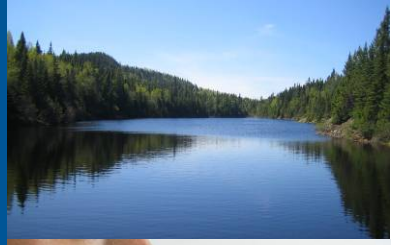
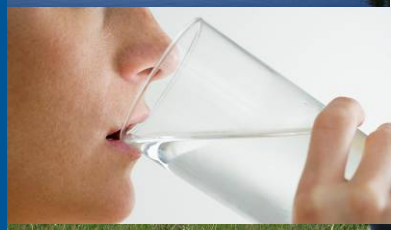



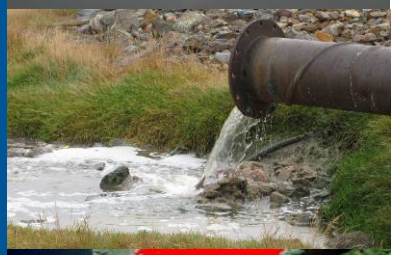


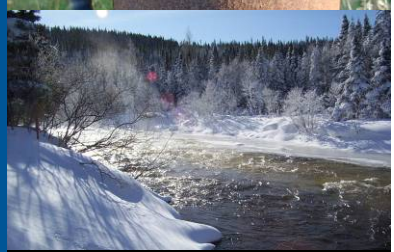

Real Time Water Quality Report
Teck Duck Pond Operations

Deployment Period 2012-07-04 to 2012-08-06

2012-08-23

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 most of the deployment period, with a brief period without discharge from July 17, 2012 to July 26, 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 July 6, 2012, and remained deployed continuously until August 6, 2012, a 30 day period.
- A **MiniSonde®** (s/n 44998) borrowed from another project was used for QA/QC purposes during the installation of the instruments. This unit was recently factory-serviced and was cleaned and calibrated to the same standards. The regular **MiniSonde® (**s/n 47591) was used for the removal of the instruments.
- The regular **Quanta G®** (s/n 00035) was deployed on July 4, 2012 after being returned from the vendor for factory servicing and replacement of the pH sensor. This unit was calibrated prior to its deployment, and remained deployed continuously in Monitoring Well After Tailings Dam Station (MW1) until the end of the reporting period; a 32 day period. This until will remain deployed until the fall, when it will be removed for cleaning and calibration prior to over-winter deployment.

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 shown in **Table 4**.
- From July 29, 2012 to August 2012 there was some interference (presumably an accumulation of debris) with the turbidity sensor at East Pond Brook. Accordingly, these unreliable data have been removed from the data set.
- From July 10, 2012 to August 4, 2012 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.
- A Fair ranking for pH was calculated for the deployment of the Quanta G. This was based upon a difference in 0.52 of a pH unit.
- 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**
2012-07-06 Deployment	Temp (^{o}C)	Good
	pH (units)	Good
	Sp. Conductivity (uS/cm)	Good
	Dissolved Oxygen (mg/L)	Excellent
	Turbidity (NTU)	Excellent
2012-08-06 Removal	Temp (^{o}C)	Excellent
	pH (units)	Excellent
	Sp. Conductivity (uS/cm)	Excellent
	Dissolved Oxygen (mg/L)	Excellent
	Turbidity (NTU)	Good

Table 2

East Pond Brook Station (NF02YO0192)		
Date (yyyy-mm-dd)	**Parameter**	**Ranking**
2012-07-06 Deployment	Temp (^{o}C)	Excellent
	pH (units)	Excellent
	Sp. Conductivity (uS/cm)	Excellent
	Dissolved Oxygen (mg/L)	Excellent
	Turbidity (NTU)	Good
2012-08-06 Removal	Temp (^{o}C)	Excellent
	pH (units)	Excellent
	Sp. Conductivity (uS/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**
2012-07-04 Deployment	pH (units)	Fair
	Sp. Conductivity (mS/cm)	Excellent

Table 4

Data Interpretation

TRIBUTARY TO GILLS POND BROOK

- The water temperature (**Figure 1**) ranged from a minimum of 12.44 ˚C to a maximum of 27.08 ˚C.
- Temperature remained fairly constant throughout the deployment period with only the diurnal variation evident.
- There appears to be little correlation with stage, although during peak flows, the diurnal variation in temperature is less, presumably due to precipitation, cloud cover and lower daytime ambient temperatures.

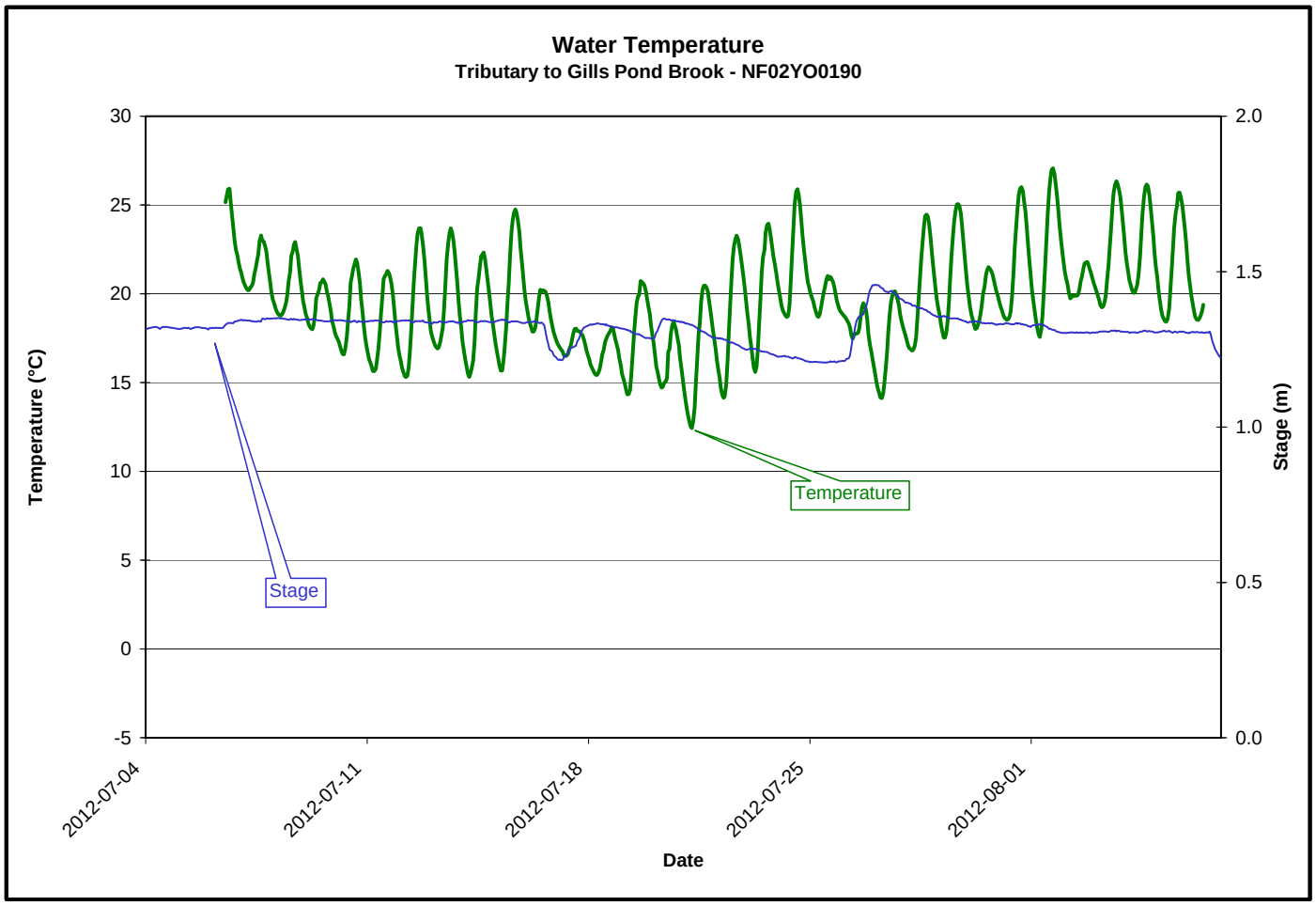

Figure 1

- Throughout the deployment period pH values (**Figure 2**) ranged from a minimum of 6.27 to a maximum of 7.47 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*.
- pH dropped slightly from July 17, 2012 to July 26, 2012 corresponding with the cessation of discharge from the Polishing Pond.
- An inverse relationship with stage is obvious during the one event during the last week of July.
- The background pH of this stream is normally around the lower limit of the recommended range.

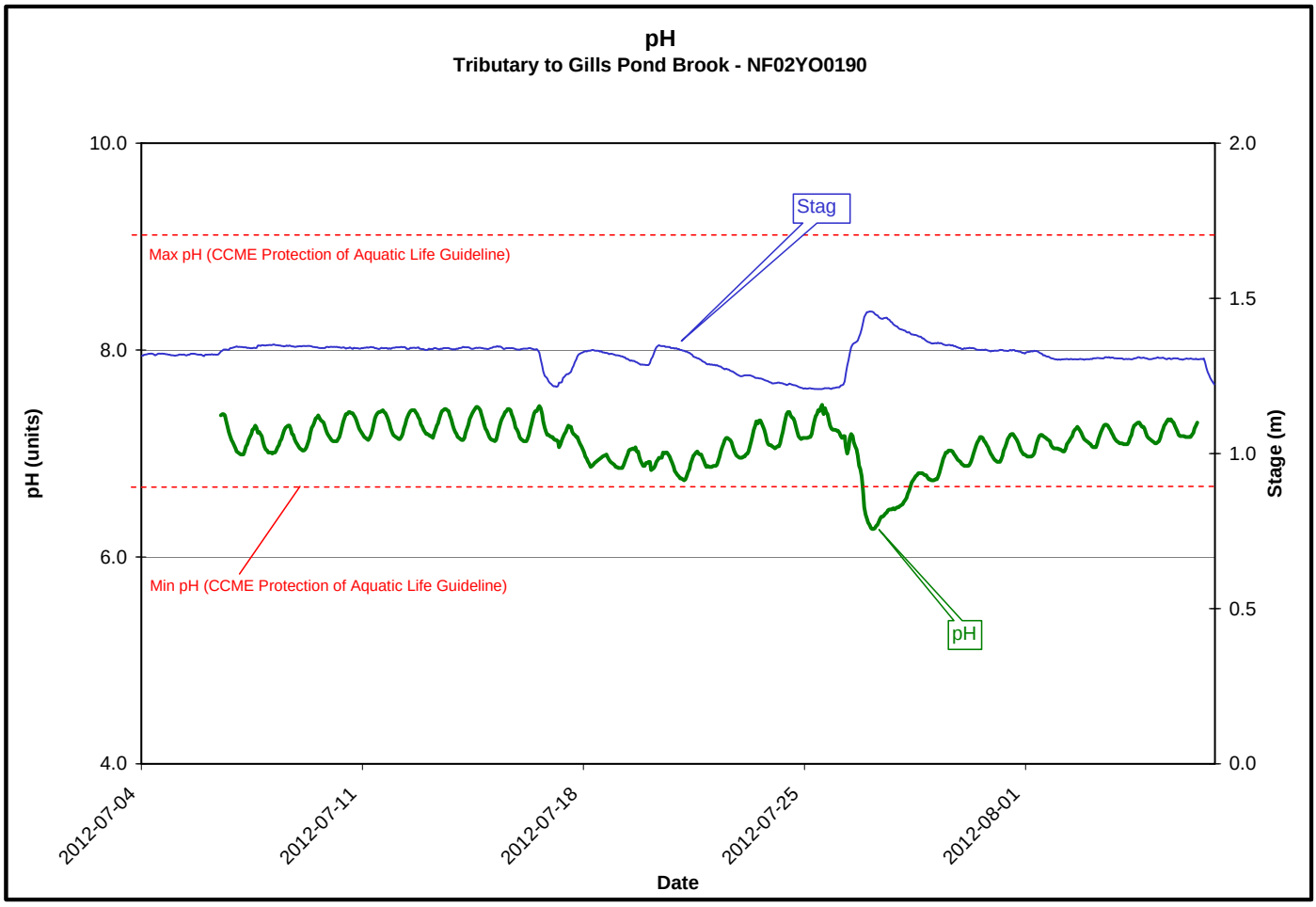

Figure 2

- The specific conductivity **(Figure 3)** ranged from a minimum of 53.4 µS/cm to a maximum of 1356.0 µS/cm over the deployment period.
- A significant decrease in specific conductance is obvious from July 17, 2012 to July 26, 2012 corresponding with the cessation of discharge from the Polishing Pond.

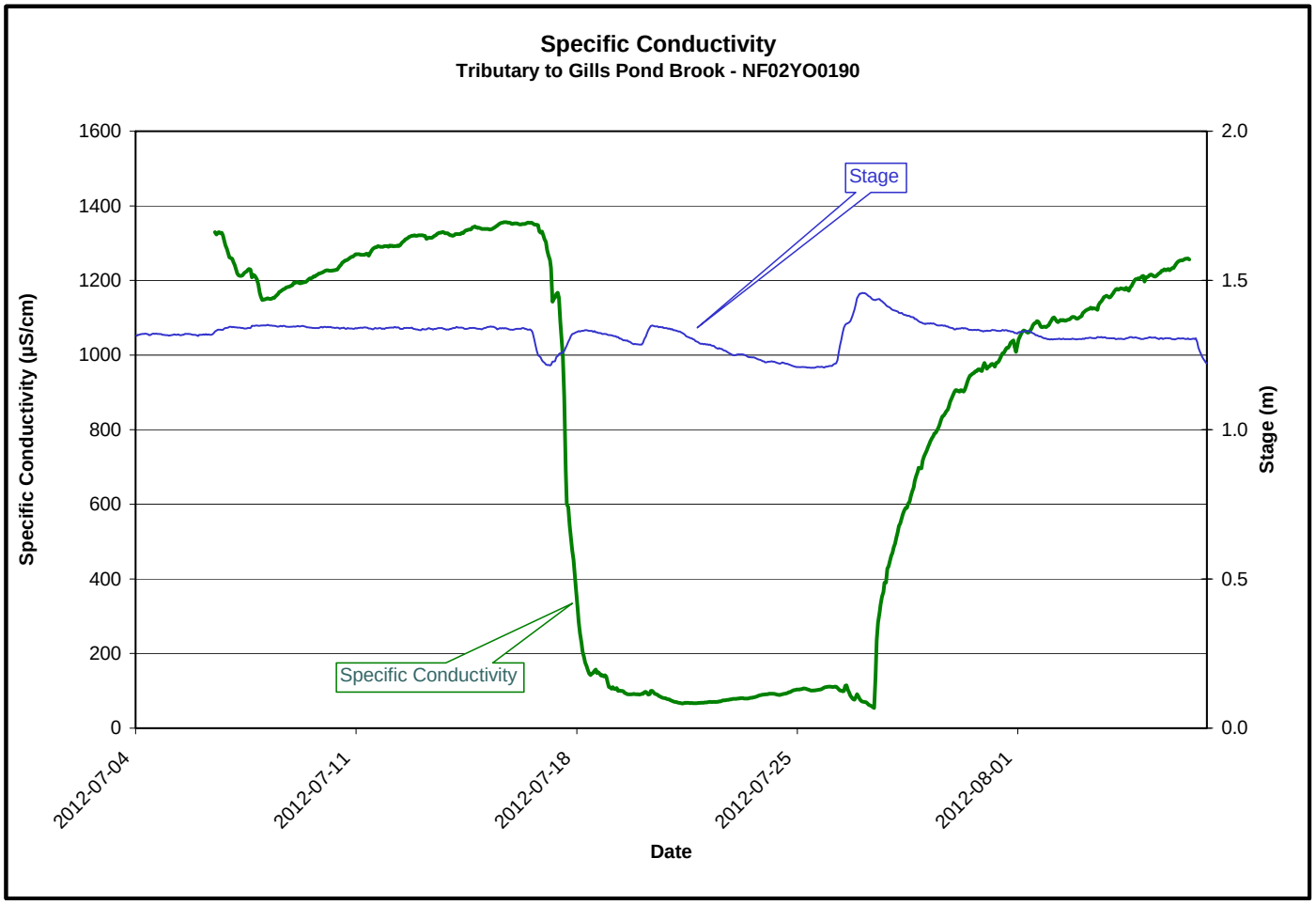

Figure 3

- The dissolved oxygen (**Figure 4**) values ranged from a minimum of 7.63 mg/L to a maximum of 9.94 mg/L over the deployment period, with the percent saturation ranging between 82.7 and 101.2.
- 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.

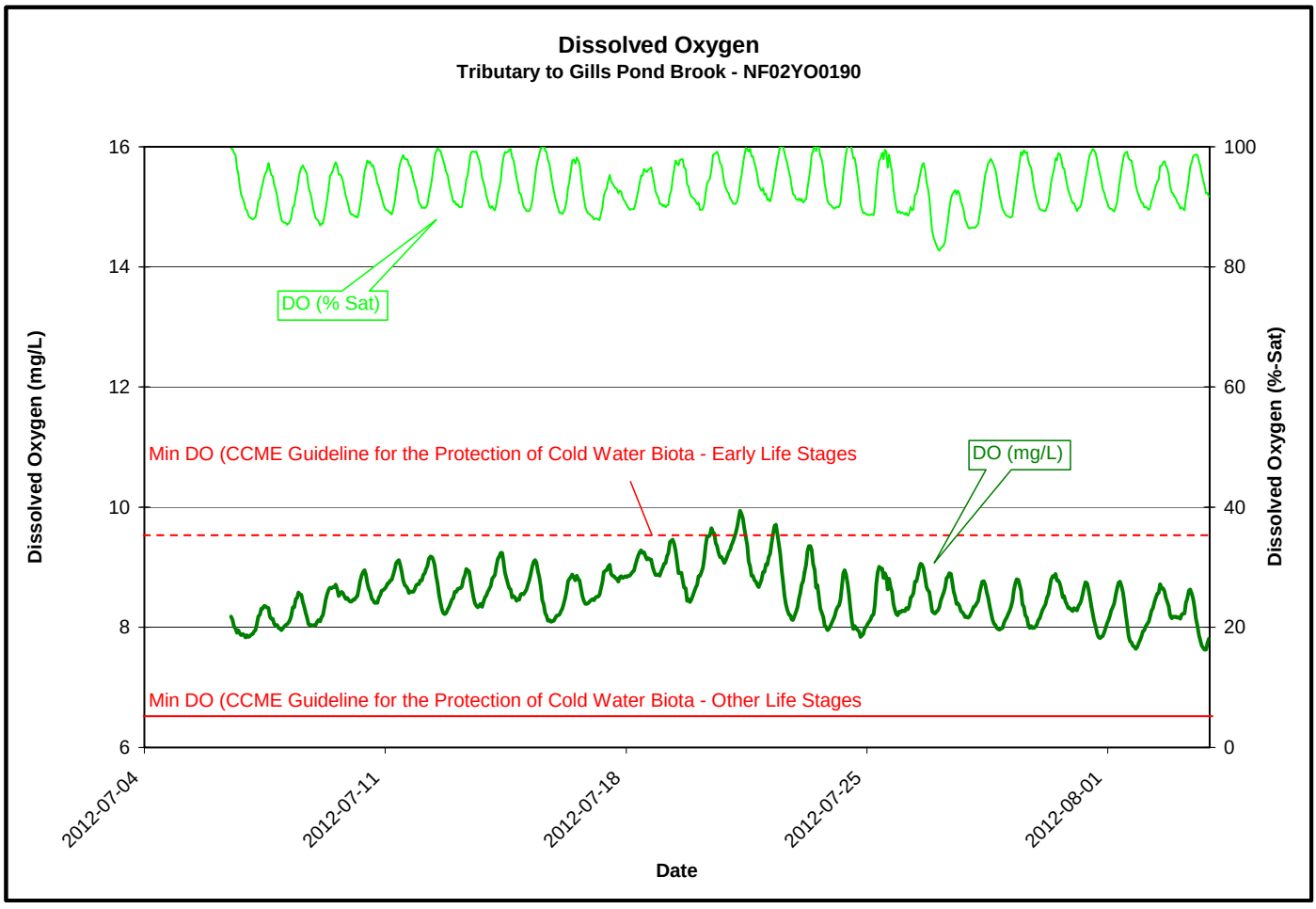

Figure 4

- The turbidity values **(Figure 5)** ranged from a minimum of 1.8 NTU to a maximum of 30.7 NTU.
- Based upon previous investigation, it has been determined that turbidity values may be artificially increased due to air entrainment during higher flows.
- There is no significant change in turbidity values during periods of discharge from Polishing Pond.
- 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.

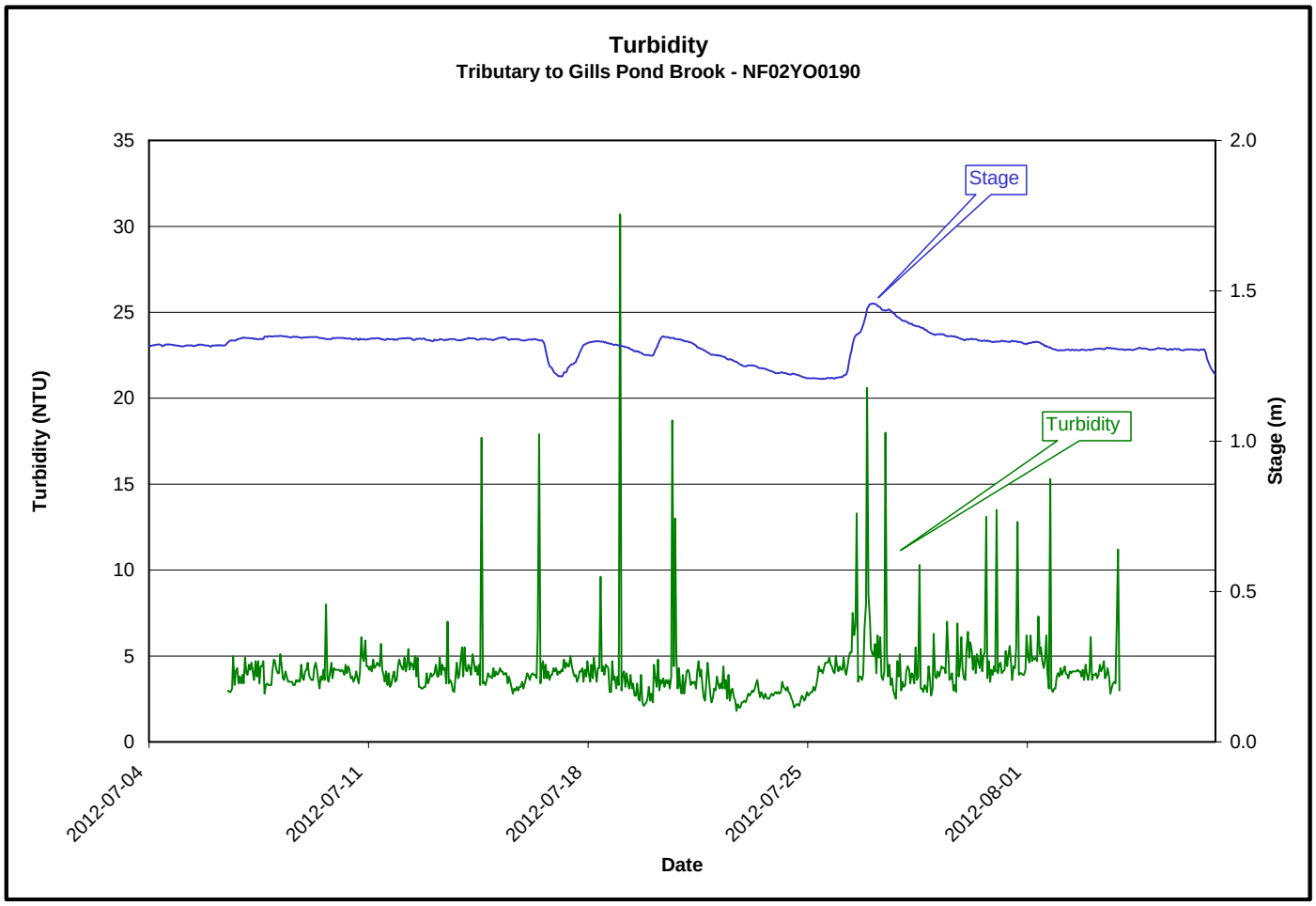

Figure 5

- The stage or water level ranged from a minimum of 1.21 m to a maximum of 1.46 m. The flow or discharge ranged from a minimum of 0.01 m^3/s to a maximum of 0.75 m^3/s (**Figure 6)**.
- There was a slight decrease in stage and flow from July 17, 2012 to July 26, 2012 corresponding with the cessation of discharge from the Polishing Pond.
- There was a slight decrease in stage and flow on the last day of the deployment period after the water quality instruments were removed. This was the beginning of another cessation of discharge from the Polishing Pond.
- The higher levels are the result of precipitation/runoff events.
- All values are within the normal range.

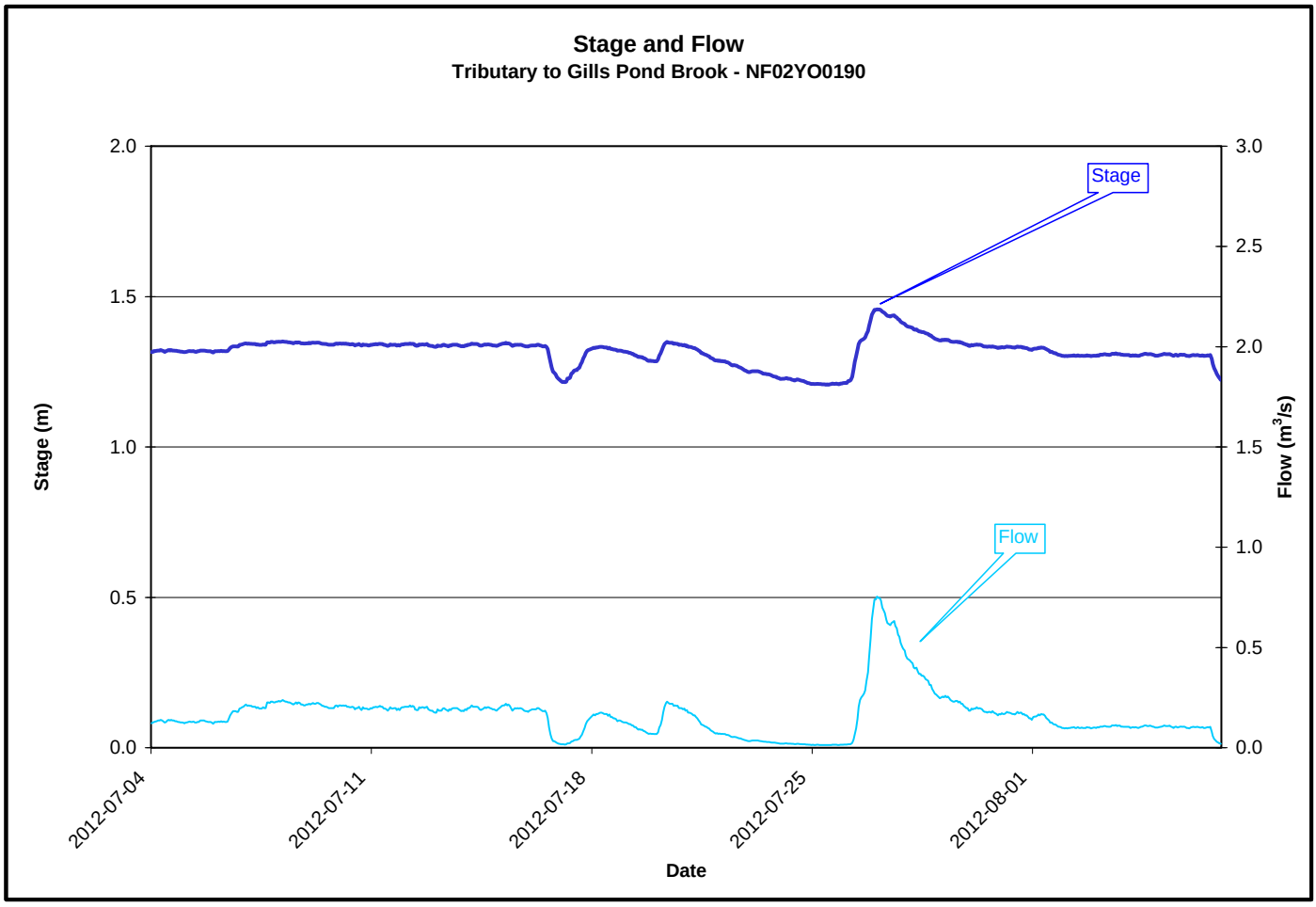

Figure 6

EAST POND BROOK

- The water temperature (**Figure 7**) ranged from a minimum of 12.96 ˚C to a maximum of 27.42 ˚C.
- Temperatures were generally stable throughout the deployment period, with only the diurnal variation evident.
- There appears to be little correlation with stage, although during peak flows, the diurnal variation in temperature is less, presumably due to precipitation, cloud cover and lower daytime ambient temperatures.

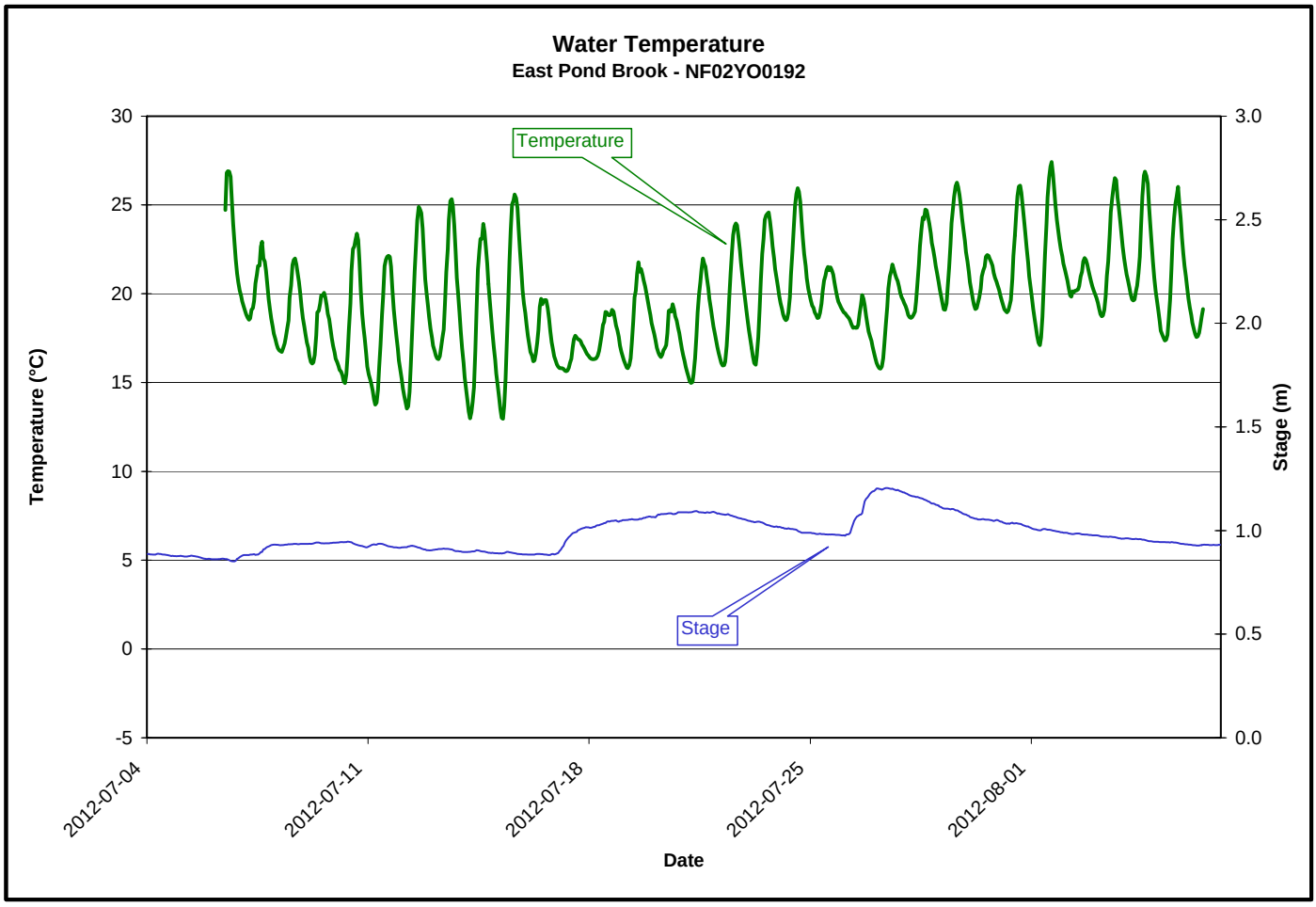

Figure 7

- Throughout the deployment period pH values (**Figure 8**) ranged from a minimum of 6.58 to a maximum of 7.31 with pH remaining constant throughout the deployment period.
- There is a temporary decrease in pH corresponding with peak flows.
- For the entire deployment period, 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*.
- The background pH of this stream is normally quite low, and values near and below the limit are not unusual.

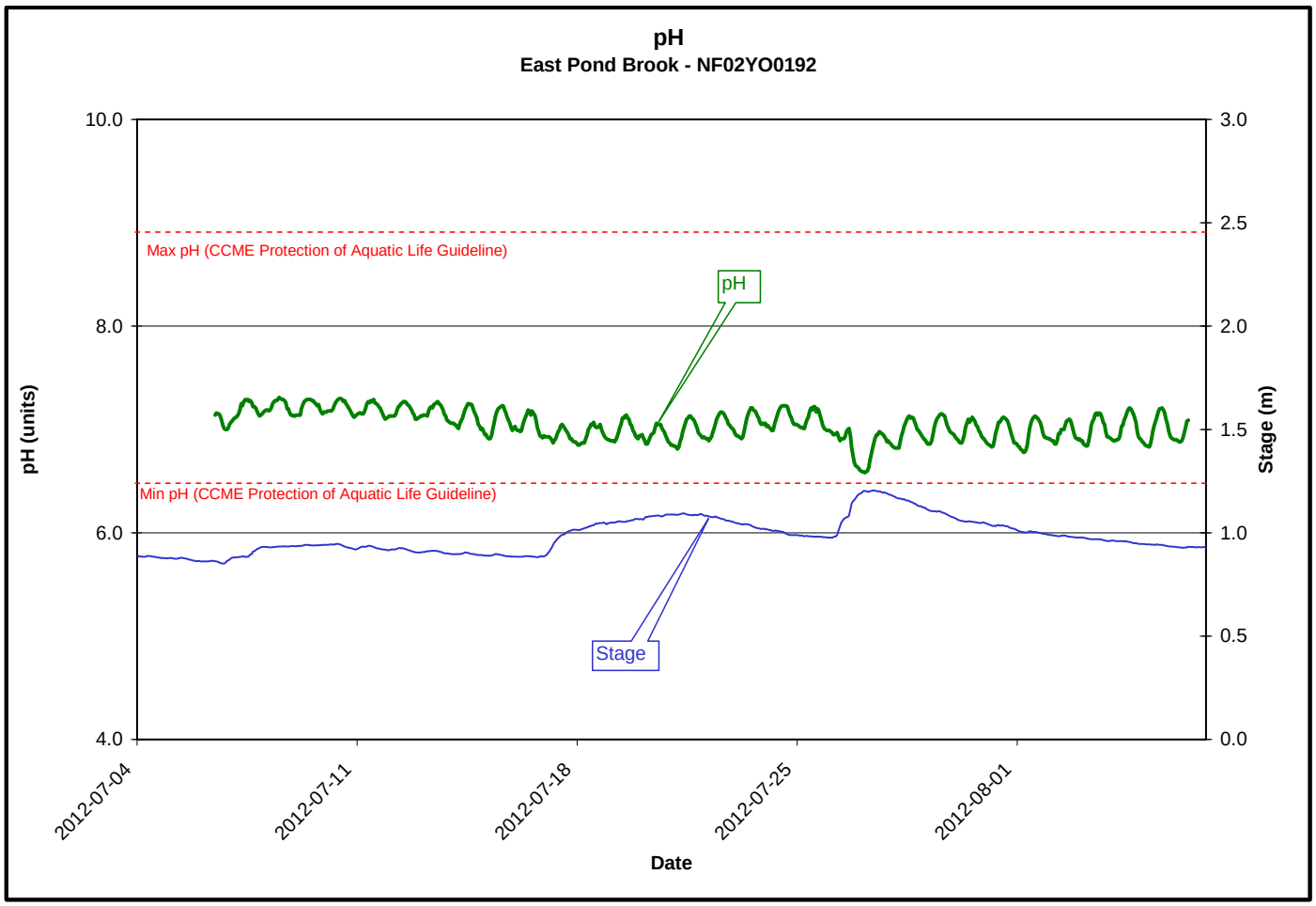

Figure 8

- The specific conductivity **(Figure 9)** ranged from a minimum of 28.3 µS/cm to a maximum of 52.3 µS/cm, with a slight increase over the deployment period.
- There is a notable increase in specific conductivity corresponding with higher flows.
- All values are within the normal range.

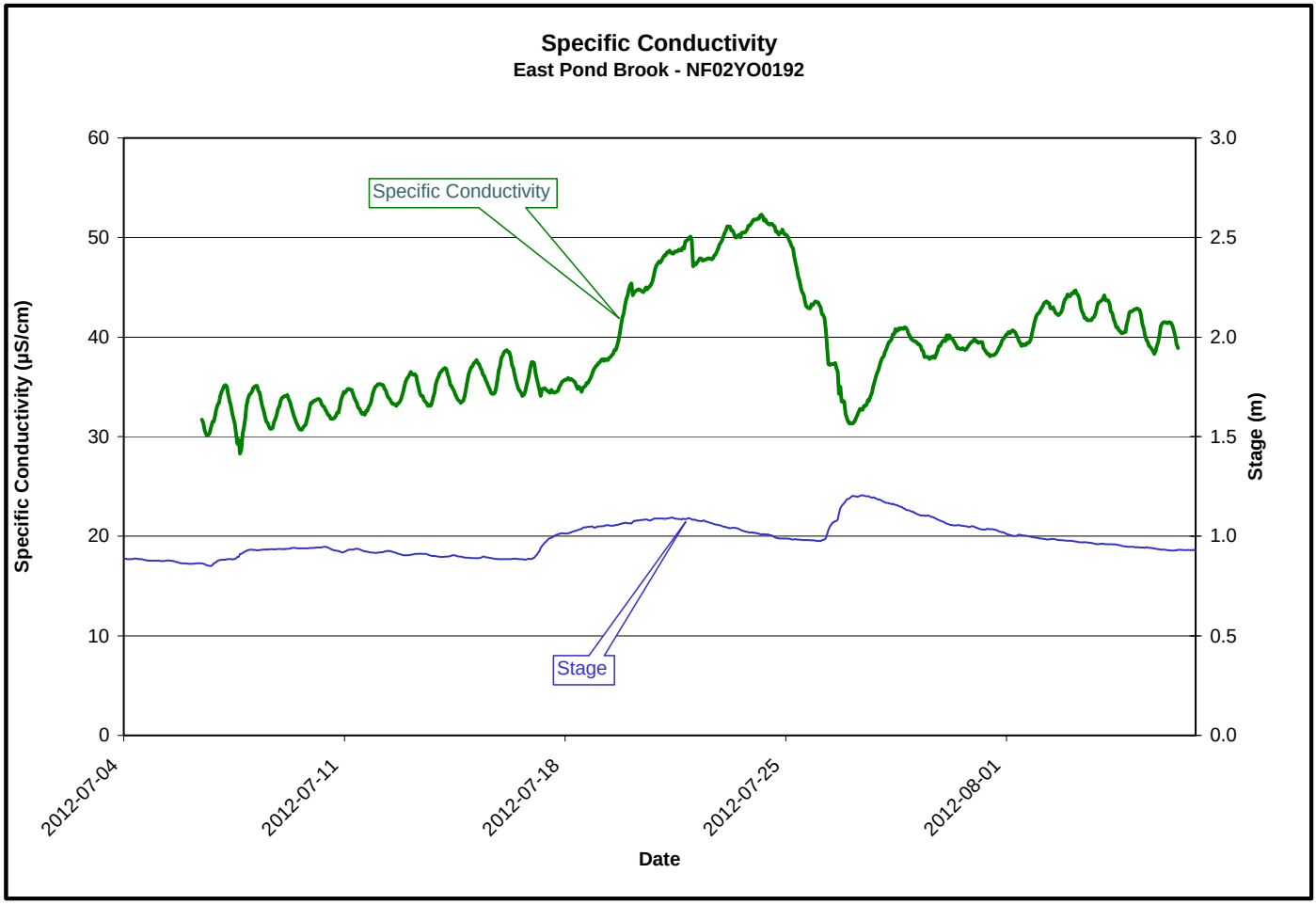

Figure 9

- The dissolved oxygen (**Figure 10**) values ranged from a minimum of 7.43 mg/L to a maximum of 9.86 mg/L over the deployment period, with the percent saturation ranging between 83.9 and 102.2.
- 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.

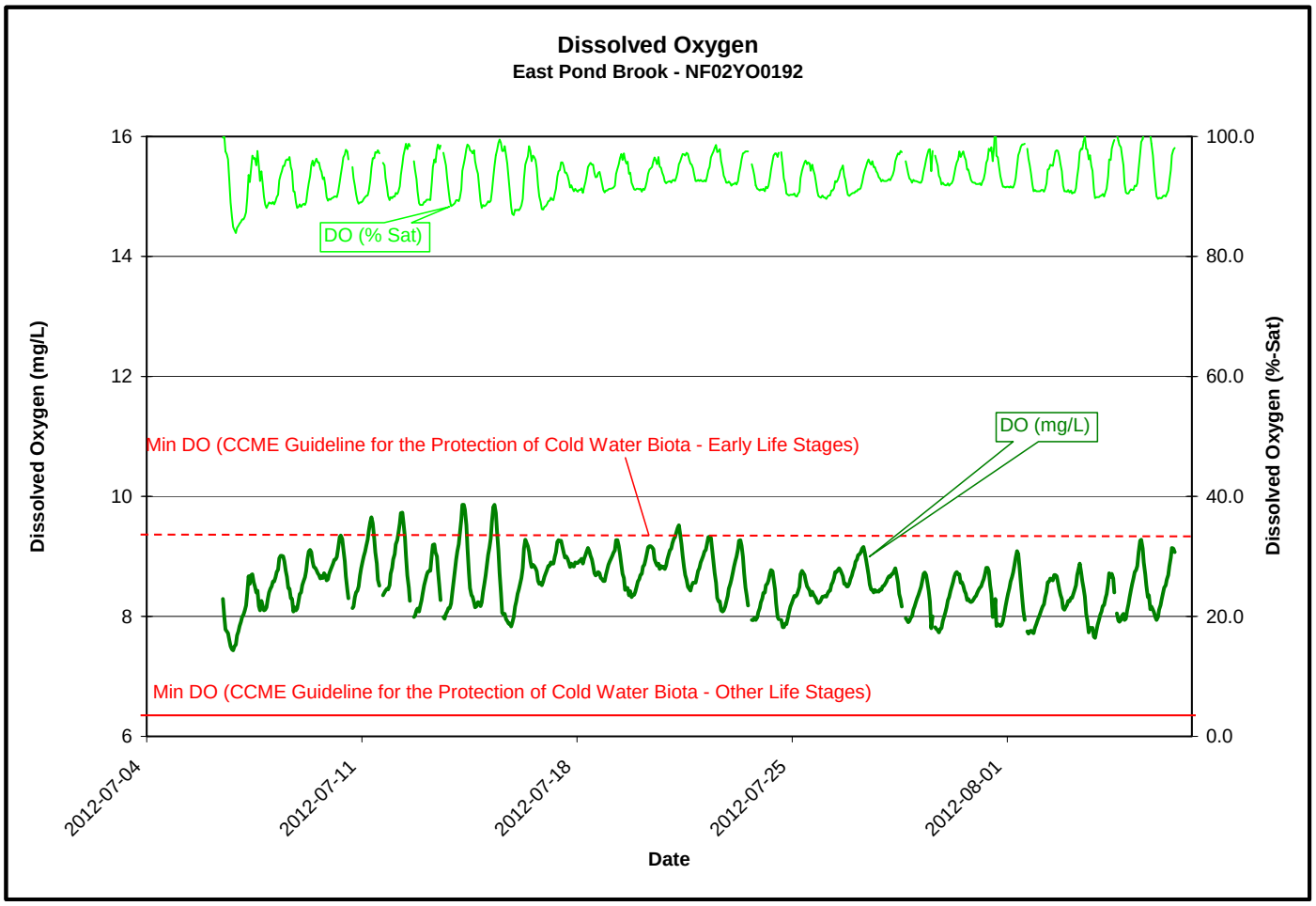

Figure 10

- The turbidity values (**Figure 11**) ranged from a minimum of 0.0 NTU to a maximum of 4.7 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.

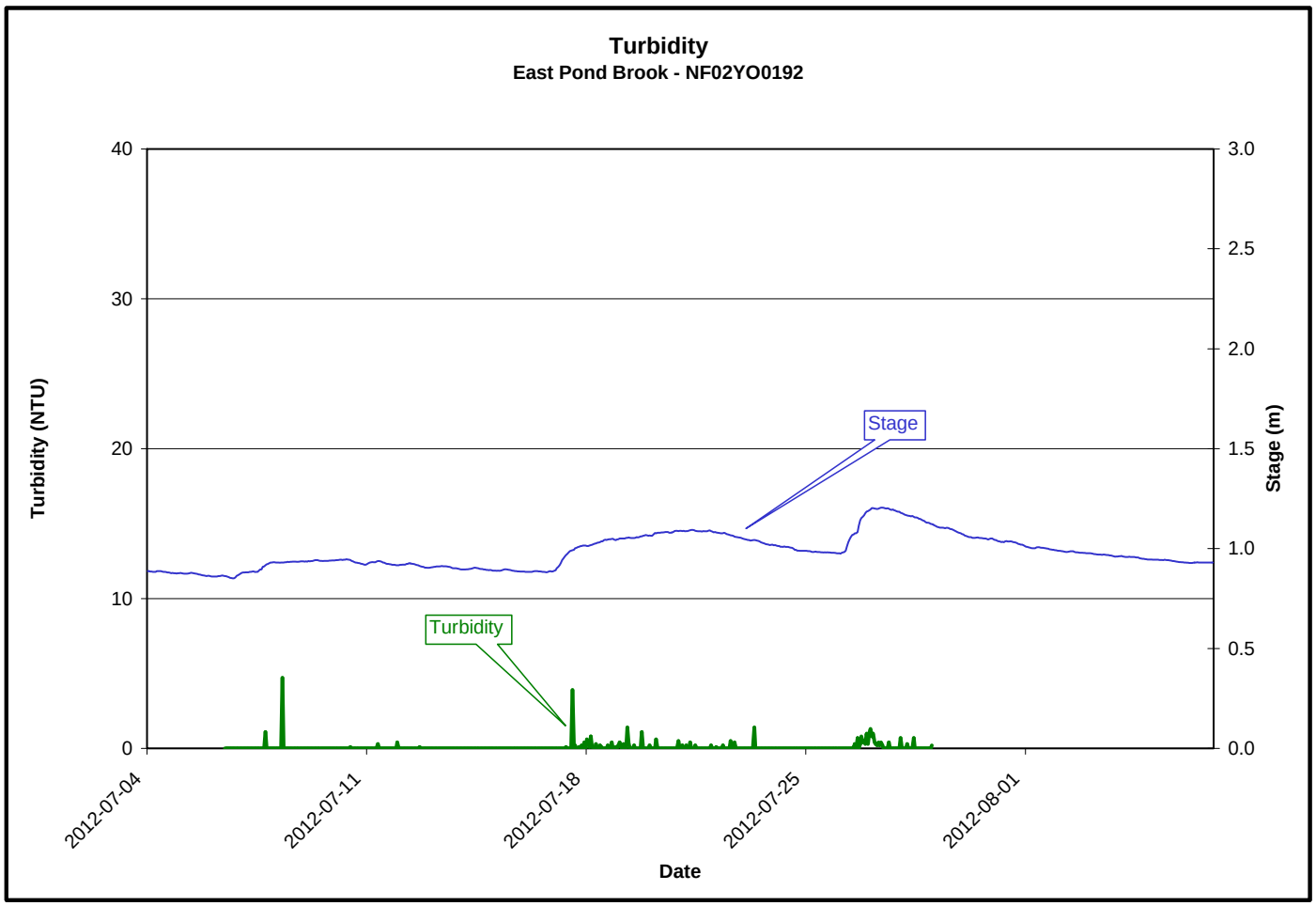

Figure 11

- The stage or water level ranged from a minimum of 0.85 m to a maximum of 1.21 m. The flow or discharge ranged from a minimum of 0.12 m^3/s to a maximum of 1.80 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.

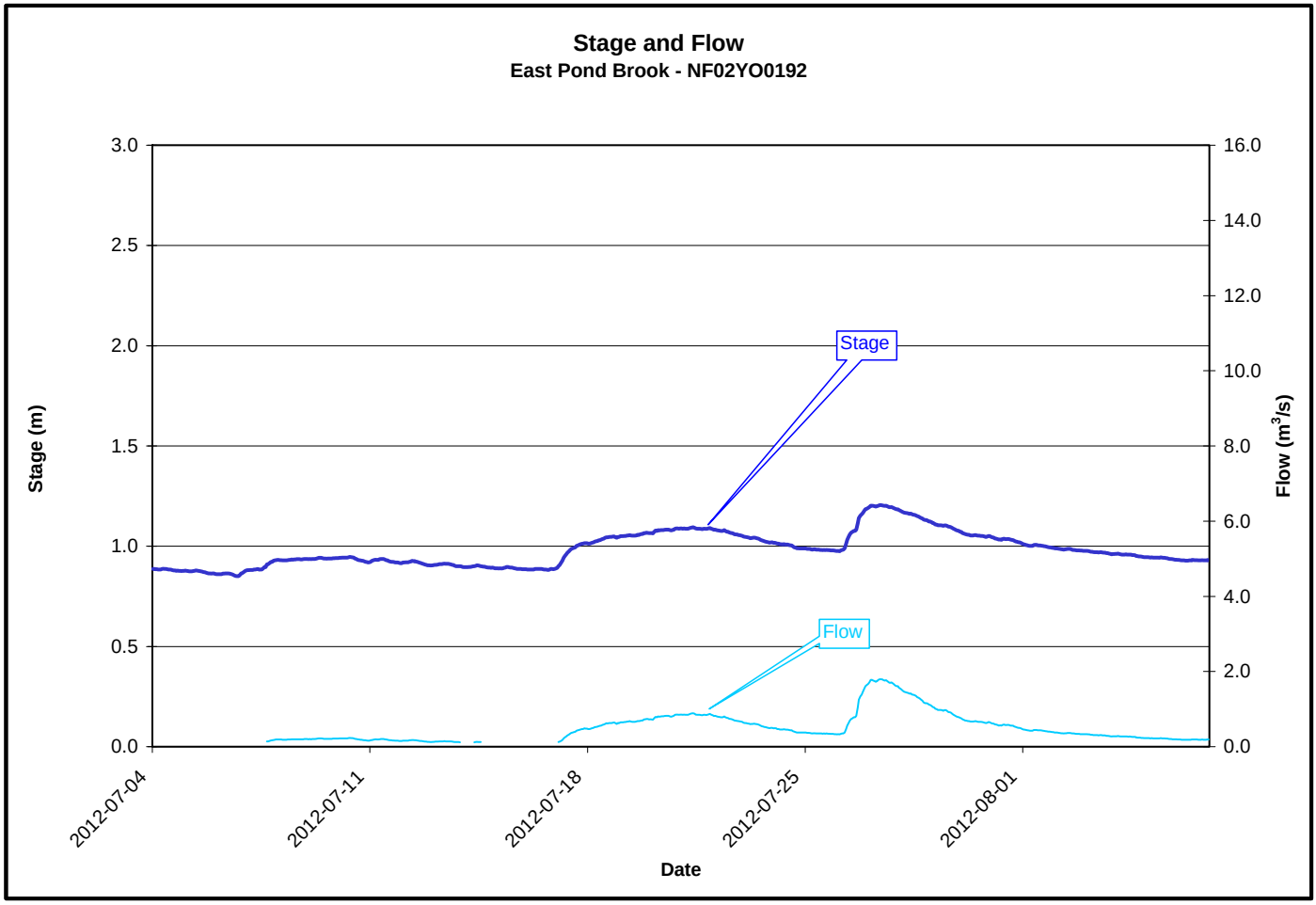

Figure 12

WELL AFTER TAILING DAM (MW1)

- The water temperature (**Figure 13**) ranged from a minimum of 4.94 ˚C to a maximum of 5.01 ˚C with a slight increase over deployment period.
- There appears to be little correlation with water elevation.

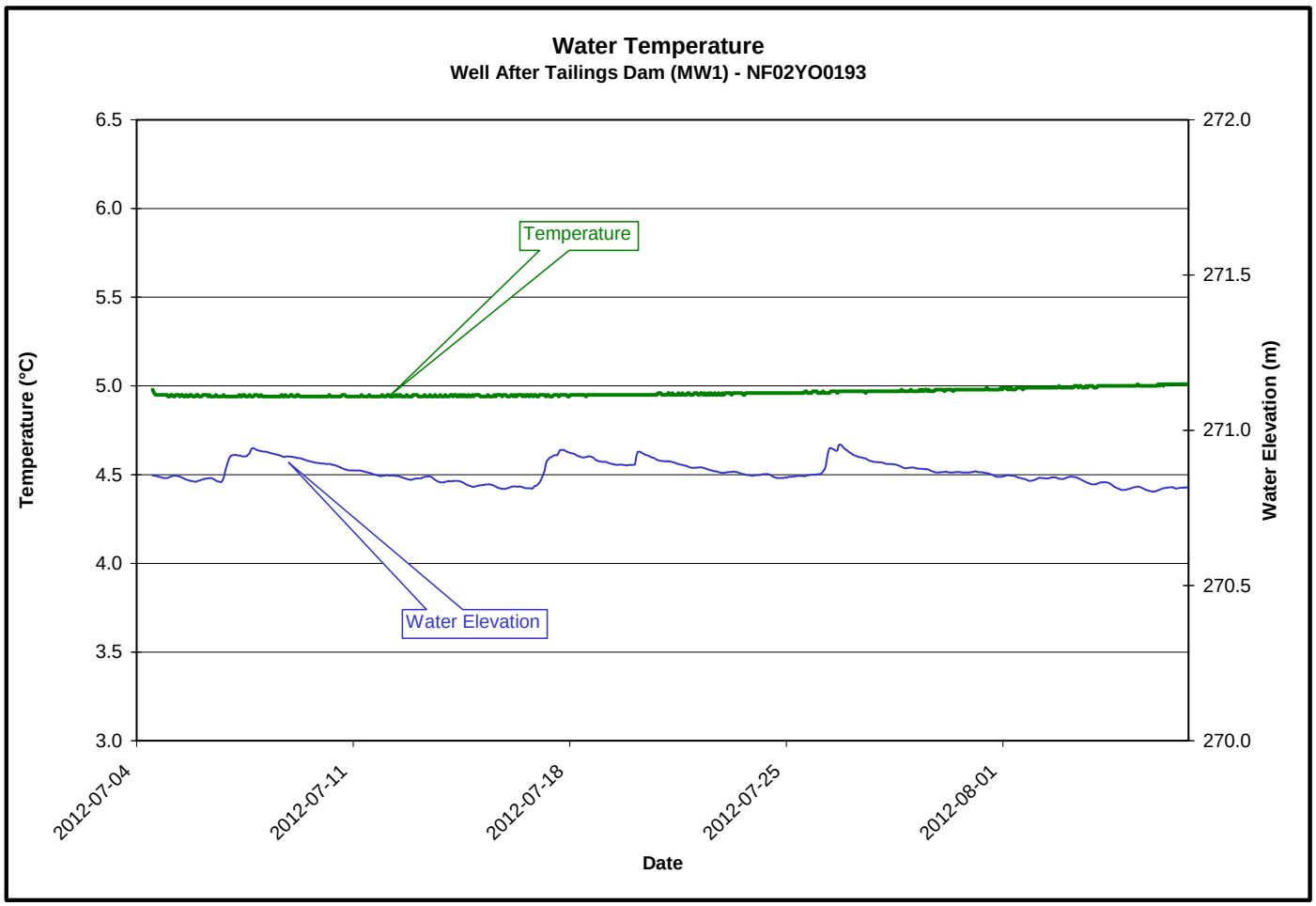

Figure 13

- The pH (**Figure 14**) ranged from a minimum of 7.75 to a maximum of 8.27.
- At the beginning of the deployment period there was a characteristic rapid increase in pH, which subsequently levelled off. It has been determined that this rapid increase in pH is the result of the physical installation of the probe in the narrow diameter monitoring well.
- There does not appear to be any correlation with water elevation.

Figure 14

- The specific conductivity **(Figure 15)** ranged from a minimum of 0.658 mS/cm to a maximum of 0.673 mS/cm, with values increasing slightly over the deployment period.
- There does not seem to be any correlation with water elevation.

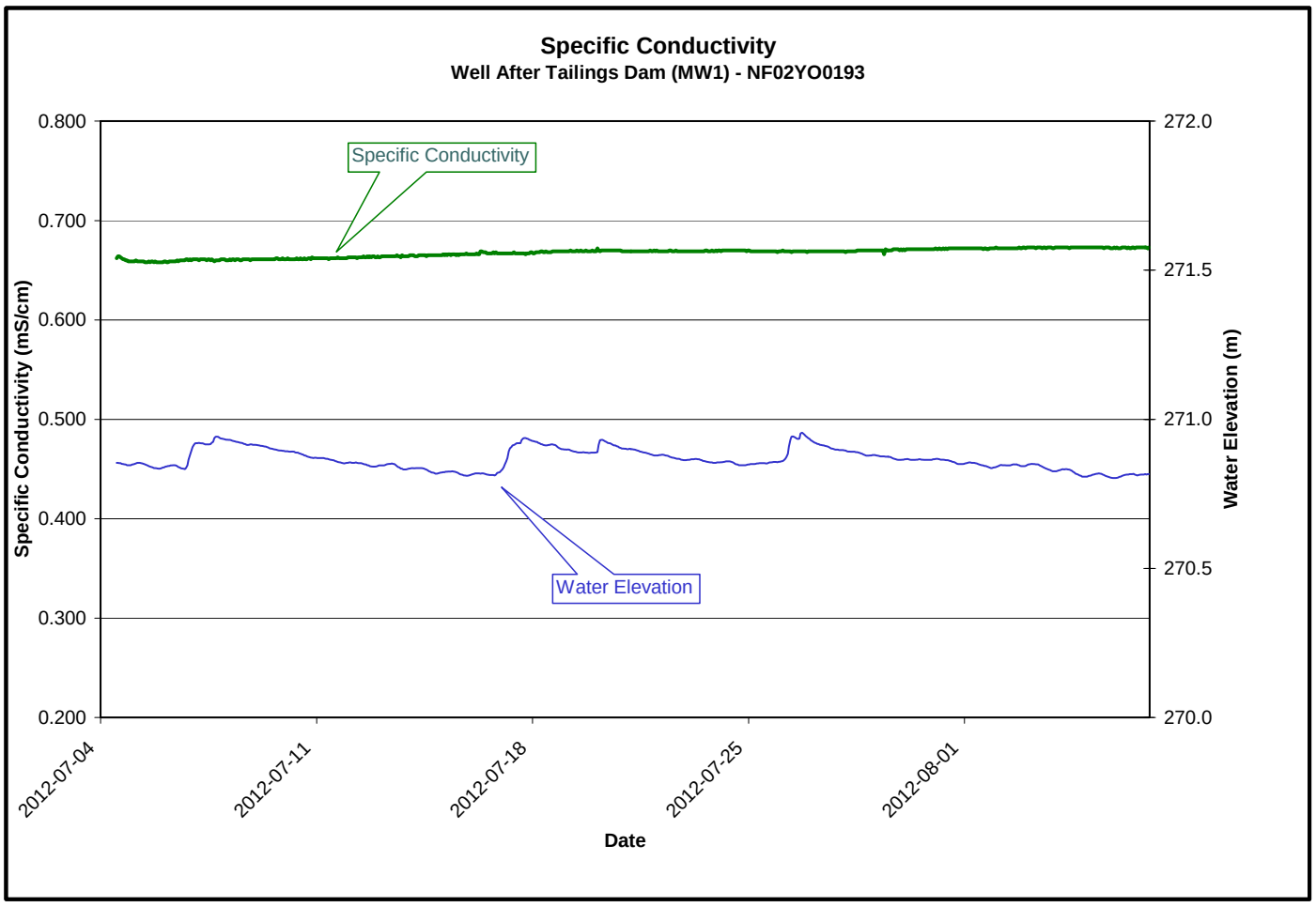

Figure 15

- The Water Elevation **(Figure 16)** ranged from a minimum of 270.80 m to a maximum of 270.96 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.

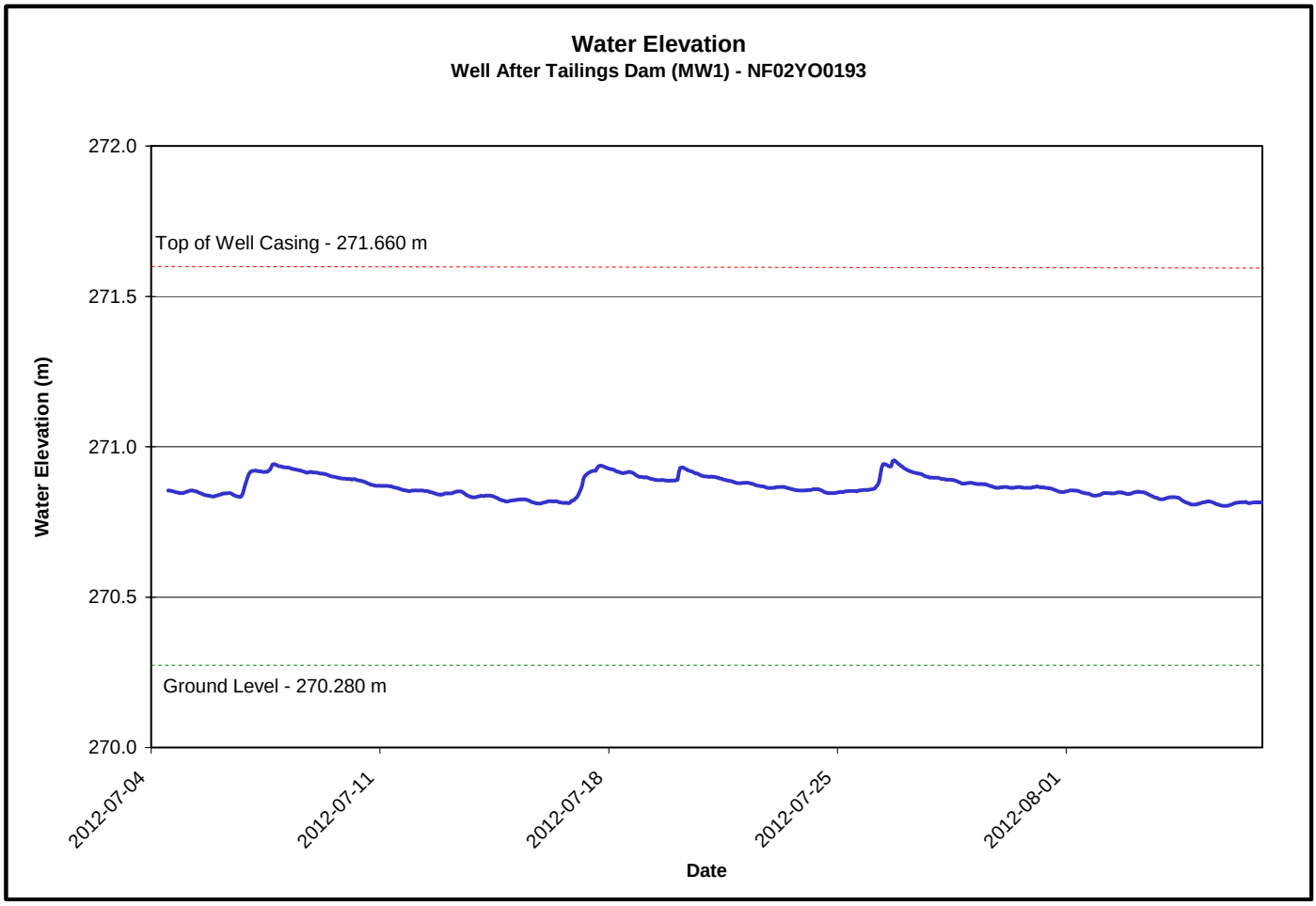

Figure 16

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