Real Time Water Quality Report
Teck Duck Pond Operations

Deployment Period 2013-08-13 to 2013-10-08

2013-10-24

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. There were brief cessations and /or reductions in discharge from 2013-08-13 to 2013-08-21, 2013-09-05 to 2013-09-06 and 2013-09-09 to 2013-09-15.

Maintenance and Calibration of Instrumentation

- As the new **DataSonde®**(s/n 62268) was out for repairs, a spare **DataSonde®**(s/n 43245) was deployed in Tributary to Gills Pond Brook on August 15, 2013 after being cleaned and freshly calibrated, and remained deployed continuously until October 8, 2013; a 53 day period.
- As the new **DataSonde®**(s/n 62267) was out for repairs, a spare **DataSonde®**(s/n 43794) was deployed in East Pond Brook on August 13, 2013 after being cleaned and freshly calibrated, and remained deployed continuously until October 8, 2013; a 55 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.
- As the new **Quanta G®** (s/n 00653) was out for repairs, the old **Quanta G®** (s/n 00035) was deployed on August 13, 2013 and remained deployed continuously in Monitoring Well After Tailings Dam Station (MW1), until beyond the end of this reporting period. This report covers a 55 day reporting 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 usually 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.
- There was a failure of the pH sensor on the Field **DataSonde®** for East Pond Brook on August 18, 2013. Thus a ranking upon removal cannot be determined. Erroneous data to the end of the deployment period have been removed from the data set. This instrument has been sent for servicing.
- Beginning on September 15, 2013 there was leafy debris caught in the sensor for East Pond Brook, which caused false positive turbidity readings until the end of the deployment period. Erroneous data have been removed from the data set.
- 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 Conductivity based upon live data and laboratory data. The installation ranking is documented in **Table 4** below. The removal ranking will be documented in a subsequent report.
- The 'Fair' ranking for pH is the result of the difference in pH (0.67 units) between the live data and a sample purged from the well. See discussion on pH in the text below.
- 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**
2013-08-15 Installation	Temp (^{o}C)	Good
	pH (units)	Excellent
	Sp. Conductivity (µS/cm)	Excellent
	Dissolved Oxygen (mg/L)	Excellent
	Turbidity (NTU)	Excellent
2013-10-08 Removal	Temp (^{o}C)	Good
	pH (units)	Excellent
	Sp. Conductivity (µS/cm)	Excellent
	Dissolved Oxygen (mg/L)	Excellent
	Turbidity (NTU)	Excellent

Table 2

East Pond Brook Station (NF02YO0192)		
Date (yyyy-mm-dd)	**Parameter**	**Ranking**
2013-08-13 Installation	Temp (^{o}C)	Excellent
	pH (units)	Good
	Sp. Conductivity (µS/cm)	Excellent
	Dissolved Oxygen (mg/L)	Excellent
	Turbidity (NTU)	Excellent
2013-10-08 Removal	Temp (^{o}C)	Excellent
	pH (units)	n/a
	Sp. Conductivity (µS/cm)	Excellent
	Dissolved Oxygen (mg/L)	Excellent
	Turbidity (NTU)	n/a

Table 3

Well After Tailings Dam (MW1) Station (NF02YO0193)		
Date (yyyy-mm-dd)	**Parameter**	**Ranking**
2013-08-13 Installation	pH (units)	Fair
	Sp. Conductivity (µS/cm)	Excellent

Table 4

Data Interpretation

TRIBUTARY TO GILLS POND BROOK

- The water temperature (**Figure 1**) ranged from a minimum of 8.22˚C to a maximum of 23.32˚C.
- The temperature generally decreased over the deployment period, with diurnal variation being lessened during periods of increased stage.
- In some instances, water temperature decreased with increases in stage. In other instances, water temperature increased. This is likely due to the nature of the weather system passing through.

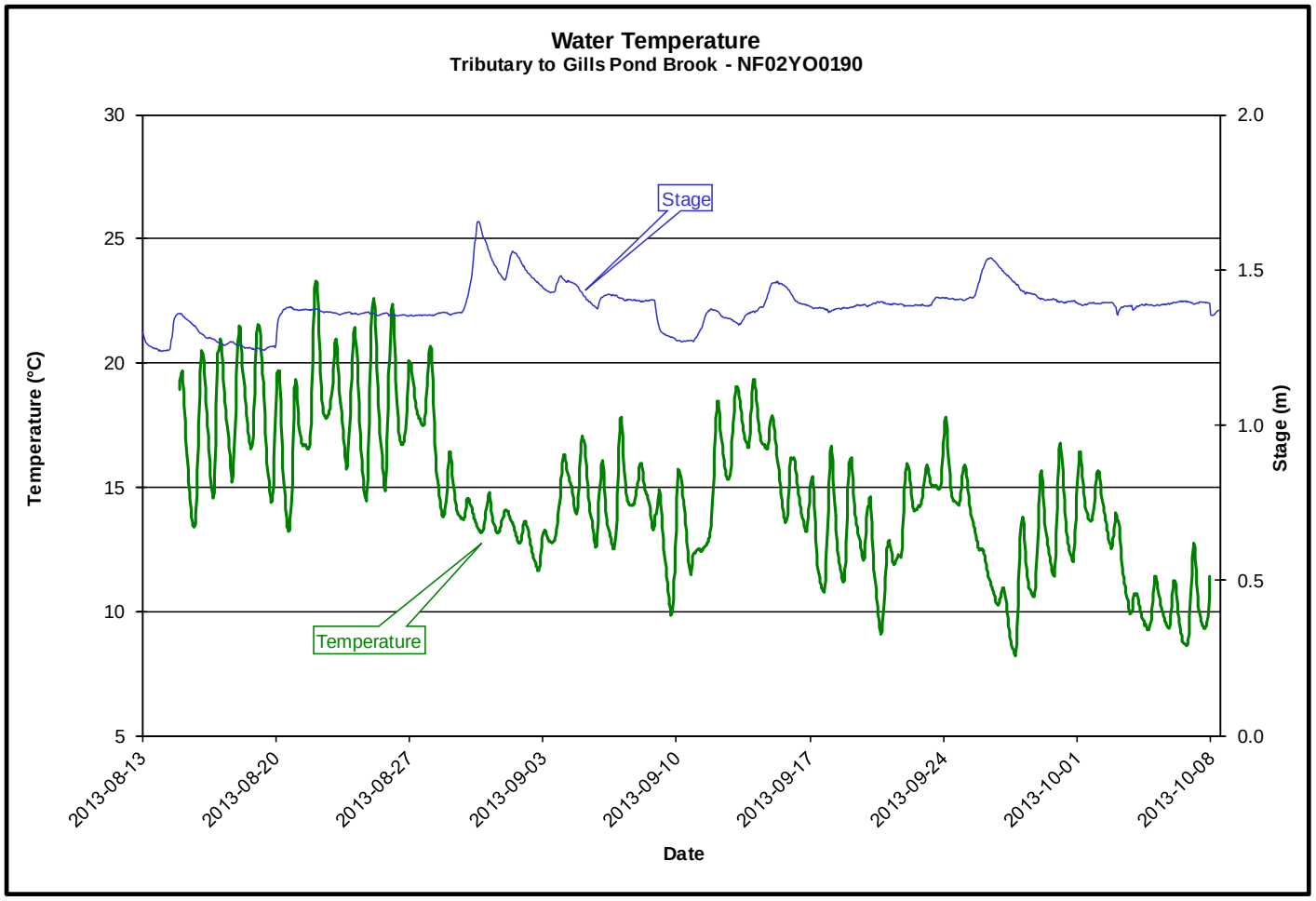

Figure 1

- Throughout the deployment period, pH values (**Figure 2**) ranged from a minimum of 6.02 to a maximum of 7.67 with most values within the recommended range (6.5 – 9.0) for the CCME *Canadian Water Quality Guidelines for the Protection of Aquatic Life*.
- pH decreased slightly with the resumption of discharge from polishing pond on August 21, 2013.
- An inverse relationship with stage is obvious over several events during the deployment period.
- The background pH of this stream is normally around the lower limit of the recommended range, and is generally higher during periods of discharge from Polishing Pond.

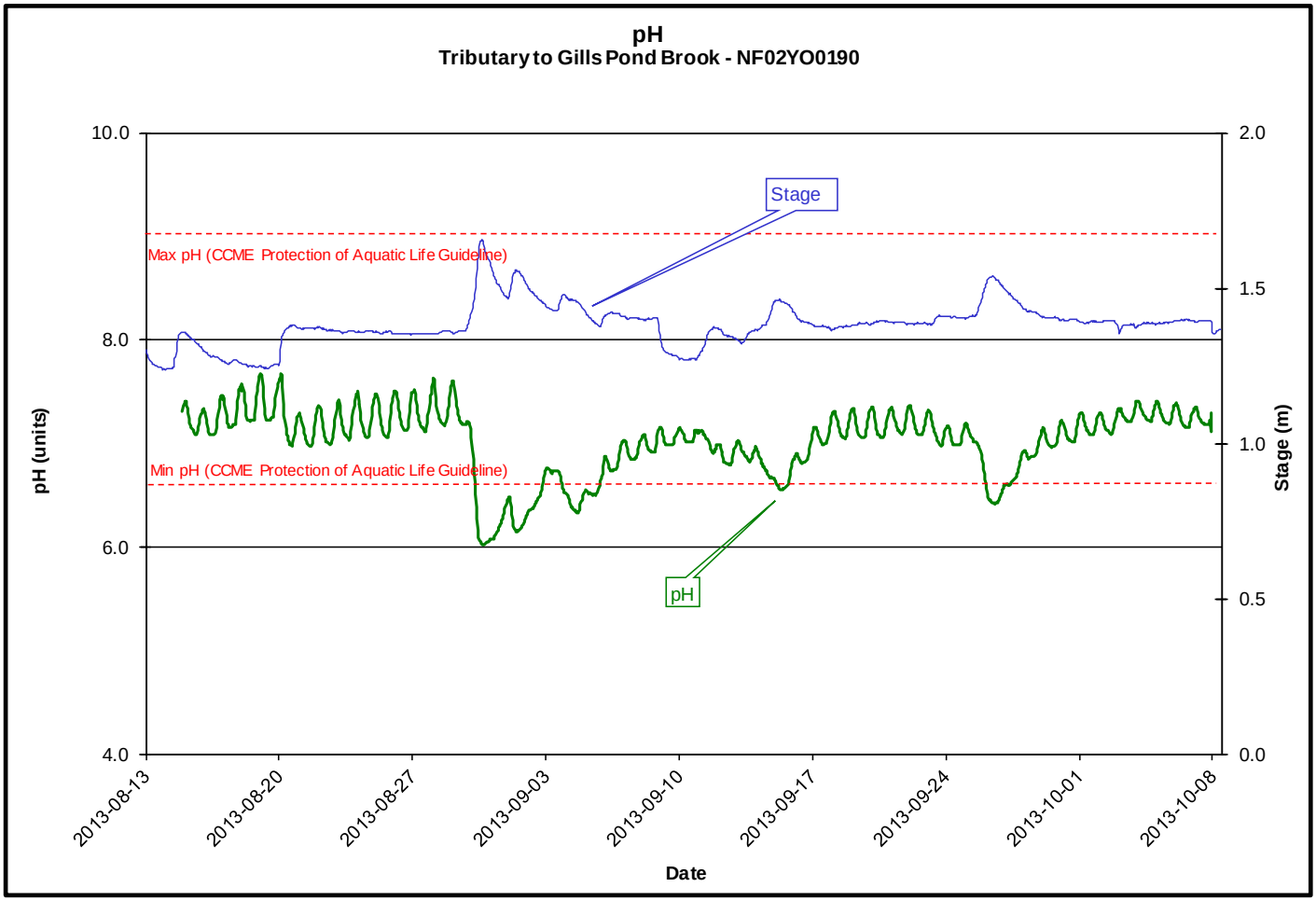

Figure 2

- The specific conductivity **(Figure 3)** ranged from a minimum of 51.2 µS/cm to a maximum of 1288.0 µS/cm over the deployment period.
- There were brief cessations and /or reductions in discharge from the Polish Pond on August 8, 2013 to August 21, 2013, September 5 and 6, 2013, and September 9, 2013 to September 15, 2013 each of which resulted in the stream's specific conductance returning to near natural background levels.
- An inverse relationship with stage is obvious over several events during the deployment period, when precipitation events effectively caused a dilution effect in the stream's specific conductivity, which was elevated from natural background levels due to discharge from the Polishing Pond.

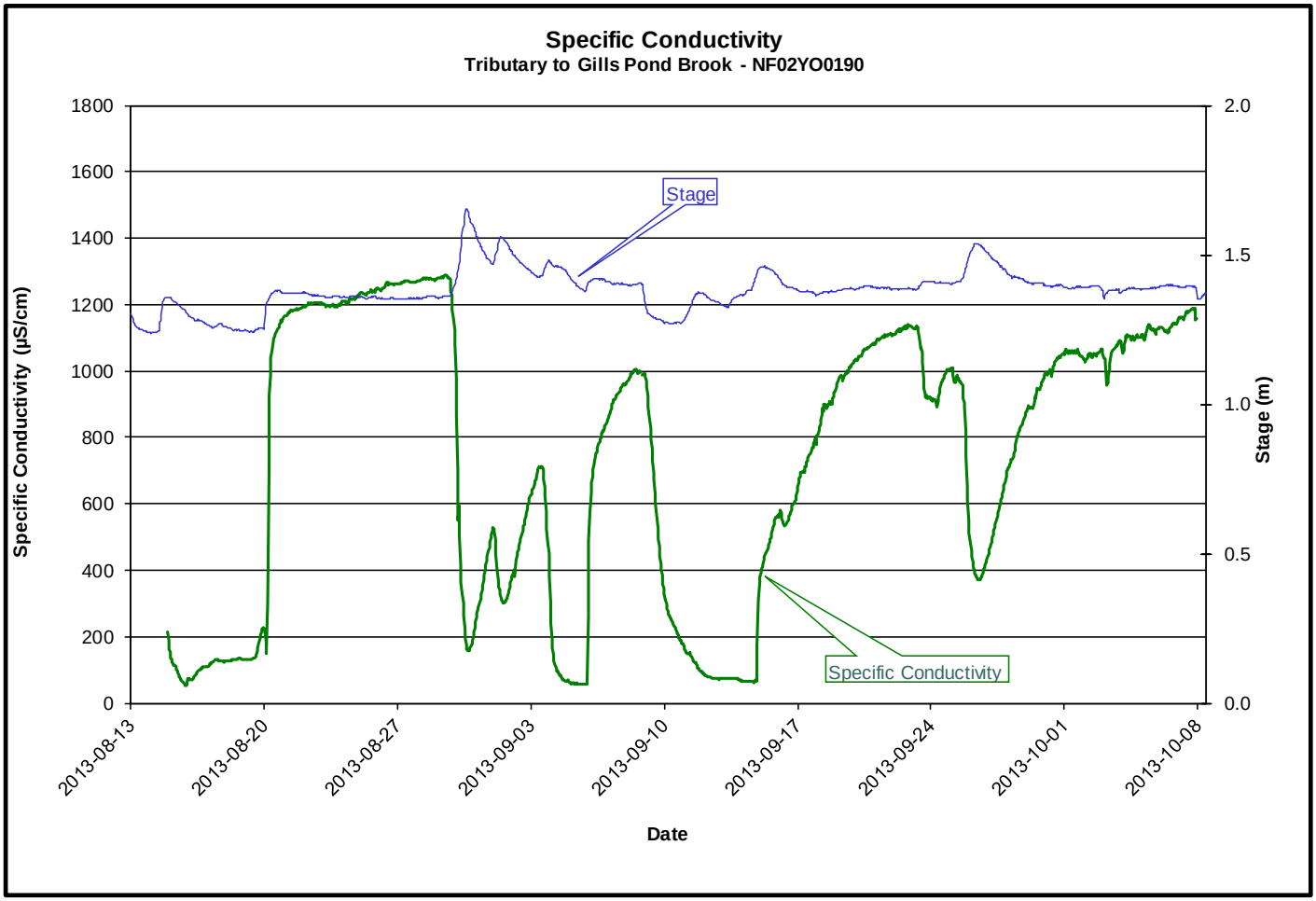

Figure 3

- The dissolved oxygen (**Figure 4**) values ranged from a minimum of 8.22 mg/L to a maximum of 11.06 mg/L over the deployment period, with the percent saturation ranging between 79.0 and 103.8.
- Dissolved oxygen increased slightly over the deployment period.
- All of the dissolved oxygen values fell around the minimum for Early Life Stages (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). This range is typical based upon water temperatures.
- 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.

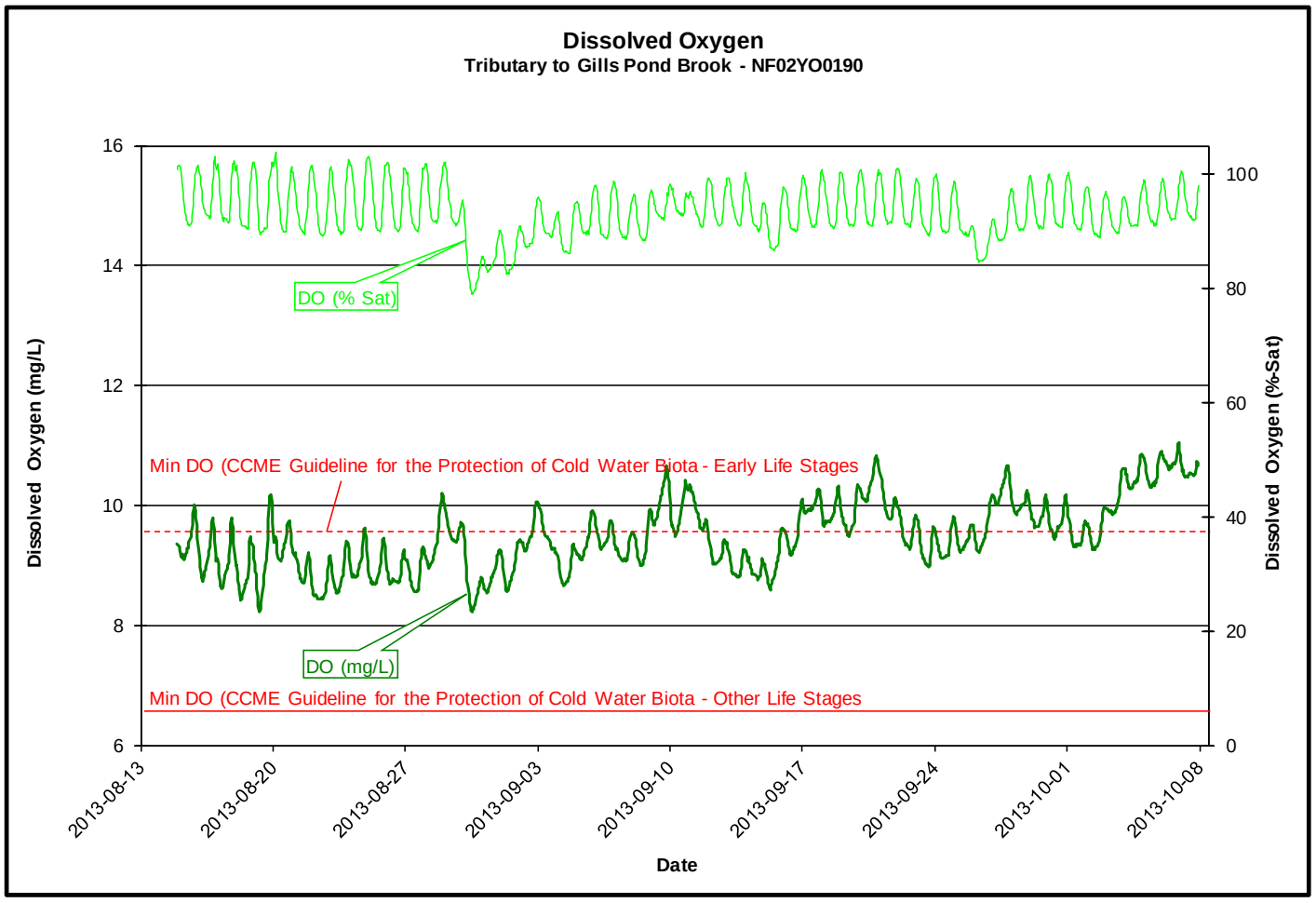

Figure 4

- The turbidity values **(Figure 5)** ranged from a minimum of 0.0 NTU to a maximum of 1295.0 NTU.

- Several days following the resumption of discharge from the polishing pond on August 21, 2013, there were three short term and unsustained peaks in turbidity which cannot be explained. Similarly, throughout the deployment period, there were some higher than normal turbidity values recorded particular during increased stage.

- Neither in-situ nor grab sample measurements nor visual observation indicated any significant or note-worthy turbidity issues.

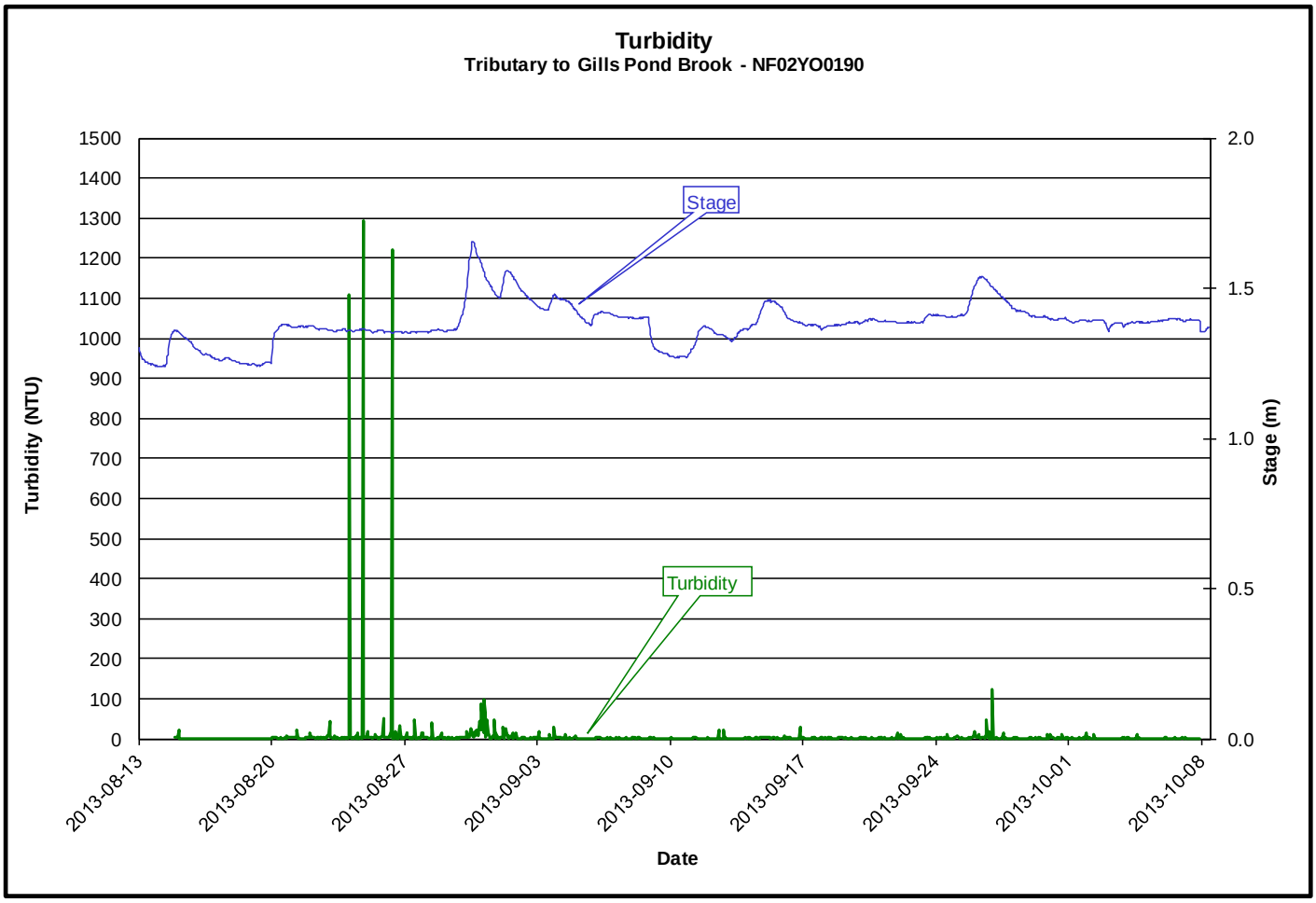

Figure 5

- The stage or water level ranged from a minimum of 1.24 m to a maximum of 1.66 m. The flow or discharge ranged from a minimum of 0.03 m^3/s to a maximum of 2.07 m^3/s (**Figure 6)**.
- Apart from the rapid increase in stage and flow following resumption of discharge from polishing pond on August 21, 2013, all other peaks in stage and flow are resultant from precipitation/runoff events.
- All values are within the normal range.

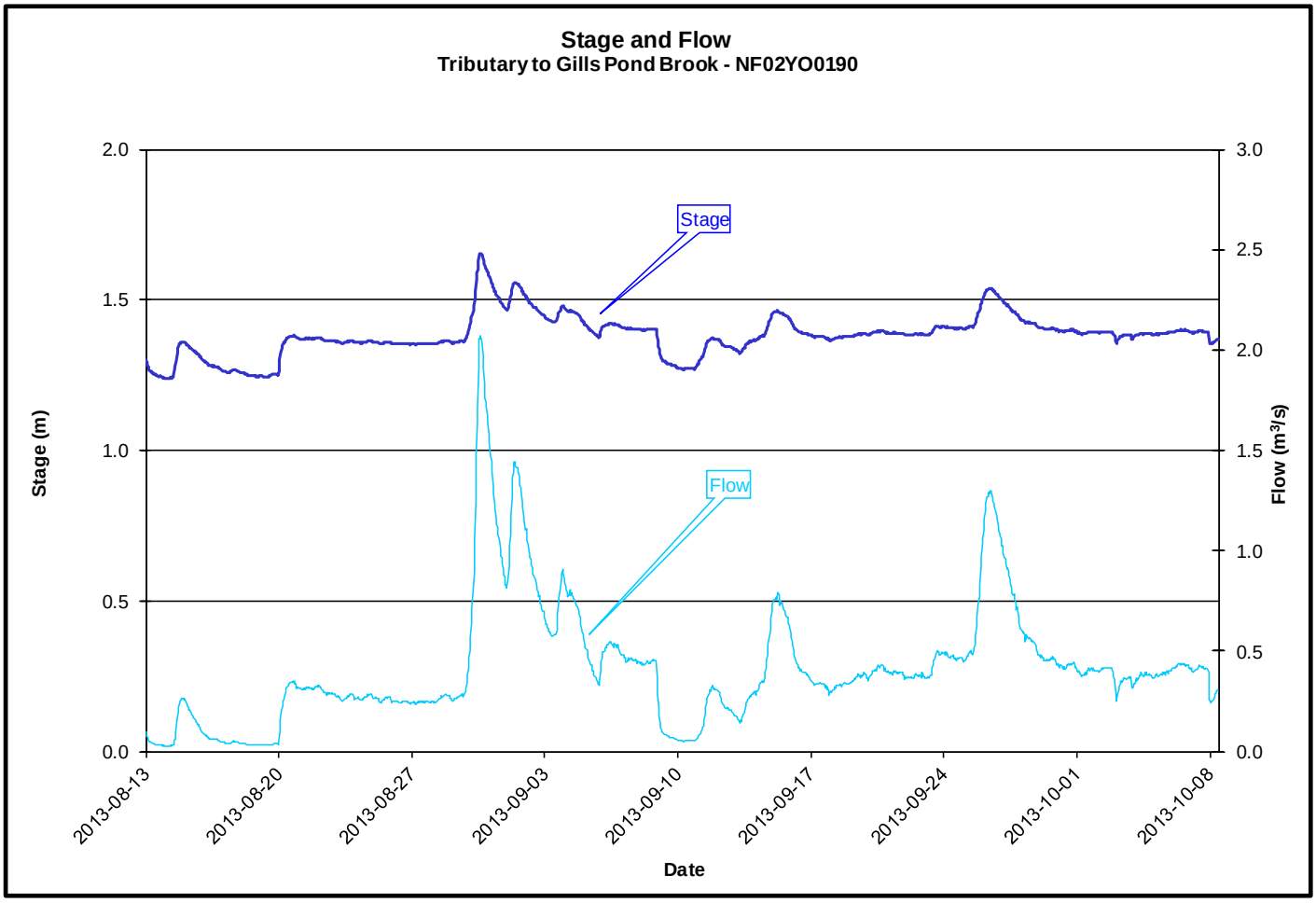

Figure 6

EAST POND BROOK

- The water temperature (**Figure 7**) ranged from a minimum of 8.14 ˚C to a maximum of 24.57 ˚C.
- The temperature generally decreased over the deployment period, with diurnal variation being lessened during periods of increased stage.
- In some instances, water temperature decreased with increases in stage. In other instances, water temperature increased. This is likely due to the nature of the weather system passing through.

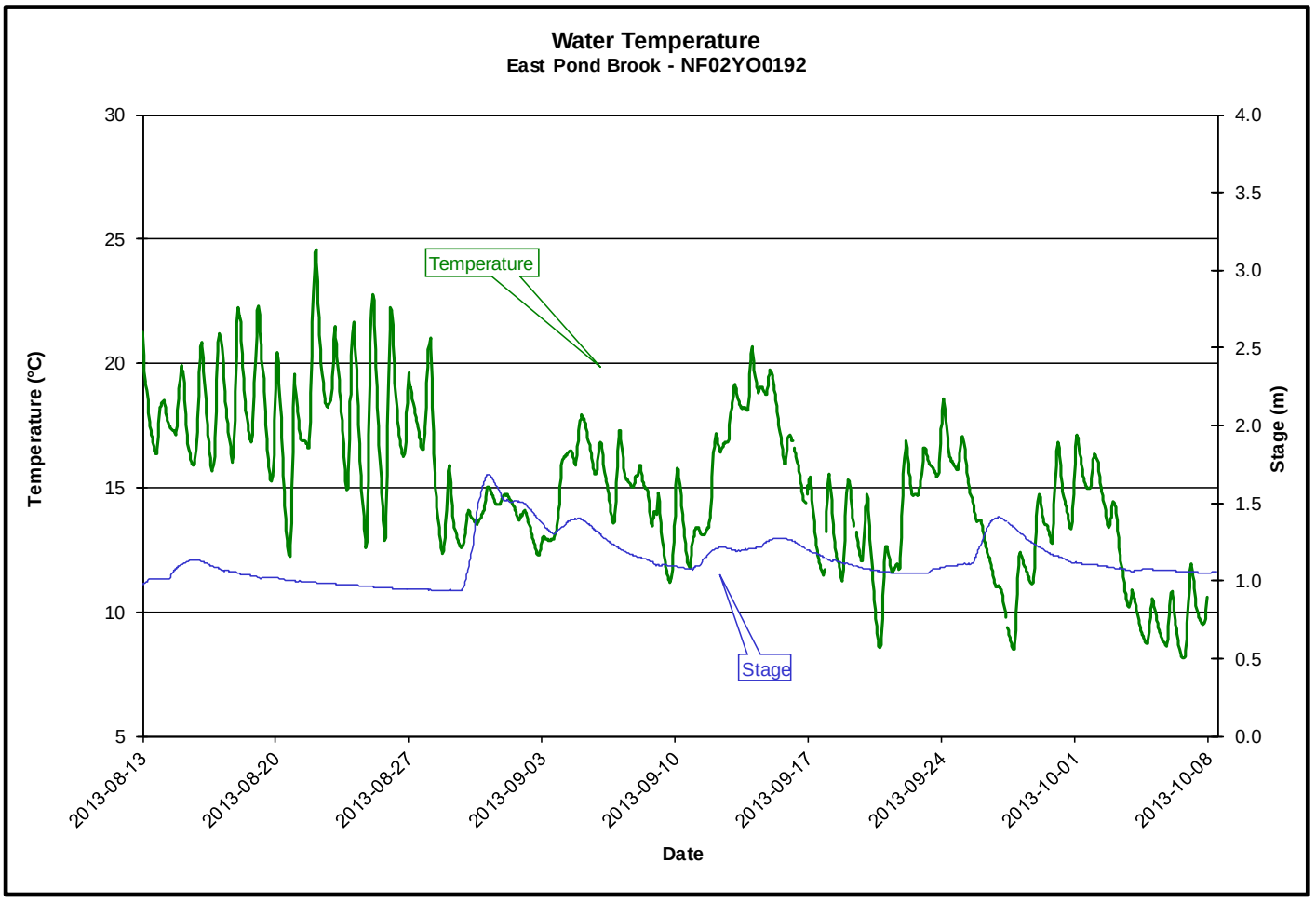

Figure 7

- Throughout the deployment period pH values (**Figure 8**) ranged from a minimum of 6.92 to a maximum of 7.23, with little change other than diurnal variation over the deployment period.
- There was a failure of the pH sensor on the Field **DataSonde**® for East Pond Brook on August 18, 2013. Erroneous data to the end of the deployment period have been removed from the data set.
- Given the limited data in this deployment period, it is impossible to determine if there is any relationship with stage.
- pH values were all within the recommended range (6.5 – 9.0) for the CCME *Canadian Water Quality Guidelines for the Protection of Aquatic Life*.
- The background pH of this stream is normally quite low, and values near and below the lower limit are not unusual.

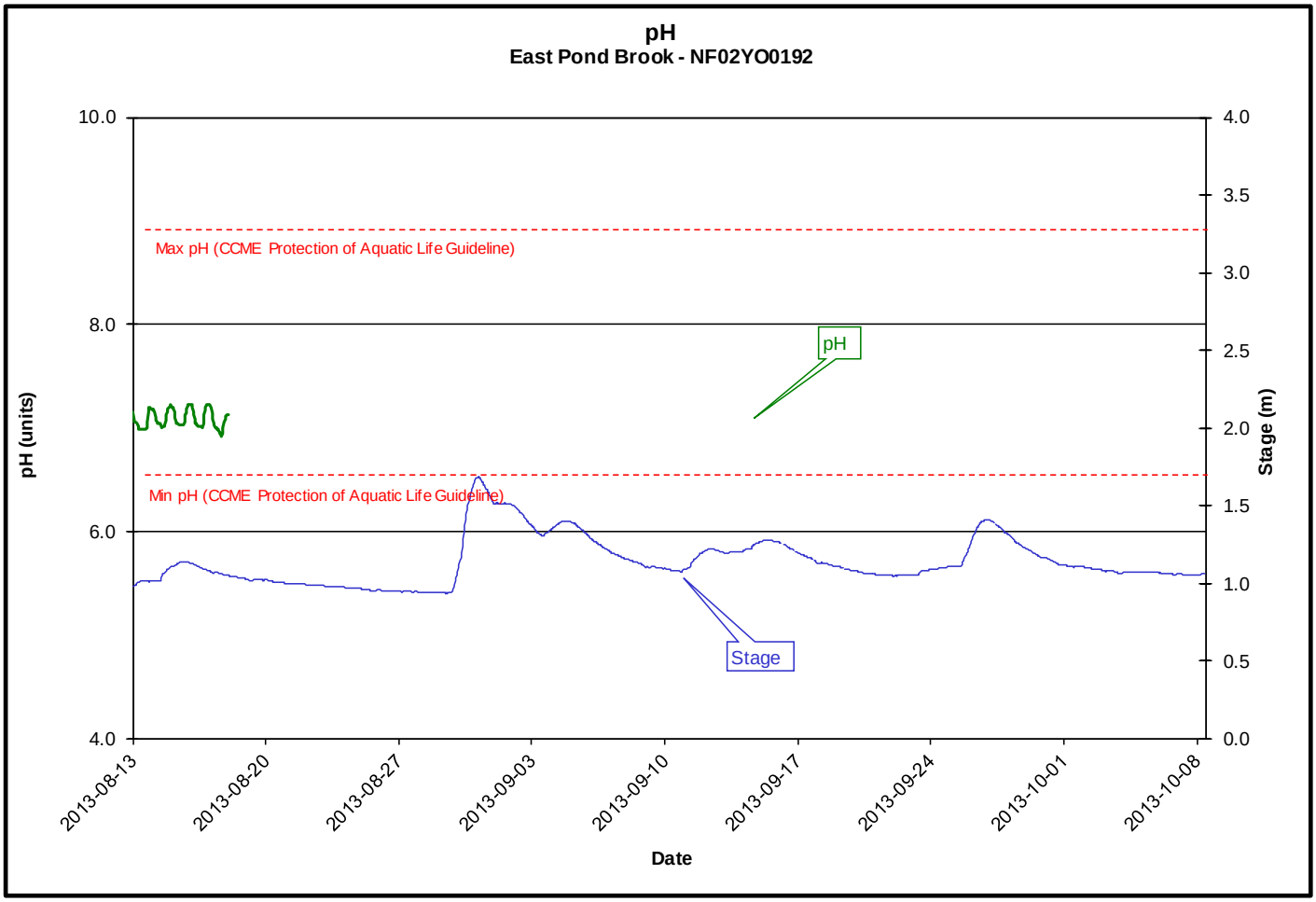

Figure 8

- The specific conductivity **(Figure 9)** ranged from a minimum of 21.4 µS/cm to a maximum of 44.1 µS/cm.
- There is a positive correlation with stage, as over several instances, specific conductance increased rapidly during the rising leg of the hydrograph.
- All values are within the normal range.

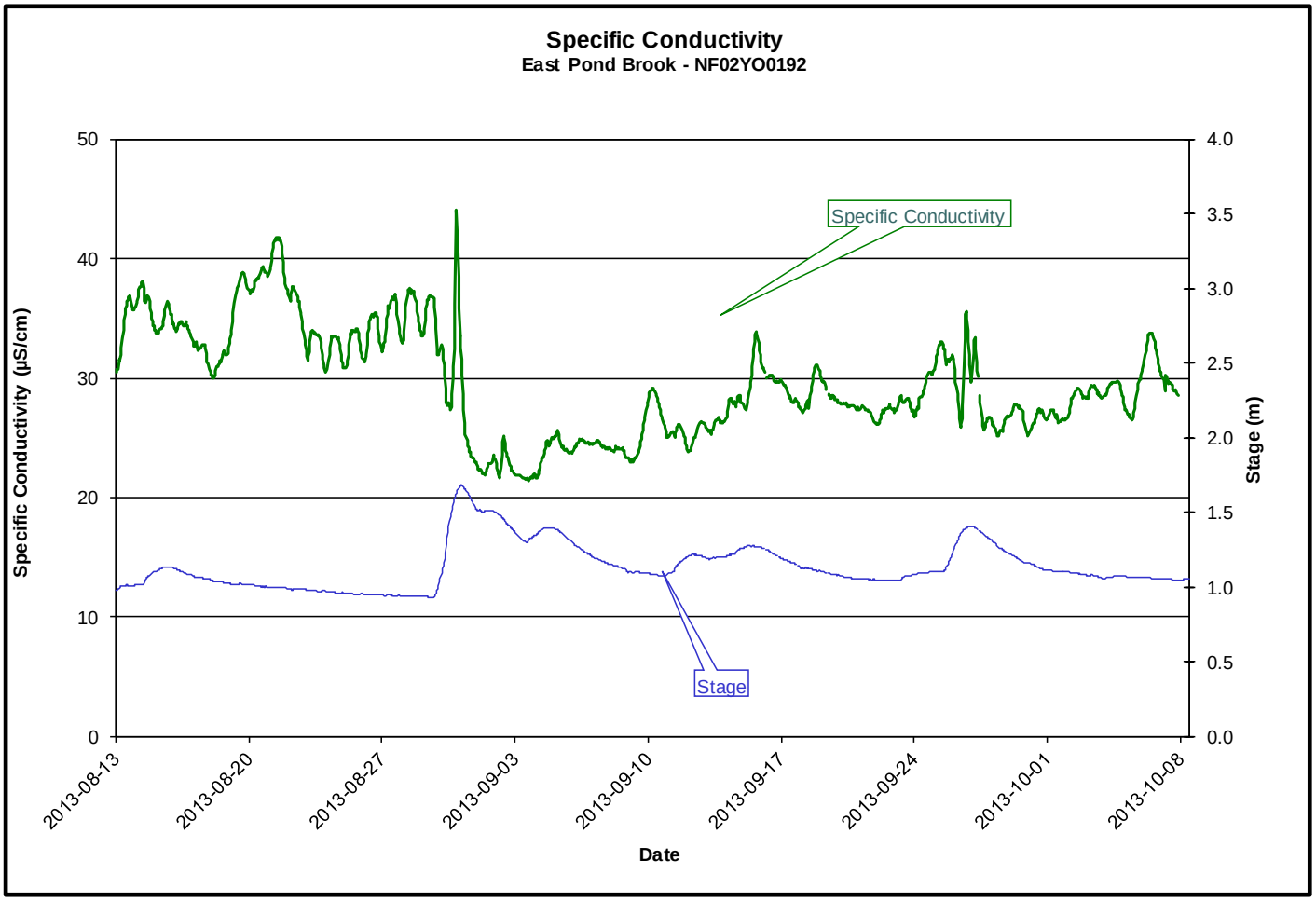

Figure 9

- The dissolved oxygen (**Figure 10**) values ranged from a minimum of 8.04 mg/L to a maximum of 11.57 mg/L over the deployment period, with the percent saturation ranging between 91.3 and 103.6.
- There was little variation in dissolved oxygen over the deployment period, other than the diurnal variation.
- All of the dissolved oxygen values fell around the minimum for Early Life Stages (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). This range is typical based upon water temperatures.
- Based upon the fact that Dissolved Oxygen % Saturation had limited drift, we can be confident that the Dissolved Oxygen mg/L values are accurate.

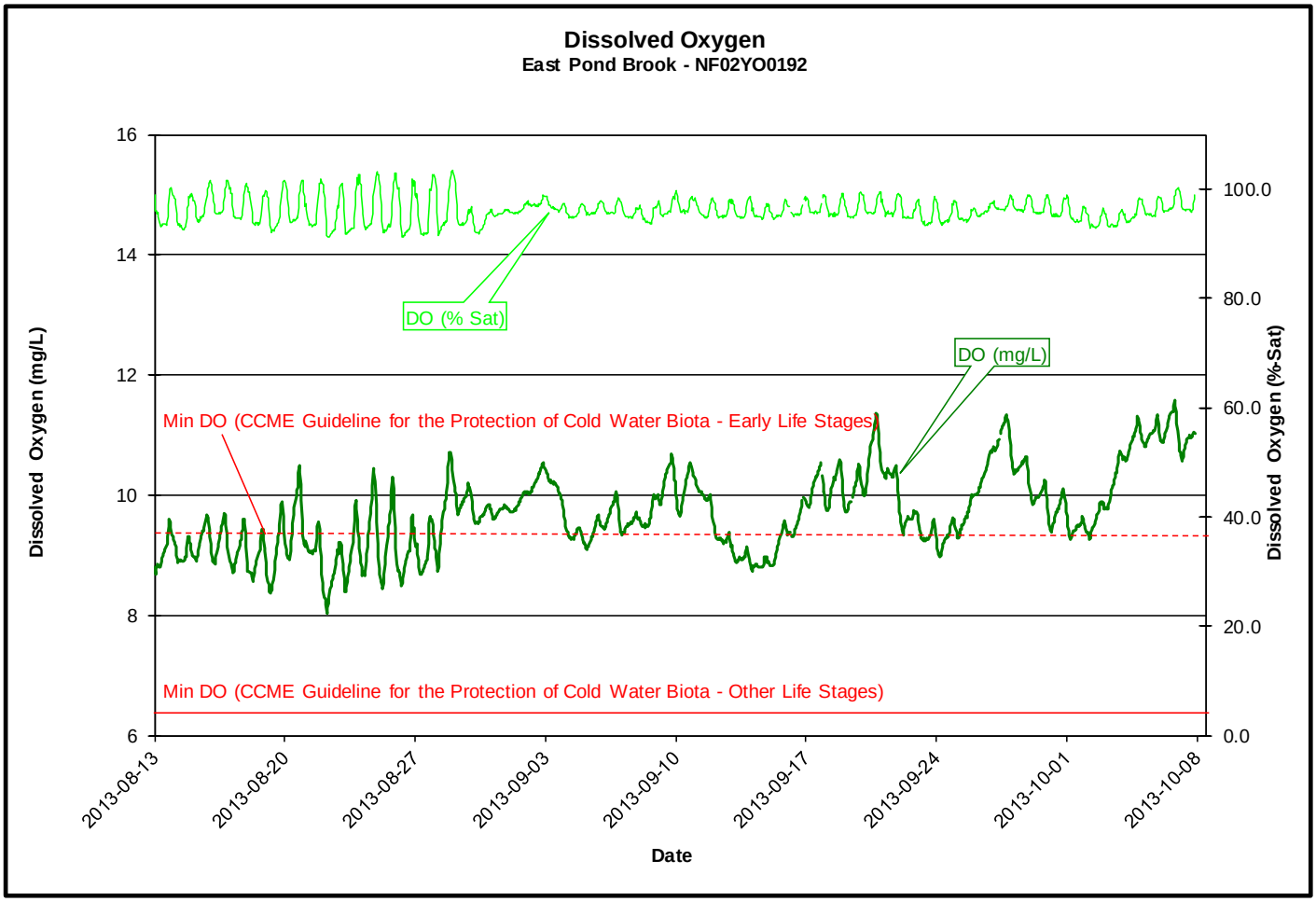

Figure 10

- The turbidity values (**Figure 11**) ranged from a minimum of 0.0 NTU to a maximum of 10.1 NTU.
- As noted above, beginning on September 15, 2013 there was leafy debris caught in the sensor for East Pond Brook, which caused false positive turbidity readings until the end of the deployment period. Erroneous data have been removed from the data set.
- Peaks in turbidity corresponded with increases in stage.
- While neither in-situ nor grab sample measurements nor visual observation indicated turbidity issues, turbidity in this stream is seldom recorded much above zero. These measurements are atypical and future measurements will be followed closely.

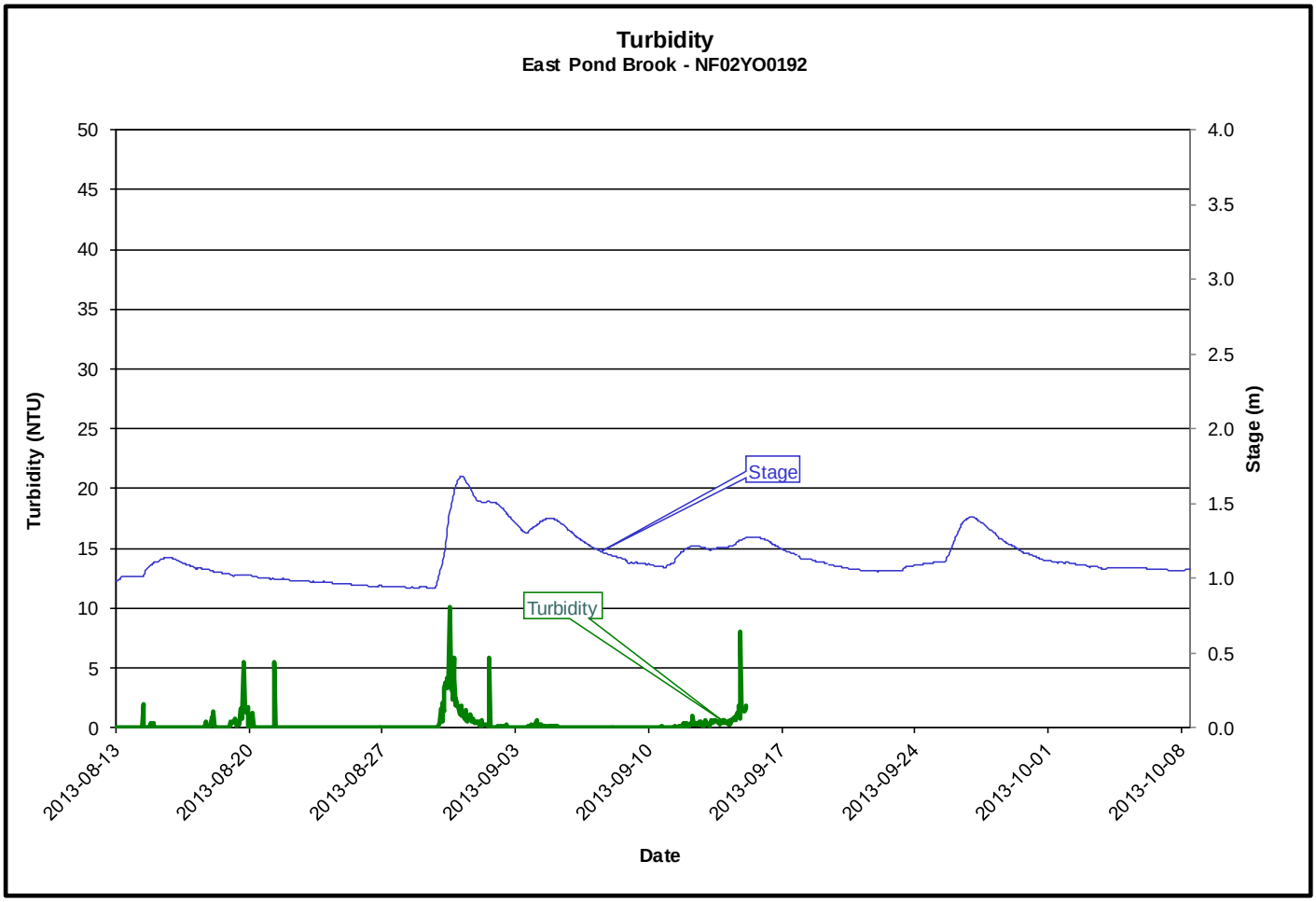

Figure 11

- The stage or water level ranged from a minimum of 0.93 m to a maximum of 1.68 m. The flow or discharge ranged from a minimum of 0.20 m^3/s to a maximum of 8.86 m^3/s **(Figure 12)**.
- Increases in stage and flow are attributed to precipitation/runoff events.
- All values for stage and flow are within the normal range.

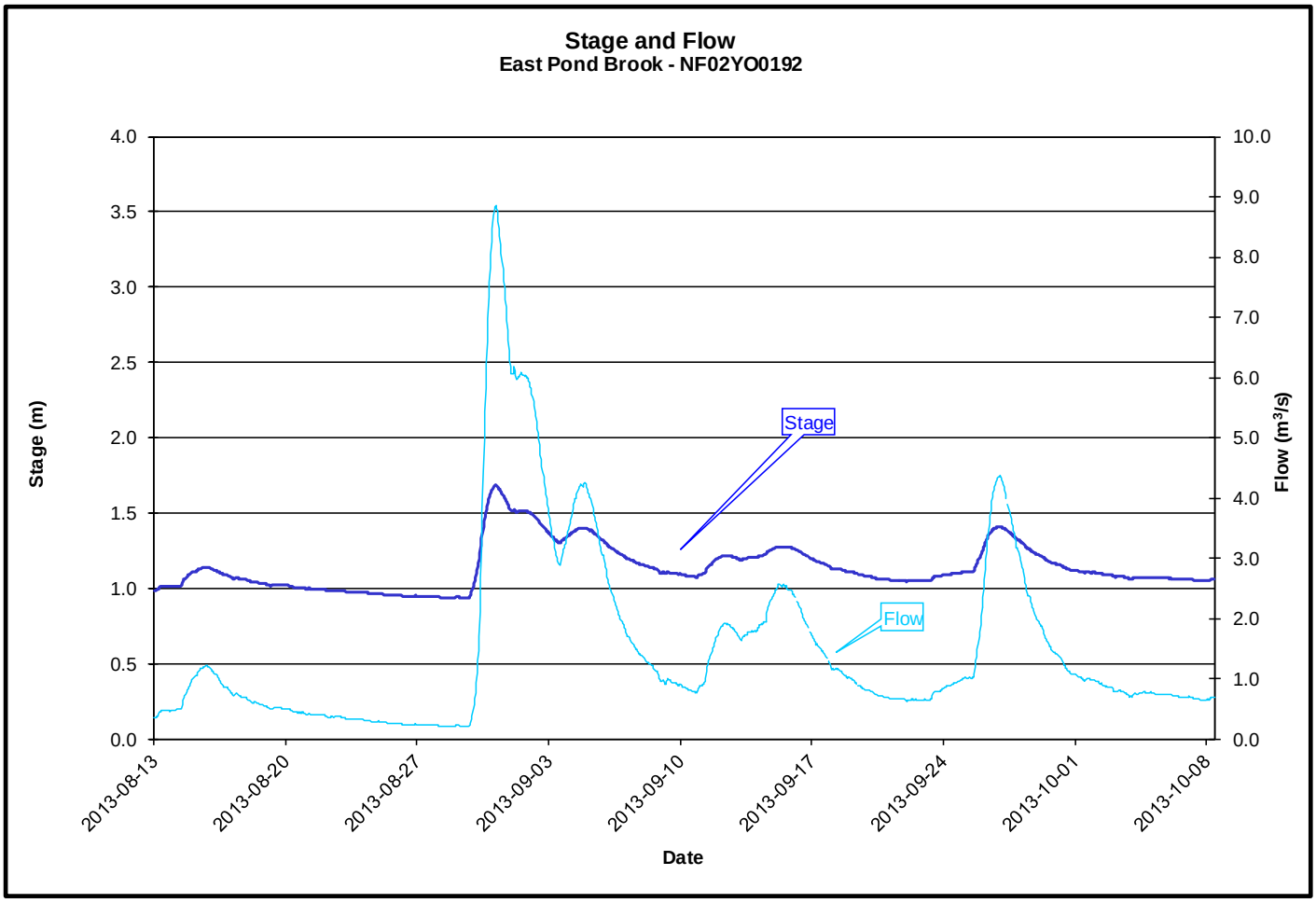

Figure 12

WELL AFTER TAILING DAM (MW1)

- The water temperature (**Figure 13**) ranged from a minimum of 5.20 ˚C to a maximum of 5.70 ˚C with a definite increase over the deployment period.
- There appears to be no correlation with water elevation.

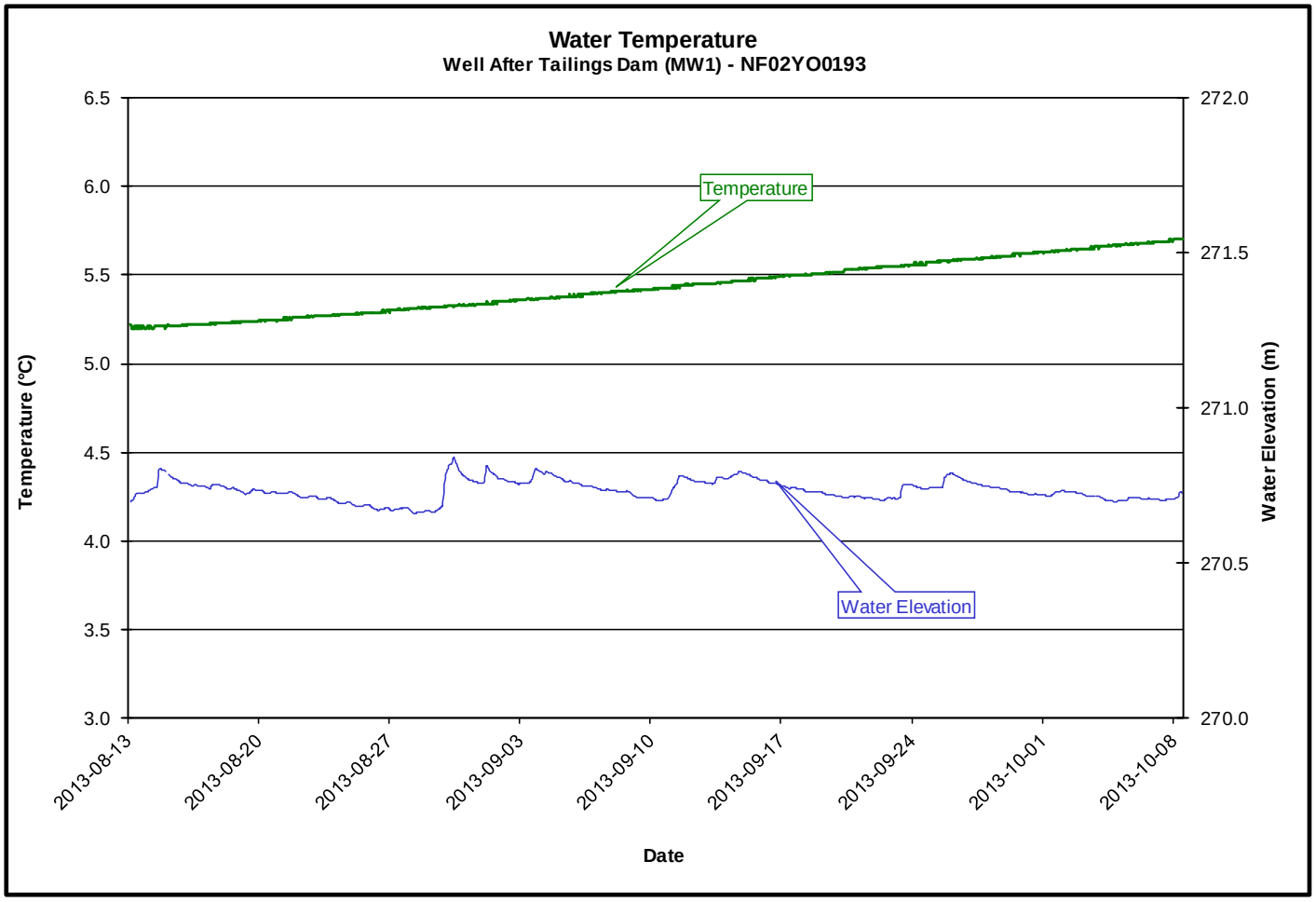

Figure 13

- The pH (**Figure 14**) ranged from a minimum of 7.68 to a maximum of 8.21 over the deployment period.
- Typical of all deployments in this well, there is a rapid increase in pH during the first few days of deployment, followed by a subsequent levelling off. This change is attributed to the disruption of the water column in the well during the replacement of the instrument.
- There does not appear to be any correlation with water elevation.

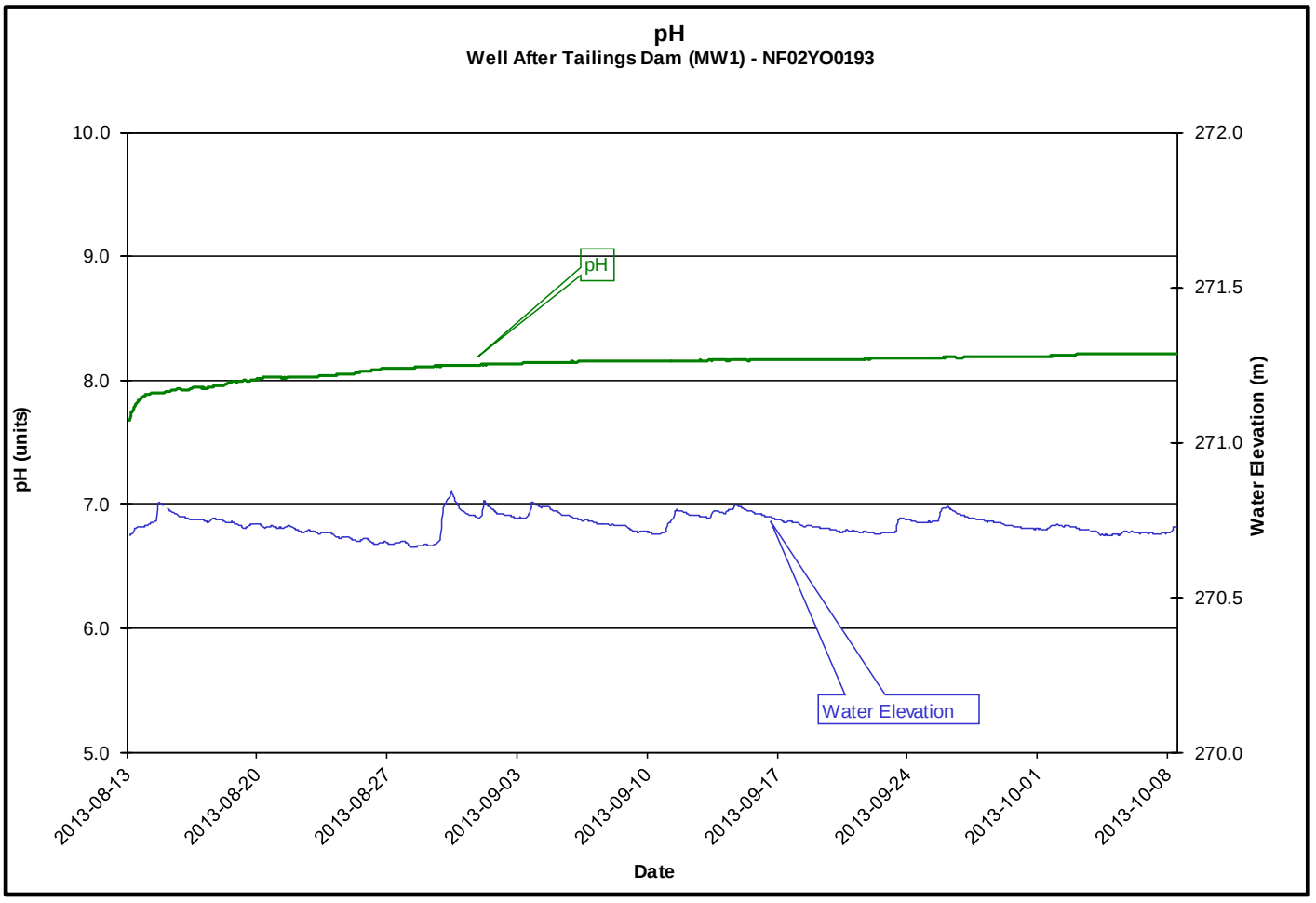

Figure 14

- The specific conductivity **(Figure 15)** ranged from a minimum of 0.757 mS/cm to a maximum of 0.790 mS/cm.
- There was a slight increase over the deployment period.
- There does not seem to be any correlation with water elevation.

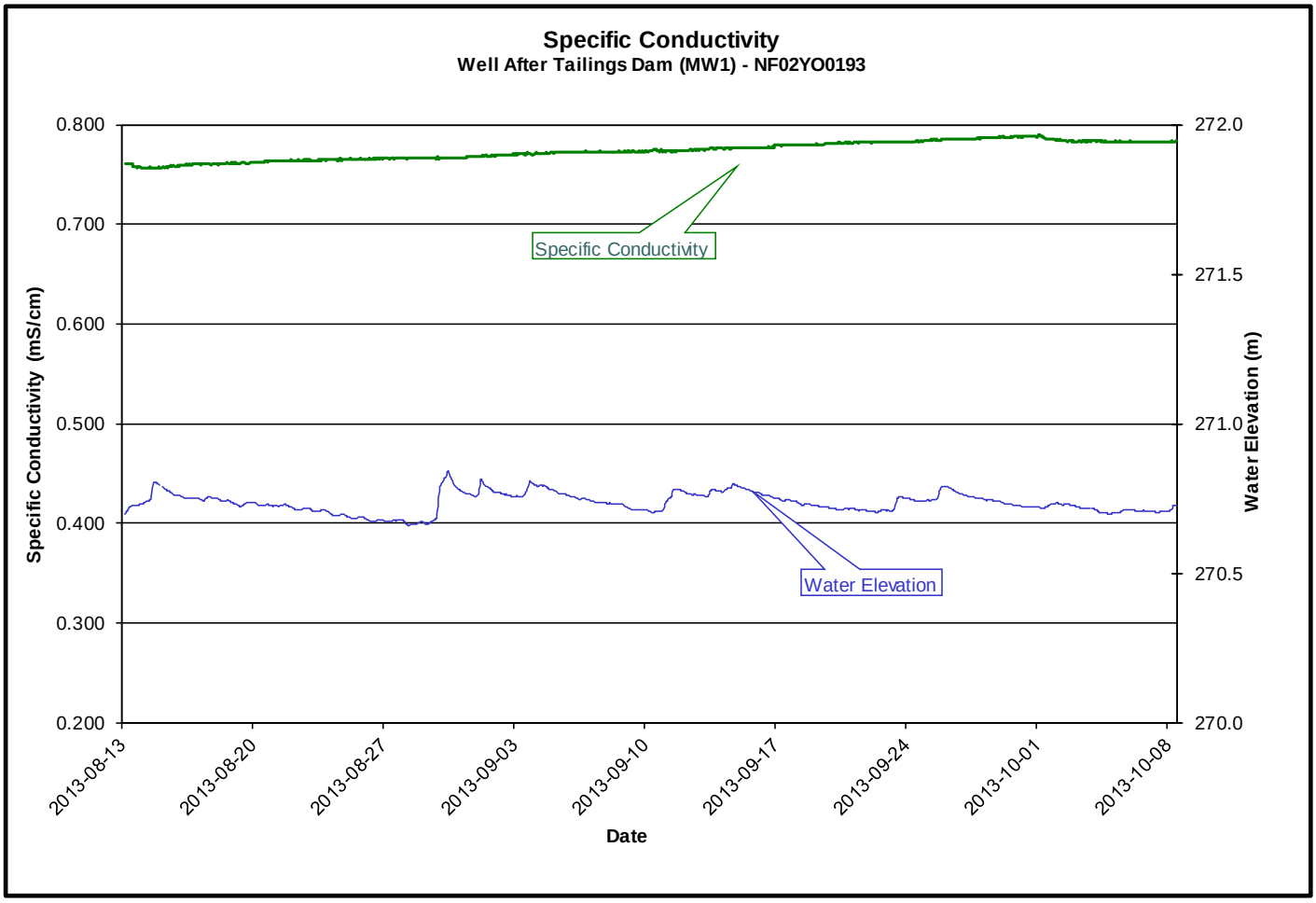

Figure 15

- The Water Elevation **(Figure 16)** ranged from a minimum of 270.66 m to a maximum of 270.84 m, remaining fairly constant 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.

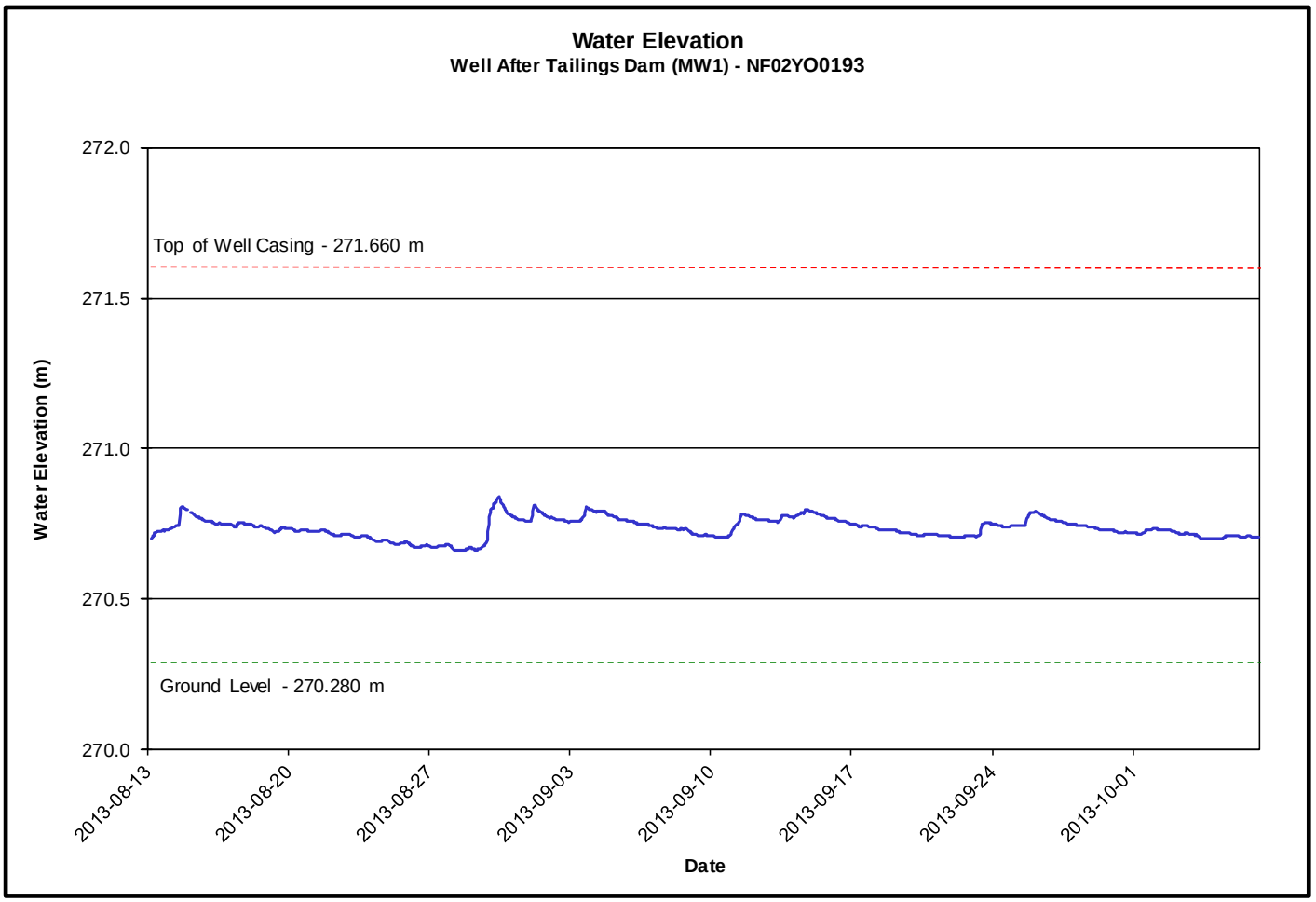

Figure 16

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