

Real Time Water Quality Report Teck Duck Pond Operations

Deployment Period 2011-11-03 to 2011-12-31

2012-01-04



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 on November 3, 2011, and remained deployed continuously until December 31, 2011, a 58 day period. Due to ice conditions in the streams, the instruments were not removed at the end of this period; they will remain deployed until the spring of 2012.
- The regular **Quanta G**® (s/n 00035) has remained deployed continuously in Monitoring Well After Tailings Dam Station (MW1) since September 7, 2011 and will remain deployed throughout the winter as this well is subject to freezing at surface. Data will be discussed only for the 58 day period covered by this report.

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**.

Parameter	Rank				
	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 of the deployment period is shown in **Table 2** for Tributary to Gill's Pond Brook and **Table 3** for East Pond Brook. As the instruments were not removed at the end of this period, no ranking can be calculated.
- 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. However, during this deployment period, no comparisons or rankings are possible.
- There is a brief period of missing data for East Pond Brook from 08:30 am on December 25, 2011 until 12:30 pm on December 26, 2011 due to data communications issues.
- The East Pond Brook Station experienced some problems whereby in-stream debris and icing conditions caused some interference with the Turbidity sensor. The erroneous data have been removed from the data set.
- 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
2011-11-03 Deployment	Temp (°C)	Good
	pH (units)	Good
	Sp. Conductivity (uS/cm)	Excellent
	Dissolved Oxygen (mg/L)	Excellent
	Turbidity (NTU)	Excellent
2011-12-31	Temp (°C)	n/a
	pH (units)	n/a
	Sp. Conductivity (uS/cm)	n/a
	Dissolved Oxygen (mg/L)	n/a
	Turbidity (NTU)	n/a

Table 2

East Pond Brook Station (NF02YO0192)		
Date (yyyy-mm-dd)	Parameter	Ranking
2011-11-03 Deployment	Temp (°C)	Excellent
	pH (units)	Excellent
	Sp. Conductivity (uS/cm)	Excellent
	Dissolved Oxygen (mg/L)	Excellent
	Turbidity (NTU)	Excellent
2011-12-31	Temp (°C)	n/a
	pH (units)	n/a
	Sp. Conductivity (uS/cm)	n/a
	Dissolved Oxygen (mg/L)	n/a
	Turbidity (NTU)	n/a

Table 3

Data Interpretation

TRIBUTARY TO GILLS POND BROOK

- The water temperature (**Figure 1**) ranged from a minimum of -0.45°C to a maximum of 7.11°C .
- Temperature generally decreased throughout the deployment period until December 9, 2011 after which they remained relatively stable near 0 degrees.
- There appears to be little correlation with stage.

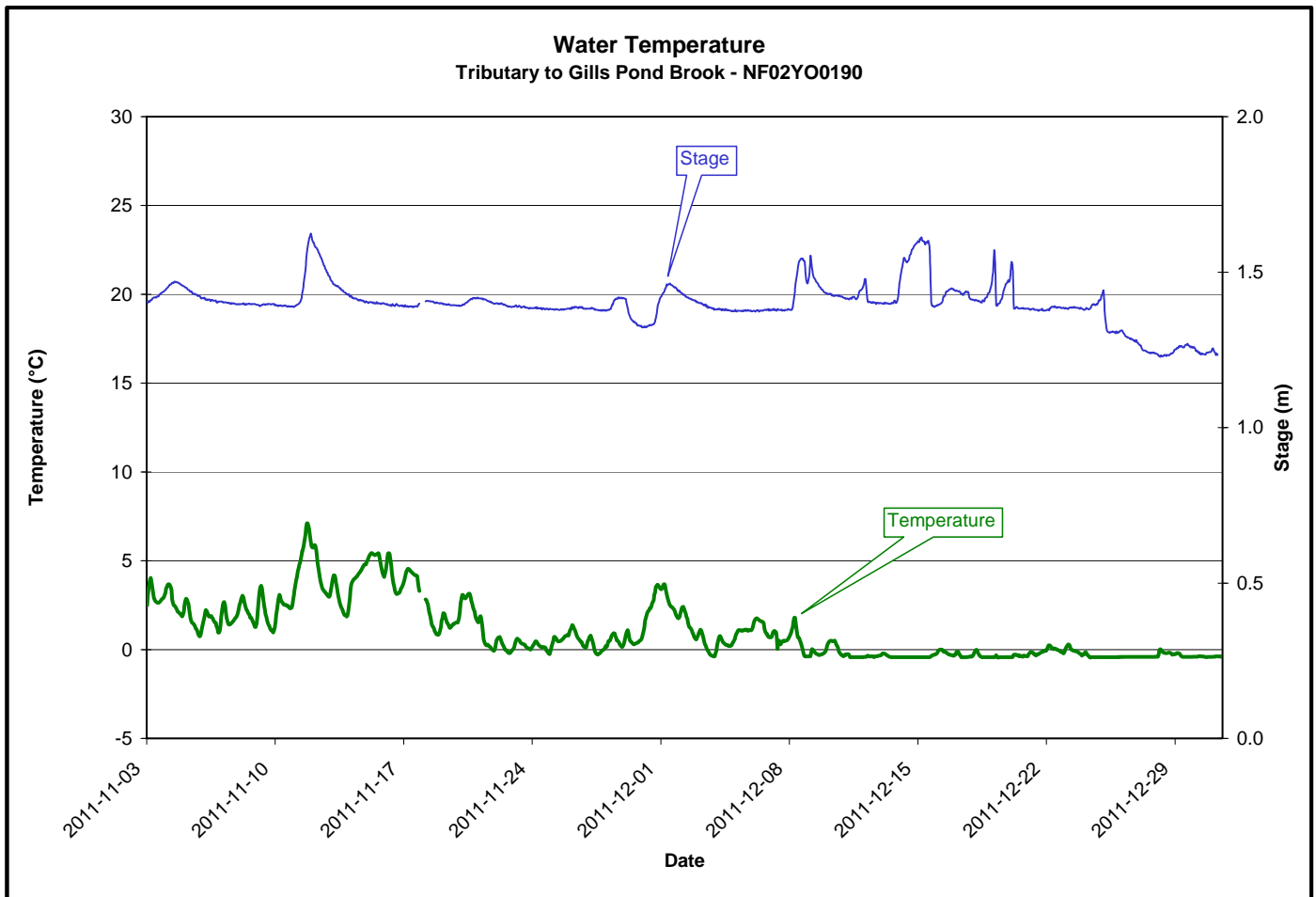
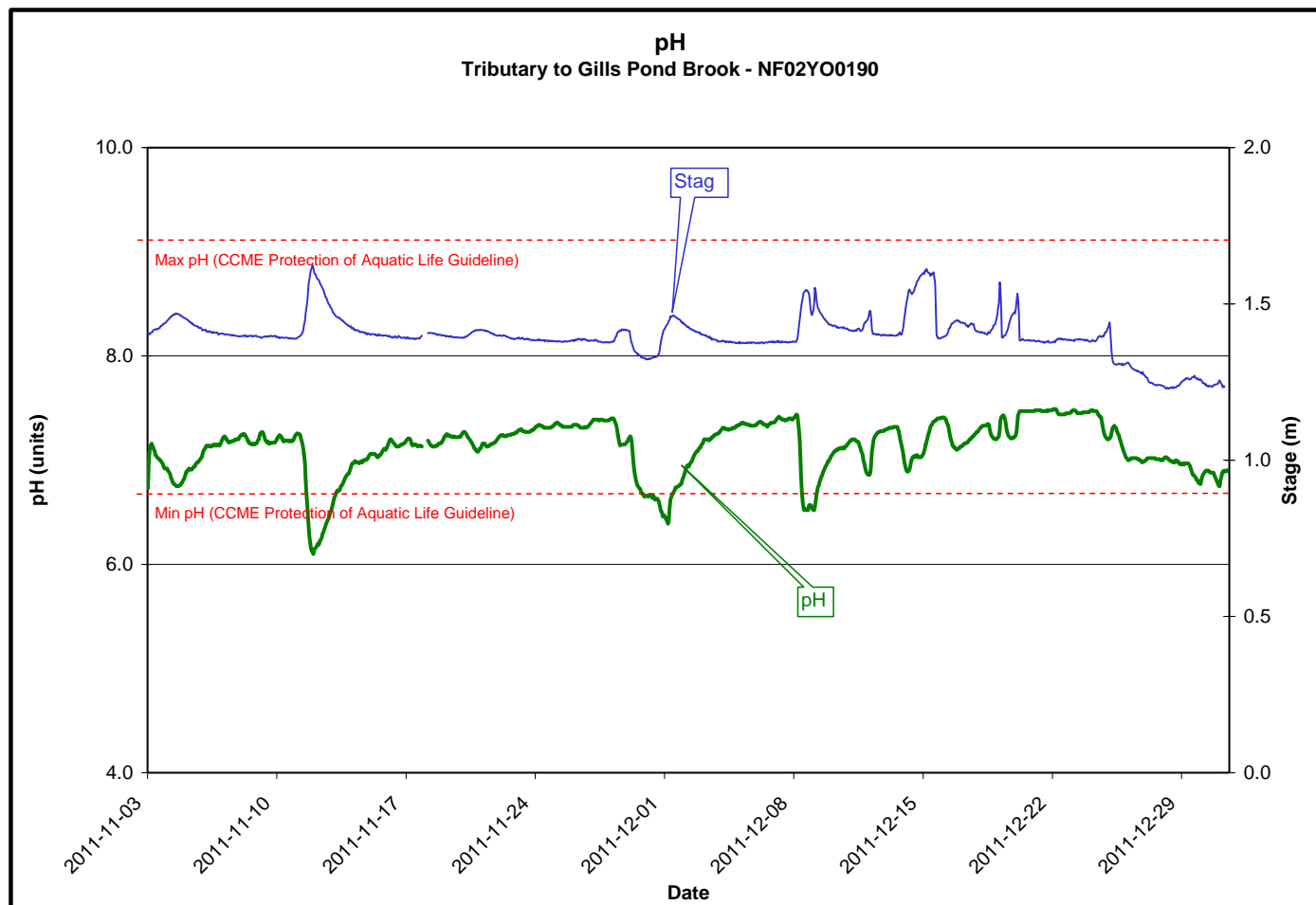
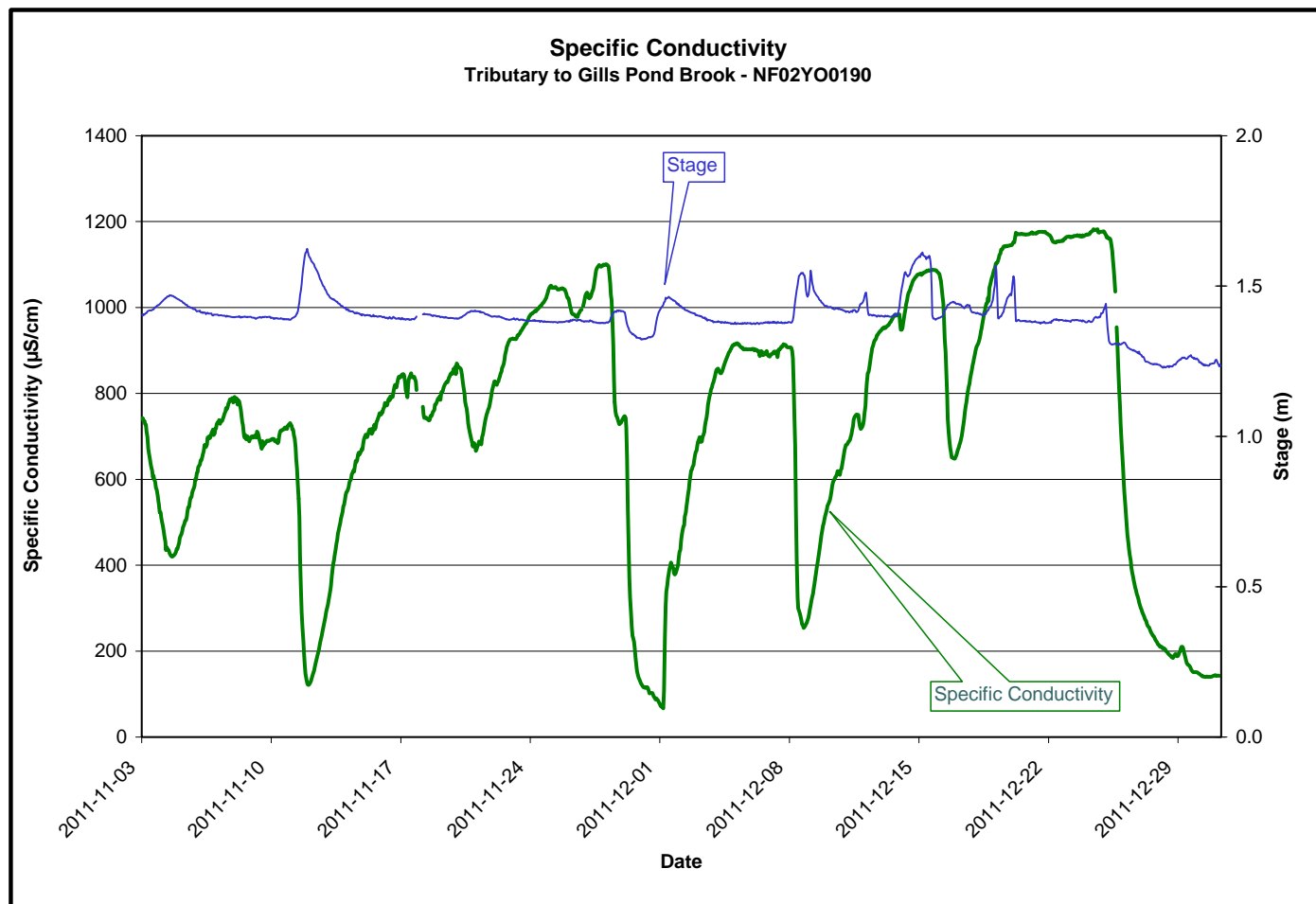


Figure 1

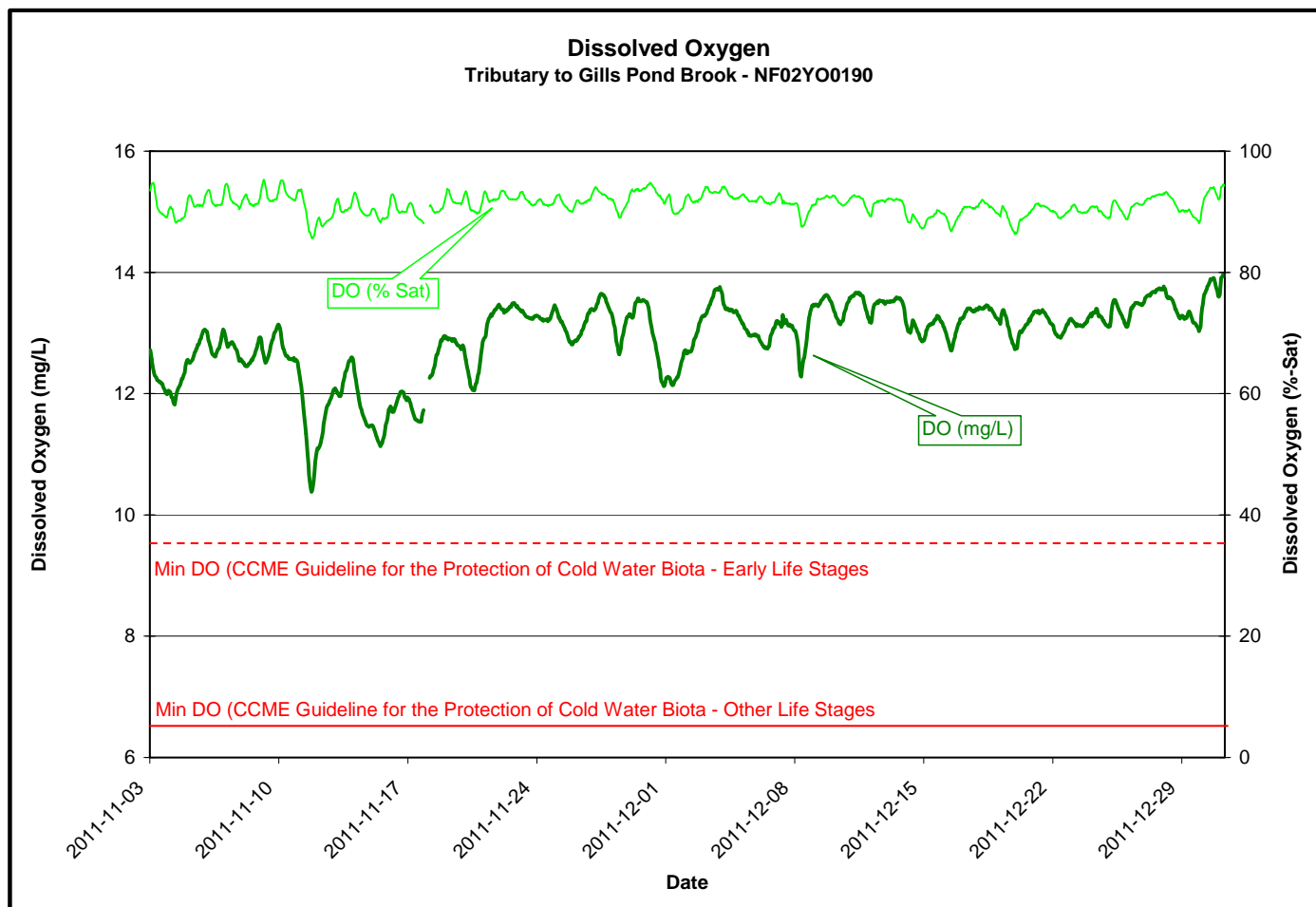
- Throughout the deployment period pH values (**Figure 2**) ranged from a minimum of 6.10 to a maximum of 7.49 with few of the values falling outside the recommended range (6.5 – 9.0) for the CCME *Canadian Water Quality Guidelines for the Protection of Aquatic Life*.
- An inverse relationship with stage is obvious during much of this deployment period.
- The background pH of this stream is normally around the lower limit of the recommended range.

**Figure 2**

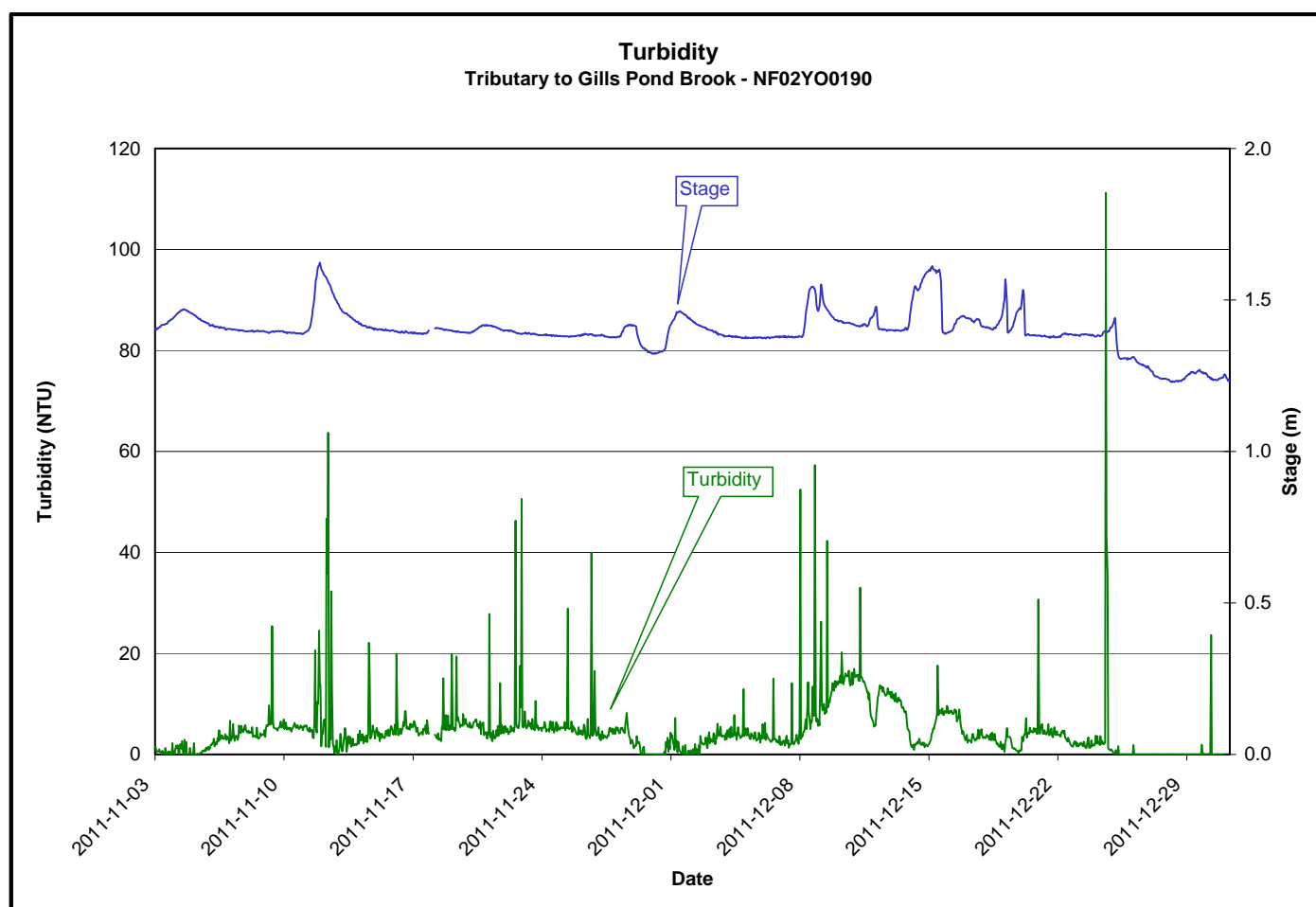
- The specific conductivity (**Figure 3**) ranged from a minimum of 66.5 $\mu\text{S}/\text{cm}$ to a maximum of 1182.0 $\mu\text{S}/\text{cm}$ over the deployment period.
- The highest specific conductance readings correspond with periods of discharge from the Polishing Pond.
- The 'V' shaped dips are the result of dilution caused by precipitation events, indicated by increases in the stage.

**Figure 3**

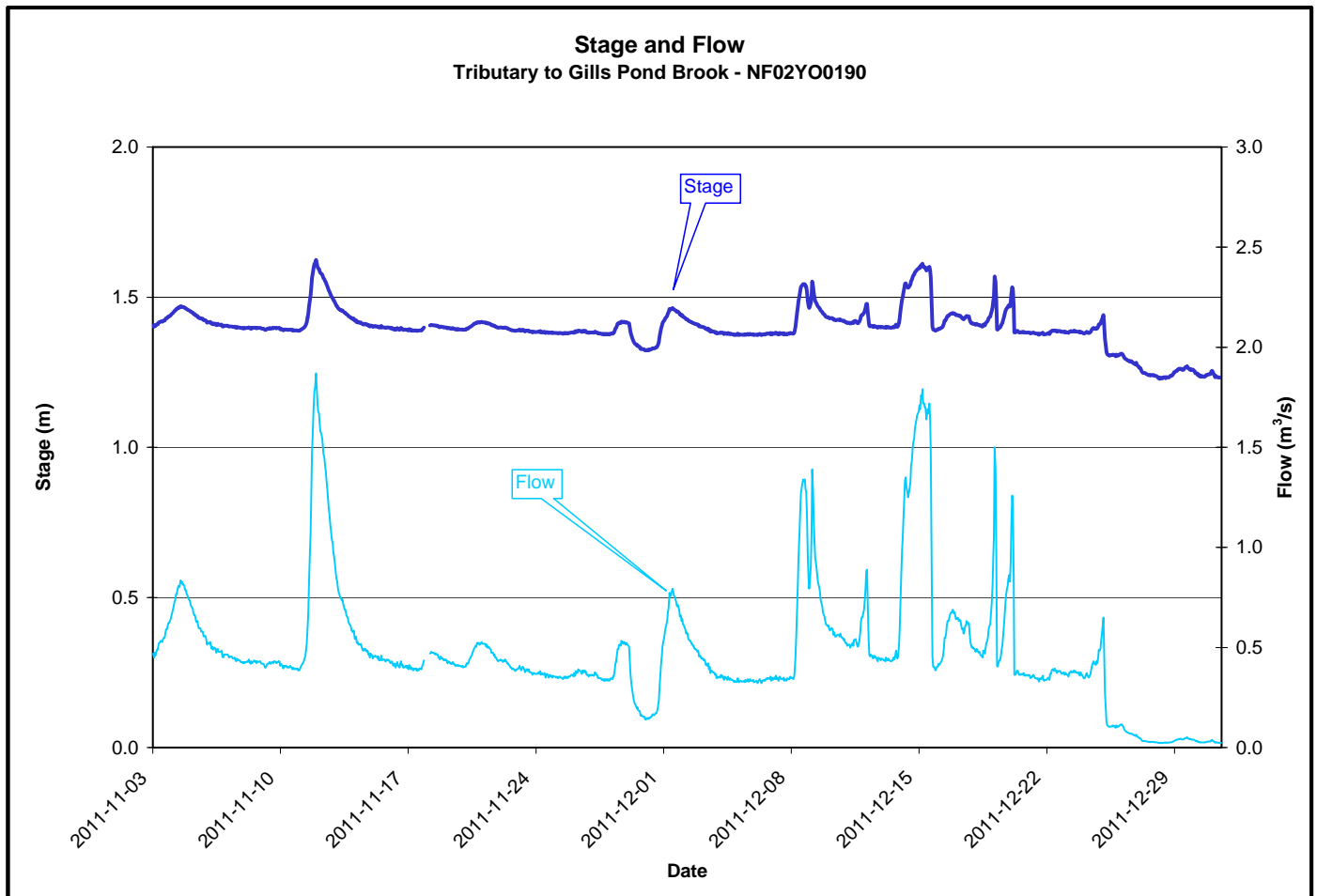
- The dissolved oxygen (**Figure 4**) values ranged from a minimum of 10.38 mg/L to a maximum of 13.96 mg/L over the deployment period, with the percent saturation ranging between 85.6 and 95.3.
- Dissolved oxygen is generally inversely proportional to water temperature.
- All of the dissolved oxygen 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 accurate.

**Figure 4**

- The turbidity values (**Figure 5**) ranged from a minimum of 0.0 NTU to a maximum of 111.2 NTU.
- The highest turbidity spikes are correlated with increases in stage which are the result of heavy precipitation / runoff events.
- During this deployment period, turbidity was seldom measured to be at or near zero until after discharge from Polishing Pond ceased on December 25, 2011. On November 21, 2011 a grab sample collected by Teck staff reported turbidity values of 7.7 NTU. On November 22, 2011 a site visit was conducted to investigate turbidity levels. In situ and QA/QC instrument readings were 5.7 NTU and 4.0 NTU respectively, which is consistent with the reported values. The water in this stream was observed to be slightly turbid.
- Based upon previous investigation, it has been determined that turbidity values may be artificially increased due to air entrainment during higher flows.
- The higher turbidity spikes likely correspond to natural in-stream debris and/or air bubbles from turbulent flow passing over the sensor.

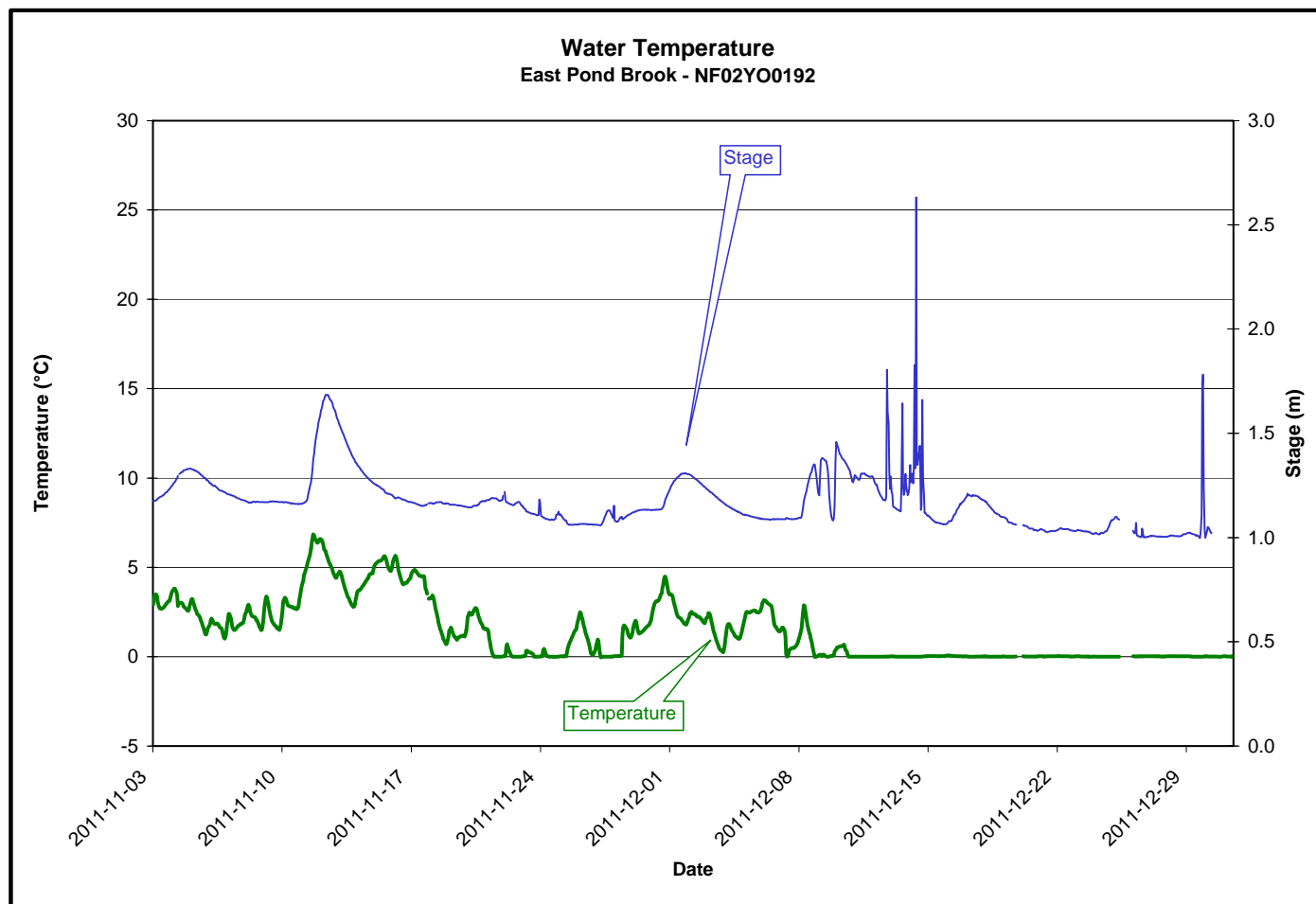
**Figure 5**

- The stage or water level ranged from a minimum of 1.23 m to a maximum of 1.62 m. The flow or discharge ranged from a minimum of 0.02 m³/s to a maximum of 1.87 m³/s (**Figure 6**).
- The higher levels correspond to periods of discharge from Polishing Pond, while the peaks correspond to precipitation events.
- Cessation of discharge from Polishing Pond on December 25, 2011 is obvious on the graph.
- All values are within the normal range.

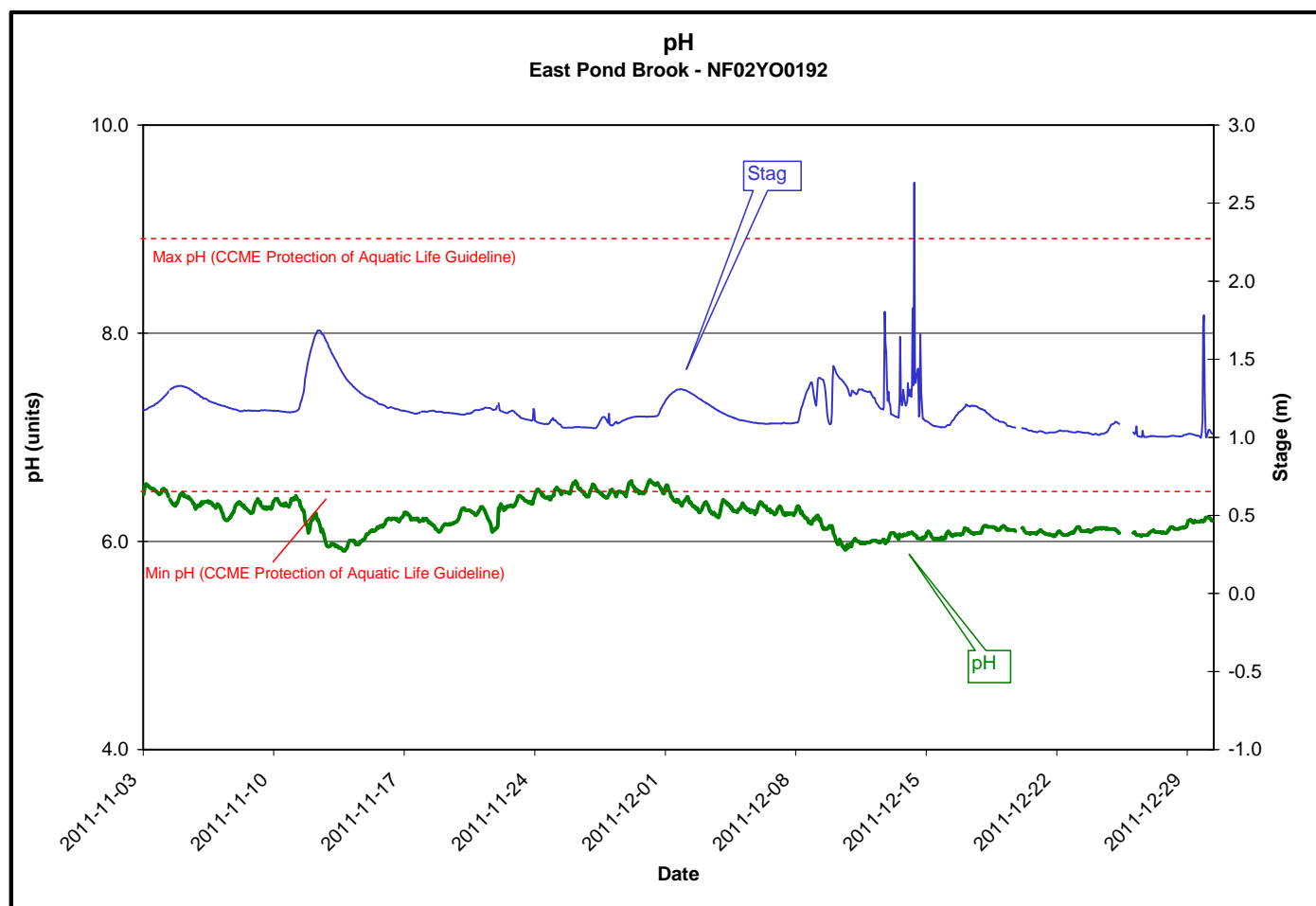
**Figure 6**

EAST POND BROOK

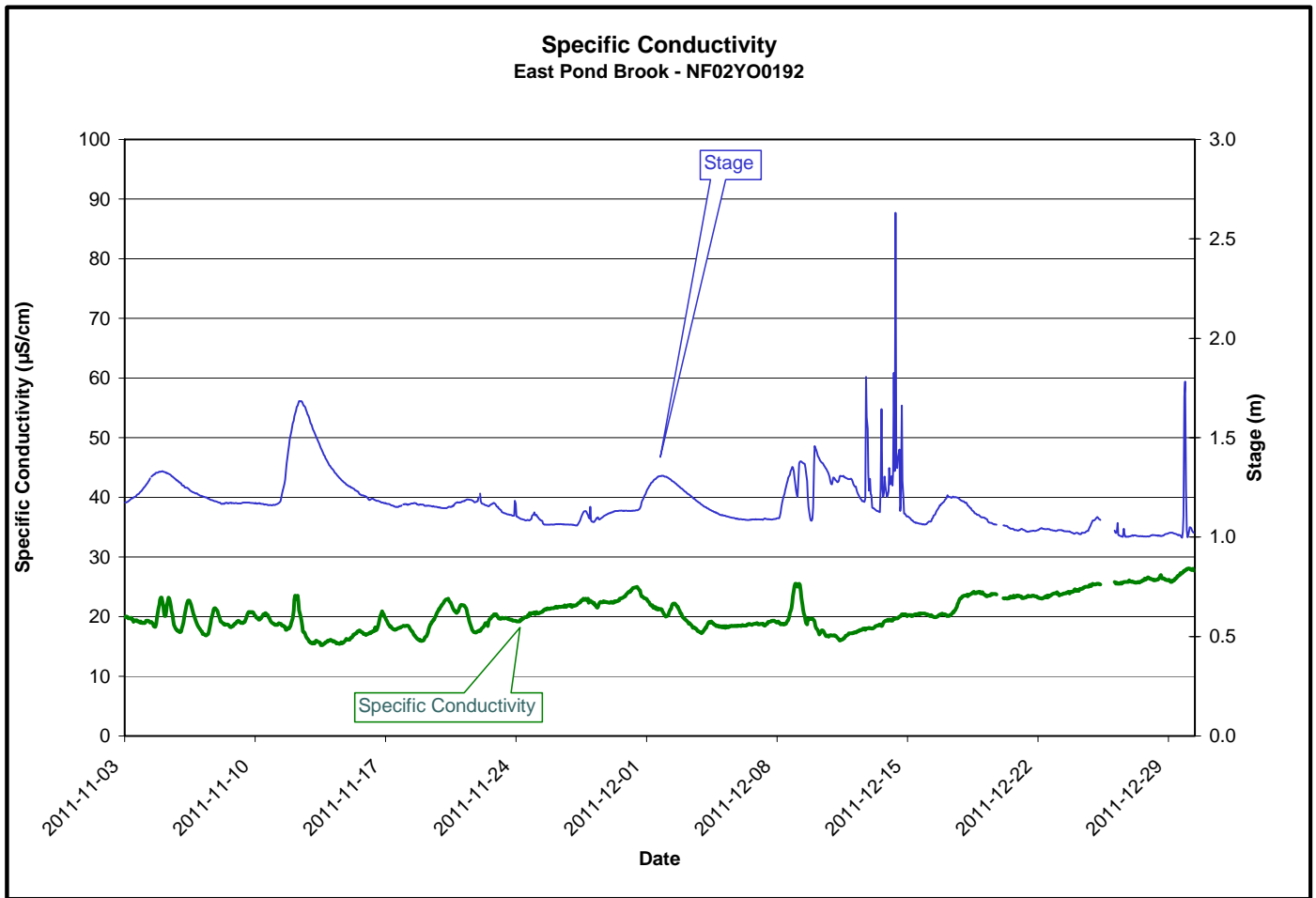
- The water temperature (**Figure 7**) ranged from a minimum of - 0.04 °C to a maximum of 6.85 °C.
- Temperatures generally decreased throughout the deployment period, until December 11, 2011 after which they remained stable near 0 degrees.
- There appears to be little correlation with stage, although 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 5.91 to a maximum of 6.59 with pH remaining fairly constant throughout the deployment period.
- There is a temporary decrease on pH corresponding with peak flows.
- For most of the deployment period, pH values fell 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.

**Figure 8**

- The specific conductivity (**Figure 9**) ranged from a minimum of 15.2 $\mu\text{S}/\text{cm}$ to a maximum of 28.1 $\mu\text{S}/\text{cm}$, with a slight increase over the deployment period.
- There are small increases in specific conductivity corresponding with peak flows.
- All values are within the normal range.

**Figure 9**

- The dissolved oxygen (**Figure 10**) values ranged from a minimum of 10.94 mg/L to a maximum of 13.89 mg/L over the deployment period, with the percent saturation ranging between 87.6 and 95.0.
- Dissolved oxygen is inversely proportional to water temperature.
- Throughout the deployment period, all 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 accurate.

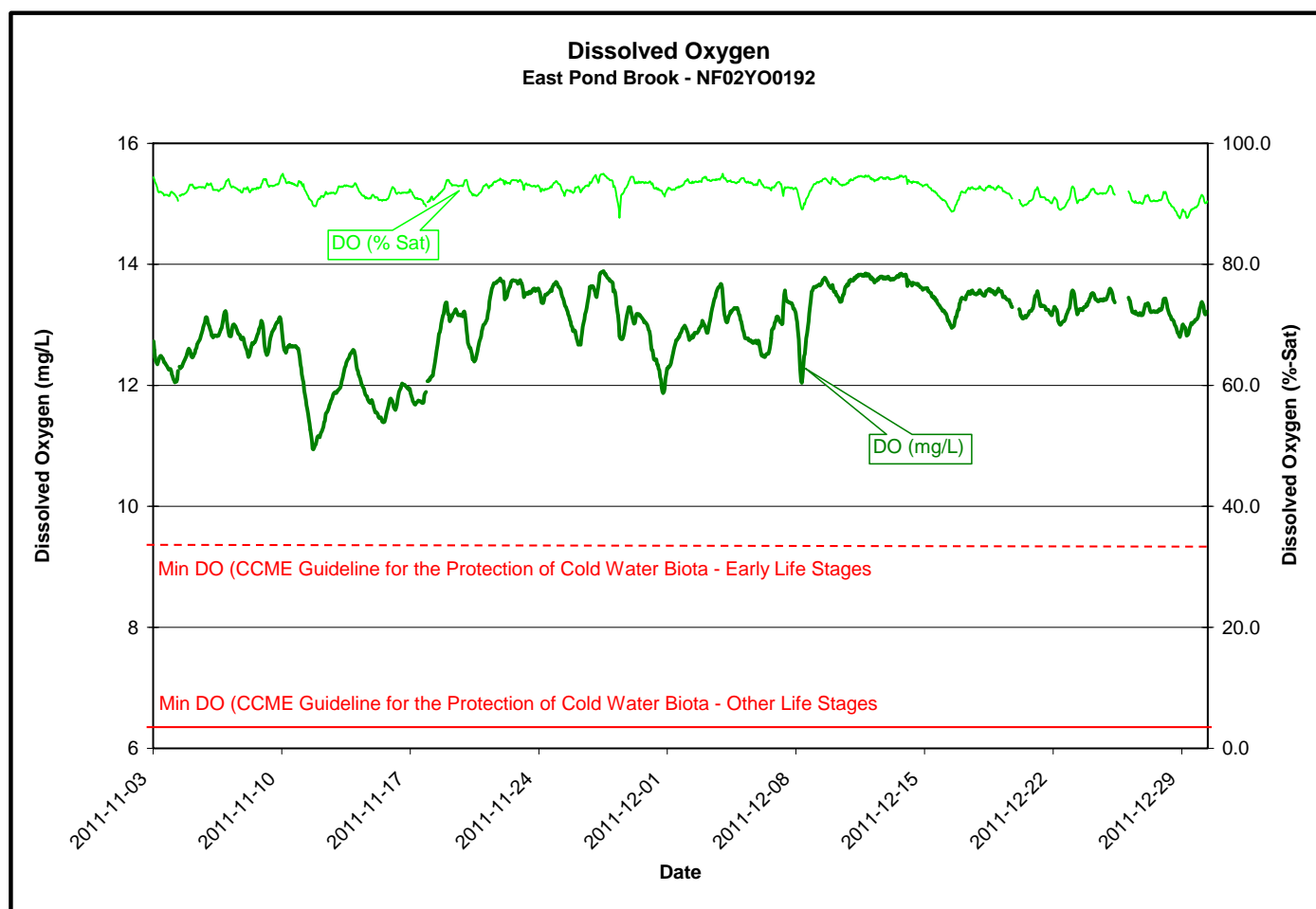
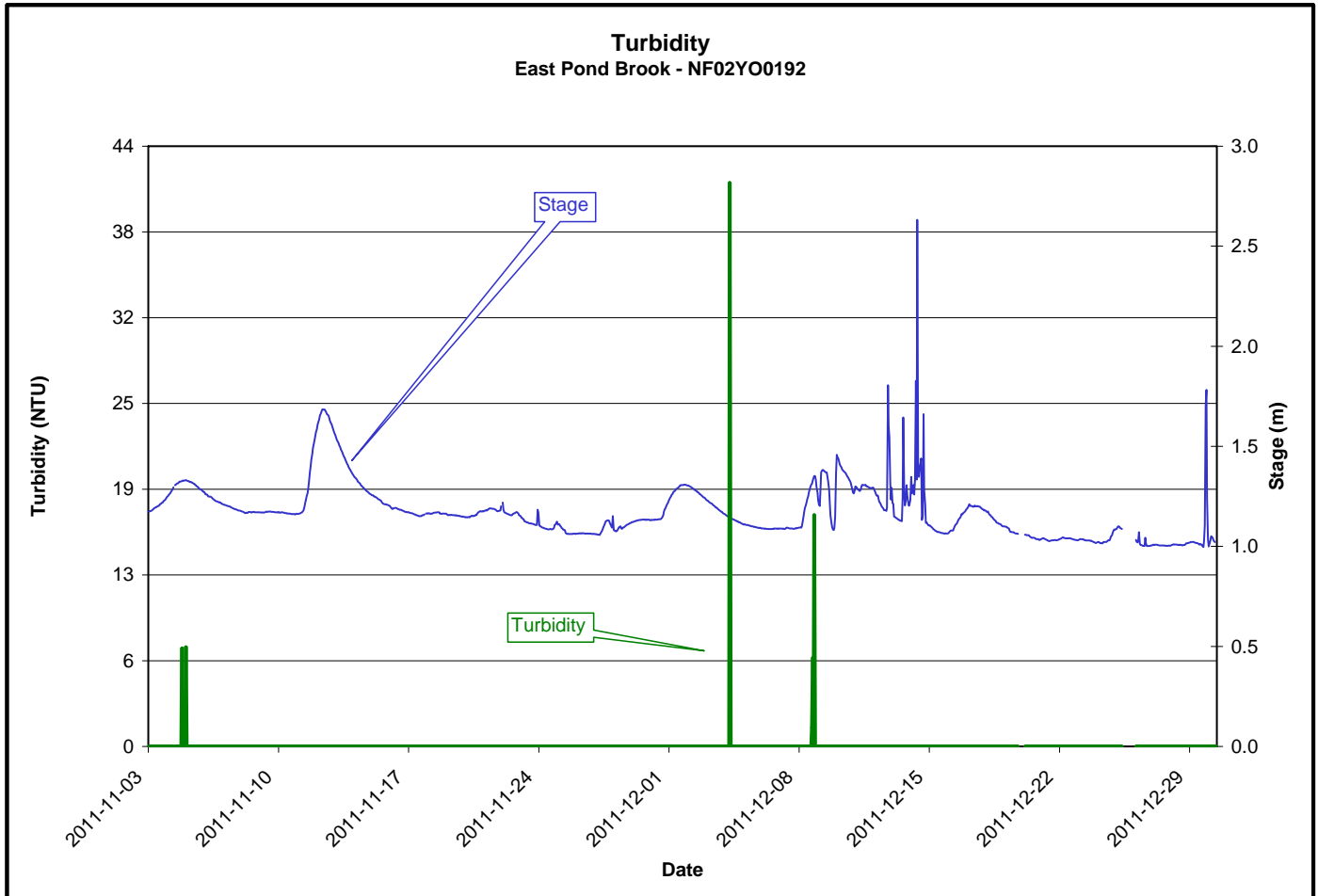
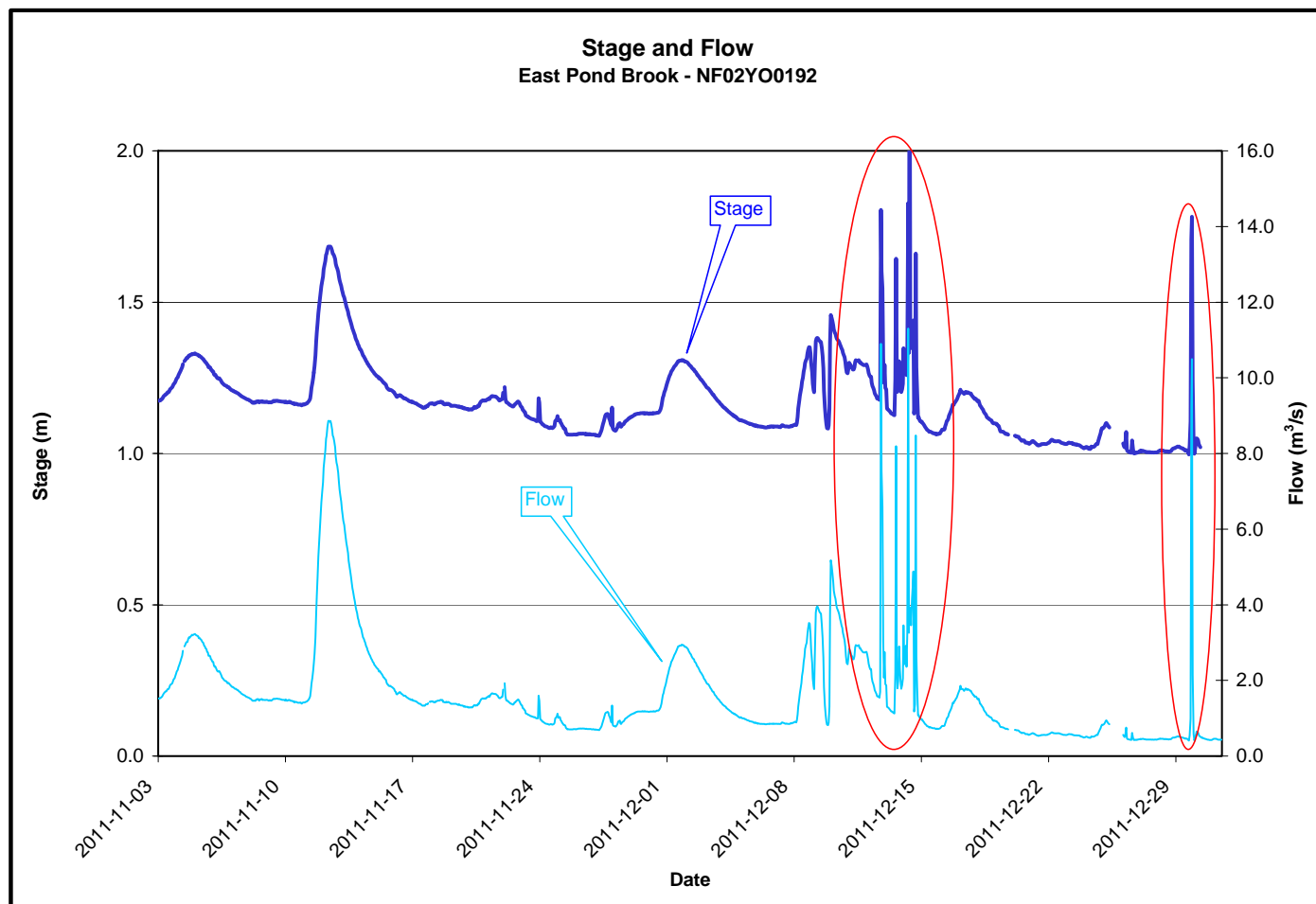


Figure 10

- The turbidity values (**Figure 11**) ranged from a minimum of 0.0 NTU to a maximum of 41.4 NTU.
- This station experienced some problems whereby in-stream debris and icing conditions caused some interference with the Turbidity sensor. The erroneous data have been removed from the data set.
- Turbidity values in this stream are typically near zero; the peaks typically 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.

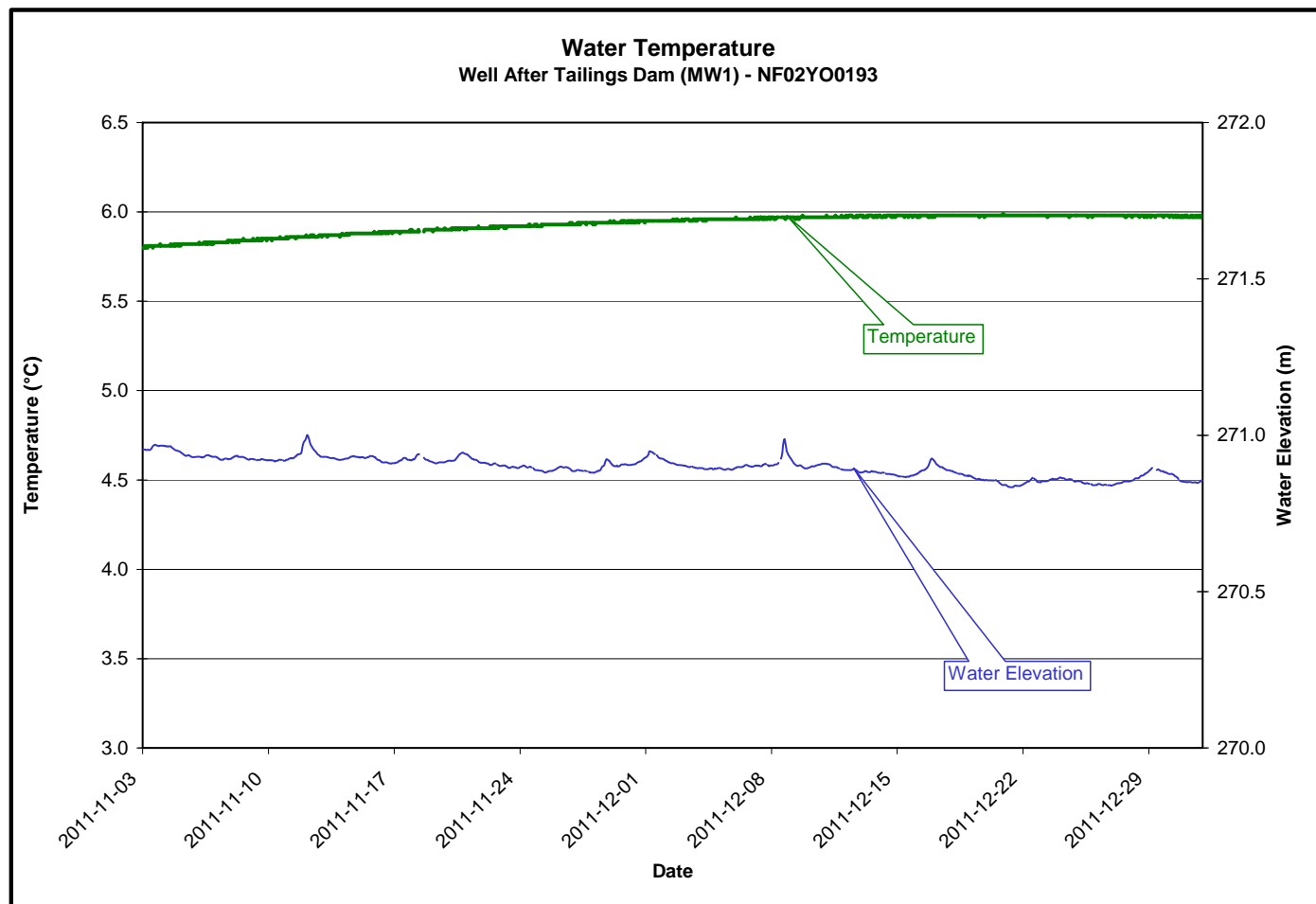
**Figure 11**

- The stage or water level ranged from a minimum of 1.00 m to a maximum of 2.63 m. The flow or discharge ranged from a minimum of 0.41 m³/s to a maximum of 11.30 m³/s (**Figure 12**).
- The stage and flow peaked rapidly in both mid and late December as indicated in the red ellipses. Based on the hydrograph's response, it is likely that this is a backwater effect caused by ice build-up in the stream.
- Peaks are the result of precipitation/runoff events.
- Both stage and flow are within normal ranges.

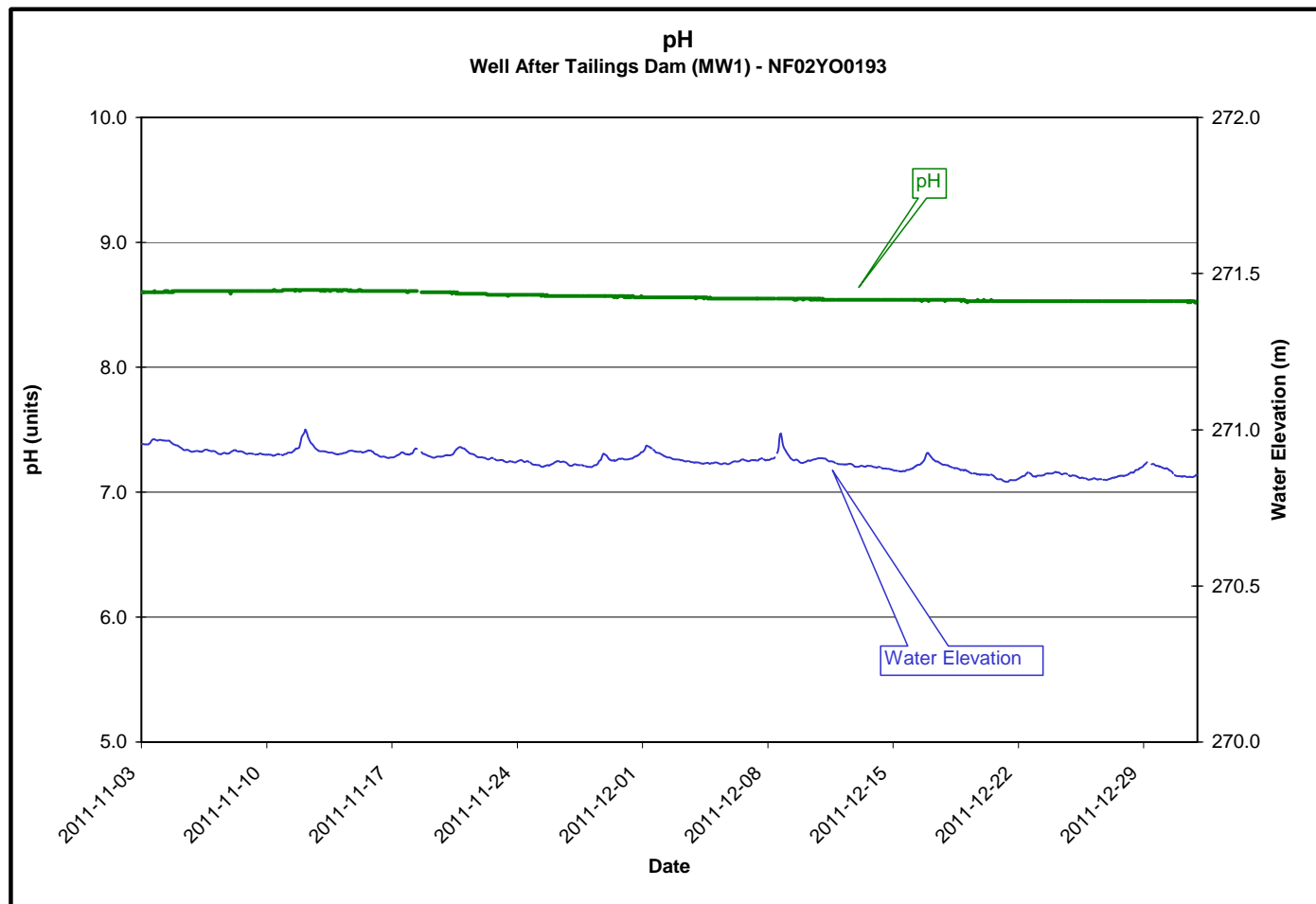
**Figure 12**

WELL AFTER TAILING DAM (MW1)

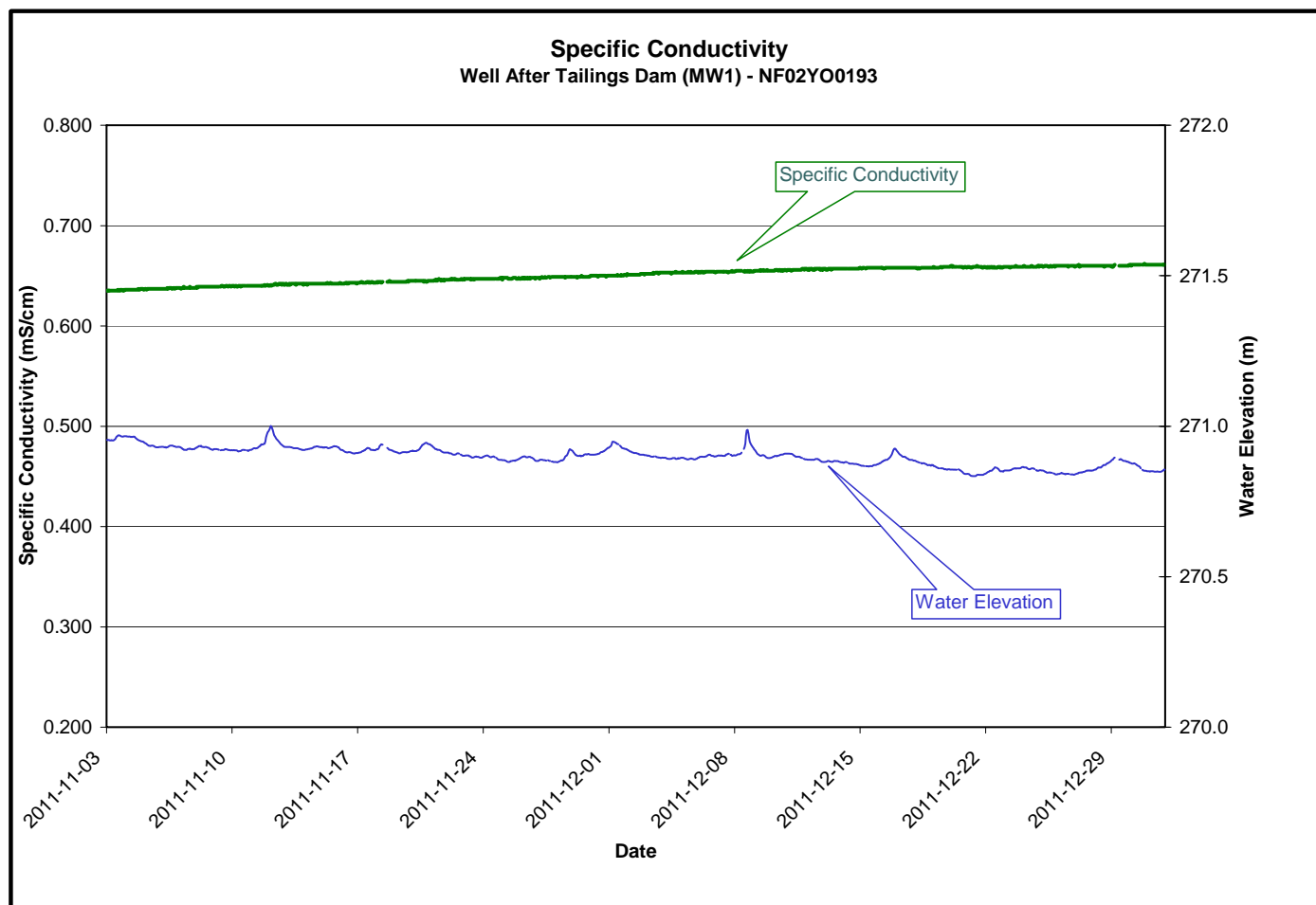
- The water temperature (**Figure 13**) ranged from a minimum of 5.80 °C to a maximum of 5.99 °C with a slight increase over the deployment period.
- There appears to be little correlation with water elevation.

**Figure 13**

- The pH (**Figure 14**) ranged from a minimum of 8.52 to a maximum of 8.62, with a slight decrease over the deployment period.
- There does not appear to be any correlation with water elevation.

**Figure 14**

- The specific conductivity (**Figure 15**) ranged from a minimum of 0.640 mS/cm to a maximum of 0.662 mS/cm over the deployment period.
- There was a slight increase in the specific conductivity during the reporting period.

**Figure 15**

- The Water Elevation (**Figure 16**) ranged from a minimum of 270.83 m to a maximum of 271.00 m. with a slight decrease over the reporting period.
- Water elevation in this well corresponds to increased water level in an adjacent stream, and is influenced by runoff from precipitation.

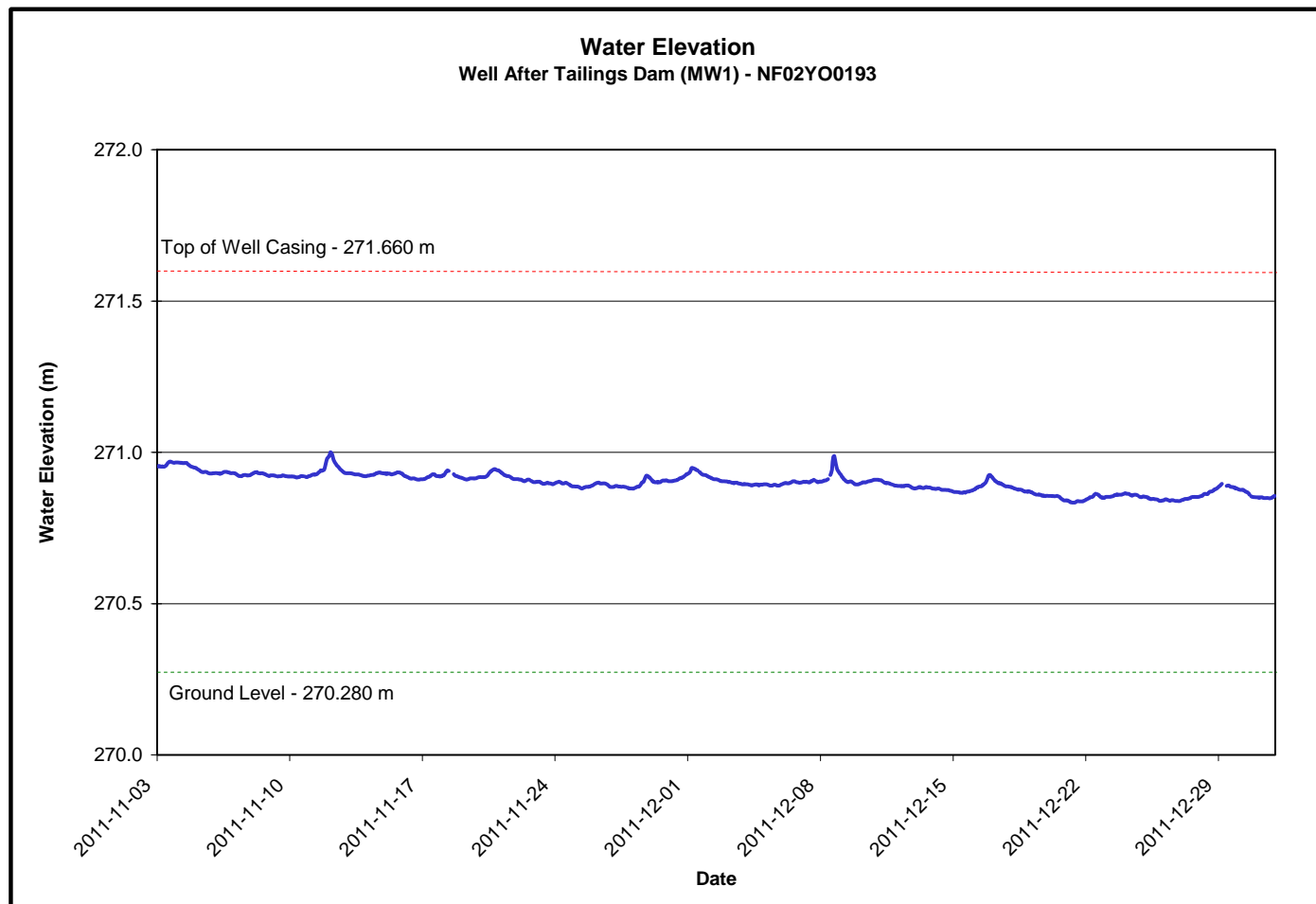


Figure 16

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