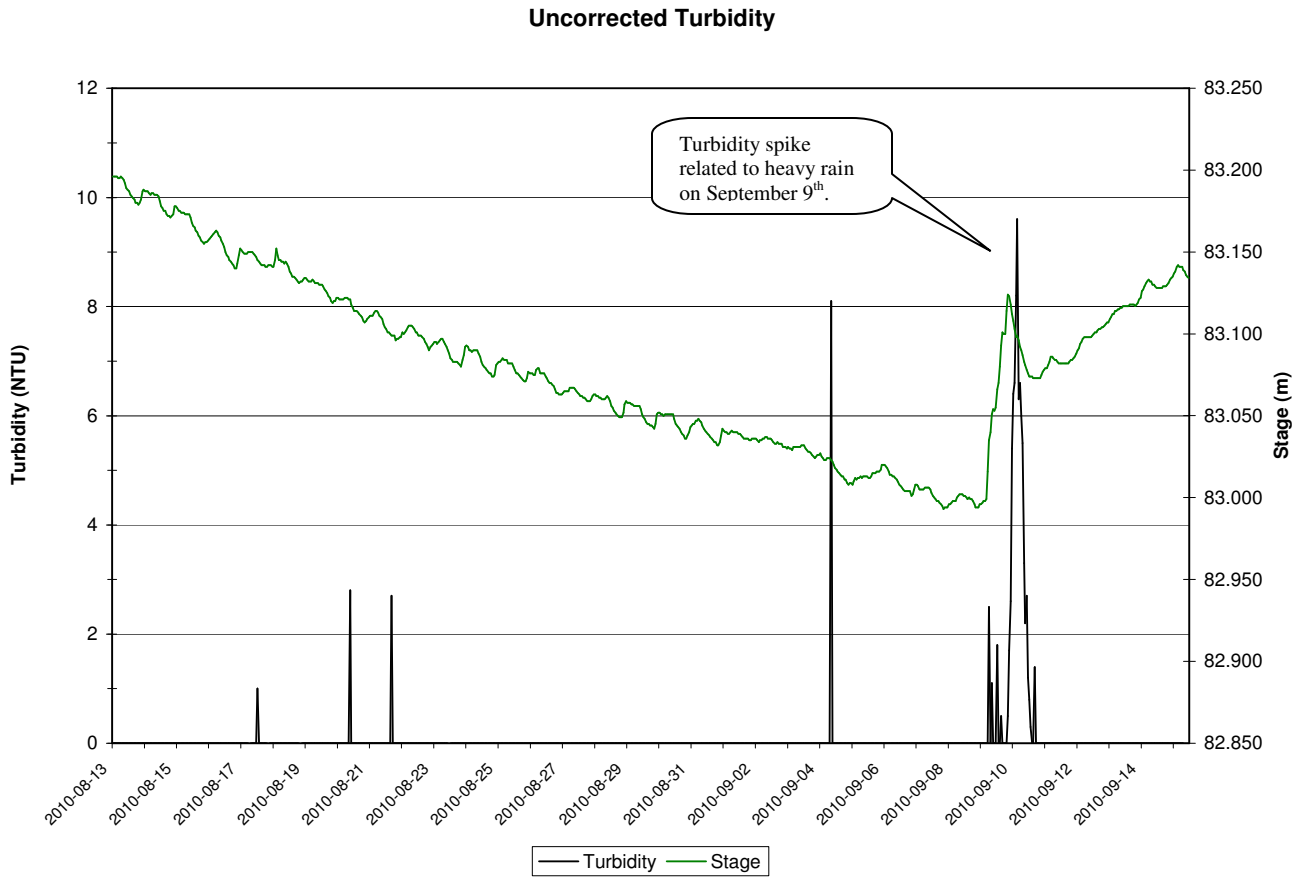
- The saturation of dissolved oxygen ranged from 89.1 to 101.2% for this deployment reaching the low point at 12:30 am on September 5th during a relatively warm day with a mean temperature of ~20^{o}C. This warm temperature may have resulted in a surge of oxidative respiration by aquatic biota causing a drop in available oxygen.
- The concentration varied from 10.04 to 7.81 mg/l reaching the low point on September 4th at 8:30 pm. This is the result of warm water temperatures at this point in time with the deployment high at this station occurring only five hours previously.
- At the beginning of deployment oxygen concentrations were found to be below the CCME Guideline for the protection of Early Life Stage cold water biota but above the guideline for the protection of Other Life Stage cold water biota. At the end of deployment, the decrease in water temperature appears to allow the dissolved oxygen to climb above both CCME guidelines.

Figure 9: Dissolved oxygen at Rattling Brook below Bridge



- Turbidity at Rattling Brook below Bridge station was low-grade for the entirety of this deployment with a range of 0.0 to 9.6 NTU and a median of 0.0 NTU.
- Due to the small size of the turbidity spikes recorded during this deployment, it is difficult to associate them with any significant rainfall. Spikes of such small magnitude can occur spontaneously and can be associated with numerous events from random chance to animals crossing the river. The spike such as the one indicated below, however, is clearly related to the 51.9 mm of precipitation that fell on September 9th.

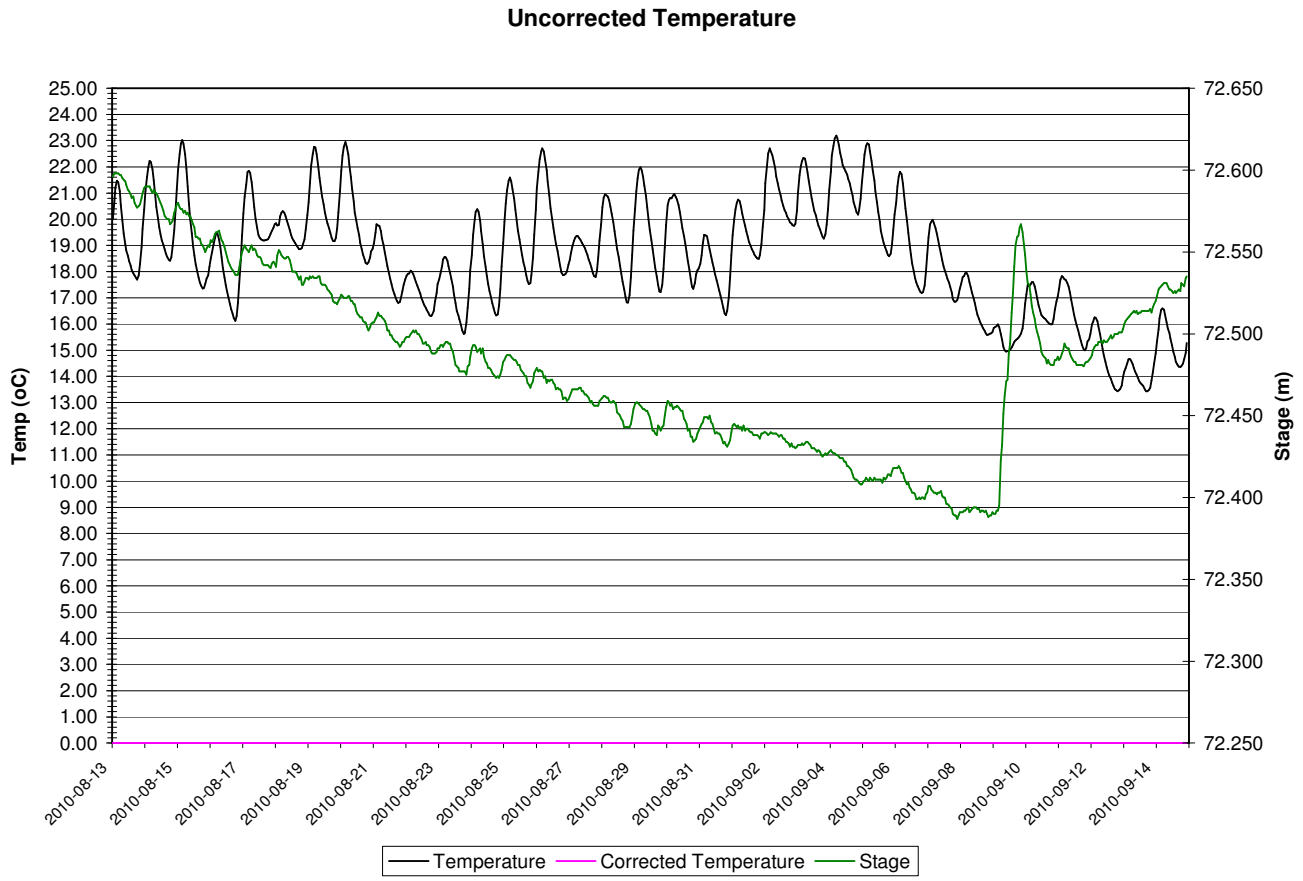
Figure 10: Turbidity at Rattling Brook below Bridge



Rattling Brook below Plant Discharge

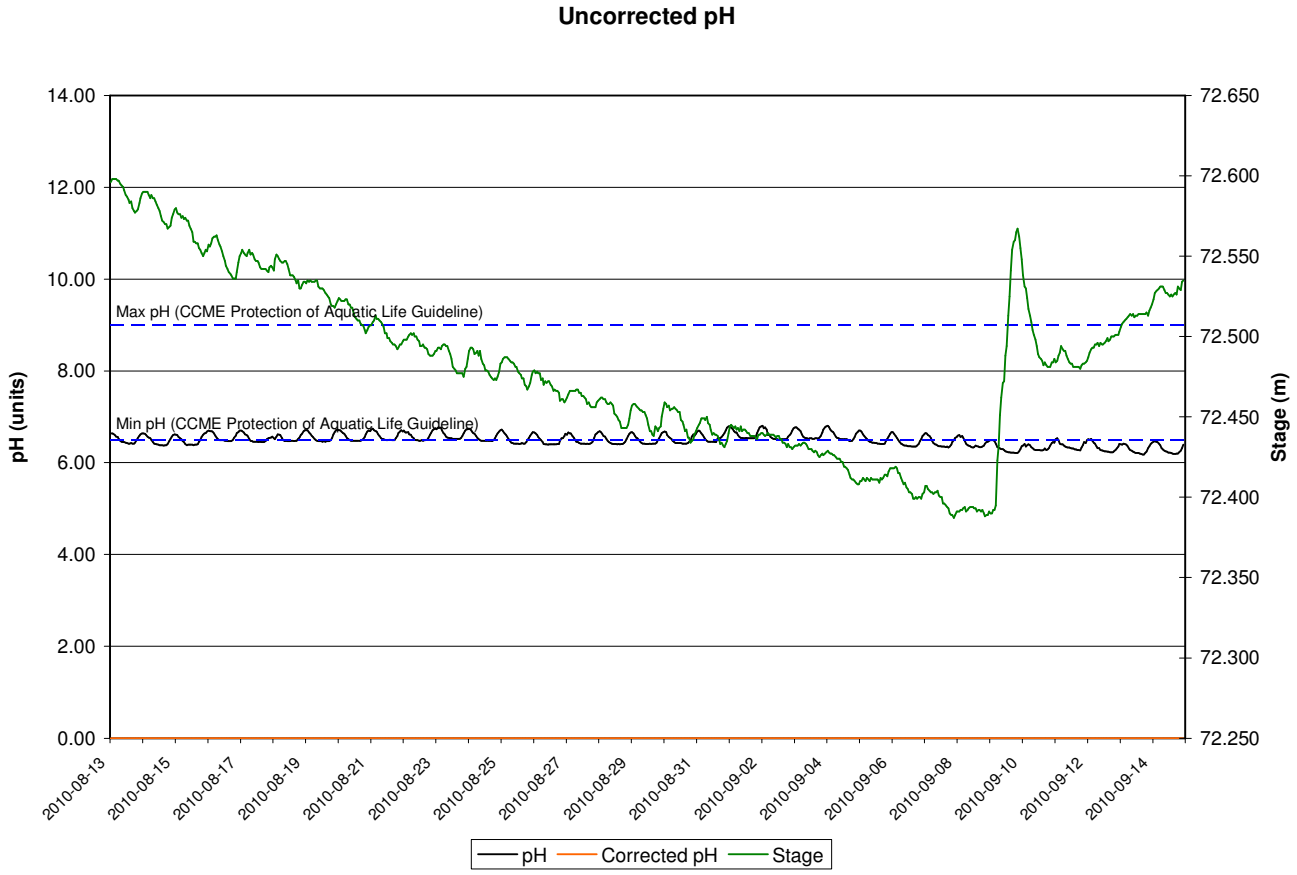
- The observed water temperature at Rattling Brook below Plant Discharge declines towards the end of the deployment period as a result of cooler air temperatures at the onset of fall. Temperature ranged from 23.19 to 13.43°C with a median value of 18.63°C.

Figure 11: Water temperature at Rattling Brook below Plant Discharge



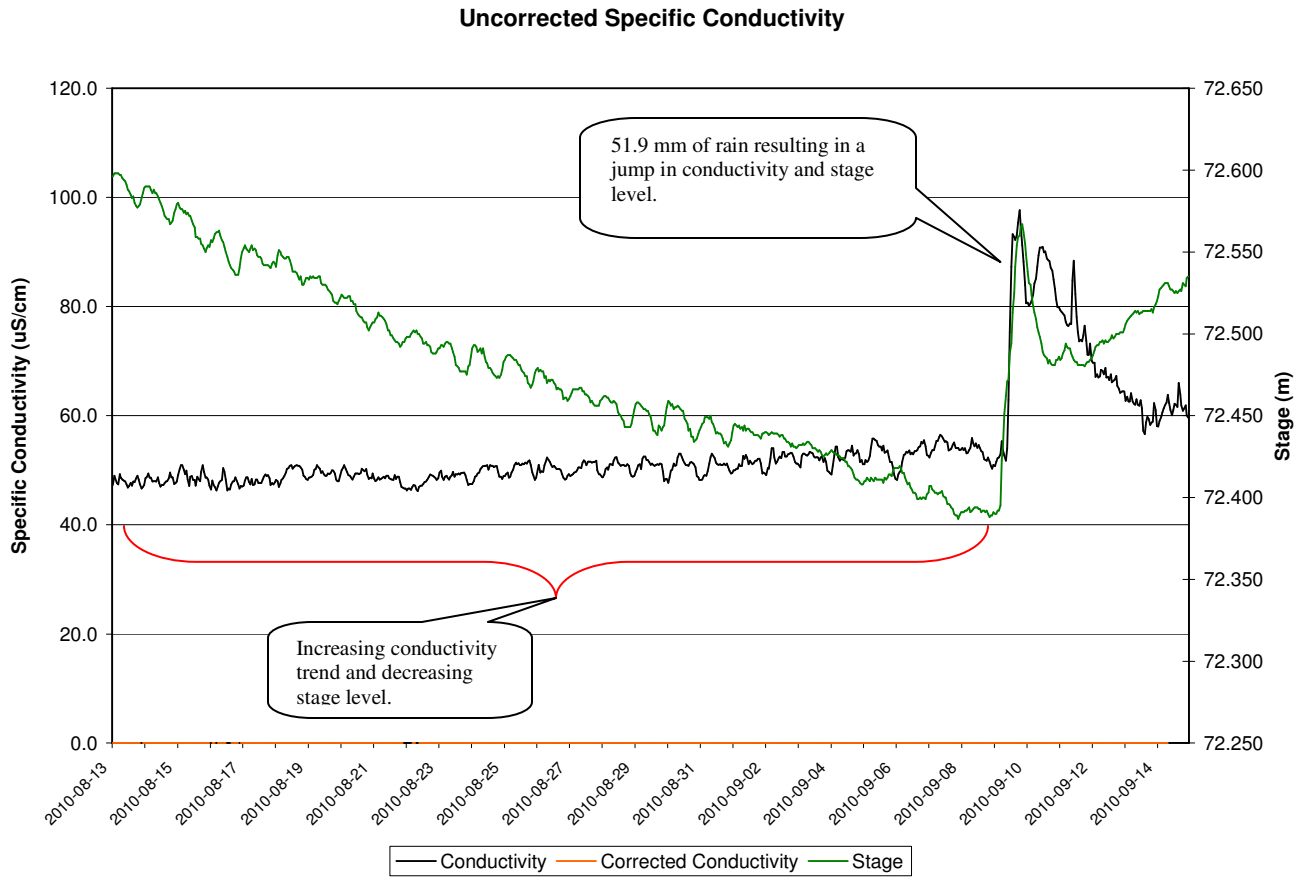
- A correction was not deemed necessary for pH since Total Error did not exceed the correction criterion.
- pH ranged from 6.18 to 6.80 for this deployment period with a median value of 6.49. At least 50% of recorded pH values for this deployment were below the CCME Guideline for the Protection of Aquatic Life. This is expected in the Rattling Brook system and no concern is warranted.
- A decline in pH in conjunction with a rapid rise in stage level is observed following heavy precipitation on September 9th as indicated in the figure below. Despite this decline, no major fluctuations are noticed in pH for this station.

Figure 12: pH at Rattling Brook below Plant Discharge



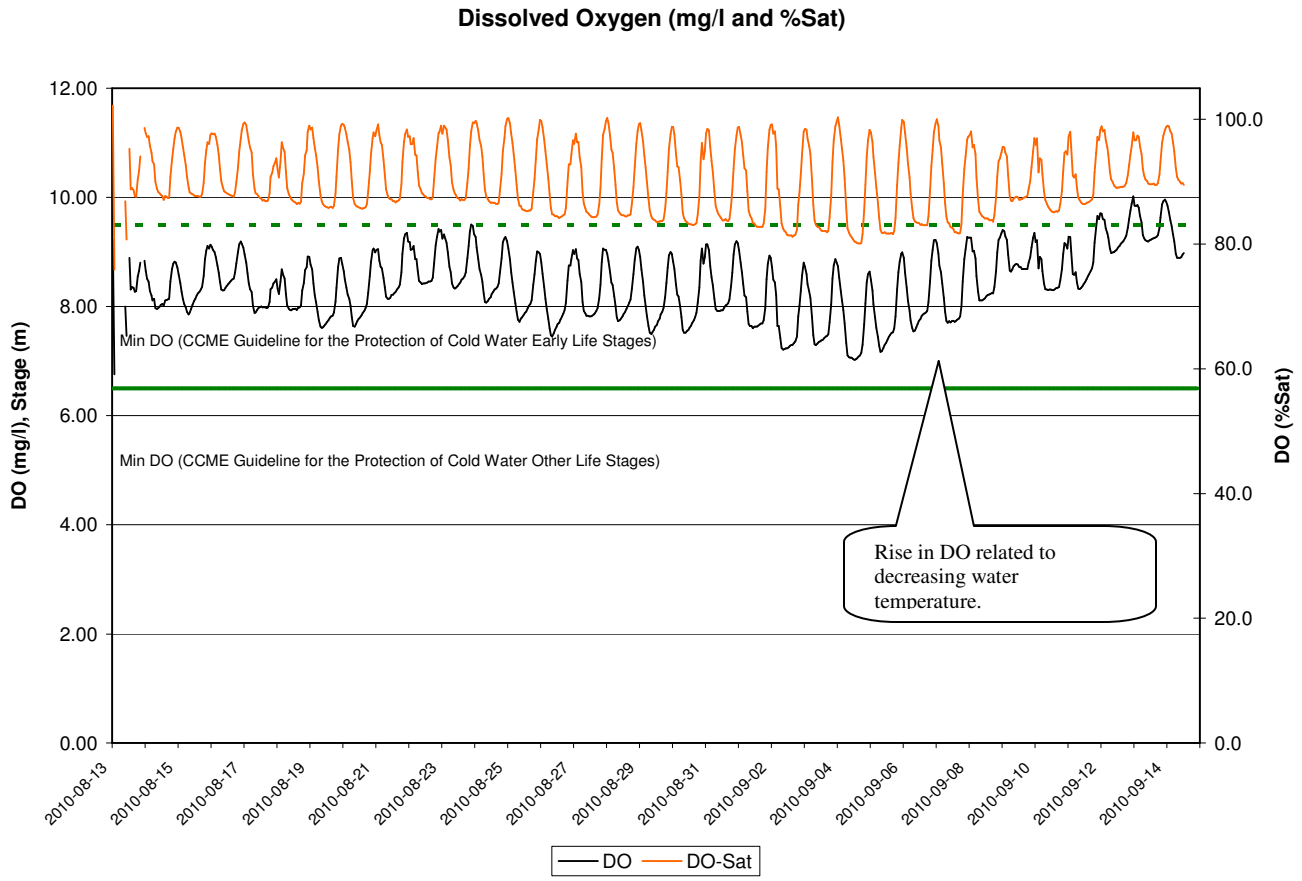
- No correction was applied to conductivity during this deployment and raw values are presented below.
- A general increase in specific conductivity was observed as stage level approached baseline and stream flow became more concentrated in ions. A subsequent jump in stage level related to precipitation on September 9th caused a surge in charged ions entering the channel resulting in a conductivity spike.
- Specific conductivity ranged from 46.2 to 97.7 µS/cm during the height of the stage level increase. Following the heavy rainfall, conductivity values began to fall towards expected values

Figure 13: Specific Conductivity at Rattling Brook below Plant Discharge



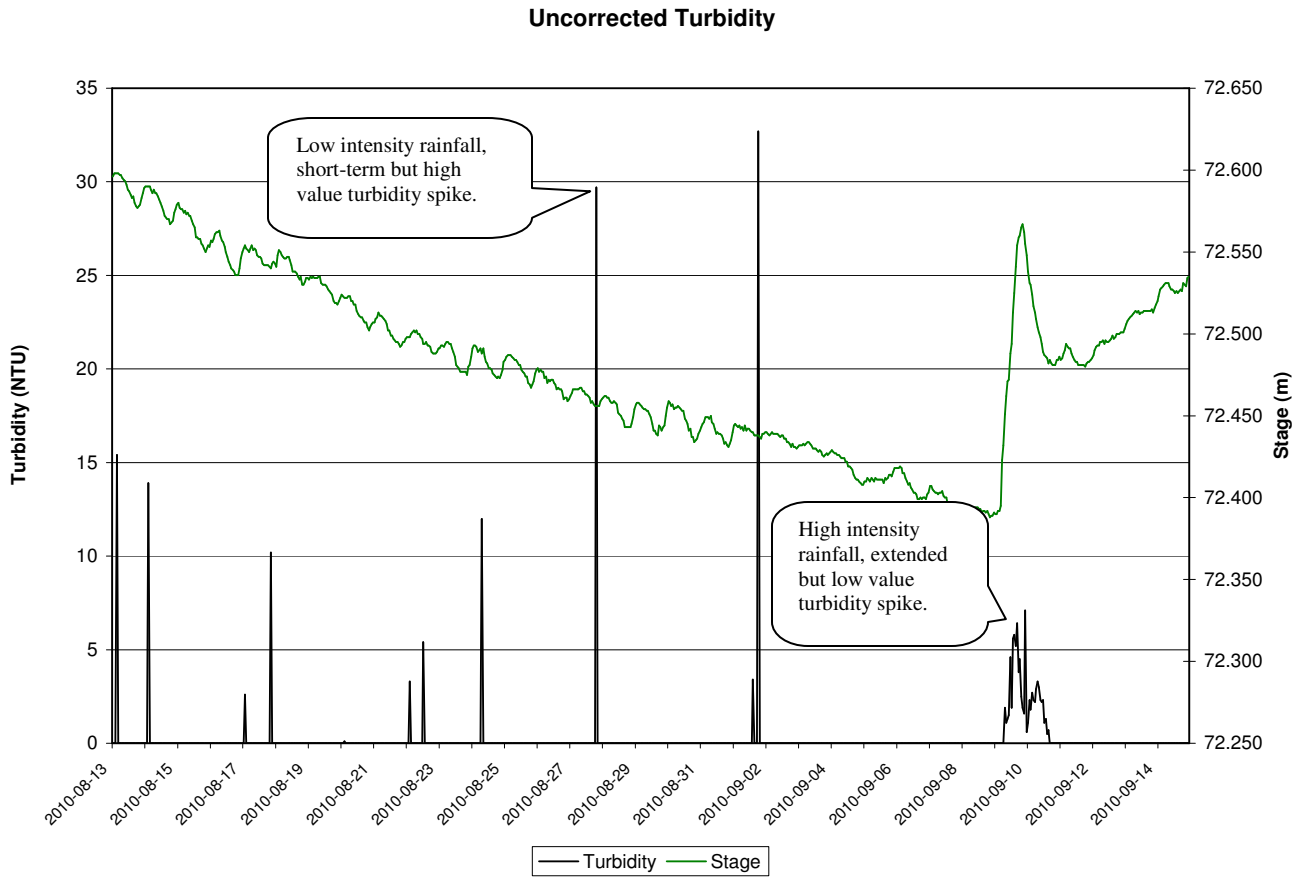
- No correction was made to dissolved oxygen for the deployment period. Raw data is presented below.
- Saturation ranged from 80.1 to 102.2% with the low point occurring on September 5th at 4:30am. This low point occurred during a period of warm overnight air temperatures. Warm air temperature results in an increase in oxidative respiration causing a net reduction in dissolved oxygen content, especially at night when there is no photosynthesis to balance consumption.
- Dissolved oxygen concentration ranged from 7.02 to 10.02 mg/l with a median value of 8.37 mg/l which places more than 50% of values below the 9.5 mg/l DO CCME Guideline for the Protection of Early Life Stage cold water biota but 100% of values above the CCME Guideline for the Protection of Other Life Stage cold water biota.
- A steady rise in DO concentration is observed near the end of the deployment period, mirroring the decrease in water temperature.

Figure 14: Dissolved Oxygen at Rattling Brook below Plant Discharge



- No correction is applied to turbidity data and the raw values are reported in the figure below.
- Most turbidity events for this deployment period at Rattling Brook below Plant Discharge station are of very short duration and correspond with precipitation events. The range in turbidity is 0.0 to 32.7 NTU with a median value of 0.0 NTU.
- The maximum value attained by a turbidity spike does not necessarily reflect the intensity of a precipitation event, but the duration of a turbidity spike is a more likely indicator of the intensity of precipitation. If precipitation events depicted in the Appendix are compared to the Turbidity figure below, it appears that small precipitation events often result in very short-duration, high intensity spike whereas larger rainfalls result in longer duration spikes of low maximum value. In this case, the spike related to rain on September 9th lasted 33 hours but peaked at 7.1 NTU. The reasoning behind this may be due to the volume of water running through Rattling Brook in small versus large rainfalls.
    - A small rainfall may result in the washing of loose silt from streambanks and adjacent roadways into the river which clears soon after the precipitation begins. A large rainfall, however, will wash debris into the river in a similar fashion, but dilutes the material in the high volume of water. High flow then re-suspends deposited sediments in a prolonged plume that remains until flow recedes to normal values.

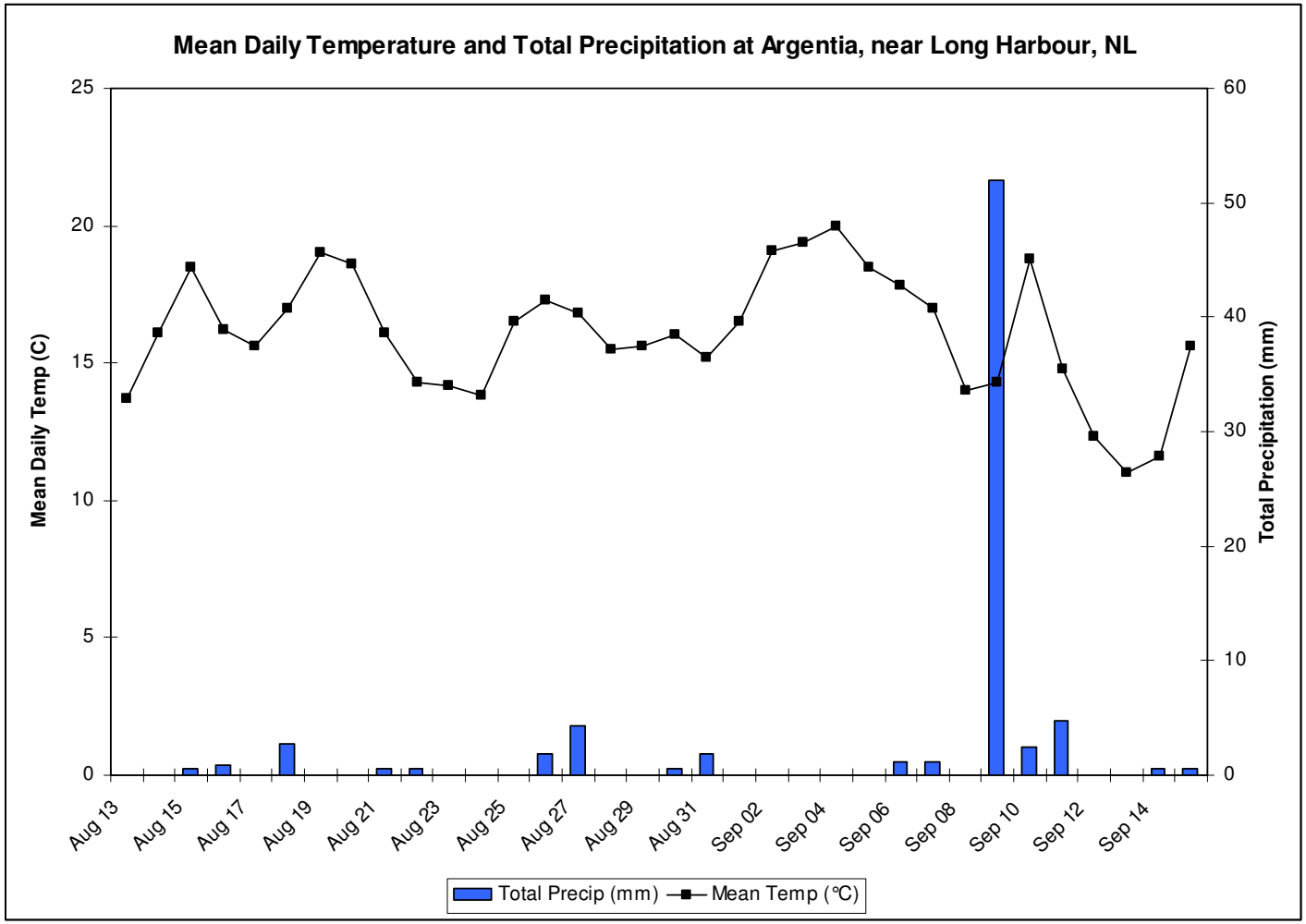
Figure 15: Turbidity at Rattling Brook below Plant Discharge



Conclusions

- S/n43679 was in place for S/n 44604 at Rattling Brook below Bridge while the latter was in Alberta for repair.
- All water quality parameters appear to be within ranges expected given the weather events recorded at Long Harbour during this deployment period.

Appendix



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