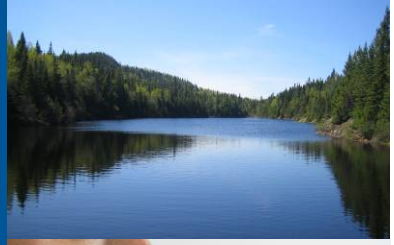
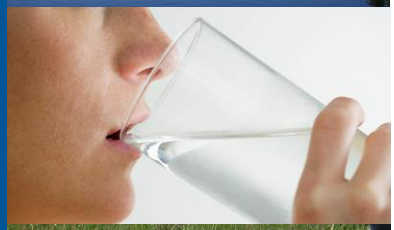



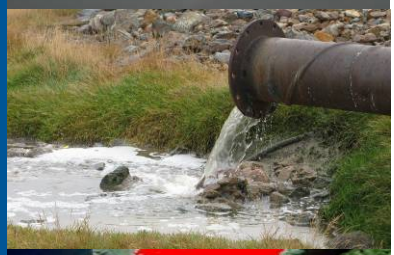


Real Time Water Quality Report
Teck Duck Pond Operations

Deployment Period 2012-08-07 to 2012-10-01

2012-10-05

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

General

- Water Resources Management Division (WRMD) staff monitors the real-time web page on a daily basis. Any unusual observations are investigated, with site visits being carried out as warranted.
- Management at Teck Duck Pond Operations are informed of any significant water quality events or instrumentation problems by WRMD.
- There was planned discharge of effluent from Polishing Pond into the receiving waters (Tributary to Gills Pond Brook) for most of the deployment period, with brief periods without discharge from August 7, 2012 to August 14, 2012 and August 27, 2012 to August 30, 2012.

Maintenance and Calibration of Instrumentation

- After being cleaned and freshly calibrated the new **DataSondes®**(s/n 62268) for Tributary to Gills Pond Brook and (s/n 62267) for East Pond Brook were installed on August 8, 2012, and remained deployed continuously until October 1, 2012, a 53 day period.
- The regular **MiniSonde®** (s/n 47591) was used for QA/QC purposes during the installation and removal of the instruments. It too, was cleaned and freshly calibrated prior to each use.
- The regular **Quanta G®** (s/n 00035) was deployed on July 4, 2012. This unit was calibrated prior to its deployment, and remained deployed continuously in Monitoring Well After Tailings Dam Station (MW1) until it was removed for pre-winter servicing and calibration on October 1, 2012. The reporting period for this instrument is from August 7, 2012 to October 1, 2012; a 54 day period.

Quality Assurance / Quality Control (QA/QC) Measures

- As part of the QA/QC protocol, 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. See **Table 1**.

	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

Table 1

- For the Surface Water Stations, upon deployment and removal, a QA/QC **MiniSonde®** is temporarily deployed along side the Field **DataSonde®**. Values for each recorded parameter are compared between the two instruments. Based upon the difference between the parameters recorded by the Field **DataSonde®** and QA/QC **MiniSonde®** a qualitative statement (Ranking) is usually made on the data.

- The ranking at the beginning and end of the deployment period is shown in **Table 2** for Tributary to Gill's Pond Brook and **Table 3** for East Pond Brook.
- Because the deployment set-up for Well After Tailings Dam (MW1) is different, comparison with another instrument is not possible. In this case, a grab sample is usually collected at the beginning and end of the deployment period, and the ranking is calculated for pH and Specific Conductance based upon live data and laboratory data. The ranking for the beginning of the deployment period is referenced in the previous Deployment Report. Laboratory data are not yet available to calculate the ranking at the end of the deployment period.
- From August 13, 2012 to September 5, 2012 there was some interference (presumably an accumulation of biofilm) with the turbidity sensor at Tributary to Gills Pond. Accordingly, these unreliable data have been removed from the data set.
- There was a loss of transmitted data for the Tributary to Gills Pond Brook site from September 25, 2012 to September 26, 2012. As this period was more than 24 hours, we were able to augment the dataset with data which was internally logged in the instrument.
- Throughout the deployment period at East Pond Brook, DO values were reporting erratically, intermittently due to undetermined sensor issues. These erratic values have been removed from the data set.
- There was a "Poor" ranking for turbidity upon removal of the instrument from Tributary to Gills Pond Brook. The QA/QC instrument read 0.2 NTU, while the deployed instrument read 10.4 NTU. It is likely that the difference was due to an accumulation of biofilm over the deployment period.
- With the exception of water quantity data (Stage and Flow), 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.

Tributary to Gills Pond Brook Station (NF02YO0190)		
Date (yyyy-mm-dd)	**Parameter**	**Ranking**
2012-08-07 Deployment	Temp (^{o}C)	Excellent
	pH (units)	Excellent
	Sp. Conductivity (uS/cm)	Excellent
	Dissolved Oxygen (mg/L)	Excellent
	Turbidity (NTU)	Excellent
2012-10-01 Removal	Temp (^{o}C)	Excellent
	pH (units)	Excellent
	Sp. Conductivity (uS/cm)	Excellent
	Dissolved Oxygen (mg/L)	Excellent
	Turbidity (NTU)	Poor

Table 2

East Pond Brook Station (NF02YO0192)		
Date (yyyy-mm-dd)	**Parameter**	**Ranking**
2012-08-07 Deployment	Temp (^{o}C)	Excellent
	pH (units)	Good
	Sp. Conductivity (uS/cm)	Good
	Dissolved Oxygen (mg/L)	Excellent
	Turbidity (NTU)	Excellent
2012-10-01 Removal	Temp (^{o}C)	Excellent
	pH (units)	Good
	Sp. Conductivity (uS/cm)	Excellent
	Dissolved Oxygen (mg/L)	Excellent
	Turbidity (NTU)	Good

Table 3

Data Interpretation

TRIBUTARY TO GILLS POND BROOK

- The water temperature (**Figure 1**) ranged from a minimum of 9.97 ˚C to a maximum of 26.36 ˚C.
- Temperature tended to decline throughout the deployment period, with the diurnal variation still quite evident.
- There appears to be little correlation with stage.

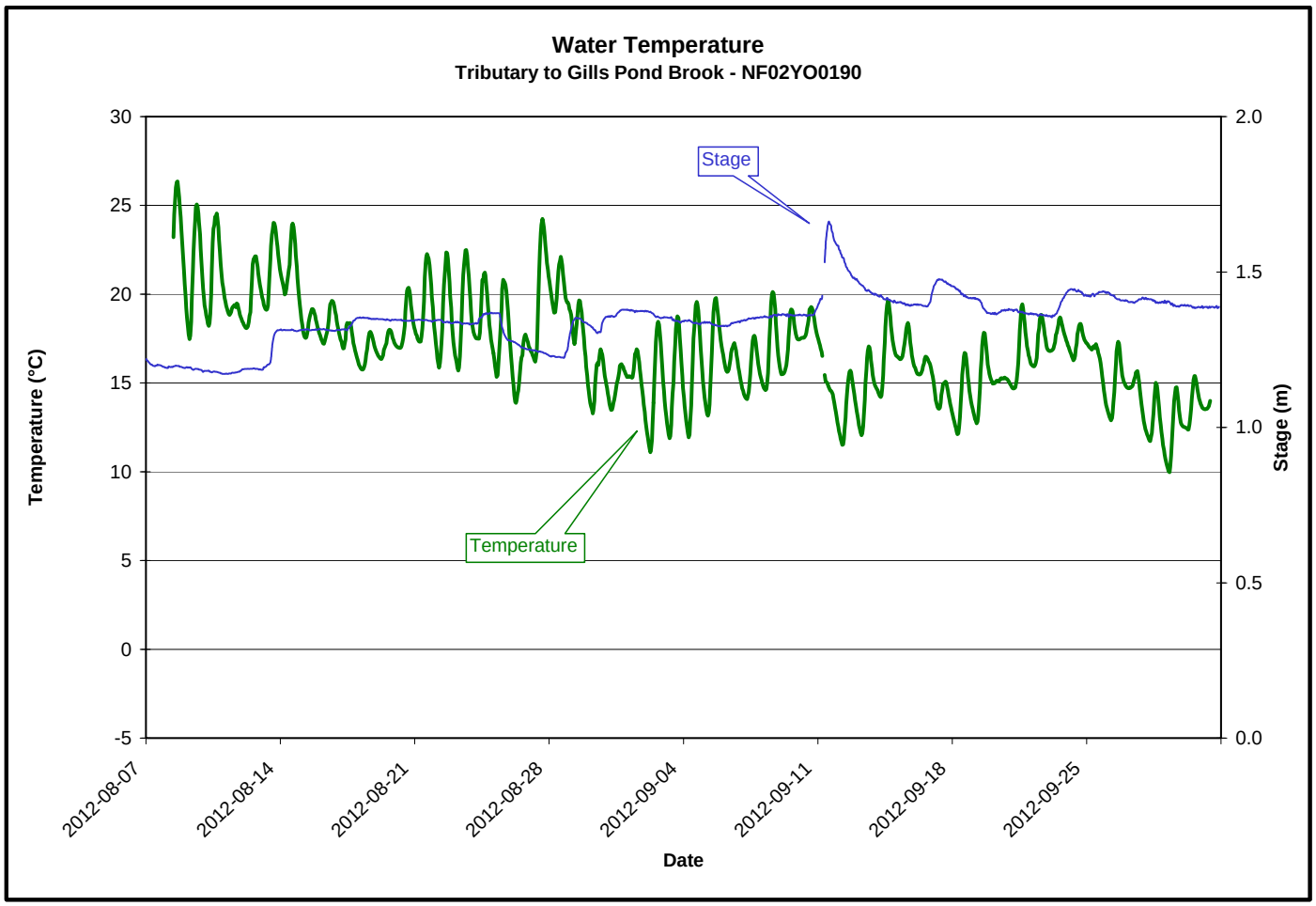

Figure 1

- Throughout the deployment period pH values (**Figure 2**) ranged from a minimum of 5.83 to a maximum of 7.69 with the majority of values falling just above the lower limit of the recommended range (6.5 – 9.0) for the CCME *Canadian Water Quality Guidelines for the Protection of Aquatic Life*.
- The most significant drop in pH happened on September 11, 2012. This corresponded with a rapid increase in stage which was a response to the heavy rainfall associated with the remnants of a tropical storm.
- An inverse relationship with stage is obvious during the several events throughout the deployment period.
- The background pH of this stream is normally around the lower limit of the recommended range.

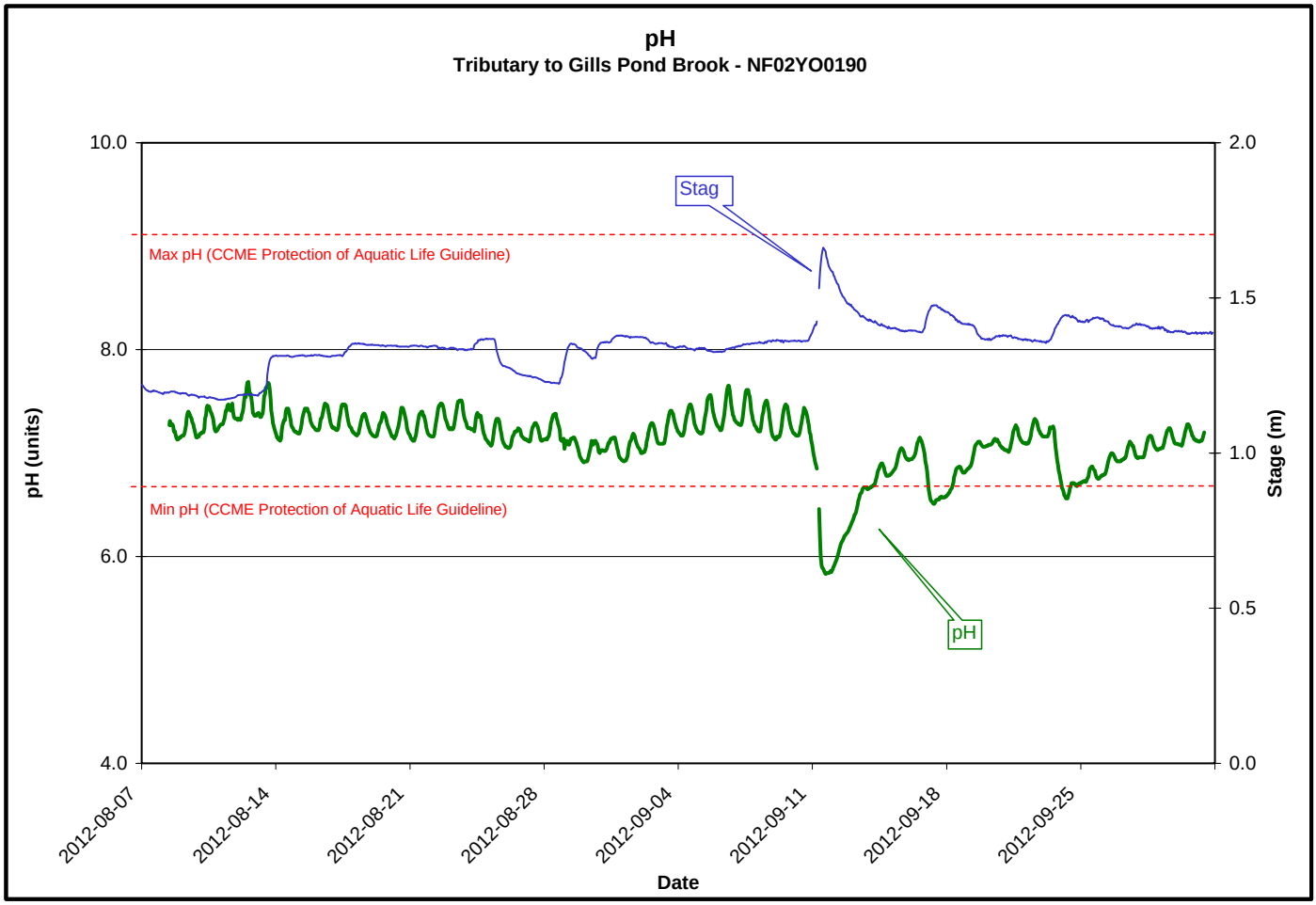

Figure 2

- The specific conductivity **(Figure 3)** ranged from a minimum of 68.4 µS/cm to a maximum of 1276.0 µS/cm over the deployment period.
- There are five significant decreases in specific conductance obvious during this deployment period: The first two incidences, highlighted by the solid red ellipses, are the direct result of cessations of discharge from the Polishing Pond. The remaining three incidences, highlighted by the dashed red ellipses, are resultant from increases in stage resulting from precipitation.
- Notice that the response of the graph is different. Following cessation of discharge, the specific conductance falls off slowly over about four or five days, then increases rapidly once discharge resumes. Following a major precipitation event, the specific conductance drops off almost immediately, and slowly recovers over the next four or five days.
- Precipitation effectively has a dilution effect on this stream which is the receiving water from the Polishing Pond.

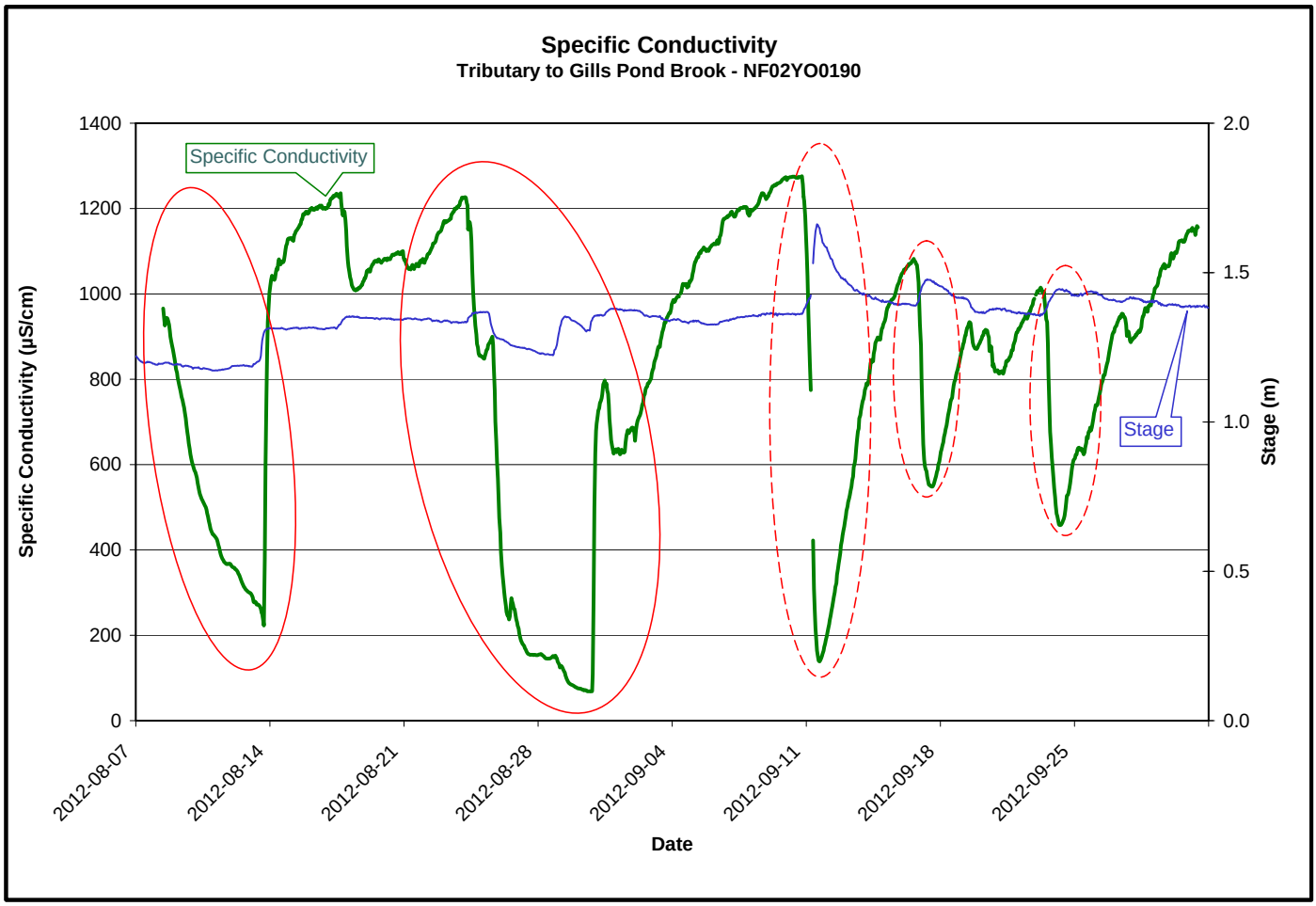

Figure 3

- The dissolved oxygen (**Figure 4**) values ranged from a minimum of 7.32 mg/L to a maximum of 10.32 mg/L over the deployment period, with the percent saturation ranging between 79.4 and 104.4.
- Dissolved oxygen is generally inversely proportional to water temperature.
- All of the dissolved oxygen values fell above the lower limit recommended by CCME *Canadian Water Quality Guidelines for the Protection of Aquatic Life* (cold water/other life stages – above 6.5 mg/L; cold water/early life stages – above 9.5 mg/L).
- Based upon the fact that Dissolved Oxygen % saturation had minimal change over the deployment period, we can be confident that the Dissolved Oxygen mg/L values are accurate.
- Note that following a precipitation event on September 11, 2012, the DO values were somewhat supressed.

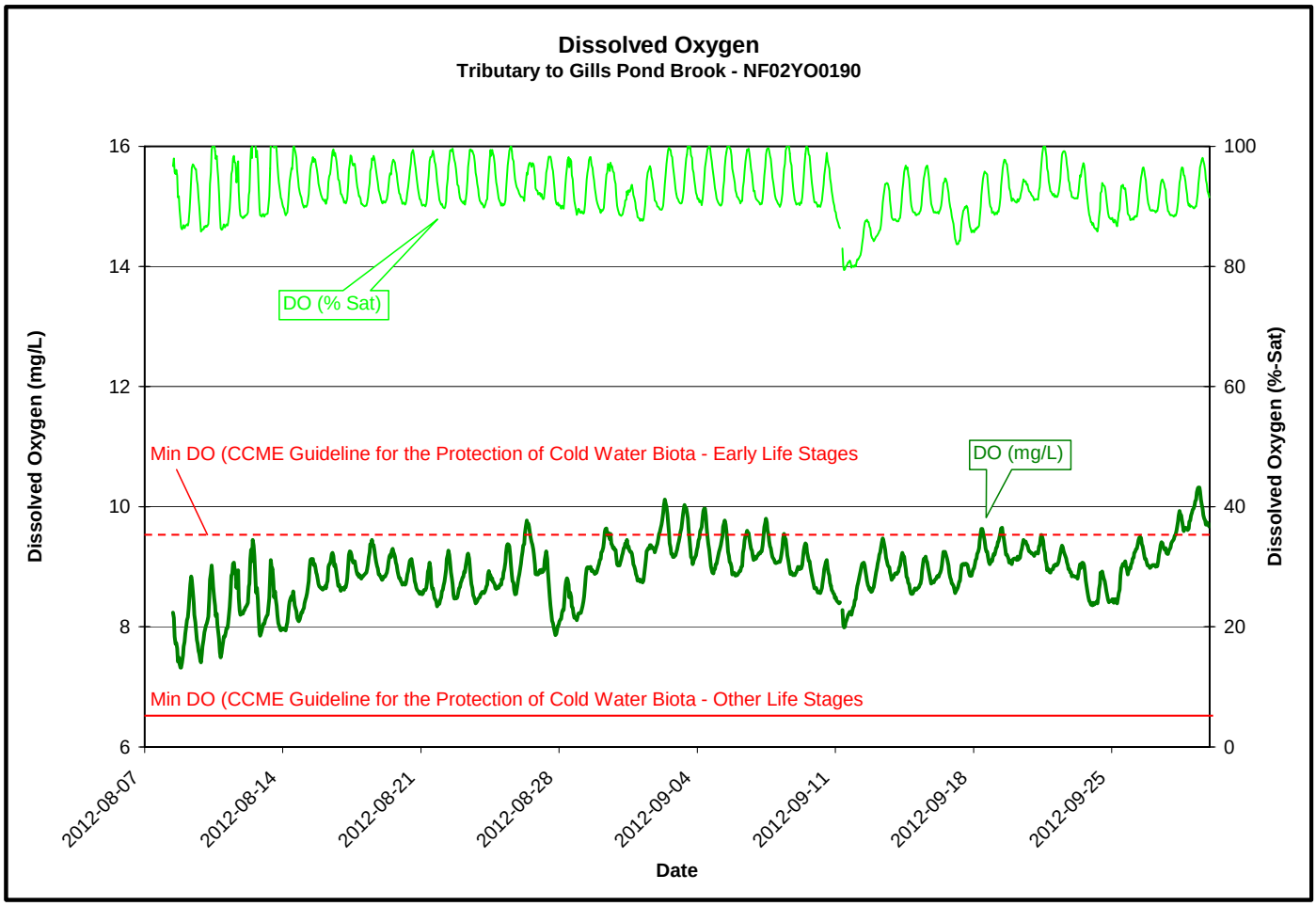

Figure 4

- The turbidity values **(Figure 5)** ranged from a minimum of 1.6 NTU to a maximum of 200.4 NTU.
- Based upon previous investigation, it has been determined that turbidity values may be artificially increased due to air entrainment during higher flows.
- From August 13, 2012 to September 5, 2012 there was some interference (presumably an accumulation of biofilm) with the turbidity sensor at Tributary to Gills Pond. Accordingly, these unreliable data have been removed from the data set.
- There was a significant peak in turbidity on September 11, 2012 following runoff after the remnants of a tropical storm blew through.
- The measurements above zero represent the greater accuracy of the unit based upon the revised turbidity calibration protocol.
- The individual turbidity spikes are likely due to air bubbles or in-stream debris passing over the sensor.
- Neither in-situ nor grab sample measurements nor visual observation indicated turbidity issues.

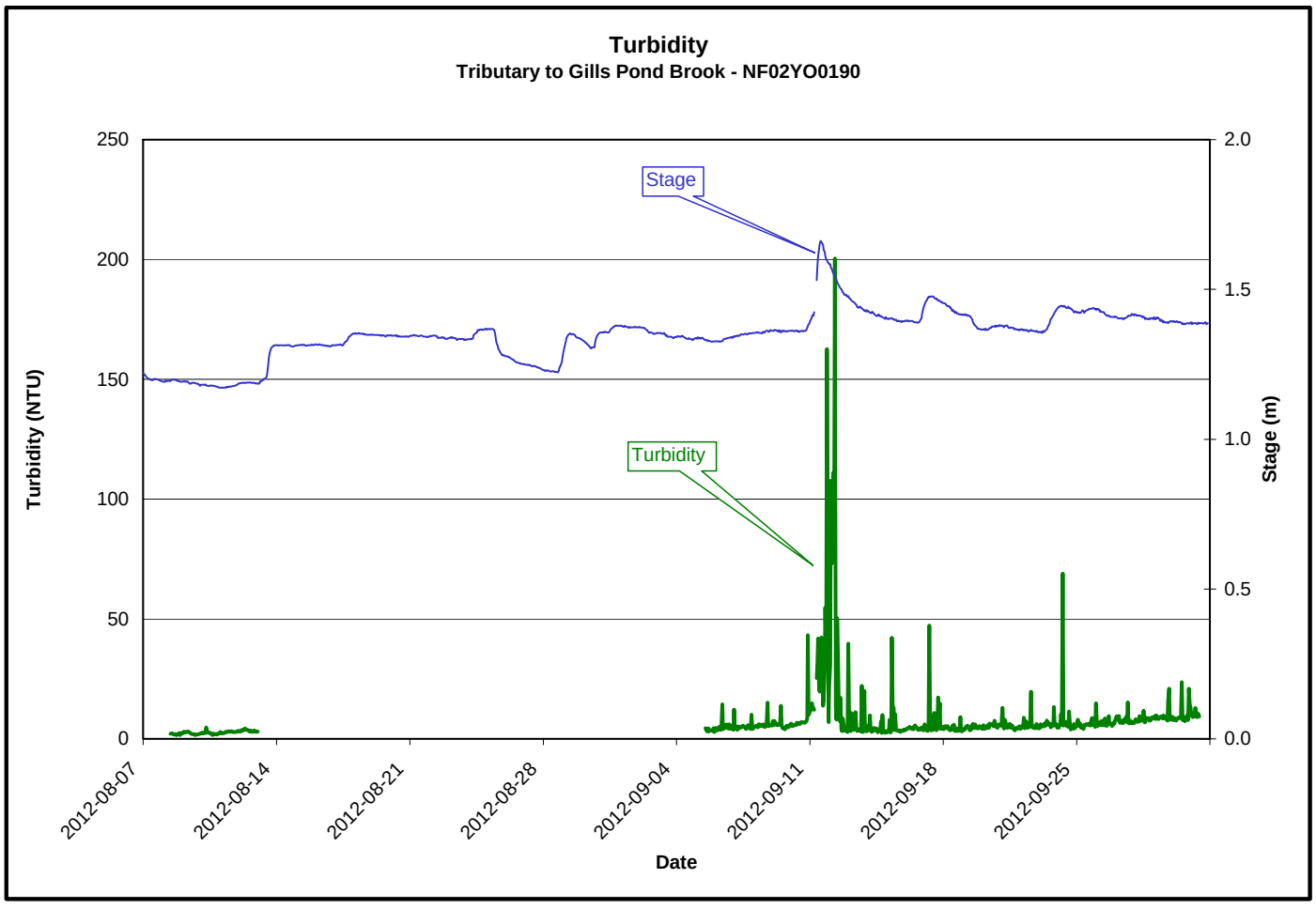

Figure 5

- The stage or water level ranged from a minimum of 1.17 m to a maximum of 1.66 m. The flow or discharge ranged from a minimum of 0.01 m^3/s to a maximum of 2.11 m^3/s (**Figure 6)**.
- The drops in stage are obvious from August 7, 2012 to August 14, 2012 and August 27, 2012 to August 30, 2012 corresponding with the cessation of discharge from the Polishing Pond.
- There was a significant peak in stage and flow on September 11, 2012 following runoff after the remnants of a tropical storm blew through.
- The higher levels are the result of other precipitation/runoff events.
- All values are within the normal range.

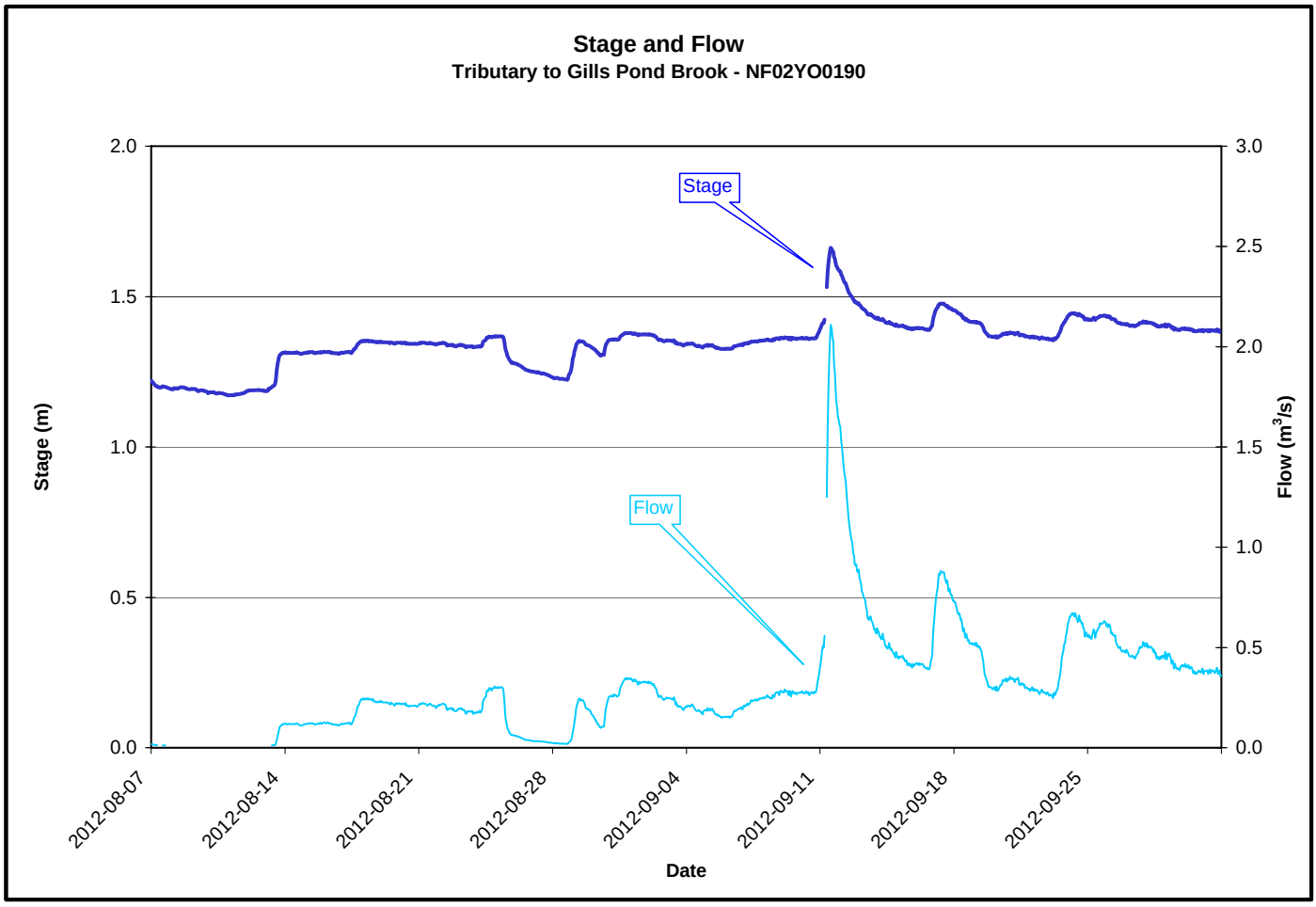

Figure 6

EAST POND BROOK

- The water temperature (**Figure 7**) ranged from a minimum of 9.55 ˚C to a maximum of 27.95 ˚C.
- Temperatures generally decreased throughout the deployment period, with the diurnal variation still quite evident.
- There appears to be little correlation with stage

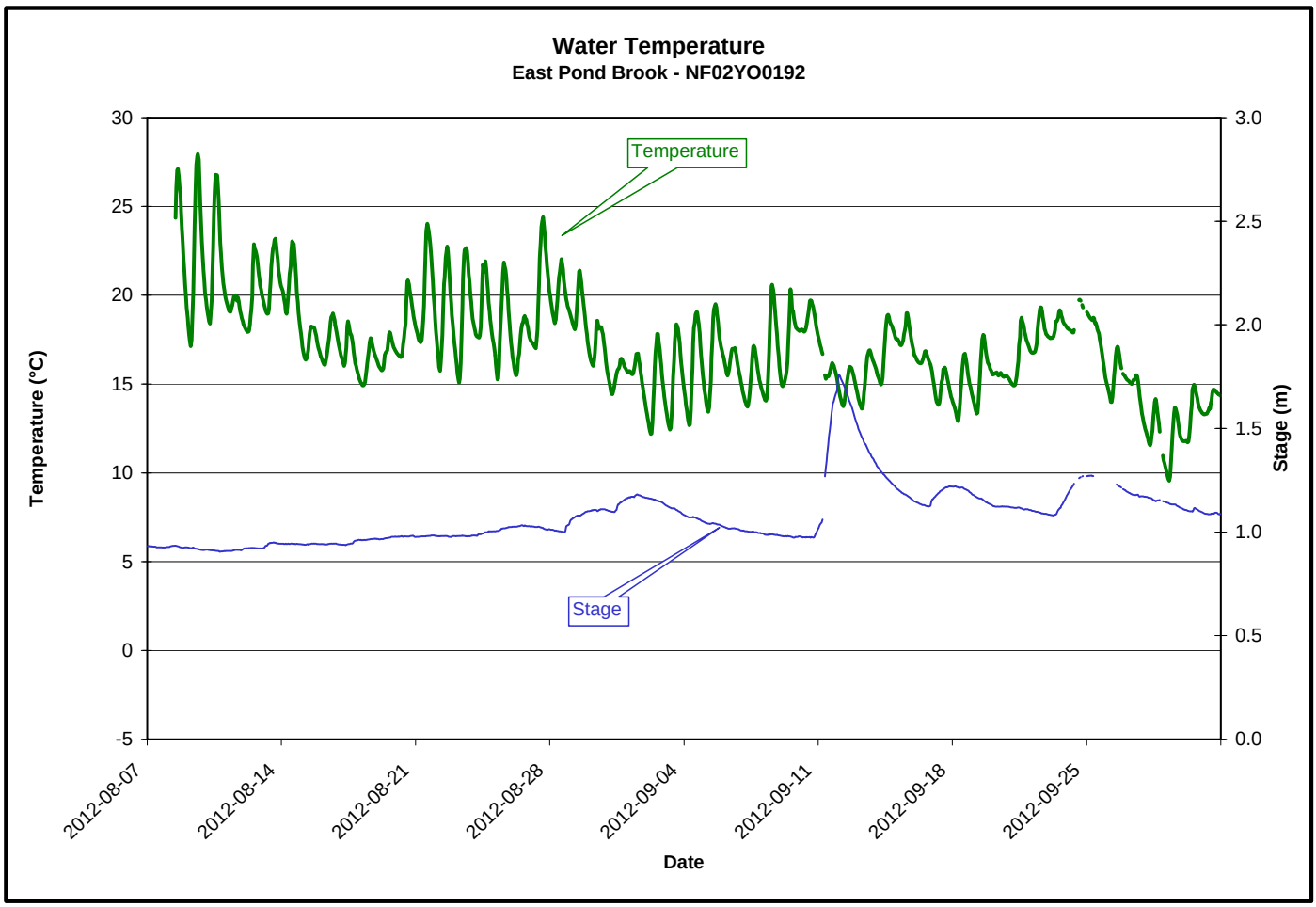

Figure 7

- Throughout the deployment period pH values (**Figure 8**) ranged from a minimum of 5.95 to a maximum of 7.38 with pH remaining constant until September 11, 2012.
- Following the increase in runoff following the remnants of a tropical storm (red ellipse), the pH dropped off significantly and remained much lower for the remainder of the deployment period.
- Prior to September 11, 2012, pH values fell just above the lower limit of the recommended range (6.5 – 9.0) for the CCME *Canadian Water Quality Guidelines for the Protection of Aquatic Life*. Following this event, pH values were generally lower than the lower limit.
- The background pH of this stream is normally quite low, and values near and below the limit are not unusual.

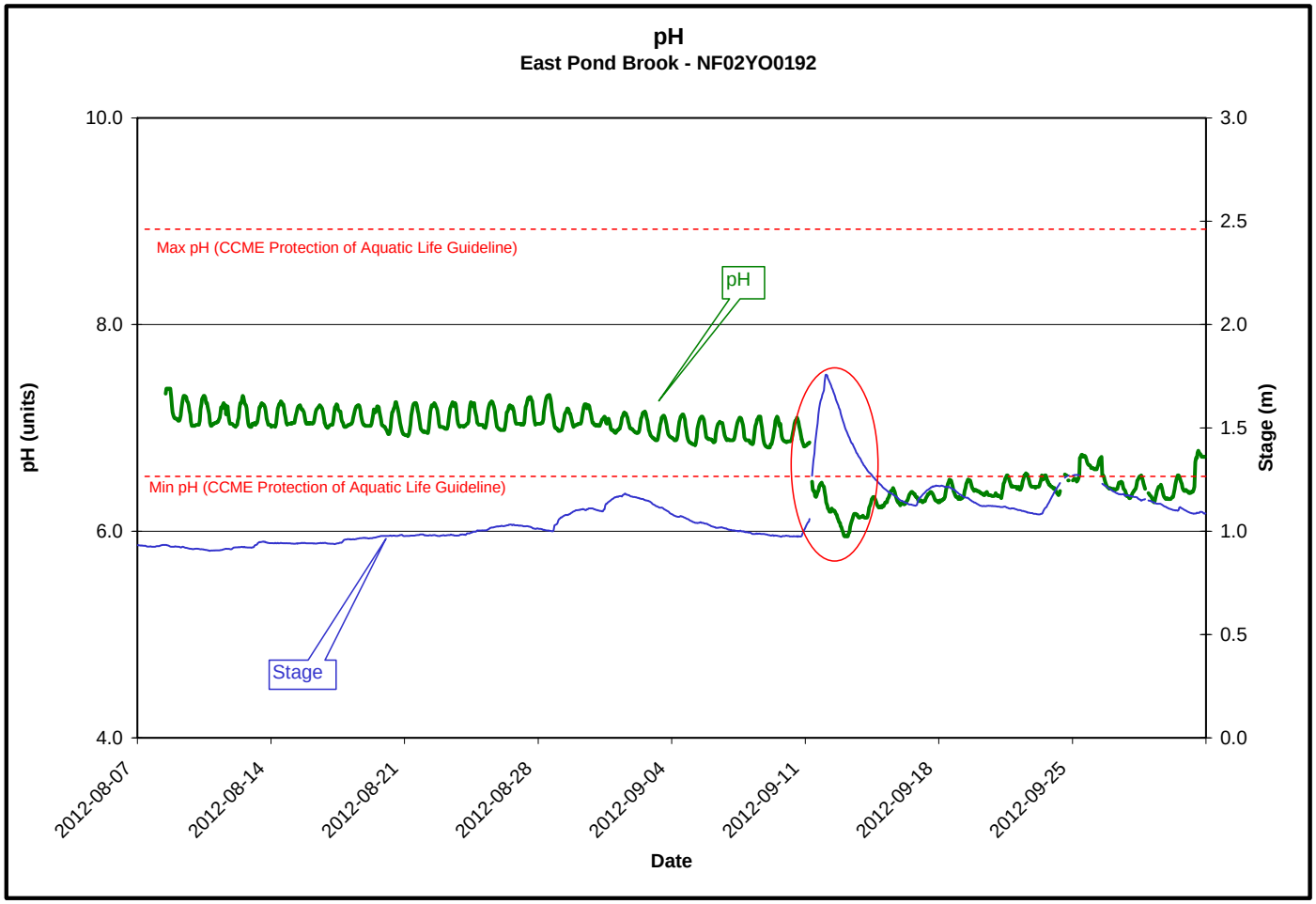

Figure 8

- The specific conductivity **(Figure 9)** ranged from a minimum of 19.0 µS/cm to a maximum of 46.1 µS/cm, with a slight decrease over the deployment period.
- There is a notable increase in specific conductivity from August 24, 2012 to September 4, 2012 (solid red ellipse). No reason is apparent, apart from some increased flow.
- On September 11, 2012, following the remnants of a tropical storm, the specific conductance varies significantly (dashed red ellipse), and subsequently remains much lower for the remainder of the deployment period.
- All values are within the normal range.

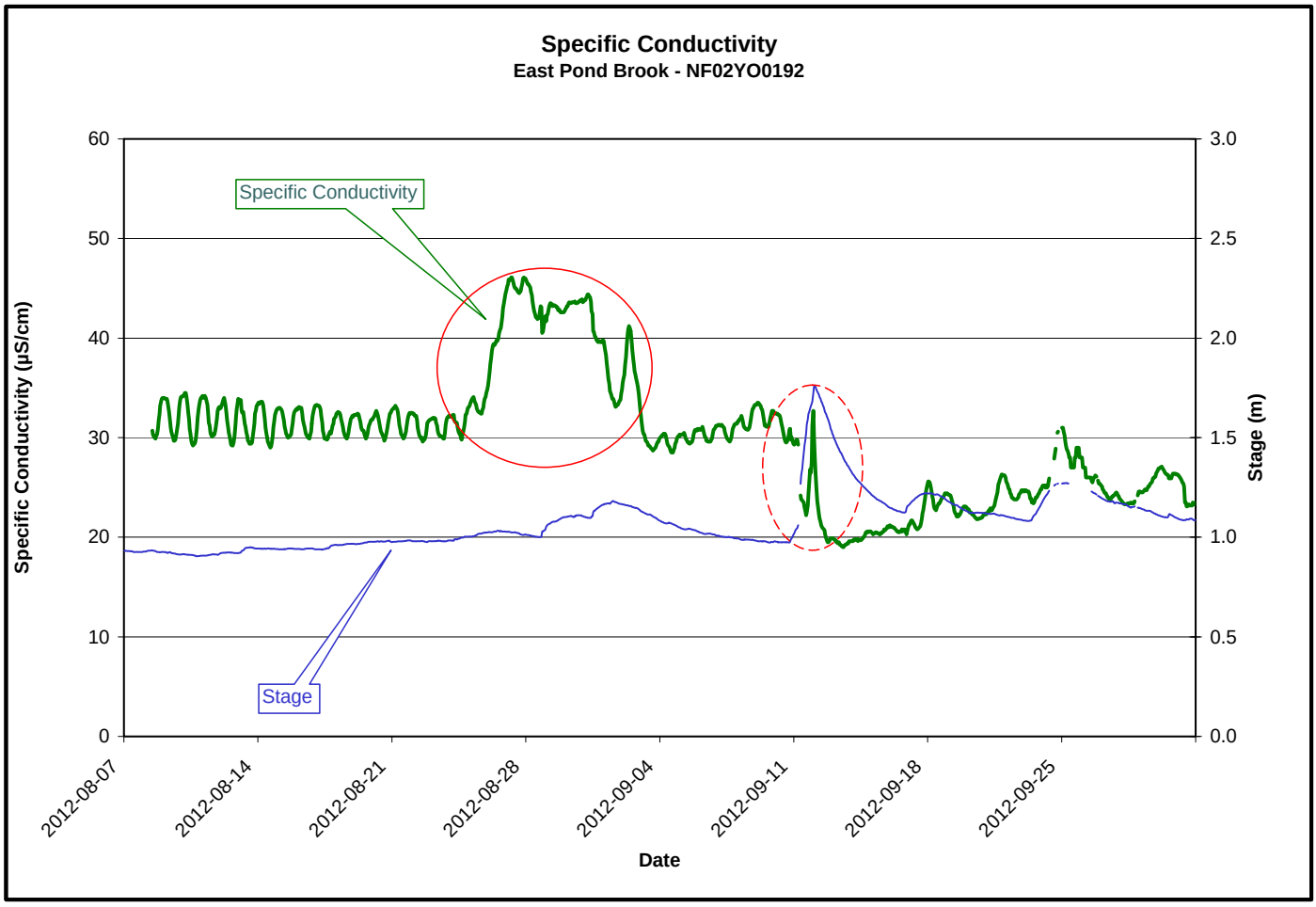

Figure 9

- The dissolved oxygen (**Figure 10**) values ranged from a minimum of 7.48 mg/L to a maximum of 10.78 mg/L over the deployment period, with the percent saturation ranging between 87.3 and 102.7.
- Dissolved oxygen is inversely proportional to water temperature.
- Throughout the deployment period, all dissolved oxygen values fell above the lower limit recommended by CCME *Canadian Water Quality Guidelines for the Protection of Aquatic Life* (cold water/other life stages – above 6.5 mg/L; cold water/early life stages – above 9.5 mg/L).
- Based upon the fact that Dissolved Oxygen % Saturation had limited drift, we can be confident that the Dissolved Oxygen mg/L values are accurate.

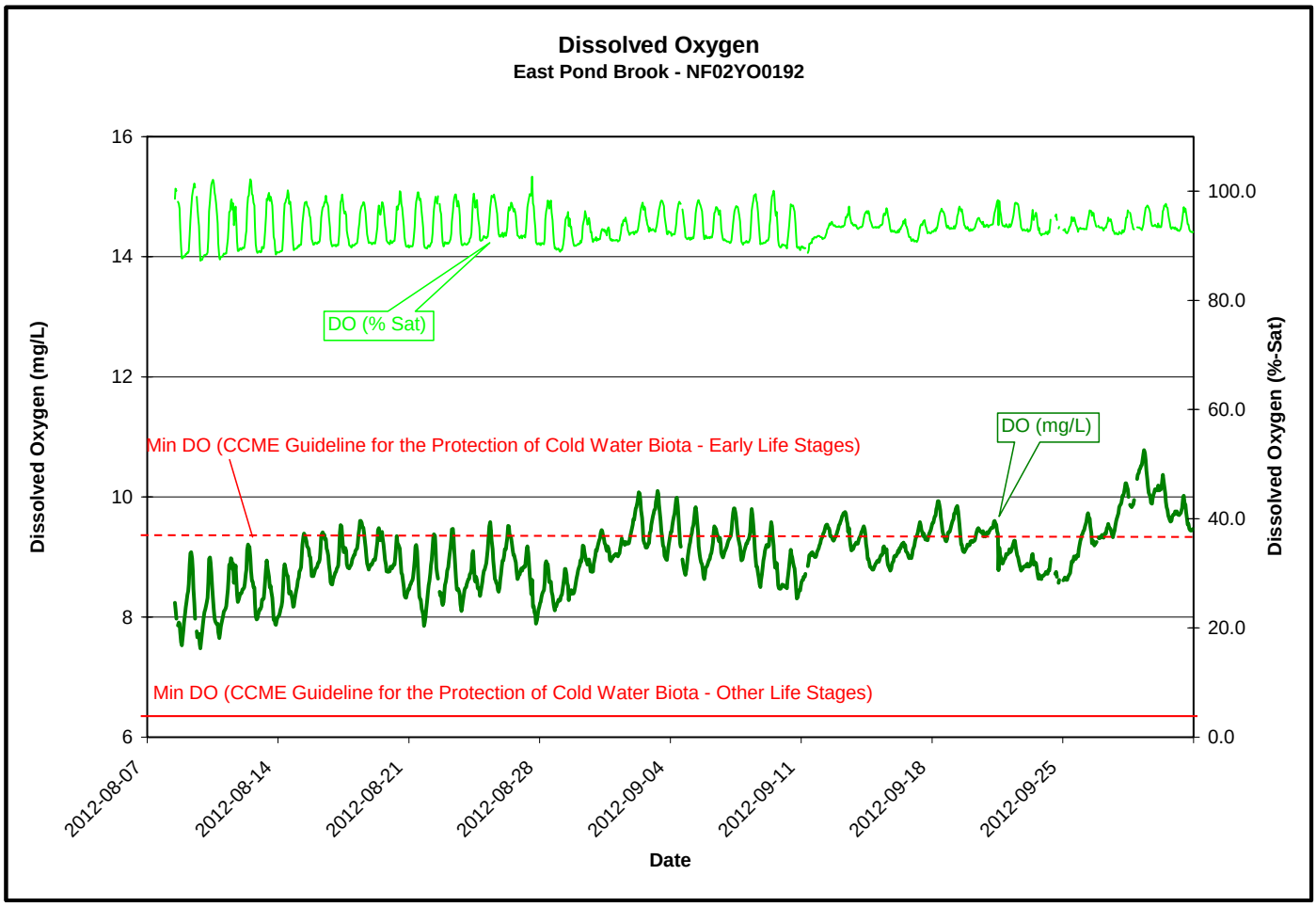

Figure 10

- The turbidity values (**Figure 11**) ranged from a minimum of 0.1 NTU to a maximum of 229.9 NTU.
- Turbidity values in this stream are typically near zero, with the measurements above zero representing the greater accuracy of the unit based upon the revised turbidity calibration protocol.
- The peaks typically represent insignificant events when natural in-stream debris or air bubbles passed near the sensor.
- Neither in-situ nor grab sample measurements nor visual observation indicated turbidity issues.

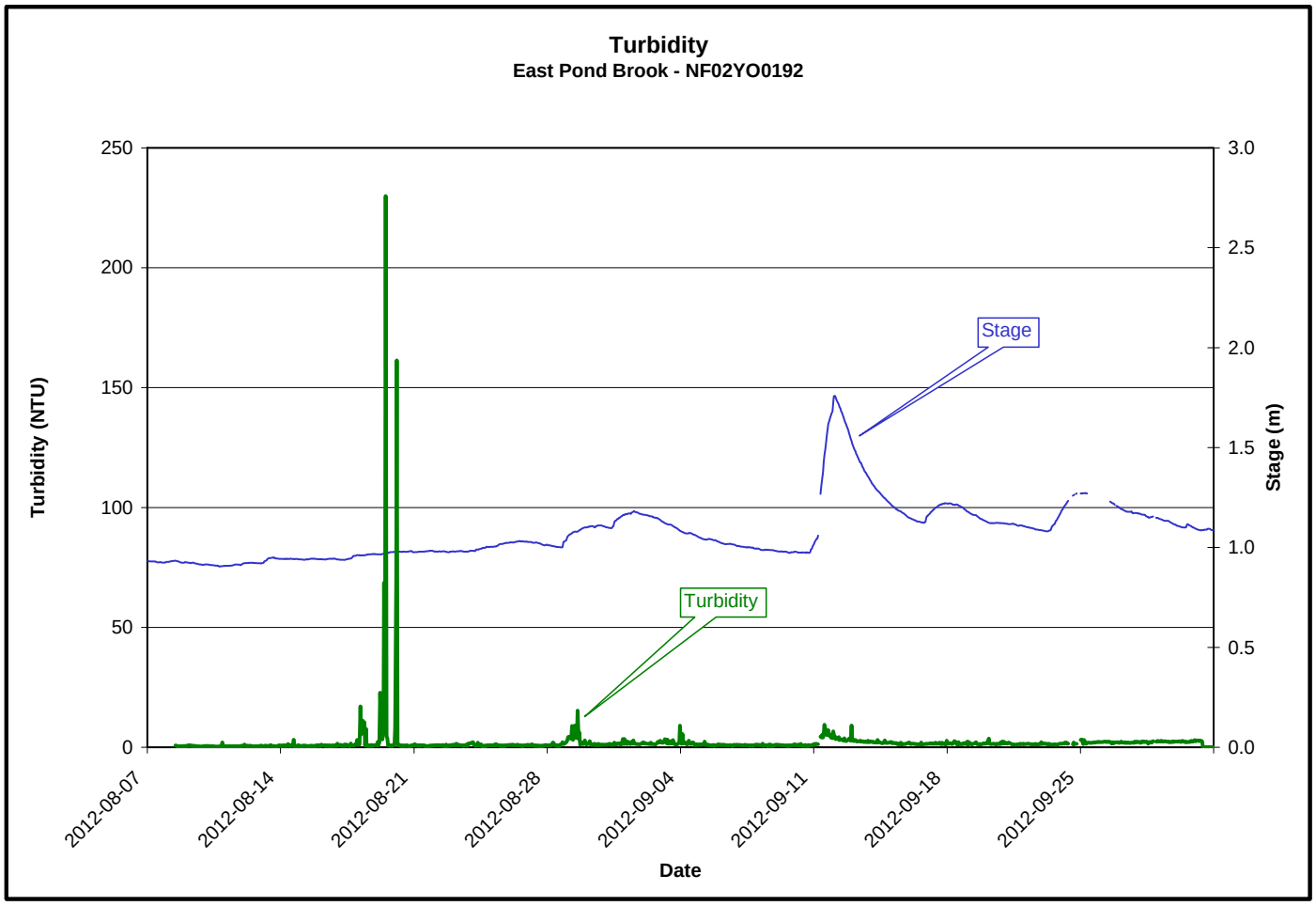

Figure 11

- The stage or water level ranged from a minimum of 0.91 m to a maximum of 1.76 m. The flow or discharge ranged from a minimum of 0.13 m^3/s to a maximum of 10.10 m^3/s **(Figure 12)**.
- The flow values for the lowest water levels could not be displayed, as the stage-flow curve for these extremely low levels has yet to be calculated.
- The peak is stage and flow on September 11, 2012 follows the remnants of a tropical storm.

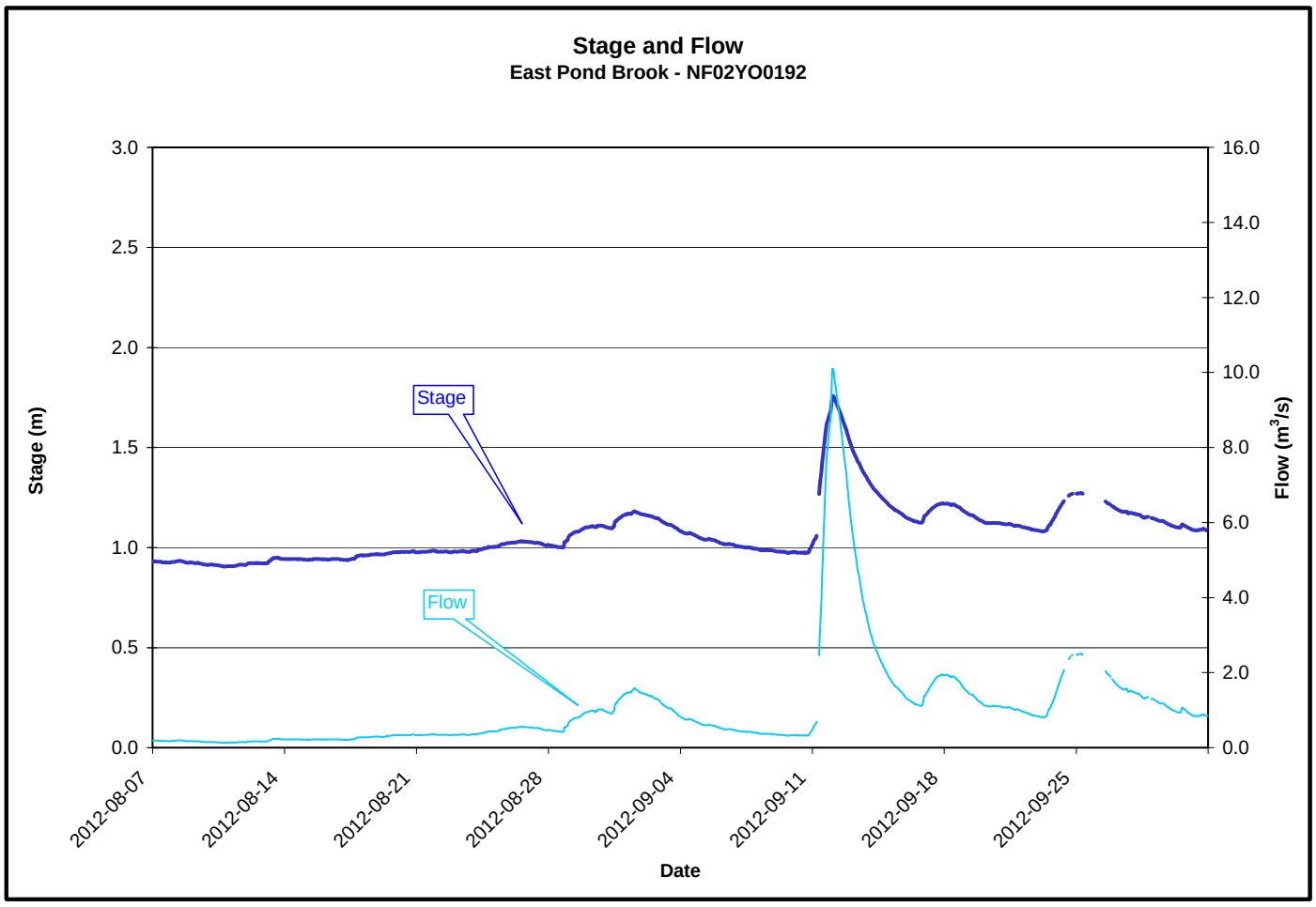

Figure 12

WELL AFTER TAILING DAM (MW1)

- The water temperature (**Figure 13**) ranged from a minimum of 5.01 ˚C to a maximum of 5.46 ˚C with a slight increase over deployment period.
- There appears to be no correlation with water elevation.

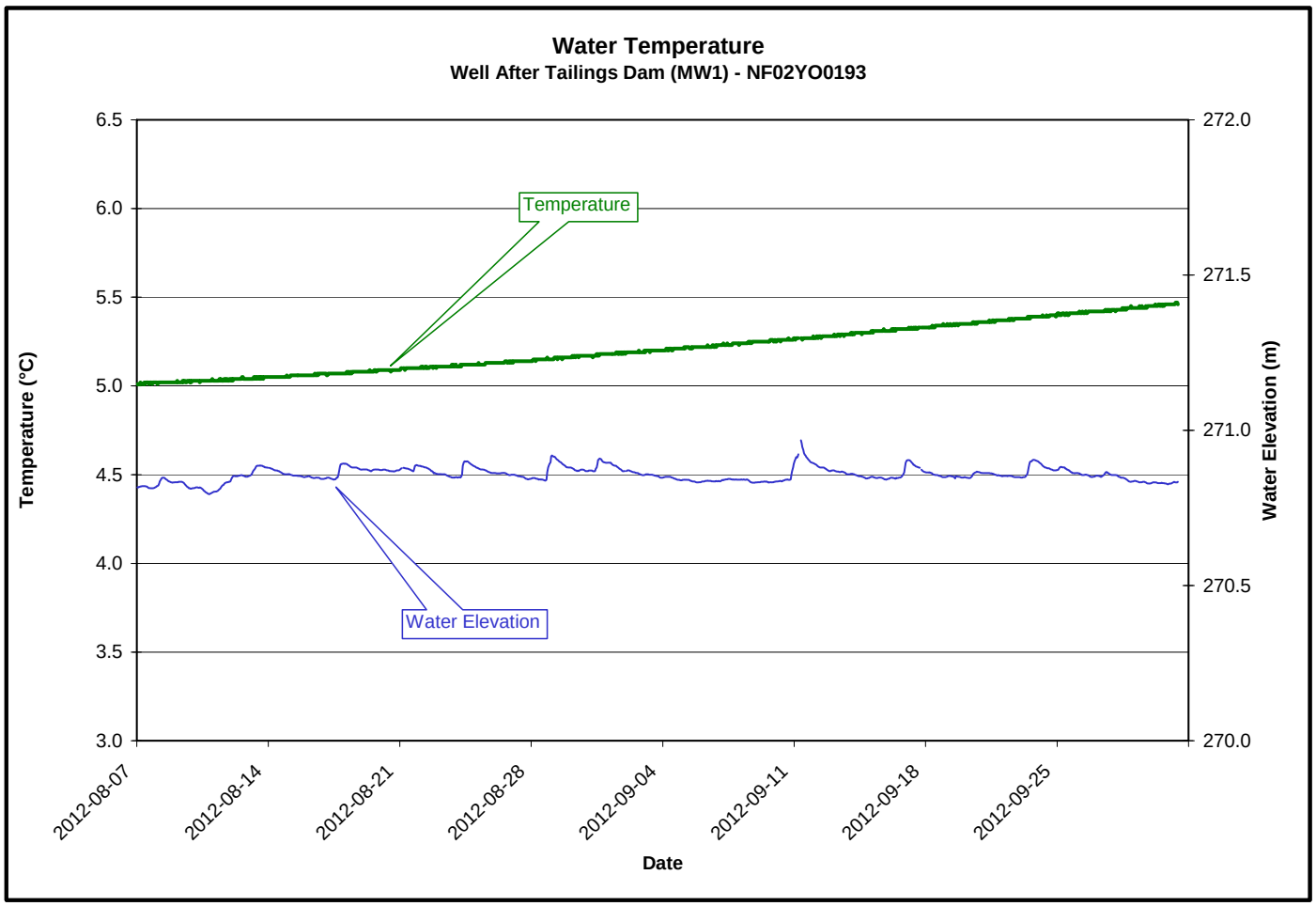

Figure 13

- The pH (**Figure 14**) ranged from a minimum of 8.17 to a maximum of 8.25.
- There was a slight decrease over the deployment period.
- There does not appear to be any correlation with water elevation.

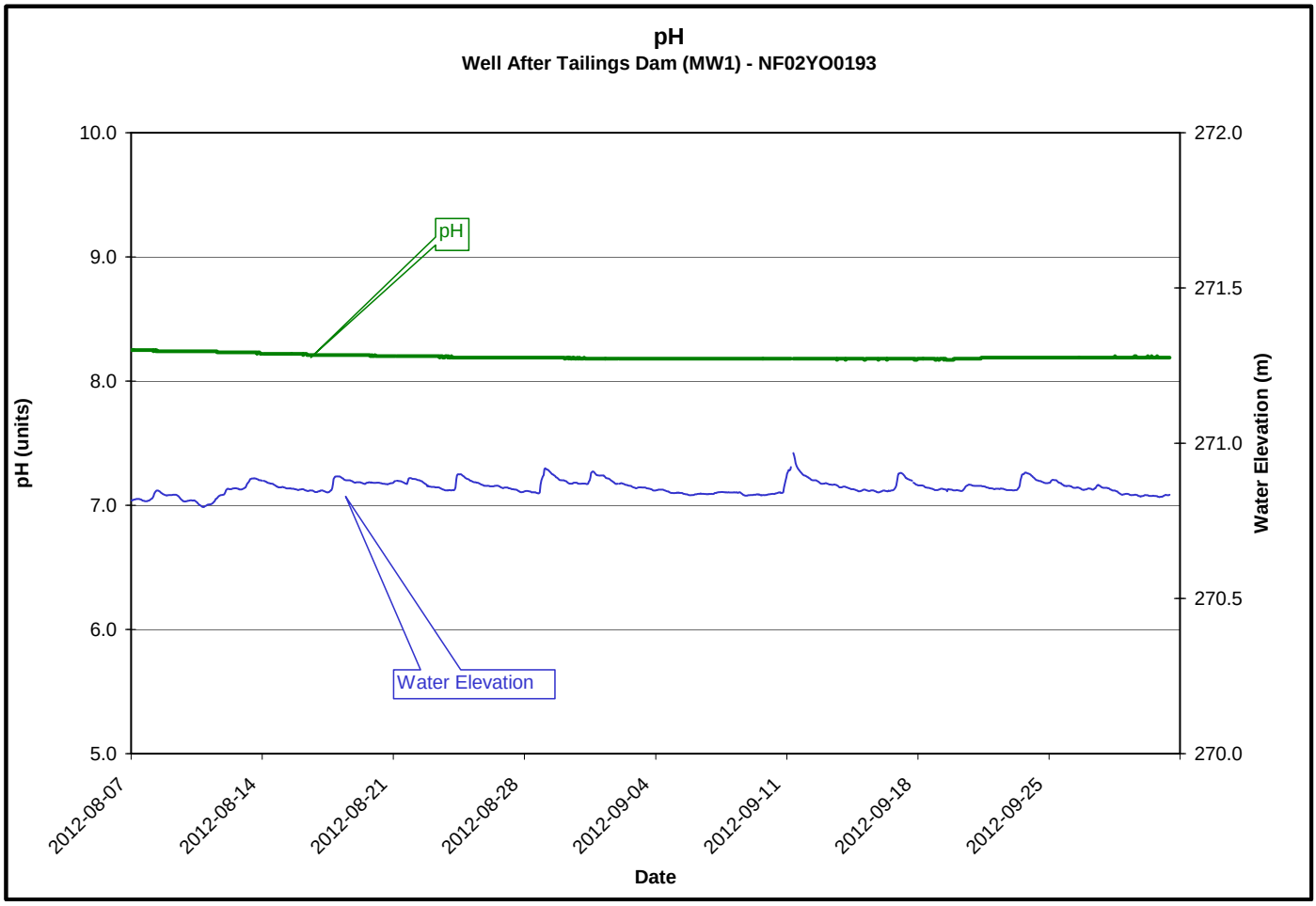

Figure 14

- The specific conductivity **(Figure 15)** ranged from a minimum of 0.672 mS/cm to a maximum of 0.695 mS/cm.
- Specific conductance values increased gradually over the deployment period until September 19, 2012, when they began to drop off slightly. This trend is atypical.
- There does not seem to be any correlation with water elevation.

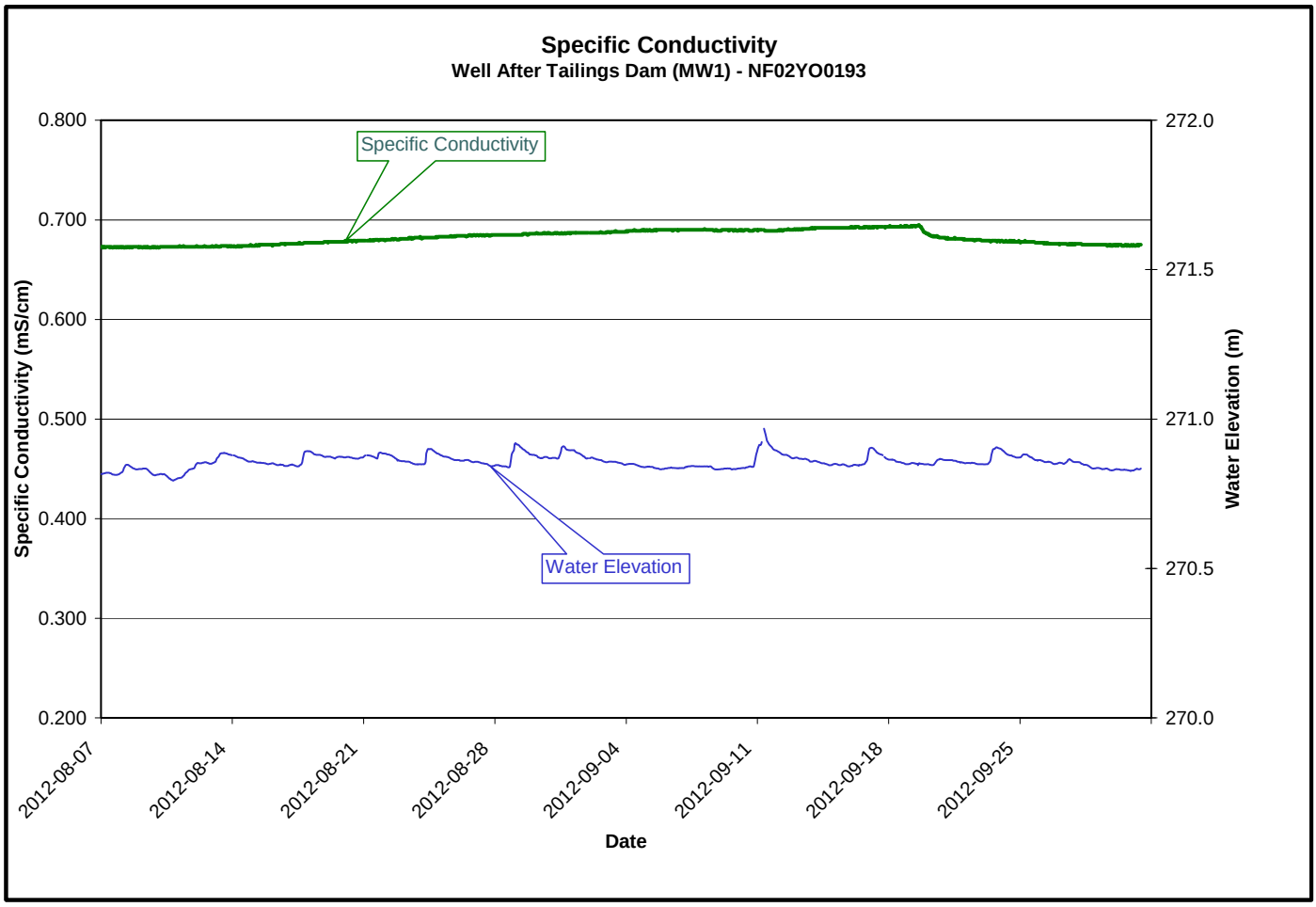

Figure 15

- The Water Elevation **(Figure 16)** ranged from a minimum of 270.79 m to a maximum of 270.97 m. with little variation over the deployment period.
- Water elevation in this well corresponds to increased water level in an adjacent stream, and is influenced by runoff from precipitation.
- The highest peak in water elevation (red ellipse) is on September 11, 2012, which corresponds to the remnants of a tropical storm.

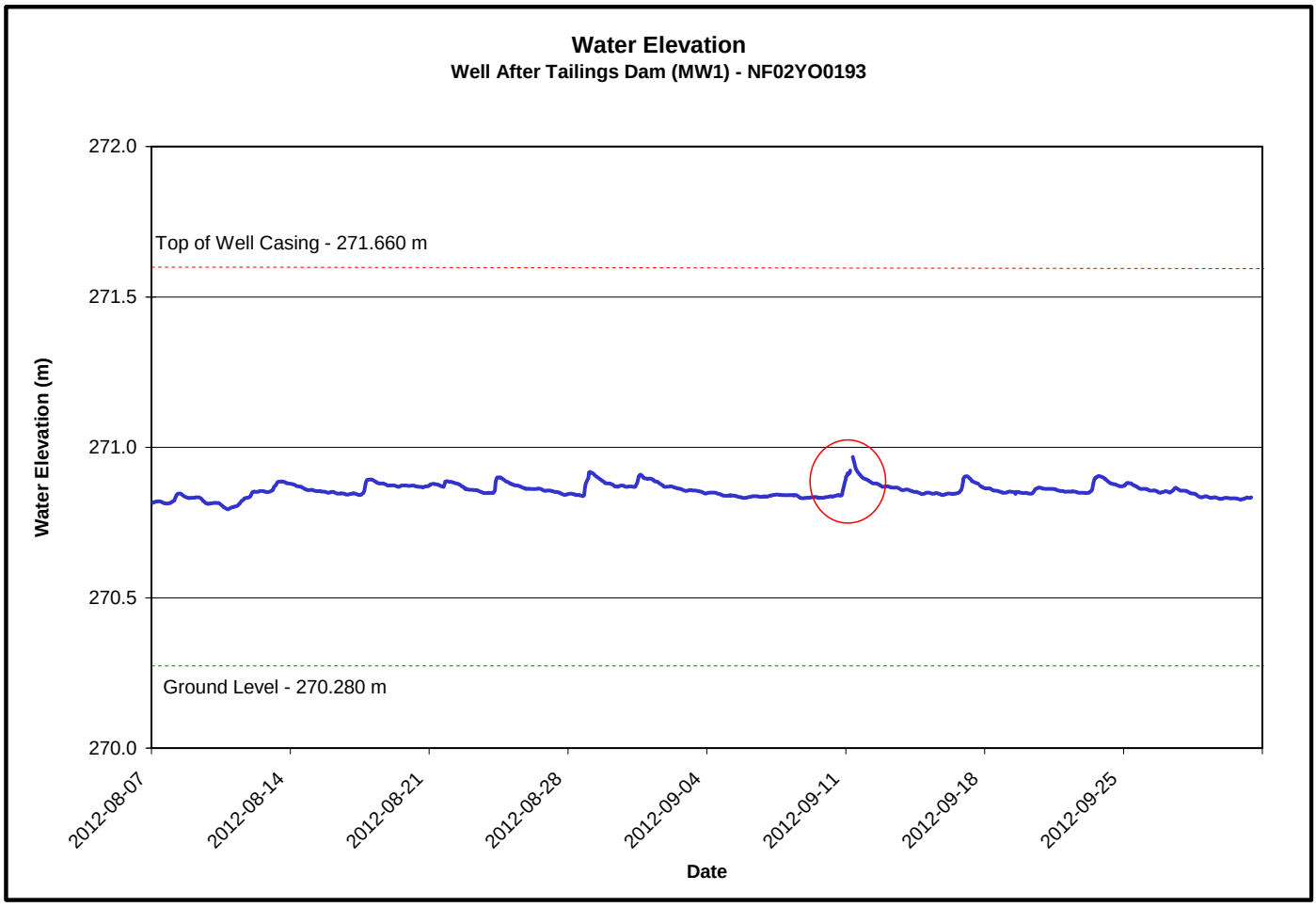

Figure 16

Prepared by:

Robert Wight
Environmental Scientist
Water Resources Management Division
Department of Environment and Conservation
Tel: 709-292-4280
Fax: 709-292-4365
e-mail: robertwight@gov.nl.ca