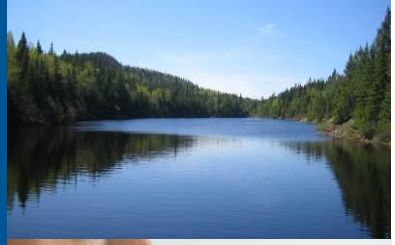




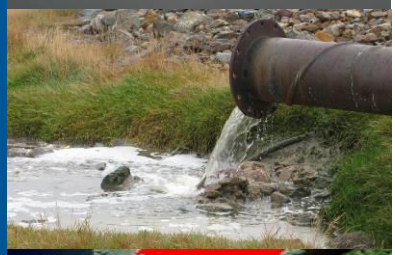


Real Time Water Quality Report
Teck Duck Pond Operations

Deployment Period 2015-01-01 to 2015-05-26

2015-06-23

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) continuously from January 19, 2015 until May 23, 2015. Volume of discharge over this period was quite variable.

Maintenance and Calibration of Instrumentation

- **DataSonde®**(s/n 43245) was deployed in Tributary to Gills Pond Brook on November 21, 2014 after being cleaned and freshly calibrated, and remained deployed continuously until May 25, 2015. This report covers the 144 day period from January 1, 2015 until the instrument was removed on May 25, 2015.
- **DataSonde®**(s/n 43794) was deployed in East Pond Brook on November 21, 2014 after being cleaned and freshly calibrated, and remained deployed continuously until May 25, 2015. This report covers the 144 day period from January 1, 2015 until the instrument was removed on May 25, 2015.
- **MiniSonde®** (s/n 47591) was used for QA/QC purposes during the installation of the instruments. This unit, having the same technical specifications as the **DataSondes®**, was cleaned and freshly calibrated prior to each use.
- **Quanta G®** (s/n 00035) was deployed on November 19, 2014 after being freshly cleaned and calibrated and remained deployed continuously in Monitoring Well After Tailings Dam Station (MW1) until after this reporting period. This reporting period covers from January 1, 2015 until May 26, 2015; 145 days.

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 usually 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 end of the deployment period is shown in **Table 2** for Tributary to Gill's Pond Brook, and **Table 3** for East Pond Brook. No ranking could be calculated at the beginning of this reporting period, as the units were deployed prior to this reporting period.
- For Tributary to Gills Pond Brook a 'Marginal' ranking for Specific Conductivity was calculated upon removal of the instrument. The over-winter deployed Sonde recorded 43.7 µS/cm, while the QA/QC Sonde recorded 36.5 µS/cm, a difference of 7.2 µS/cm.
- Due to issues with data logging and transmission, satellite transmitted data for Monitoring Well After Tailings Dam Station (MW1) were not available for intermittent periods from January 7, 2015 until February 3, 2015. From February 3, 2015 until April 21, 2015 there was absolutely no data transmitted from this station. Unfortunately, there is no back-up data source for this station. This is been a recurring problem with this station, despite repeated efforts to affect a permanent remedy. It regularly happens during the coldest months of the winter and rectifies automatically once weather conditions improve.
- 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 Conductivity based upon live data and laboratory data.
- No ranking is available for this reporting period, as the **Quanta G®** was deployed in the well prior to the beginning of this period, and remained deployed following the end of this reporting period.
- 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**
2015-05-25 Removal	Temp (^{o}C)	Good
	pH (units)	Good
	Sp. Conductivity (µS/cm)	Marginal
	Dissolved Oxygen (mg/L)	Good
	Turbidity (NTU)	Excellent

Table 2

East Pond Brook Station (NF02YO0192)		
Date (yyyy-mm-dd)	**Parameter**	**Ranking**
2015-05-25 Removal	Temp (^{o}C)	Excellent
	pH (units)	Excellent
	Sp. Conductivity (µS/cm)	Excellent
	Dissolved Oxygen (mg/L)	Good
	Turbidity (NTU)	Excellent

Table 3

Data Interpretation

TRIBUTARY TO GILLS POND BROOK

- The water temperature (**Figure 1**) ranged from a minimum of -0.39˚C to a maximum of 17.11˚C.
- Water temperatures rose to typical levels towards the end of the deployment period.
- There does not appear to be any correlation with stage during this deployment period.

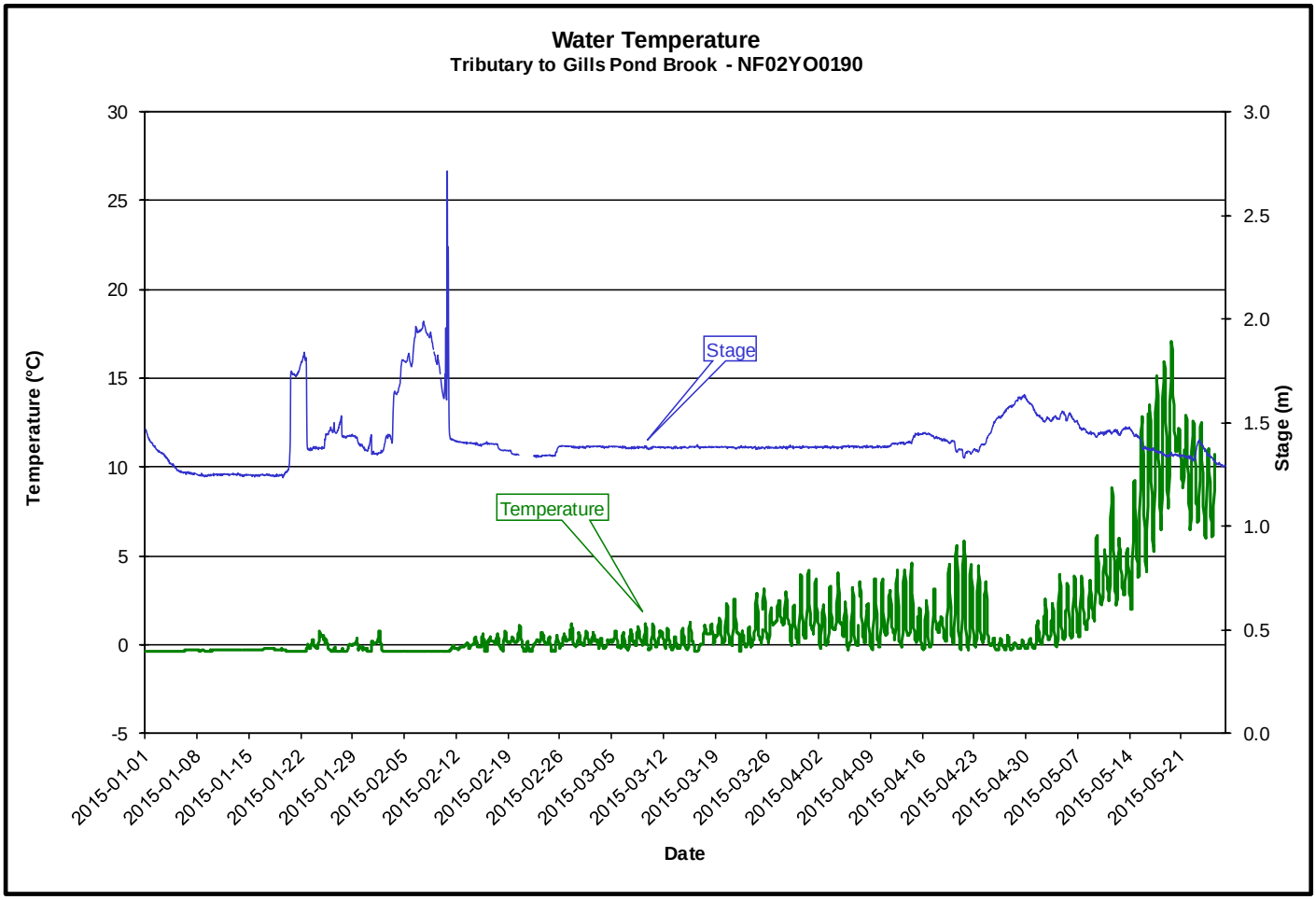

Figure 1

- Throughout the deployment period, pH values (**Figure 2**) ranged from a minimum of 5.80 to a maximum of 7.15.
- During this deployment period pH remained just above or below the recommended range (6.5 – 9.0) for the CCME *Canadian Water Quality Guidelines for the Protection of Aquatic Life*. There was discharge of treated effluent from Polishing Pond for nearly all of the deployment period.
- An inverse relationship with stage is obvious throughout the deployment period.

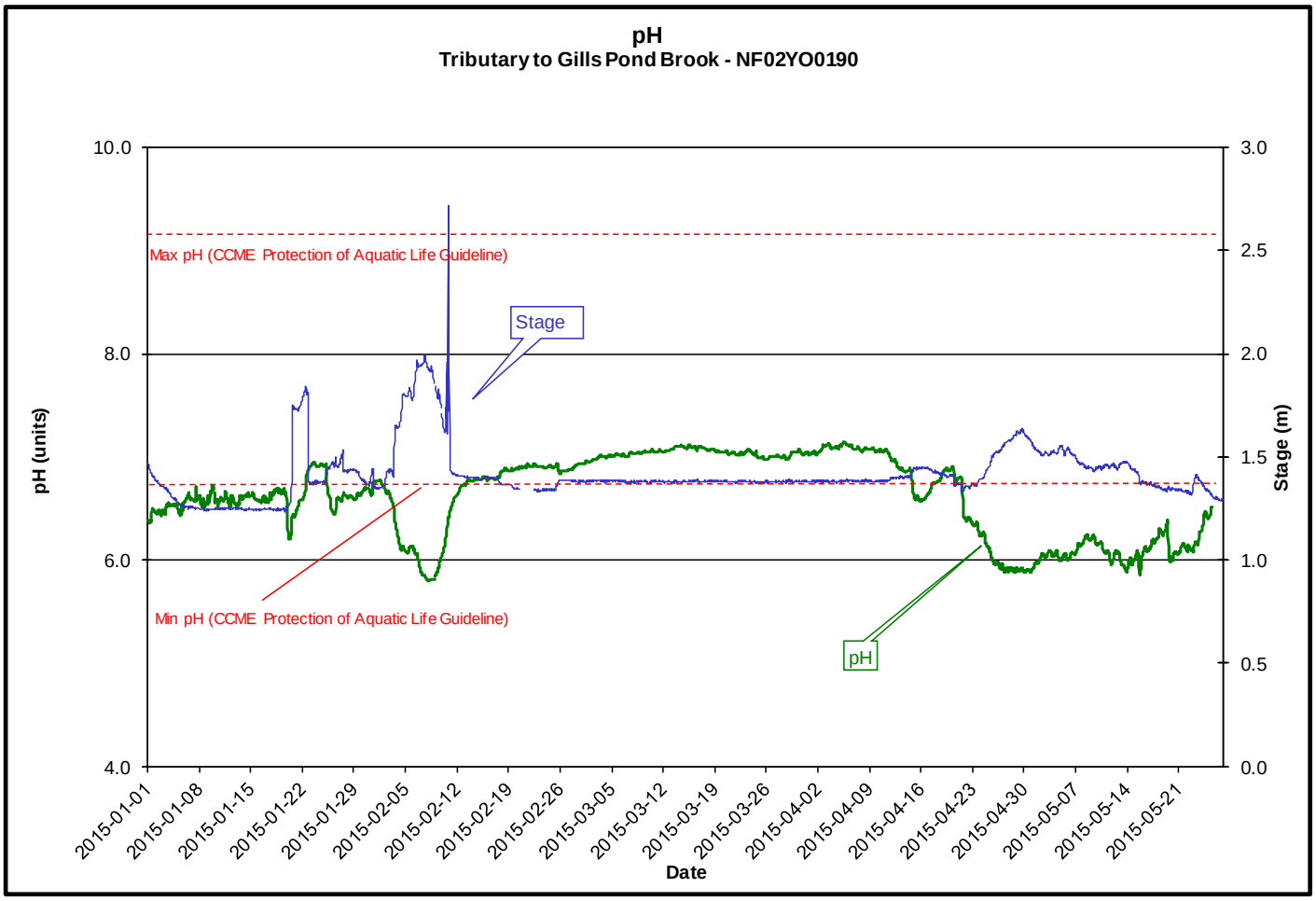

Figure 2

- The specific conductivity **(Figure 3)** ranged from a minimum of 42.5 µS/cm to a maximum of 1755.0 µS/cm over the deployment period.
- There was discharge of treated effluent from Polishing Pond for nearly all of the deployment period.
- The onset of discharge on January 19, 2015 is quite obvious.
- Other episodic dips in specific conductance are the result of the 'dilution effect' caused by precipitation and runoff events, and reduced volumes of discharge.

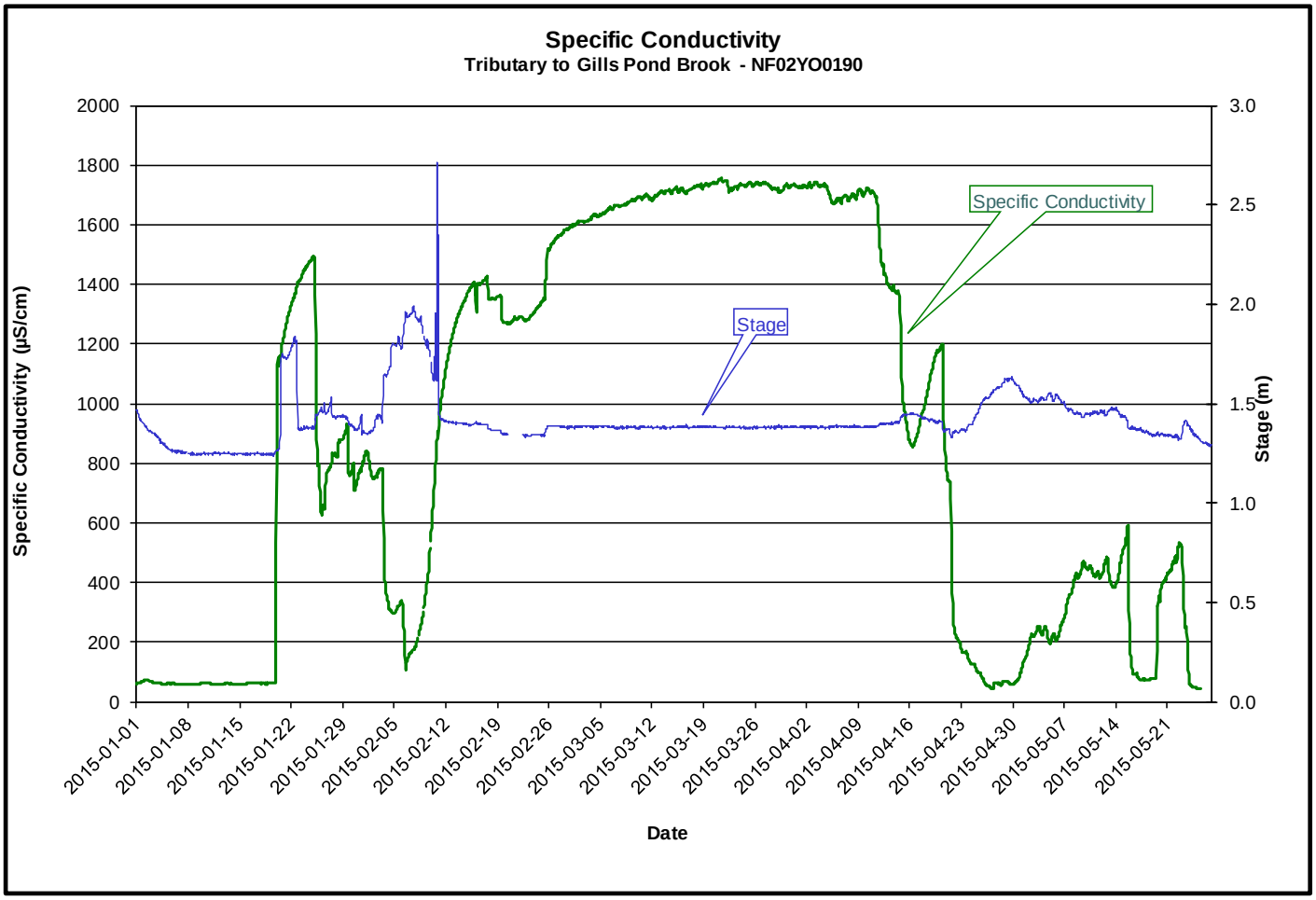

Figure 3

- The dissolved oxygen (**Figure 4**) values ranged from a minimum of 8.77 mg/L to a maximum of 13.50 mg/L over the deployment period, with the percent saturation ranging between 77.4 and 94.7.
- Dissolved oxygen (mg/L) decreased towards the end of the deployment period, inversely proportional to the increase in water temperature (see **Figure 1**).
- Apart from a few days towards the end of the deployment period, all of the dissolved oxygen values fell above the minimum for Early Life Stages (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). This range is typical based upon water temperatures.
- Based upon the fact that dissolved oxygen % saturation had minimal and predictable change over the deployment period, we can be confident that the dissolved oxygen mg/L values are accurate.

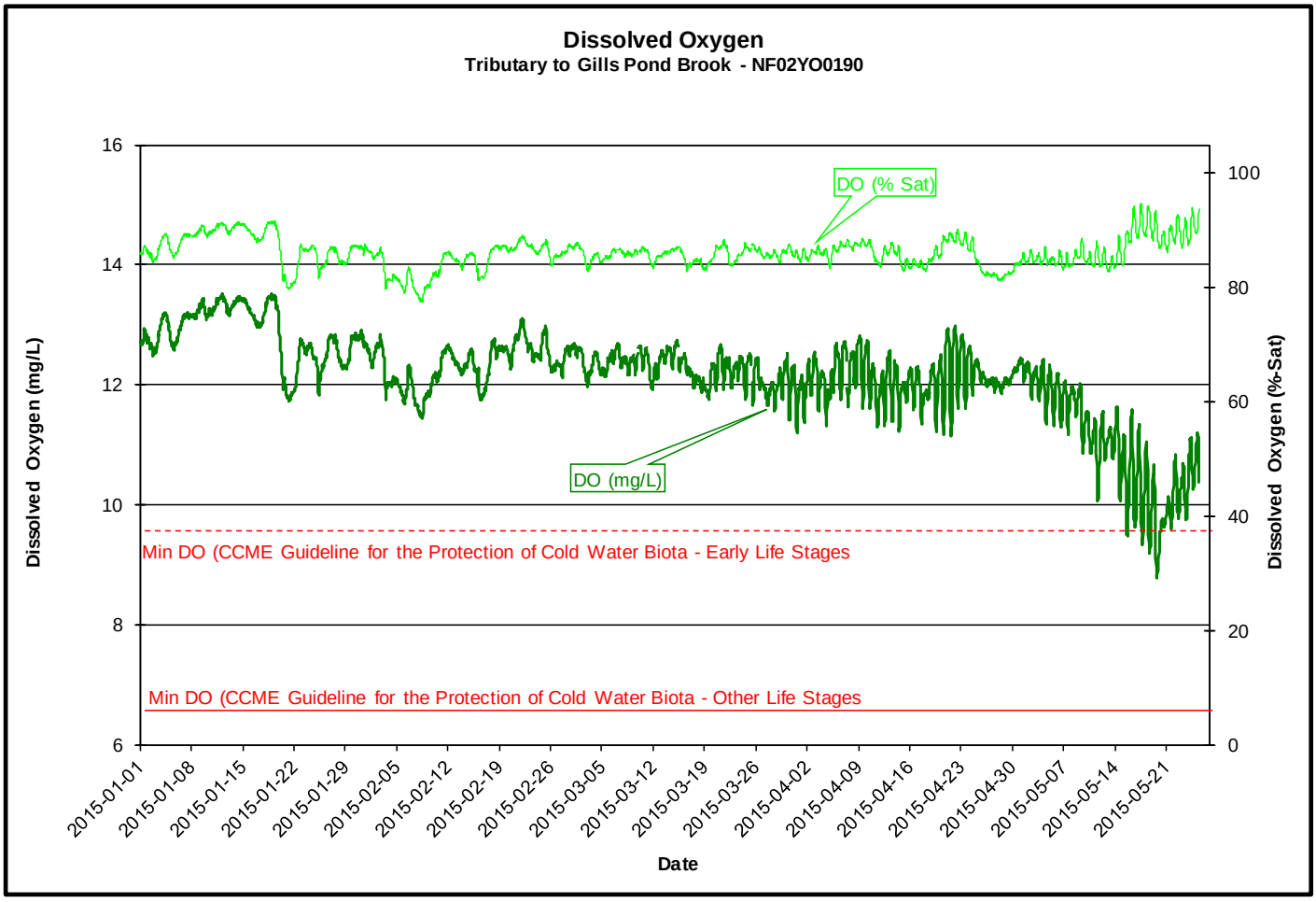

Figure 4

- The turbidity values **(Figure 5)** ranged from a minimum of 0.0 NTU to a maximum of 21.1 NTU.
- Minor and unsustained spikes in turbidity happened throughout the deployment period. The minor spikes are typical.
- Around the last few days of April, there was a sustained increase in turbidity over several hours. This increase corresponded with increased flows of the spring snow melt period.

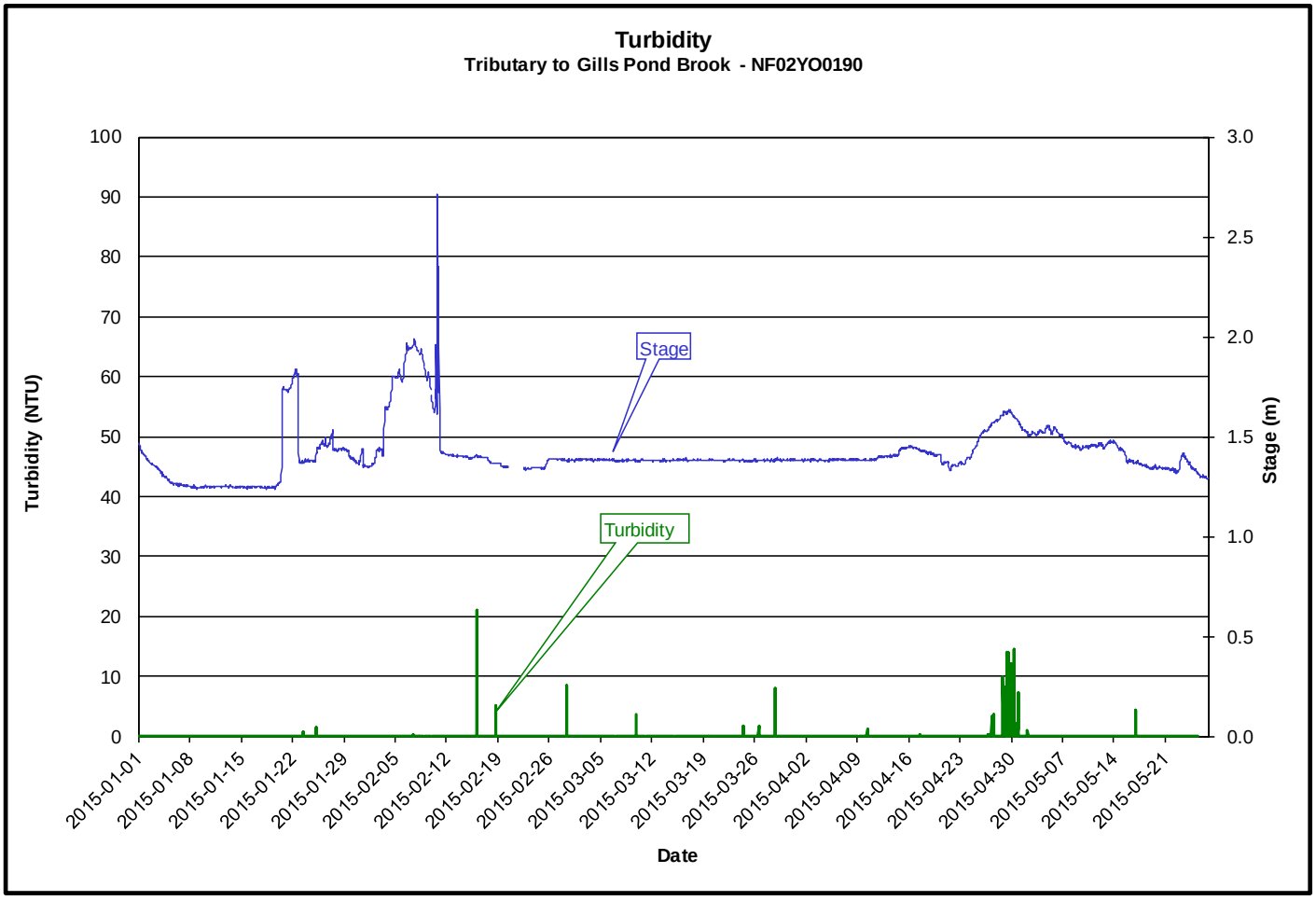

Figure 5

- The stage or water level ranged from a minimum of 1.23 m to a maximum of 2.72 m. The flow or discharge ranged from a minimum of 0.03 m^3/s to a maximum of 4.92 m^3/s (**Figure 6)**.
- The highest peaks in January and February are the result of the backwater influence of ice in the stream.
- Stage and flow are all within normal ranges.
- Water Survey of Canada is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.

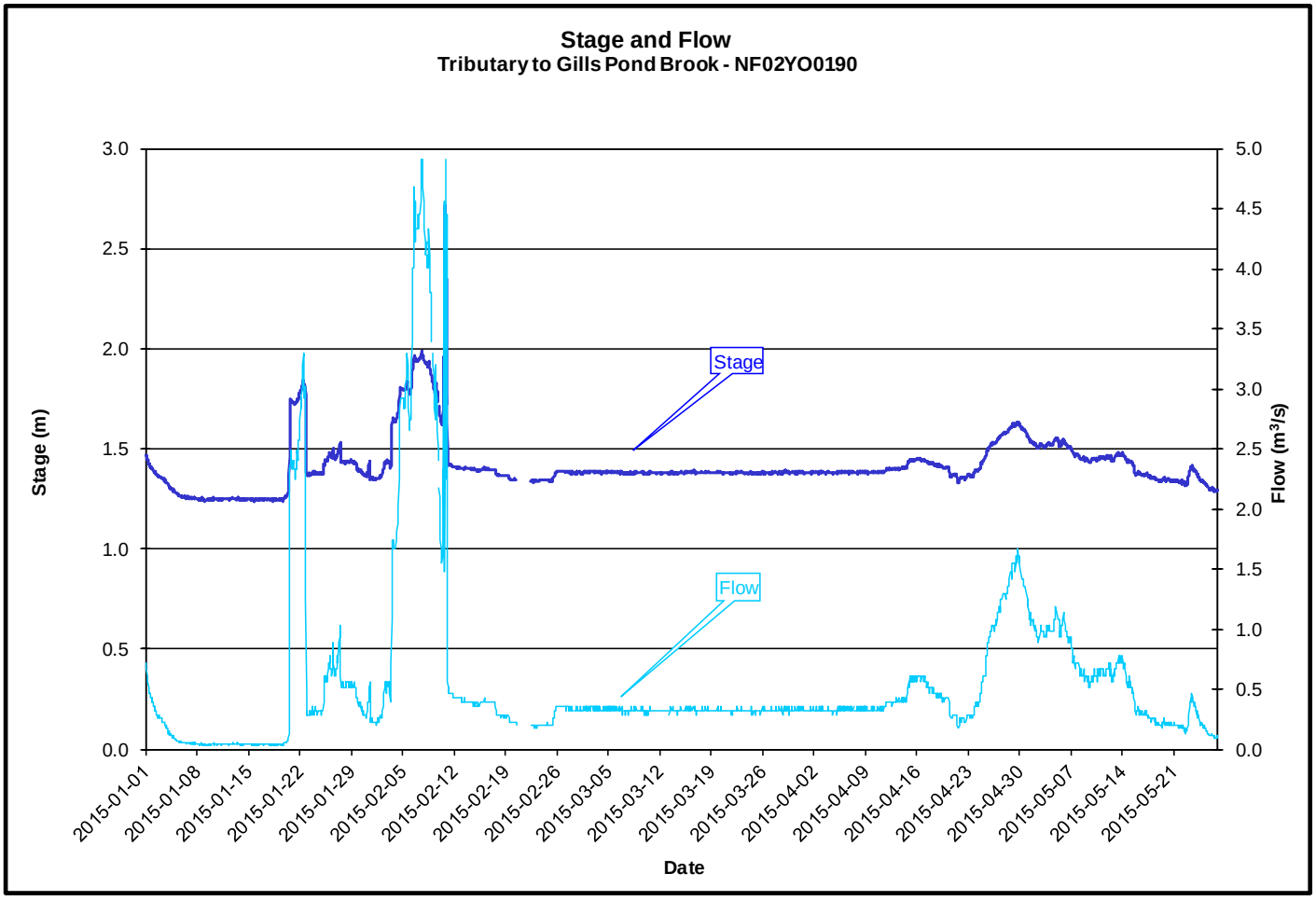

Figure 6

EAST POND BROOK

- The water temperature (**Figure 7**) ranged from a minimum of 0.05 ˚C to a maximum of 18.78 ˚C.
- Water temperatures rose to typical levels towards the end of the deployment period.
- There does not appear to be any correlation with stage during this deployment period.

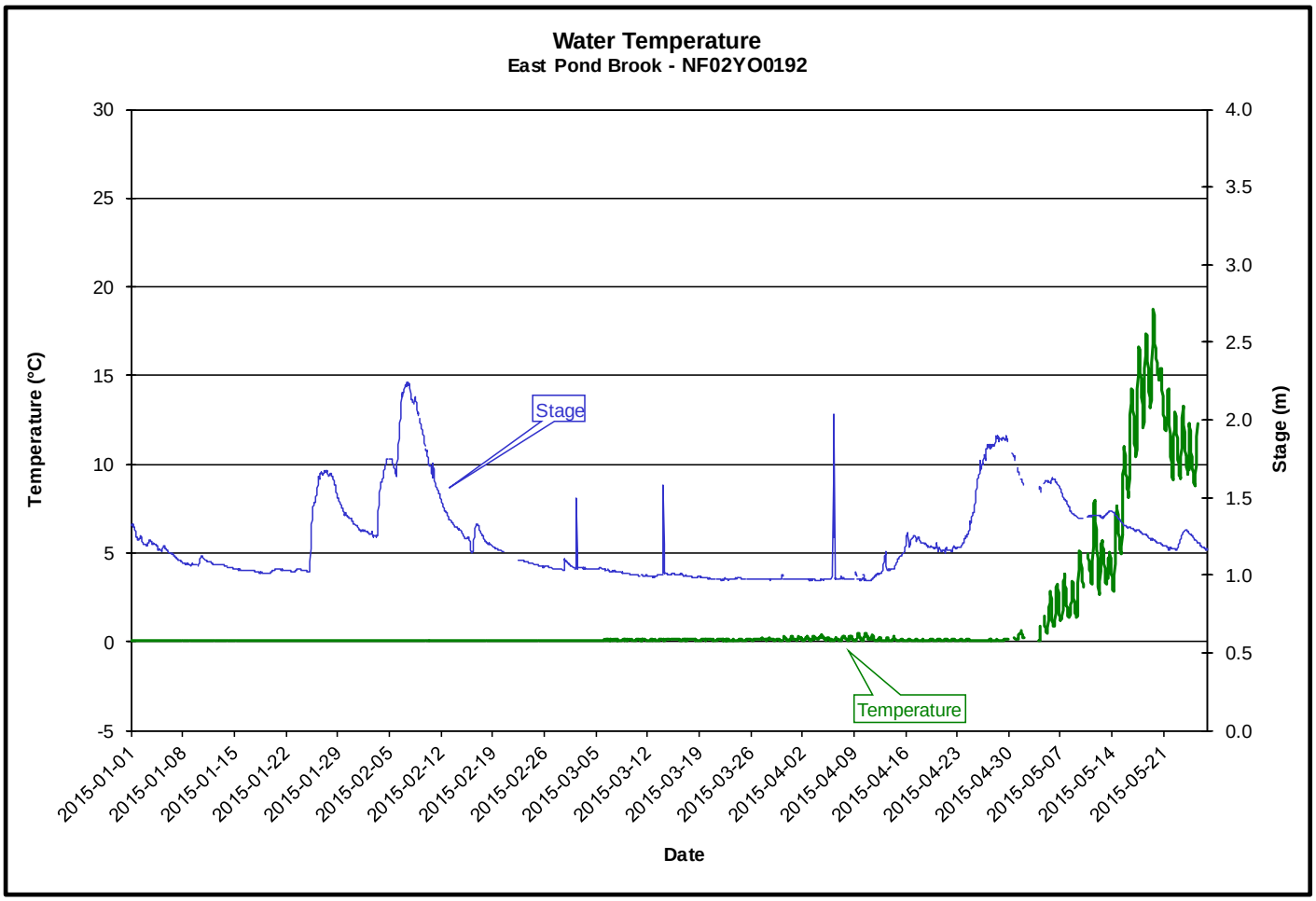

Figure 7

- Throughout the deployment period pH values (**Figure 8**) ranged from a minimum of 4.94 to a maximum of 6.62.
- Throughout most of the deployment period, pH values were below 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 minimum pH of 4.94 recorded on April 30, 2015, is the lowest pH recorded to date in this stream.
- There is an inverse relationship between pH and stage throughout most of the period.
- Between February 5, 2105 and February 12, 2015, and again, between April 23, 2015 and May 14, 2015, pH levels were particularly low, while stage peaked. This inverse relationship is believed to be a response to mild weather and runoff and spring runoff respectively.
- The background pH of this stream is normally quite low, and values near and below the lower limit are not unusual.

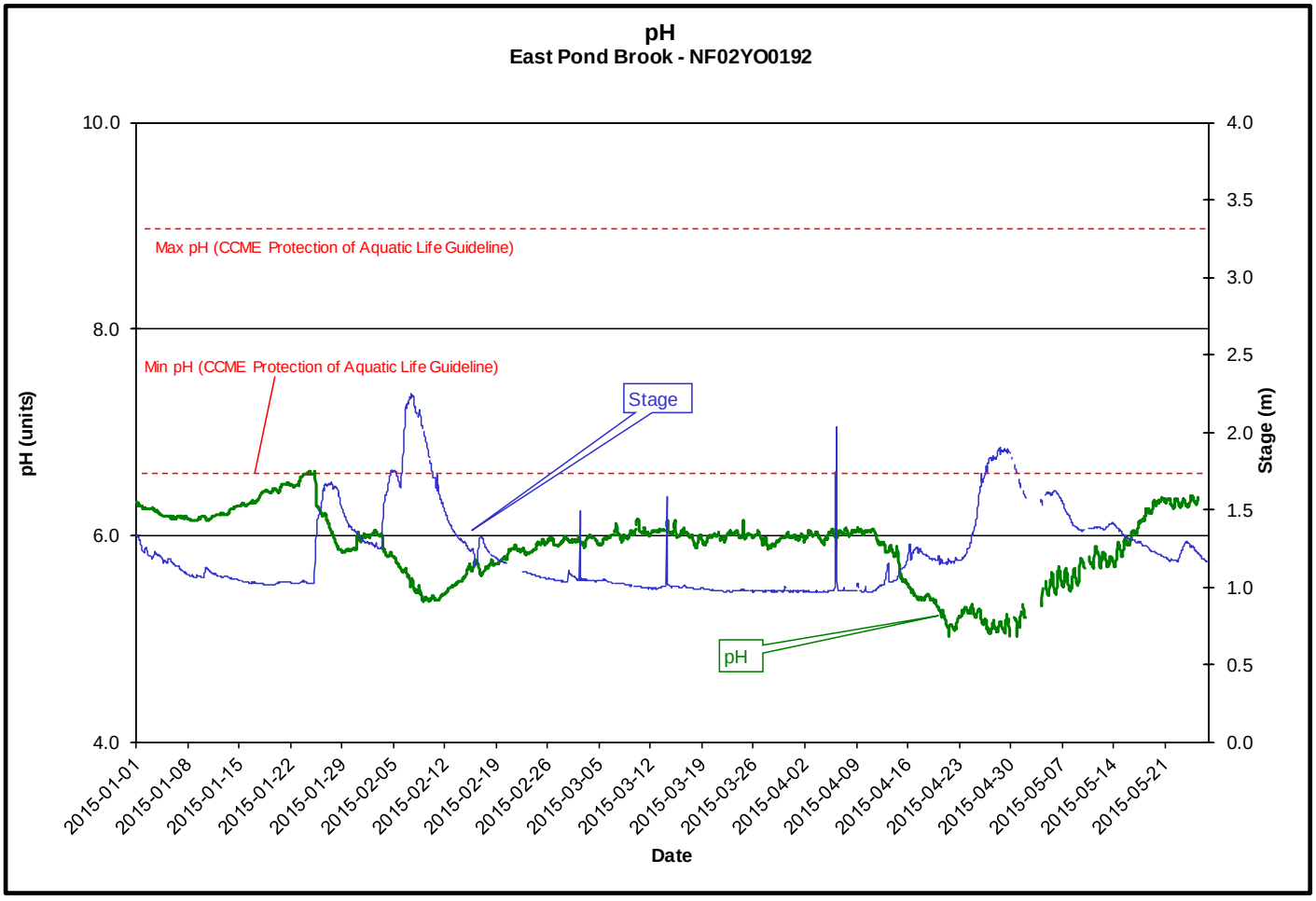

Figure 8

- The specific conductivity **(Figure 9)** ranged from a minimum of 15.3 µS/cm to a maximum of 97.3 µS/cm.
- There was a significant spike in specific conductance, peaking on April 21, 2015, with the highest value recorded to date in this stream.
- There was a negative correlation between specific conductivity and stage evident during some precipitation/runoff events.

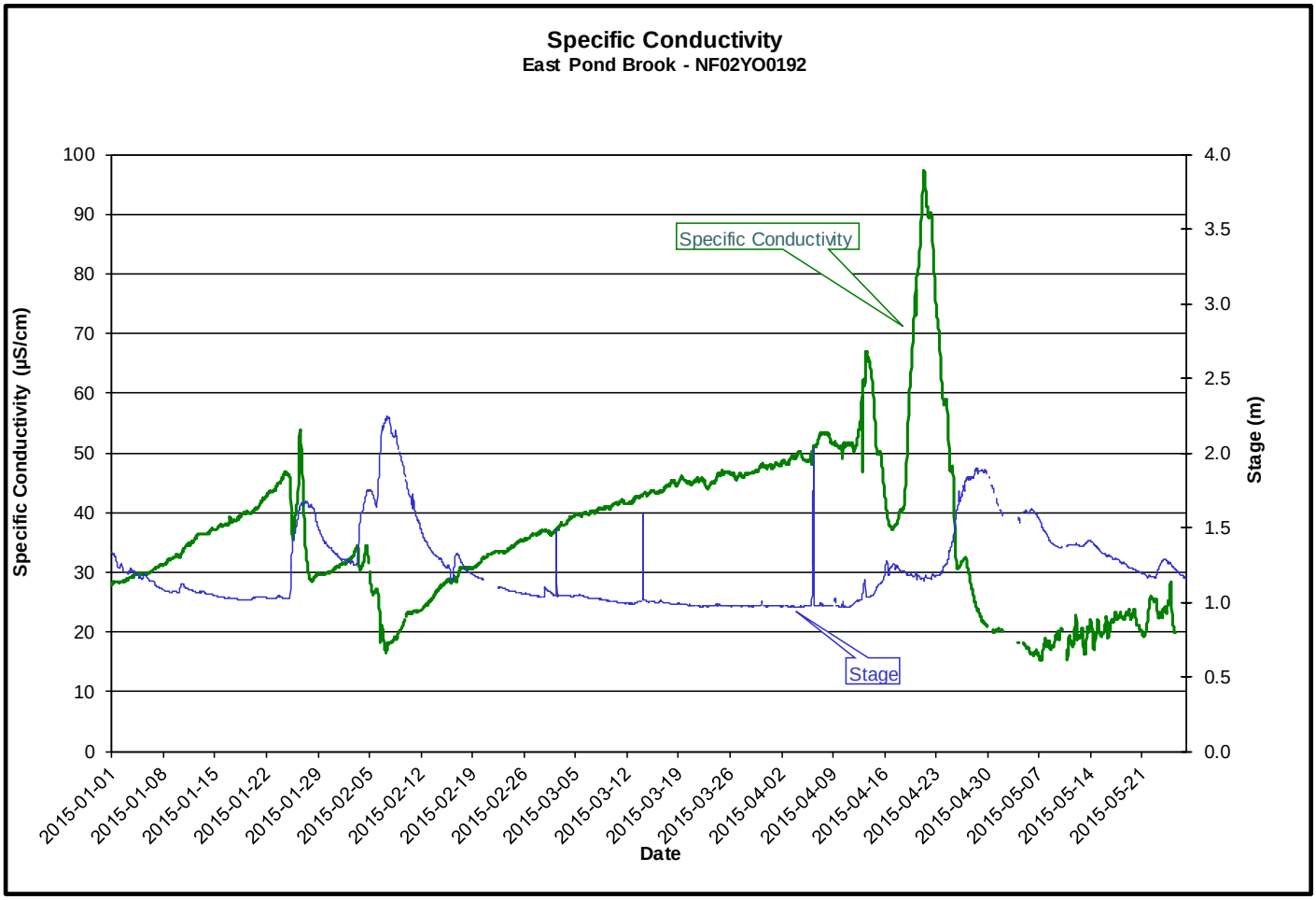

Figure 9

- The dissolved oxygen (**Figure 10**) values ranged from a minimum of 8.71mg/L to a maximum of 13.54 mg/L over the deployment period, with the percent saturation ranging between 80.6 and 96.3.
- Dissolved oxygen (mg/L) decreased towards the end of the deployment period, inversely proportional to the increase in water temperature (see **Figure 7**).
- Apart from a few days towards the end of the deployment period, all of the dissolved oxygen values fell above the minimum for Early Life Stages (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). This range is typical based upon water temperatures.
- Based upon the fact that dissolved oxygen % saturation had minimal and predictable change over the deployment period, we can be confident that the dissolved oxygen mg/L values are accurate.

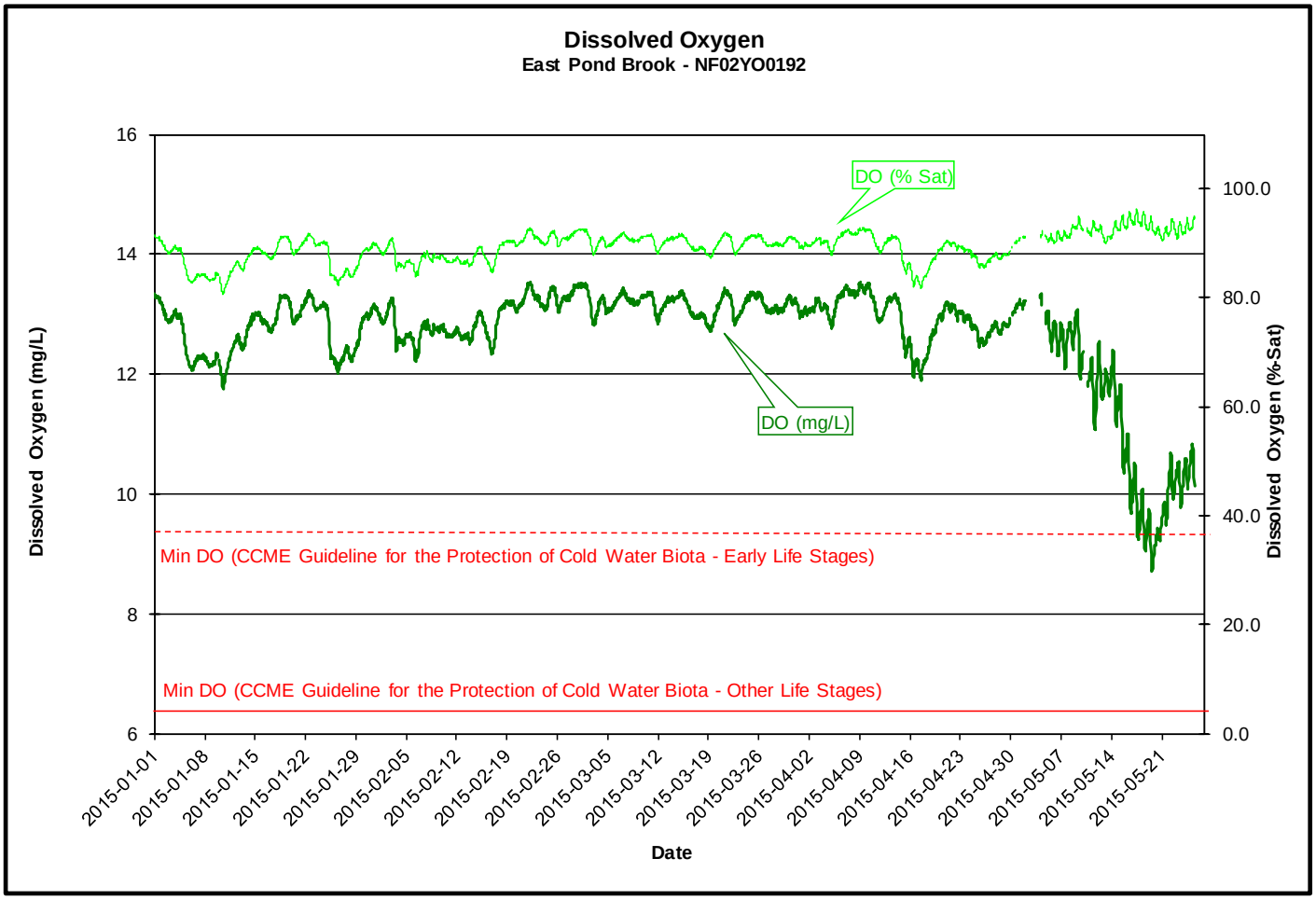

Figure 10

- The turbidity values **(Figure 11)** ranged from a minimum of 0.0 NTU to a maximum of 41.7 NTU.
- Minor and unsustained spikes in turbidity happened throughout the deployment period. The minor spikes are typical.
- Around the last few days of April, there was a sustained increase in turbidity over several hours. This increase corresponded with increased flows of the spring snow melt period.

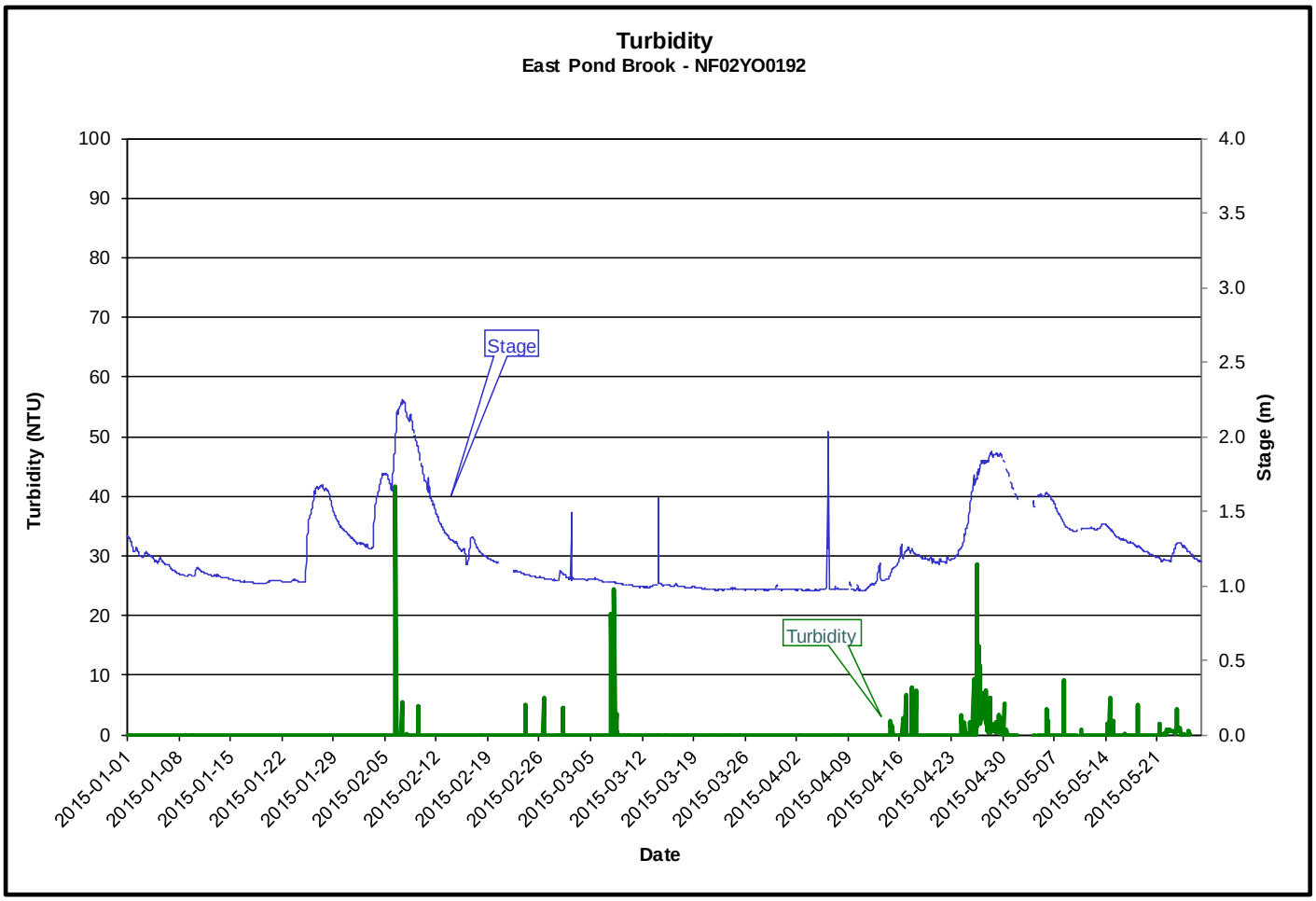

Figure 11

- The stage or water level ranged from a minimum of 0.97 m to a maximum of 2.24 m. The flow or discharge ranged from a minimum of 0.27 m^3/s to a maximum of 22.52 m^3/s **(Figure 12)**.
- The highest peaks in January and February are the result of the backwater influence of ice in the stream.
- Stage and flow are all within normal ranges.
- Water Survey of Canada is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.

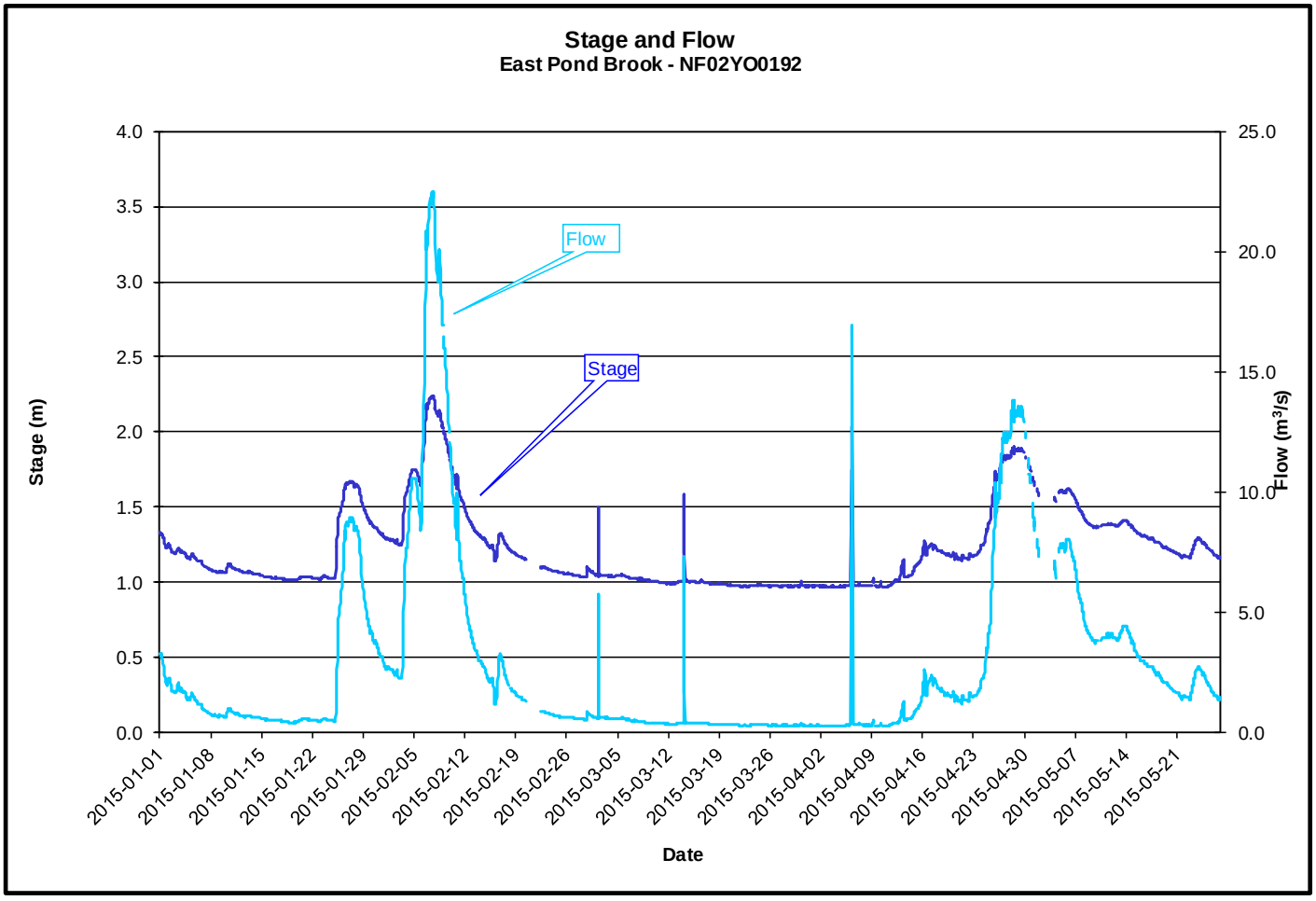

Figure 12

WELL AFTER TAILING DAM (MW1)

- The water temperature (**Figure 13**) ranged from a minimum of 5.05 ˚C to a maximum of 6.28 ˚C with a general decrease over the reporting period.

- There appears to be no correlation with water elevation.

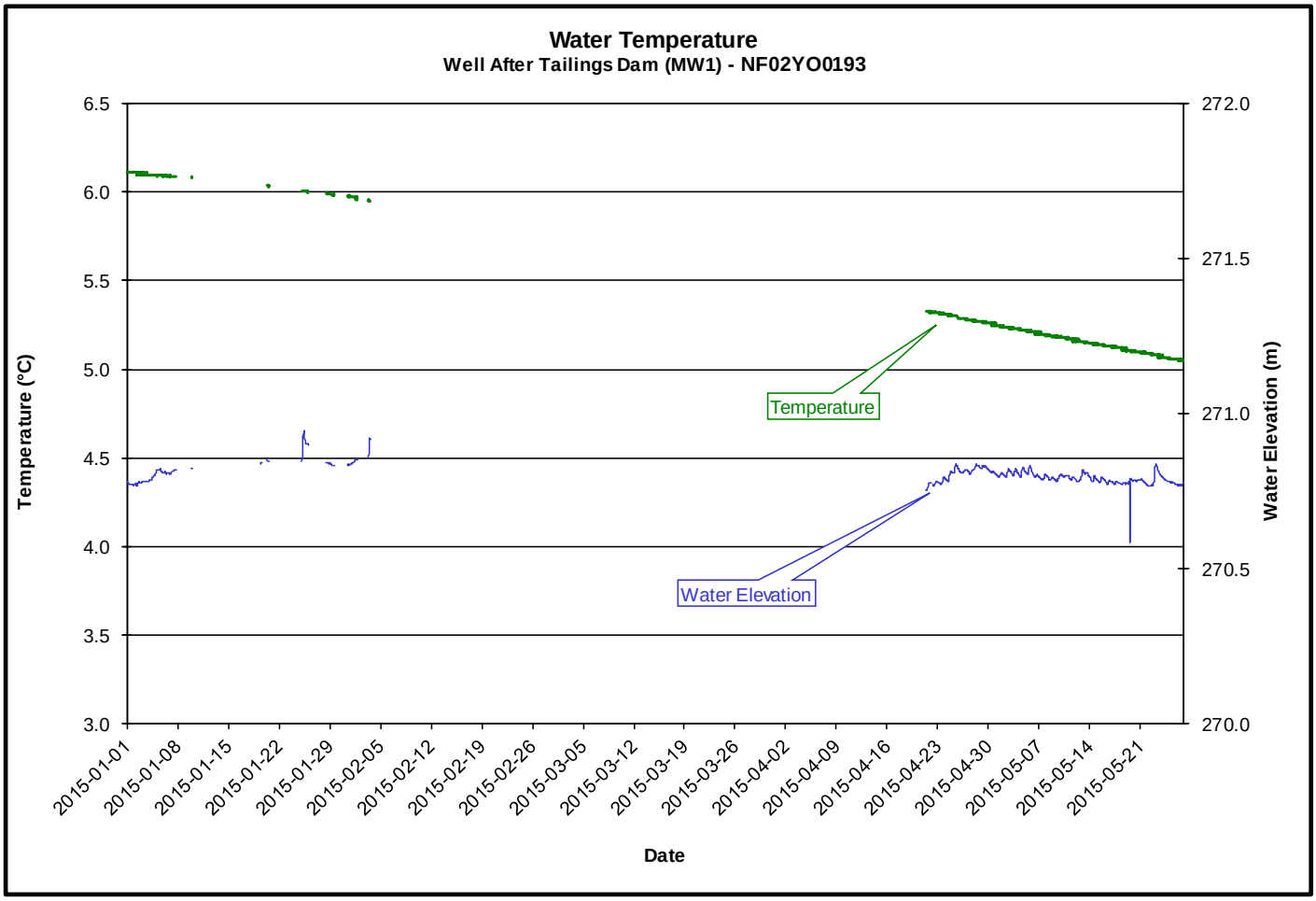

Figure 13

- The pH (**Figure 14**) ranged from a minimum of 8.25 to a maximum of 8.70.
- There was a slight increase over the reporting period.
- There does not appear to be any correlation with water elevation.

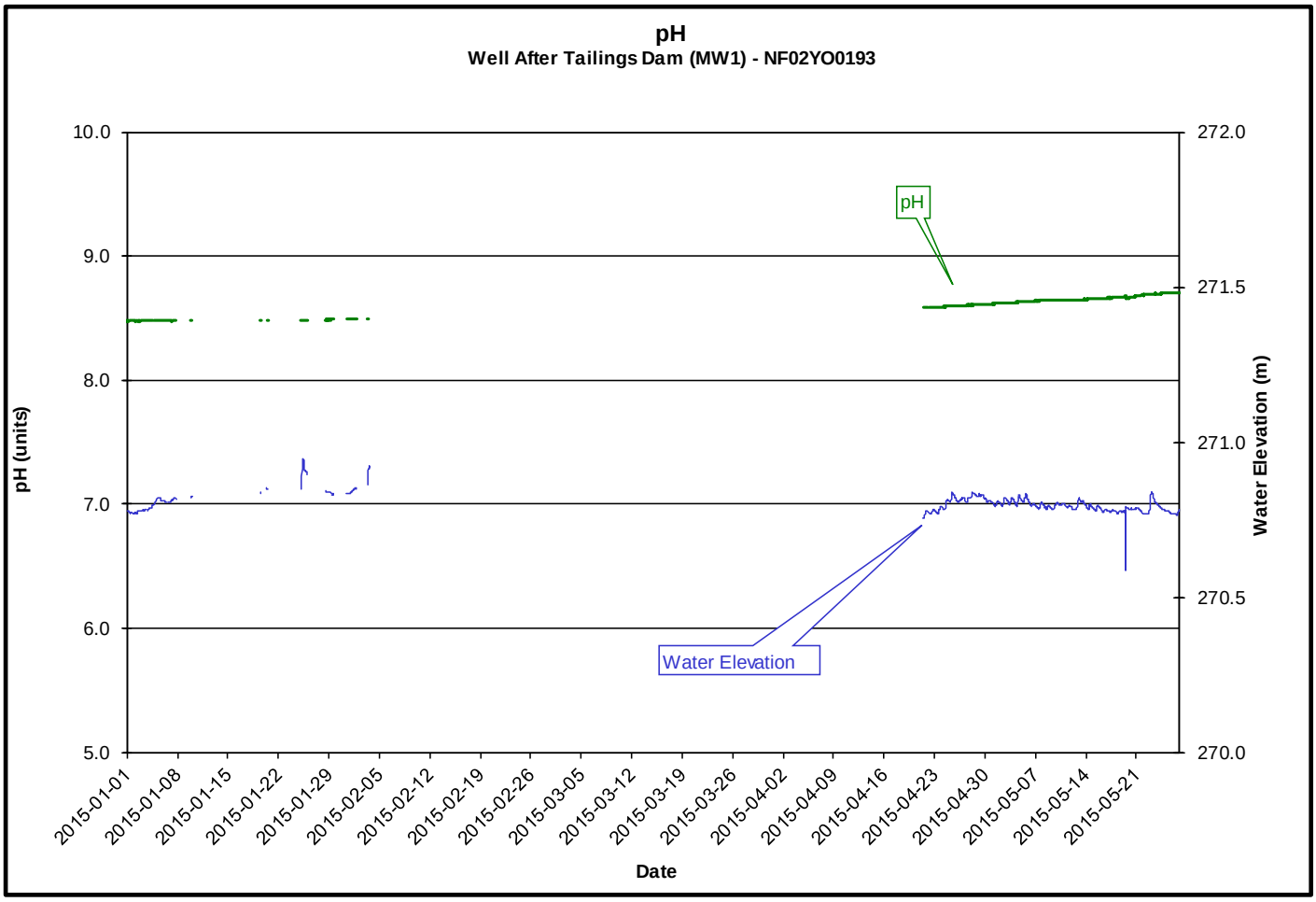

Figure 14

- The specific conductivity **(Figure 15)** ranged from a minimum of 0.780 mS/cm to a maximum of 0.797 mS/cm.
- Values remained fairly constant over the reporting period.

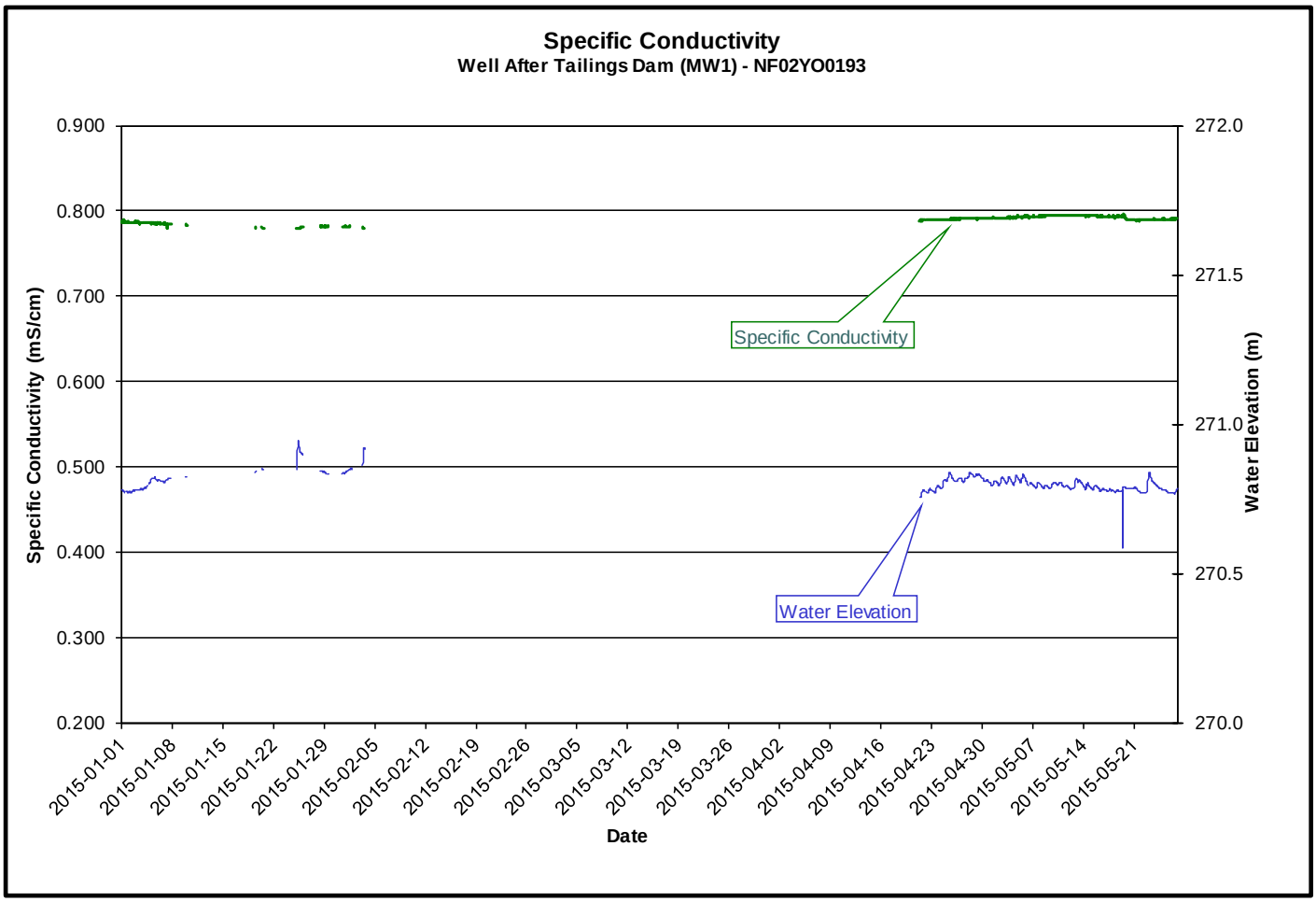

Figure 15

- The Water Elevation **(Figure 16)** ranged from a minimum of 270.59 m to a maximum of 270.95 m.
- The rapid dip in water elevation on May 19, 2015 highlighted by the red ellipse corresponds to a sampling event within the previous hour, when Teck staff purged the well to collect a sample.
- Water elevation in this well corresponds to increased water level in an adjacent stream, and is influenced by precipitation/runoff events, as well as the water elevation in the nearby Tailings Management Area.

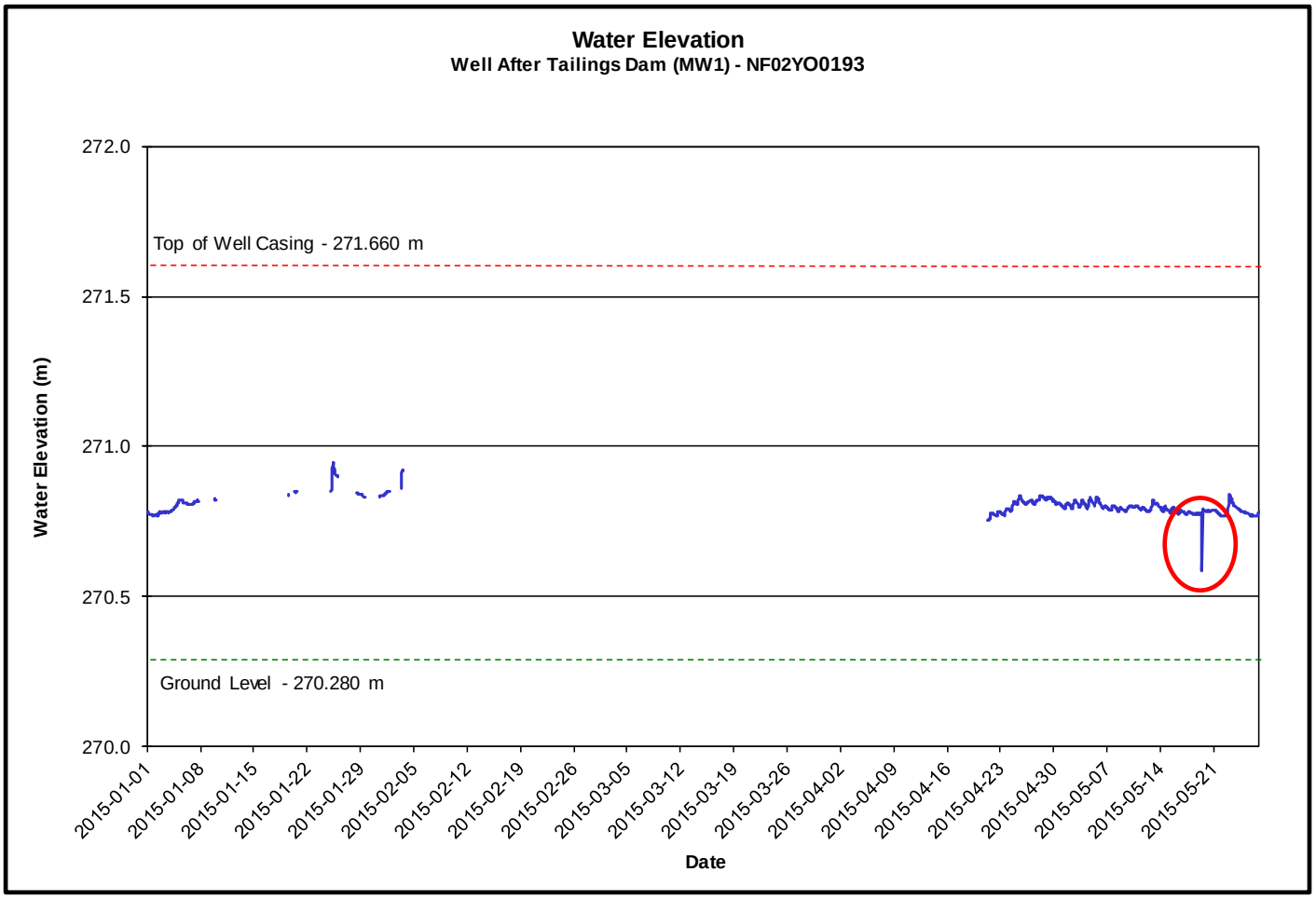

Figure 16

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