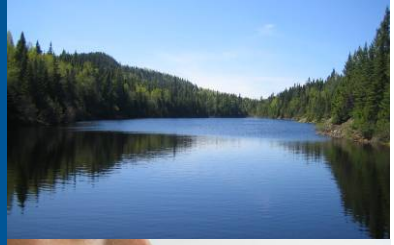
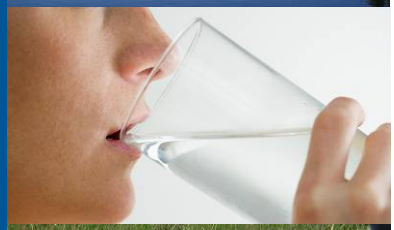



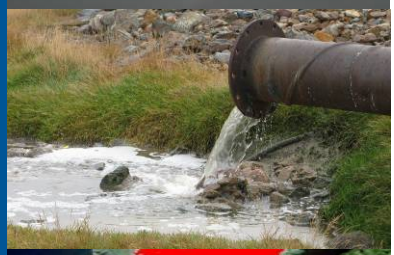


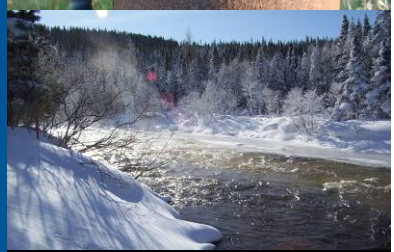

Real Time Water Quality Report
Teck Duck Pond Operations

Deployment Period 2011-05-05 to 2011-07-12

2011-08-16

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 effluent from Polishing Pond into the receiving waters (Tributary to Gills Pond Brook) episodically throughout the deployment period.

Maintenance and Calibration of Instrumentation

- After being cleaned and freshly calibrated the regular **DataSondes®**(s/n 43245) for Tributary to Gills Pond Brook and (s/n 43794) for East Pond Brook were installed in on May 5, 2011, and remained deployed continuously until July 12, 2011 a 67 day period.

- The regular **Quanta G®** (s/n 00035) required factory servicing, thus a spare instrument having the same technical specifications was deployed in Monitoring Well After Tailings Dam Station (MW1) on May 12, 2011 after being cleaned and freshly calibrated, and remained deployed until July 12, 2011, a 61 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 QAQC **MiniSonde®** a qualitative statement (Ranking) is usually made on the data.

- The ranking at the beginning and end of the deployment period are 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 deployment is ranking calculated for pH and Specific Conductance based upon live data and laboratory data. However, in during this deployment period, neither grab sample data nor ranking are available.

- 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 Quality Assurance and Quality Control (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**
2011-05-05 Deployment	Temp (^{o}C)	Good
	pH (units)	Excellent
	Sp. Conductivity (uS/cm)	Excellent
	Dissolved Oxygen (mg/L)	Excellent
	Turbidity (NTU)	Excellent
2011-07-12 Removal	Temp (^{o}C)	Good
	pH (units)	Good
	Sp. Conductivity (uS/cm)	Excellent
	Dissolved Oxygen (%)	Excellent
	Turbidity (NTU)	Excellent

Table 2

East Pond Brook Station (NF02YO0192)		
Date (yyyy-mm-dd)	**Parameter**	**Ranking**
2011-05-05 Deployment	Temp (^{o}C)	Excellent
	pH (units)	Good
	Sp. Conductivity (uS/cm)	Excellent
	Dissolved Oxygen (mg/L)	Excellent
	Turbidity (NTU)	Excellent
2011-07-12 Removal	Temp (^{o}C)	Excellent
	pH (units)	Good
	Sp. Conductivity (uS/cm)	Excellent
	Dissolved Oxygen (%)	Good
	Turbidity (NTU)	Excellent

Table 3

Data Interpretation

TRIBUTARY TO GILLS POND BROOK

- The water temperature (**Figure 1**) ranged from a minimum of 4.05 ˚C to a maximum of 25.22 ˚C, with temperatures generally increasing throughout the summer.
- There appears to be little correlation with stage.

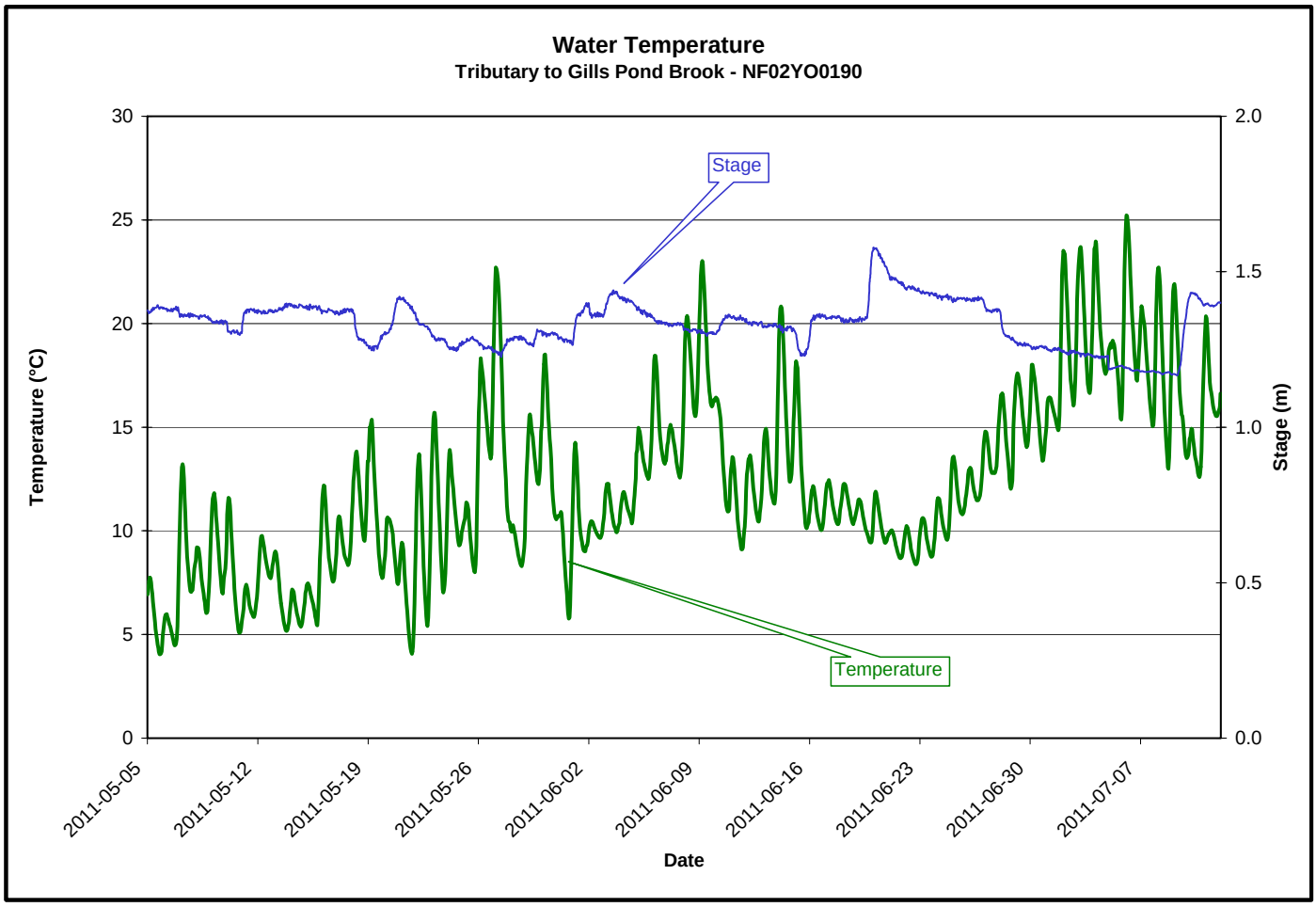

Figure 1

- Throughout the deployment period pH values (**Figure 2**) ranged from a minimum of 6.06 to a maximum of 7.29 with some of the values falling below 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 around the lower limit of the recommended range. pH varies with periods of discharge from Polishing Pond, as discharge water has a slightly higher pH than the background water quality.
- There is an obvious inverse relationship between pH and Stage.

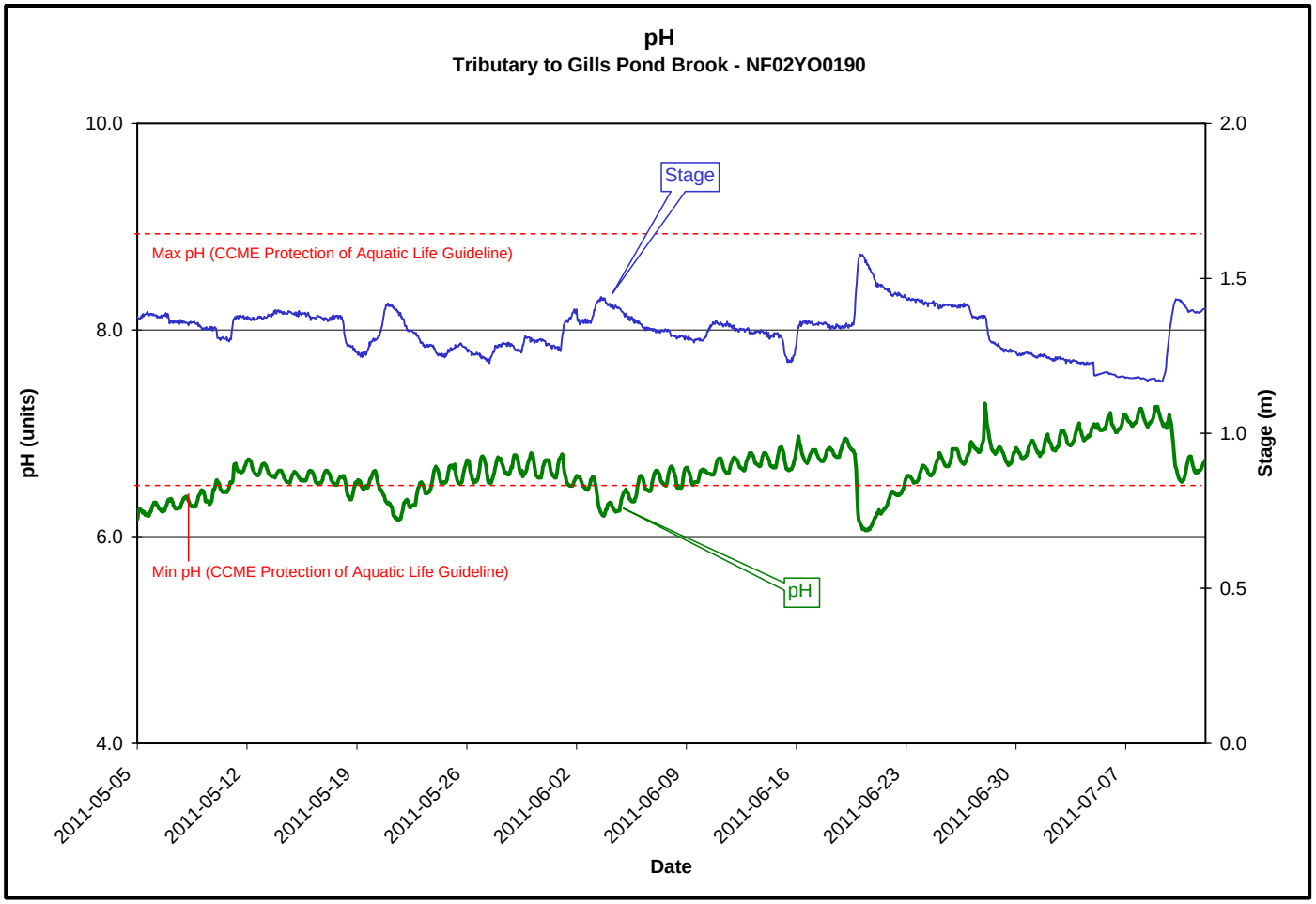

Figure 2

- The specific conductivity **(Figure 3)** ranged from a minimum of 19.3 µS/cm to a maximum of 881.0 µS/cm over the deployment period.
- The highest specific conductance readings correspond with periods of discharge from the Polishing Pond.
- The several 'V' shaped dips are the result of dilution caused by precipitation events, indicated by peaks in the stage.

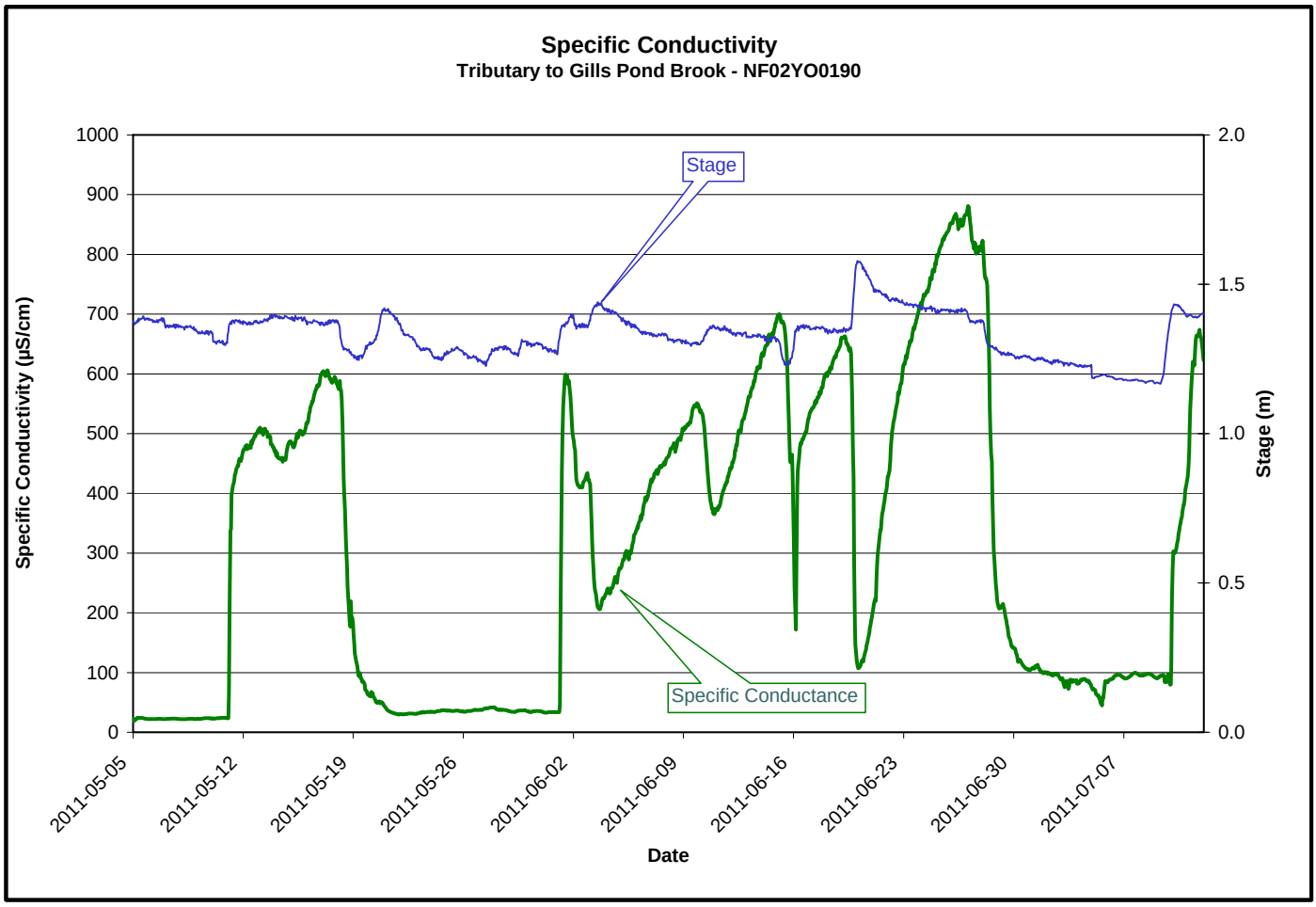

Figure 3

- The dissolved oxygen (**Figure 4**) values ranged from a minimum of 7.57 mg/L to a maximum of 12.35 mg/L over the deployment period, with the percent saturation ranging between 81.7 and 99.3.
- Dissolved oxygen is generally inversely proportional to water temperature.
- All 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.

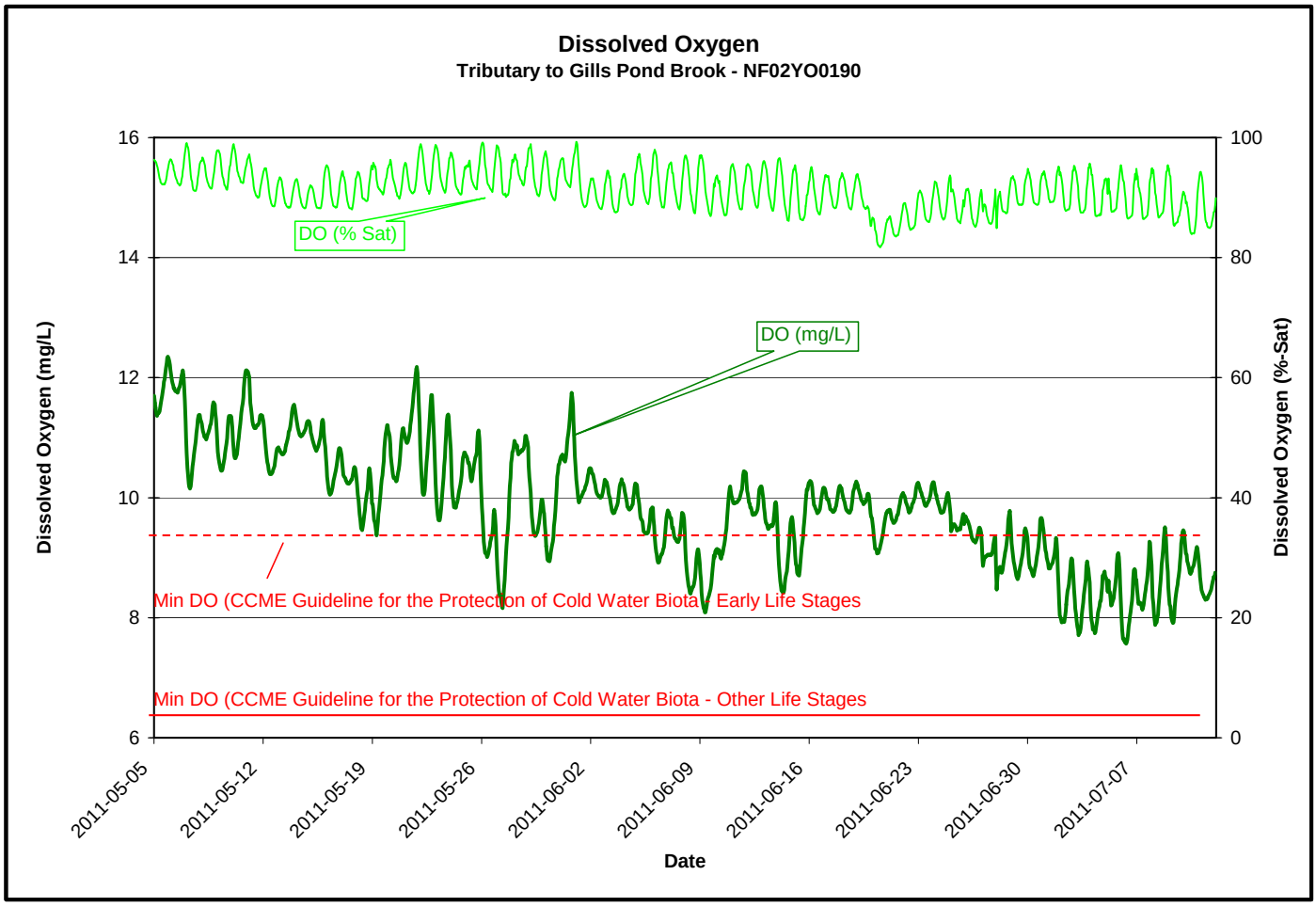

Figure 4

- The turbidity values **(Figure 5)** ranged from a minimum of 0.0 NTU to a maximum of 182.2 NTU.
- Based upon previous investigation, it has been determined that turbidity values may be artificially increased due to air entrainment during high flows.
- The higher turbidity values likely correspond to natural in-stream debris and/or air bubbles from turbulent flow passing over the sensor.
- Periods of sustained high turbidity values on the graph are likely the result of debris caught on the sensor.
- Neither *in situ* nor grab sample measurements nor visual observations indicated turbidity issues.

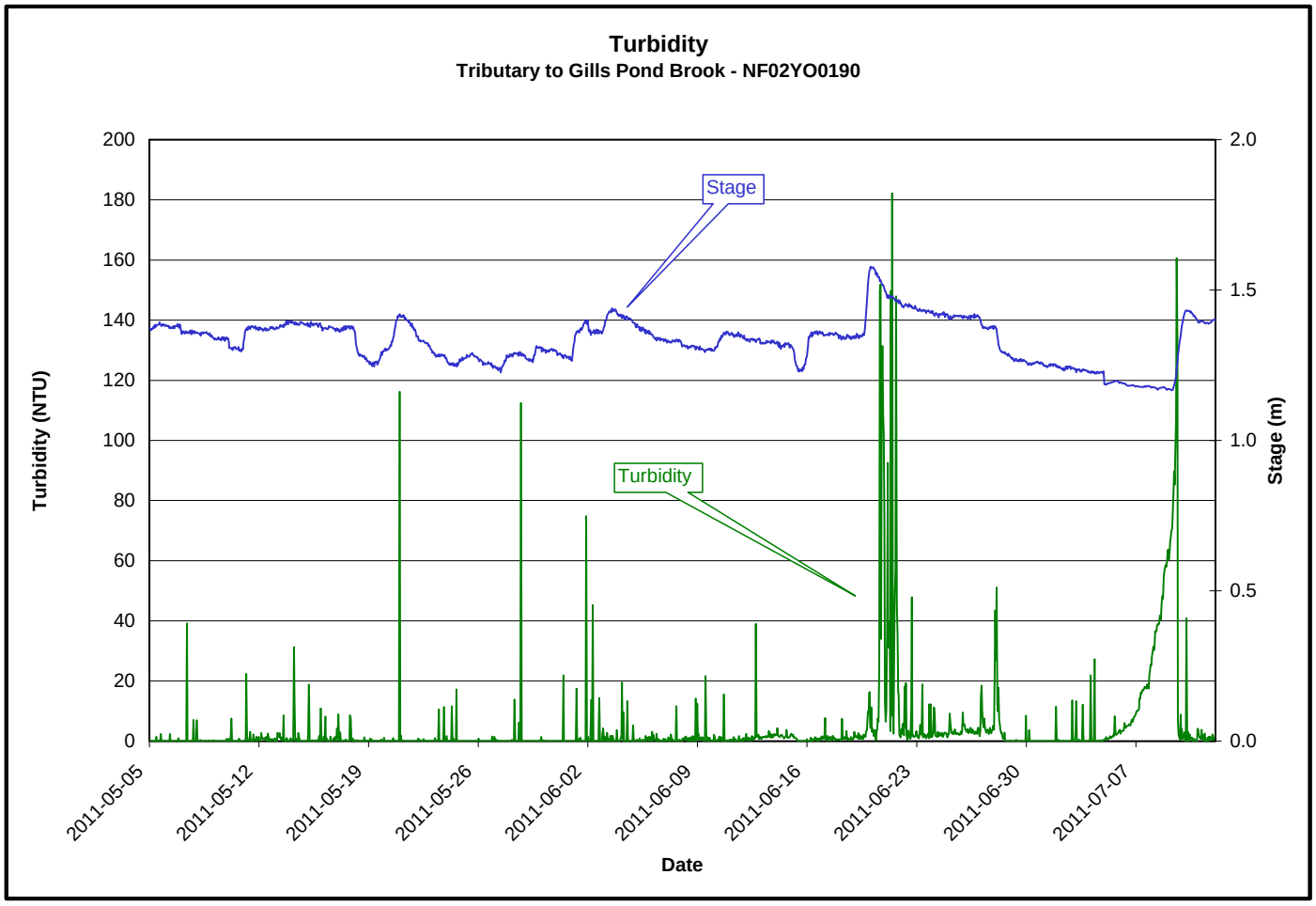

Figure 5

- The stage or water level ranged from a minimum of 1.17 m to a maximum of 1.58 m. The flow or discharge ranged from a minimum of 0.02 m^3/s to a maximum of 1.56 m^3/s (**Figure 6)**.
- The peaks correspond to periods of discharge from Polishing Pond and precipitation events.
- All values are within the normal range.

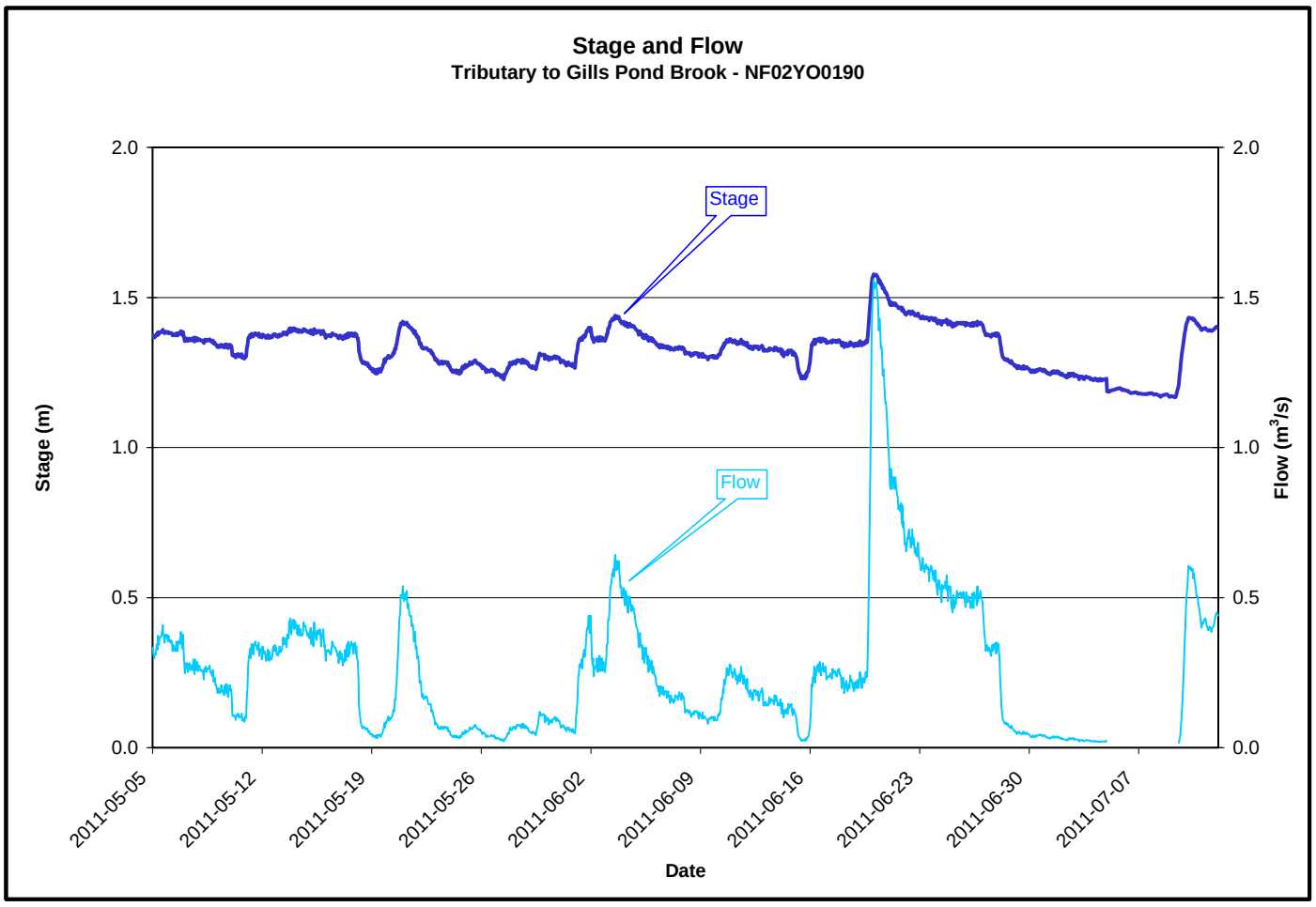

Figure 6

EAST POND BROOK

- The water temperature (**Figure 7**) ranged from a minimum of 5.87 ˚C to a maximum of 25.35 ˚C, with temperatures generally increasing over the summer.
- There appears to be little correlation with stage.

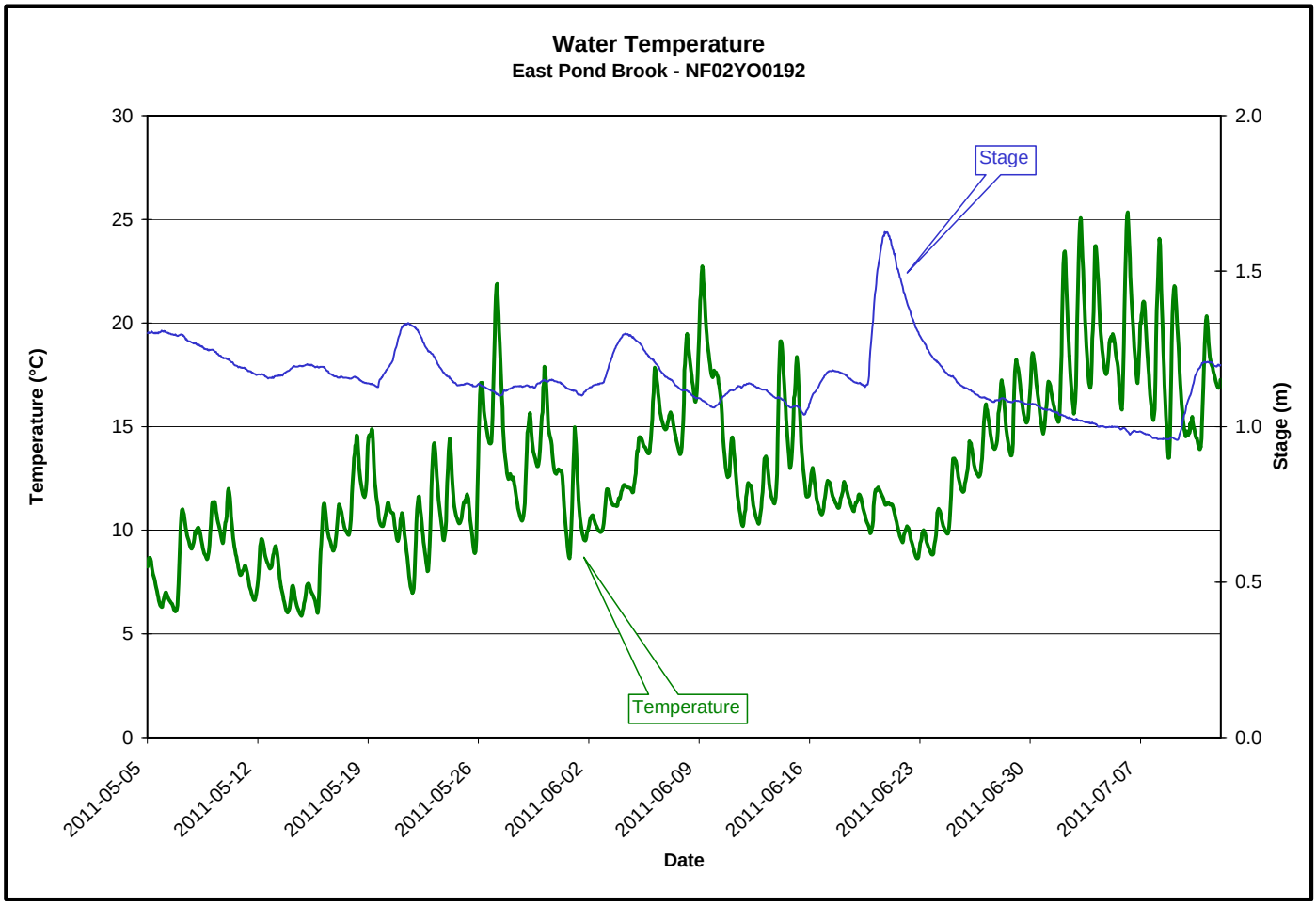

Figure 7

- Throughout the deployment period pH values (**Figure 8**) ranged from a minimum of 5.67 to a maximum of 6.76 with some of the values falling below 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 limit are not unusual.
- There is an obvious inverse relationship between pH and Stage

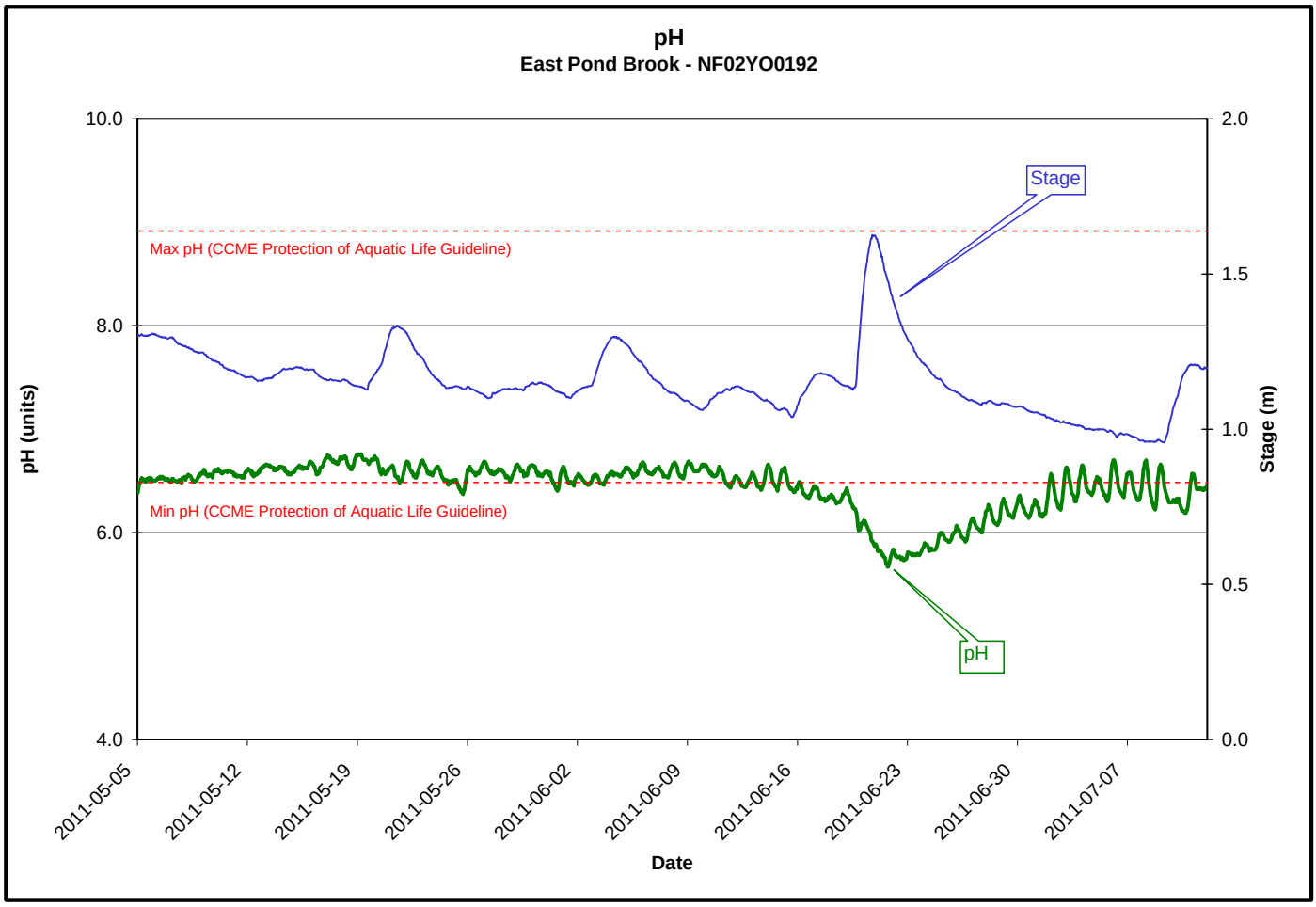

Figure 8

- The specific conductivity **(Figure 9)** ranged from a minimum of 14.8 µS/cm to a maximum of 41.2 µS/cm.

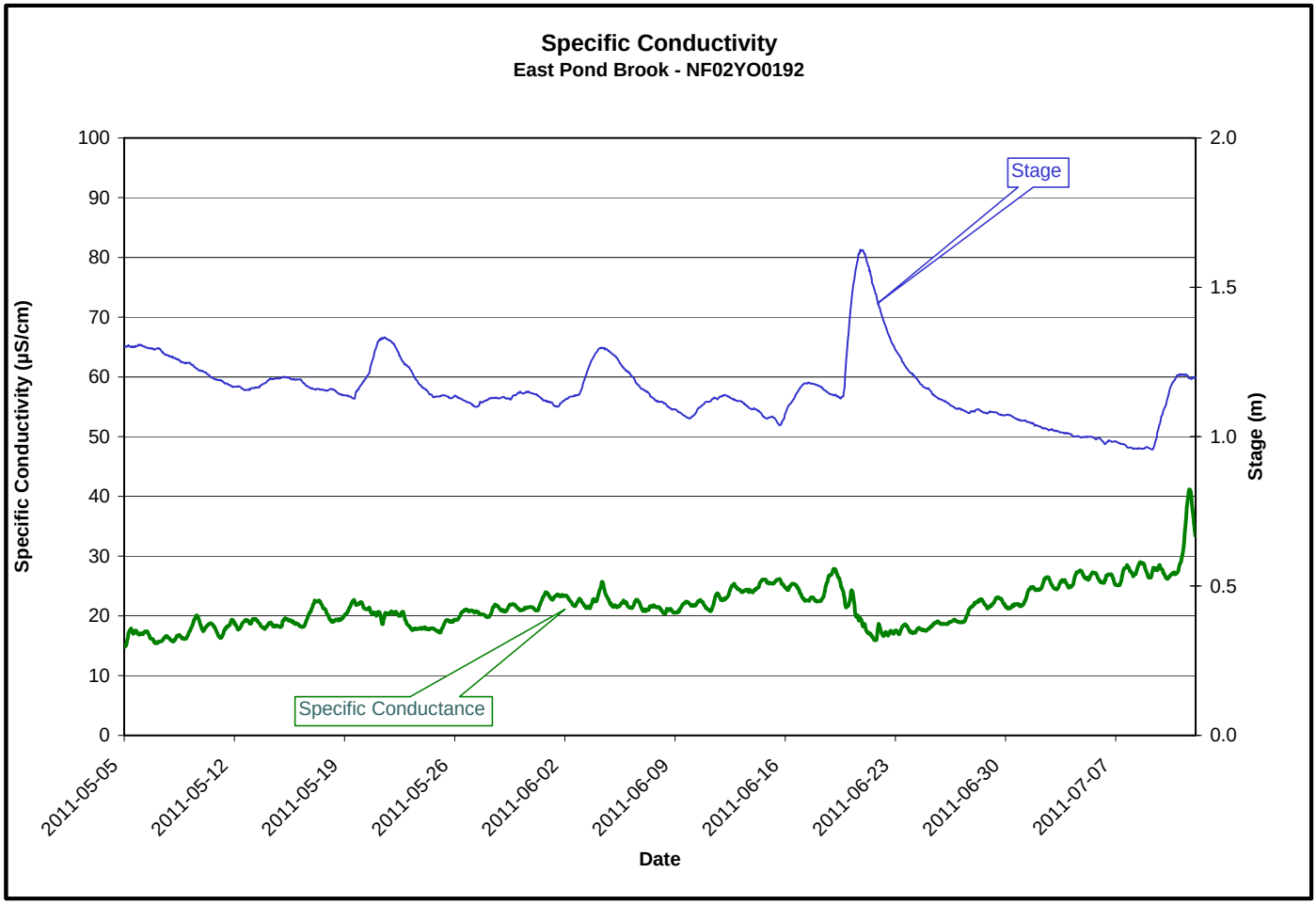

Figure 9

- The dissolved oxygen (**Figure 10**) values ranged from a minimum of 7.70 mg/L to a maximum of 11.55 mg/L over the deployment period, with the percent saturation ranging between 86.0 and 95.6.
- Dissolved oxygen is inversely proportional to water temperature.
- Throughout all of the deployment period, 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.

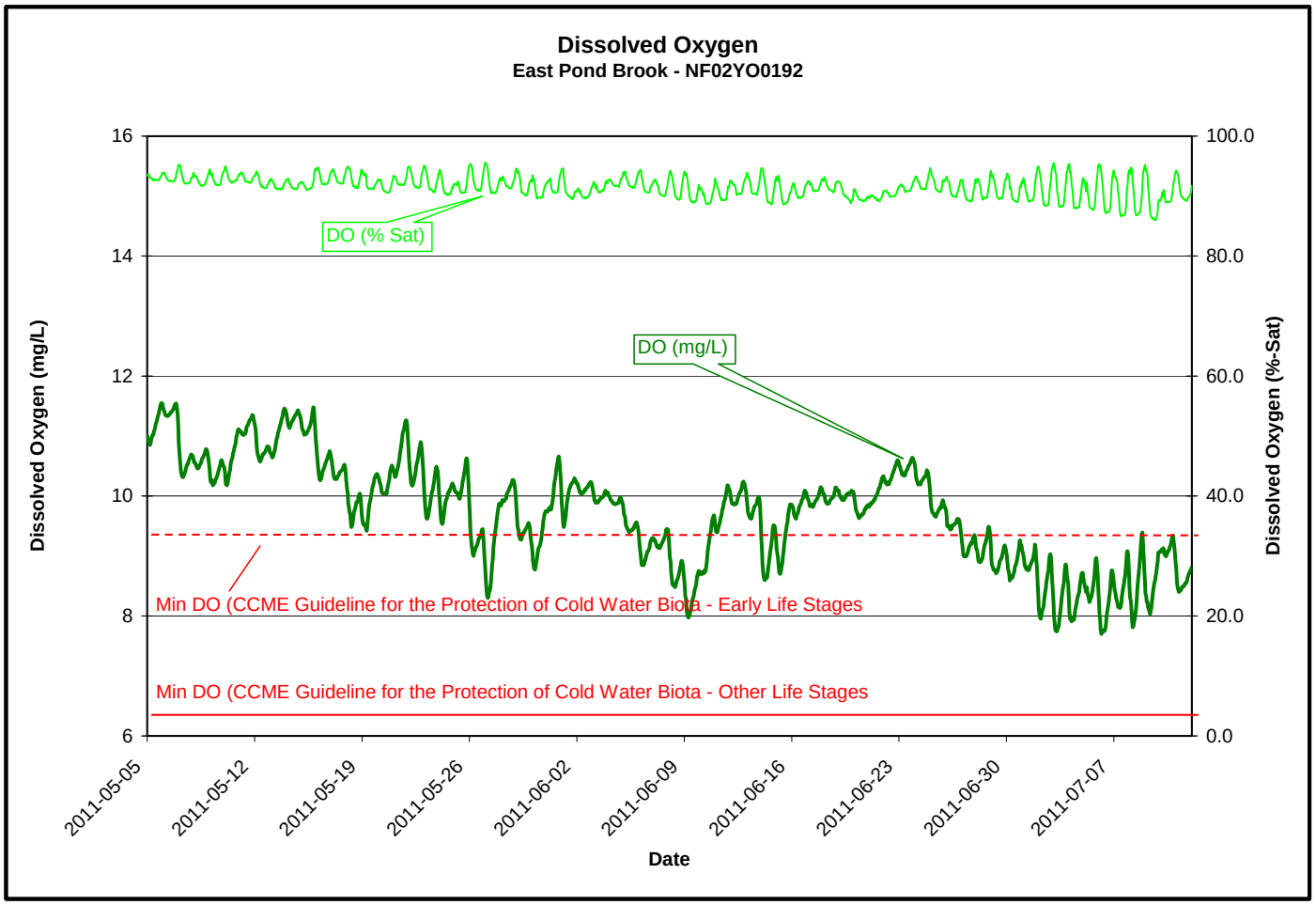

Figure 10

- The turbidity values **(Figure 11)** ranged from a minimum of 0.0 NTU to a maximum of 204.1 NTU.
- Typically, turbidity values in this stream are near zero; the peaks being insignificant events when natural in-stream debris and/or air bubbles passed near the sensor.
- Neither *in situ* nor grab sample measurements nor visual observations indicated turbidity issues.

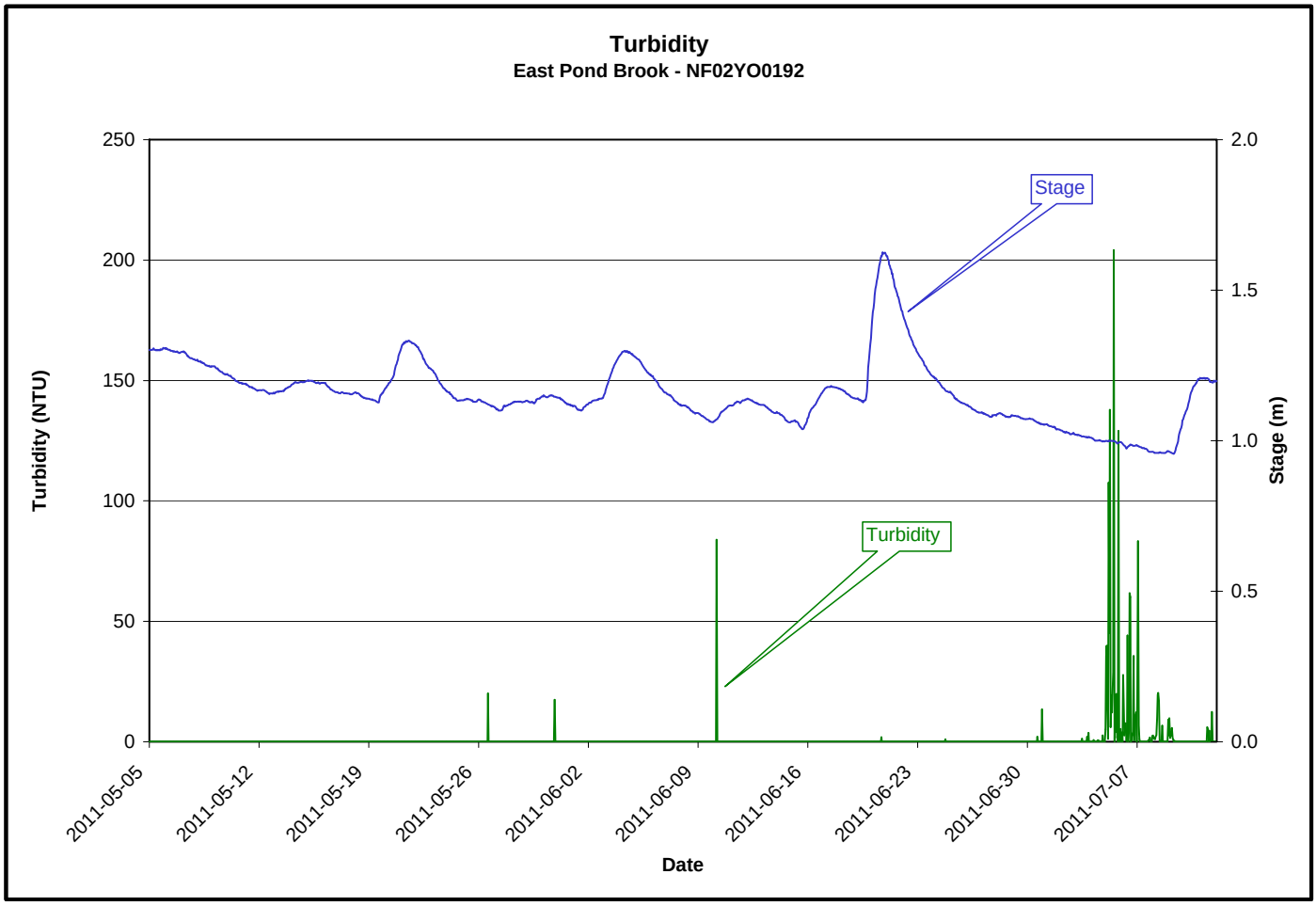

Figure 11

- The stage or water level ranged from a minimum of 0.96 m to a maximum of 1.63 m. The flow or discharge ranged from a minimum of 0.27 m^3/s to a maximum of 7.91 m^3/s **(Figure 12)**.
- Both stage and flow are within normal ranges.

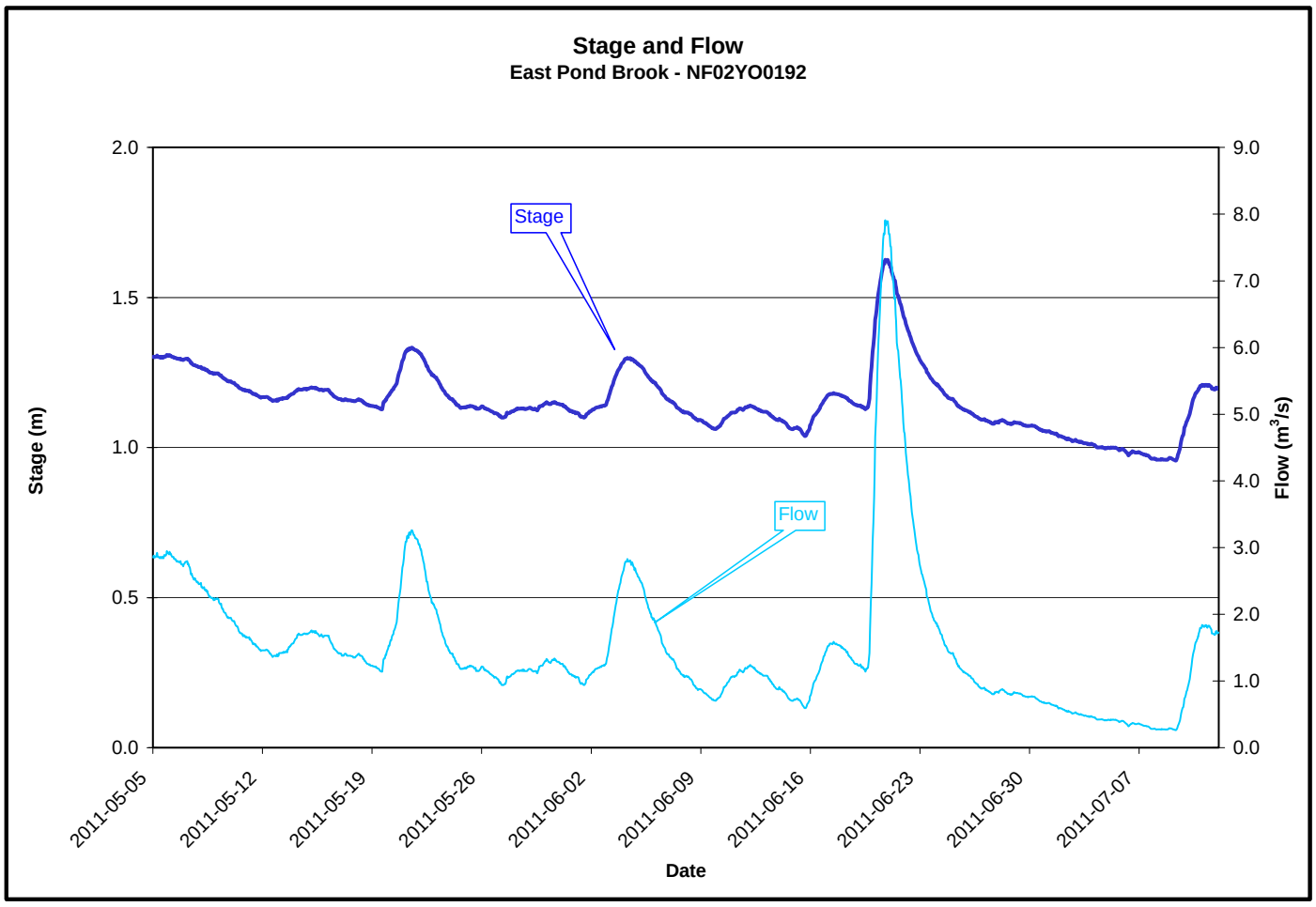

Figure 12

WELL AFTER TAILING DAM (MW1)

- The water temperature (**Figure 13**) ranged from a minimum of 5.03 ˚C to a maximum of 5.22 ˚C with a slight decrease over the deployment period.
- There appears to be little correlation with water elevation.

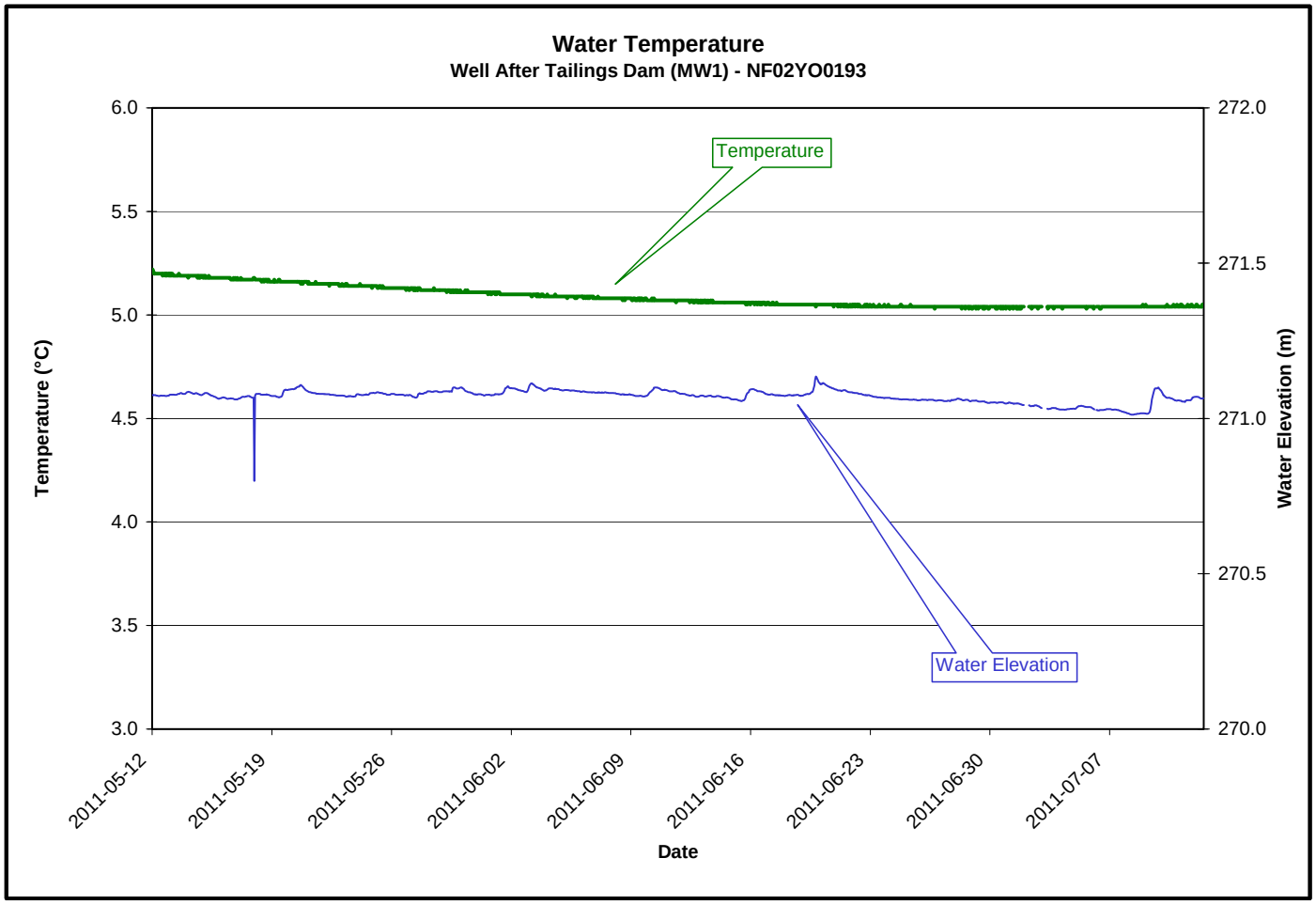

Figure 13

- The pH (**Figure 14**) ranged from a minimum of 6.69 to a maximum of 8.99.
- Following the initial deployment on May 12, 2011, there was a significant increase in pH for the next 24 hours, than a moderate increase for the remaining 13 days. This swing in pH is typical following each instrument deployment and continues to be the subject of investigation.
- From May 26, 2011 on to the end of the reporting period, pH increased gradually.

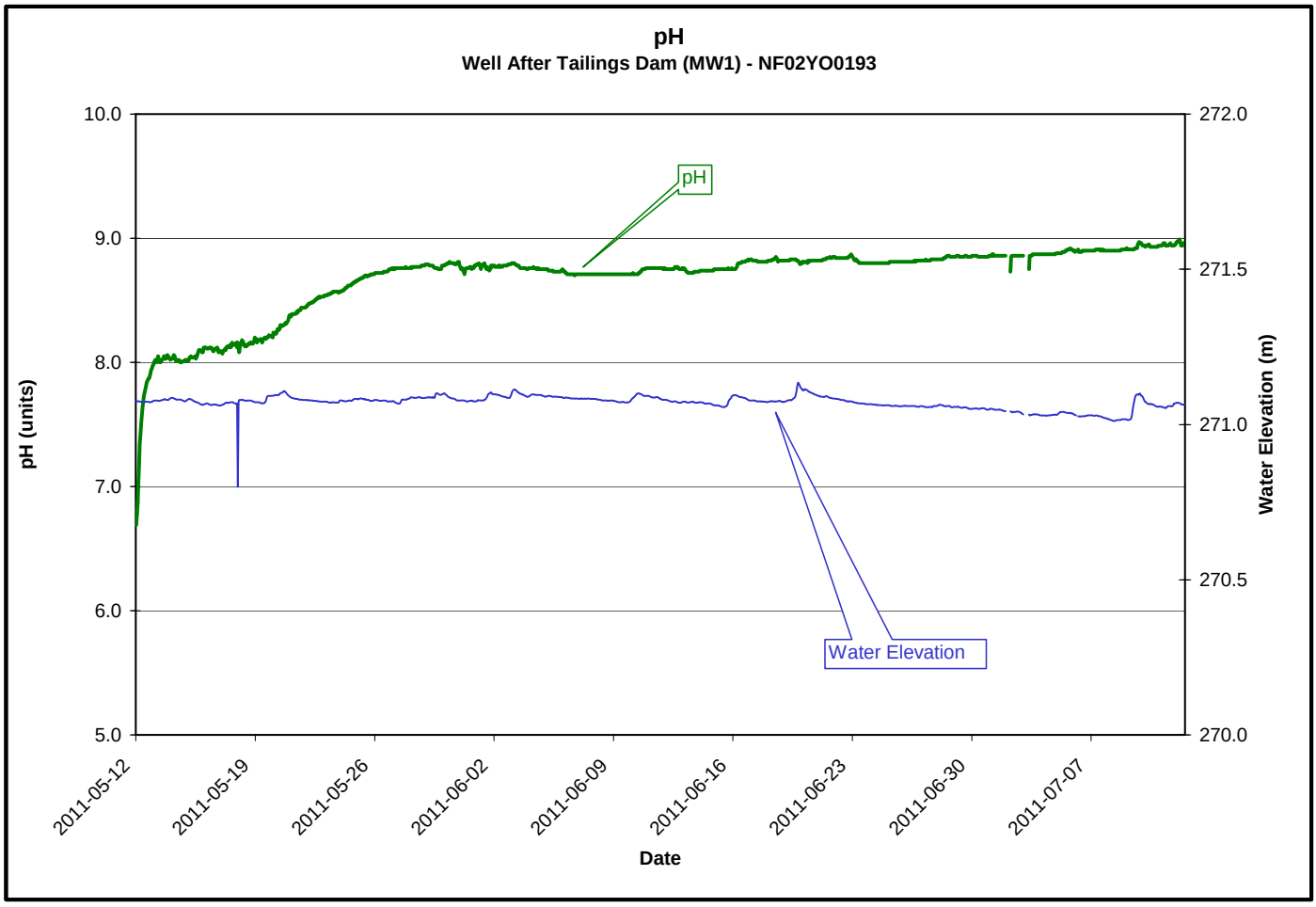

Figure 14

- The specific conductivity **(Figure 15)** ranged from a minimum of 0.607 mS/cm to a maximum of 0.645 mS/cm over the deployment period.
- There was a slight decrease on specific conductivity during the reporting period.

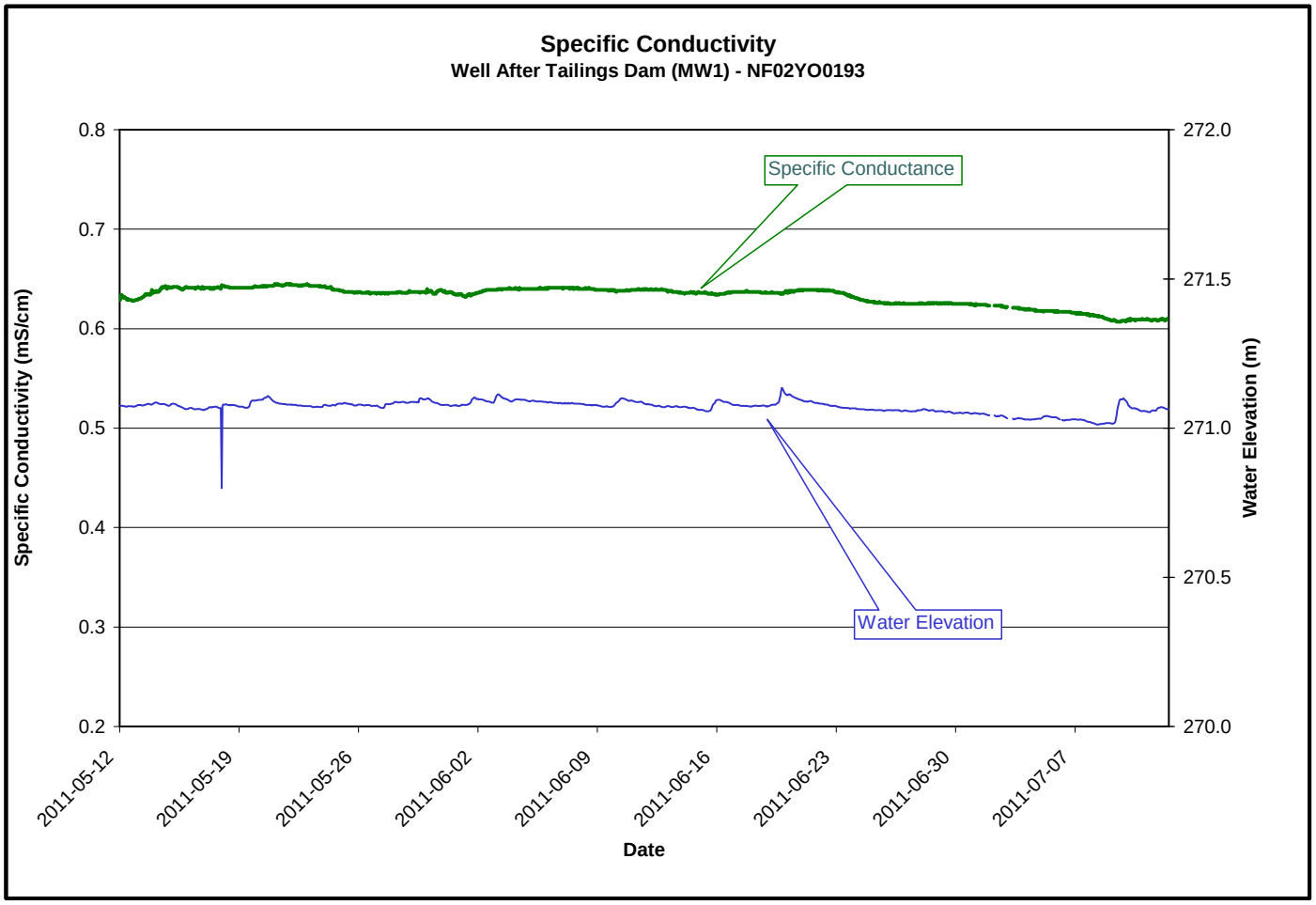

Figure 15

- The Water Elevation ranged from a minimum of 270.80 m to 271.13 m, with little change over the deployment period.
- On May 18, 2011 there is a notable short-term decrease in the water elevation. This decrease coincides with a pump test that was being carried out on this well.
- It is interesting to note that this pump test did not result any significant changes in water temperature, pH or specific conductance in the hours following the pump test.
- It was noted that water was flowing from the outer (protective) well casing at the beginning of the deployment period.

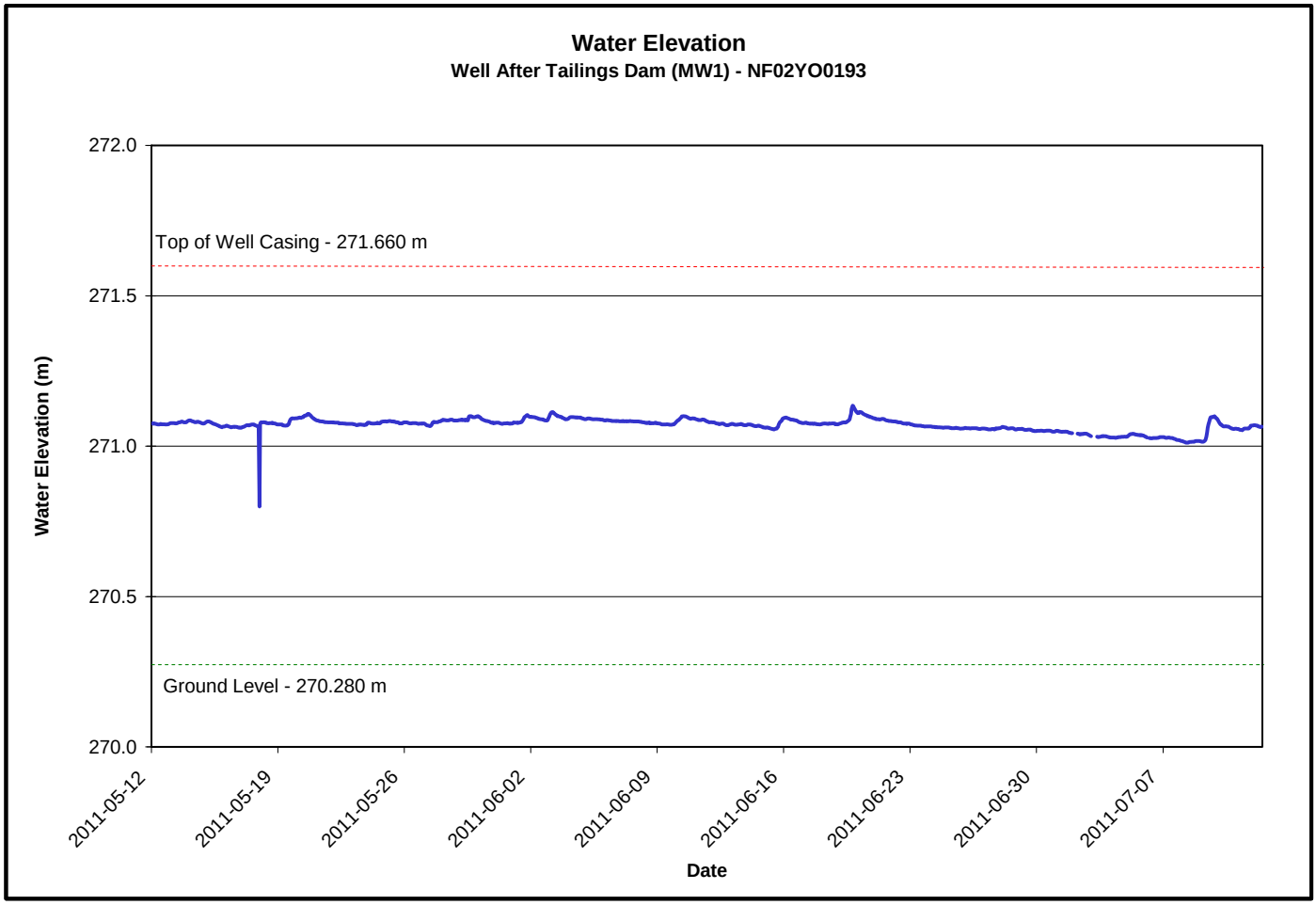

Figure 16

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