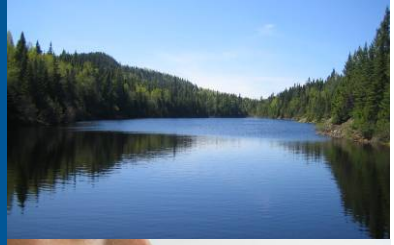
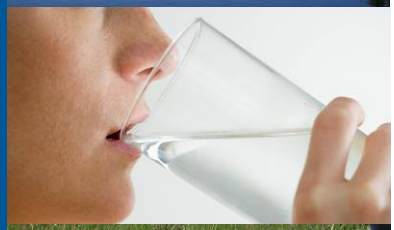



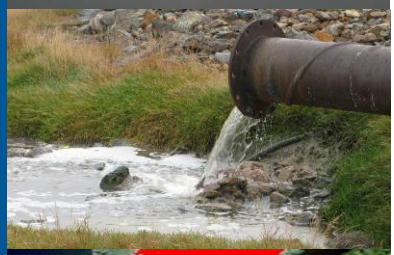


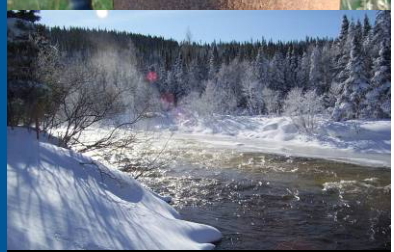

Real Time Water Quality Report
Teck Duck Pond Operations

Deployment Period 2010-04-28 to 2010-07-05

2010-07-14

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.
- The graphs below may sometimes show vertical lines from the data string to zero or the bottom of the graph. These lines should be ignored, as they are an artefact of individual missing data points. We are working to resolve this issue.
- There was effluent from Polishing Pond into the receiving waters (Tributary to Gills Pond Brook) numerous times throughout the deployment period, as there were short term batch discharges.

Maintenance and Calibration of Instrumentation

- After being cleaned and freshly calibrated the **DataSondes®** for Tributary to Gills Pond Brook and East Pond Brook were installed on April 28, 2010, and remained deployed continuously until July5, 2010, a 68 day period.
- After being removed from service for the winter and sent to the vendor for its bi-annual service, the **Quanta G®** was replaced in Monitoring Well After Tailings Dam Station (MW1) on April 28, 2010 and will remain in service until the fall of 2010, provided there are no operation issues.

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

- Upon deployment, a QA/QC **MiniSonde®** is temporarily deployed along side the Field **DataSonde®**. Values for temperature and dissolved oxygen are compared between the two instruments. Normally, a grab sample is taken to compare with the Field **DataSonde®** for specific conductivity, pH and turbidity parameters. Based on the difference between parameters recorded by the Field **DataSonde®**, QAQC **MiniSonde®** and grab sample a qualitative statement is made on the data quality upon deployment. In this incident a grab sample was not collected during deployment, thus a qualitative statement for these parameters cannot be made.

- At the end of a deployment period, readings are taken in the water body from the Field **DataSonde®** before and after a thorough cleaning in order to assess the degree of biofouling. During calibration in the laboratory, an assessment of calibration drift is made and the two error values are combined to give Total Error (T_e). If T_e exceeds a predetermined data correction criterion, a correction based on T_e is applied to the dataset using linear interpolation. Based on the value for T_e, a qualitative statement is also made on the data quality upon removal.
- 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, thus Total Error cannot be calculated. In this case, since no grab sample was collected, there data cannot be ranked against laboratory data.
- With the exception of water quantity data (Stage), 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. Where appropriate, corrected data for water quality parameters are indicated.

Tributary to Gills Pond Brook Station (NF02YO0190)		
Date (yyyy-mm-dd)	**Parameter**	**Ranking**
2009-11-25 Deployment	Temp (°C)	Good
	pH (units)	n/a
	Sp. Conductivity (uS/cm)	n/a
	Dissolved Oxygen (mg/L)	Excellent
	Turbidity (NTU)	n/a
2010-04-26 Removal	Temp (°C)	Excellent
	pH (units)	Excellent
	Sp. Conductivity (uS/cm)	Excellent
	Dissolved Oxygen (%)	Excellent
	Turbidity (NTU)	Excellent

Table 2

East Pond Brook Station (NF02YO0192)		
Date (yyyy-mm-dd)	**Parameter**	**Ranking**
2009-11-25 Deployment	Temp (°C)	Excellent
	pH (units)	n/a
	Sp. Conductivity (uS/cm)	n/a
	Dissolved Oxygen (mg/L)	Excellent
	Turbidity (NTU)	n/a
2010-04-26 Removal	Temp (°C)	Excellent
	pH (units)	Excellent
	Sp. Conductivity (uS/cm)	Good
	Dissolved Oxygen (%)	Excellent
	Turbidity (NTU)	Excellent

Table 3

Data Interpretation

TRIBUTARY TO GILLS POND BROOK

- The water temperature (**Figure 1**) ranged from a minimum of 4.44 ˚C to a maximum of 21.47 ˚C.
- There appears to be little correlation with stage.
- As fouling and instrument drift were negligible, no data corrections were required for temperature.

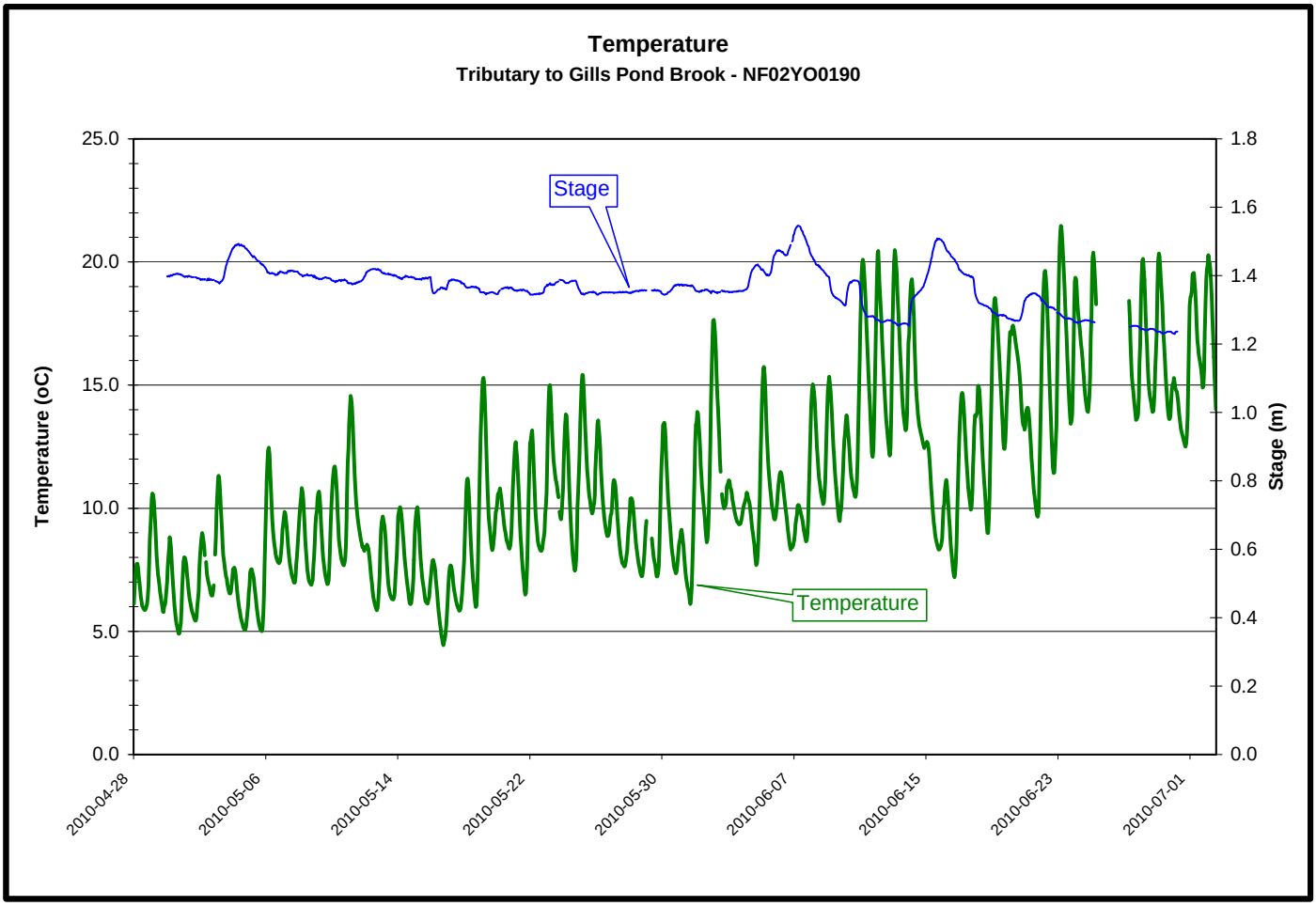

Figure 1

- Throughout the deployment period pH values (**Figure 2**) ranged from a minimum of 6.11 to a maximum of 7.22 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 inverse correlation with discharge.
- As fouling and instrument drift were negligible, no data corrections were required for pH.

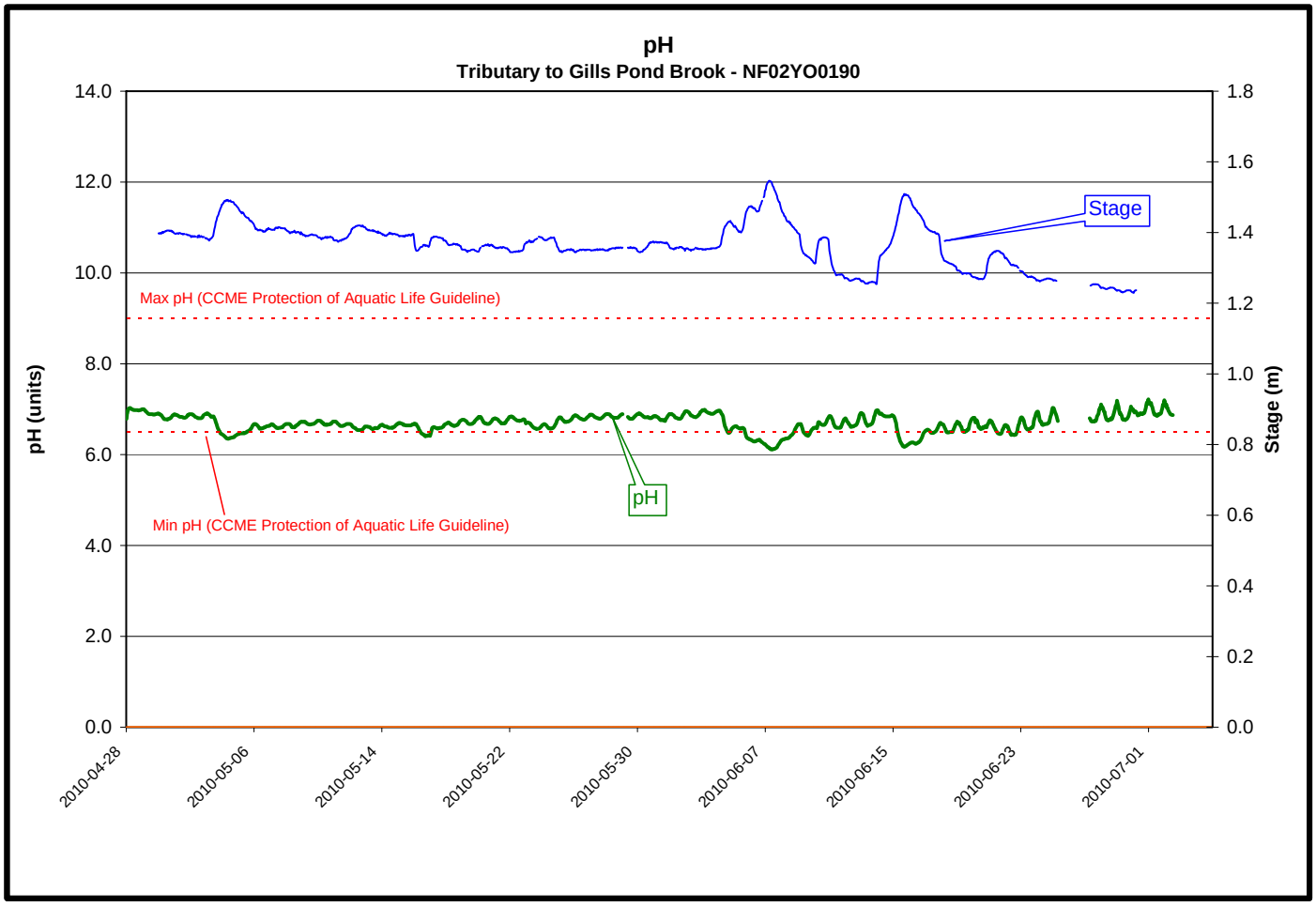

Figure 2

- The specific conductivity **(Figure 3)** ranged from a minimum of 39.8 µS/cm to a maximum of 738.0 µS/cm over the deployment period.
- During the multiple discharge periods from Polishing Pond there are marked increases in conductivity. The 'V' shaped dips during some of the higher periods of specific conductivity are the result of dilution caused by precipitation events.
- As fouling and instrument drift were negligible, no data corrections were required for Specific Conductance.

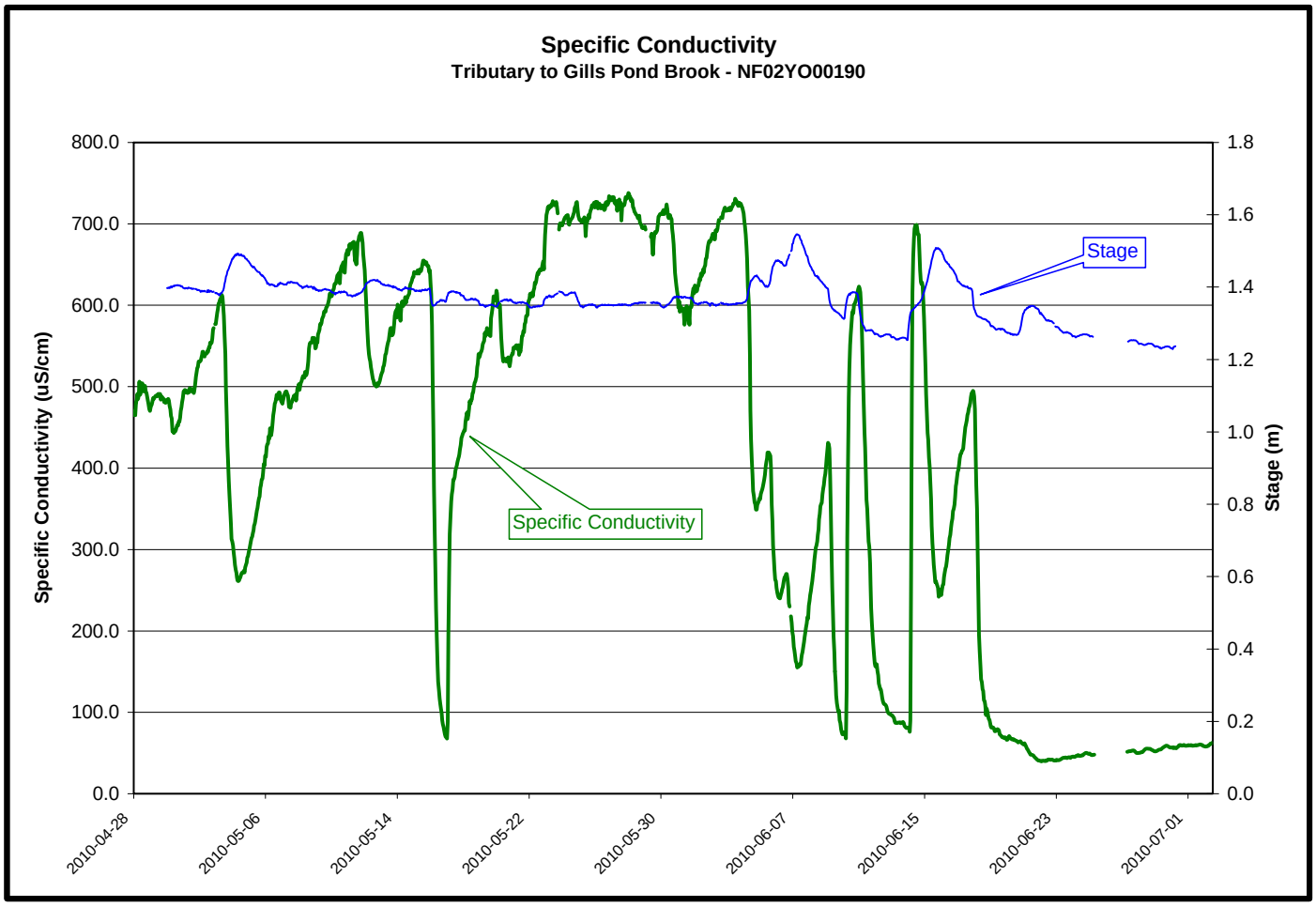

Figure 3

- The dissolved oxygen (**Figure 4**) values ranged from a minimum of 8.46 mg/L to a maximum of 11.86 mg/L over the deployment period.
- Dissolved oxygen is inversely proportional to water temperature.
- Throughout the latter half of the deployment period, dissolved oxygen values sometimes fell below the upper 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). Lower dissolved oxygen values are considered to be solely a function of the naturally increasing temperatures during this period.
- The QA/QC protocol revealed a net decrease of 0.9 % in the Dissolved Oxygen (% Sat) over the 68 day deployment period. All of this decrease was due to instrument drift. Accordingly the correction factor has been applied to the raw data.
- Based upon the fact that Dissolved Oxygen % Saturation had minimal drift, we can be confident that the Dissolved Oxygen mg/L values are reasonably accurate.

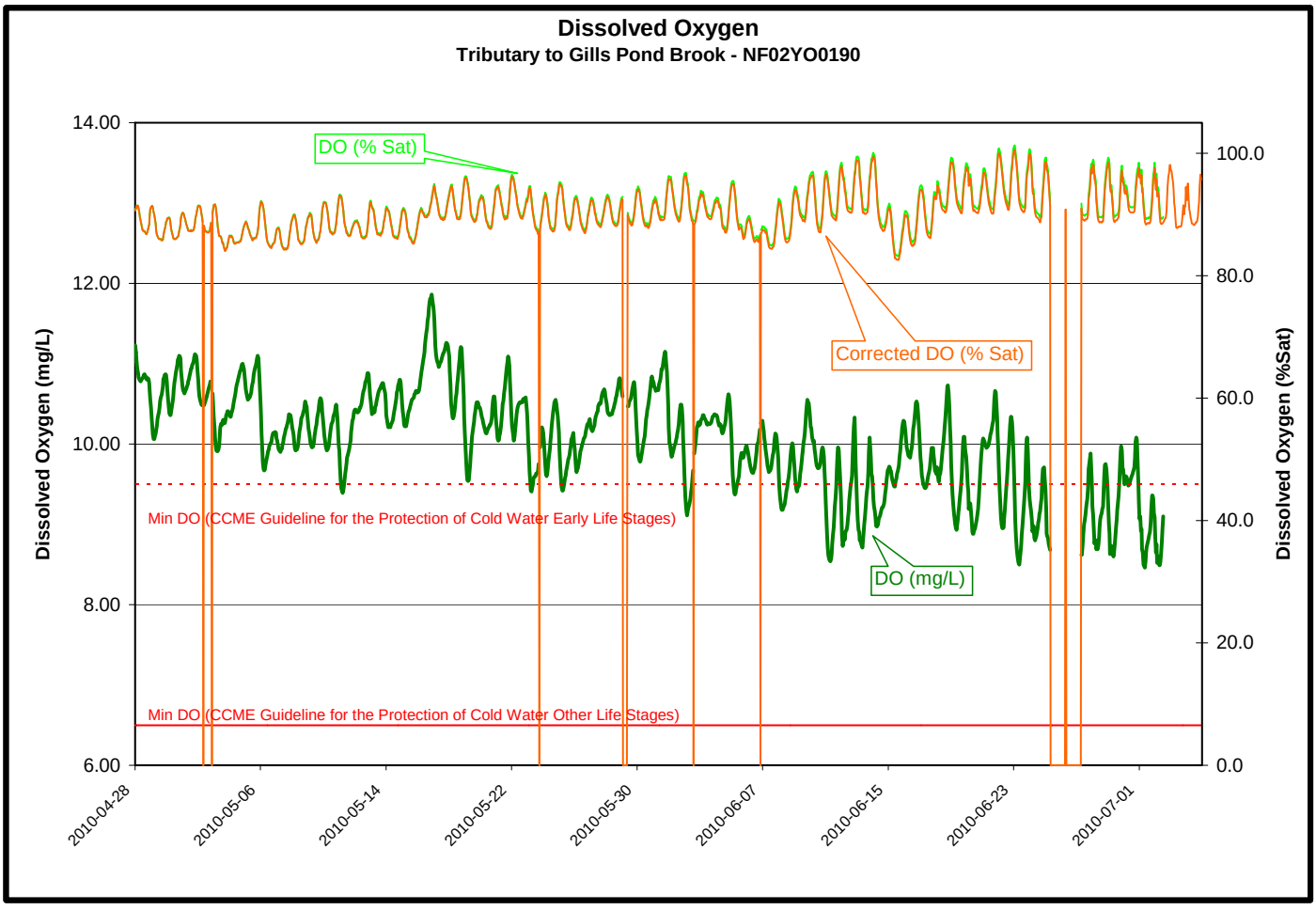

Figure 4

- The turbidity values **(Figure 5)** ranged from a minimum of 0.0 NTU to a maximum of 665.0 NTU. Higher turbidity values correspond to periods of discharge from the Polishing Pond, precipitation events and high stage. Based upon previous investigation, it has been determined that turbidity values may be artificially increased due to air entrainment during high flows.
- Neither *in situ* nor grab sample measurements nor visual observations indicated turbidity issues.
- The QA/QC protocol revealed a net decrease of 1.5 NTU over the 68 day deployment period. Accordingly the correction factor has been applied to the raw data.
- Because the spread (correction factor) is so small, the corrected data obscure the raw data.

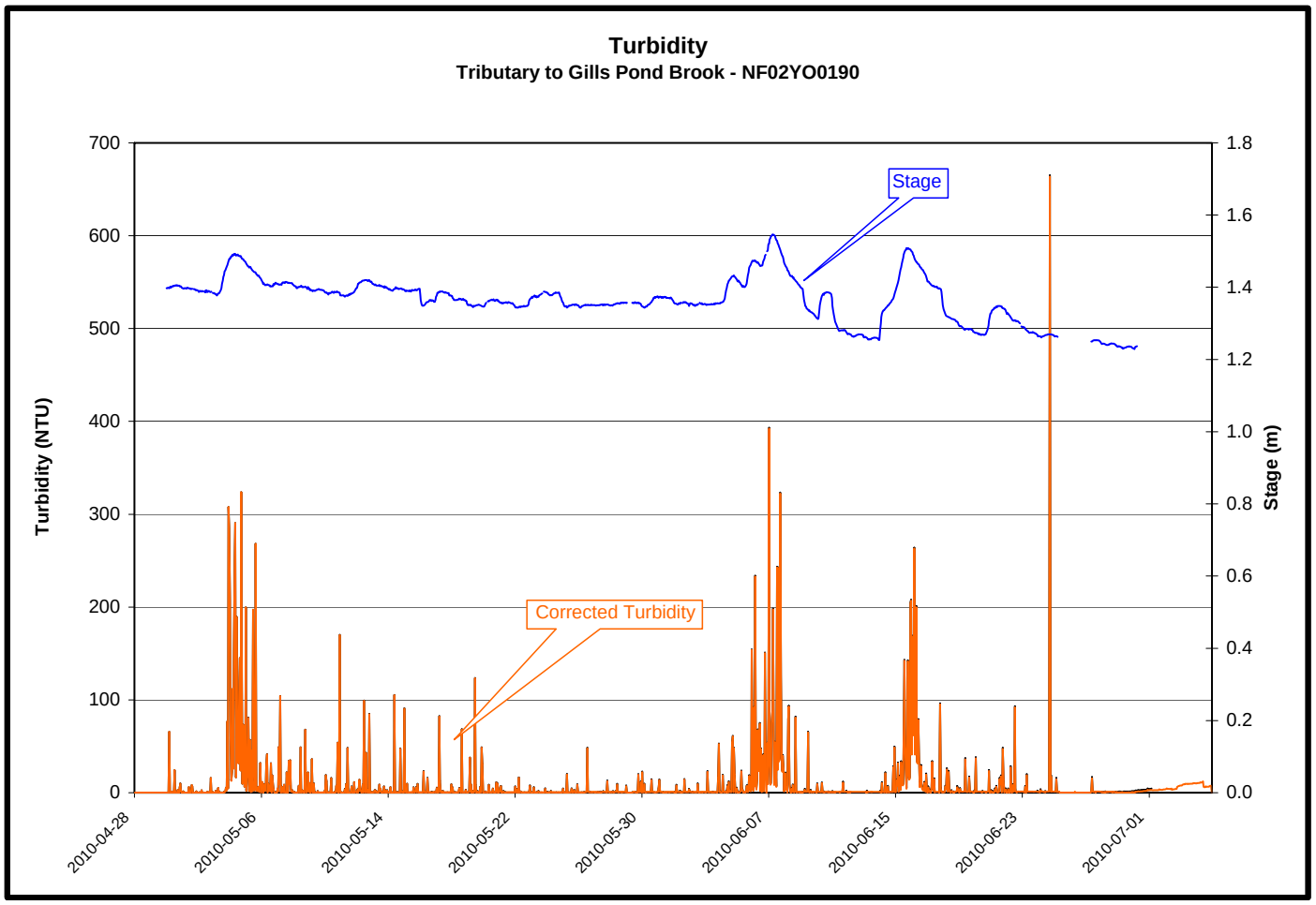

Figure 5

- The stage (**Figure 6)** or water level ranged from a minimum of 1.23 m to a maximum of 1.55 m with the highest peaks corresponding to discharge from Polishing Pond and precipitation events.
- All values are within the normal range.

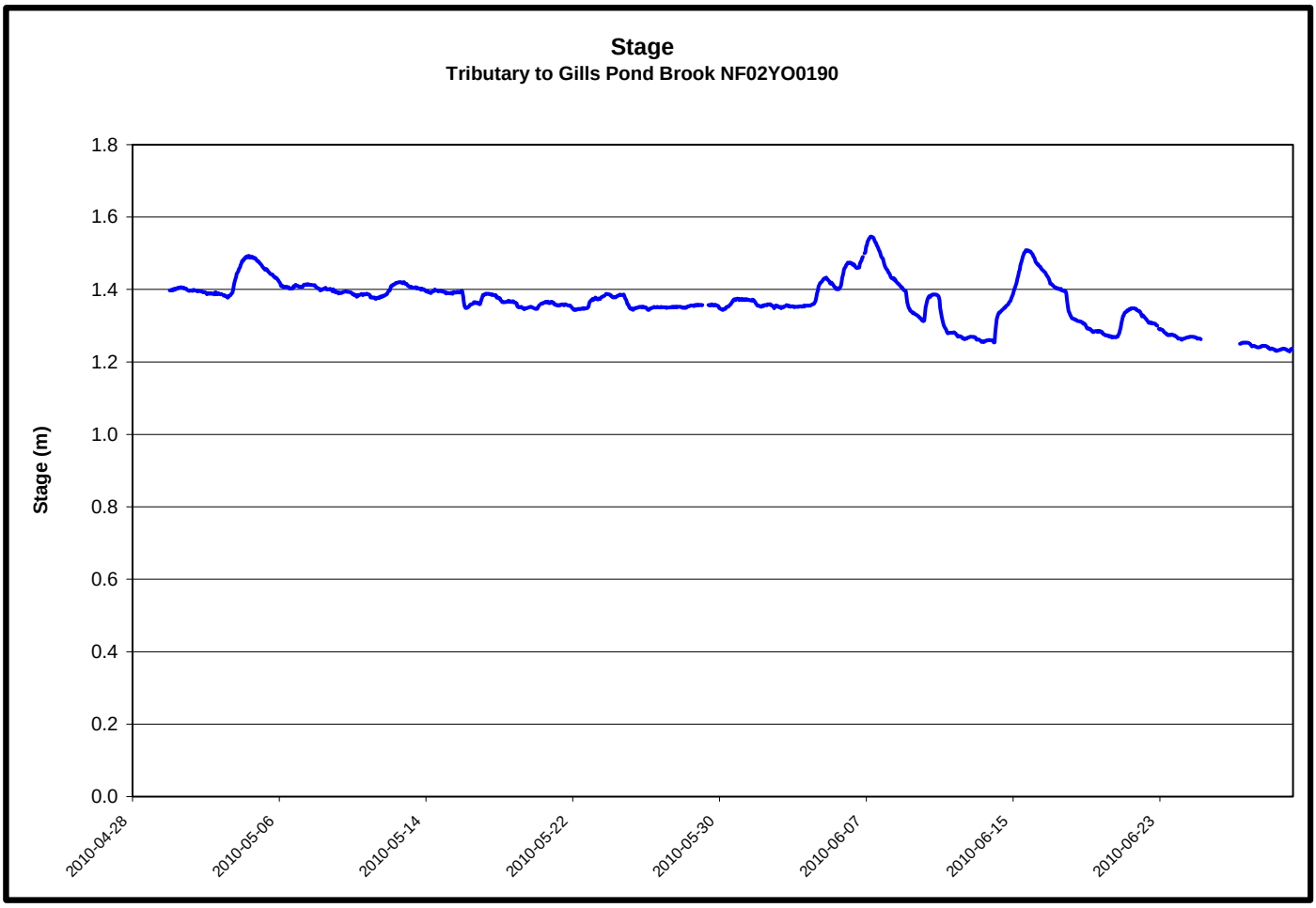

Figure 6

EAST POND BROOK

- The water temperature (**Figure 7**) ranged from a minimum of 5.66 ˚C to a maximum of 21.42 ˚C.
- There appears to be little correlation with stage.
- As fouling and instrument drift were negligible, no data corrections were required for temperature.

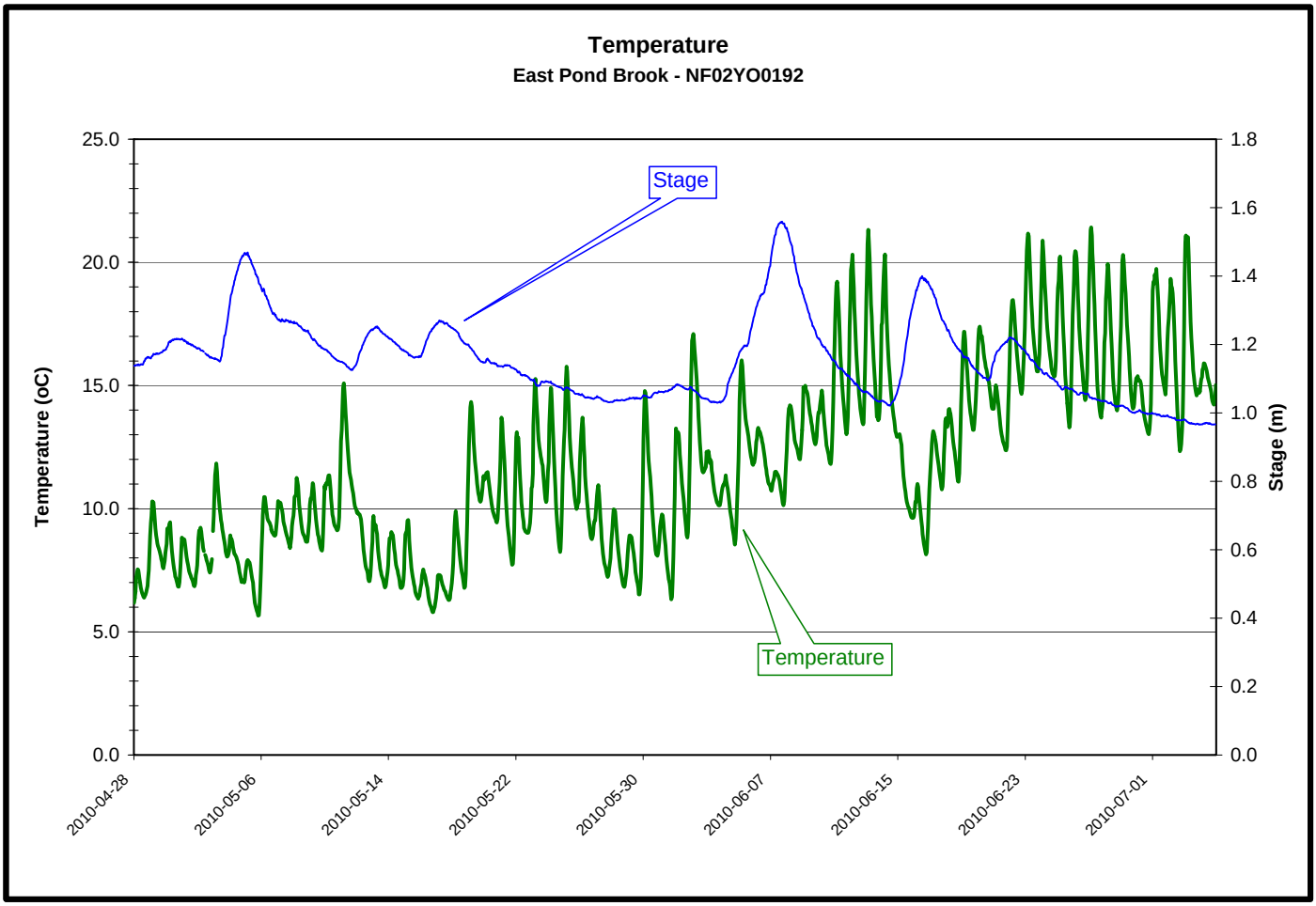

Figure 7

- Throughout the deployment period pH values (**Figure 8**) ranged from a minimum of 6.19 to a maximum of 6.83 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 inverse correlation with discharge.
- As fouling and instrument drift were negligible, no data corrections were required for pH.

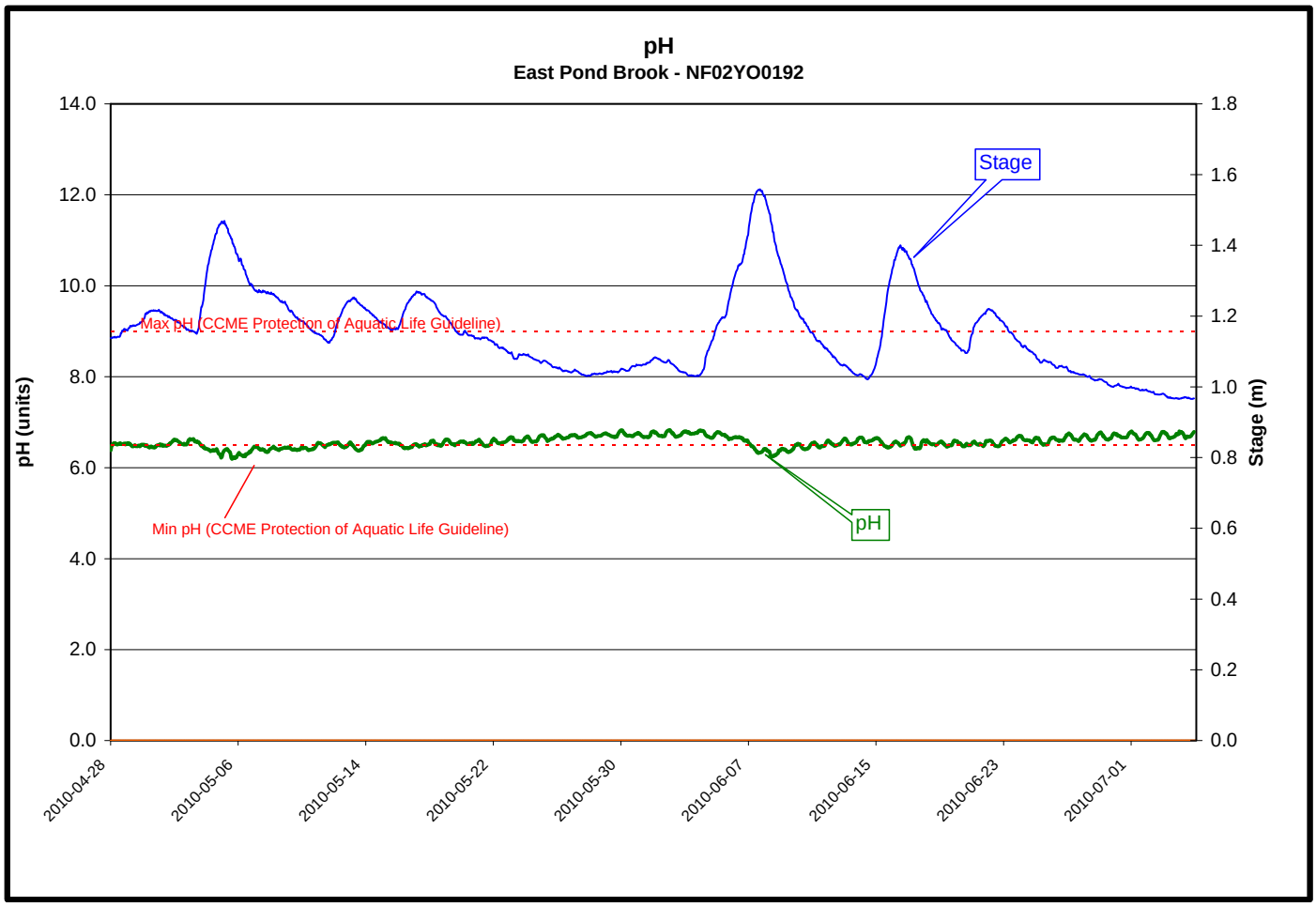

Figure 8

- The specific conductivity **(Figure 9)** ranged from a minimum of 12.2 µS/cm to a maximum of 26.6 µS/cm.
- Lowest conductivity values correspond to periods of precipitation and high runoff.
- The QA/QC protocol revealed a net decrease of 4.6 µS/cm over the 68 day deployment period. The majority (4.1 µS/cm) of this decrease was due to instrument drift. Accordingly the correction factor has been applied to the raw data.

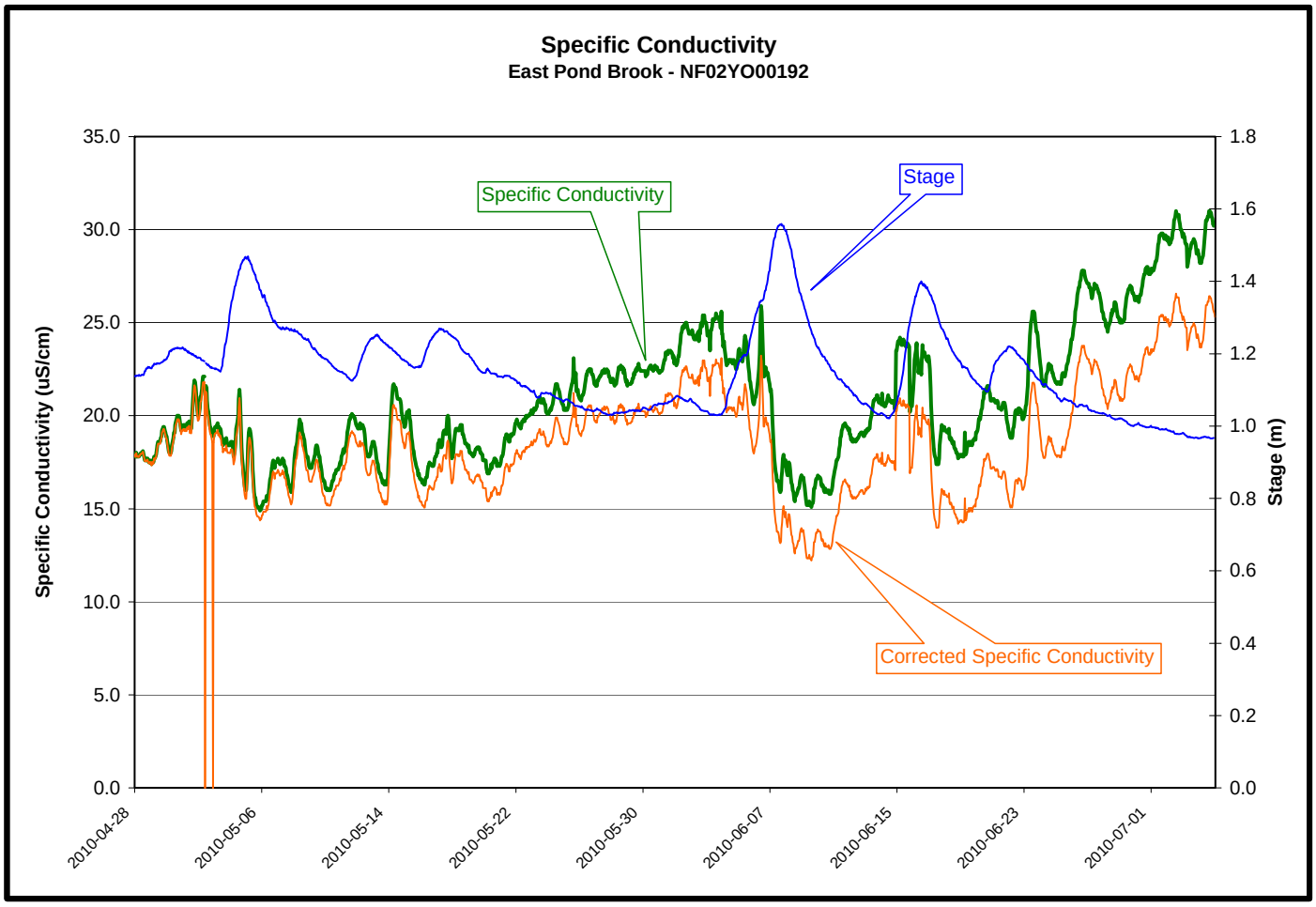

Figure 9

- The dissolved oxygen (**Figure 10**) values ranged from a minimum of 8.59 mg/L to a maximum of 11.95 mg/L over the deployment period.
- Dissolved oxygen is inversely proportional to water temperature.
- Throughout the latter half of the deployment period, dissolved oxygen values often fell below the upper 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). Lower dissolved oxygen values are considered to be solely a function of the naturally increasing temperatures during this period.
- The QA/QC protocol revealed an decrease of 1.6 % in the Dissolved Oxygen (% Sat) over the 68 day deployment period. The majority of this decrease was due to instrument drift. Accordingly the correction factor has been applied to the raw data.
- Based upon the fact that Dissolved Oxygen % Saturation had minimal drift, we can be confident that the Dissolved Oxygen mg/L values are reasonably accurate.

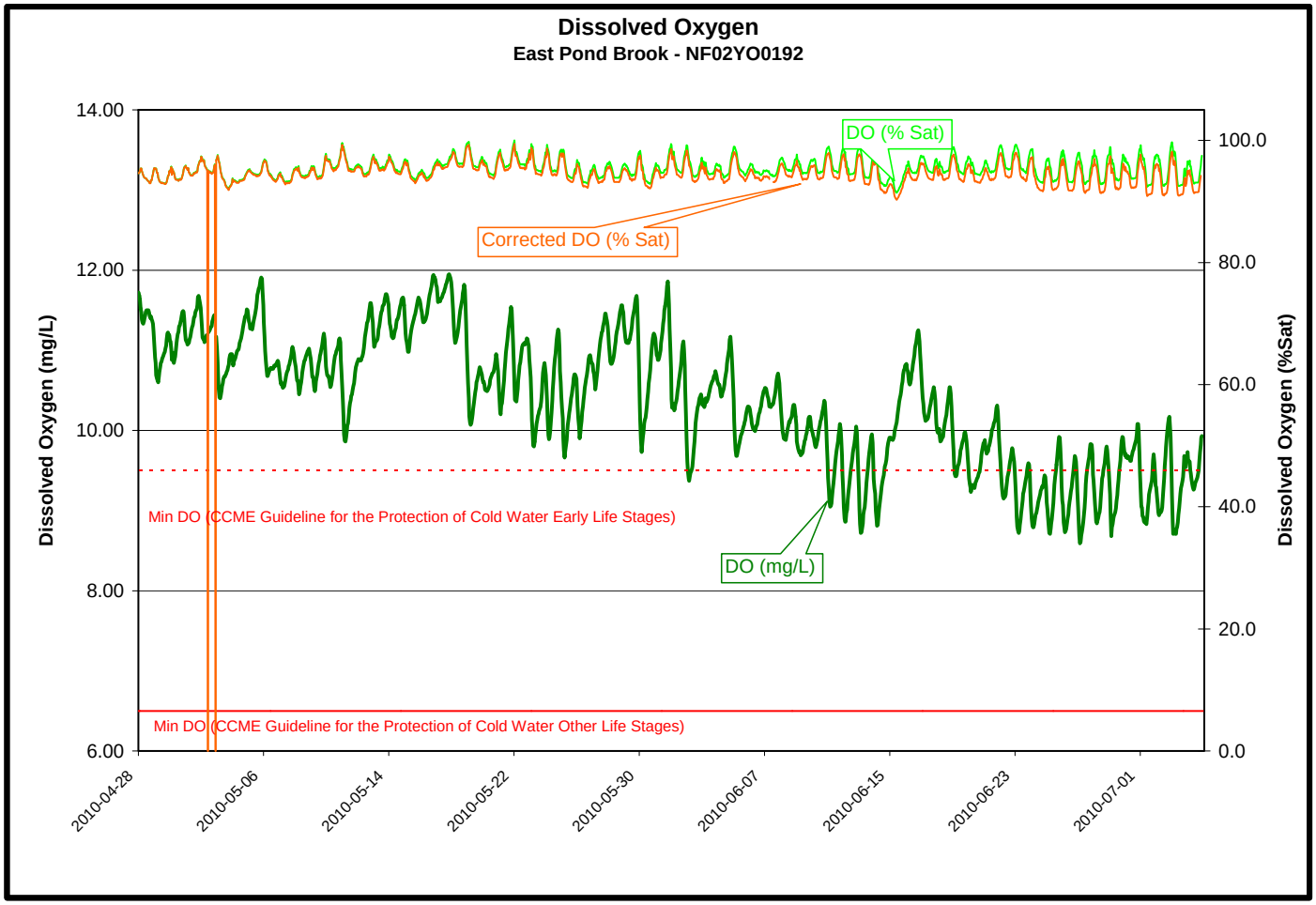

Figure 10

- The turbidity values **(Figure 11)** ranged from a minimum of 0.0 NTU to a maximum of 70.5 NTU.
- Typically, turbidity values in this stream are near zero; the higher peaks being insignificant events when natural stream debris passed near the sensor.
- Neither *in situ* nor grab sample measurements nor visual observations indicated turbidity issues.
- The QA/QC protocol revealed an increase of 1.1 NTU over the 68 day deployment period. All of this increase was due to instrument drift. Accordingly the correction factor has been applied to the raw data.
- Because the spread (correction factor) is so small, the corrected data obscure the raw data for all but the last few days of the deployment period.

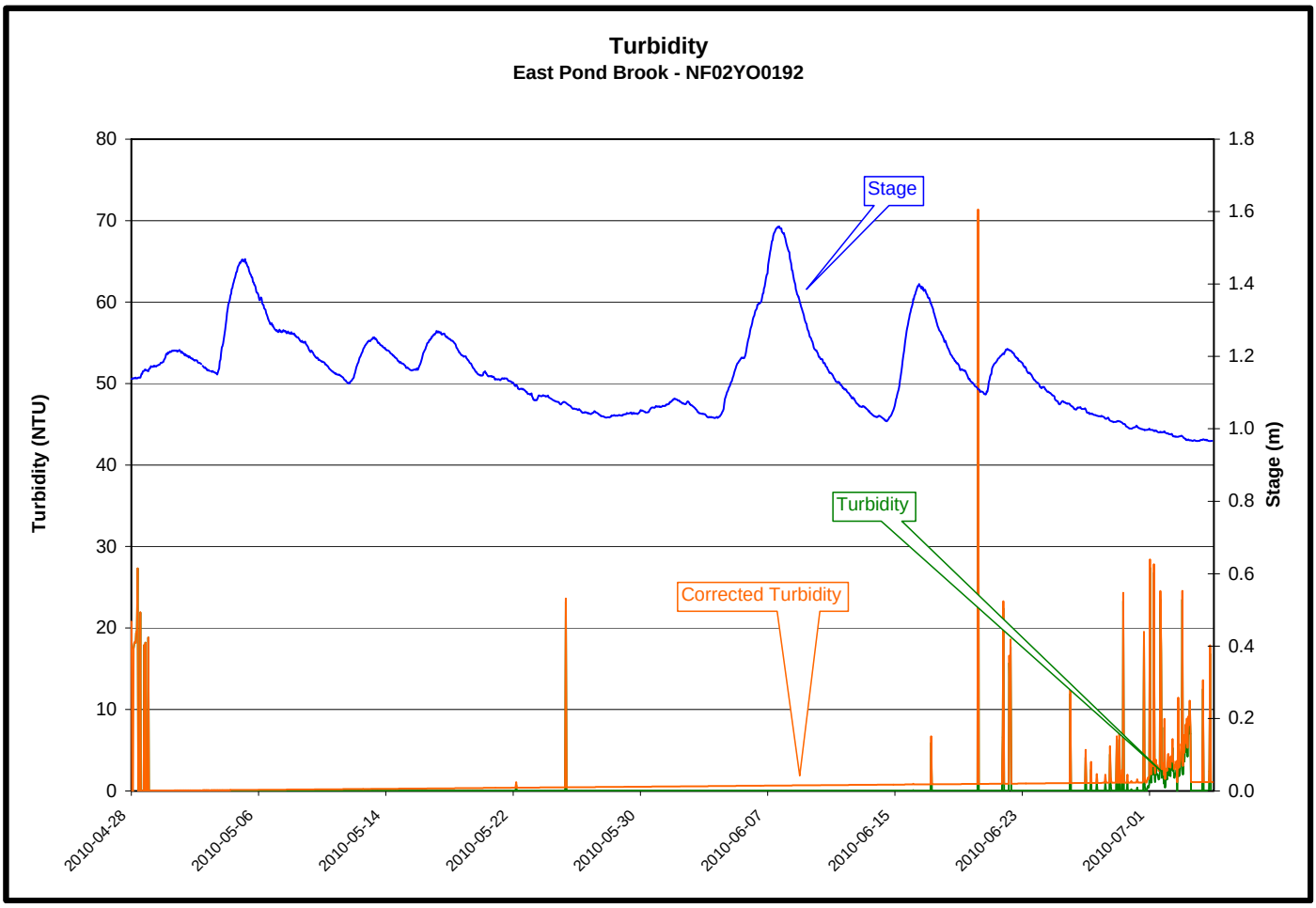

Figure 11

- The stage **(Figure 12)** or water level ranged from a minimum of 0.97 m to a maximum of 1.56 m.
- Peaks correspond to precipitation and runoff events.

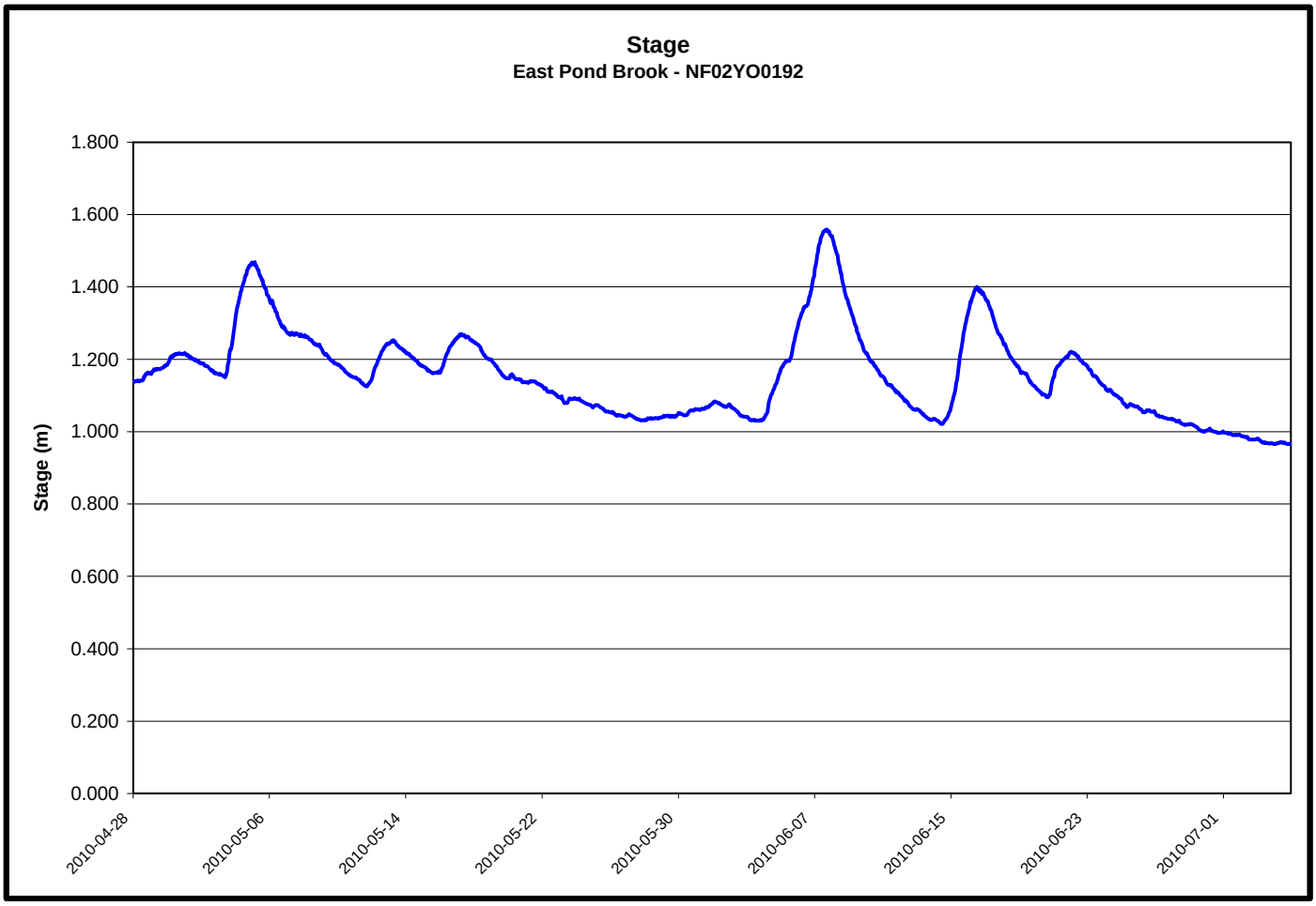

Figure 12

WELL AFTER TAILING DAM (MW1)

- The water temperature (**Figure 13**) ranged from a minimum of 4.81 ˚C to a maximum of 5.09 ˚C; generally decreasing over the deployment period.
- There appears to be little correlation with water elevation.

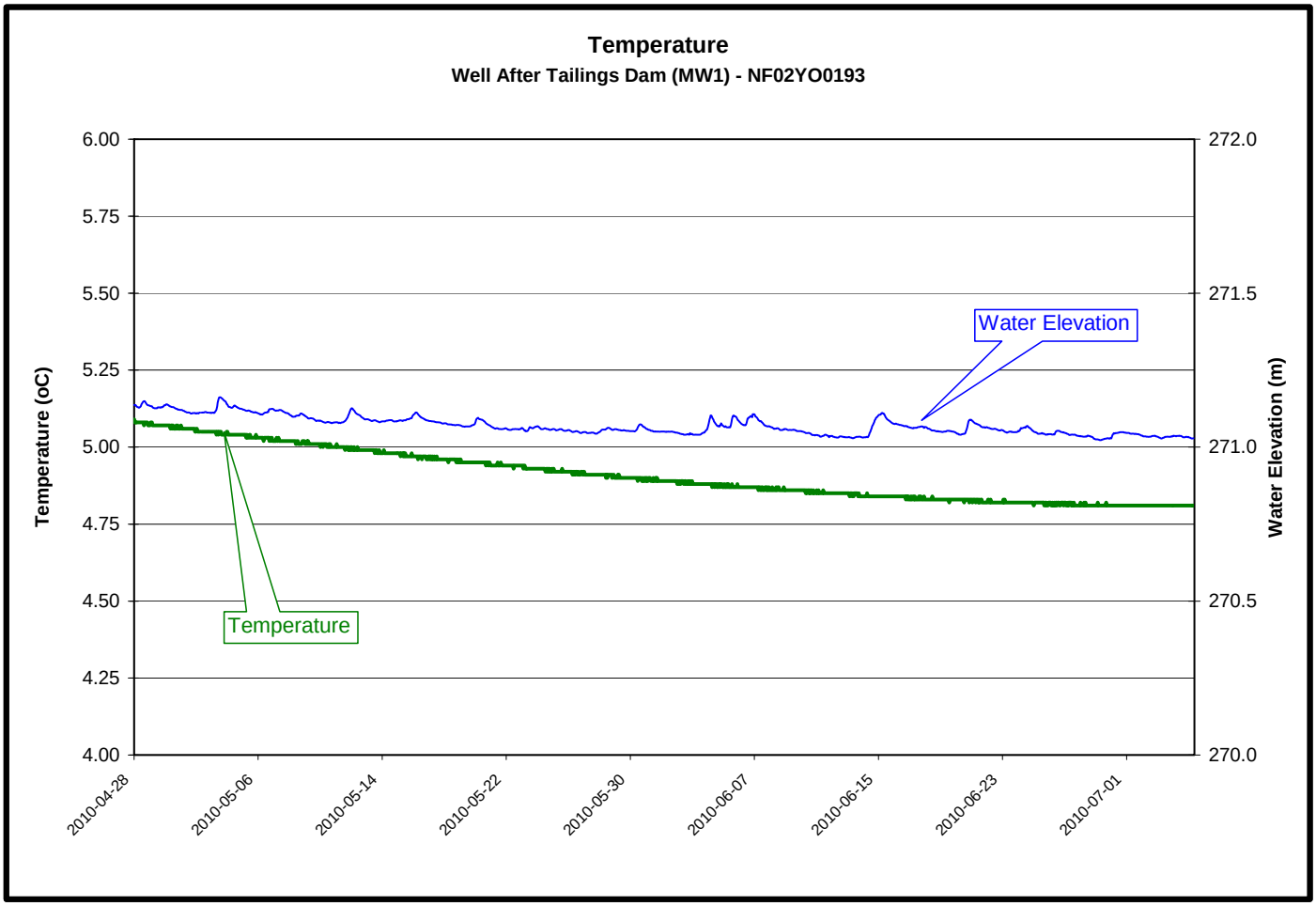

Figure 13

- The pH (**Figure 14**) ranged from a minimum of 7.90 to a maximum of 8.88 over the deployment period.
- The rapid increase in pH during the first few hours of deployment is typical, likely the result of the well being purged prior to deployment.
- There appears to be a general increase in pH throughout the deployment period.

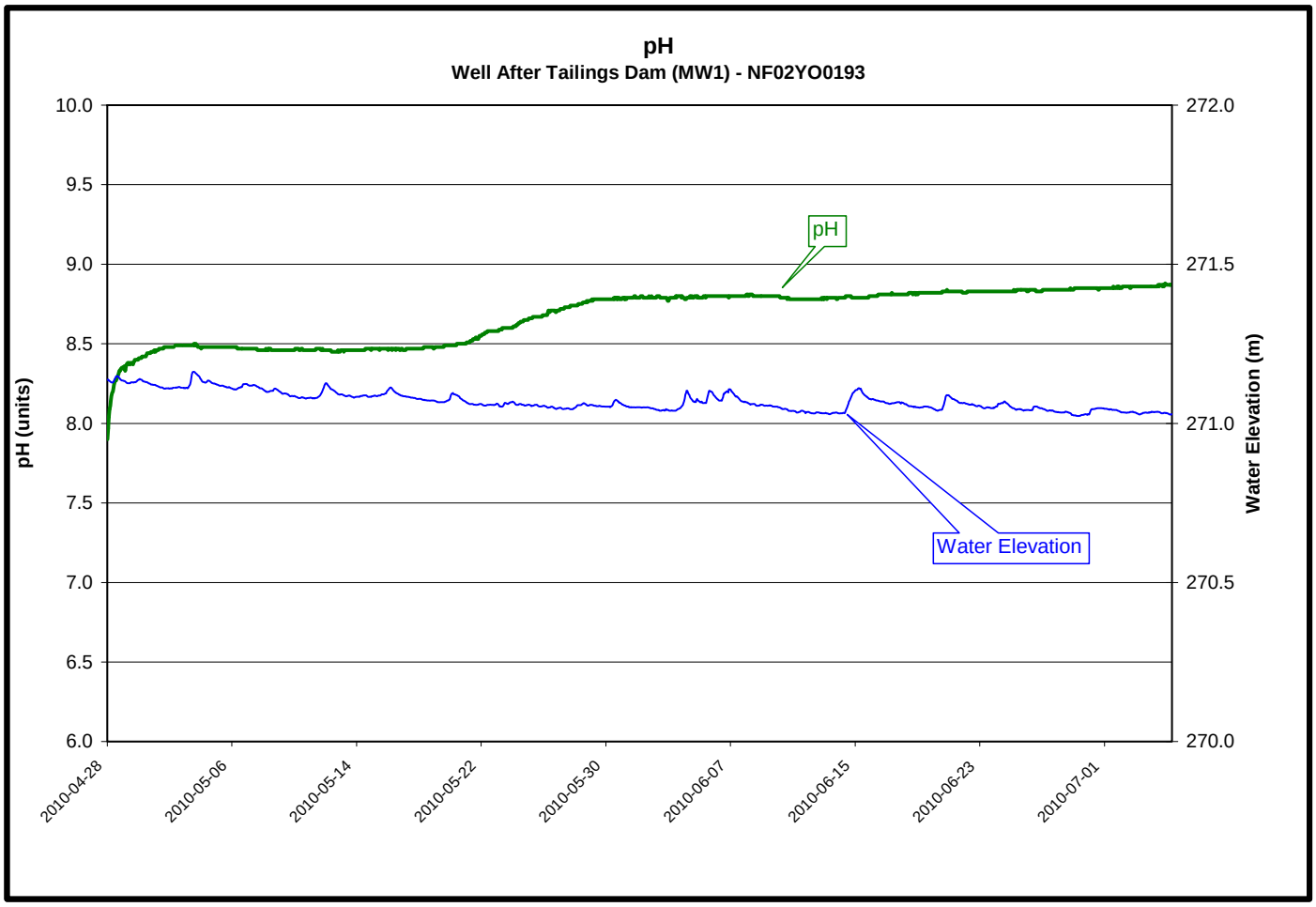

Figure 14

- The specific conductivity **(Figure 15)** ranged from a minimum of 0.517 mS/cm to a maximum of 0.543 mS/cm.
- There was a slight decrease throughout the deployment period.

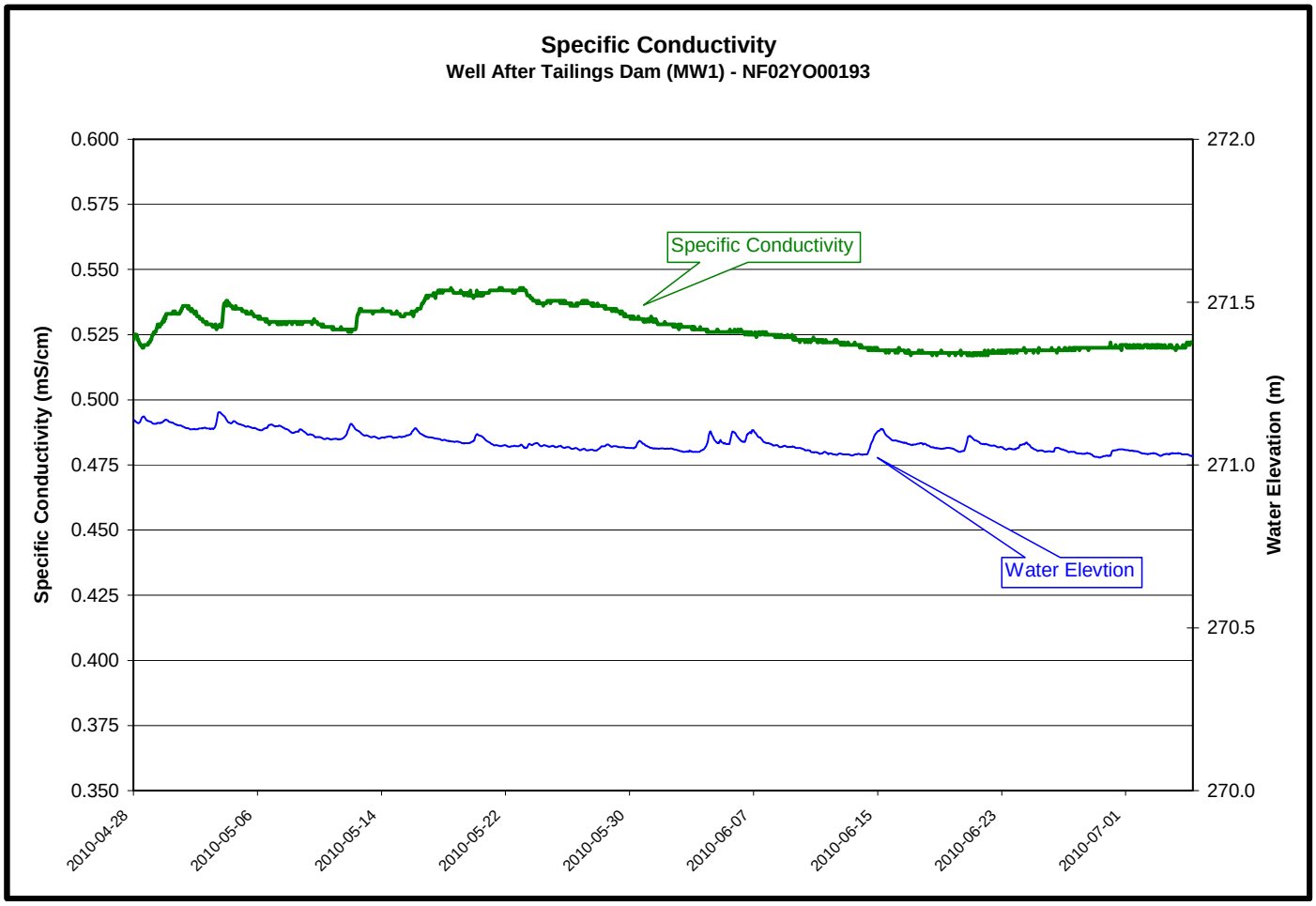

Figure 15

- The Water Elevation ranged from a minimum of 271.02 m to 271.16 m, through the deployment period with a slight decrease over the 68 days.

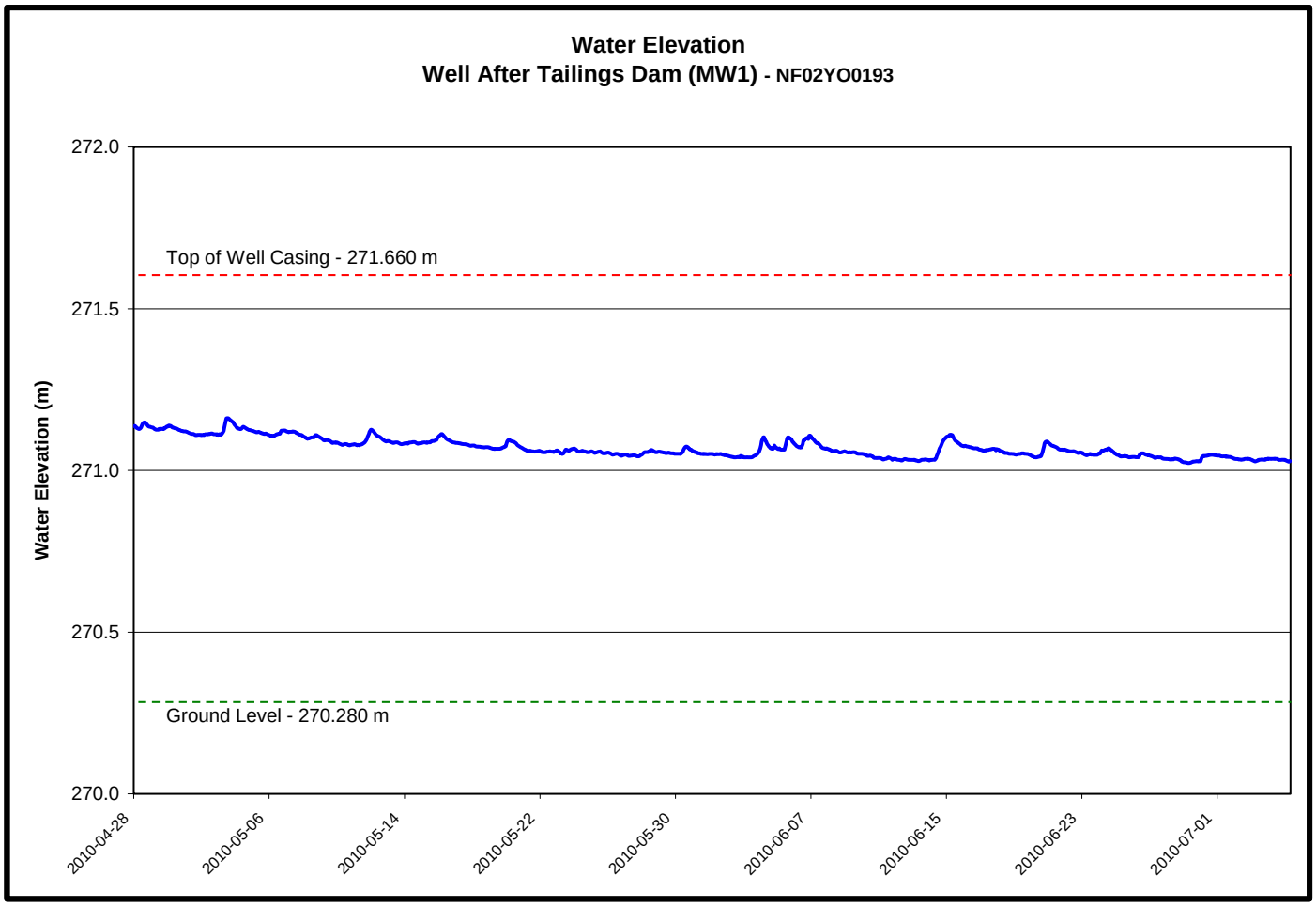

Figure 16

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