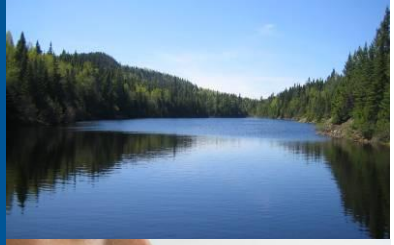




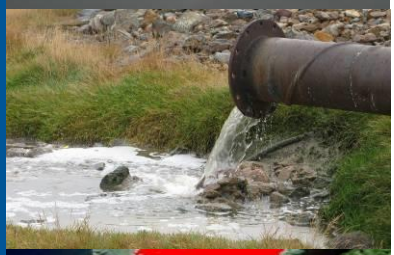


Real Time Water Quality Report
Teck Duck Pond Operations

Deployment Period 2013-07-23 to 2013-08-13

2013-10-11

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 the entire deployment period, however, discharge volume was being reduced on the last day of the deployment period.

Maintenance and Calibration of Instrumentation

- The new **DataSonde®**(s/n 62268) for Tributary to Gills Pond Brook and an old **DataSonde®**(s/n 43245) for East Pond Brook were installed on July 24, 2013, after being freshly cleaned and calibrated. Both units remained deployed until August 13, 2013; a 19 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 new **Quanta G®** (s/n 00653) was deployed on May 14, 2013 and remained deployed continuously in Monitoring Well After Tailings Dam Station (MW1), until August 13, 2013. This report covers a 20 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 an intermittent failure of Dissolved Oxygen on the Field **DataSonde®** for Tributary to Gills Pond Brook during the first two days of deployment. Thus a ranking during installation cannot be determined. Erroneous data have been removed from the data set. This instrument has been sent for servicing.
- A 'Fair' ranking was calculated for pH for East Pond Brook upon removal. This spread of 0.67 pH unit has been noted, and the instruments used will continue to be monitored in the future to ensure that all pH data are valid.
- 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 a previous report. The removal ranking is documented in **Table 4** below.
- Beginning on August 4, 2013, the **Quanta G®** (s/n 00653) in Monitoring Well After Tailings Dam Station (MW1) began to report erroneous pH data. Thus a ranking for pH upon removal cannot be determined. These data have been removed the data set. This instrument has subsequently been sent for servicing.
- 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**
2013-07-24 Installation	Temp (^{o}C)	Excellent
	pH (units)	Excellent
	Sp. Conductivity (µS/cm)	Excellent
	Dissolved Oxygen (mg/L)	N/A
	Turbidity (NTU)	Excellent
2013-08-13 Removal	Temp (^{o}C)	Excellent
	pH (units)	Good
	Sp. Conductivity (µS/cm)	Excellent
	Dissolved Oxygen (mg/L)	Excellent
	Turbidity (NTU)	Good

Table 2

East Pond Brook Station (NF02YO0192)		
Date (yyyy-mm-dd)	**Parameter**	**Ranking**
2013-07-24 Installation	Temp (^{o}C)	Good
	pH (units)	Excellent
	Sp. Conductivity (µS/cm)	Excellent
	Dissolved Oxygen (mg/L)	Excellent
	Turbidity (NTU)	Excellent
2013-08-13 Removal	Temp (^{o}C)	Good
	pH (units)	Fair
	Sp. Conductivity (µS/cm)	Good
	Dissolved Oxygen (mg/L)	Excellent
	Turbidity (NTU)	Excellent

Table 3

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

Table 4

Data Interpretation

TRIBUTARY TO GILLS POND BROOK

- The water temperature (**Figure 1**) ranged from a minimum of 15.82˚C to a maximum of 24.55˚C.
- The temperature generally remained consistent over the deployment period, with the only variation being diurnal.
- There is no significant relationship obvious with stage.

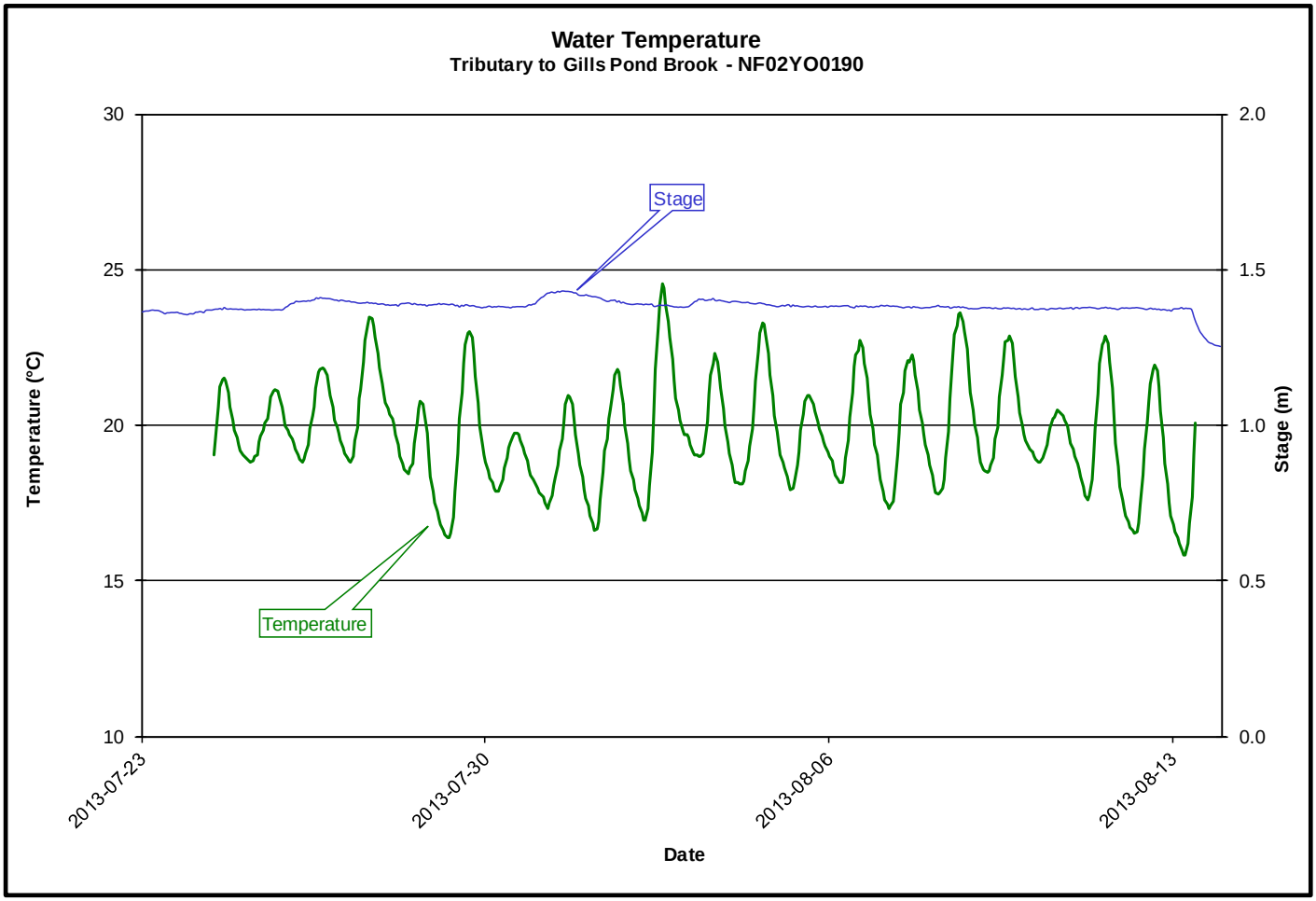

Figure 1

- Throughout the deployment period, pH values (**Figure 2**) ranged from a minimum of 6.72 to a maximum of 7.57 with all values around the lower limit of the recommended range (6.5 – 9.0) for the CCME *Canadian Water Quality Guidelines for the Protection of Aquatic Life*.
- An inverse relationship with stage is obvious over only one event during the deployment period.
- There is little change in pH throughout the deployment period apart from the diurnal variation.
- 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.

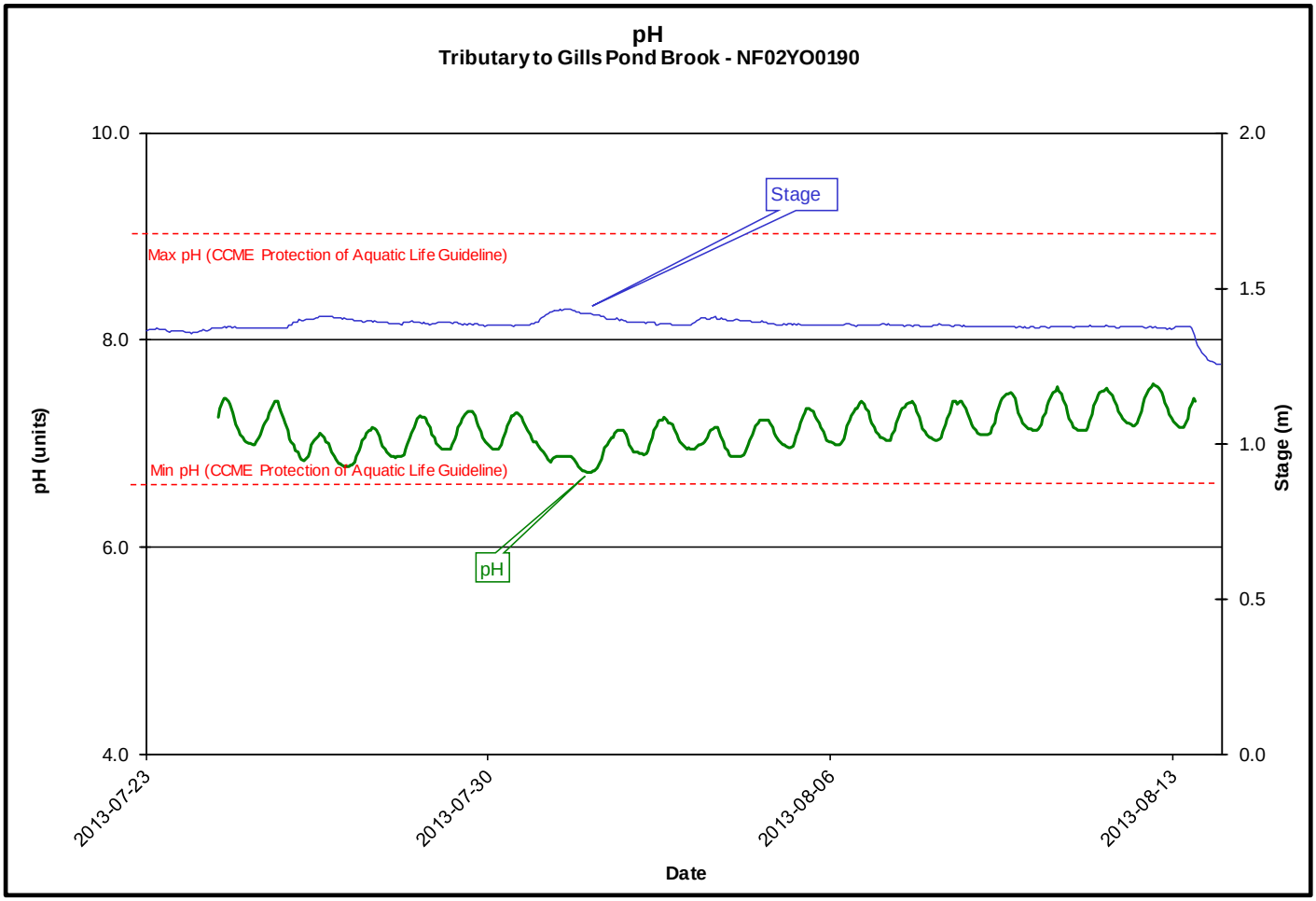

Figure 2

- The specific conductivity **(Figure 3)** ranged from a minimum of 661.0 µS/cm to a maximum of 1209.0 µS/cm over the deployment period.
- An inverse relationship with stage is obvious over several events during the deployment period.
- Precipitation events effectively cause a dilution effect in the stream's specific conductivity, which was elevated from natural background levels throughout the entire deployment period due to discharge from the Polishing Pond.

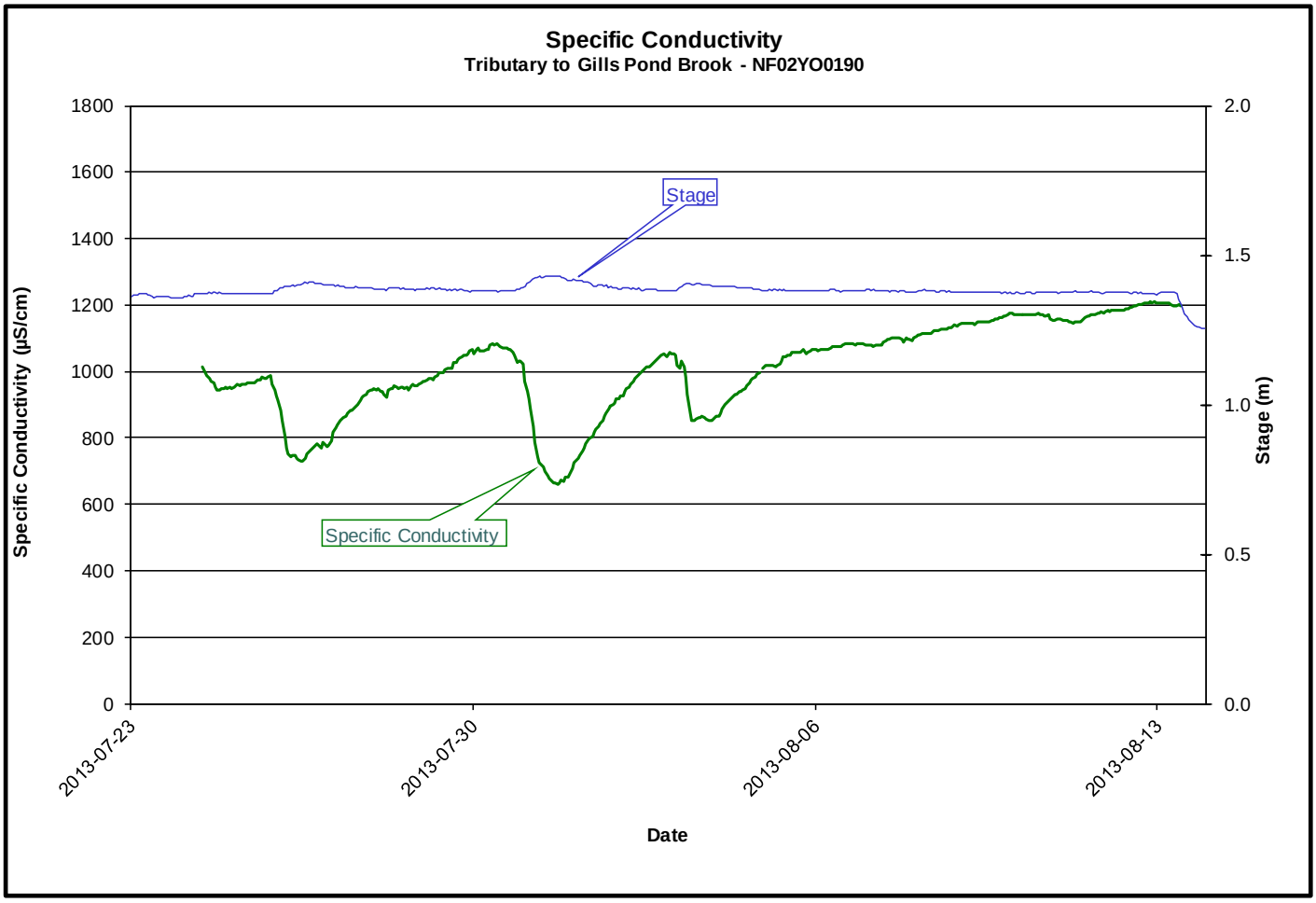

Figure 3

- The dissolved oxygen (**Figure 4**) values ranged from a minimum of 7.89 mg/L to a maximum of 9.33 mg/L over the deployment period, with the percent saturation ranging between 87.0 and 102.6.
- Dissolved oxygen remained fairly constant over the deployment period with the only variation being diurnal.
- All of the dissolved oxygen values fell between the minimum for Early Life Stages and the minimum for Other 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.

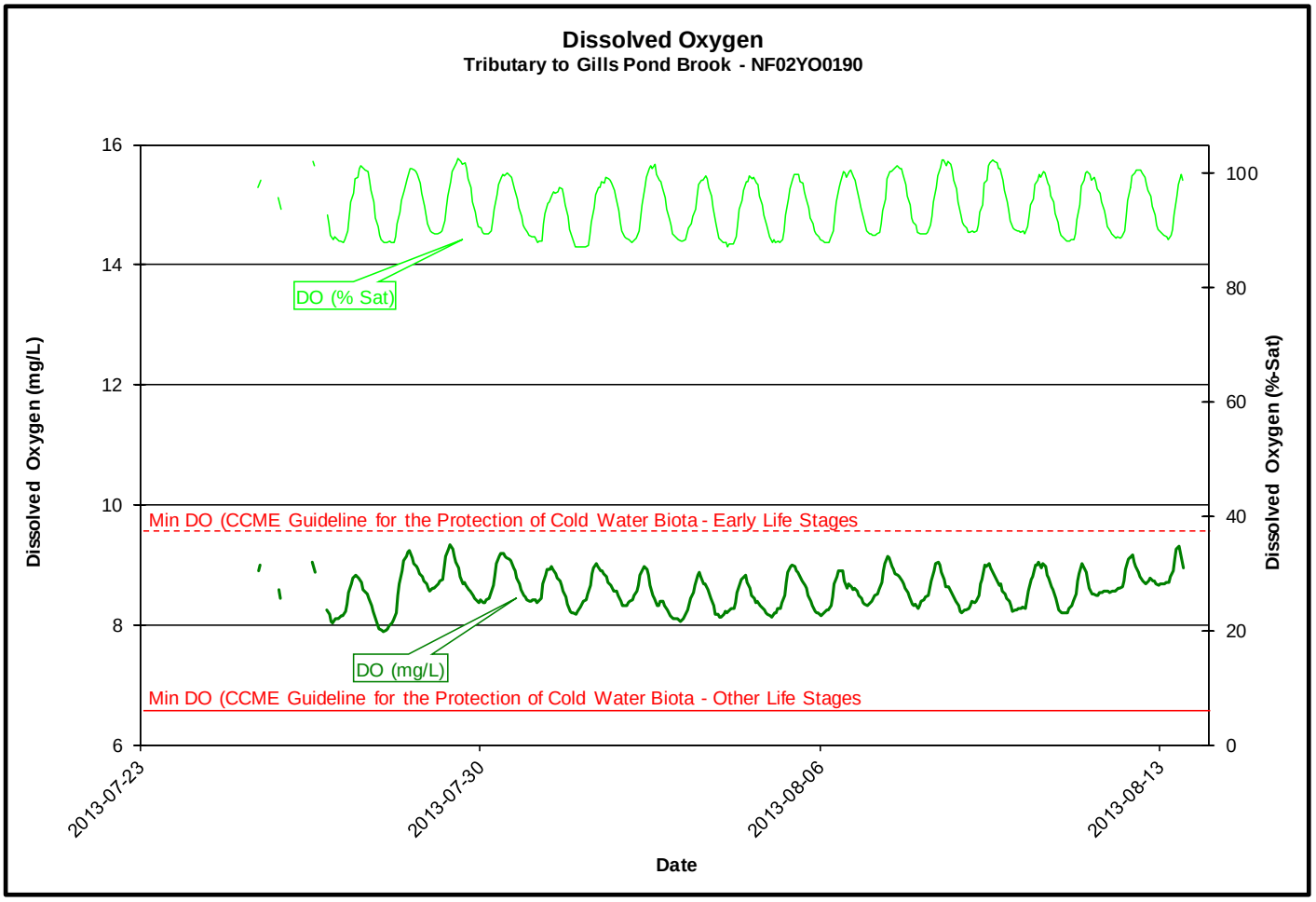

Figure 4

- The turbidity values **(Figure 5)** ranged from a minimum of 0.0 NTU to a maximum of 0.1 NTU.
- Neither in-situ nor grab sample measurements nor visual observation indicated any significant or note-worthy turbidity issues.

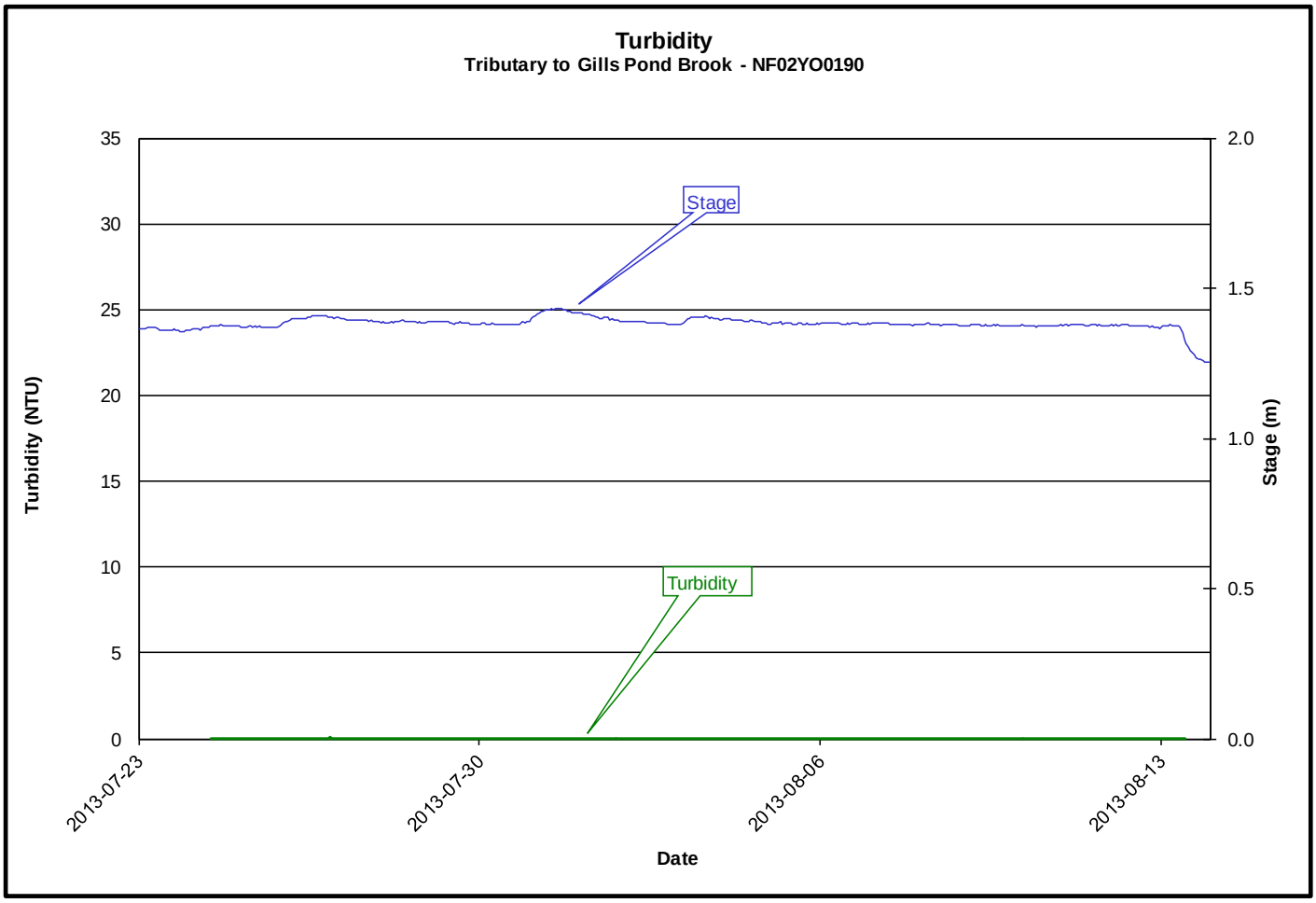

Figure 5

- The stage or water level ranged from a minimum of 1.25 m to a maximum of 1.43 m. The flow or discharge ranged from a minimum of 0.4 m^3/s to a maximum of 0.60 m^3/s (**Figure 6)**.
- The peaks in stage and flow are resultant from precipitation/runoff events.
- The decrease in stage and flow during the last day are due to a reduction in discharge from Dam C, at the upstream Polishing Pond.
- All values are within the normal range.

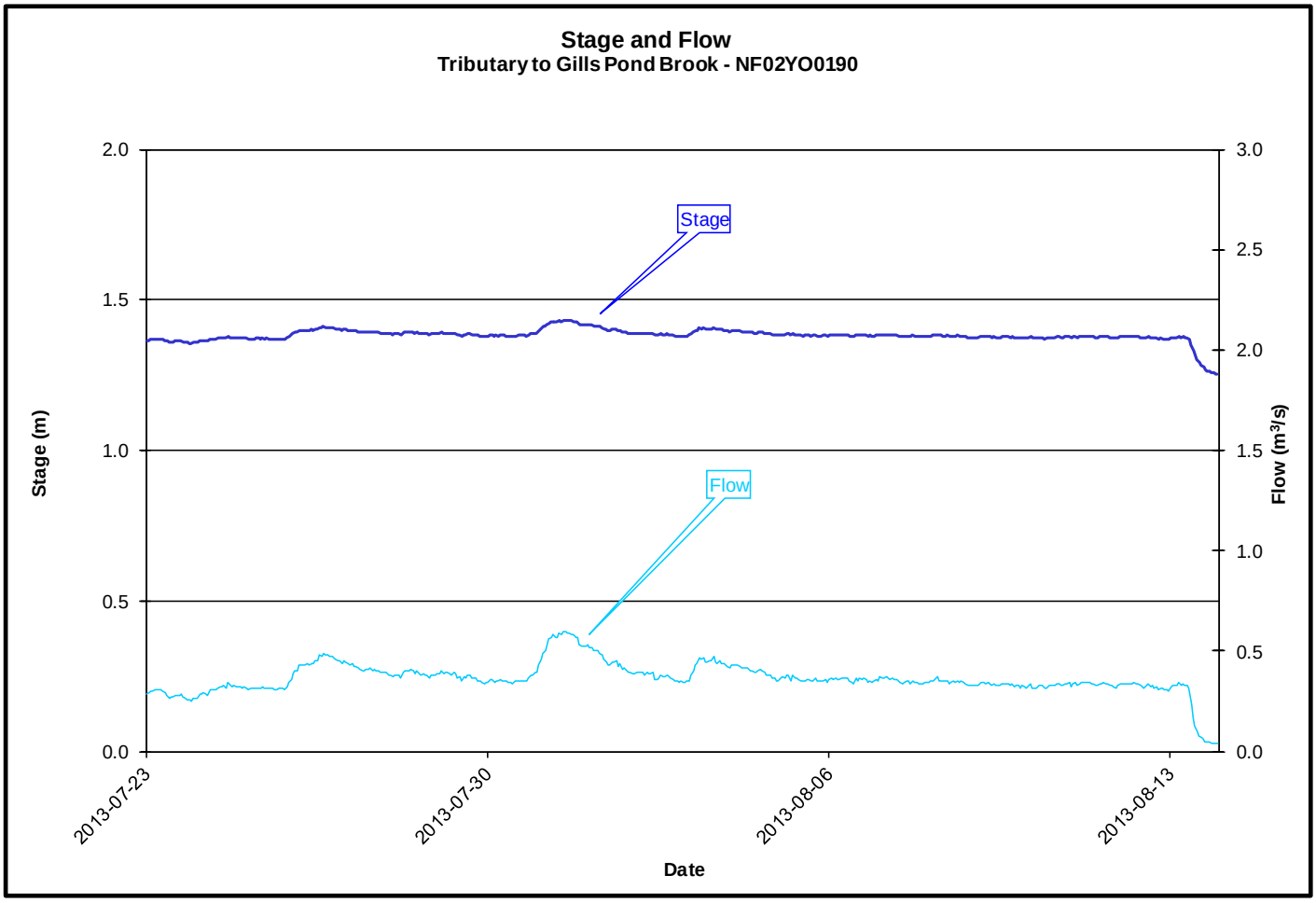

Figure 6

EAST POND BROOK

- The water temperature (**Figure 7**) ranged from a minimum of 14.13 ˚C to a maximum of 24.08 ˚C.
- Temperature decreased slightly over the deployment period.
- The diurnal variation is most obvious.
- There does not appear to be any relationship with stage during this period.

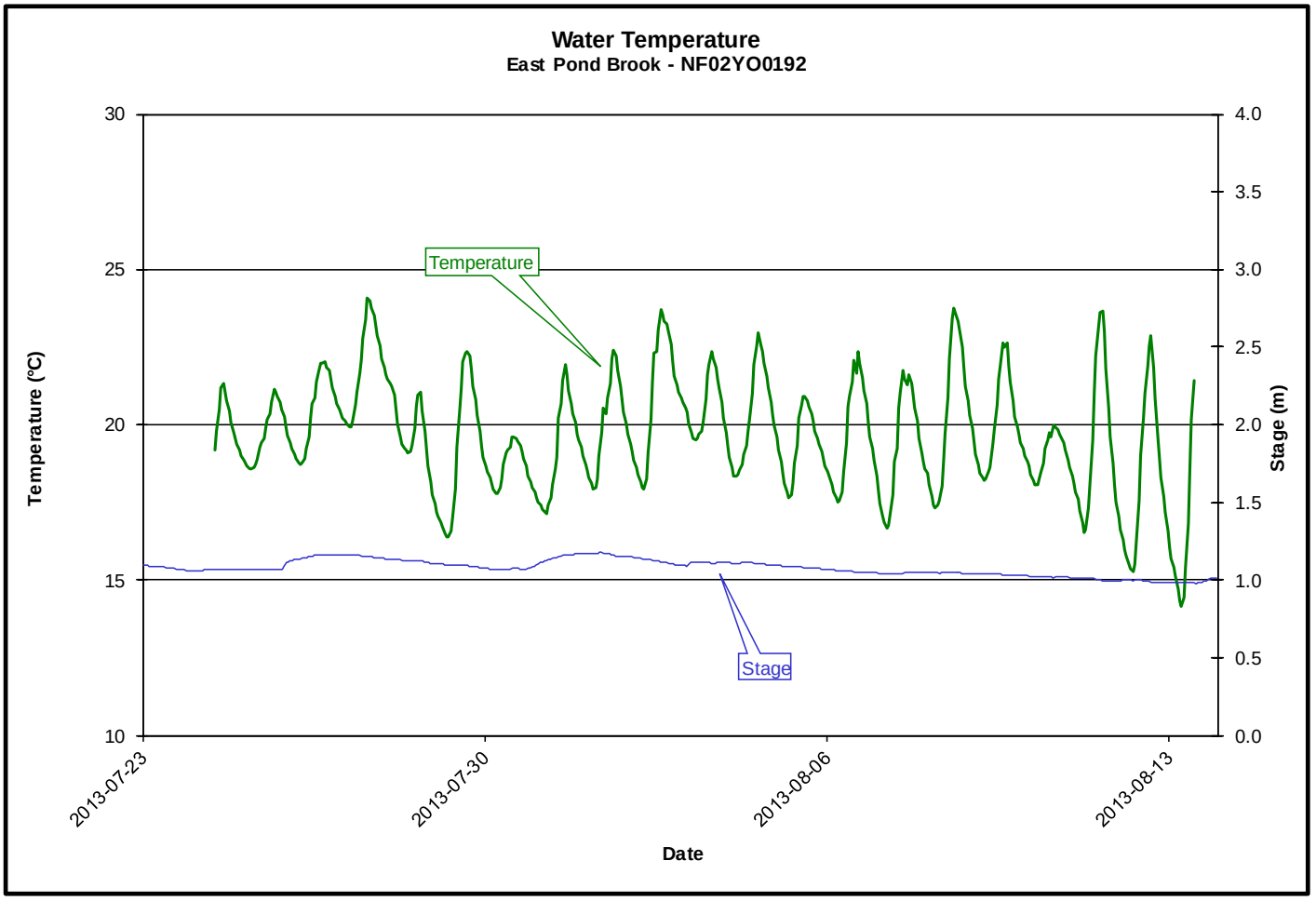

Figure 7

- Throughout the deployment period pH values (**Figure 8**) ranged from a minimum of 6.67 to a maximum of 7.13, with little change other than diurnal variation over the deployment period.
- There does not appear to be any relationship with stage over this deployment period.
- pH values were all near 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 background pH of this stream is normally quite low, and values near and below the lower limit are not unusual.

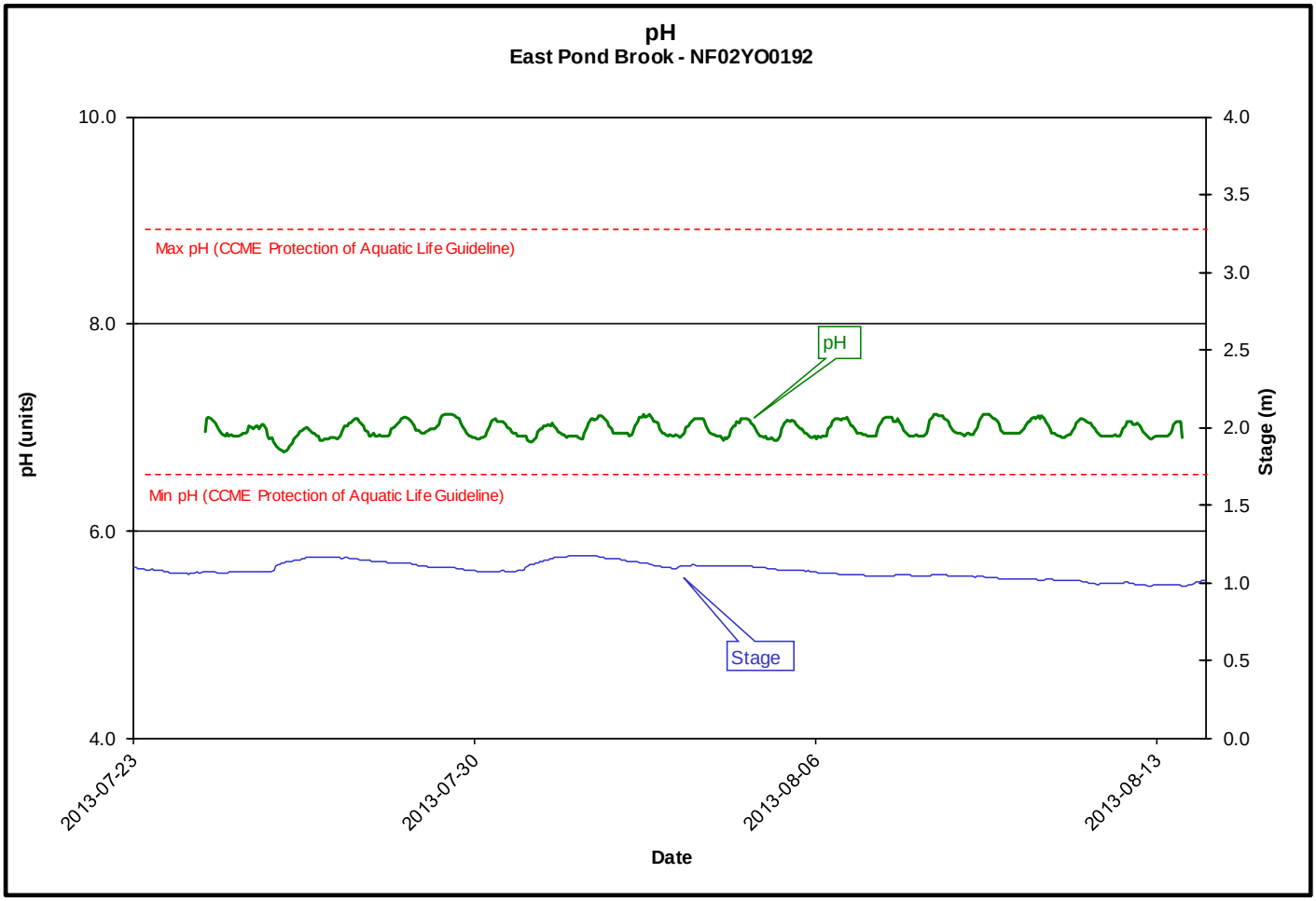

Figure 8

- The specific conductivity **(Figure 9)** ranged from a minimum of 26.1 µS/cm to a maximum of 37.5 µS/cm.
- There were minor changes in specific conductance, none of which appear to be related to stage.
- All values are within the normal range.

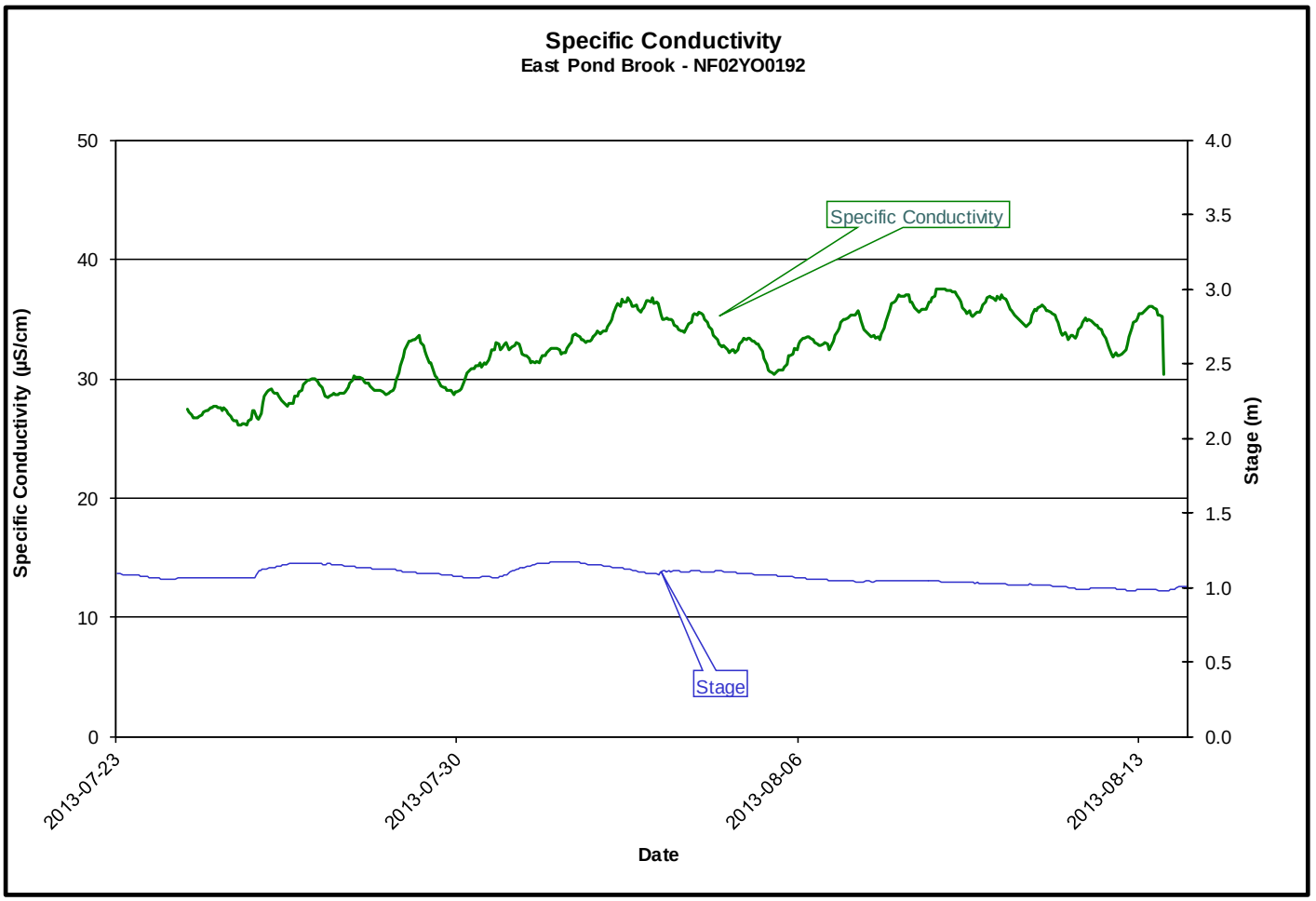

Figure 9

- The dissolved oxygen (**Figure 10**) values ranged from a minimum of 8.06 mg/L to a maximum of 9.79 mg/L over the deployment period, with the percent saturation ranging between 90.4 and 100.6.
- There was little variation in dissolved oxygen over the deployment period, other than the diurnal variation.
- Nearly all of the dissolved oxygen values fell between the minimum for Early Life Stages and the minimum for Other 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.

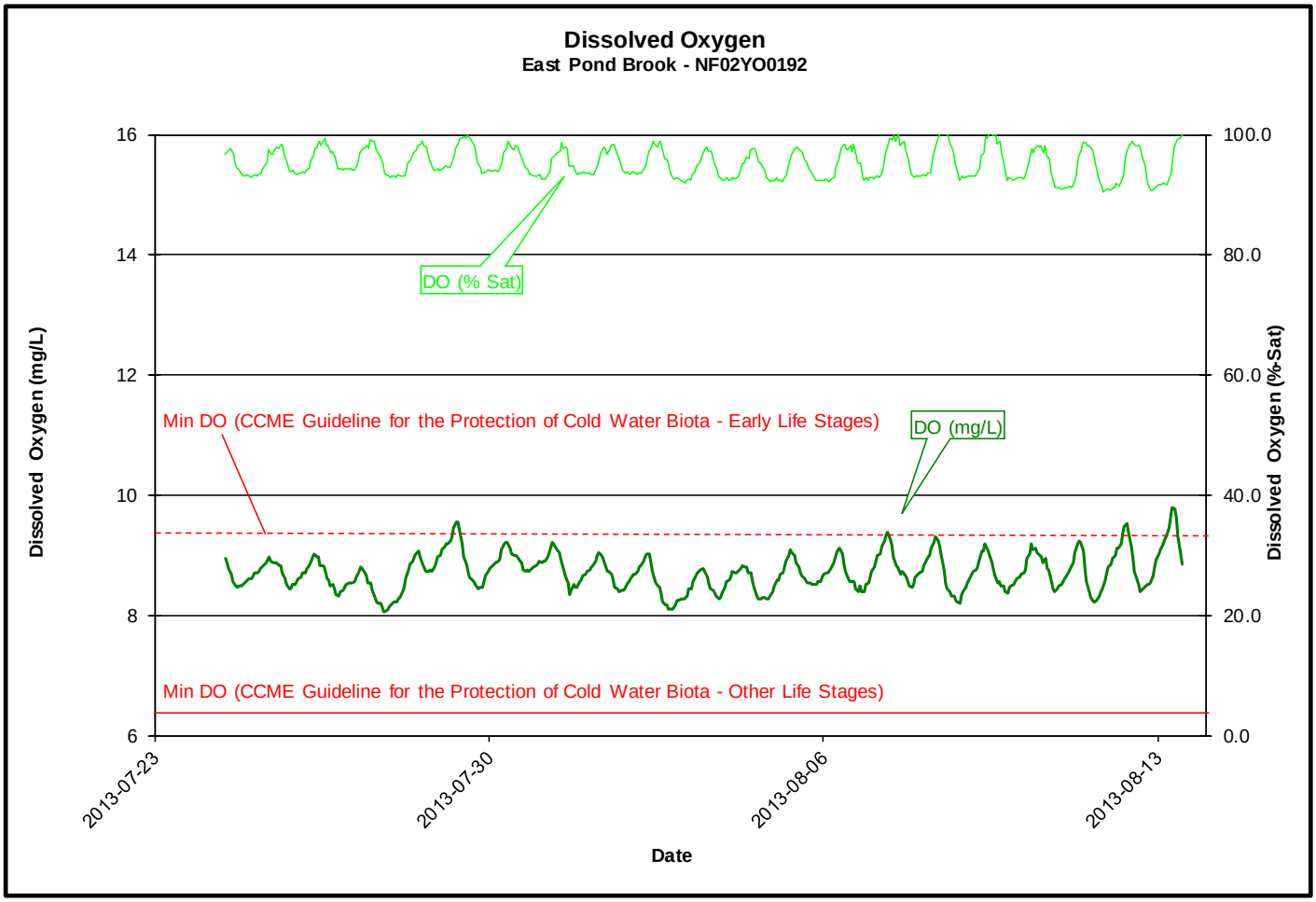

Figure 10

- The turbidity values (**Figure 11**) ranged from a minimum of 0.0 NTU to a maximum of 51.9 NTU.

- Neither in-situ nor grab sample measurements nor visual observation indicated turbidity issues.

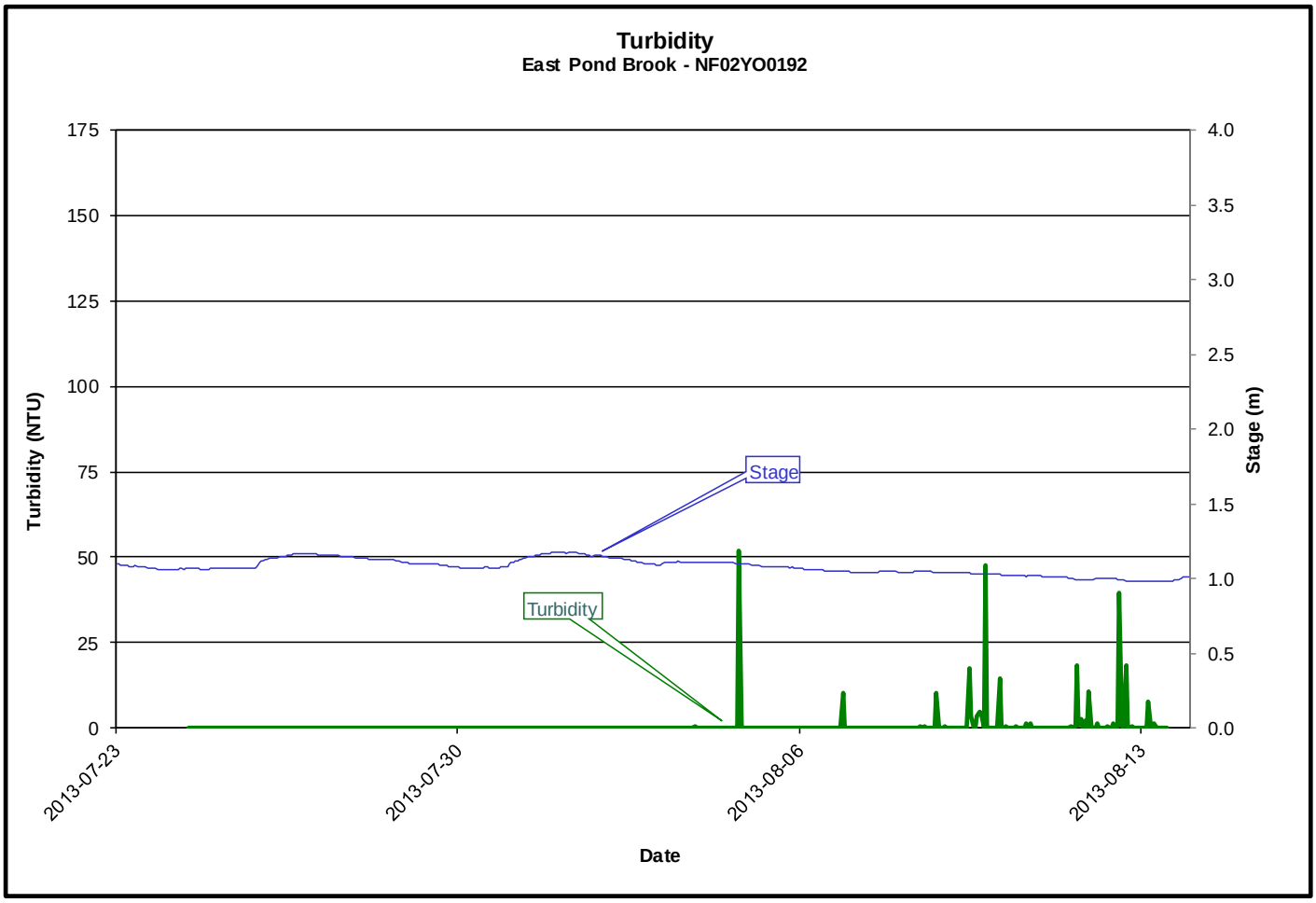

Figure 11

- The stage or water level ranged from a minimum of 0.98 m to a maximum of 1.18 m. The flow or discharge ranged from a minimum of 0.34 m^3/s to a maximum of 1.53 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.

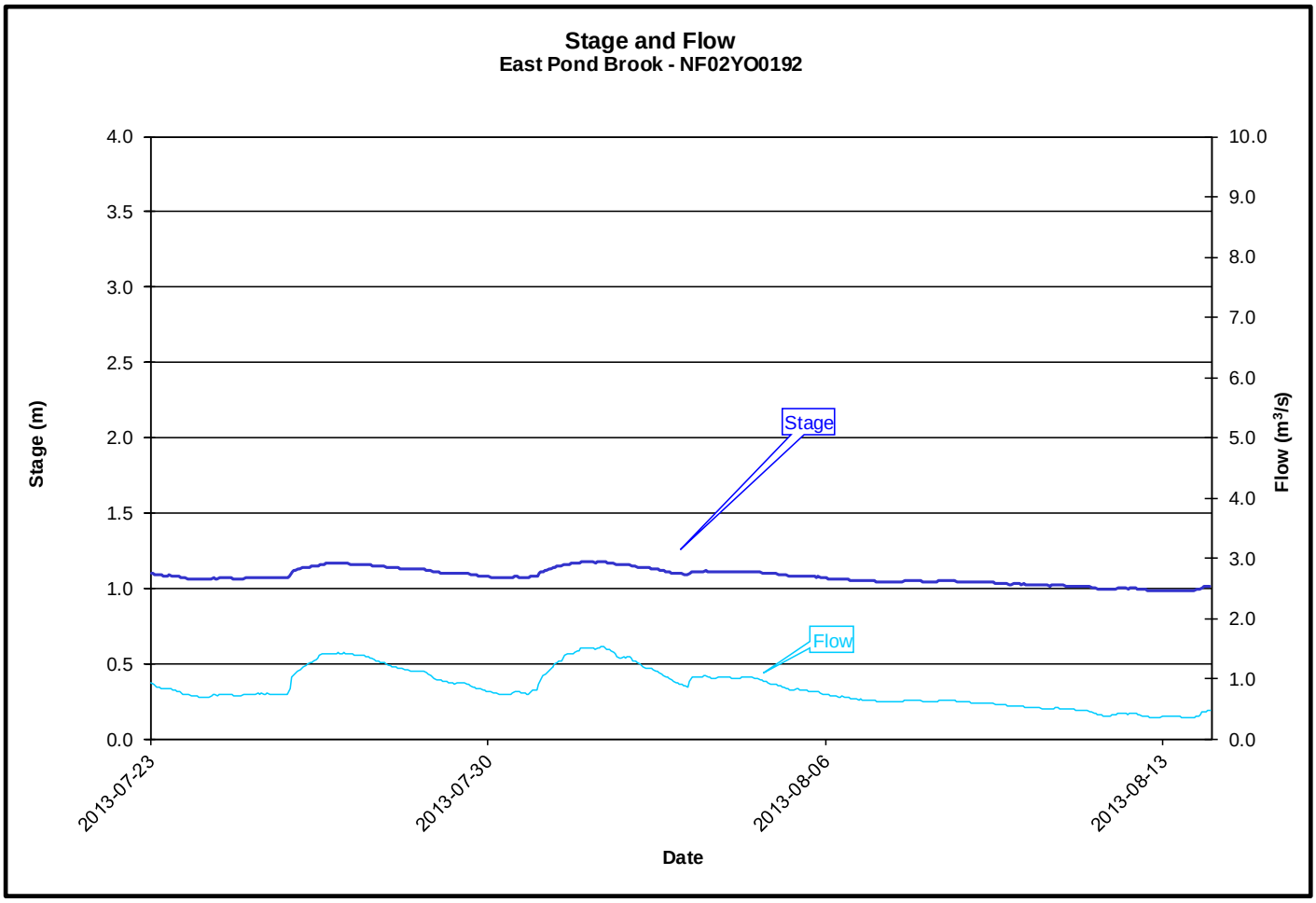

Figure 12

WELL AFTER TAILING DAM (MW1)

- The water temperature (**Figure 13**) ranged from a minimum of 5.31 ˚C to a maximum of 5.41 ˚C with slight increase over the deployment period.
- There appears to be no correlation with water elevation.

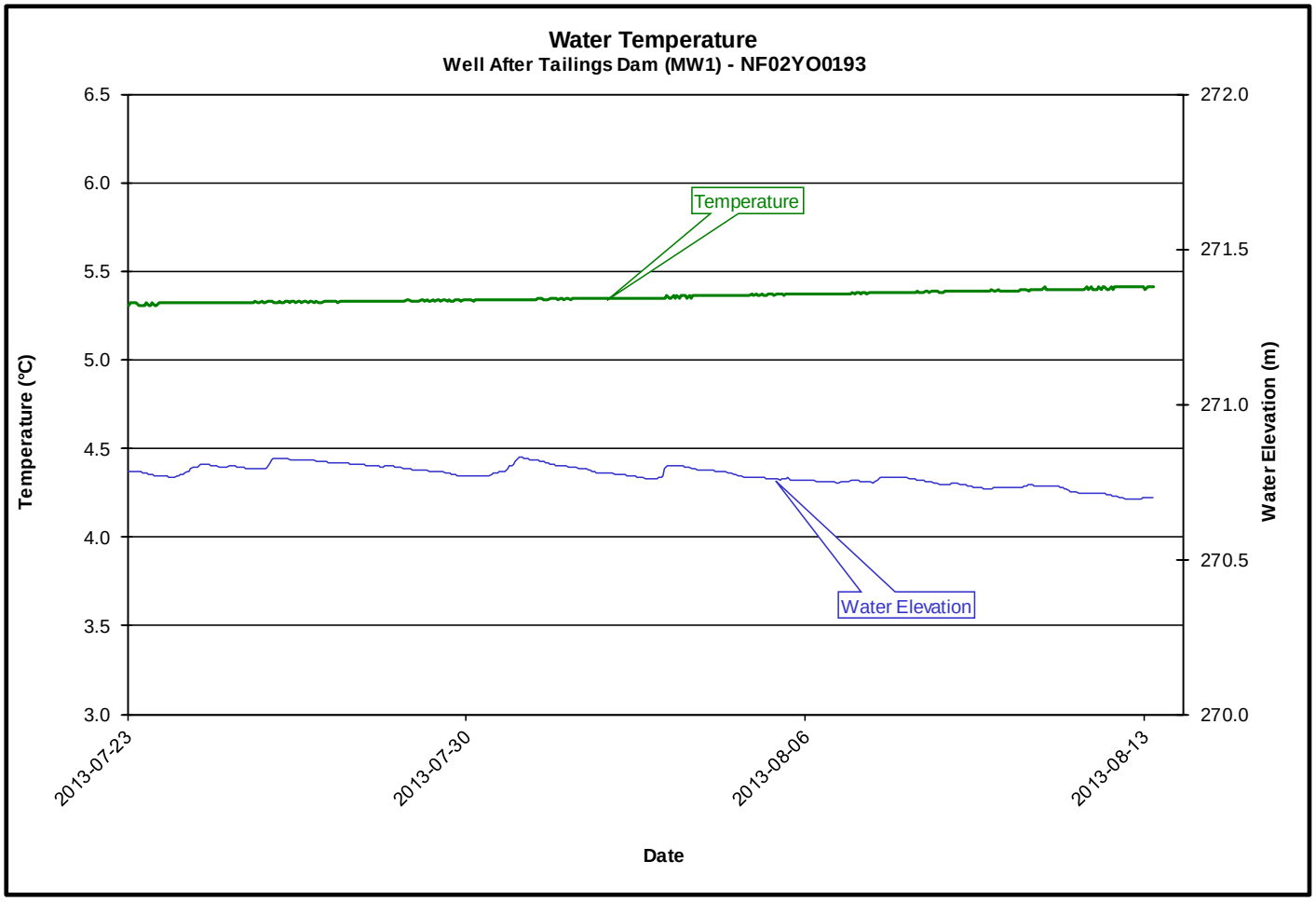

Figure 13

- The pH (**Figure 14**) ranged from a minimum of 8.76 to a maximum of 8.80 over the portion of the deployment period prior to pH sensor failure.
- There does not appear to be any correlation with water elevation.

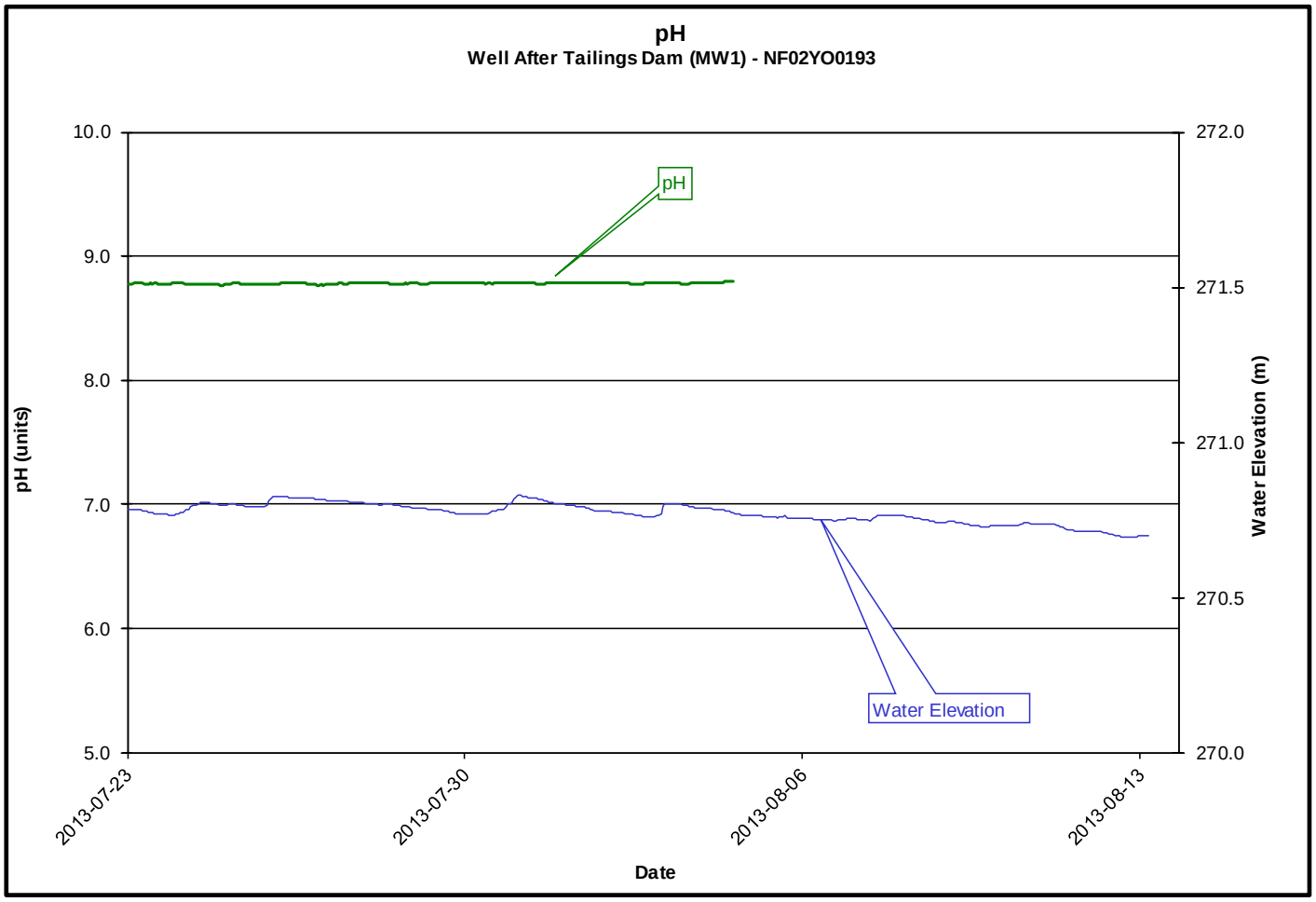

Figure 14

- The specific conductivity **(Figure 15)** ranged from a minimum of 0.756 mS/cm to a maximum of 0.770 mS/cm.
- There was a slight increase over the deployment period.
- There does not seem to be any correlation with water elevation.

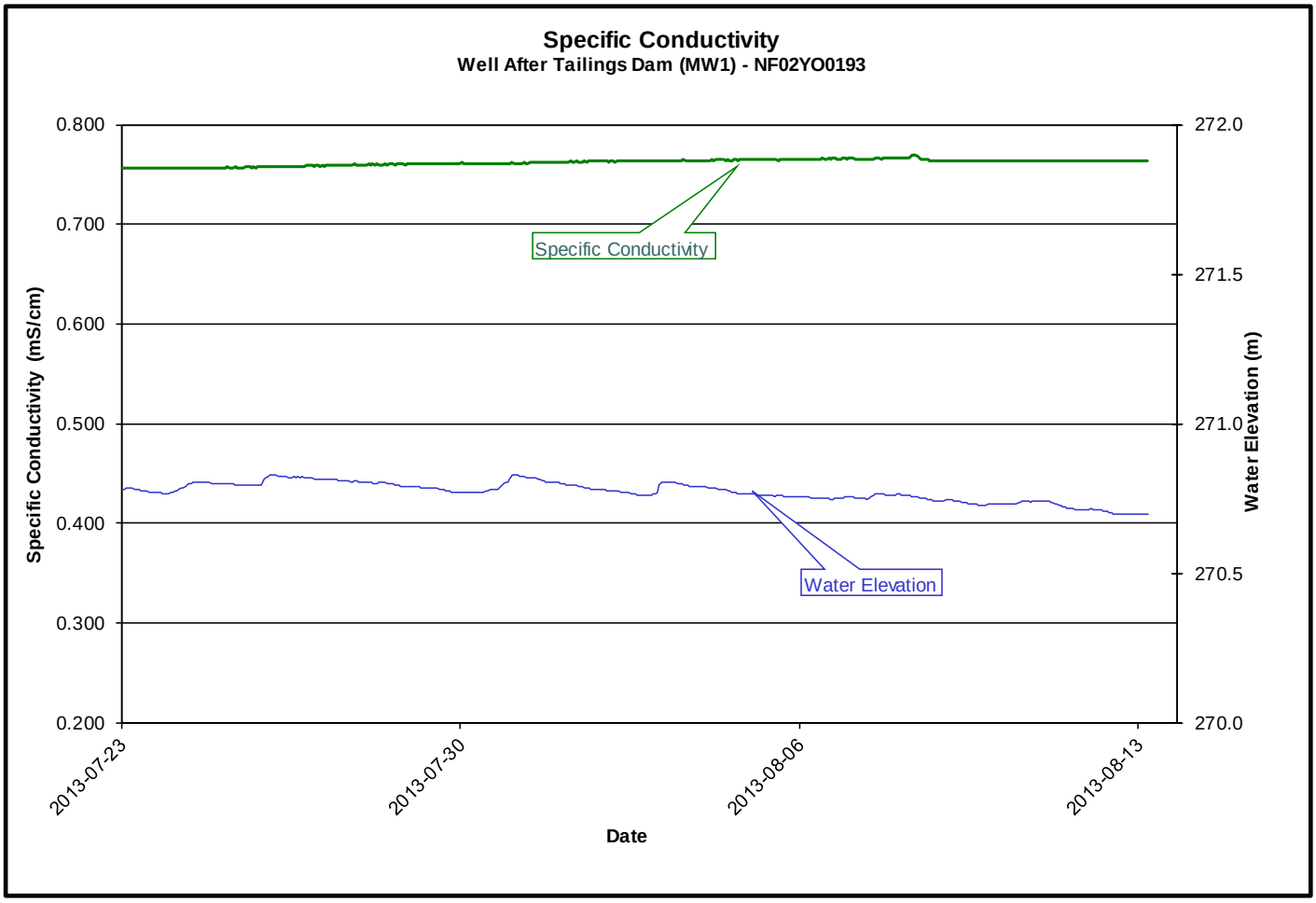

Figure 15

- The Water Elevation **(Figure 16)** ranged from a minimum of 270.70 m to a maximum of 270.83 m, with a slight decrease 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.

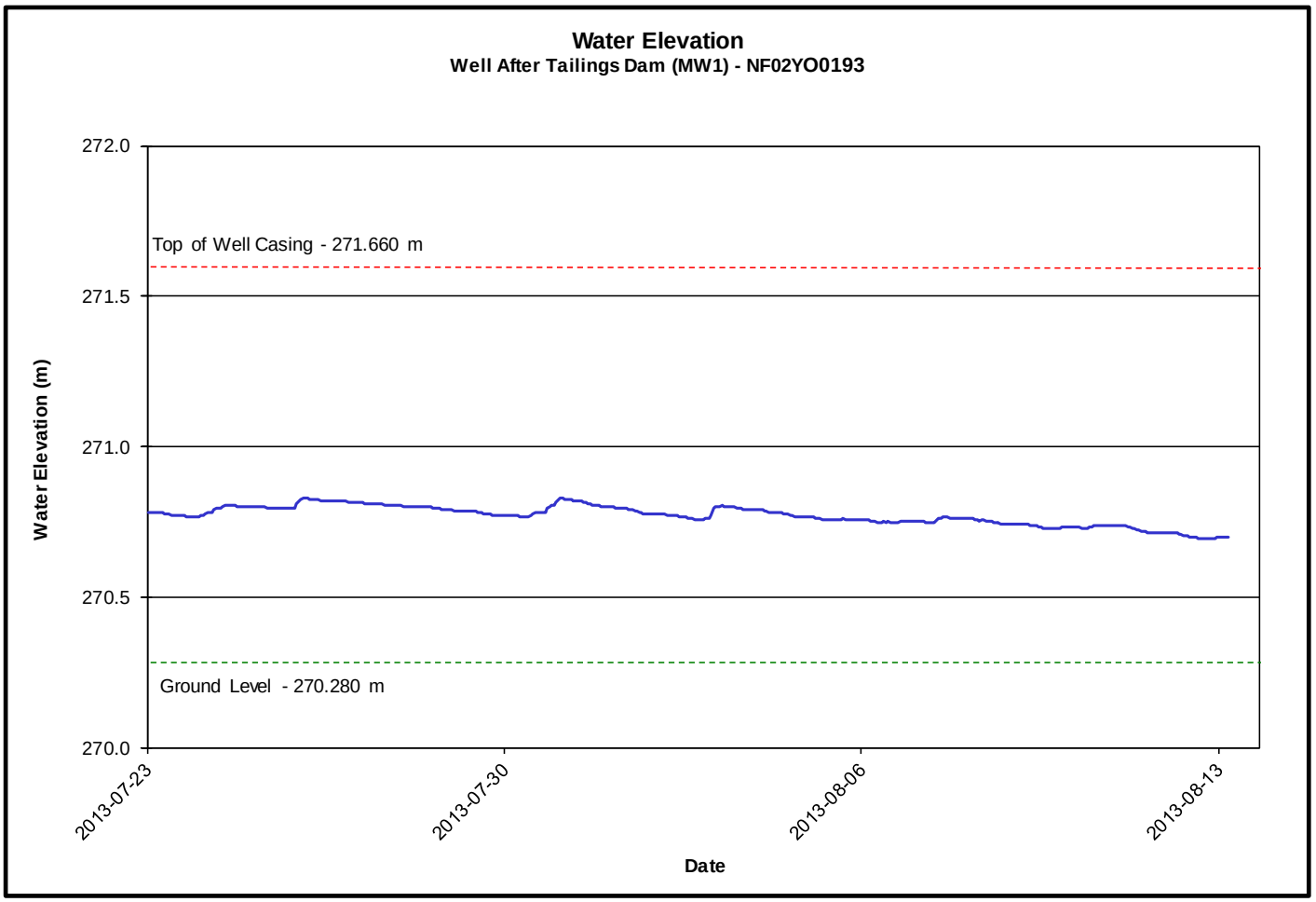

Figure 16

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