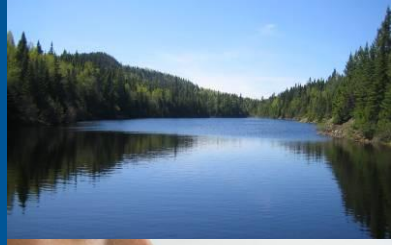







Real Time Water Quality Report
Teck Duck Pond Operations

Deployment Period 2013-06-13 to 2013-07-22

2013-08-12

Newfoundland Labrador

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.
- There was a loss of data transmission from the East Pond Brook station from 08:30 on June 18, 2013 to 08:30 on June 25, 2013 due to a data logger failure. During this period, the DataSonde logged the water quality data internally; this data was used to complete the data set. Stream stage and flow data are unavailable for that period.

Maintenance and Calibration of Instrumentation

- The new **DataSondes®**(s/n 62268) for Tributary to Gills Pond Brook and (s/n 62267) for East Pond Brook were installed on June 13, 2013, after being freshly cleaned and calibrated. The Tributary to Gills Pond Brook unit remained deployed continuously for the 39 day period. However, the East Pond Brook unit had a failure of the dissolved oxygen sensor shortly after deployment. On June 17, 2013 a replacement DataSonde s/n 43245 was installed for the remainder of the 39 day deployment 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), beyond this 39 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.
- 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. No ranks are available for this report. The installation ranking is documented in a previous report. The removal ranking will be documented in a subsequent report.
- 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**
2013-06-13 Installation	Temp (^{o}C)	Excellent
	pH (units)	Excellent
	Sp. Conductivity (µS/cm)	Excellent
	Dissolved Oxygen (mg/L)	Excellent
	Turbidity (NTU)	Excellent
2013-07-22 Removal	Temp (^{o}C)	Excellent
	pH (units)	Excellent
	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**
2013-06-13 Installation	Temp (^{o}C)	Excellent
	pH (units)	Excellent
	Sp. Conductivity (µS/cm)	Good
	Dissolved Oxygen (mg/L)	Excellent
	Turbidity (NTU)	Excellent
2013-06-17 Removal	Temp (^{o}C)	Excellent
	pH (units)	Good
	Sp. Conductivity (µS/cm)	Excellent
	Dissolved Oxygen (mg/L)	N/A
	Turbidity (NTU)	Excellent
Change out DataSonde s/n 62267 with s/n 43245		
2013-06-17 Installation	Temp (^{o}C)	Good
	pH (units)	Good
	Sp. Conductivity (µS/cm)	Good
	Dissolved Oxygen (mg/L)	Excellent
	Turbidity (NTU)	Excellent
2013-07-22 Removal	Temp (^{o}C)	Excellent
	pH (units)	Excellent
	Sp. Conductivity (µS/cm)	Excellent
	Dissolved Oxygen (mg/L)	Excellent
	Turbidity (NTU)	Excellent

Table 3

Data Interpretation

TRIBUTARY TO GILLS POND BROOK

- The water temperature (**Figure 1**) ranged from a minimum of 10.78˚C to a maximum of 25.43˚C.
- There temperature generally increased over the deployment period.
- With the two obvious increases in stage, there were slight decreases in temperature, coupled with less diurnal variation.

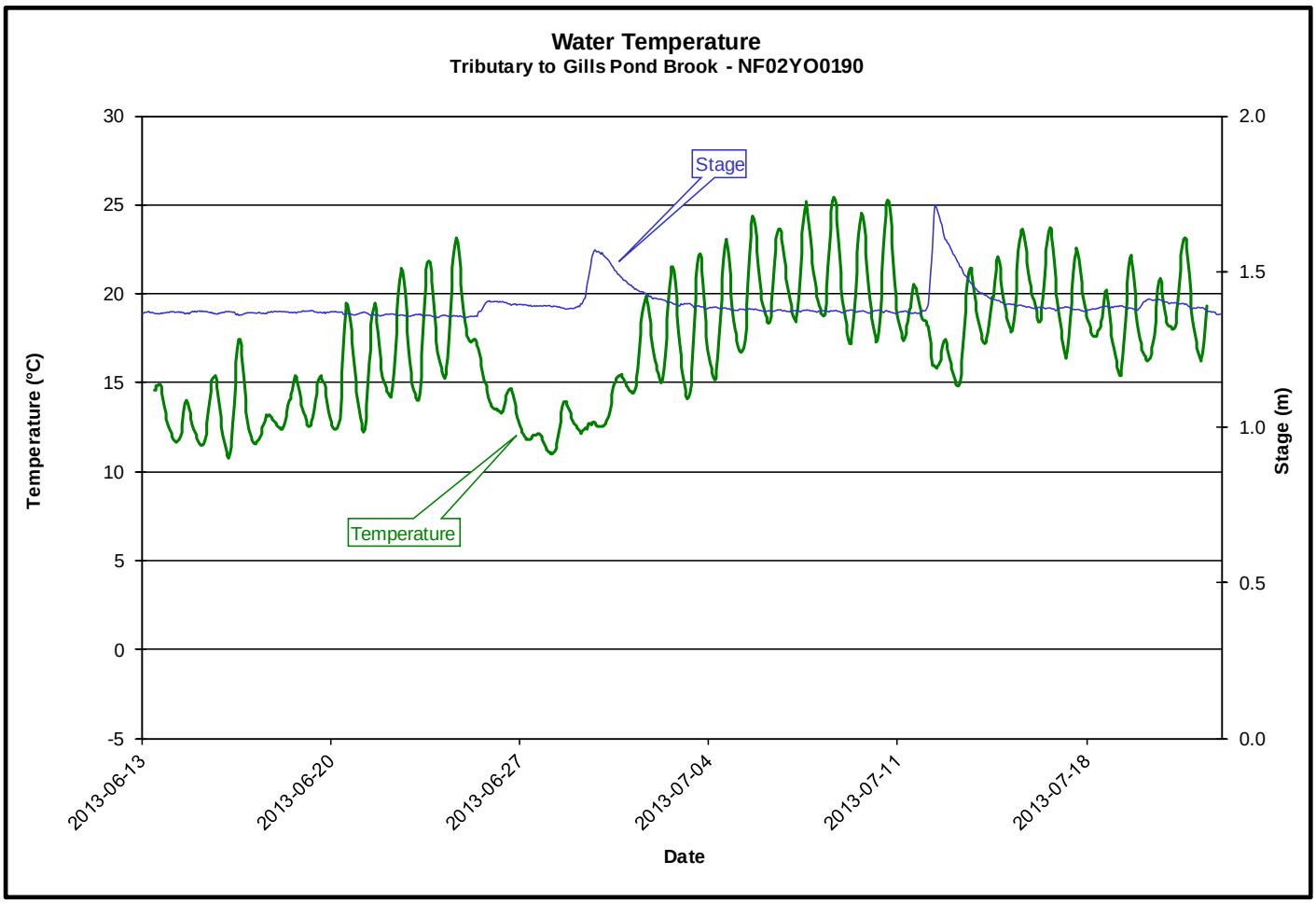

Figure 1

- Throughout the deployment period, pH values (**Figure 2**) ranged from a minimum of 5.86 to a maximum of 7.30 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 two events during the deployment period.
- There is a slight decrease in pH throughout 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.

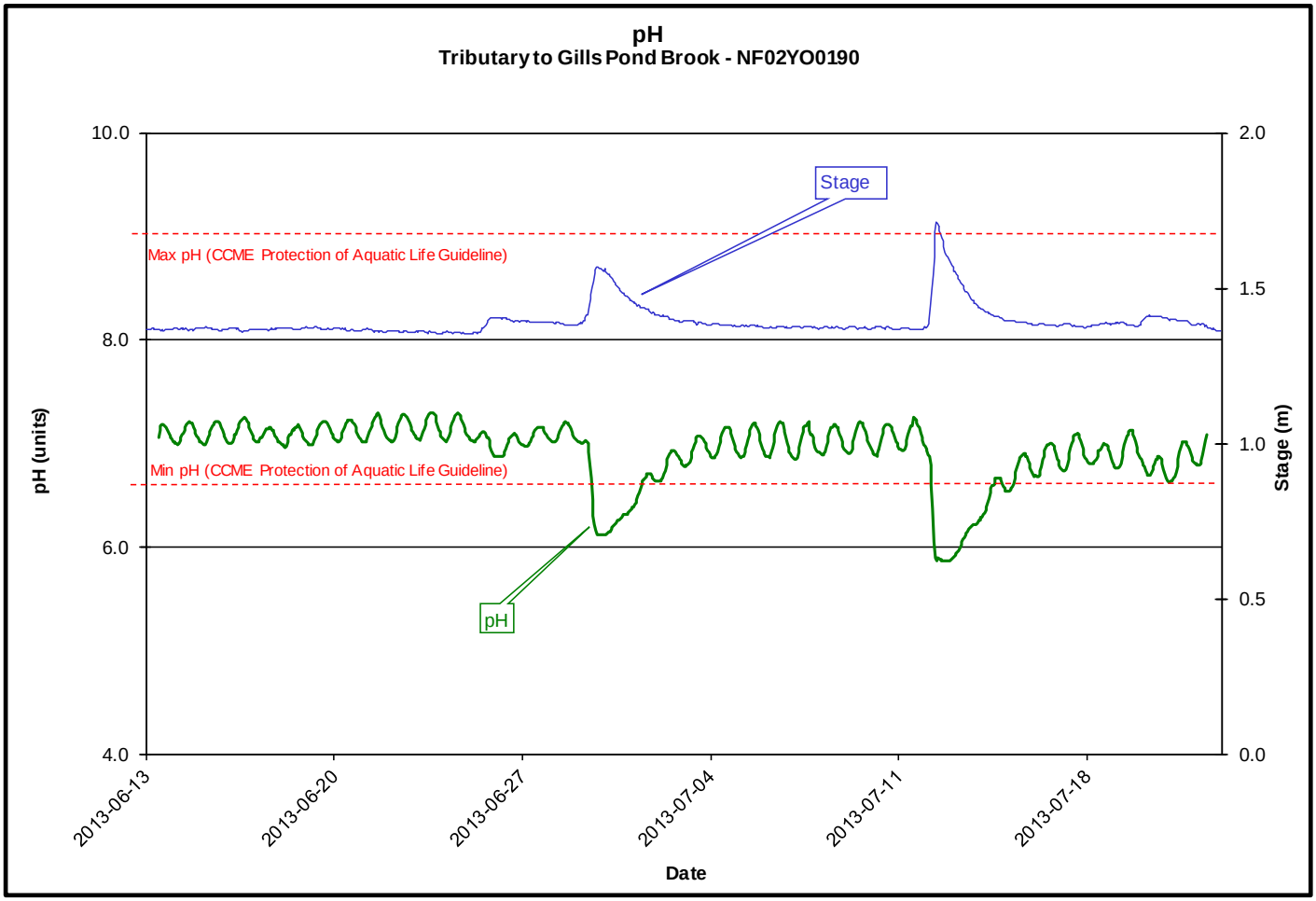

Figure 2

- The specific conductivity **(Figure 3)** ranged from a minimum of 157.6 µS/cm to a maximum of 1220.0 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.

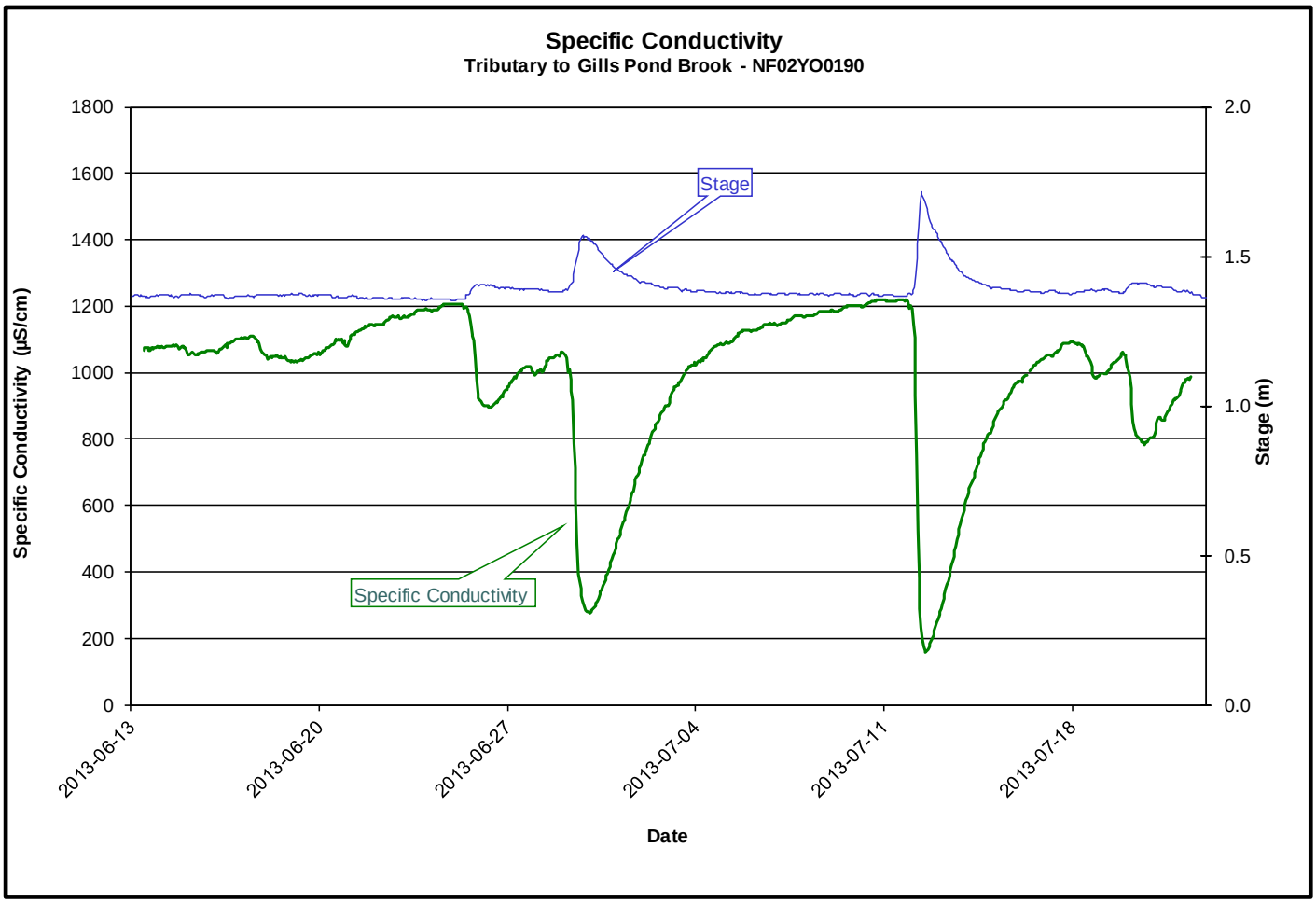

Figure 3

- The dissolved oxygen (**Figure 4**) values ranged from a minimum of 7.79 mg/L to a maximum of 10.28 mg/L over the deployment period, with the percent saturation ranging between 79.8 and 102.2.
- Dissolved oxygen decreased slightly over the deployment period and 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.

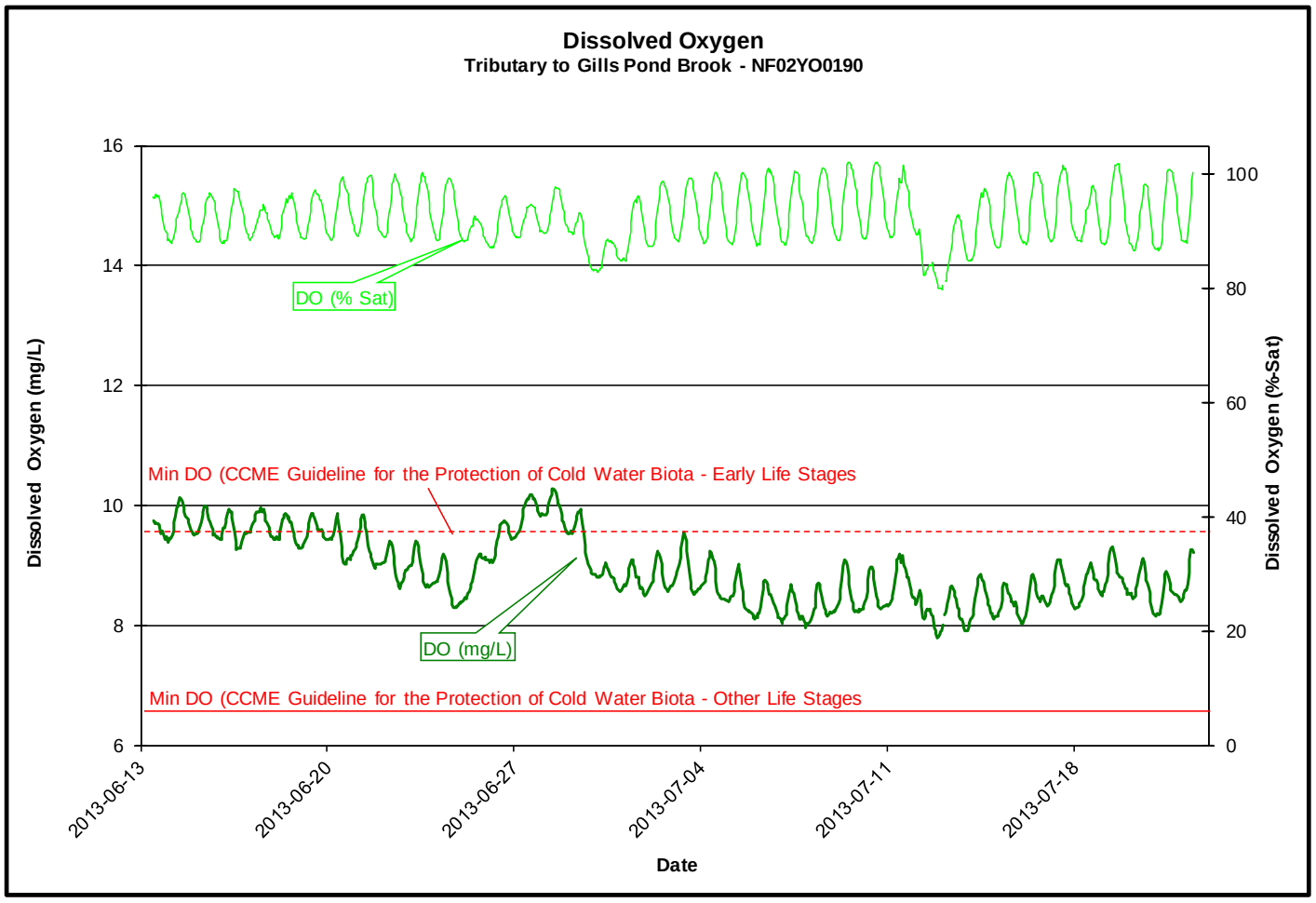

Figure 4

- The turbidity values **(Figure 5)** ranged from a minimum of 0.0 NTU to a maximum of 34.1 NTU.
- Based upon previous investigation, it has been determined that turbidity values may be artificially increased to some degree due to air entrainment during higher flows.
- Increases in turbidity values occur during the two obvious increases in stage, which are resultant from precipitation/runoff events.
- Neither in-situ nor grab sample measurements nor visual observation indicated any significant or note-worthy turbidity issues.

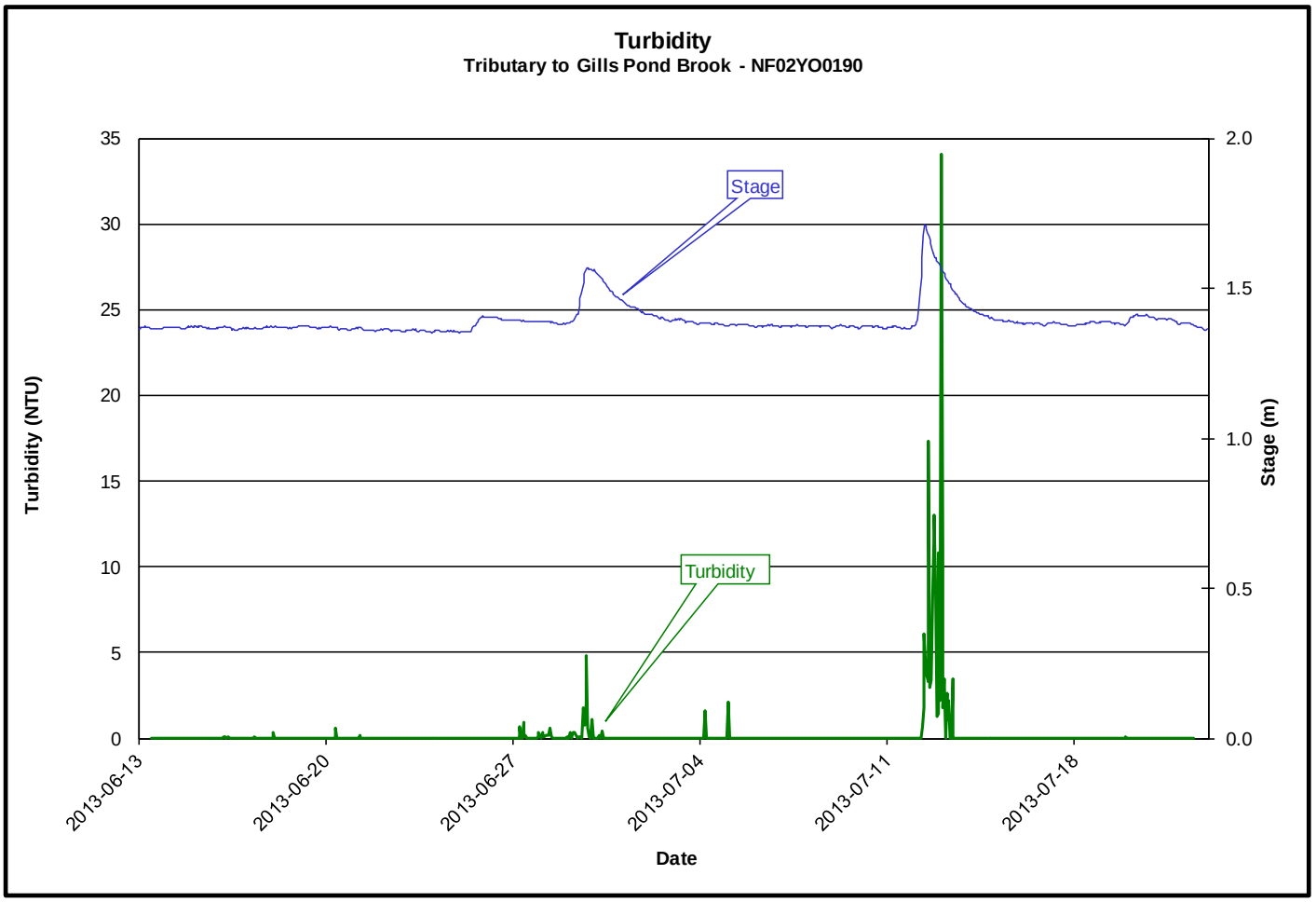

Figure 5

- The stage or water level ranged from a minimum of 1.35 m to a maximum of 1.71 m. The flow or discharge ranged from a minimum of 0.24 m^3/s to a maximum of 2.45 m^3/s (**Figure 6)**.
- The peaks in stage and flow are resultant from precipitation/runoff events.
- All values are within the normal range.

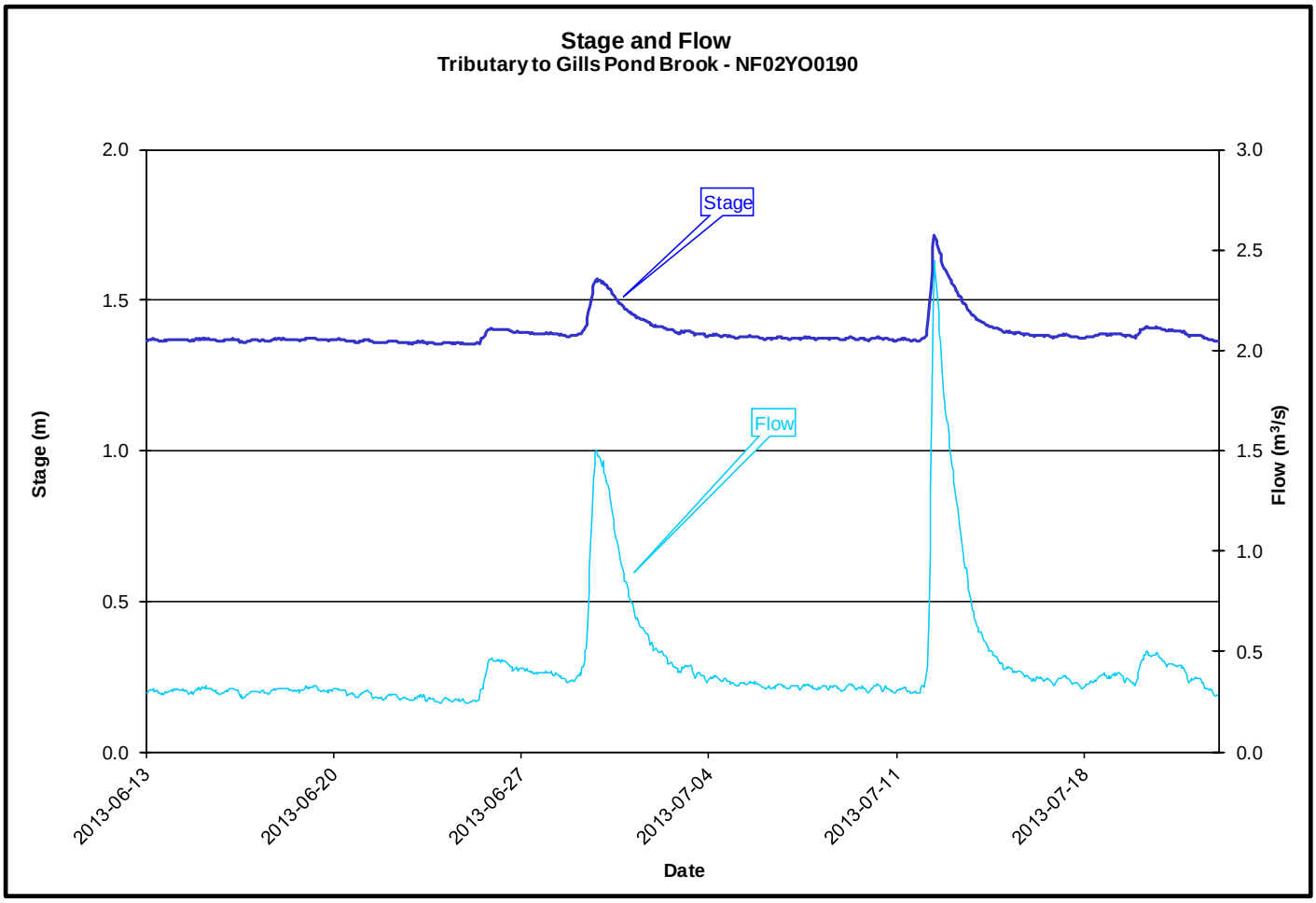

Figure 6

EAST POND BROOK

- The water temperature (**Figure 7**) ranged from a minimum of 9.64 ˚C to a maximum of 26.05 ˚C.
- Temperature increased slightly over the deployment period.
- With the two obvious increases in stage, there were slight decreases in temperature, coupled with less diurnal variation

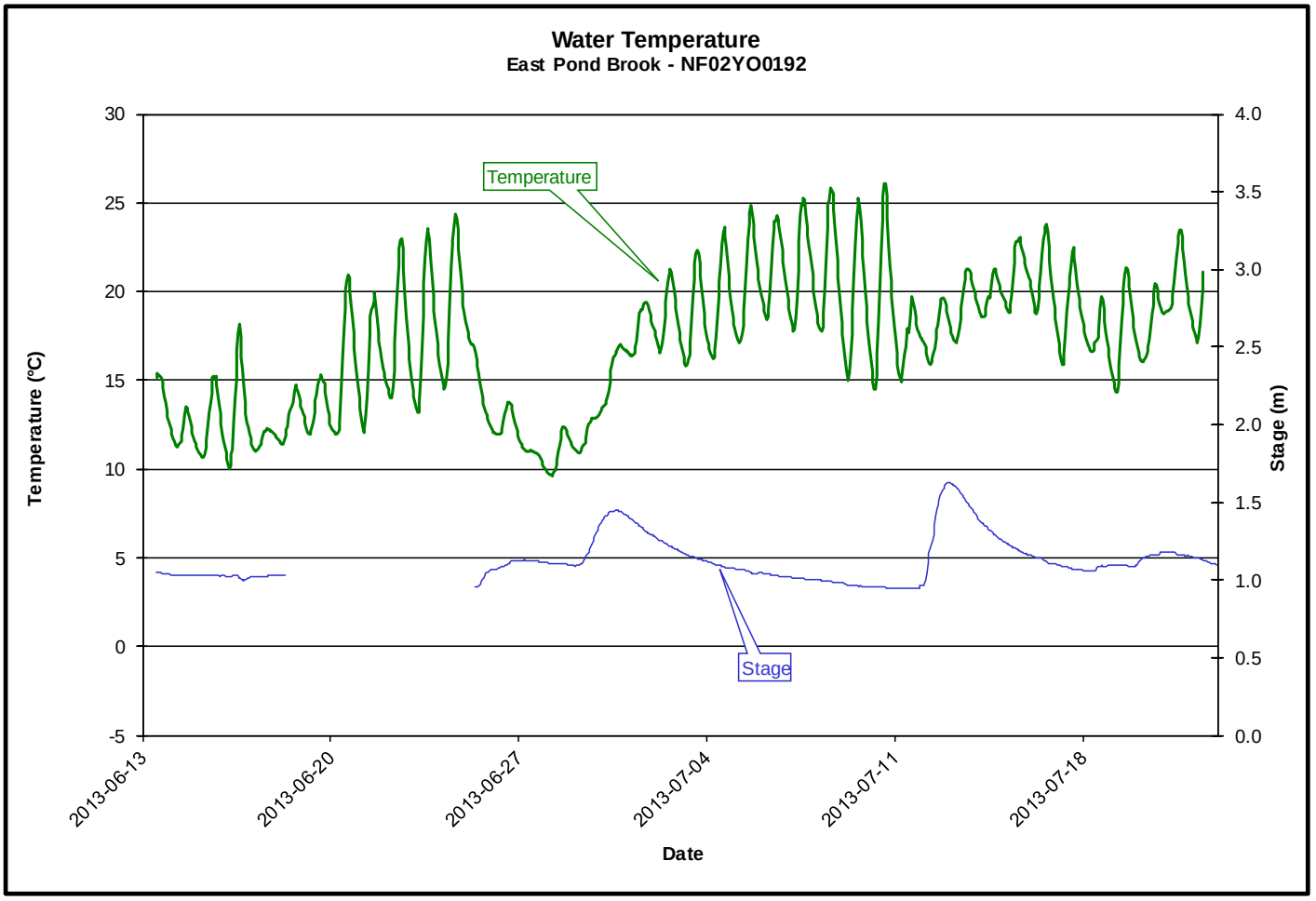

Figure 7

- Throughout the deployment period pH values (**Figure 8**) ranged from a minimum of 6.23 to a maximum of 7.00, with a slight decrease over the deployment period.
- pH decreased slightly during periods of increased stage.
- 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.

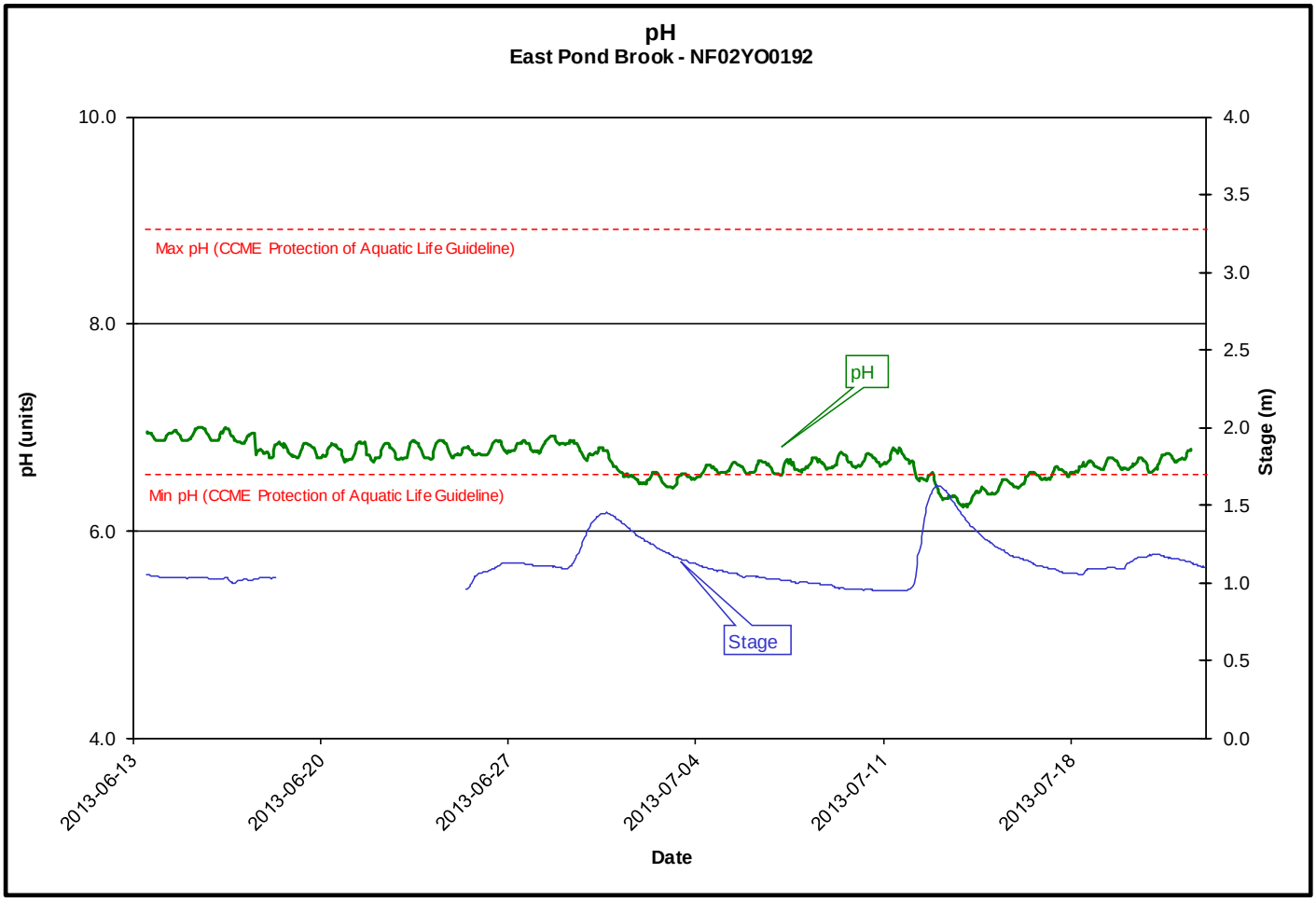

Figure 8

- The specific conductivity **(Figure 9)** ranged from a minimum of 19.6 µS/cm to a maximum of 37.3 µS/cm.
- There were minor increases in specific conductance, which corresponds to increased stage.
- All values are within the normal range.

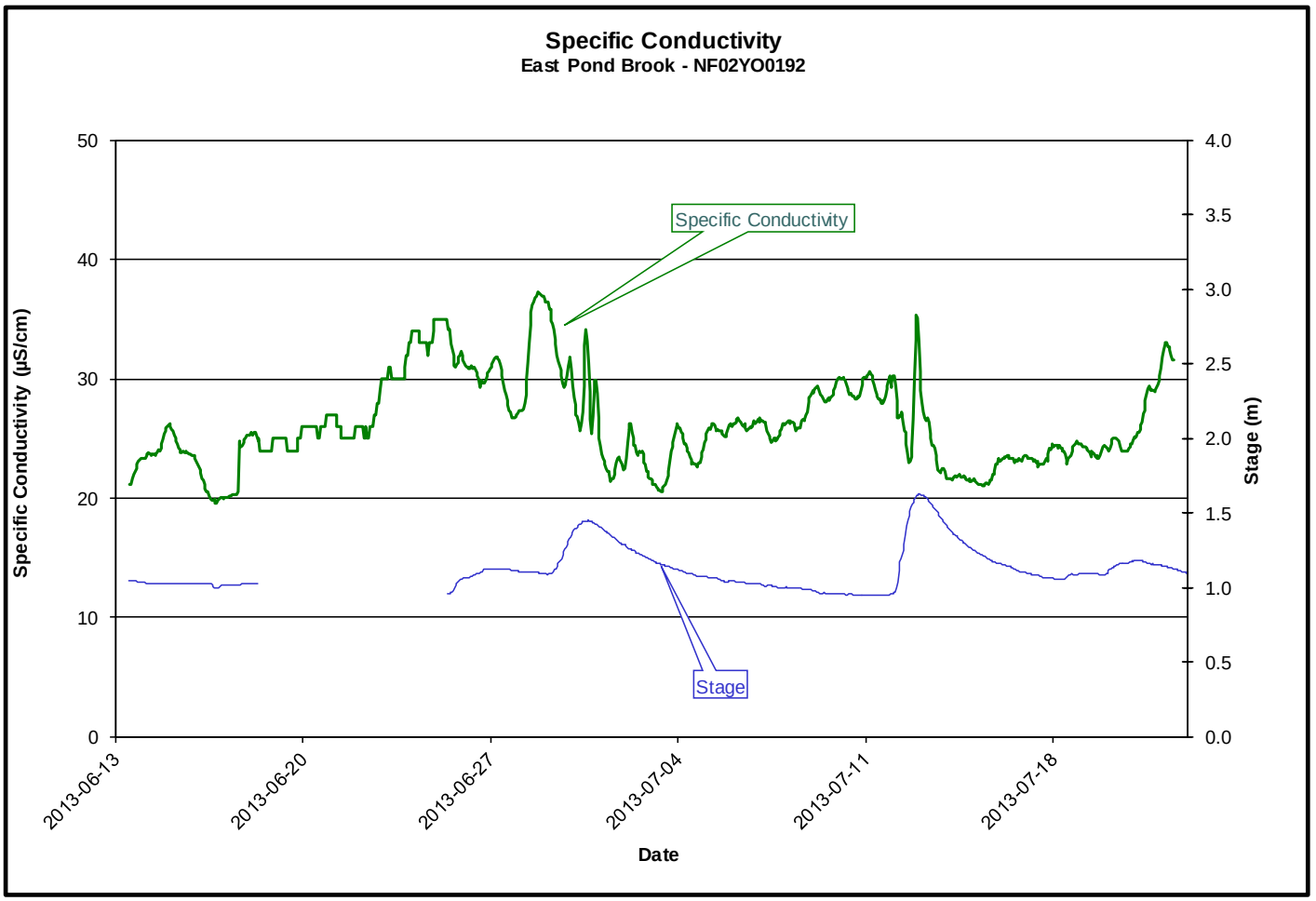

Figure 9

- The dissolved oxygen (**Figure 10**) values ranged from a minimum of 7.81 mg/L to a maximum of 10.99 mg/L over the deployment period, with the percent saturation ranging between 89.6 and 100.1.
- Dissolved oxygen generally decreased over the deployment period, and is generally 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.

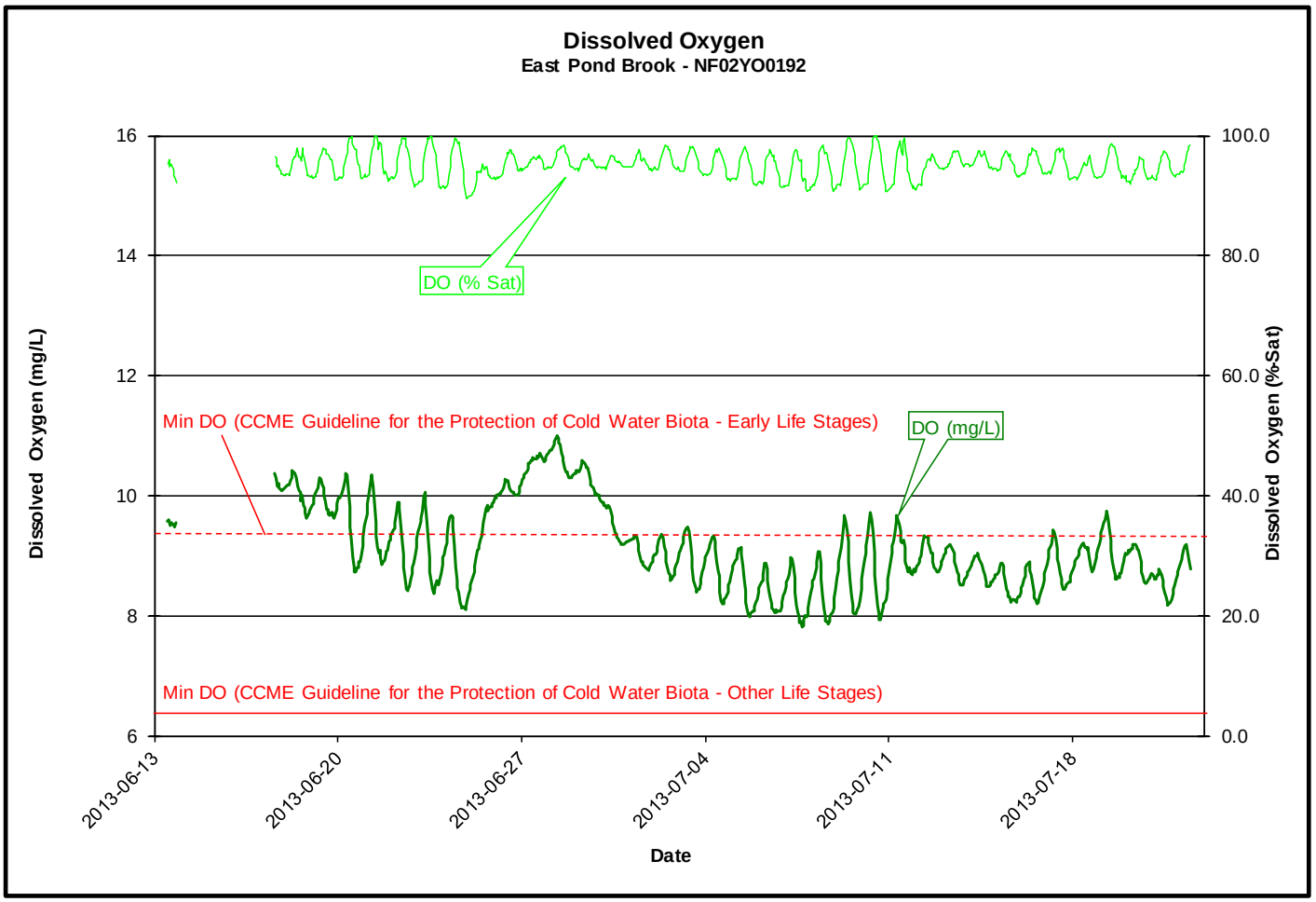

Figure 10

- The turbidity values (**Figure 11**) ranged from a minimum of 0.0 NTU to a maximum of 152.3 NTU.
- The single spike on June 25, 2013 is likely due to natural in-stream debris passing near the sensor.
- The other increases in turbidity values occur during the two obvious increases in stage, which are resultant from precipitation/runoff events.
- Neither in-situ nor grab sample measurements nor visual observation indicated turbidity issues.

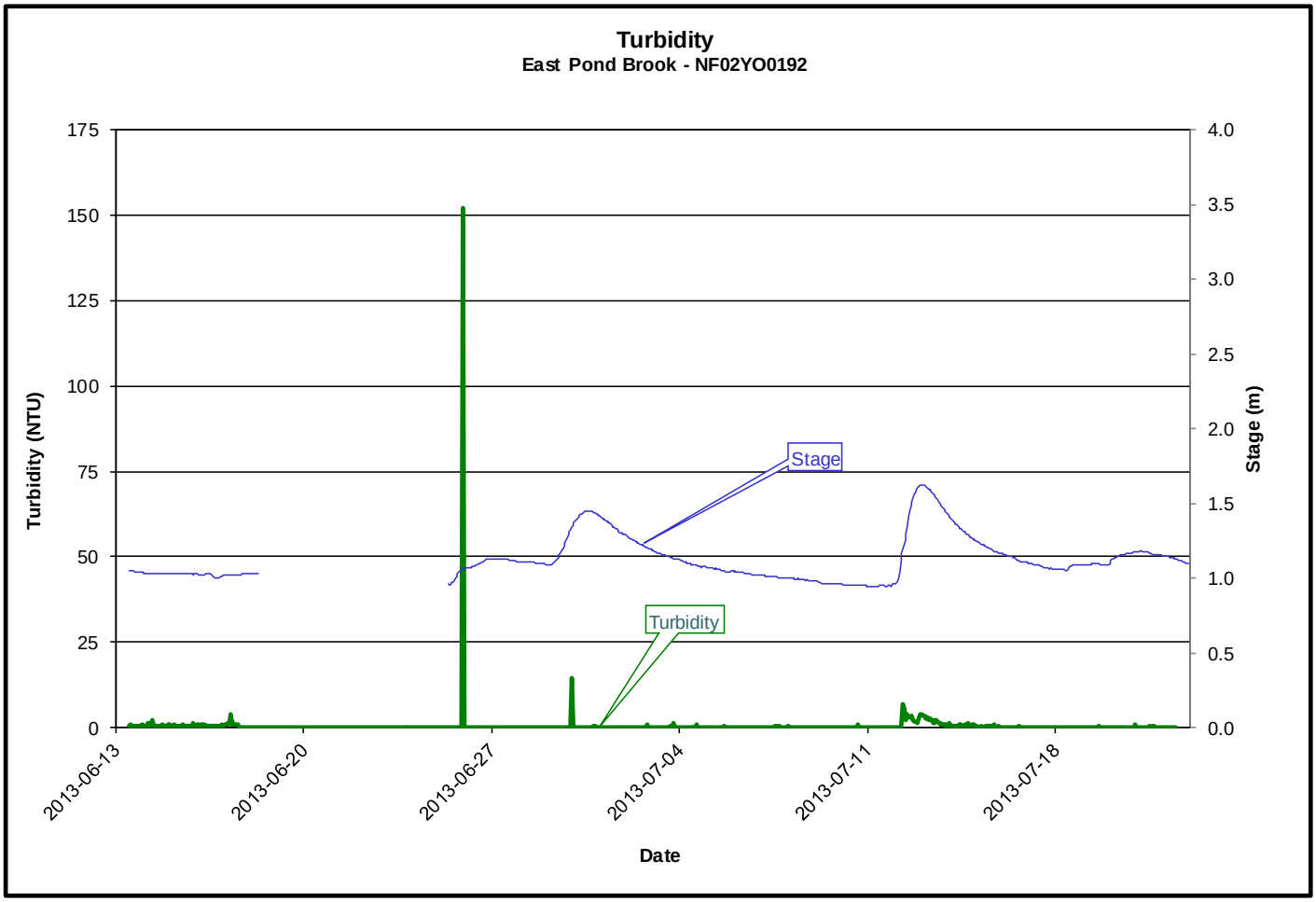

Figure 11

- The stage or water level ranged from a minimum of 0.94 m to a maximum of 1.62 m. The flow or discharge ranged from a minimum of 0.23 m^3/s to a maximum of 7.92 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.

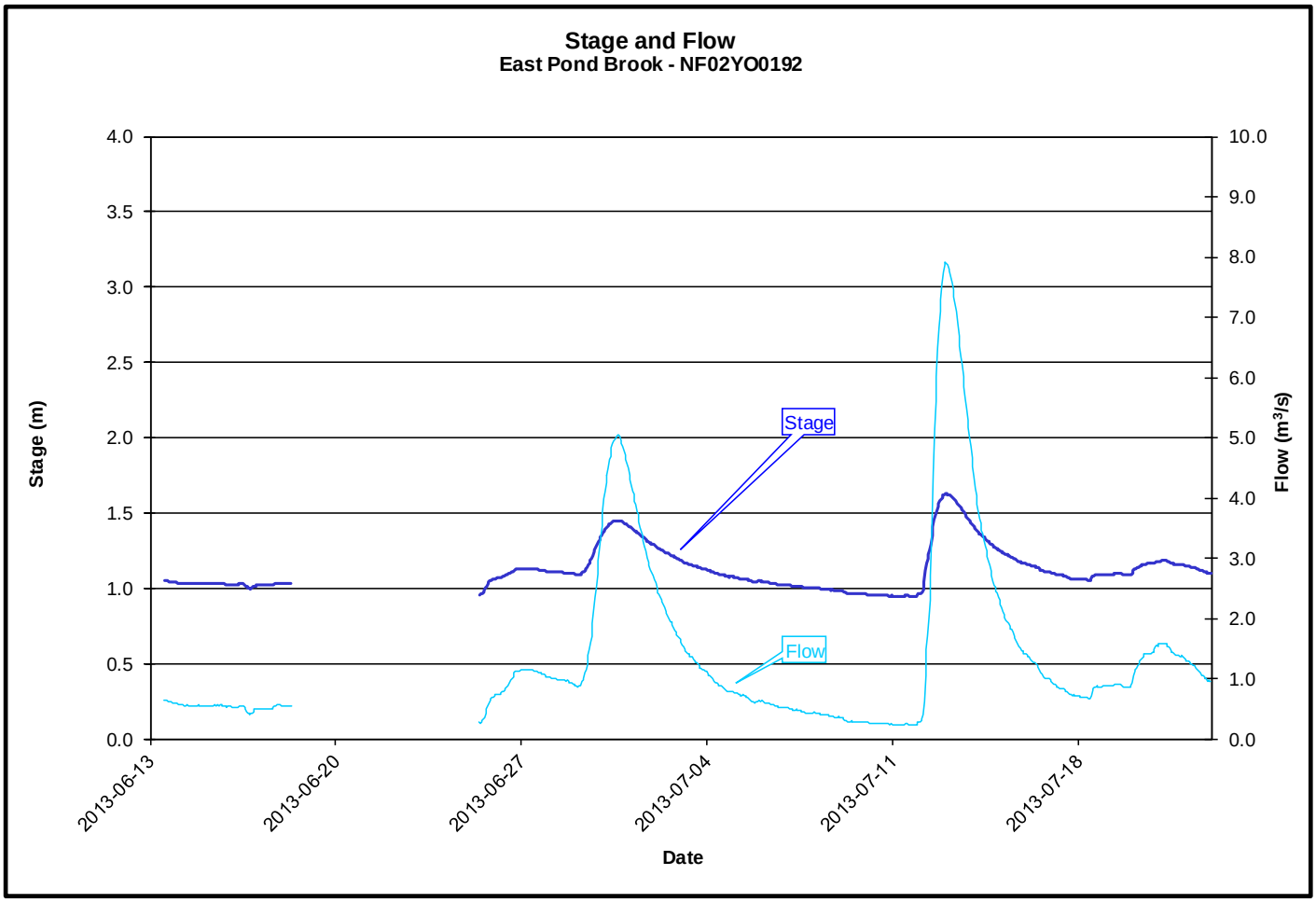

Figure 12

WELL AFTER TAILING DAM (MW1)

- The water temperature (**Figure 13**) ranged from a minimum of 5.28 ˚C to a maximum of 5.32 ˚C with very little change over the deployment period.
- There appears to be no correlation with water elevation.

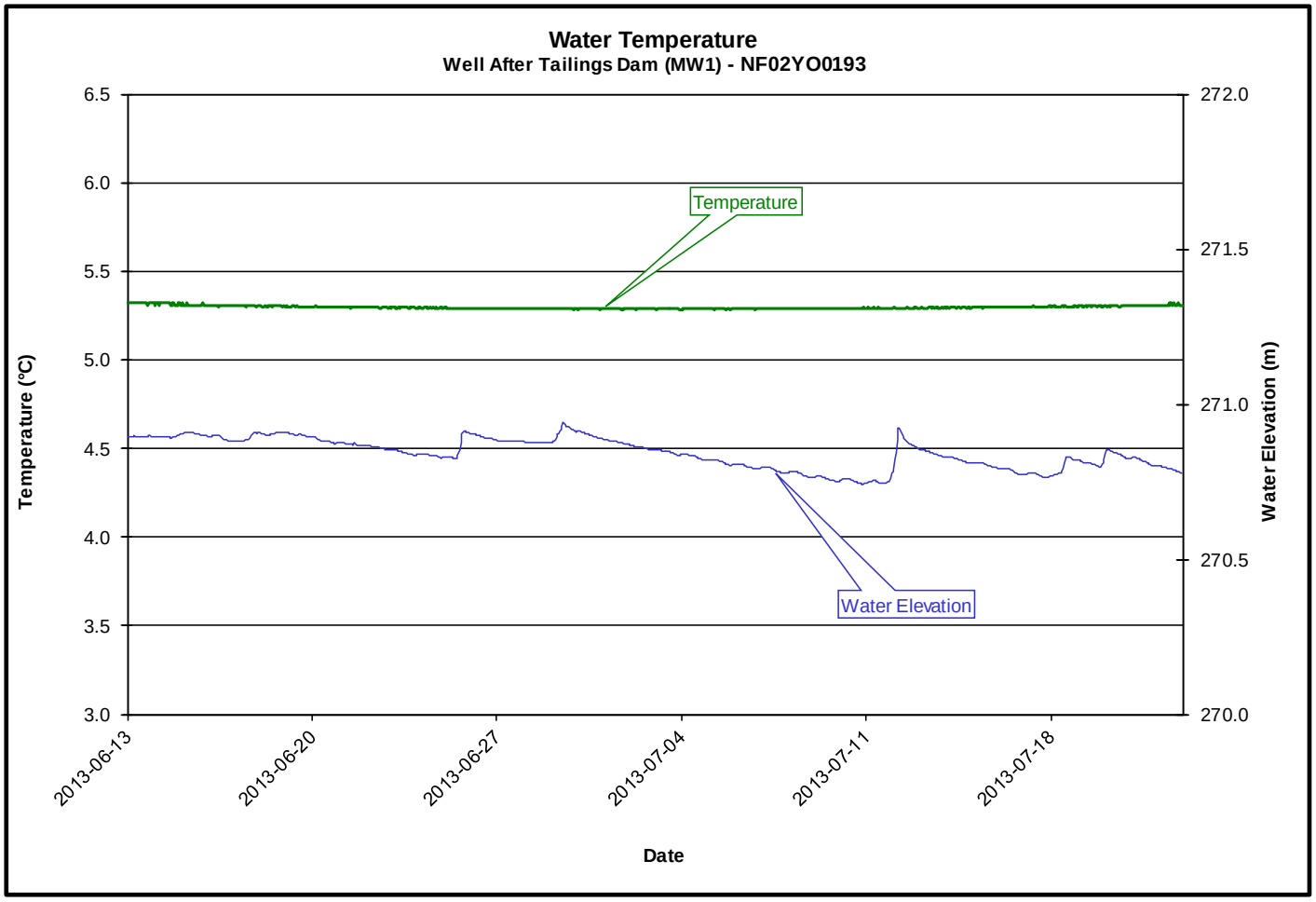

Figure 13

- The pH (**Figure 14**) ranged from a minimum of 8.29 to a maximum of 8.85 over the deployment period.
- There does not appear to be any correlation with water elevation.

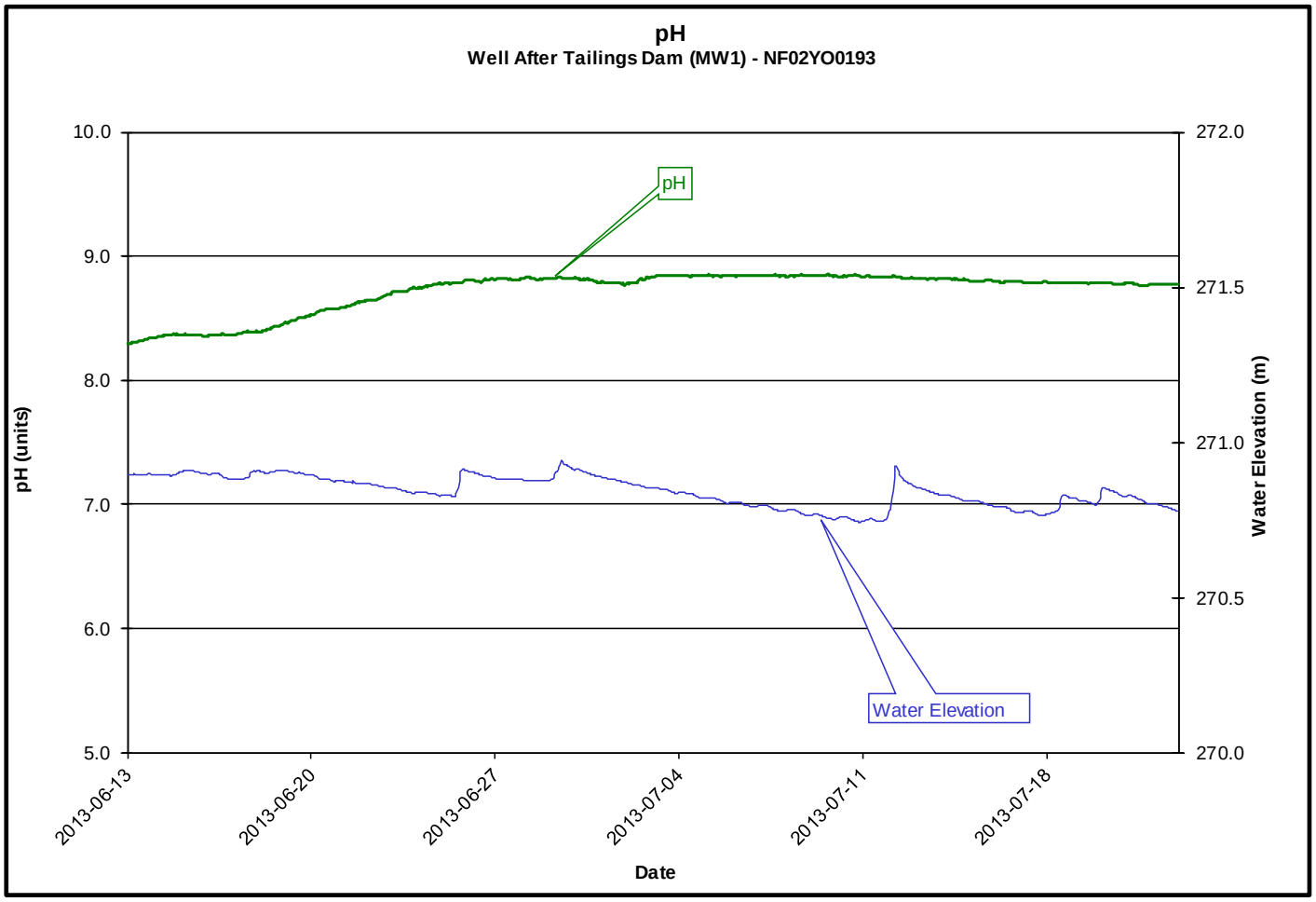

Figure 14

- The specific conductivity **(Figure 15)** ranged from a minimum of 0.728 mS/cm to a maximum of 0.756 mS/cm.
- There was a slight increase over the deployment period.
- There does not seem to be any correlation with water elevation.

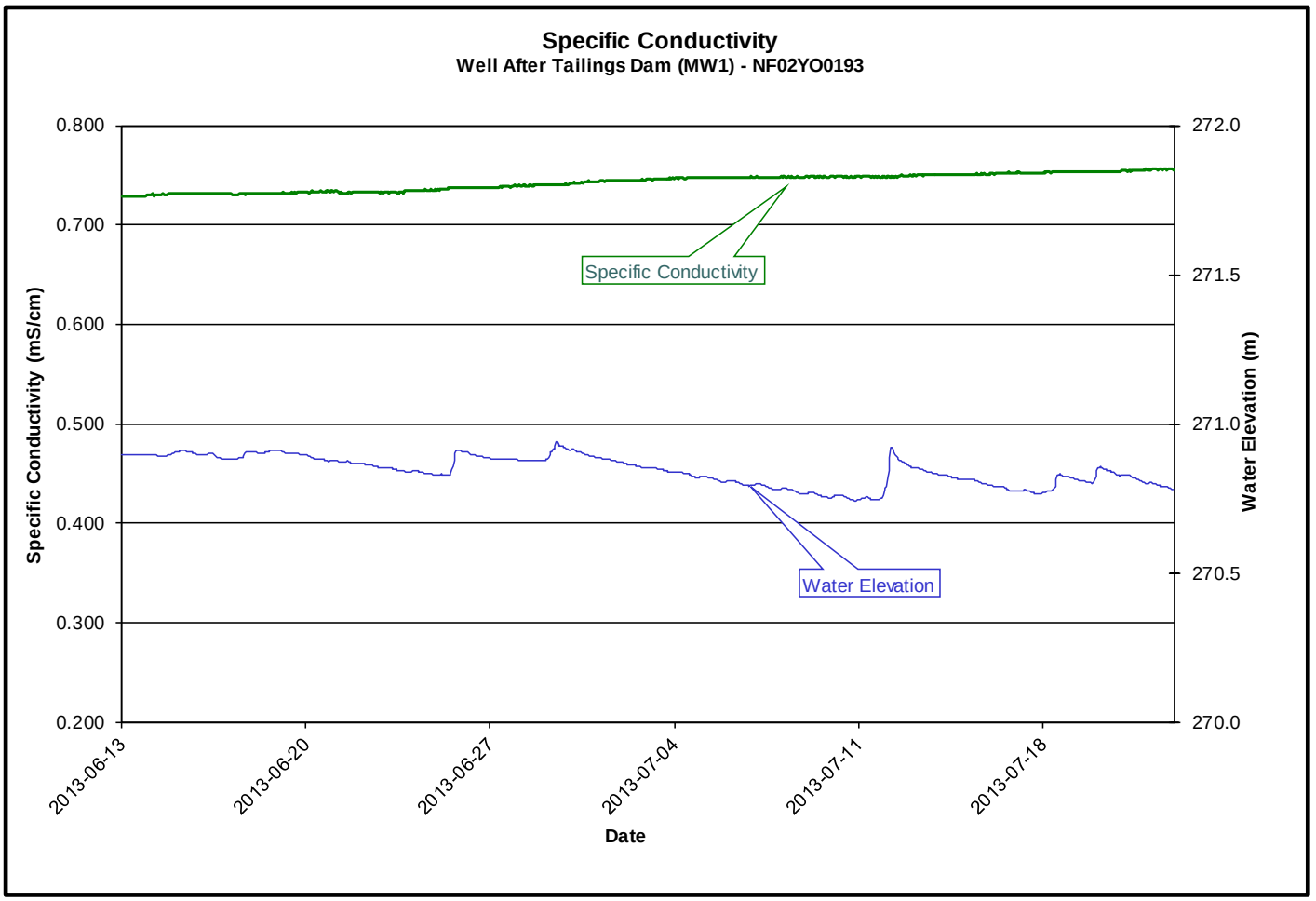

Figure 15

- The Water Elevation **(Figure 16)** ranged from a minimum of 270.74 m to a maximum of 270.94 m.
- Water elevation in this well corresponds to increased water level in an adjacent stream, and is influenced by runoff from precipitation.

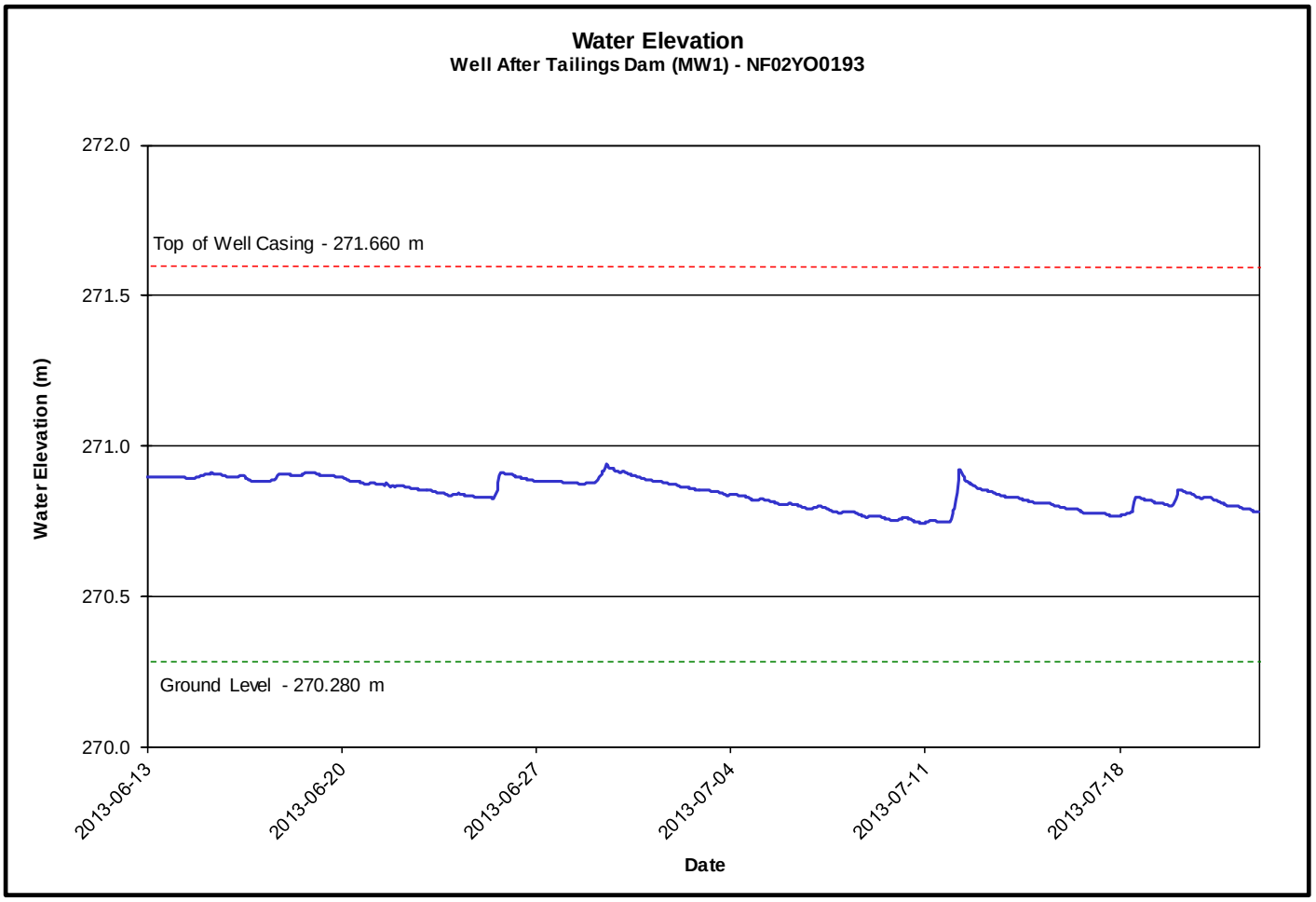

Figure 16

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