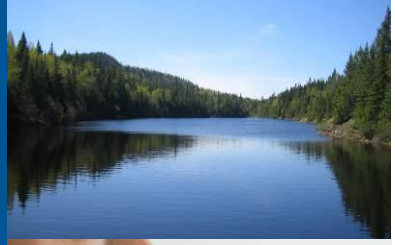




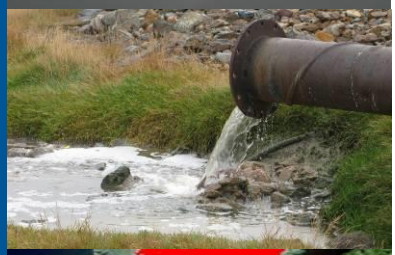


Real Time Water Quality Report
Teck Duck Pond Operations

Deployment Period 2015-09-01 to 2015-10-06

2015-10-09

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 discharge of effluent from Polishing Pond into the receiving waters (Tributary to Gills Pond Brook) for the entire deployment period.

Maintenance and Calibration of Instrumentation

- **DataSonde®**(s/n 62268) was deployed in Tributary to Gills Pond Brook on September 1, 2015 after being cleaned and freshly calibrated, and remained deployed continuously until October 6, 2015; a 35 day period.
- **DataSonde®**(s/n 62267) was deployed in East Pond Brook on September 1, 2015 after being cleaned and freshly calibrated, and remained deployed continuously until October 6, 2015; a 35 day period.
- **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 June 16, 20115 and remained deployed until past the end of the current reporting period.

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 rankings 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. There are no rankings for Well After Tailings Dam (MW1) as the instrument was neither deployed nor removed during this reporting period.

- 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.
- As **Quanta G®** (s/n 00035) was deployed in this well, prior to the beginning of this reporting period, the ranking for the initial deployment is documented in a previous report. As the unit remains deployed, rankings for removal will be documented in a subsequent report.

- 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**
2015-09-01 Installation	Temp (^{o}C)	Excellent
	pH (units)	Excellent
	Sp. Conductivity (µS/cm)	Excellent
	Dissolved Oxygen (mg/L)	Excellent
	Turbidity (NTU)	Excellent
2015-10-06 Removal	Temp (^{o}C)	Excellent
	pH (units)	Good
	Sp. Conductivity (µS/cm)	Excellent
	Dissolved Oxygen (mg/L)	Excellent
	Turbidity (NTU)	Excellent

Table 2

East Pond Brook Station (NF02YO0192)		
Date (yyyy-mm-dd)	**Parameter**	**Ranking**
2015-09-01 Installation	Temp (^{o}C)	Excellent
	pH (units)	Good
	Sp. Conductivity (µS/cm)	Good
	Dissolved Oxygen (mg/L)	Excellent
	Turbidity (NTU)	Excellent
2015-10-06 Removal	Temp (^{o}C)	Excellent
	pH (units)	Excellent
	Sp. Conductivity (µS/cm)	Excellent
	Dissolved Oxygen (mg/L)	Excellent
	Turbidity (NTU)	Good

Table 3

Data Interpretation

TRIBUTARY TO GILLS POND BROOK

- The water temperature (**Figure 1**) ranged from a minimum of 7.79˚C to a maximum of 19.66˚C.
- The water temperature decreased slightly over the deployment period.
- Water temperatures were slightly lower, with less diurnal variation during a period of increased stage around September 3, 2015.

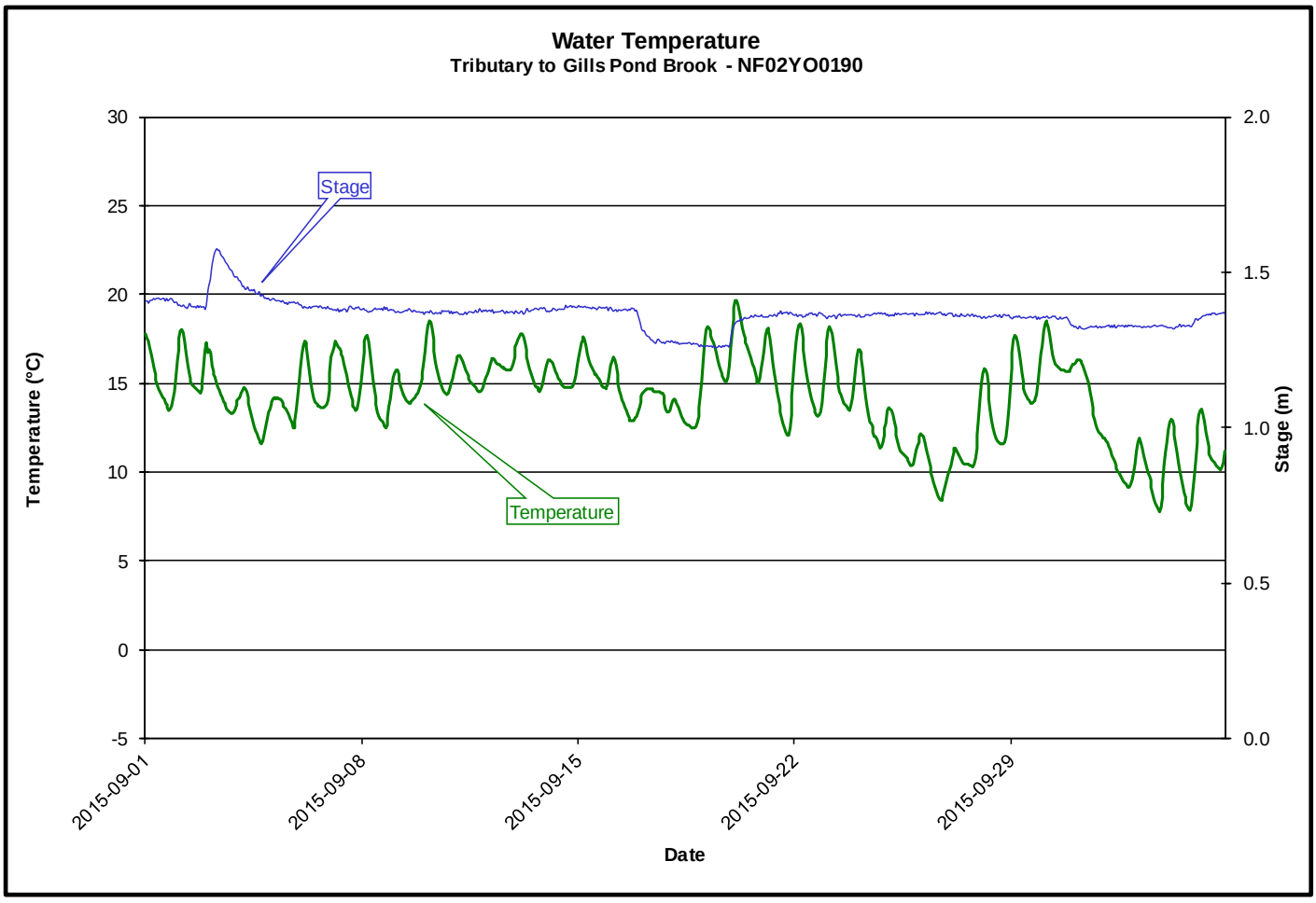

Figure 1

- Throughout the deployment period, pH values (**Figure 2**) ranged from a minimum of 6.04 to a maximum of 7.46.
- During this deployment period pH remained near the lower limit of 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 following a precipitation/runoff event on September 3, 2015.
- On September 18 and 19, 2015, discharge volumes from Polishing Pond were reduced significantly, as evidenced by the short term reduction in stage. However, this did not affect the recorded pH.

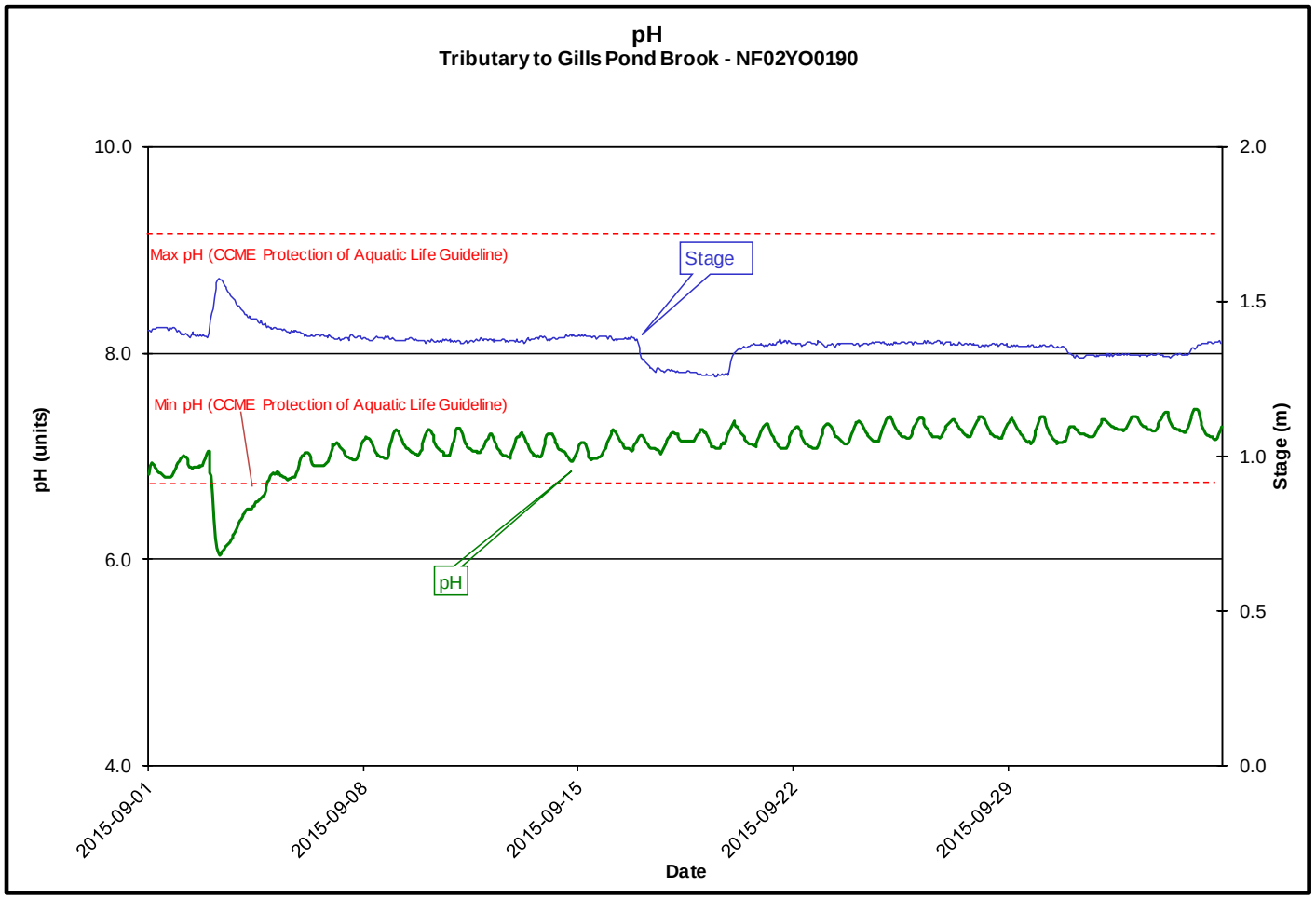

Figure 2

- The specific conductivity **(Figure 3)** ranged from a minimum of 352.0 µS/cm to a maximum of 1468.0 µS/cm over the deployment period.
- An inverse relationship with stage is obvious following a precipitation/runoff event on September 3, 2015. This is essentially the dilution effect of the rainwater on the highly conductive discharge water.
- On September 18 and 19, 2015, discharge volumes from Polishing Pond were reduced significantly, as evidenced by the short term reduction in stage. A corresponding reduction on specific conductance is quite obvious.

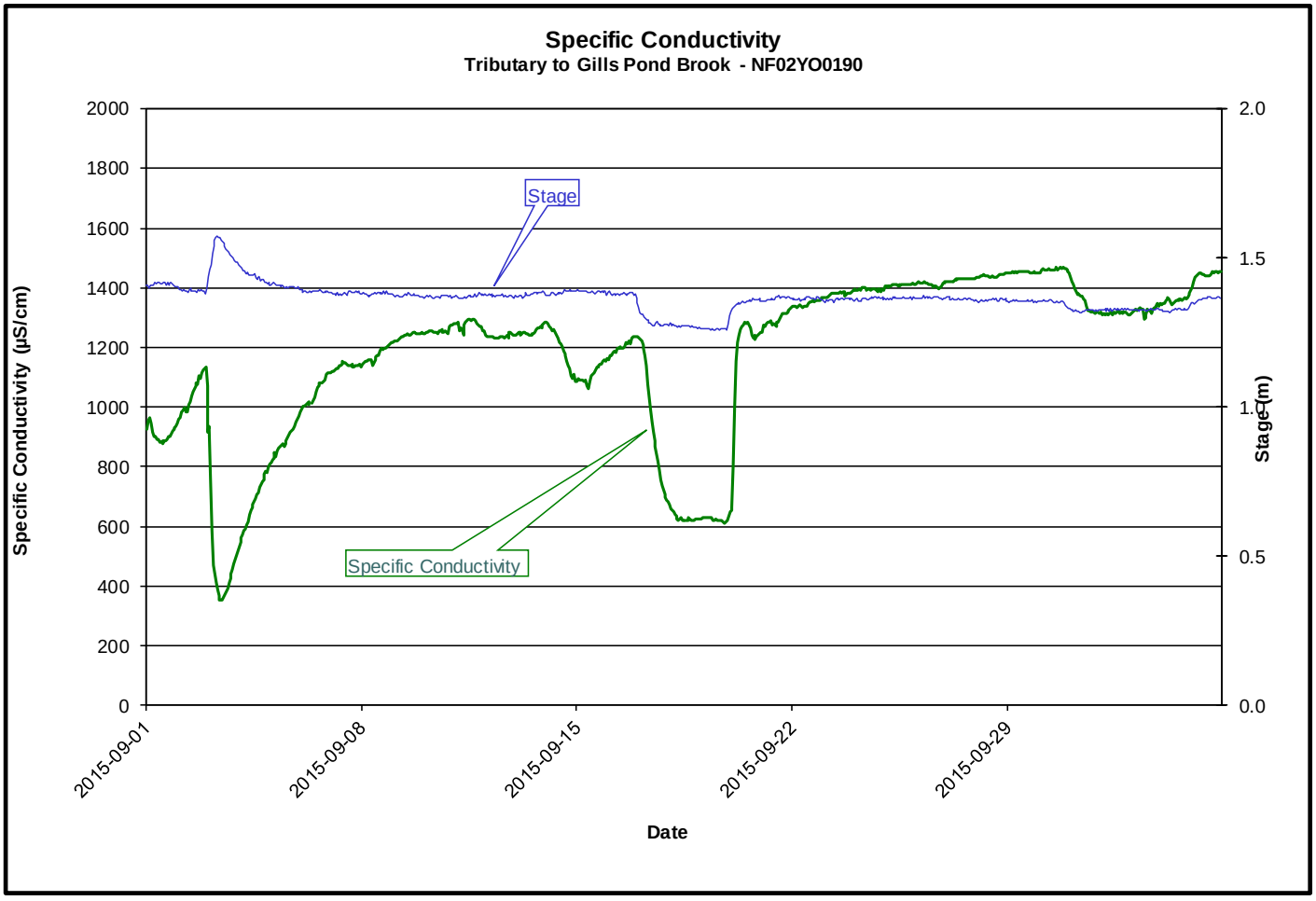

Figure 3

- The dissolved oxygen (**Figure 4**) values ranged from a minimum of 8.18 mg/L to a maximum of 11.47 mg/L over the deployment period, with the percent saturation ranging between 81.3 and 103.2.
- Dissolved oxygen (mg/L) levels increased toward the end of the deployment period, as one would expect with reduced water temperatures.
- All of the dissolved oxygen values fell above the minimum for Other 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.

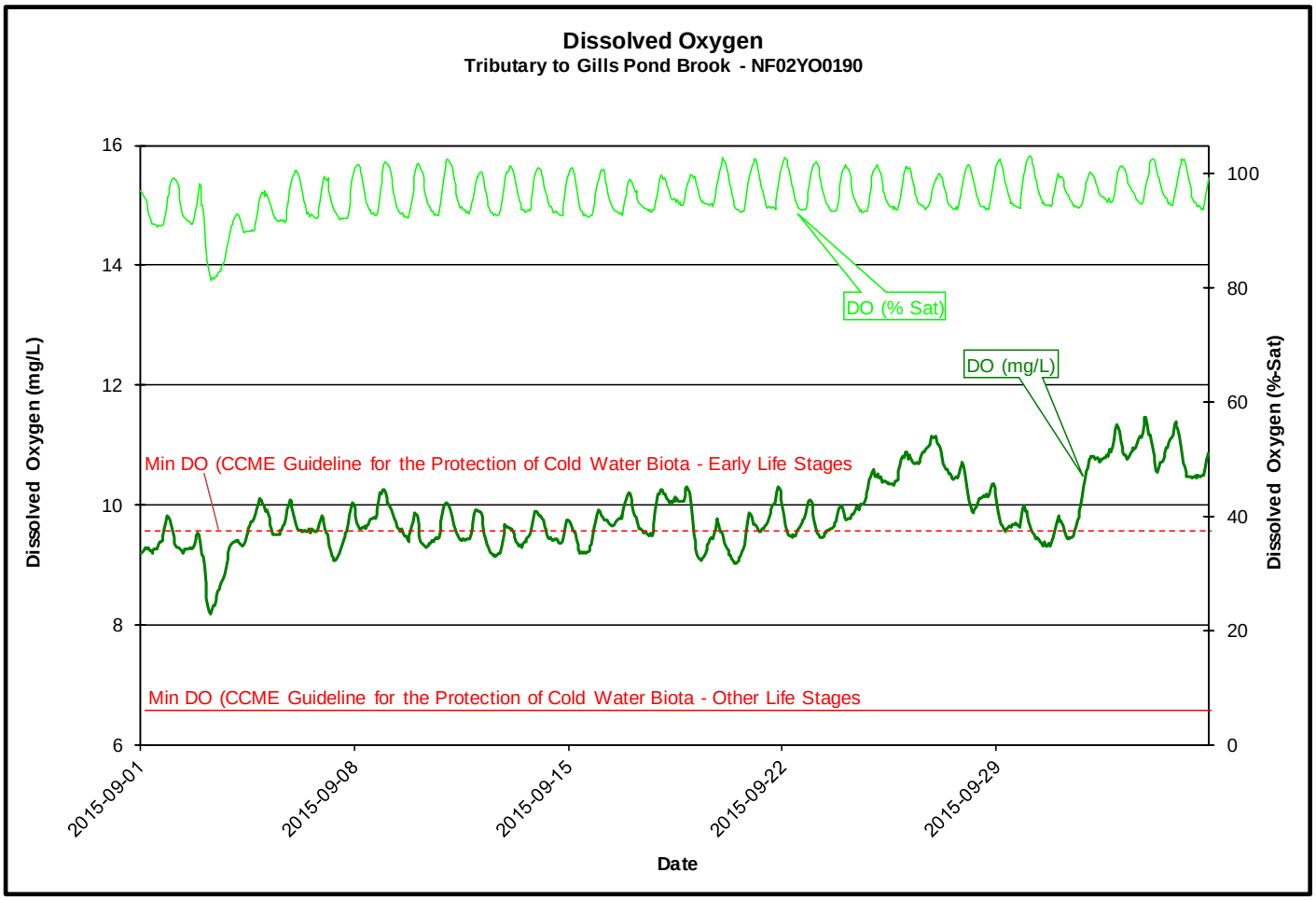

Figure 4

- The turbidity values **(Figure 5)** ranged from a minimum of 0.0 NTU to a maximum of 42.3 NTU.
- The highest peak on September 5, 2013, being unsustained was likely the result of some natural in-stream debris passing near the sensor, during higher flows following the precipitation/runoff event on September 3, 2015.
- Upon removal at the end of the deployment period, it was noted that there was some accumulation of algae on the sensors. This may have resulted in the low-level turbidity measurements throughout the deployment period.
- No issues with turbidity were evident.

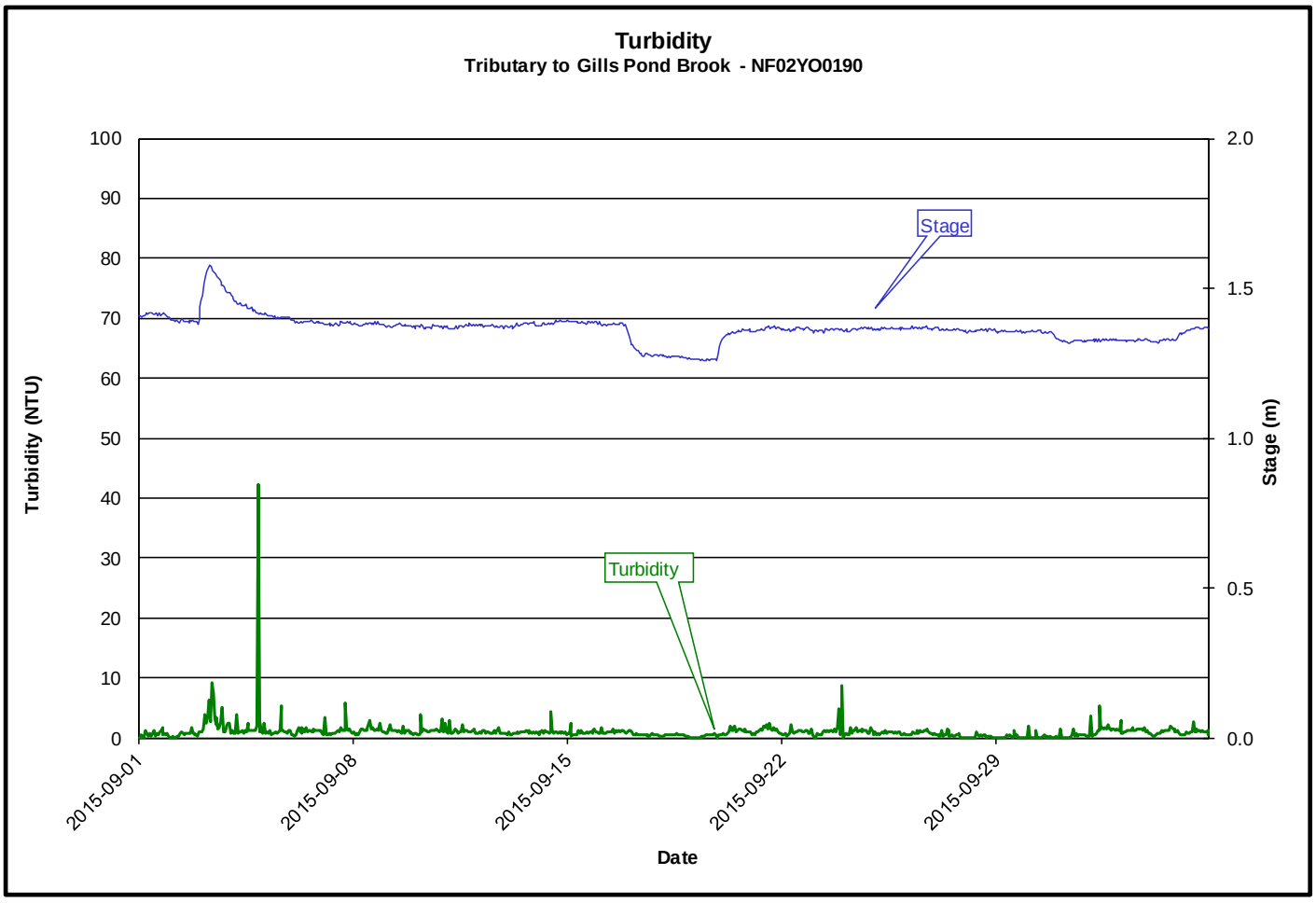

Figure 5

- The stage or water level ranged from a minimum of 1.26 m to a maximum of 1.58 m. The flow or discharge ranged from a minimum of 0.05 m^3/s to a maximum of 1.30 m^3/s (**Figure 6)**.
- Higher stage and flow are evident following a precipitation/runoff event on September 3, 2015.
- Lower stage and flow on September 18 and 19, 2015, are the result of discharge volumes from Polishing Pond being reduced significantly,
- 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.

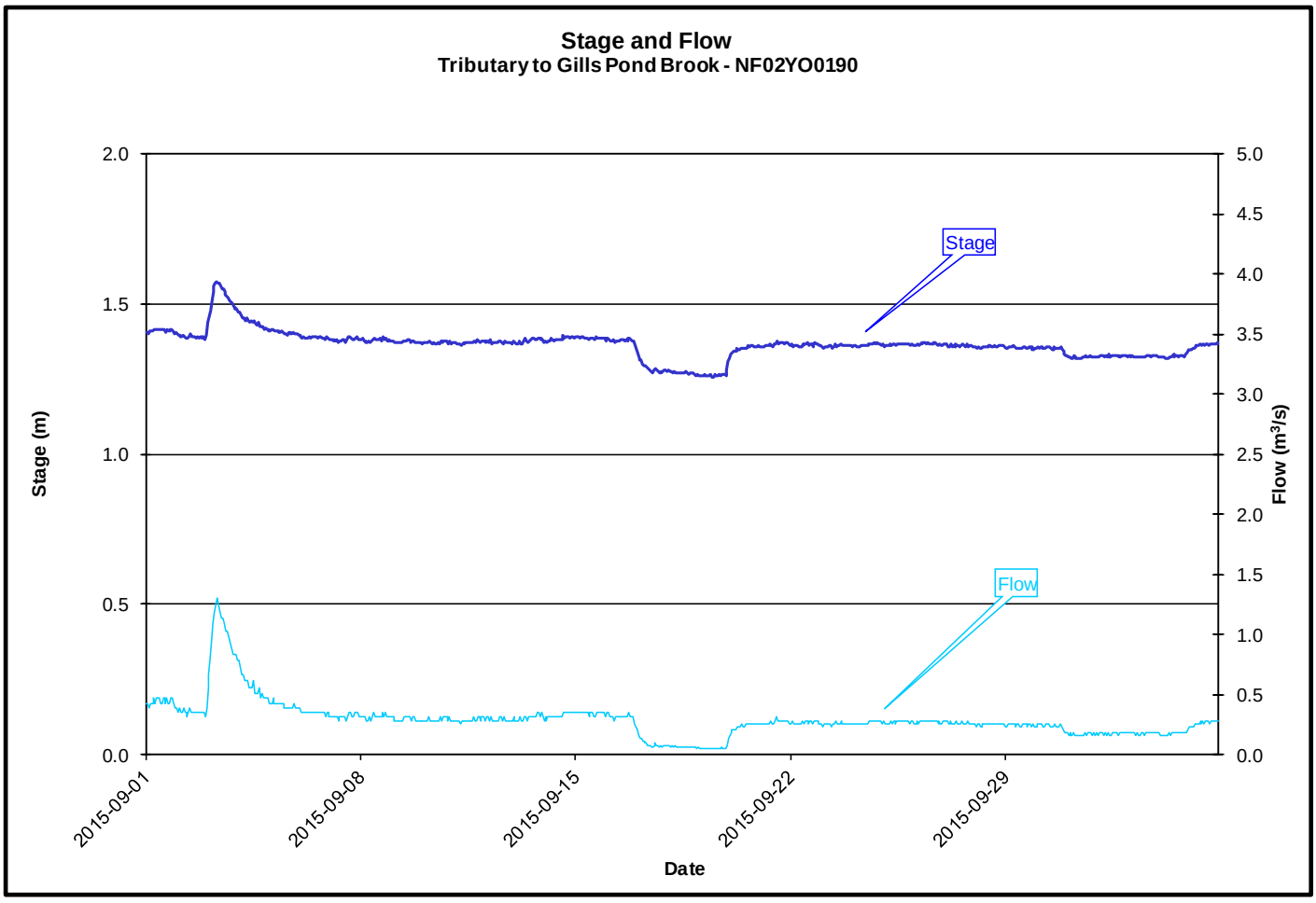

Figure 6

EAST POND BROOK

- The water temperature (**Figure 7**) ranged from a minimum of 5.88 ˚C to a maximum of 19.75 ˚C.
- The water temperature decreased slightly over the deployment period.
- Water temperatures were slightly lower, with less diurnal variation during a period of increased stage around September 3, 2015.

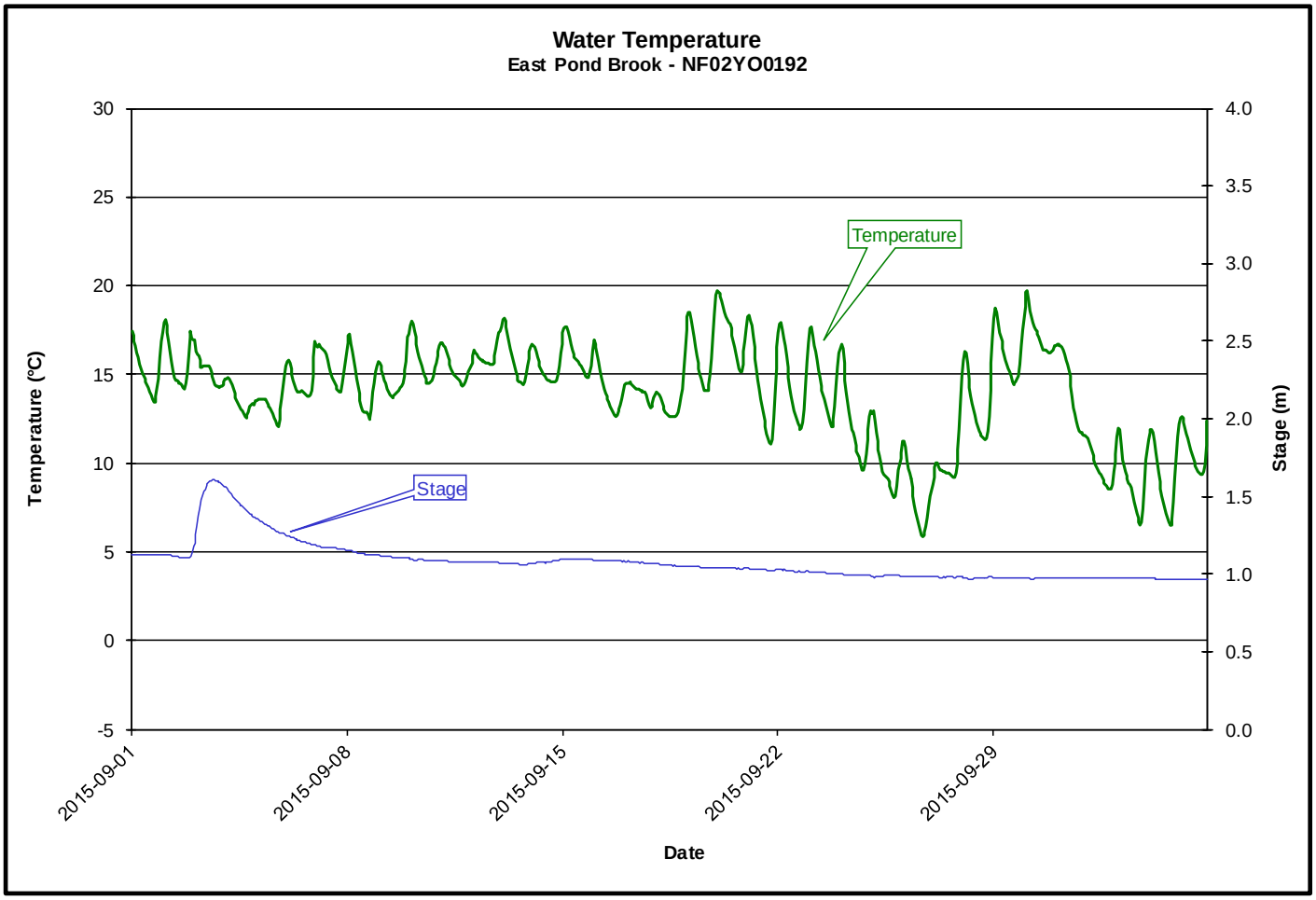

Figure 7

- Throughout the deployment period pH values (**Figure 8**) ranged from a minimum of 6.44 to a maximum of 7.11.
- Throughout the deployment period, pH values were right around the lower limit of the recommended range (6.5 – 9.0) for the CCME *Canadian Water Quality Guidelines for the Protection of Aquatic Life*.
- There is an inverse relationship between pH and stage particularly evident during the first week of this deployment period.
- The background pH of this stream is normally quite low, and values near and below the lower limit are not unusual.

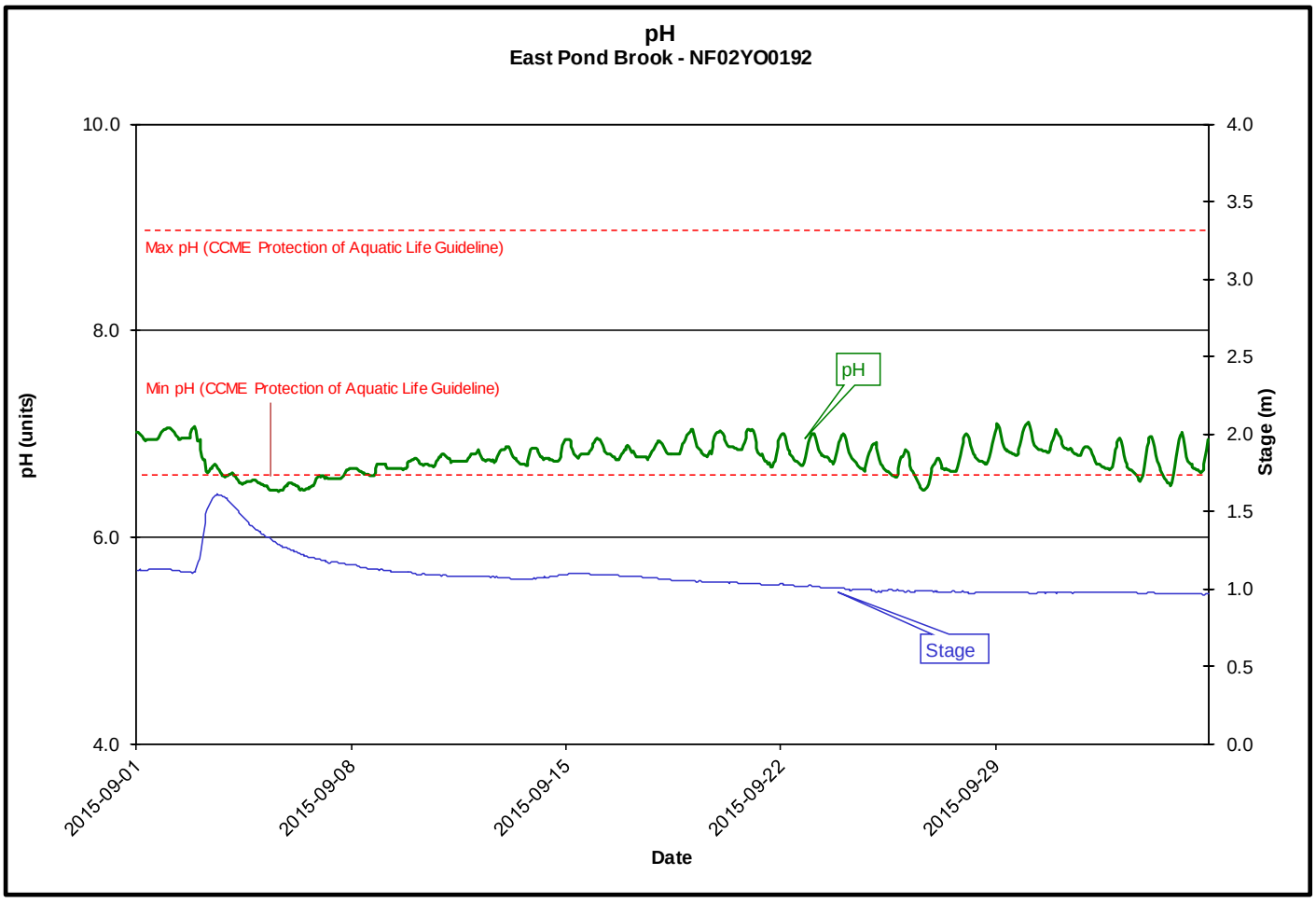

Figure 8

- The specific conductivity **(Figure 9)** ranged from a minimum of 21.6 µS/cm to a maximum of 34.1 µS/cm.
- Conductivity values in this range are typical for this stream.

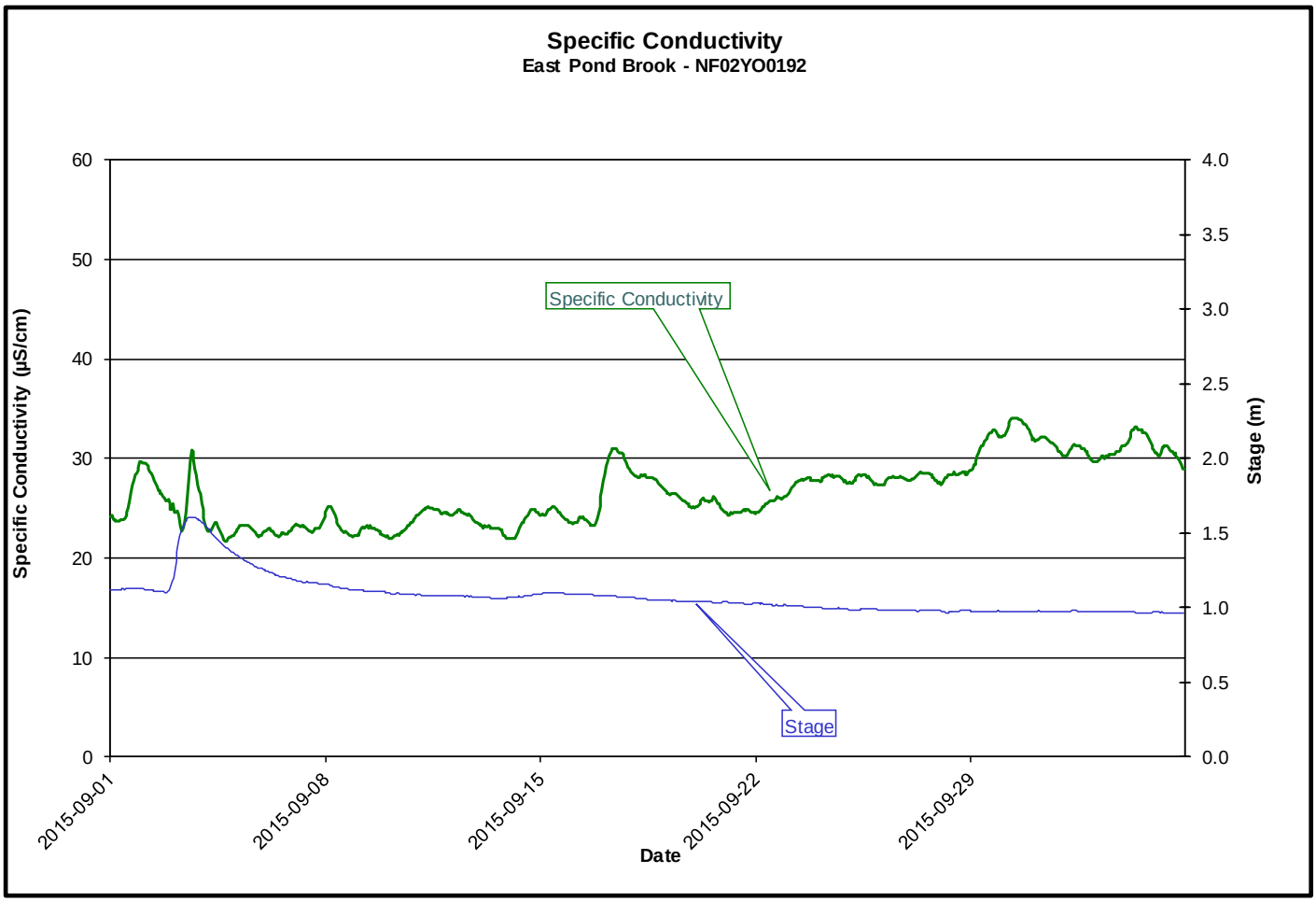

Figure 9

- The dissolved oxygen (**Figure 10**) values ranged from a minimum of 8.75 mg/L to a maximum of 11.90 mg/L over the deployment period, with the percent saturation ranging between 92.1 and 102.2.
- Dissolved oxygen (mg/L) levels increased toward the end of the deployment period, as one would expect with reduced water temperatures.
- All of the dissolved oxygen values fell above the minimum for Other 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.

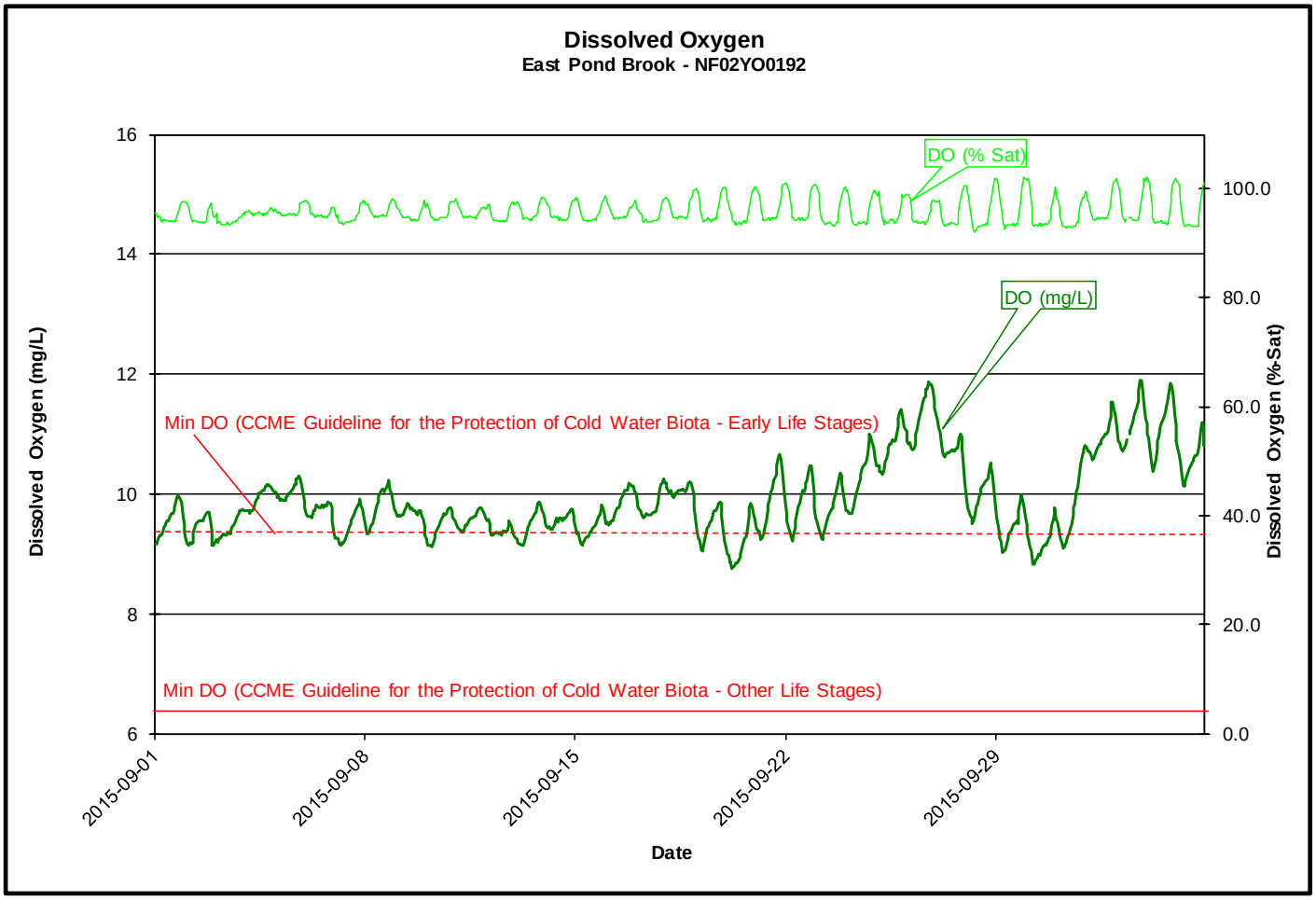

Figure 10

- The turbidity values **(Figure 11)** ranged from a minimum of 0.0 NTU to a maximum of 129.3 NTU.
- The one major and short duration spike in turbidity on October 1, 2015 is likely the result of natural in-stream debris passing near the sensor.
- Upon removal at the end of the deployment period, it was noted that there was significant accumulation of algae on the sensors. This may have resulted in the low-level turbidity measurements throughout the deployment period.
- Very low turbidity values are typical in this stream.

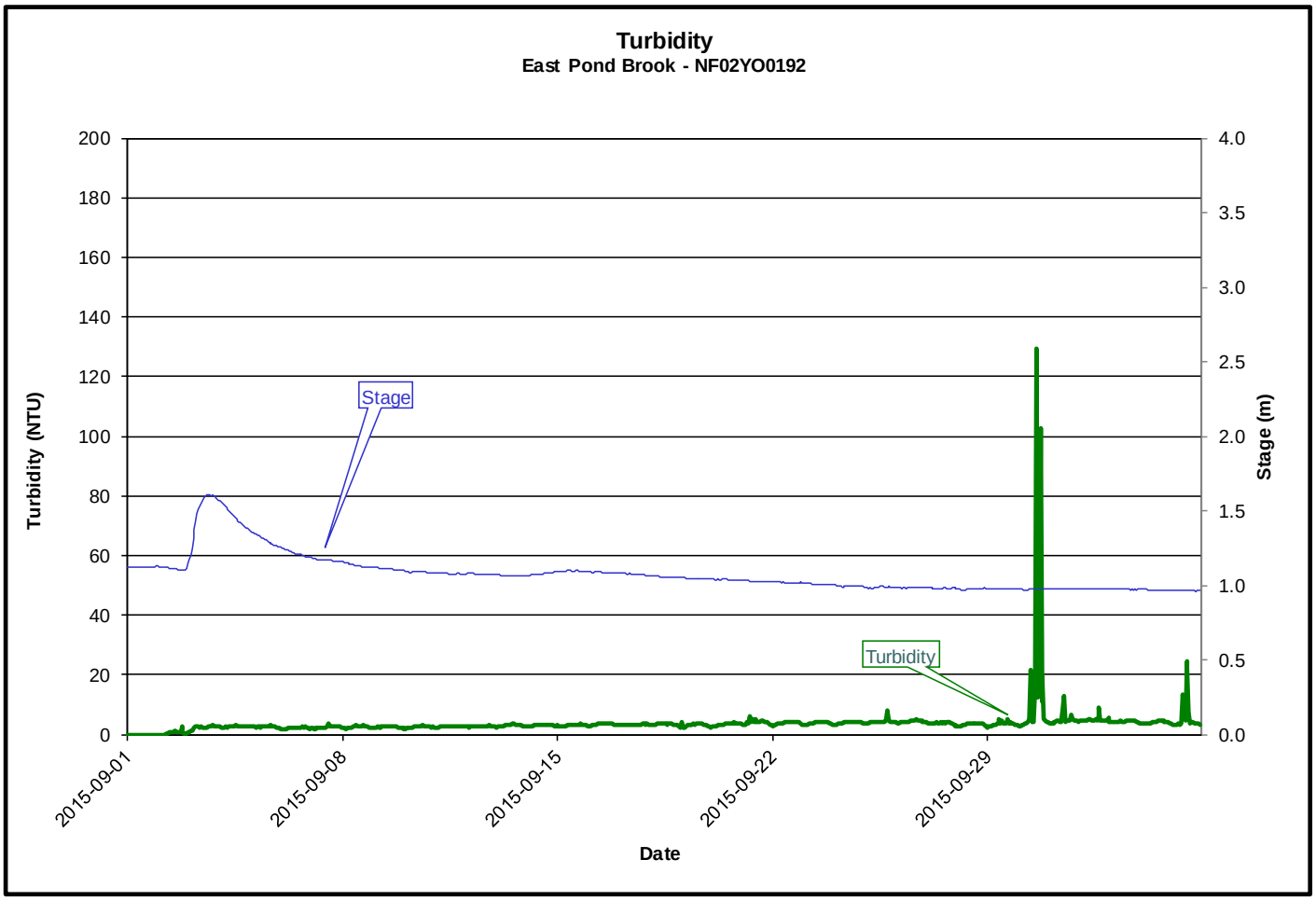

Figure 11

- The stage or water level ranged from a minimum of 0.96 m to a maximum of 1.61 m. The flow or discharge ranged from a minimum of 0.23 m^3/s to a maximum of 7.83 m^3/s **(Figure 12)**.
- The increase in stage and flow is the result of a precipitation/runoff event.
- 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.

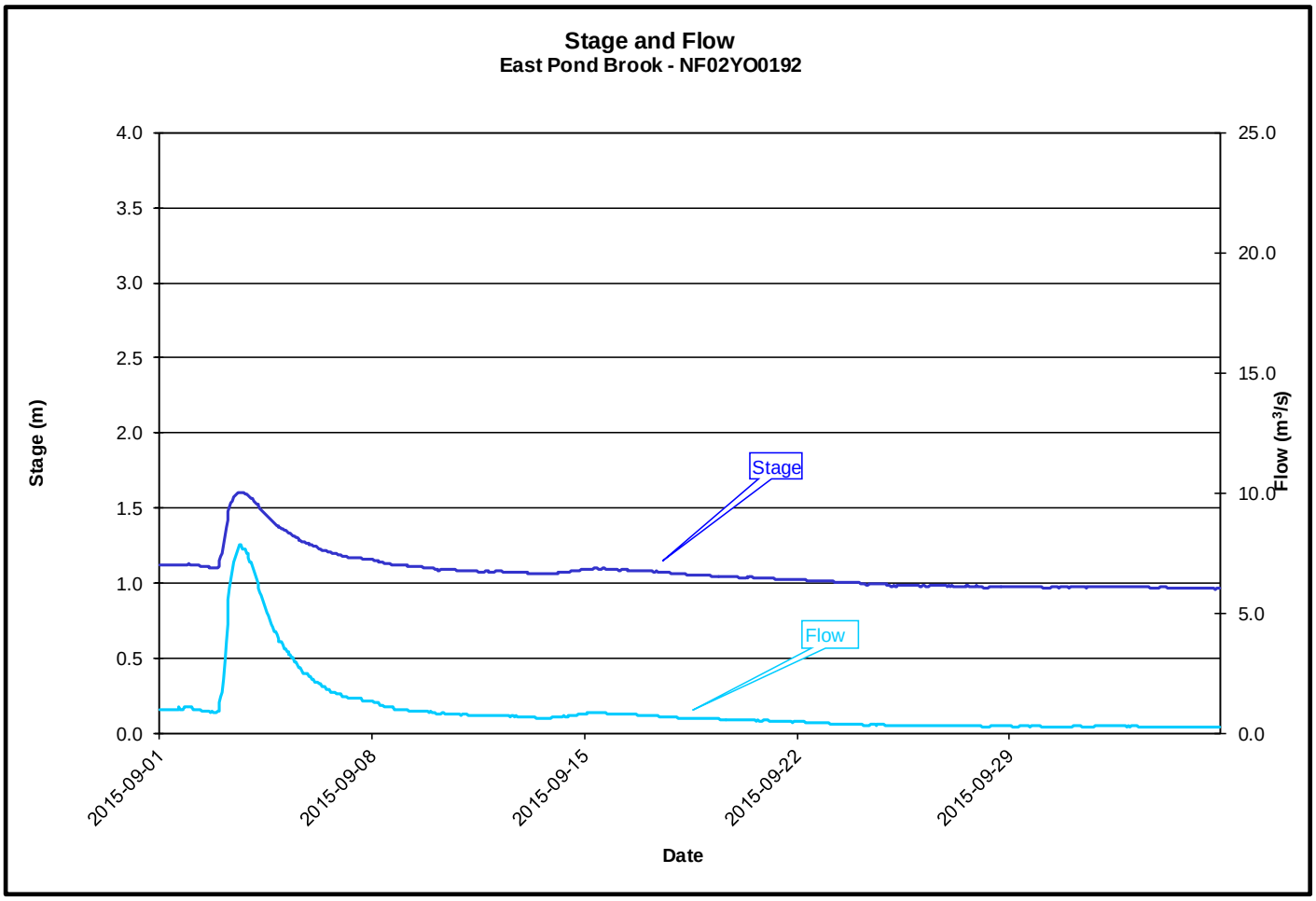

Figure 12

WELL AFTER TAILING DAM (MW1)

- The water temperature (**Figure 13**) ranged from a minimum of 5.04 ˚C to a maximum of 5.35 ˚C with a slight increase over the reporting period.
- There appears to be no correlation with water elevation.

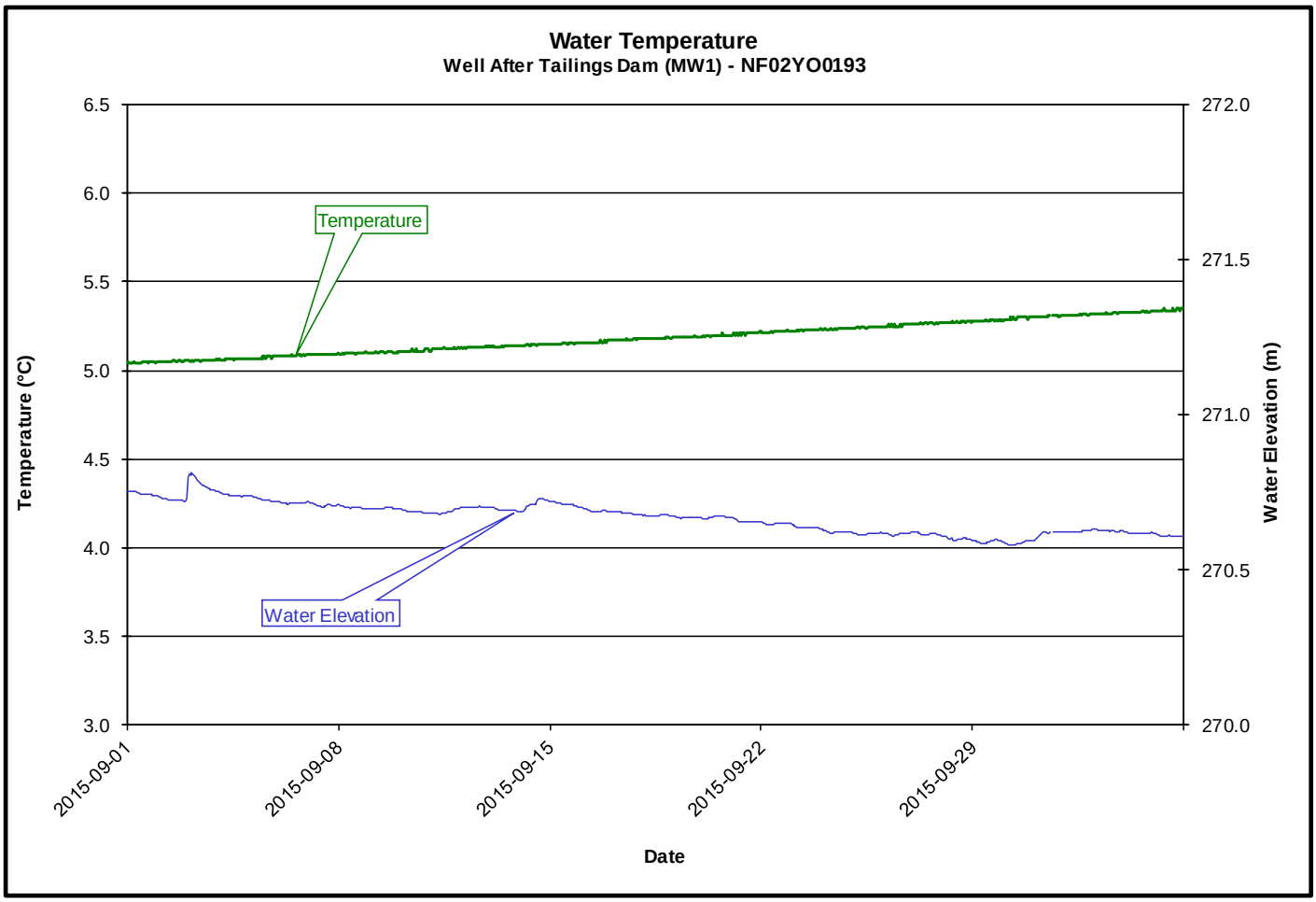

Figure 13

- The pH (**Figure 14**) ranged from a minimum of 8.44 to a maximum of 8.47.
- There was little change in pH over the deployment period.
- There does not appear to be any correlation with water elevation.

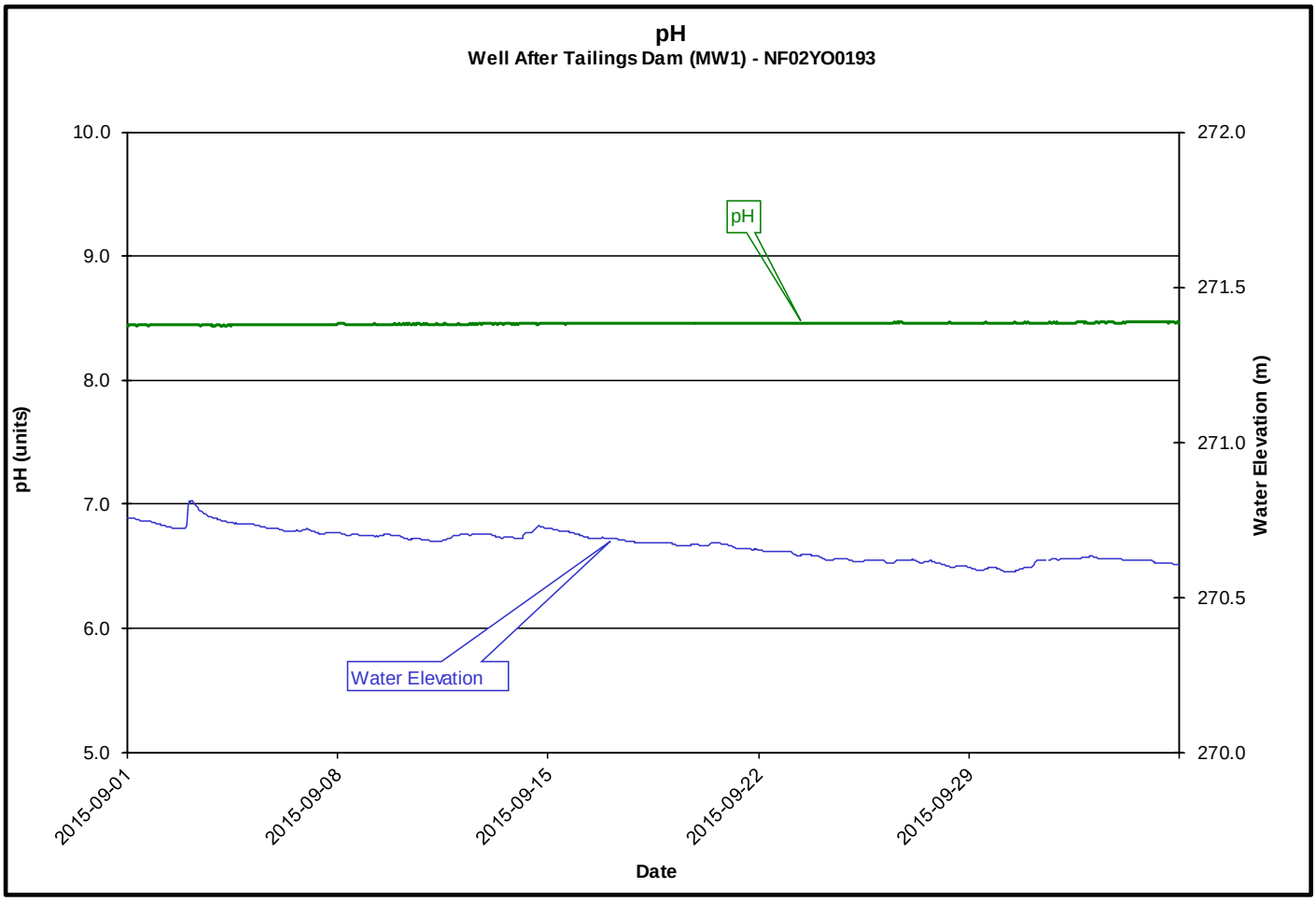

Figure 14

- The specific conductivity **(Figure 15)** ranged from a minimum of 0.783 mS/cm to a maximum of 0.801 mS/cm.
- There was a slight increase over the reporting period.

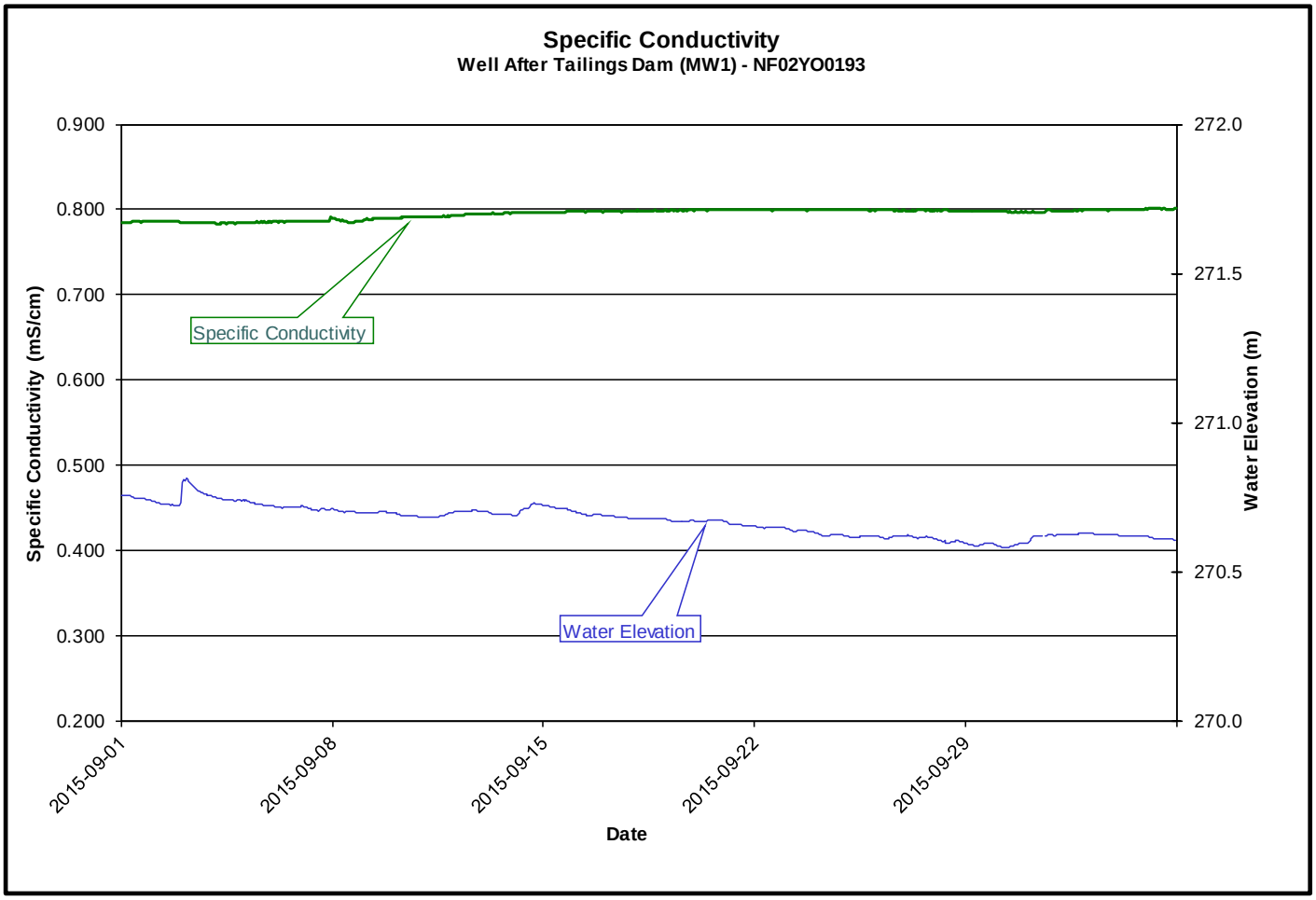

Figure 15

- The Water Elevation **(Figure 16)** ranged from a minimum of 270.58 m to a maximum of 270.81 m.
- 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.

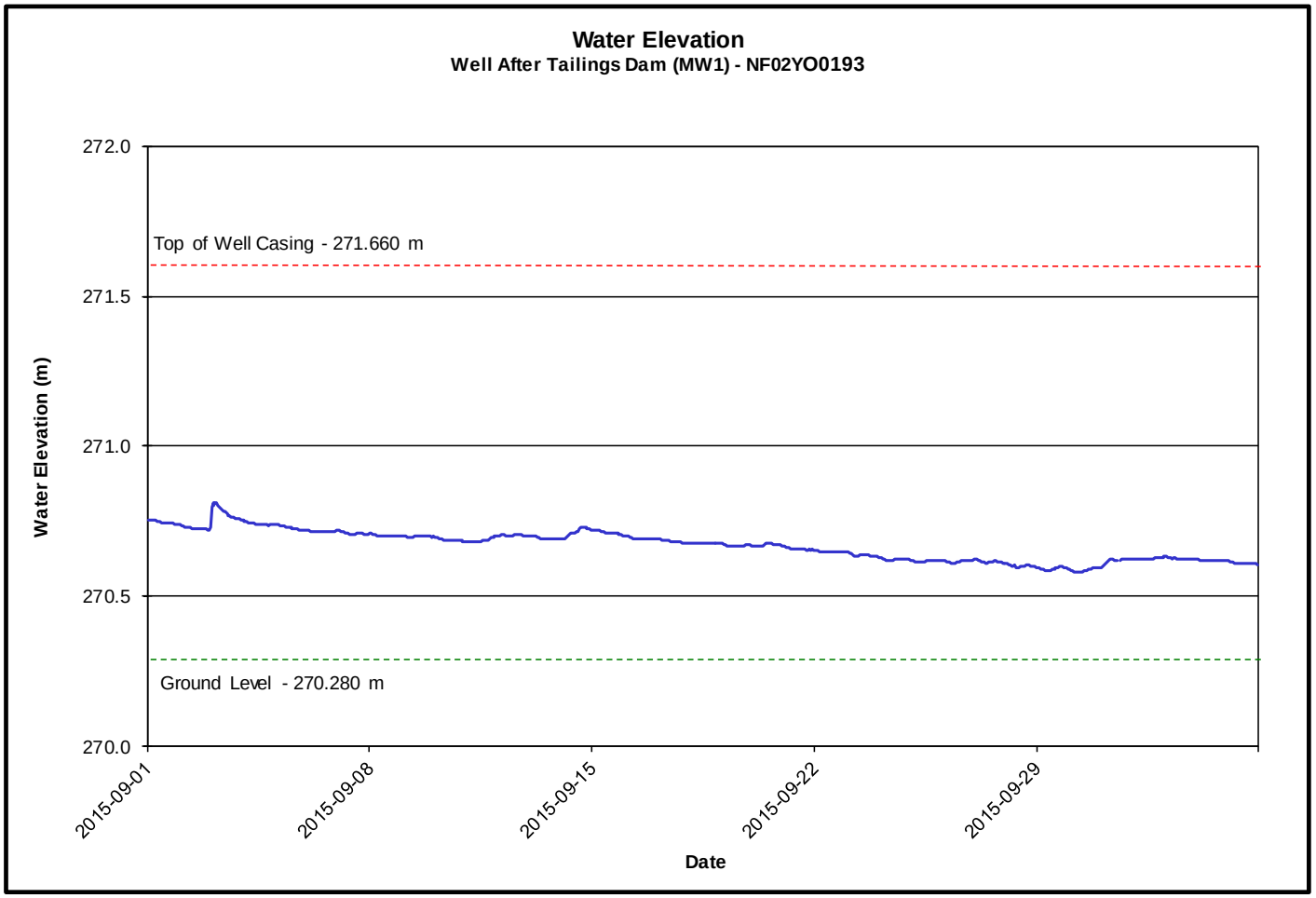

Figure 16

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