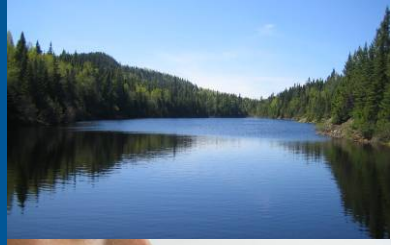
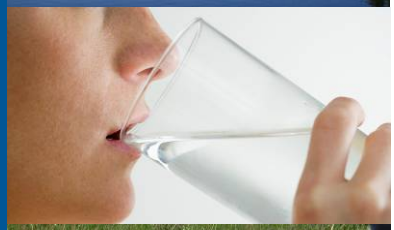



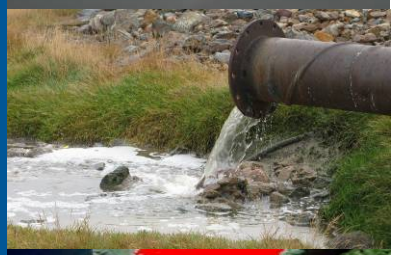


Real Time Water Quality Report
Teck Duck Pond Operations

Deployment Period 2010-10-21 to 2010-11-30

2010-12-14

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) episodically throughout the deployment period.

Maintenance and Calibration of Instrumentation

- The regular **DataSonde®** (s/n 43245) for Tributary to Gills Pond Brook had a DO sensor failure during the previous deployment, thus it was retuned to the vendor for repairs. After being cleaned and freshly calibrated a spare **DataSonde®** (s/n 43323) was installed in Tributary to Gills Pond Brook on October 21, 2010, and remained deployed continuously until November 30, 2010, a 40 day period.
- After being cleaned and freshly calibrated the regular **DataSonde®** (s/n 43794) for East Pond Brook was installed on October 21, 2010 and remained deployed continuously until November 30, 2010, a 40 day period.
- The **Quanta G®** (s/n 00035) was deployed in Monitoring Well After Tailings Dam Station (MW1) on October 21, 2010 after being removed for its semi-annual cleaning and calibration. Due to this well freezing at surface in the winter, it is anticipated that this probe will remain deployed until late spring 2011.

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. 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.

- 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.
- As there was a transmission error with the Turbidity data on the Tributary to Gills Pond Brook instrument, data logged internally in the unit were used to augment the missing transmitted data.
- Due to a failure of the Data Logger at Tributary to Gills Pond Brook, there was no transmitted data from November 6, 2010 to November 7, 2010 and again from November 10, 2010 to November 17, 2010. During these periods, data logged internally in the unit were used to augment the missing transmitted data.
- The removal ranking for Dissolved Oxygen at Tributary to Gills Pond Brook could not be calculated as the sensor failed prior to the end of the Deployment period. Accordingly, Total Error cannot be calculated nor shown on the graphs for Dissolved Oxygen at Tributary to Gills Pond Brook.
- The ranking for DO at deployment at East Pond Brook is Poor. The difference between the Field Sonde and the QA/QC Sonde was 1.1 mg/L or 10%. See page 14.
- 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, a grab sample was collected at the beginning of the deployment period, and the deployment ranking was calculated for pH and Specific Conductance based upon live data and laboratory data. See **Table 4**.
- The ranking for pH at deployment in Well After Tailings Dam (MW1) is ranked as Marginal. There is a significant variation in pH during the initial period of the deployment due to the well being purged to collect the sample. See page 18.
- 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**
2009-10-21 Deployment	Temp (^oC)	Excellent
	pH (units)	Good
	Sp. Conductivity (uS/cm)	Excellent
	Dissolved Oxygen (mg/L)	Fair
	Turbidity (NTU)	Excellent
2010-11-30 Removal	Temp (^oC)	Excellent
	pH (units)	Good
	Sp. Conductivity (uS/cm)	Excellent
	Dissolved Oxygen (%)	NA
	Turbidity (NTU)	Excellent

Table 2

East Pond Brook Station (NF02YO0192)		
Date (yyyy-mm-dd)	**Parameter**	**Ranking**
2009-10-21 Deployment	Temp (^{o}C)	Excellent
	pH (units)	Good
	Sp. Conductivity (uS/cm)	Good
	Dissolved Oxygen (mg/L)	Poor
	Turbidity (NTU)	Excellent
2010-11-30 Removal	Temp (^{o}C)	Excellent
	pH (units)	Excellent
	Sp. Conductivity (uS/cm)	Excellent
	Dissolved Oxygen (%)	Good
	Turbidity (NTU)	Excellent

Table 3

Well After Tailings Dam (MW1) Station (NF02YO0193)		
Date (yyyy-mm-dd)	**Parameter**	**Ranking**
2009-10-21 Deployment	pH (units)	Marginal
	Sp. Conductivity (mS/cm)	Excellent
2010-11-30 Removal	pH (units)	NA
	Sp. Conductivity (mS/cm)	NA

Table 4

Data Interpretation

TRIBUTARY TO GILLS POND BROOK

- The water temperature (**Figure 1**) ranged from a minimum of 0.00 ˚C to a maximum of 11.76 ˚C, with temperatures generally decreasing with the onset of winter.
- There appears to be little correlation with stage.
- As fouling and instrument drift were negligible, no data corrections were required for temperature.

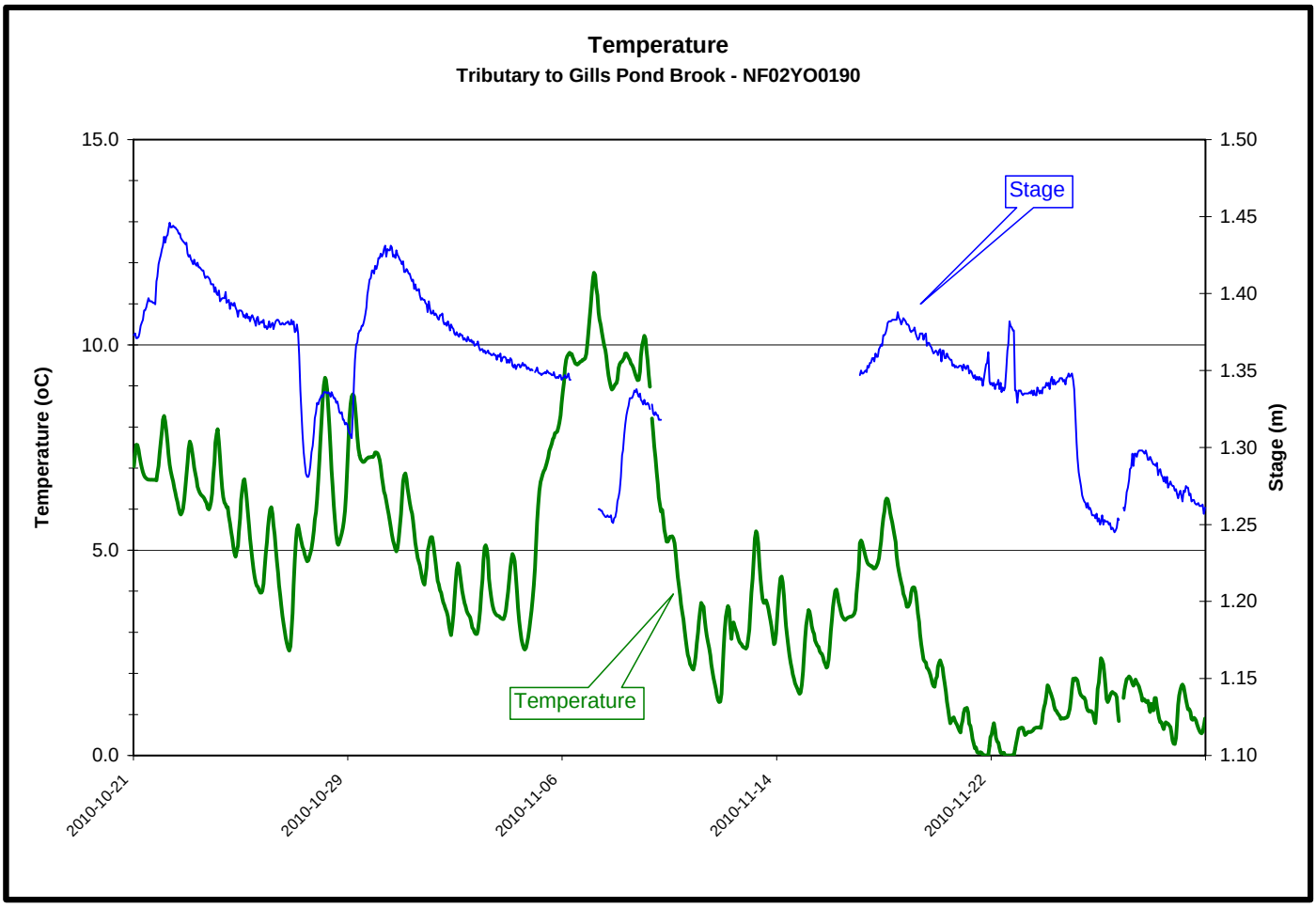

Figure 1

- Throughout the deployment period pH values (**Figure 2**) ranged from a minimum of 6.19 to a maximum of 7.23 with few 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.
- The QA/QC protocol revealed a net decrease of 0.50 (7 %) over the 40 day deployment period. Most of this decrease was due to fouling of the instrument. Accordingly, the correction factor has been applied to the data.

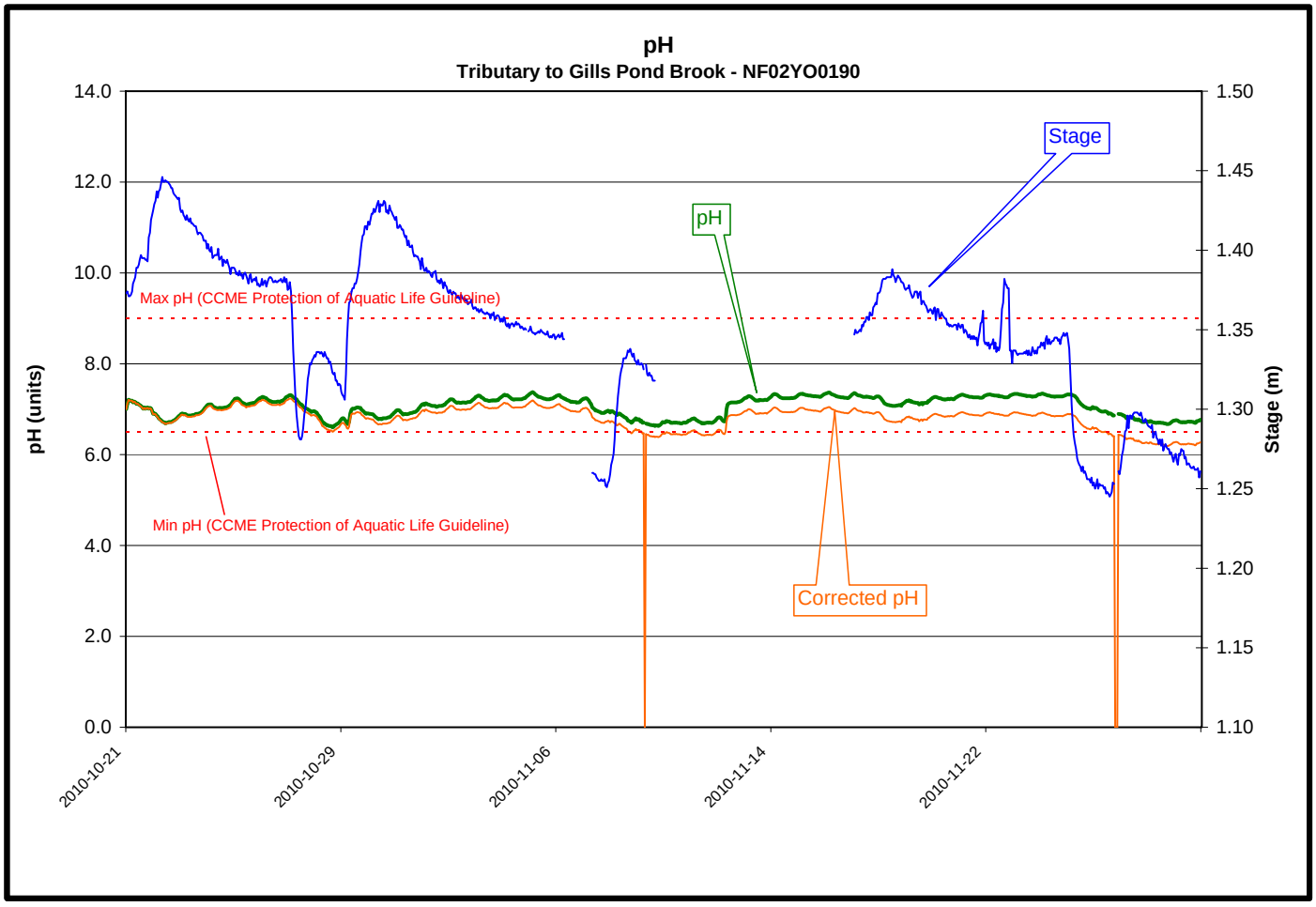

Figure 2

- The specific conductivity **(Figure 3)** ranged from a minimum of 54.0 µS/cm to a maximum of 859.0 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.
- As fouling and instrument drift were negligible, no data corrections were required for Specific Conductivity.

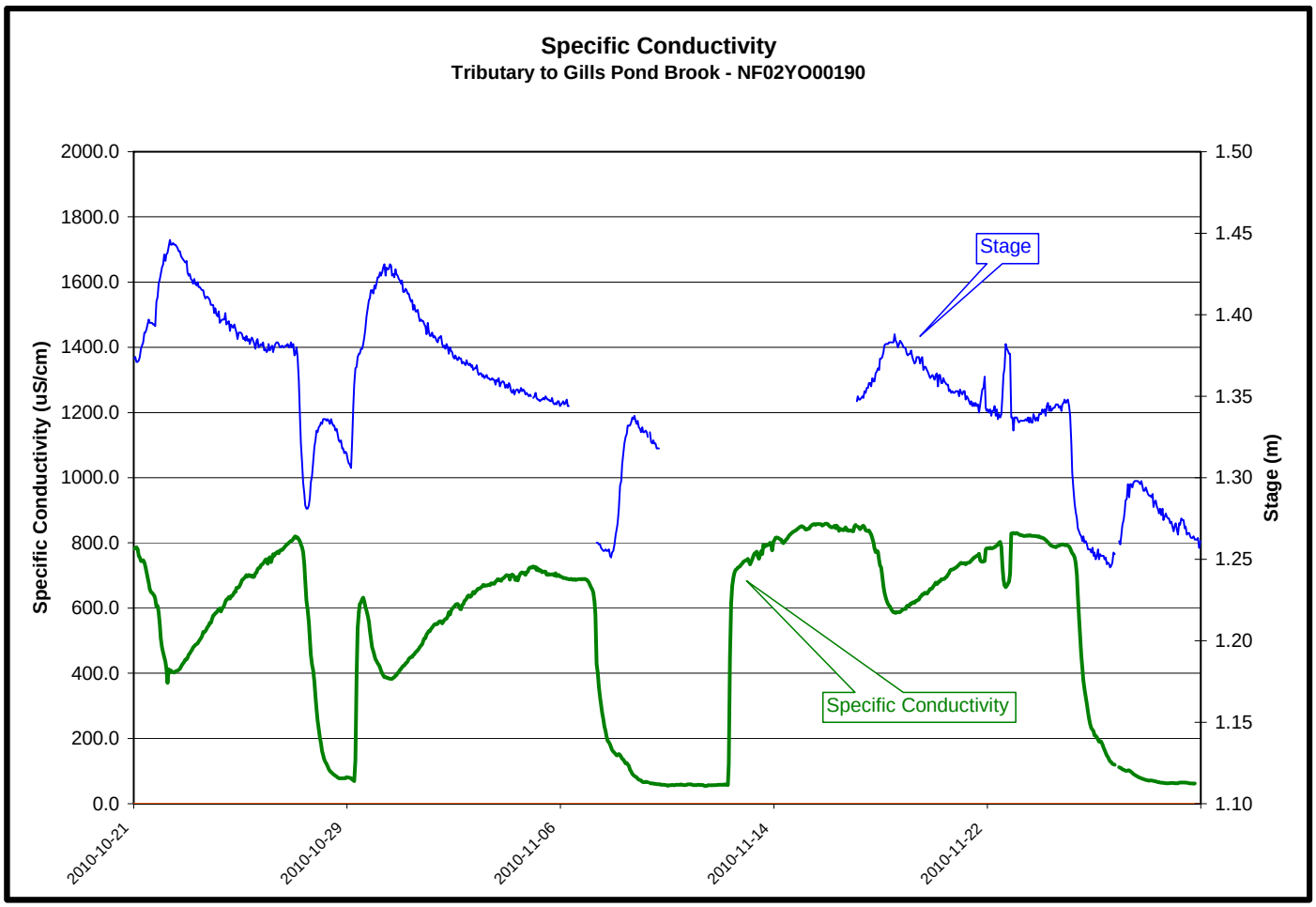

Figure 3

- The dissolved oxygen (**Figure 4**) values ranged from a minimum of 0.00 mg/L to a maximum of 13.17 mg/L over the deployment period.
- On November 20, 2010 the DO sensor failed, resulting in unreliable or no data to the end of the deployment period.
- Dissolved oxygen is inversely proportional to water temperature.
- From the beginning of the deployment period until the sensor failed, all the dissolved oxygen values fell above 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 warmer water temperatures during this period.
- As the sensor failed, the QA/QC protocol could not be employed to calculate a correction factor for this data.

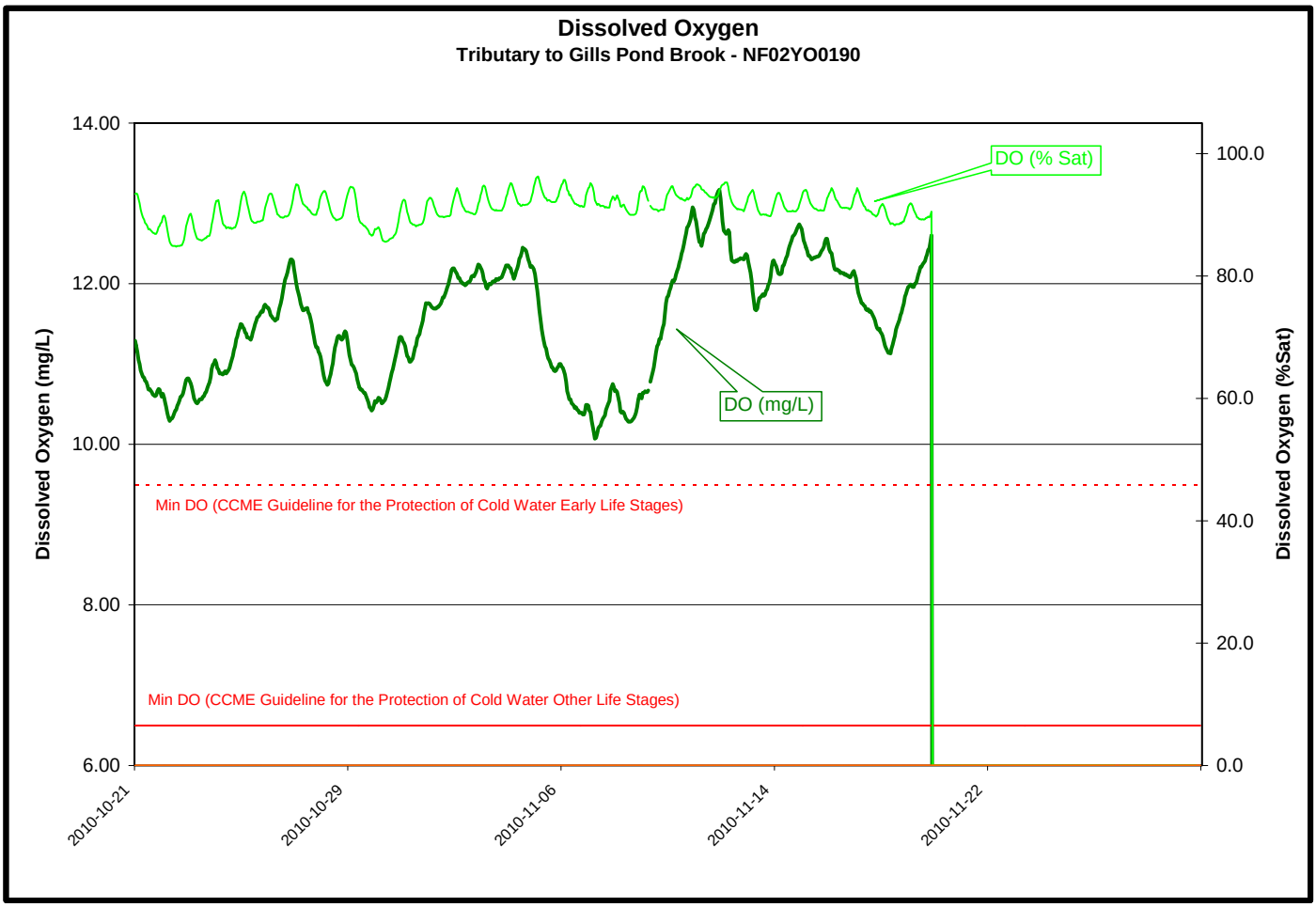

Figure 4

- The turbidity values **(Figure 5)** ranged from a minimum of 0.0 NTU to a maximum of 1635.0 NTU.
- 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 highest turbidity value likely corresponds to in-stream debris passing over the sensor.
- As fouling and instrument drift were negligible, no data corrections were required for turbidity.

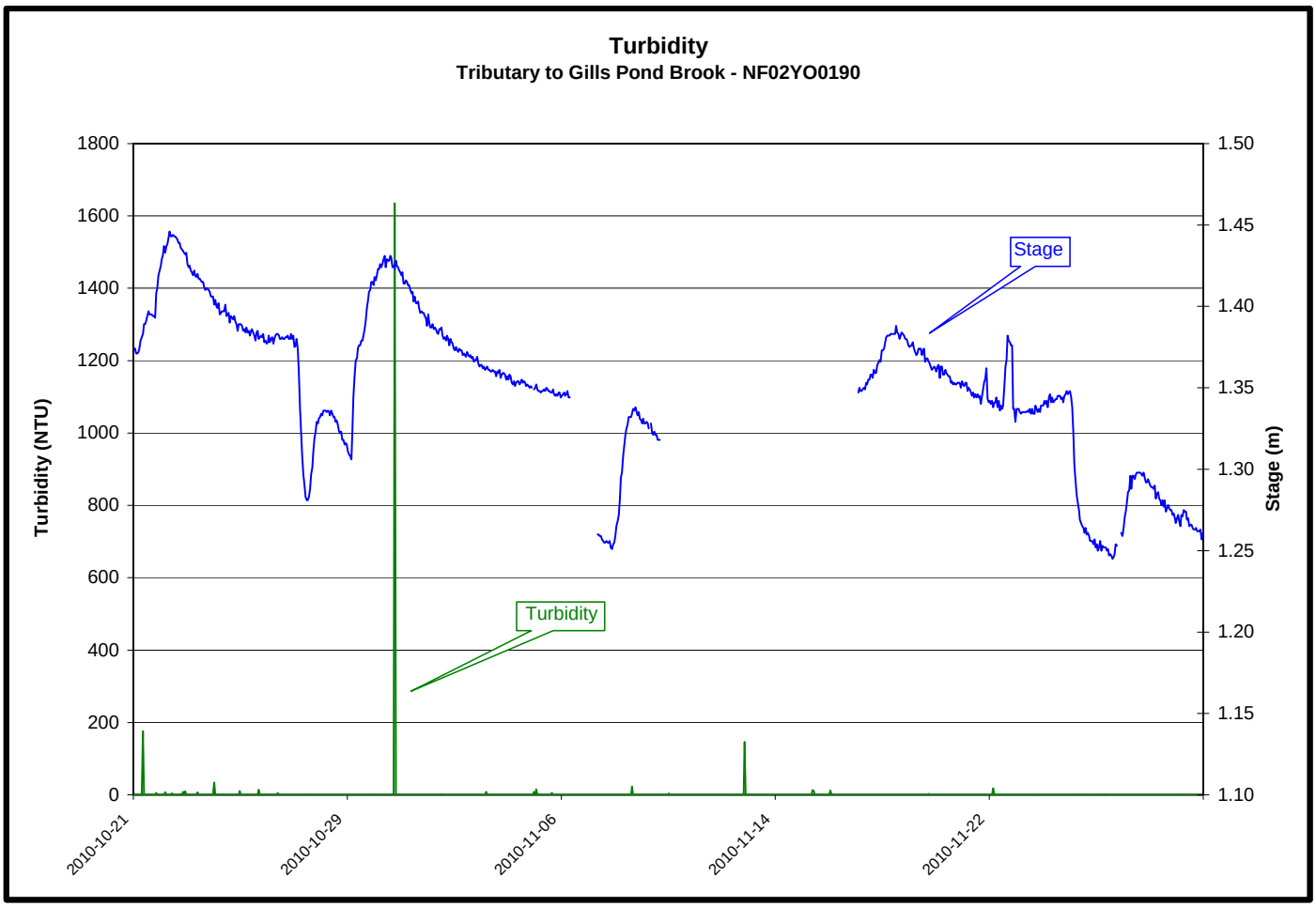

Figure 5

- The stage (**Figure 6)** or water level ranged from a minimum of 1.25 m to a maximum of 1.45 m with the peaks corresponding to precipitation events, and the dips corresponding to short terms cessation of discharge from Polishing Pond.
- There is some intermittent loss of stage data due to failure of the data logger.
- All values are within the normal range.

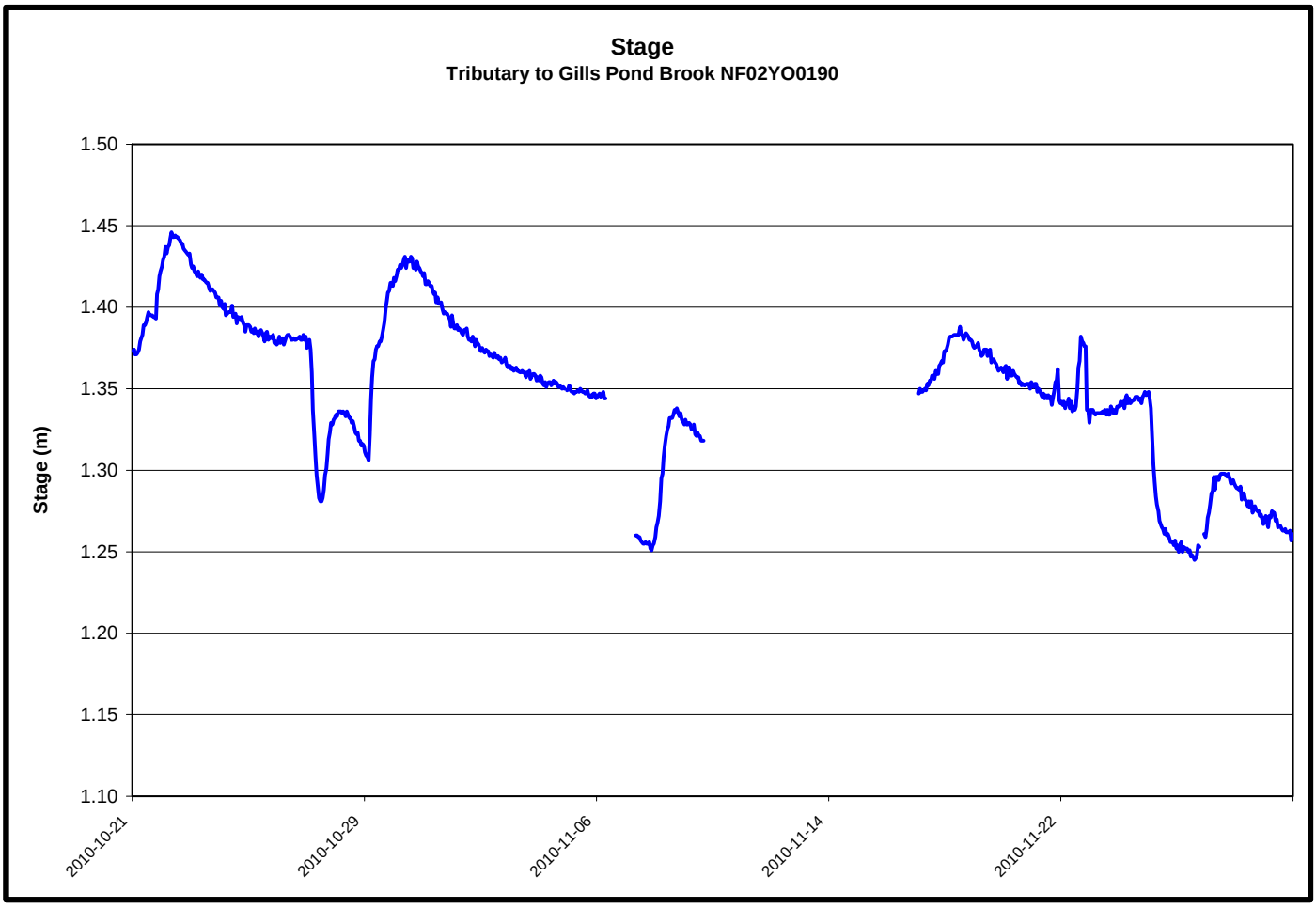

Figure 6

EAST POND BROOK

- The water temperature (**Figure 7**) ranged from a minimum of -0.04 ˚C to a maximum of 11.91 ˚C.
- There appears to be little correlation with stage.
- As fouling and instrument drift were negligible, no data corrections were required for temperature.

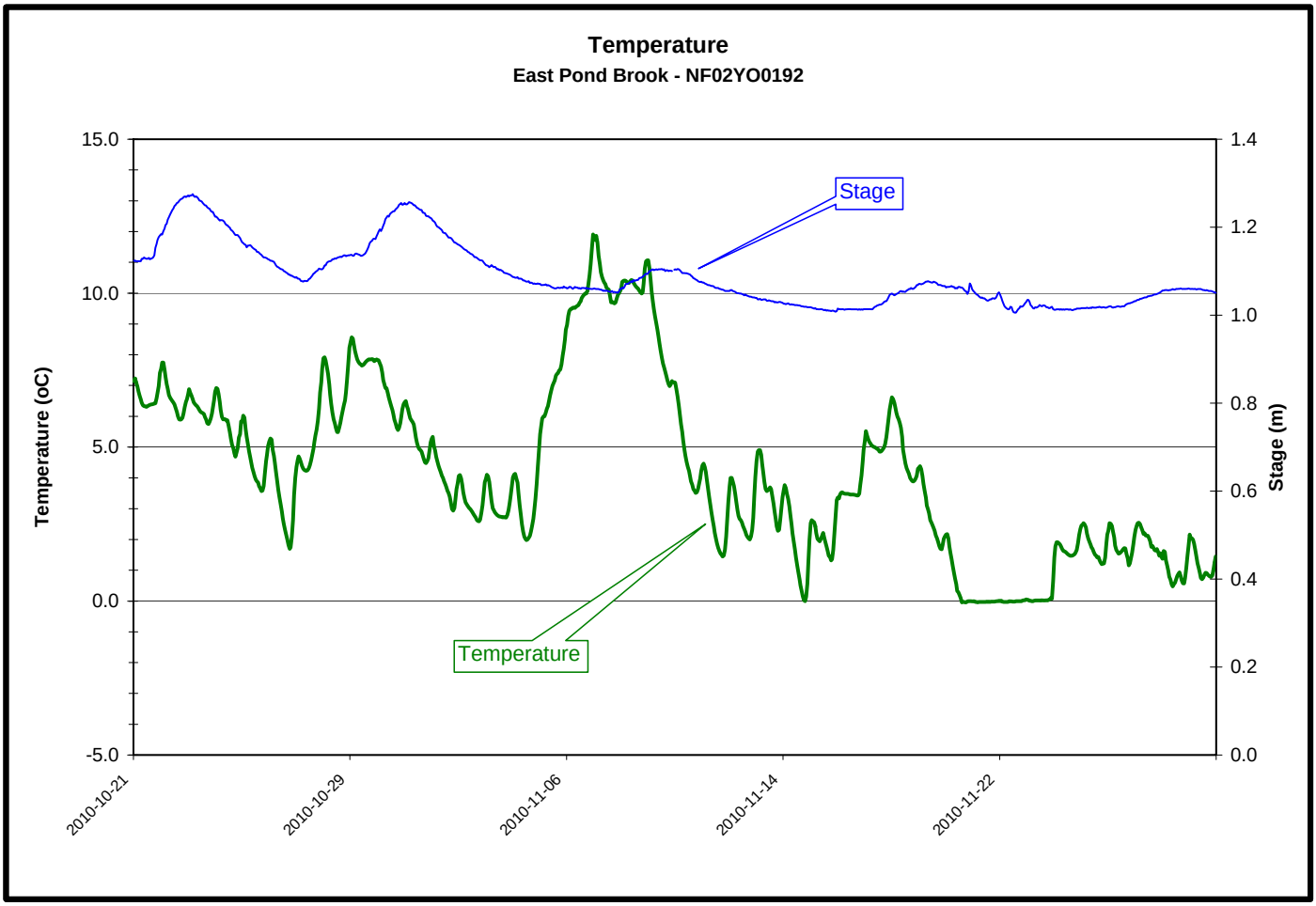

Figure 7

- Throughout the deployment period pH values (**Figure 8**) ranged from a minimum of 6.42 to a maximum of 6.84 with very few 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.
- As fouling and instrument drift were negligible, no data corrections were required for pH.

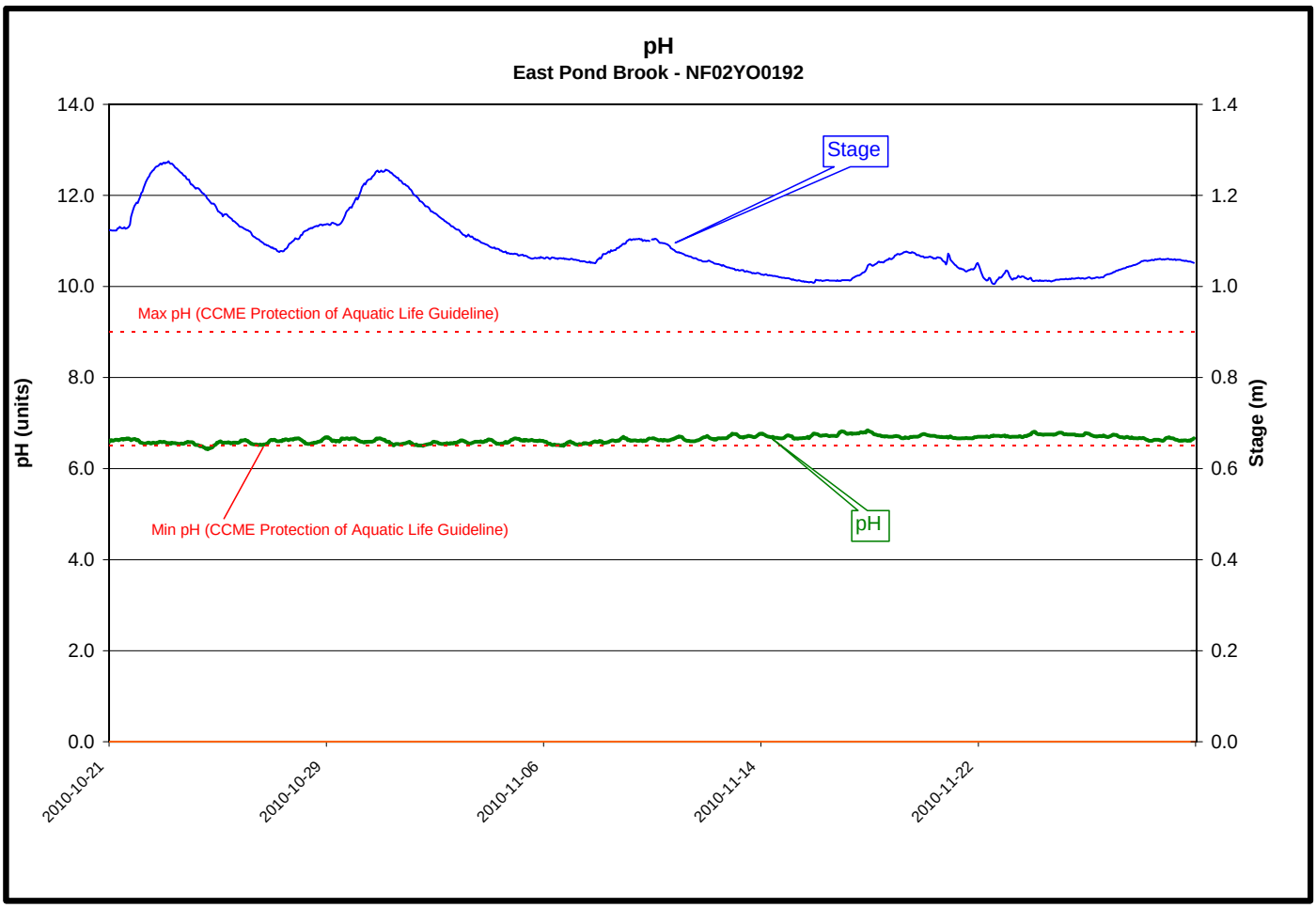

Figure 8

- The specific conductivity **(Figure 9)** ranged from a minimum of 20.6 µS/cm to a maximum of 31.1 µS/cm.
- As fouling and instrument drift were negligible, no data corrections were required for specific conductivity.

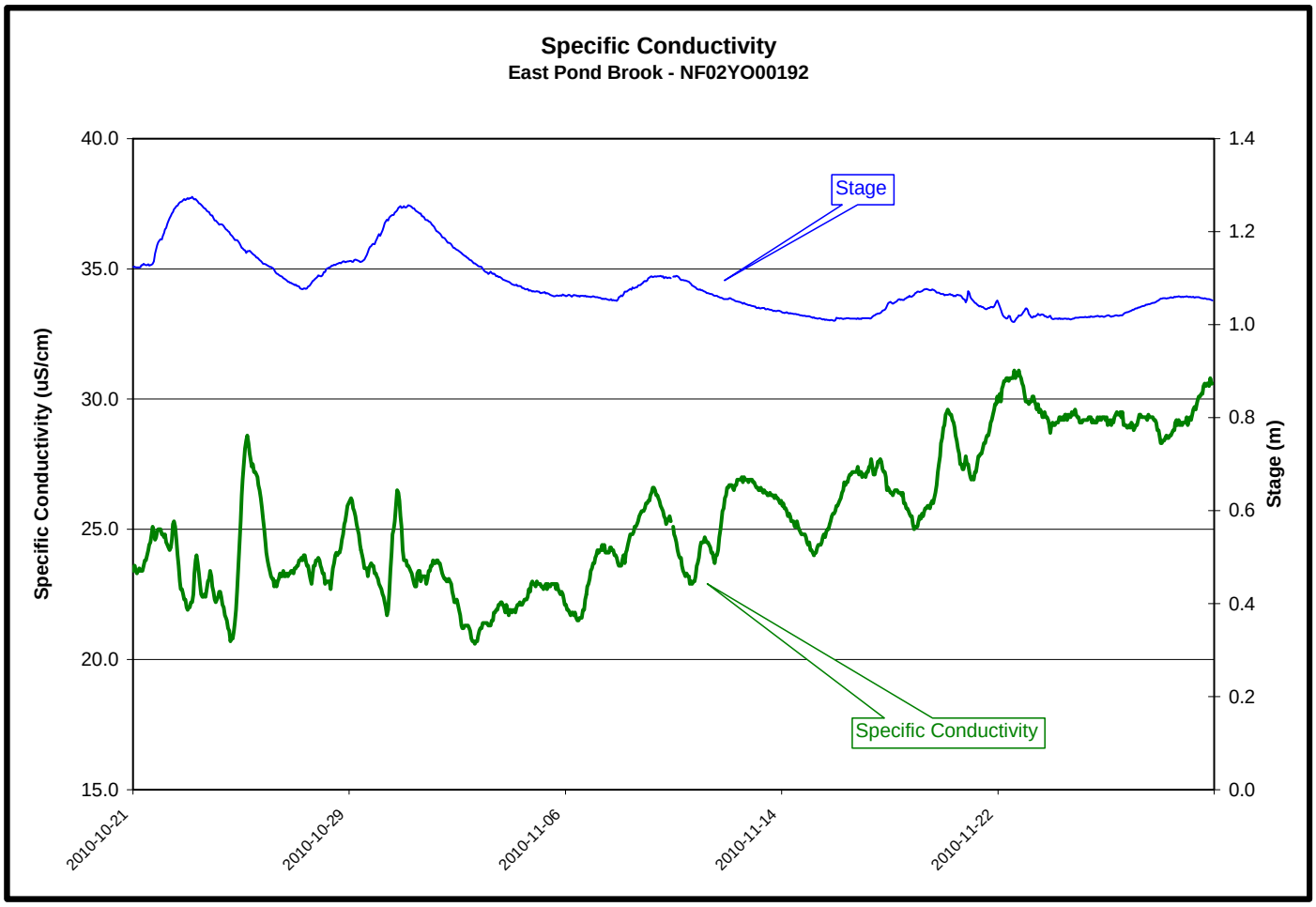

Figure 9

- The dissolved oxygen (**Figure 10**) values ranged from a minimum of 10.56 mg/L to a maximum of 14.44 mg/L over the deployment period.
- Dissolved oxygen is inversely proportional to water temperature.
- Throughout all of the deployment period, dissolved oxygen values fell above 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 warmer water temperatures during this period.
- The QA/QC protocol revealed a net decrease of 7.2 % in the Dissolved Oxygen (% Sat) over the 40 day deployment period. The majority 7.1 % of this increase 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 limited drift, we can be confident that the Dissolved Oxygen mg/L values are reasonably accurate as well.

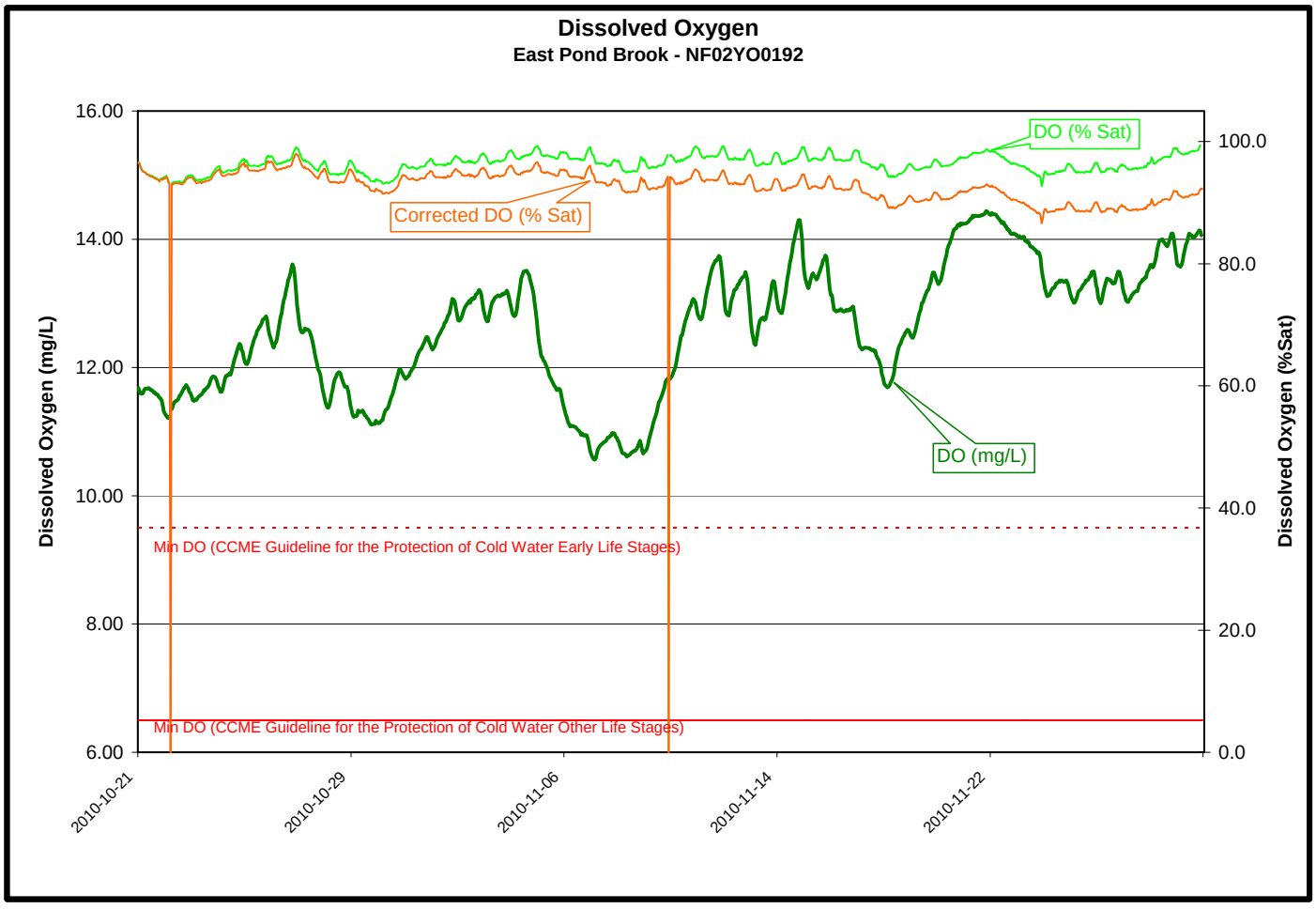

Figure 10

- The turbidity values **(Figure 11)** ranged from a minimum of 0.0 NTU to a maximum of 7.0 NTU.
- Typically, turbidity values in this stream are near zero; the 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.
- As fouling and instrument drift were negligible, no data corrections were required for turbidity.

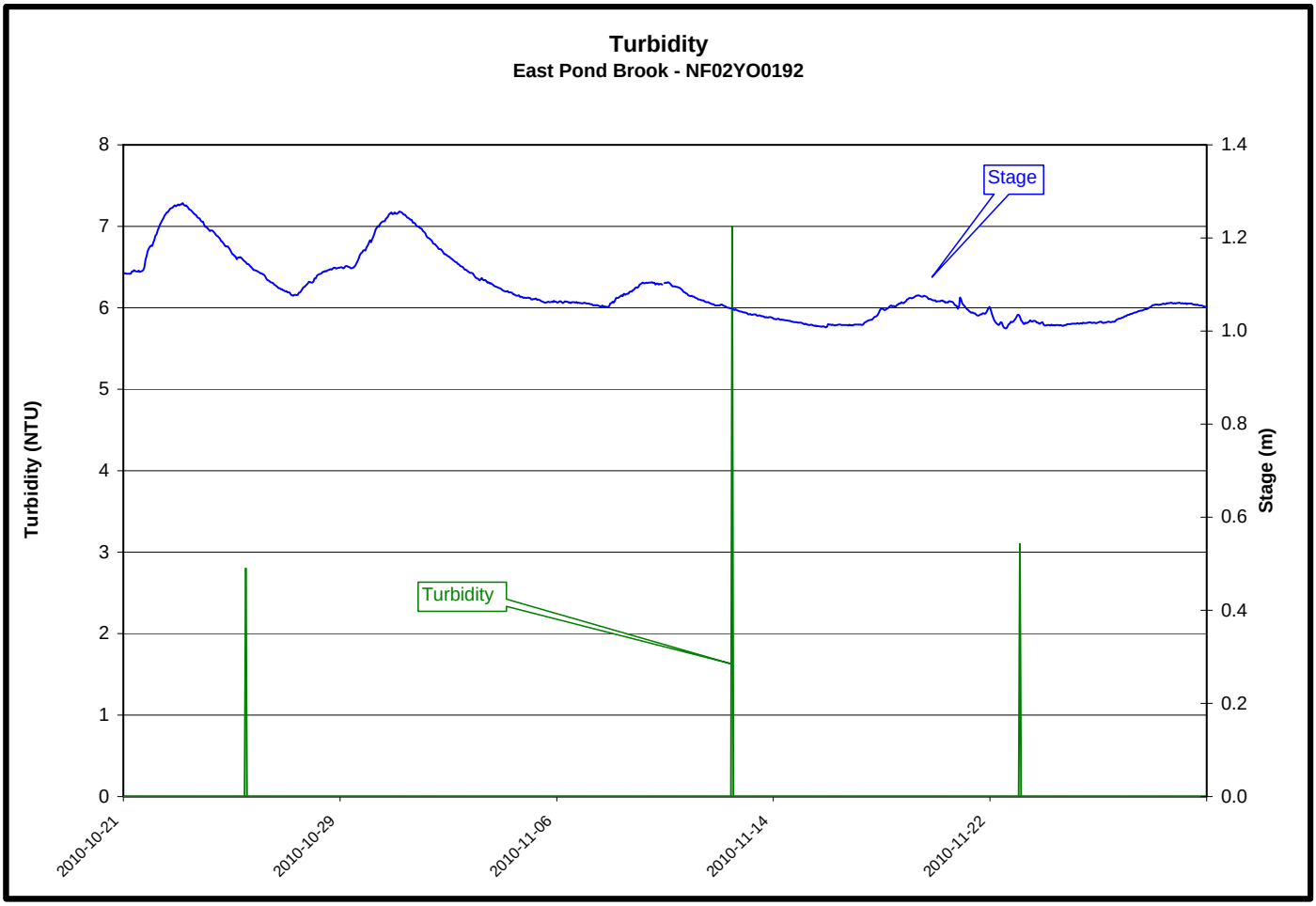

Figure 11

- The stage **(Figure 12)** or water level ranged from a minimum of 1.01 m to a maximum of 1.27 m.
- Peaks correspond to precipitation and runoff events.

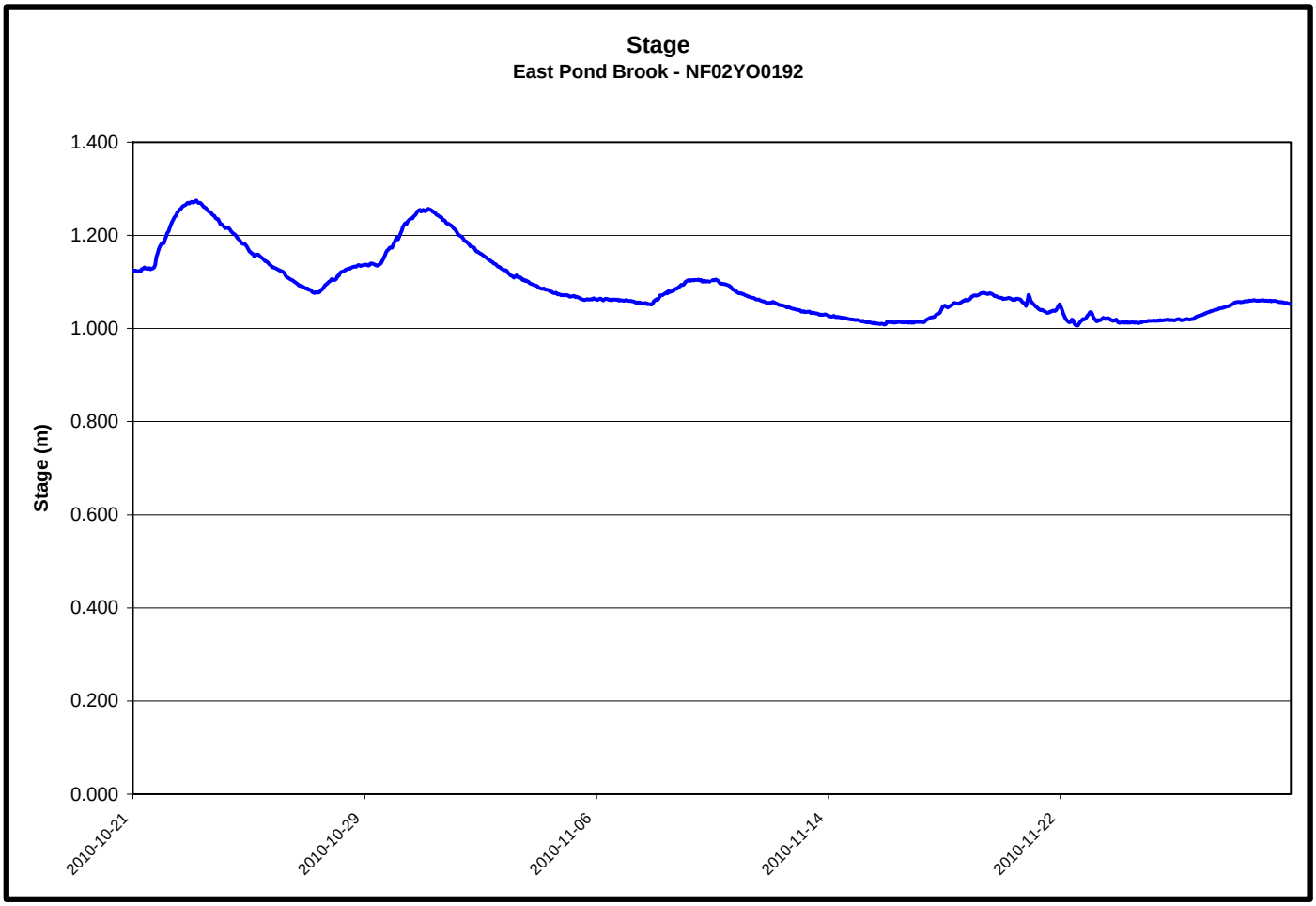

Figure 12

WELL AFTER TAILING DAM (MW1)

- The water temperature (**Figure 13**) ranged from a minimum of 5.49 ˚C to a maximum of 5.75 ˚C; generally increasing over the deployment period.
- There appears to be little correlation with water elevation.

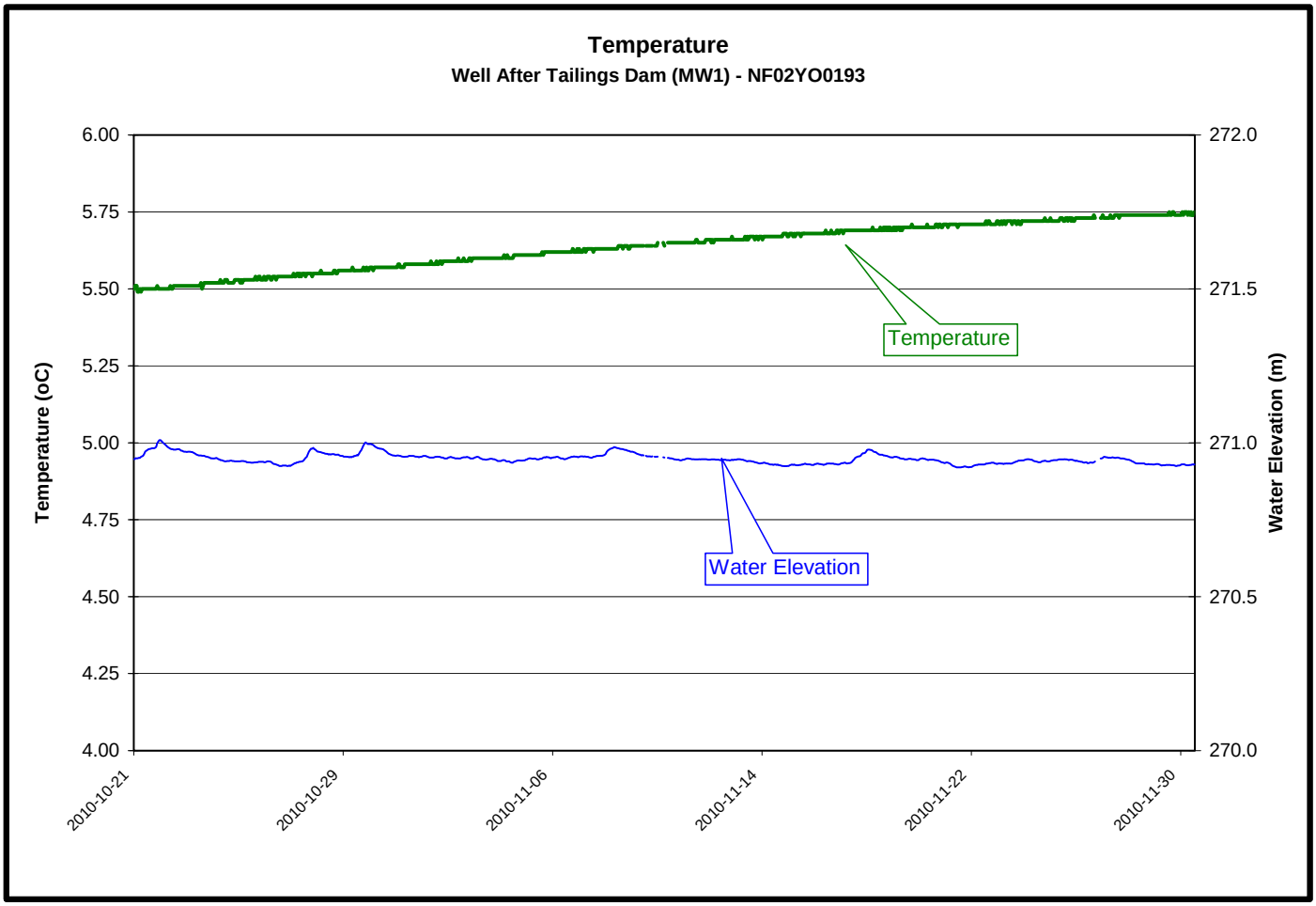

Figure 13

- The pH (**Figure 14**) ranged from a minimum of 7.34 to a maximum of 8.49 over the deployment period
- There was a significant increase in pH during the first dew days of the deployment period. This is the result of the purging of this well to collect water samples during deployment.
- Over the course of the deployment period, the pH slowly returned to it normal range.

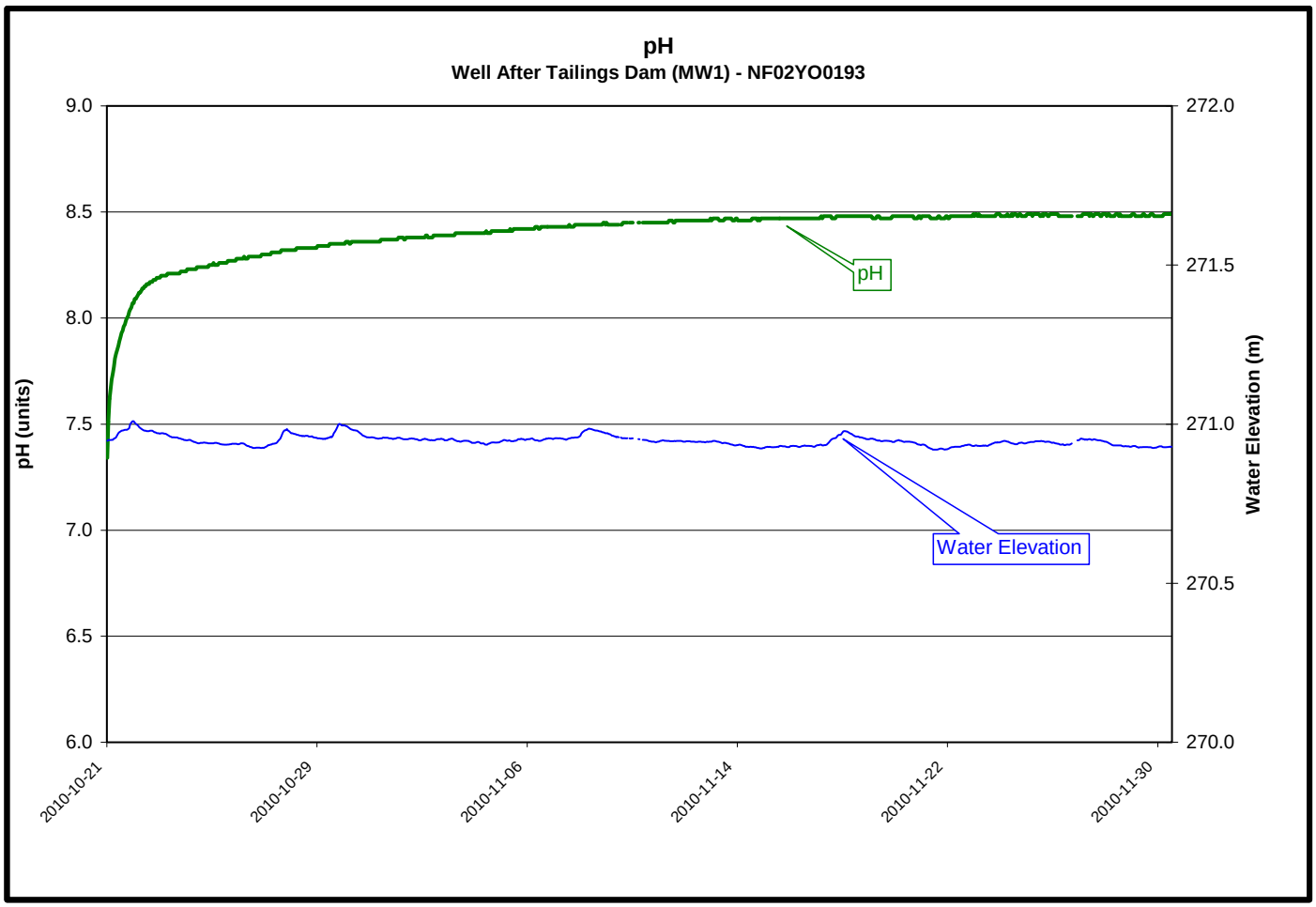

Figure 14

- The specific conductivity **(Figure 15)** ranged from a minimum of 0.583 mS/cm to a maximum of 0.594 mS/cm.
- There was a slight increase throughout the deployment period.

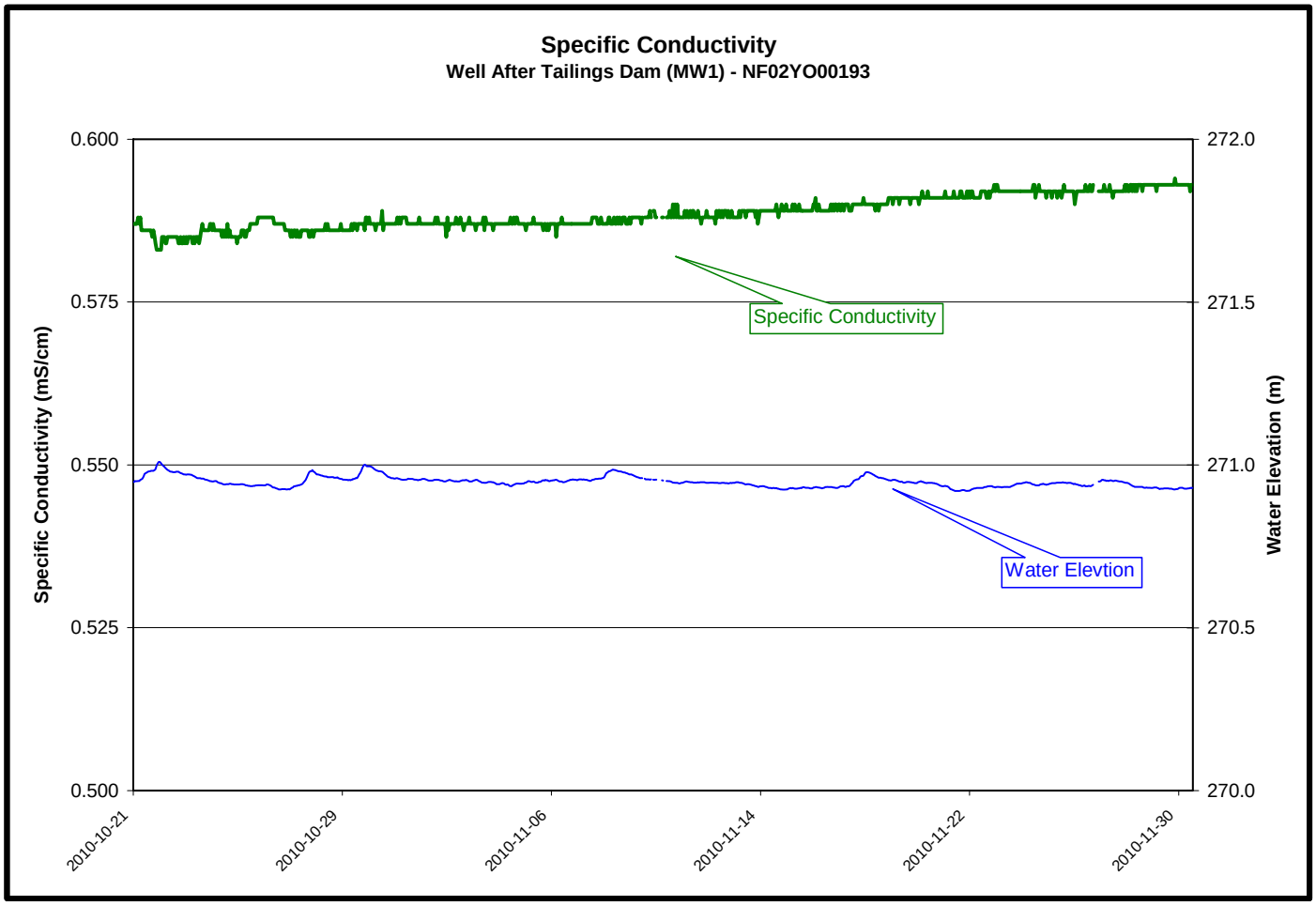

Figure 15

- The Water Elevation ranged from a minimum of 270.92 m to 271.01 m, remaining fairly constant throughout the deployment period.

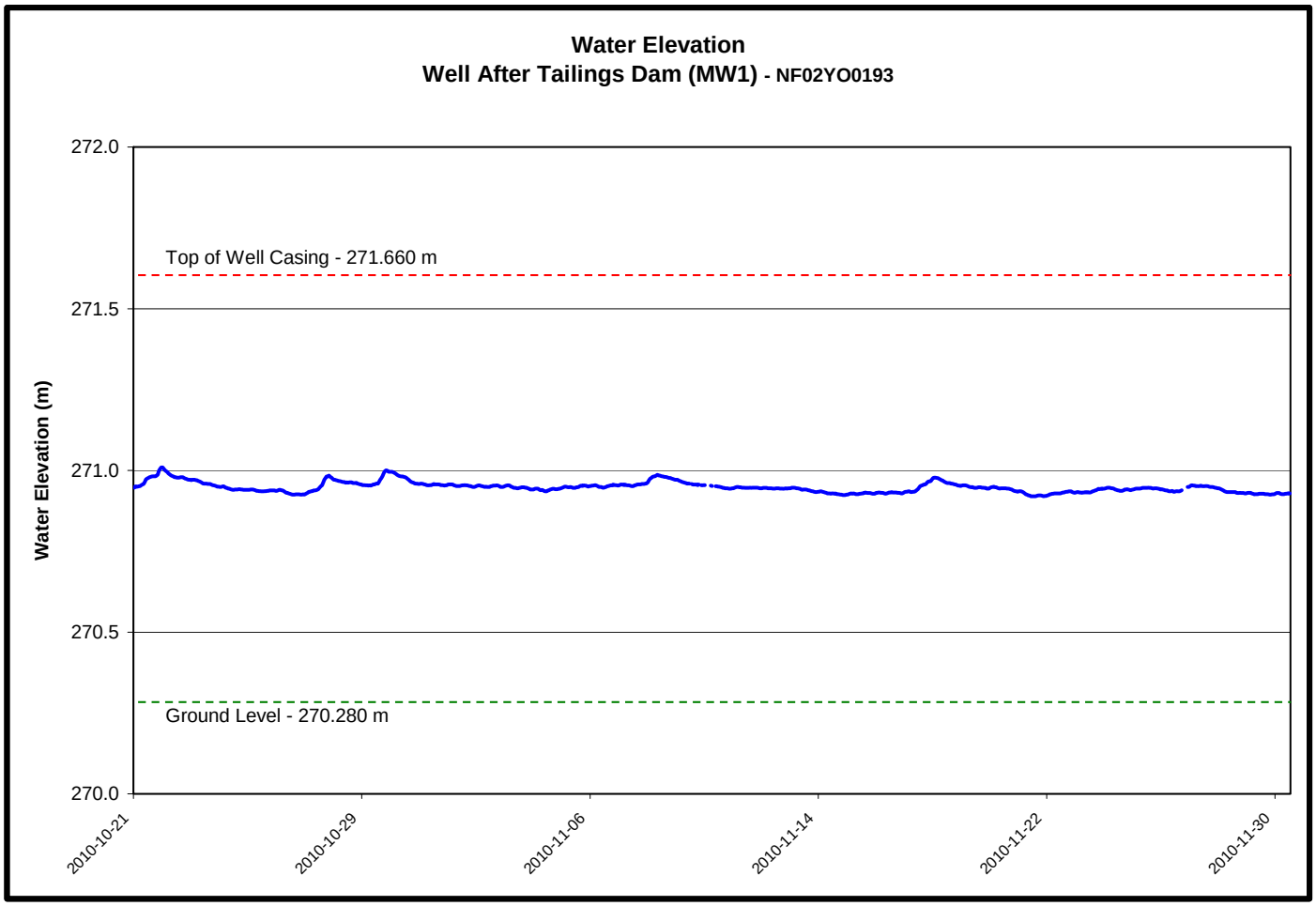

Figure 16

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