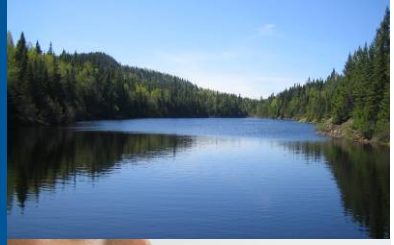
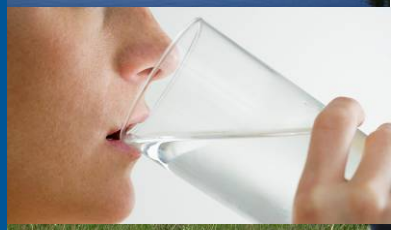



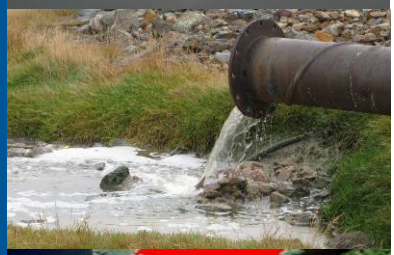


Real Time Water Quality Report
Teck Duck Pond Operations

Deployment Period 2010-11-30 to 2011-05-03

2011-06-20

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 **DataSonde®**(s/n 43245) for Tributary to Gills Pond Brook was installed in on November 30, 2010, and remained deployed continuously until May 3, 2011 a 153 day period.
- After being cleaned and freshly calibrated the regular **DataSonde®** (s/n 43794) for East Pond Brook was installed on December 2, 2010 and remained deployed continuously until May 3, 2011, a 151 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, this probe remained deployed until May 3, 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

- 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.
- As there was a transmission error with the Turbidity data from the Tributary to Gills Pond Brook station from February 26, 2011 to March 3, 2011, data logged internally in the unit were used to augment the erroneous transmitted data.
- As there was a transmission error with the Turbidity data from the East Pond Brook station from January 2, 2011 to January 9, 2011, data logged internally in the unit were used to augment the erroneous transmitted data.
- The ranking for pH at removal at Tributary to Gills Pond Brook was Fair. The difference between the Field Sonde and the QA/QC Sonde was 0.58 pH units, which is reasonable after such a long deployment.
- 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 was collected at the beginning of the deployment period in October, and the deployment ranking was calculated for pH and Specific Conductance based upon live data and laboratory data. See previous Deployment Report.
- There were some communications issues with Well After Tailings Dam (MW1) station throughout the deployment period. There are some gaps in the data which cannot be filled as this instrument does not have the capability to log internally.
- The pH sensor failed on the Well After Tailings Dam (MW1) instrument on March 7, 2011. Accordingly, no pH data is available after this date.
- The depth sensor (Water Elevation) on the Well After Tailings Dam (MW1) instrument was reporting variable numbers (outside it normal performance specifications) at the end of the deployment period.
- The Well After Tailings Dam (MW1) instrument has been returned to the factory for repairs and factory calibration.
- 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**
2010-11-30 Deployment	Temp (^{o}C)	Good
	pH (units)	Good
	Sp. Conductivity (uS/cm)	Good
	Dissolved Oxygen (mg/L)	Good
	Turbidity (NTU)	Excellent
2011-05-03 Removal	Temp (^{o}C)	Good
	pH (units)	Fair
	Sp. Conductivity (uS/cm)	Excellent
	Dissolved Oxygen (%)	Good
	Turbidity (NTU)	Excellent

Table 2

East Pond Brook Station (NF02YO0192)		
Date (yyyy-mm-dd)	**Parameter**	**Ranking**
2010-12-02 Deployment	Temp (^{o}C)	Excellent
	pH (units)	Excellent
	Sp. Conductivity (uS/cm)	Excellent
	Dissolved Oxygen (mg/L)	Excellent
	Turbidity (NTU)	Excellent
2011-05-03 Removal	Temp (^{o}C)	Excellent
	pH (units)	Good
	Sp. Conductivity (uS/cm)	Excellent
	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 -.044 ˚C to a maximum of 11.42 ˚C, with temperatures remaining constant below ice cover for most of the winter period.
- There appears to be little correlation with stage.

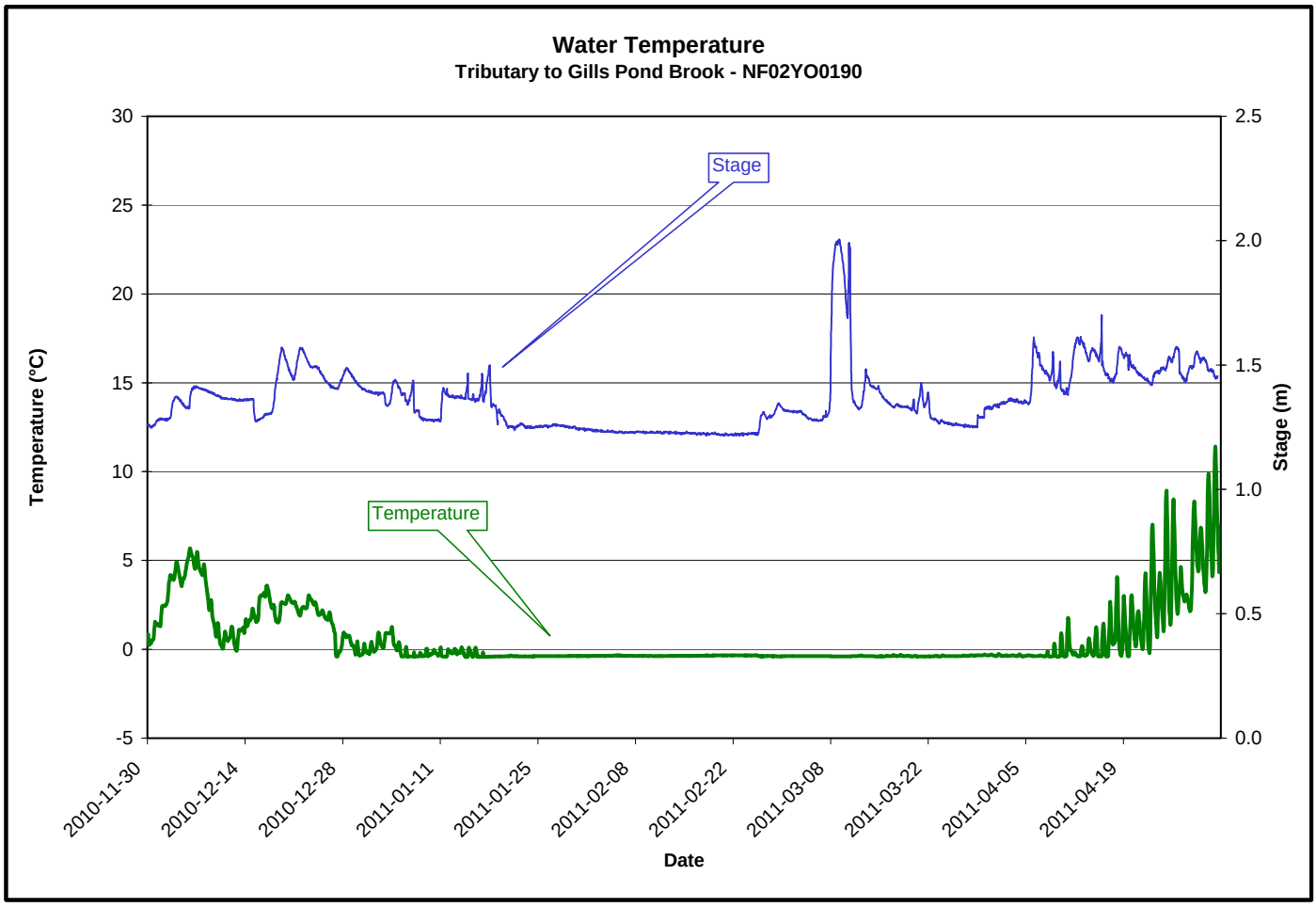

Figure 1

- Throughout the deployment period pH values (**Figure 2**) ranged from a minimum of 5.97 to a maximum of 7.18 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.

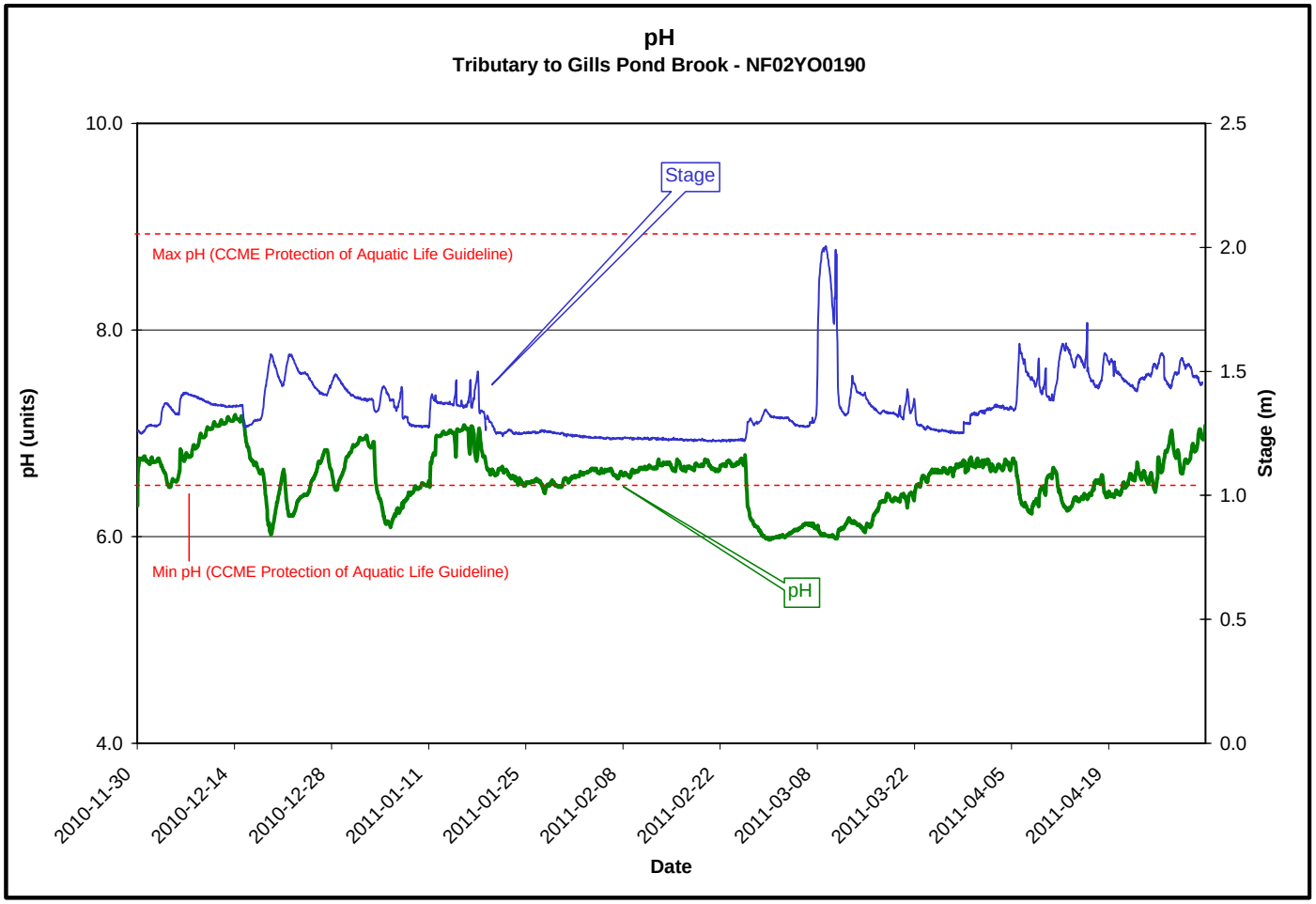

Figure 2

- The specific conductivity **(Figure 3)** ranged from a minimum of 17.3 µS/cm to a maximum of 939.0 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.

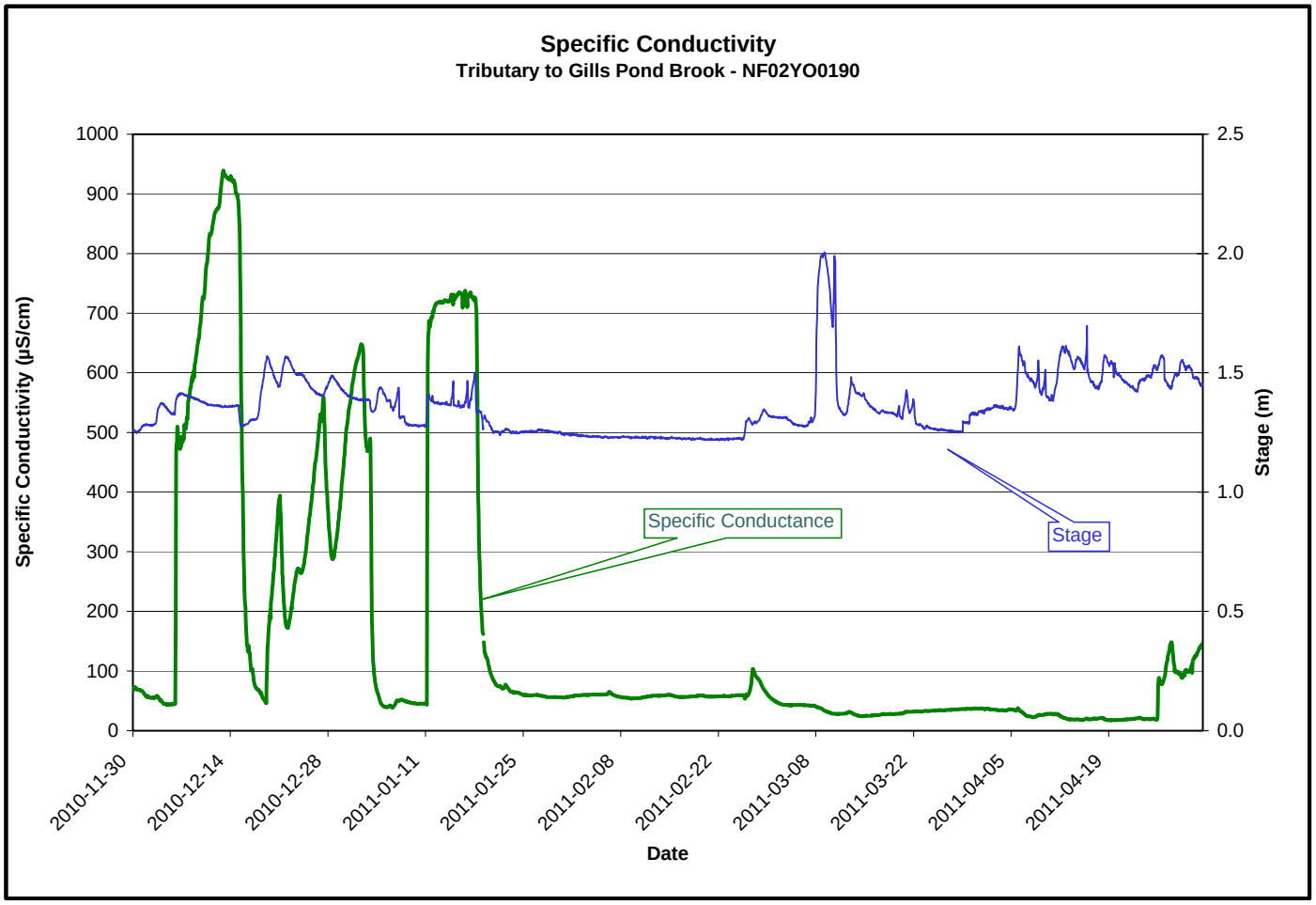

Figure 3

- The dissolved oxygen (**Figure 4**) values ranged from a minimum of 10.63 mg/L to a maximum of 14.38 mg/L over the deployment period, with the percent saturation ranging between 73.9 and 100.4.
- Dissolved oxygen is generally inversely proportional to water temperature.
- 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).
- 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 reasonably accurate.

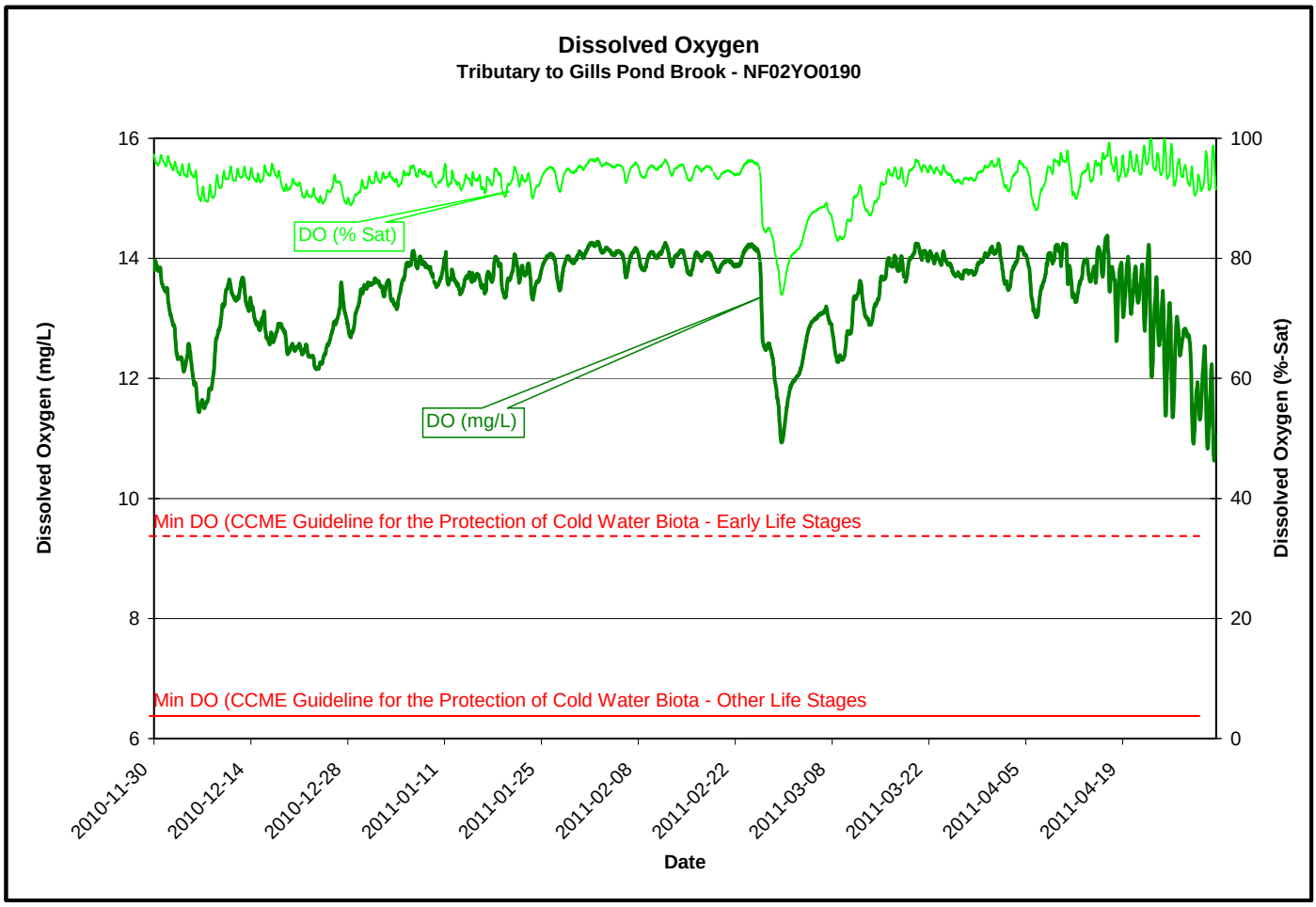

Figure 4

- The turbidity values **(Figure 5)** ranged from a minimum of 0.0 NTU to a maximum of 746.0 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 higher turbidity values likely correspond to natural in-stream debris and/or air bubbles from turbulent flow passing over the sensor.
- Turbidity values were at or near zero under ice cover during the coldest part of the winter.

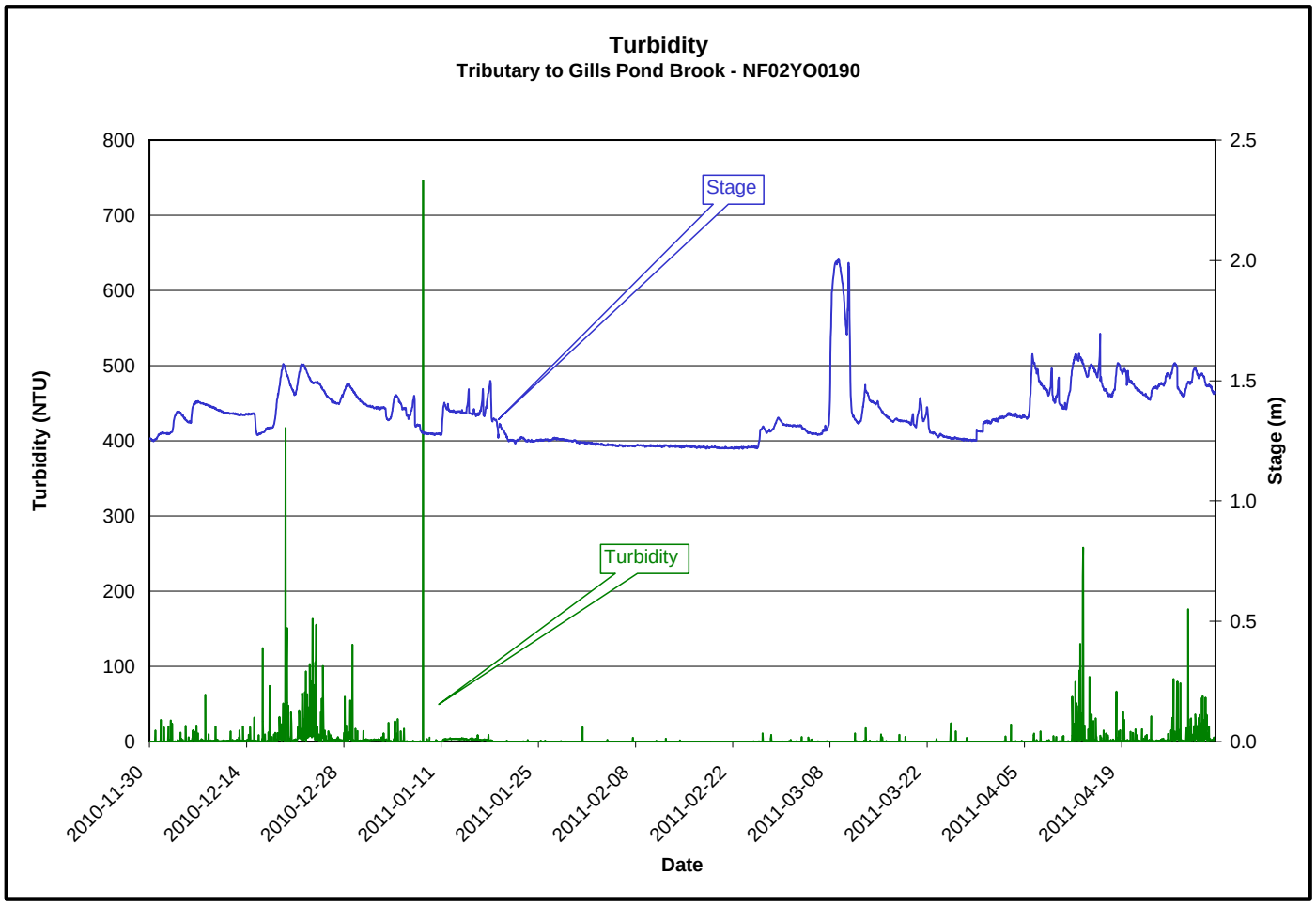

Figure 5

- The stage or water level ranged from a minimum of 1.22 m to a maximum of 2.01 m. The flow or discharge ranged from a minimum of 0.02 m^3/s to a maximum of 2.48 m^3/s (**Figure 6)**.
- The peaks correspond to periods of discharge from Polishing Pond, precipitation events and spring snow melt.
- All values are within the normal range.

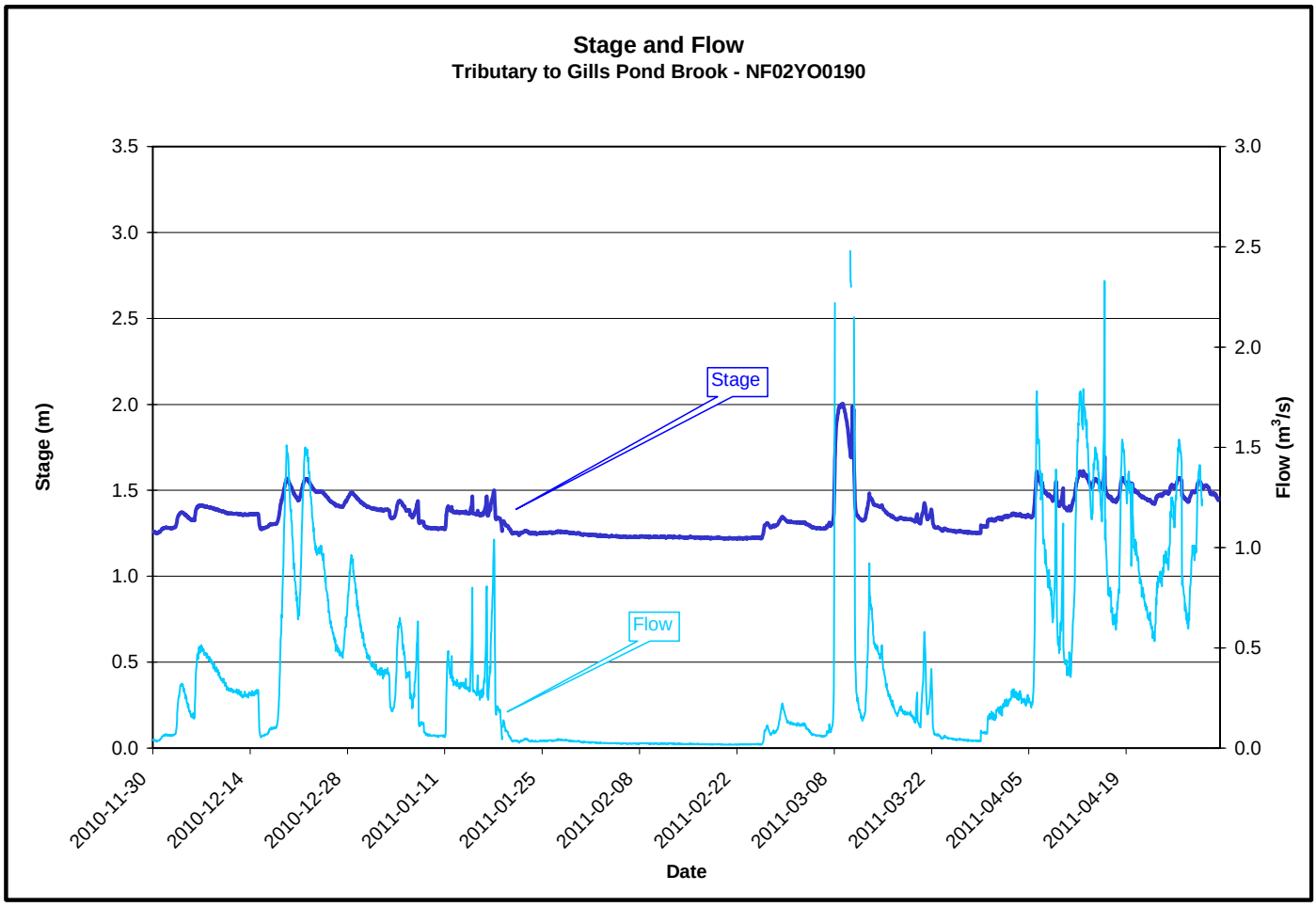

Figure 6

EAST POND BROOK

- The water temperature (**Figure 7**) ranged from a minimum of -0.08 ˚C to a maximum of 8.20 ˚C, with temperatures remaining constant below ice cover for most of the winter period.
- There appears to be little correlation with stage.

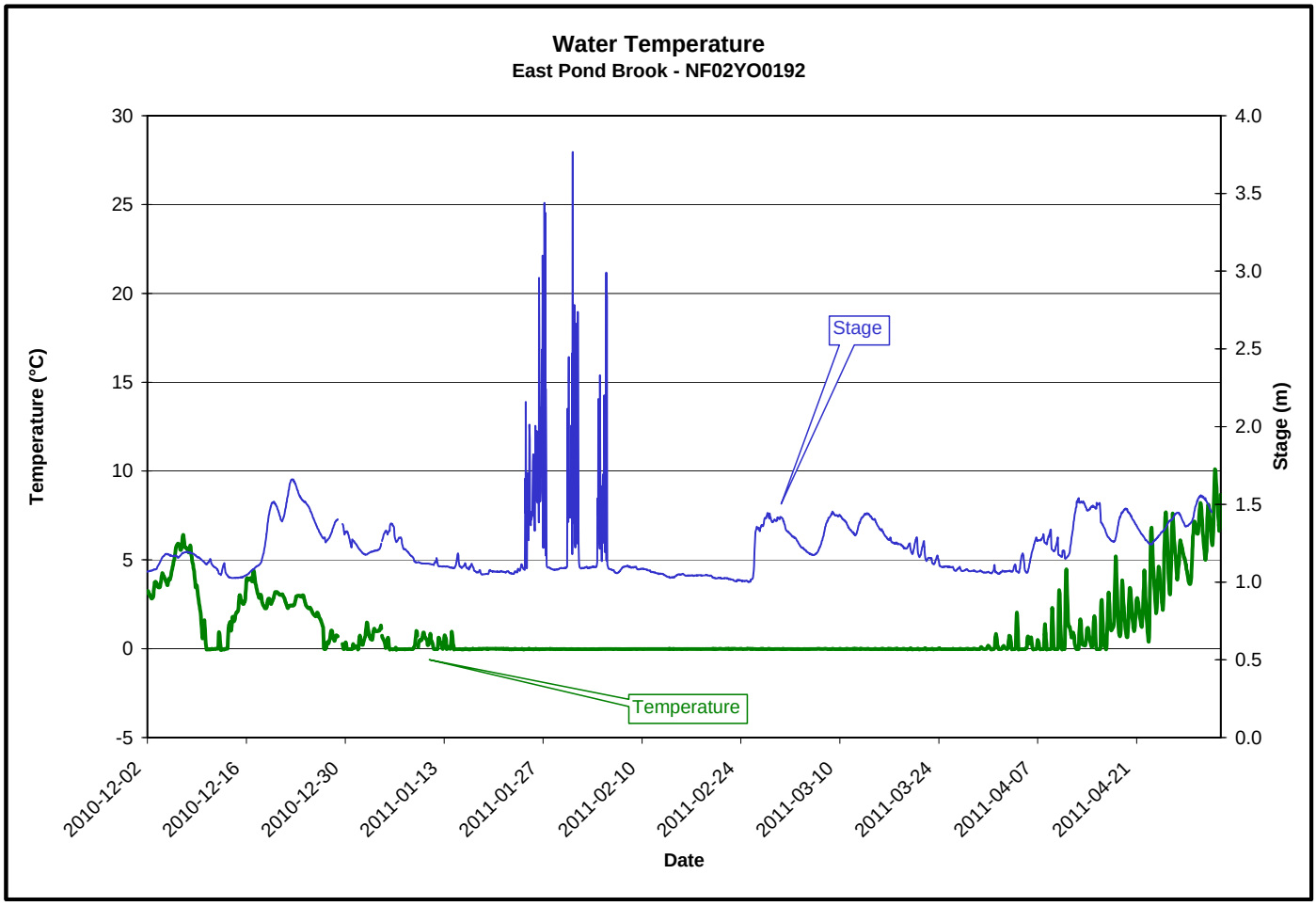

Figure 7

- Throughout the deployment period pH values (**Figure 8**) ranged from a minimum of 5.54 to a maximum of 6.96 with most 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

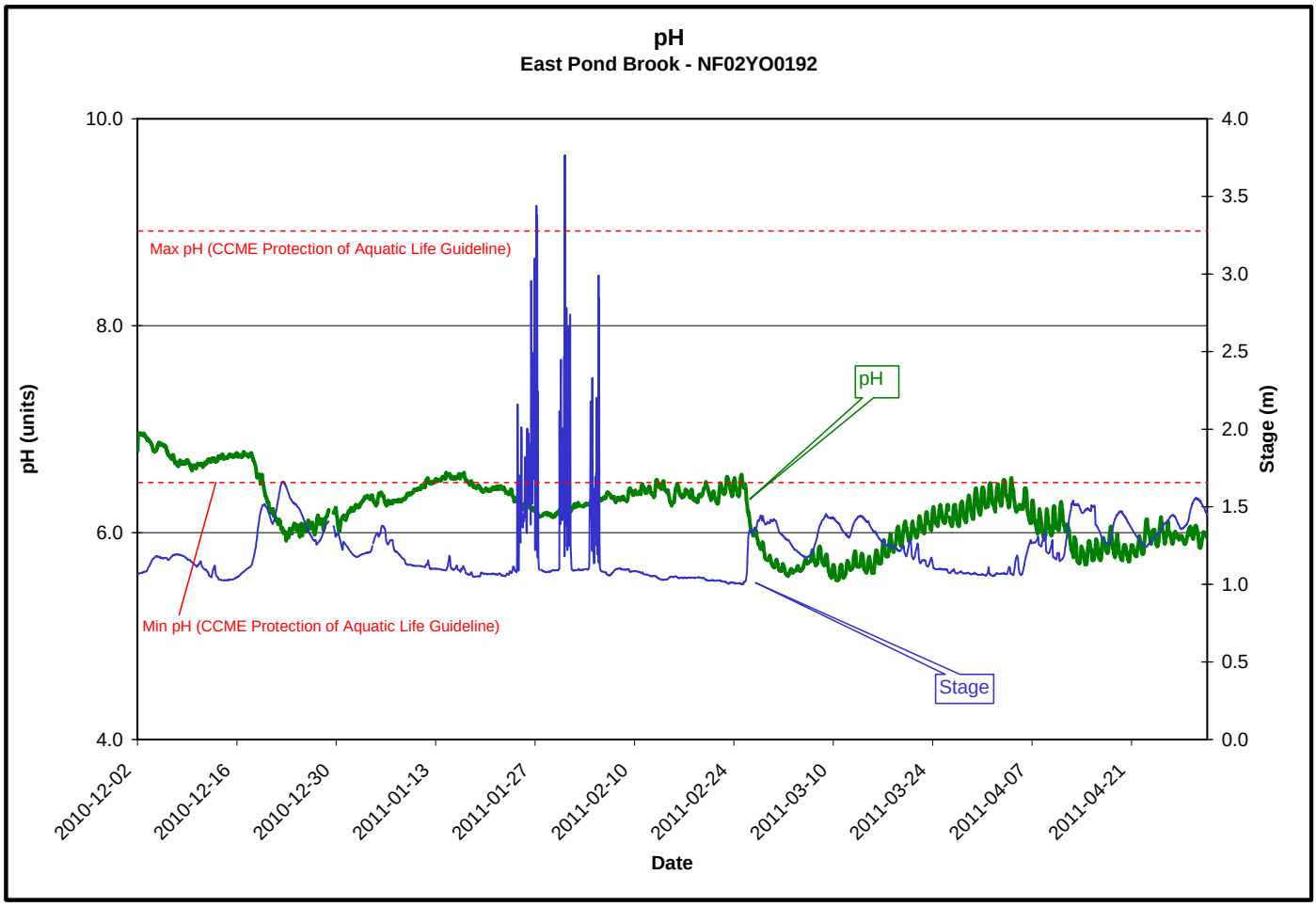

Figure 8

- The specific conductivity **(Figure 9)** ranged from a minimum of 6.3 µS/cm to a maximum of 33.7 µS/cm.

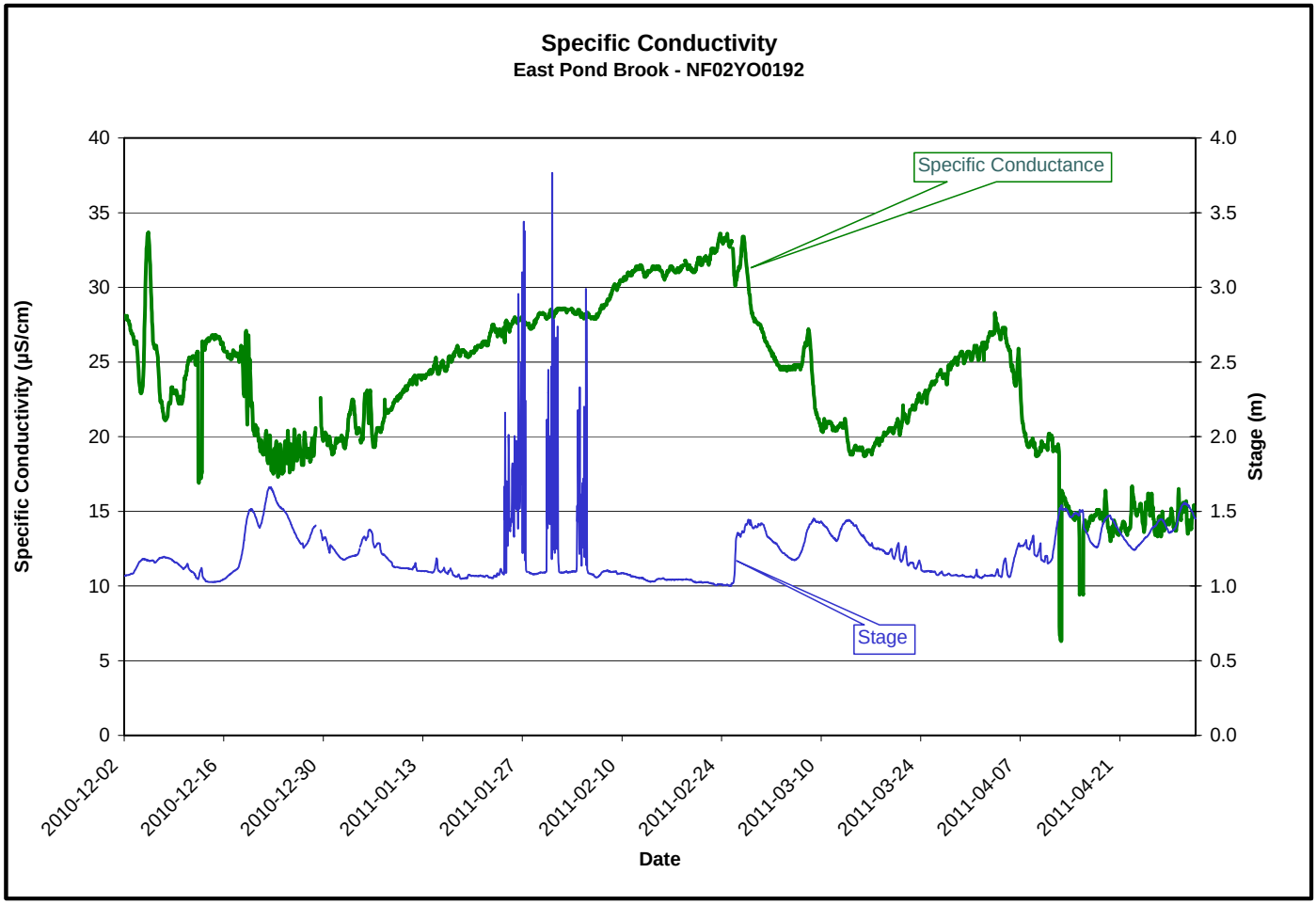

Figure 9

- The dissolved oxygen (**Figure 10**) values ranged from a minimum of 11.07 mg/L to a maximum of 14.06 mg/L over the deployment period, with the percent saturation ranging between 76.6 and 97.7.
- 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).
- 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.

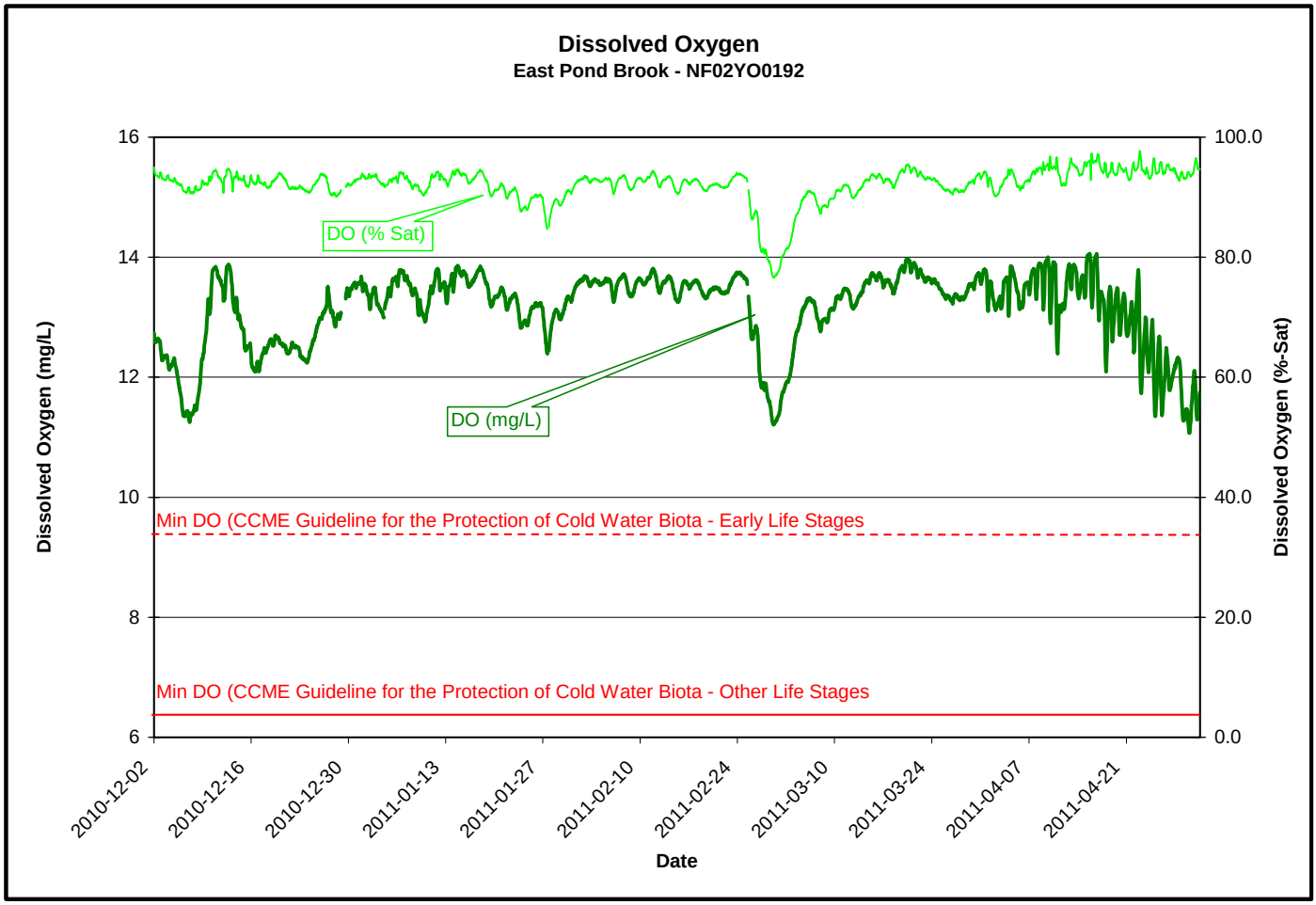

Figure 10

- The turbidity values **(Figure 11)** ranged from a minimum of 0.0 NTU to a maximum of 30.6 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.

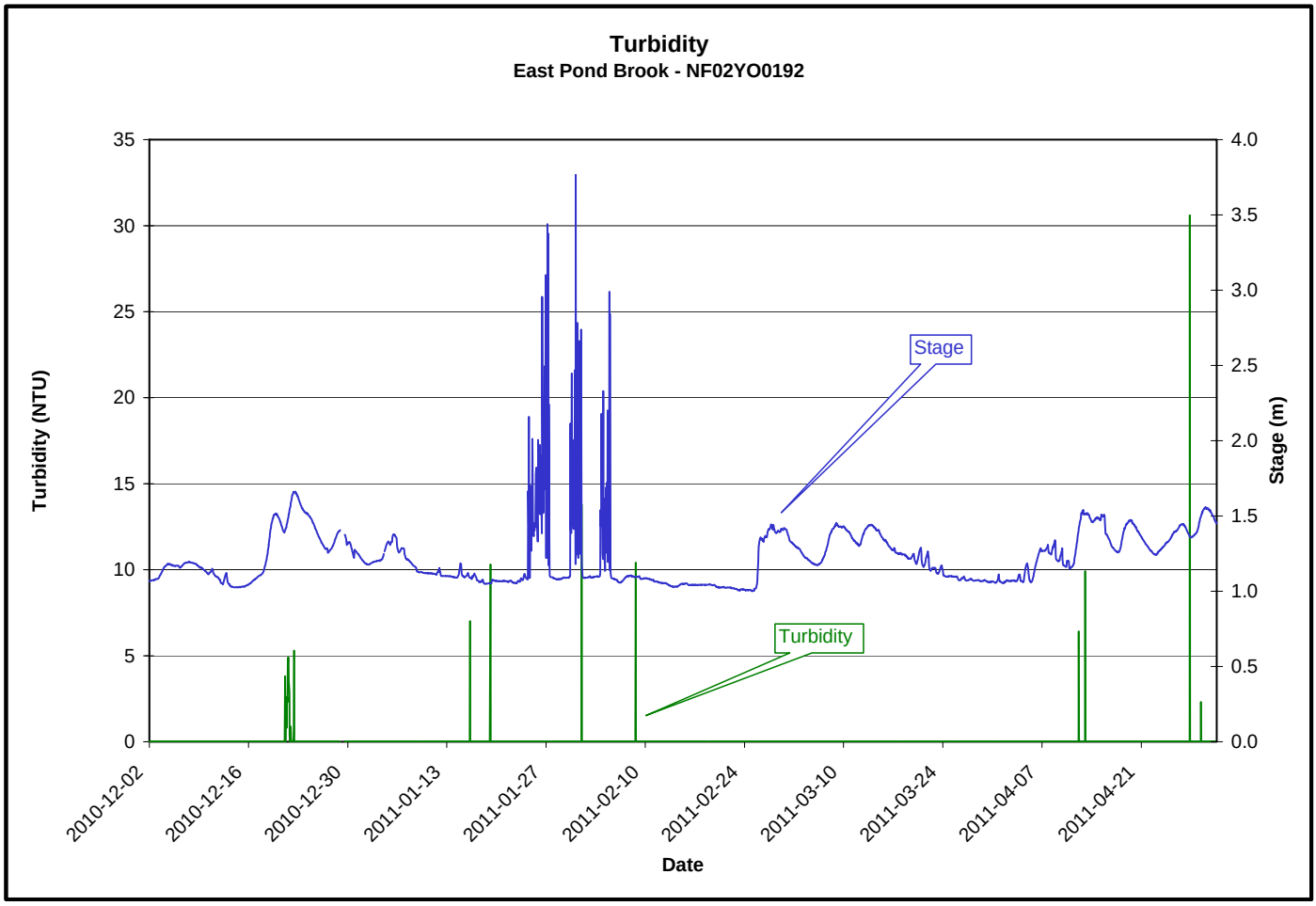

Figure 11

- The stage or water level ranged from a minimum of 1.00 m to a maximum of 3.77 m. The flow or discharge ranged from a minimum of 0.42 m^3/s to a maximum of 13.00 m^3/s **(Figure 12)**.
- The three very large peaks in late January and early February are likely the result of backwater effect caused by ice.
- Other peaks correspond to precipitation and spring snowmelt events.

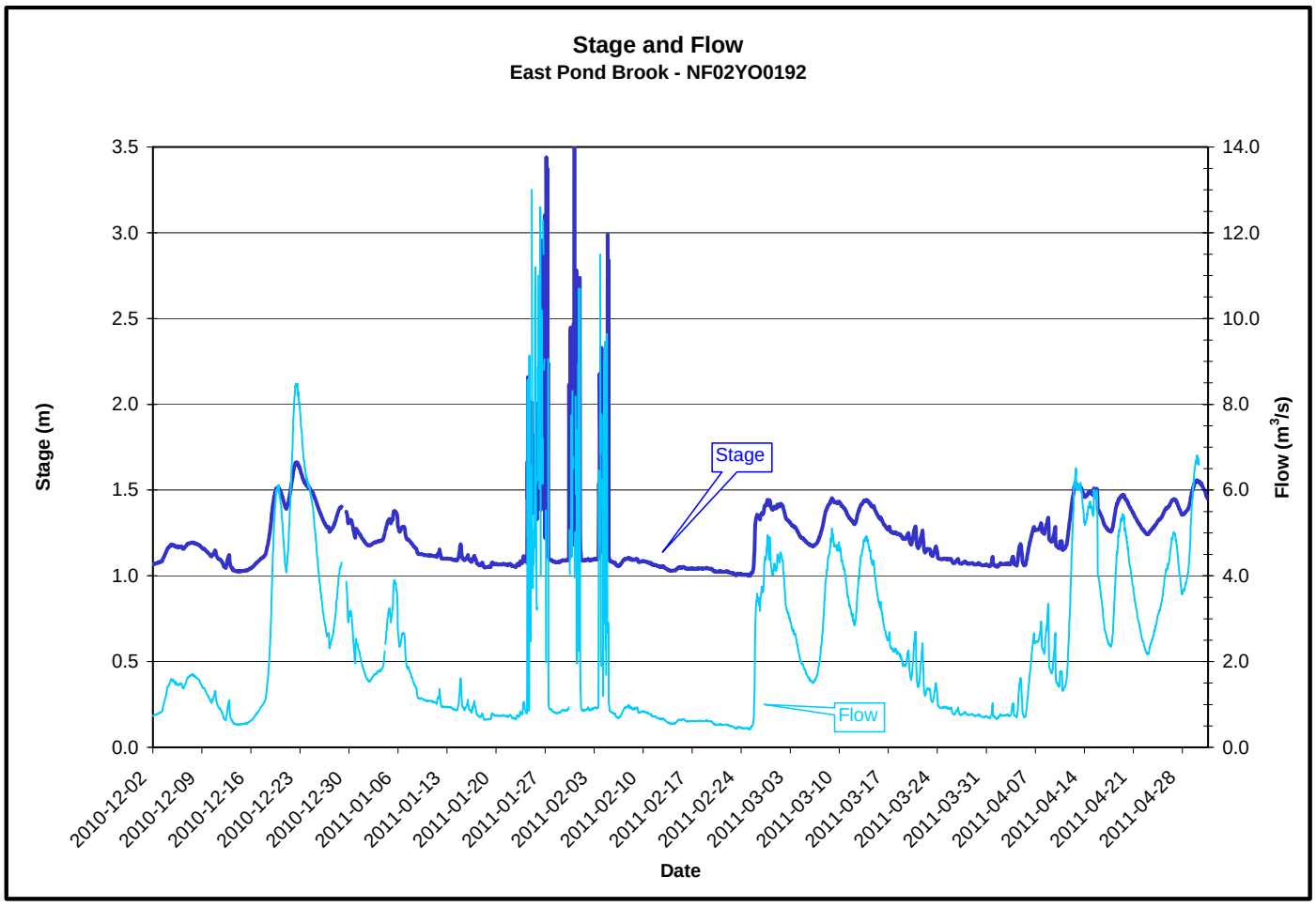

Figure 12

WELL AFTER TAILING DAM (MW1)

- The water temperature (**Figure 13**) ranged from a minimum of 5.35 ˚C to a maximum of 5.80 ˚C with a slight decrease over the deployment period.
- There appears to be little correlation with water elevation.

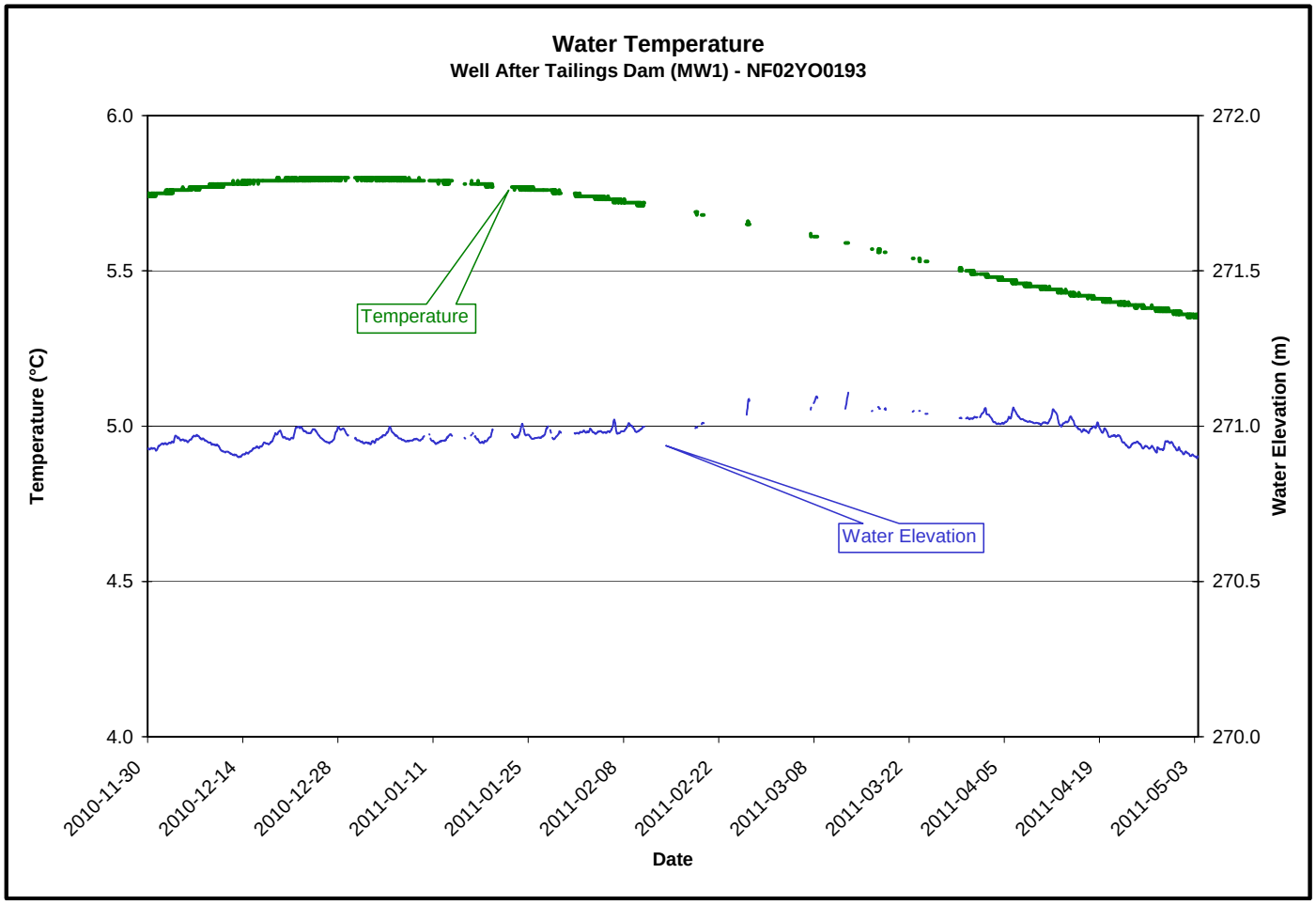

Figure 13

- The pH (**Figure 14**) ranged from a minimum of 8.37 to a maximum of 8.51 with little change over the deployment period.
- The pH sensor failed on March 7, 2011.

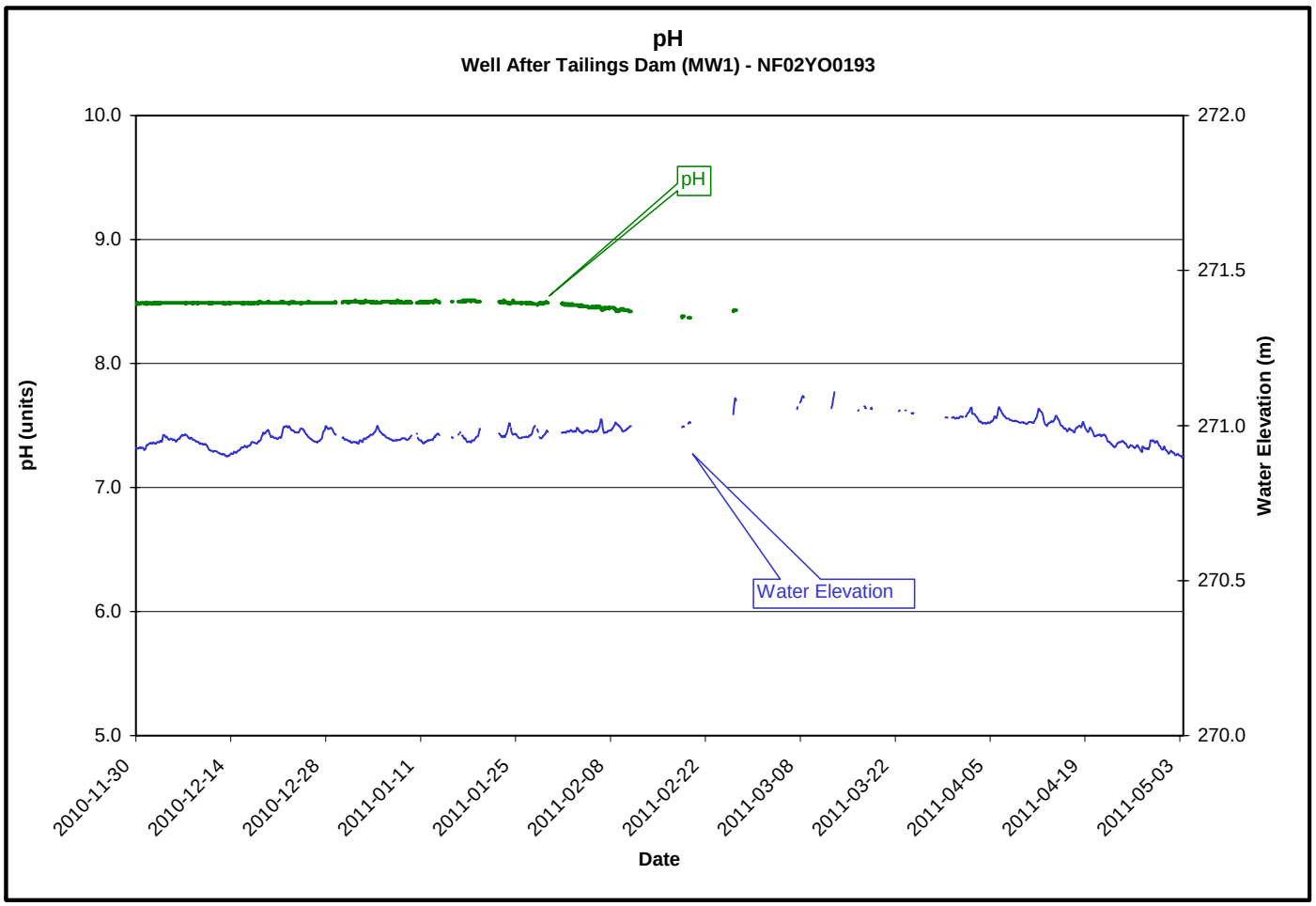

Figure 14

- The specific conductivity **(Figure 15)** ranged from a minimum of 0.526 mS/cm to a maximum of 0.600 mS/cm over the deployment period.
- There was a slight decrease on specific conductivity during the last month of deployment.

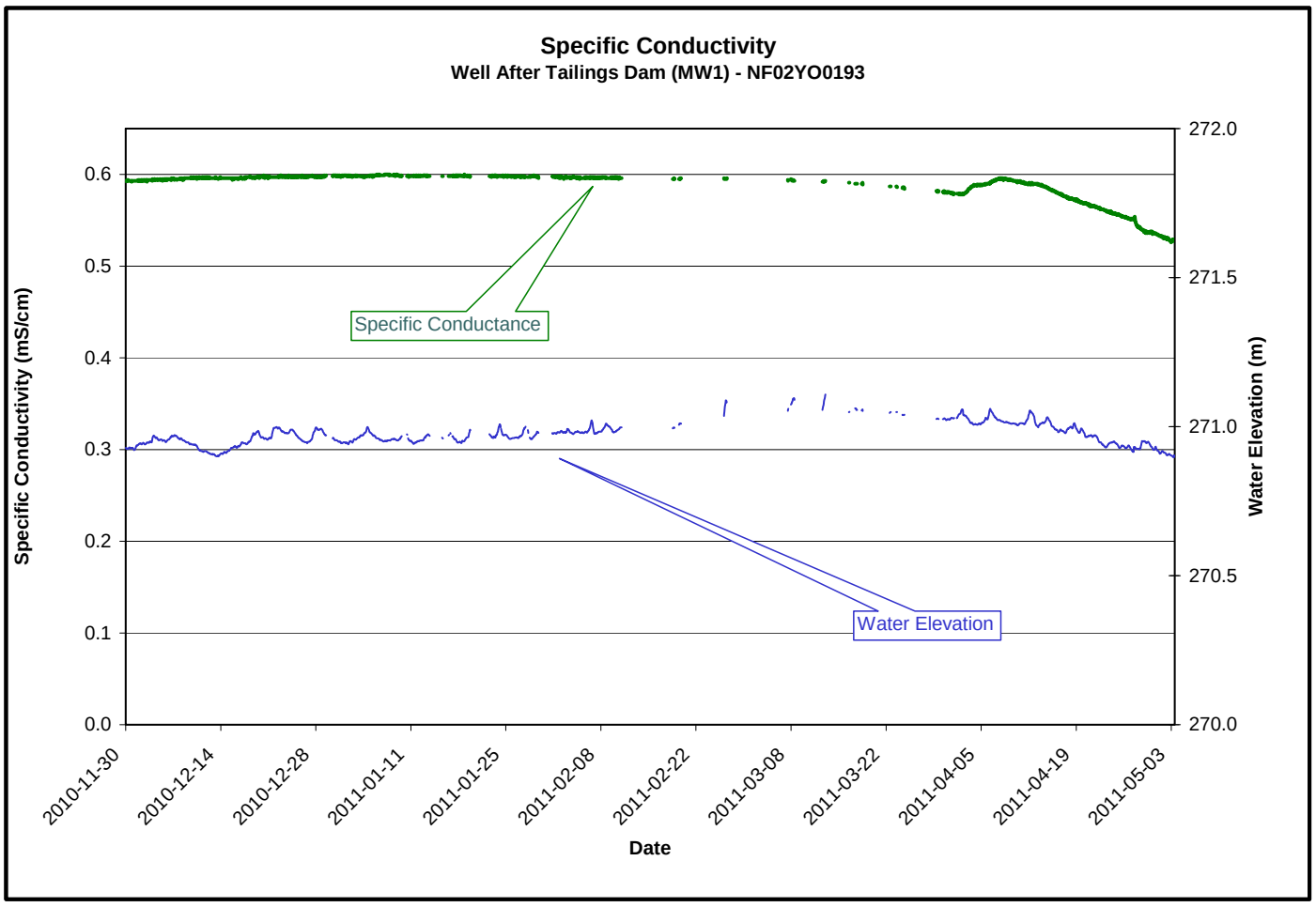

Figure 15

- The Water Elevation ranged from a minimum of 270.89 m to 271.11 m, with little change over the deployment period.
- It was noted that water was flowing from the outer (protective) well casing at the end of the deployment period.

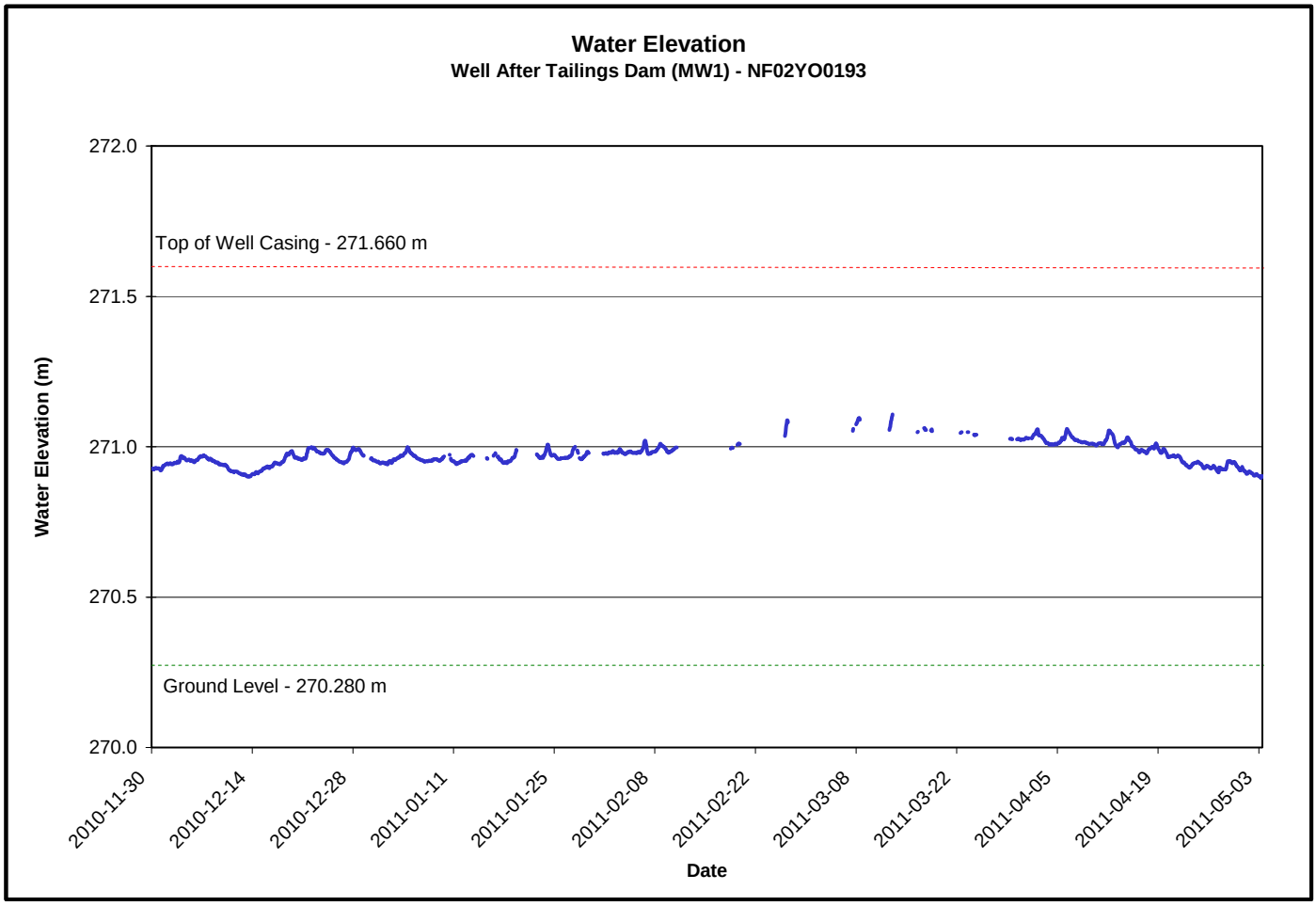

Figure 16

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