Real-Time Water Quality Deployment Report

Rattling Brook Network

October 4, 2013 to November 7, 2013

Newfoundland Labrador

Government of Newfoundland & Labrador
Department of Environment and Conservation
Water Resources Management Division
St. John's, NL, A1B 4J6 Canada

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2013-10-04 to 2013-11-07

General

- Department of Environment and Conservation staff monitors the real-time web pages consistently.

Maintenance and Calibration of Instrument

- As part of the Quality Assurance and Quality Control protocol (QAQC), 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.
  - Upon deployment, a QA/QC Sonde is temporarily deployed *in situ*, adjacent to the Field Sonde. Depending on the degree of difference between each parameter from the Field and QAQC sondes a qualitative rank is assigned (See Table 1). The possible ranks, from most to least desirable, are: Excellent, Good, Fair, Marginal, and Poor. A grab sample is also taken for additional confirmation of conditions at deployment and to allow for future modelling studies.
  - At the end of a deployment period, a freshly cleaned and calibrated QAQC Sonde is placed *in situ*, adjacent to the Field Sonde. Values are compared between all parameters and differences are ranked for placement in Table 1.

Table 1: Qualitative QAQC Ranking

Station	Date	Action	Comparison Ranking				
			Temperature	pH	Conductivity	Dissolved Oxygen	Turbidity
Rattling Brook Big Pond	October 4, 2013	Deployment	Excellent	Excellent	Good	Excellent	Excellent
	November 7, 2013	Removal	Excellent	NA	Fair	Excellent	Excellent
Rattling Brook below Bridge	October 4, 2013	Deployment	Excellent	Good	Good	Excellent	Excellent
	November 7, 2013	Removal	Good	Excellent	Good	Good	Excellent
Rattling Brook below Plant Discharge	October 4, 2013	Deployment	Excellent	Excellent	Excellent	Excellent	Excellent
	November 7, 2013	Removal	Good	Good	Good	Excellent	Excellent

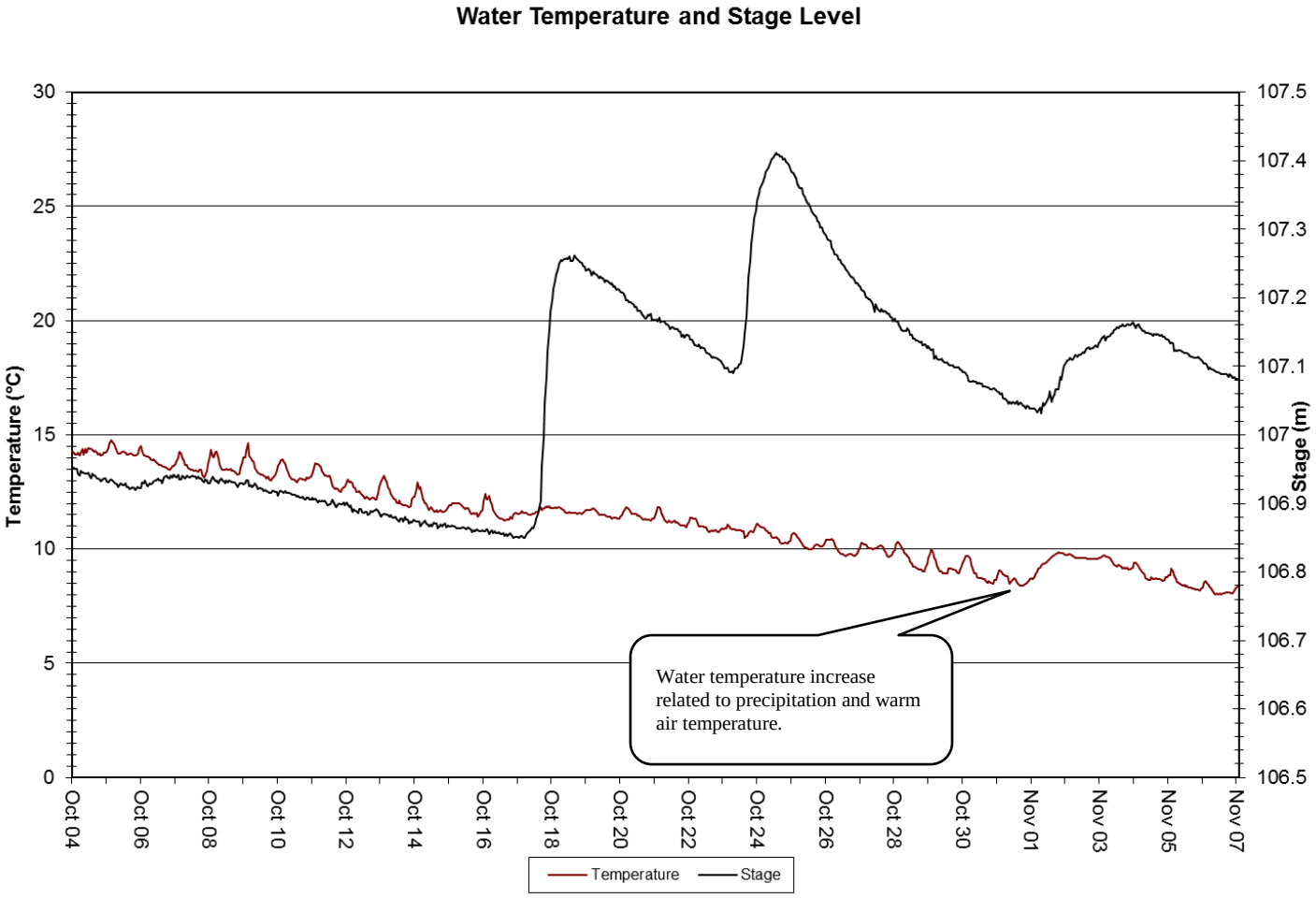
- pH values on the QAQC sonde read unreasonably low during deployment at Big Pond station – pH ranking is not accurate.

Data Interpretation

Temperature

Water Temperature is a major factor used to describe water quality. Temperature has major implications on both the ecology and chemistry of a water body, governing processes such as the metabolic rate of aquatic plants and animals and the degree of dissolved oxygen saturation.

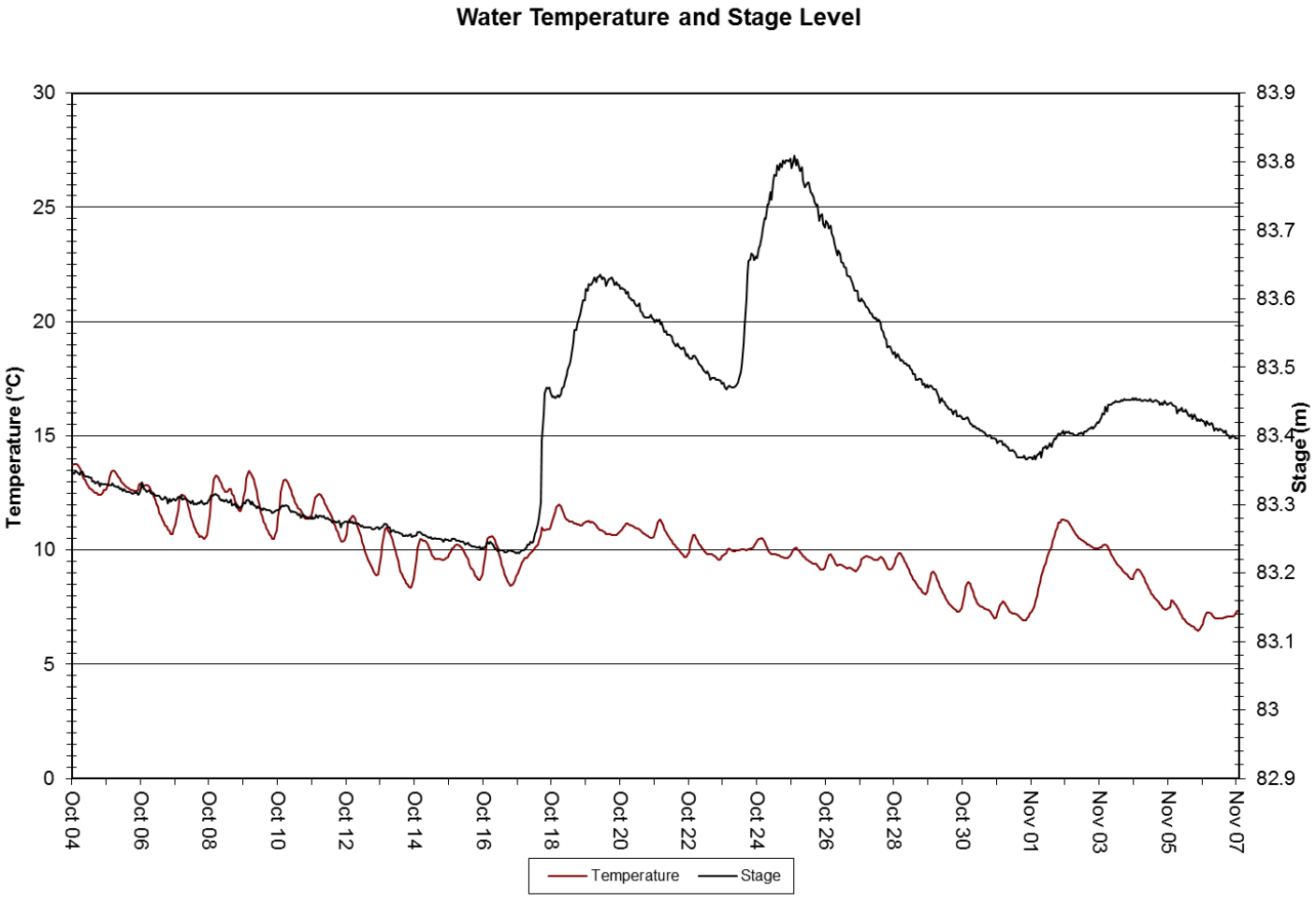
Figure 1: Water Temperature at Rattling Brook Big Pond from October 4 to November 7, 2013



Parameter	Max	Min	Median
Temperature('C)	14.76	8.01	11.31

- Water temperature declined steadily throughout this deployment period with a rise observed on November 1st. At this time, the mean temperature for the day was approximately 9.5°C with a total rainfall nearing 20 mm.

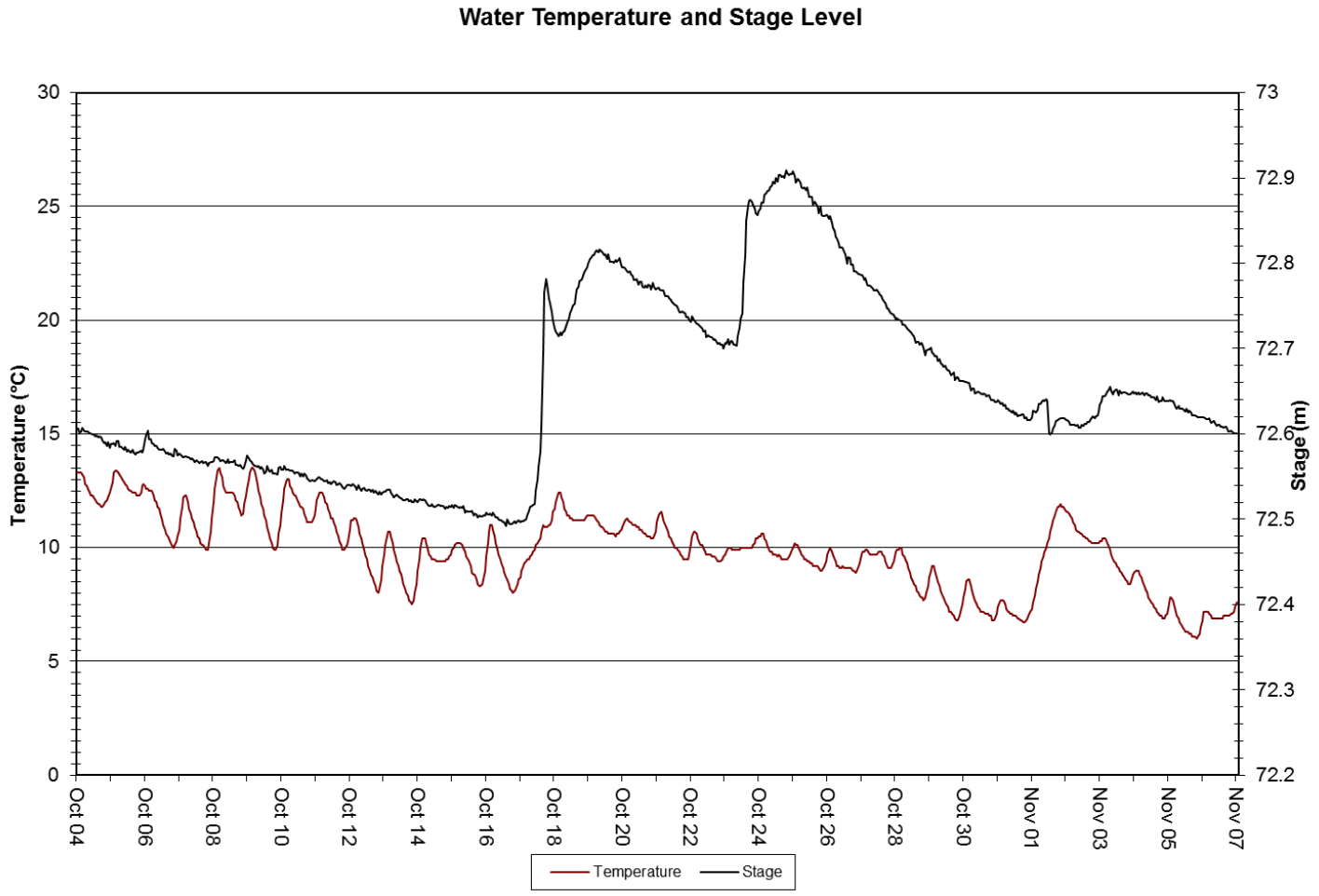
Figure 2: Water Temperature at Rattling Brook below Bridge from October 4 to November 7, 2013



Parameter	Max	Min	Median
Temperature('C)	13.76	6.48	10.05

- Two interruptions were observed in the downward temperature trend. On October 17th and November 1st, high precipitation and air temperatures resulted in water temperature rises.
- Maximum and minimum recorded temperatures were lower at Bridge station compared to Big Pond. At this time of the year, the still waters of Big Pond retain more heat than the moving and flowing waters of the river.

Figure 3: Water Temperature at Rattling Brook below Plant Discharge from October 4 to November 7, 2013



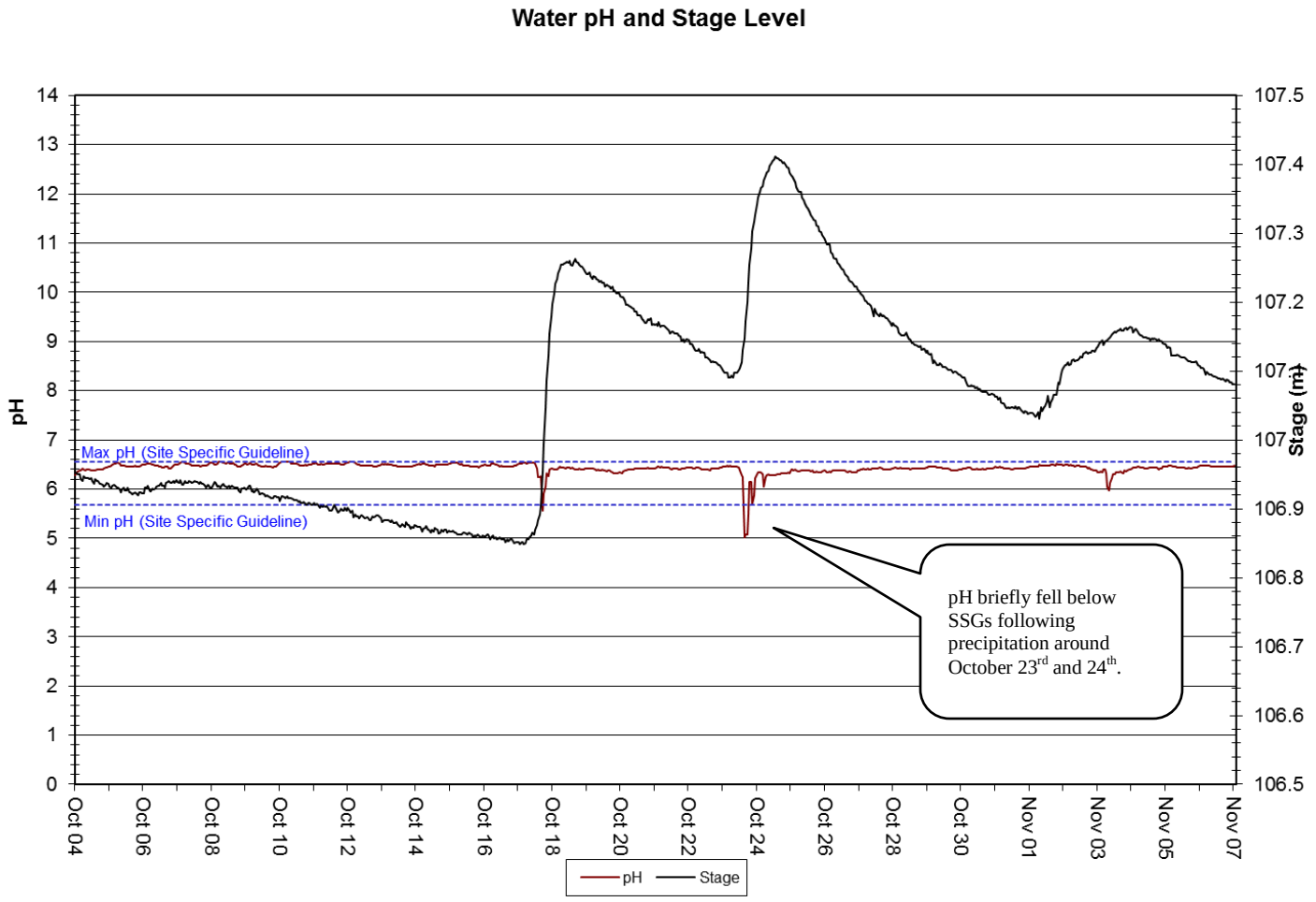
Parameter	Max	Min	Median
Temperature('C)	13.50	6.00	9.90

- Cooler water temperatures were observed at Plant Discharge station than at both Bridge and Big Pond stations. As the warm waters of Big Pond flow into Rattling Brook, heat is released through interaction with cool air.
- The decline in temperature was arrested twice during the deployment period: on October 17th and again on November 1st as a result of warm air temperatures and precipitation.

pH

pH is used to give an indication of the acidity or basicity of a solution. A pH of 7 denotes a neutral solution while lower values are acidic and higher values are basic. Technically, the pH of a solution indicates the availability of protons to react with molecules dissolved in water. Such reactions can affect how molecules function chemically and metabolically.

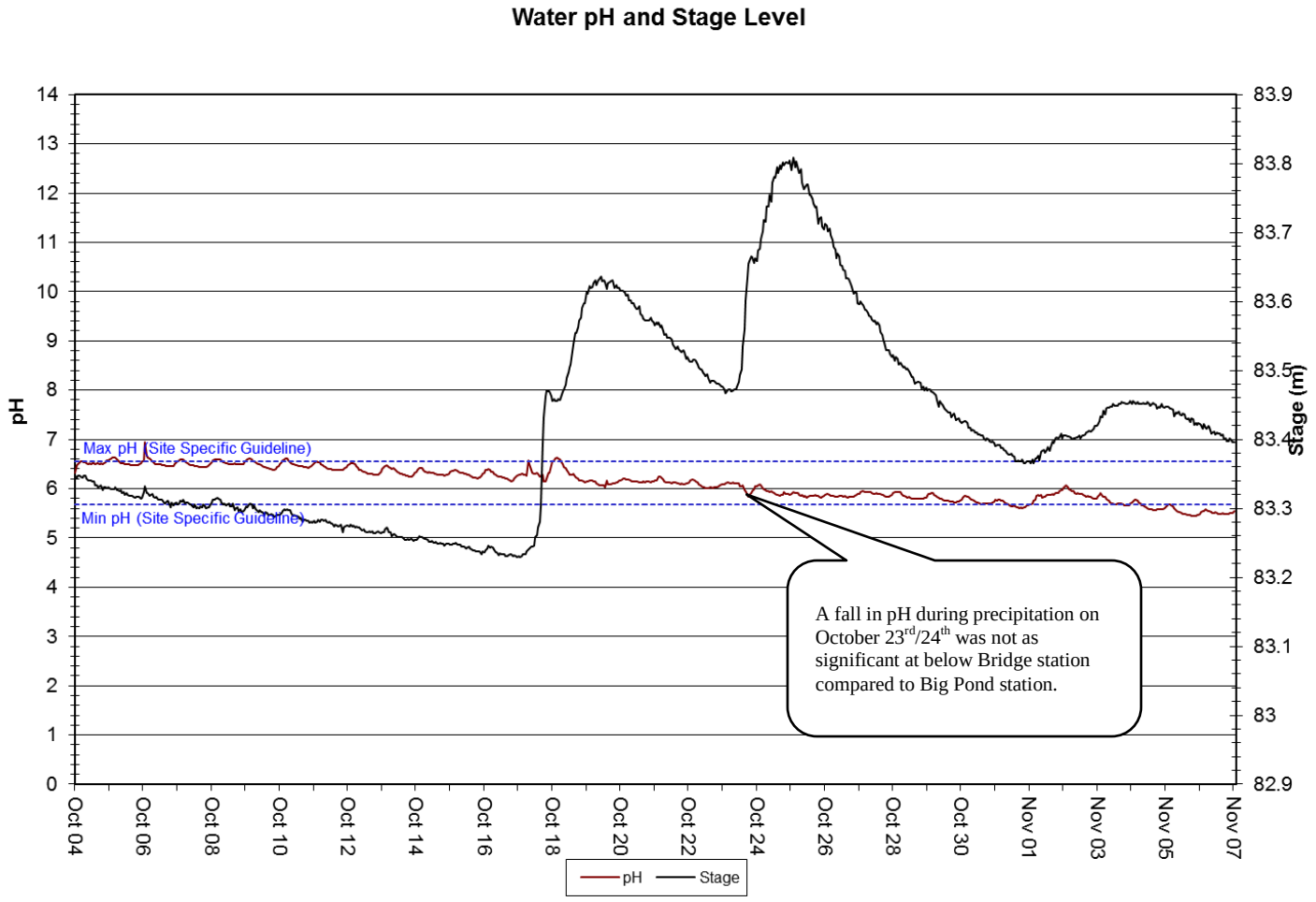
Figure 4: pH at Rattling Brook Big Pond from October 4 to November 7, 2013



Parameter	Max	Min	Median
pH	6.56	5.02	6.44

- pH was stable at Big Pond station during this deployment period except for three sharp drops associated with stage level increase. These three drops, occurring on October 17th, October 24th, and November 3rd are related to rainfall amounts of 10 mm, 40 mm, and ~7 mm, respectively.

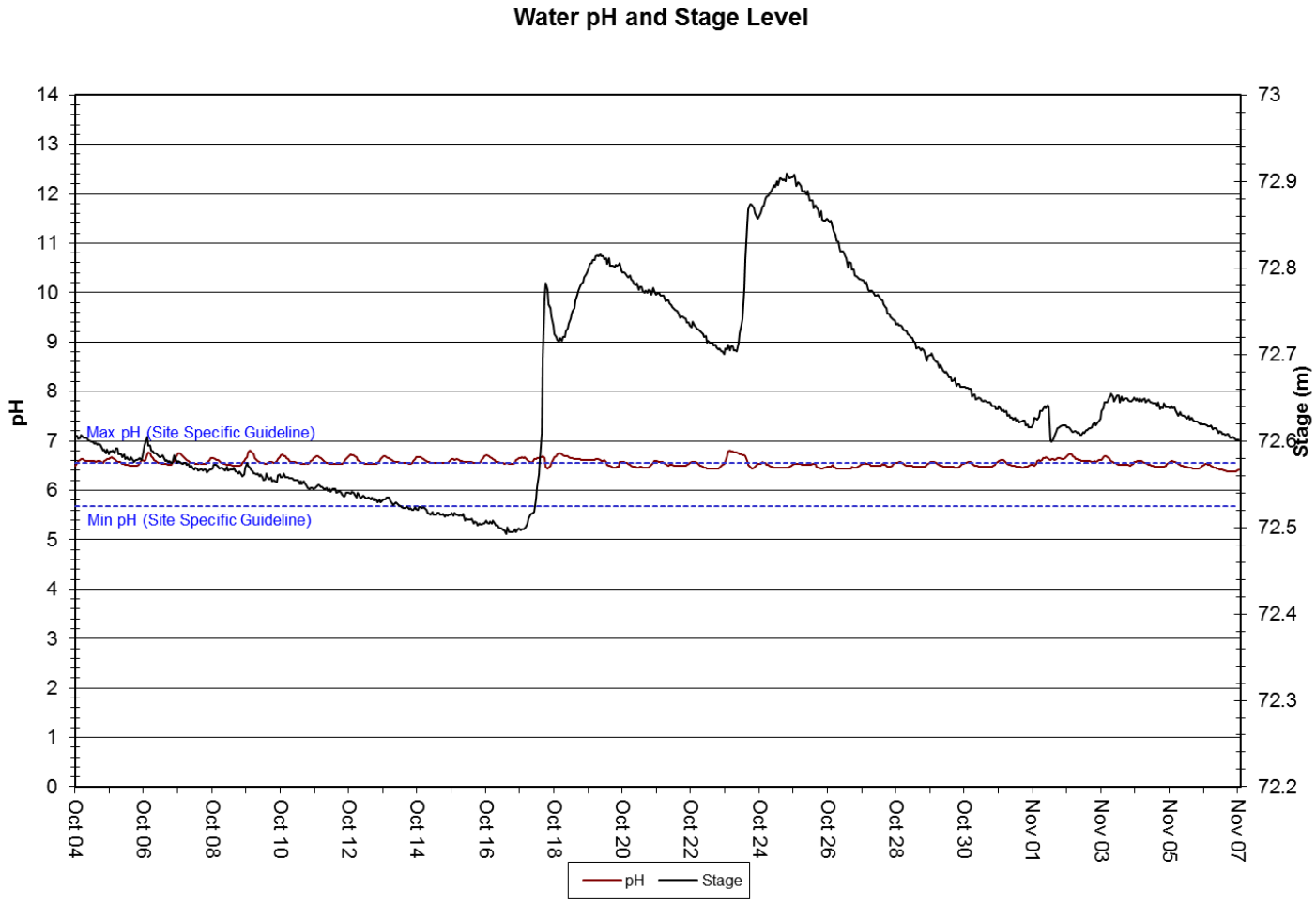
Figure 5: pH at Rattling Brook below Bridge from October 4 to November 7, 2013



Parameter	Max	Min	Median
pH	6.94	5.44	6.13

- pH fell throughout the deployment period, unlike the stable pH observed concurrently at Big Pond station. Most values fell within the Site Specific Guidelines for the Rattling Brook network.

Figure 6: pH at Rattling Brook below Plant Discharge from October 4 to November 7, 2013



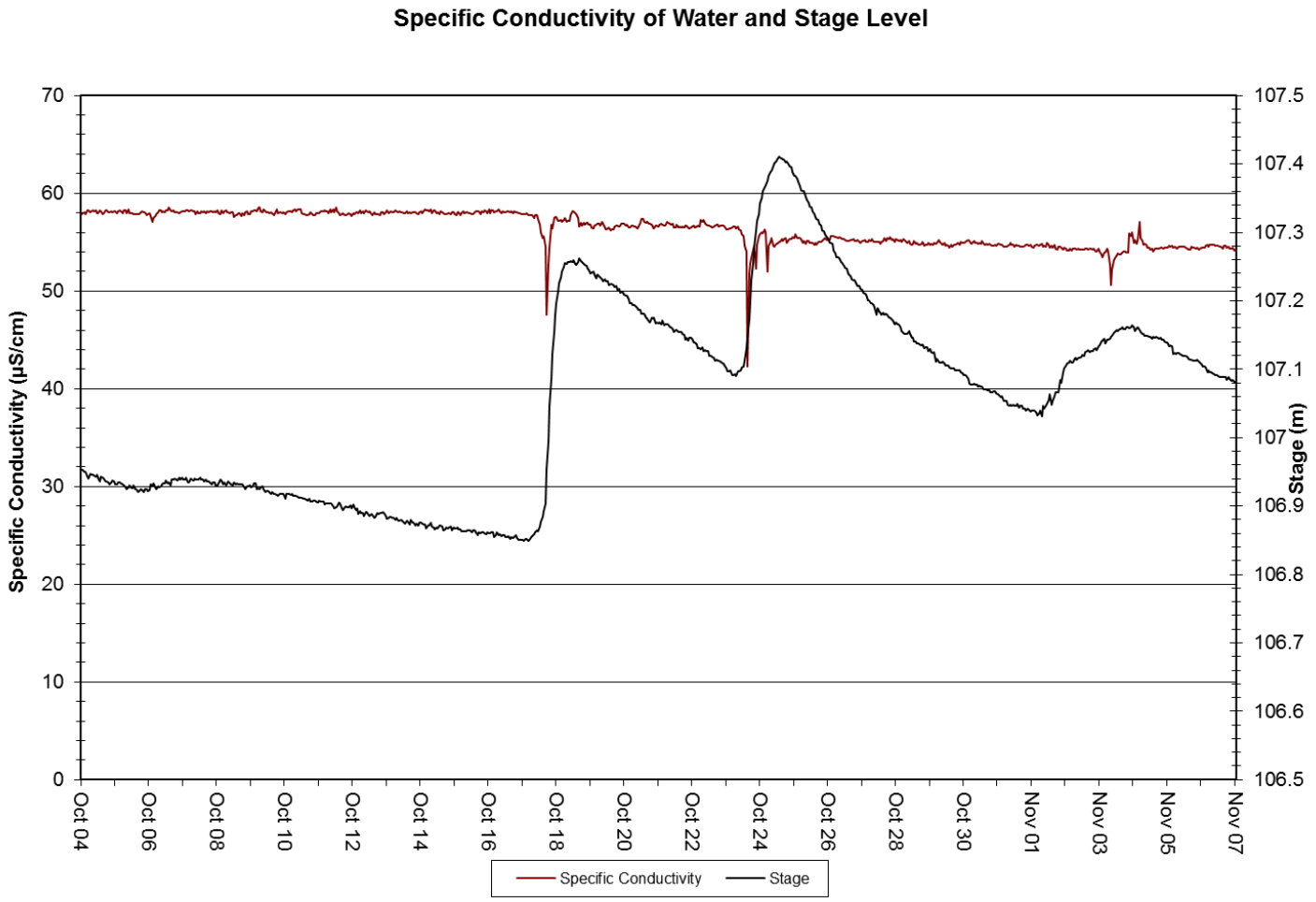
Parameter	Max	Min	Median
pH	6.80	6.37	6.55

- pH was stable during this deployment period with most values falling within the Site Specific Guidelines for Rattling Brook.

Specific Conductivity

Conductivity relates to the ease of passing an electric charge – or resistance – through a solution. Conductivity is highly influenced by the concentration of dissolved ions in solution: distilled water has zero conductivity (infinite resistance) while salty solutions have high conductivity (low resistance). Specific Conductivity is corrected to 25°C to allow comparison across variable temperatures.

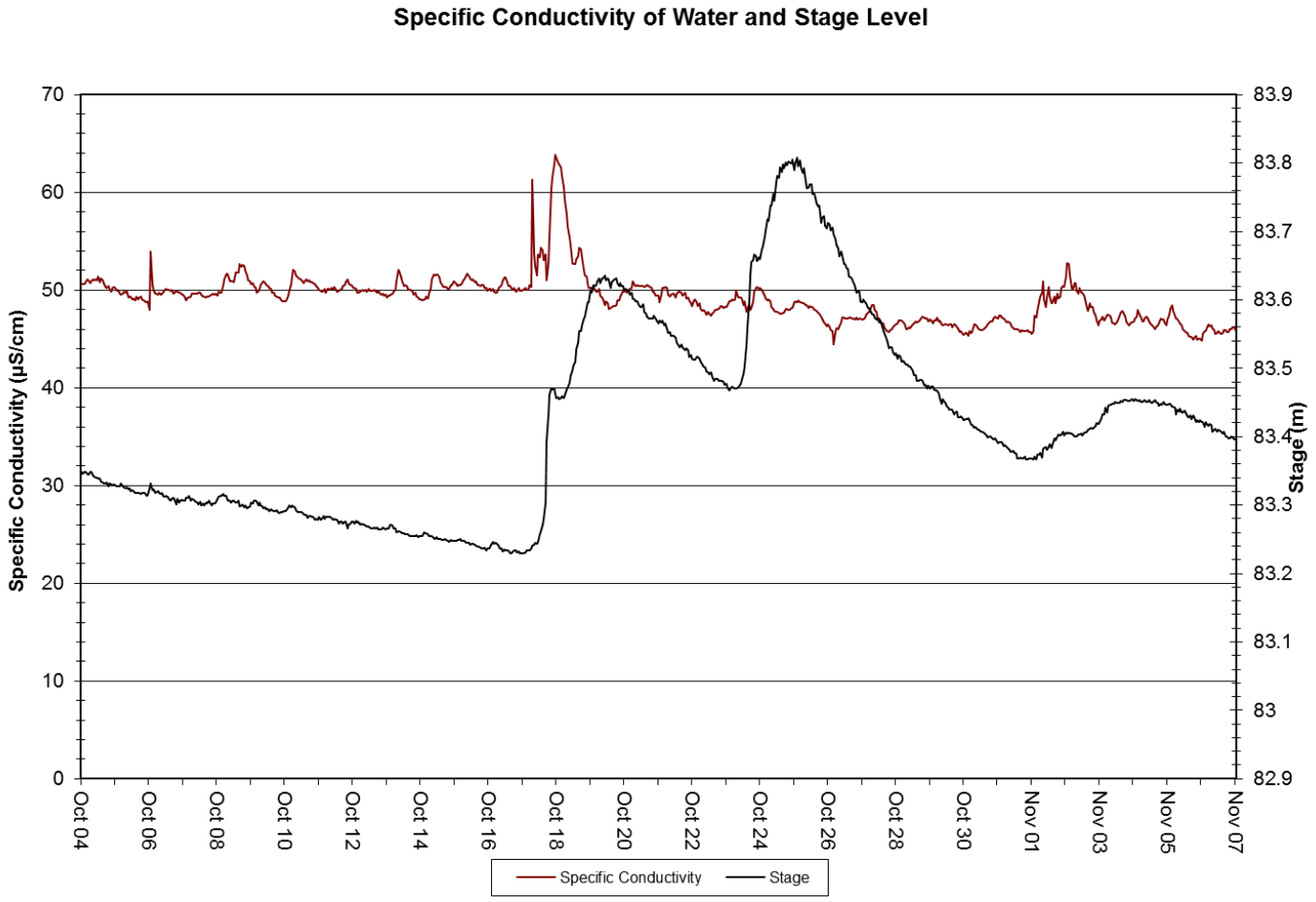
Figure 7: Conductivity at Rattling Brook Big Pond from October 4 to November 7, 2013



Parameter	Max	Min	Median
Specific Conductivity (µS/cm)	58.5	42.3	56.7

- Conductivity decreased over the course of this deployment period. This is likely the result of increasing water levels, evidenced by the fact that conductivity was stable until precipitation on October 17th. Following the heavy rainfall, conductivity declined consistently.

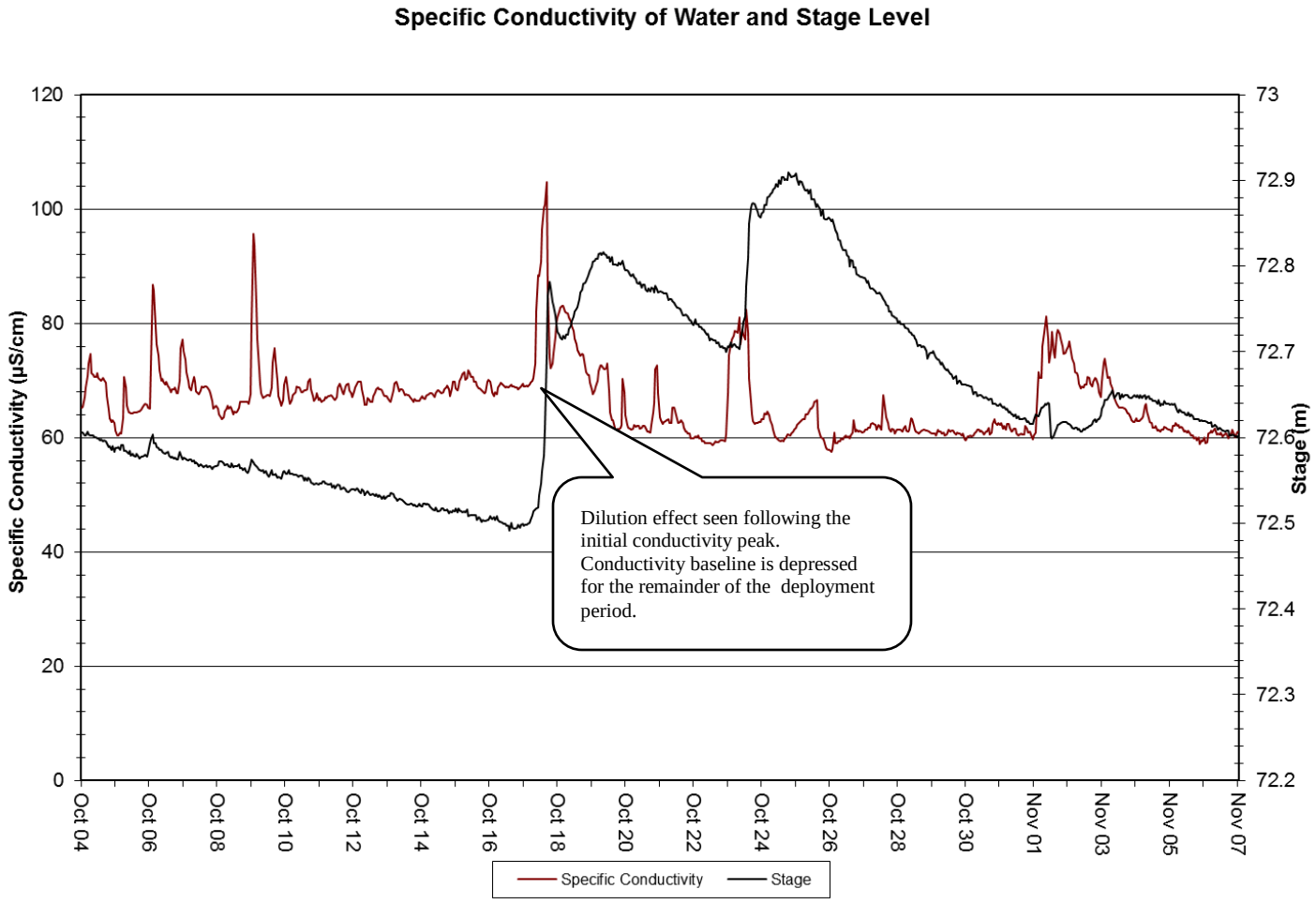
Figure 8: Conductivity at Rattling Brook below Bridge from October 4 to November 7, 2013



Parameter	Max	Min	Median
Specific Conductivity (µS/cm)	63.8	44.4	49.3

- Mirroring the trend at Big Pond station, conductivity decreased over the course of the deployment period. This is likely the result of relatively pure precipitation entering the Rattling Brook watershed and diluting the dissolved solids and salts that are normally present.
- Two large peaks in conductivity are observed concurrently with drops at Big Pond station. Superficially, this seems to be counterintuitive; however, unlike Big Pond, Rattling Brook intercepts much more overland flow from disturbed areas that contains silt and sediment.

Figure 9: Conductivity at Rattling Brook below Plant Discharge from October 4 to November 7, 2013



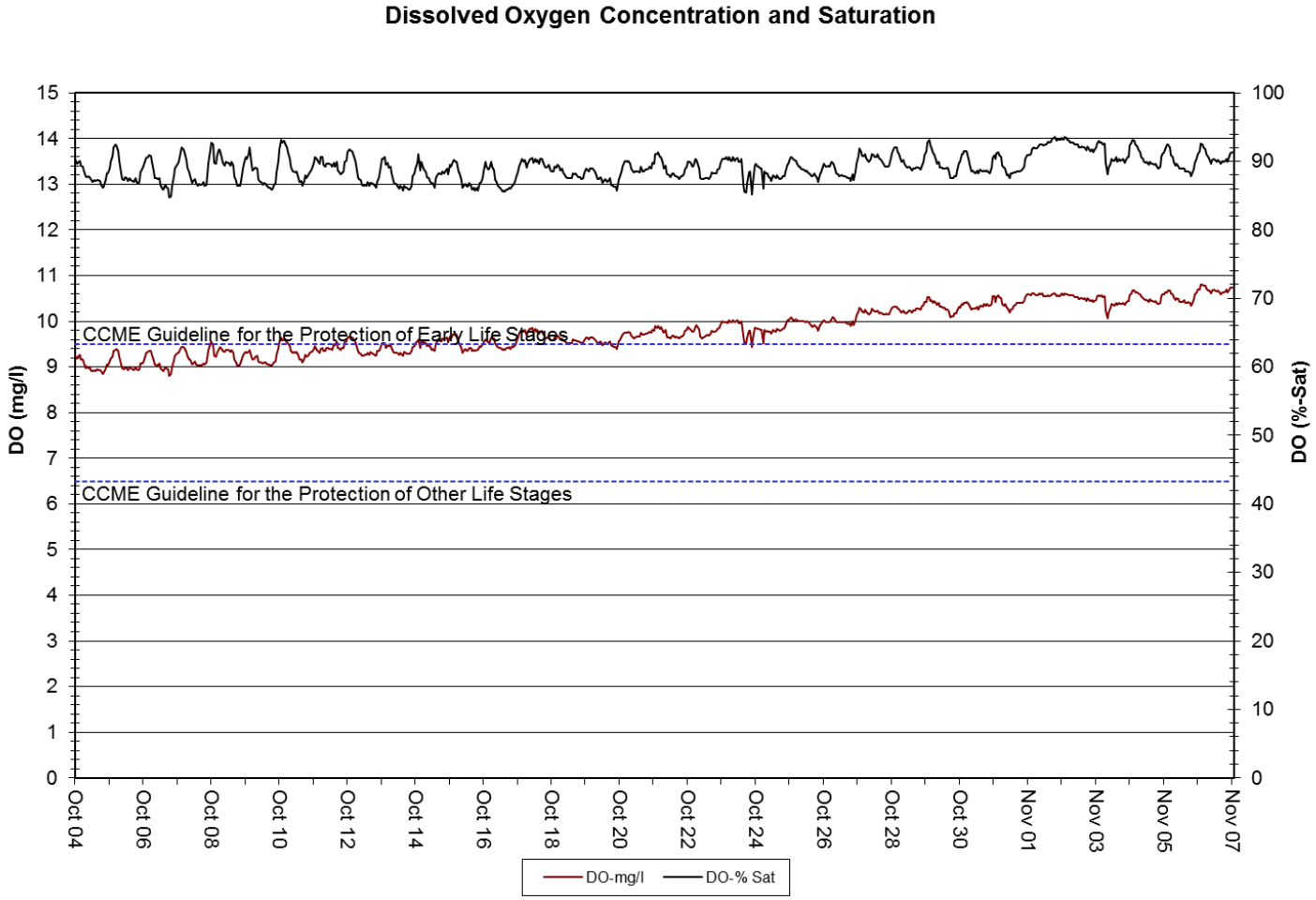
Parameter	Max	Min	Median
Specific Conductivity (µS/cm)	104.7	57.6	65.7

- Conductivity was higher at Plant Discharge station than both Bridge and Big Pond station due to the continual influx of dissolved solids along the length of the river channel. Peaks in conductivity are notable around times of high precipitation such as October 17th and November 1st, though a noticeable dilution effect seems to have occurred after high precipitation on October 17th.

Dissolved Oxygen

Dissolved oxygen is a metabolic requirement of aquatic plants and animals. The concentration of oxygen in water depends on many factors, especially temperature – the saturation of oxygen in water is inversely proportional to water temperature. Oxygen concentrations also tend to be higher in flowing water compared to still, lake environments. Low oxygen concentrations can give an indication of excessive decomposition of organic matter or the presence of oxidizing materials.

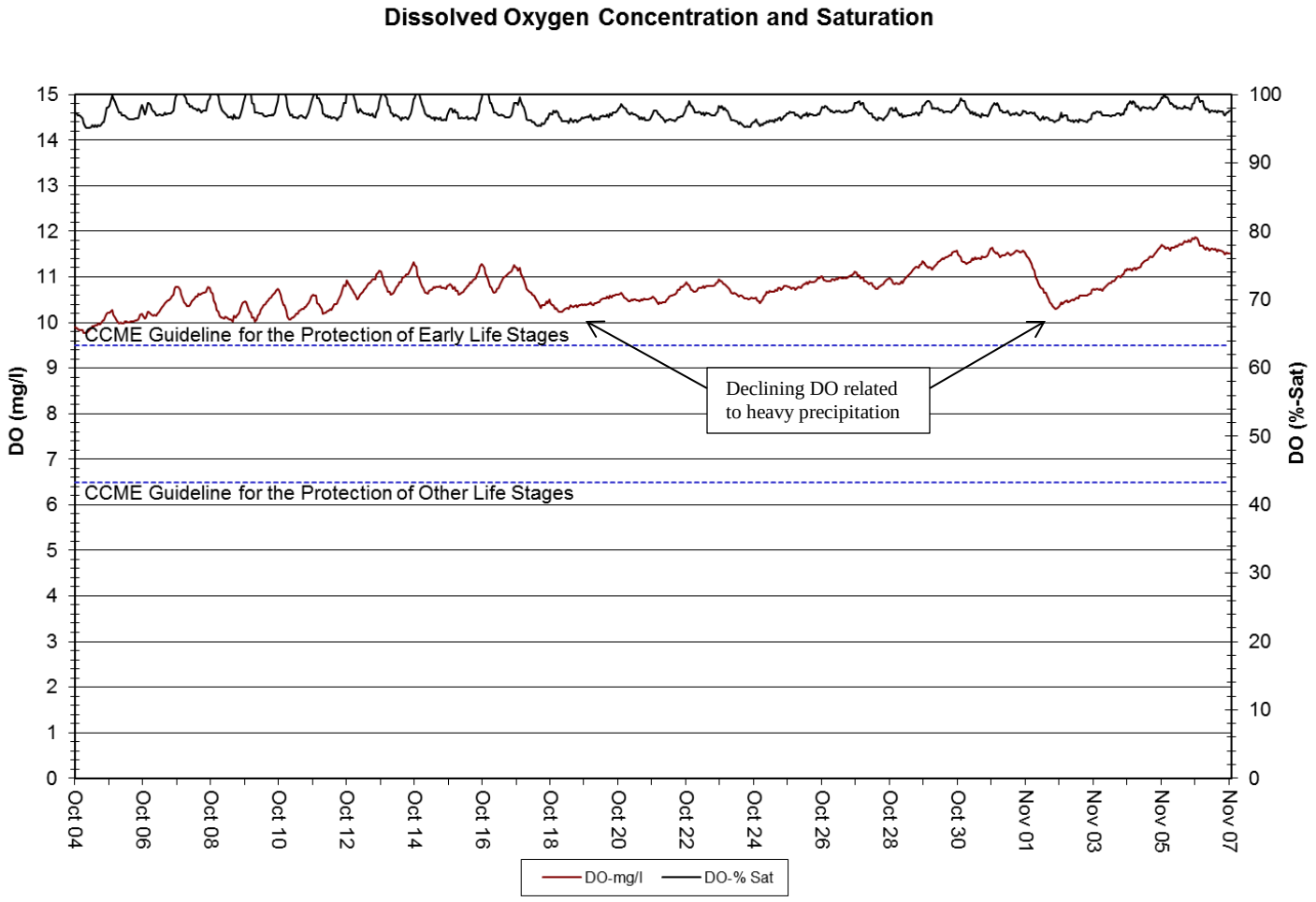
Figure 10: Dissolved Oxygen at Rattling Brook Big Pond from October 4 to November 7, 2013



Parameter	Max	Min	Median
Dissolved Oxygen (%-Sat)	93.6	84.7	89.1
Dissolved Oxygen (mg/l)	10.81	8.81	9.72

- Dissolved oxygen concentration increased consistently from October 4th to November 7th as water temperature fell. Oxygen levels are expected to be at their annual high until water temperatures begin to rise in March, 2014.

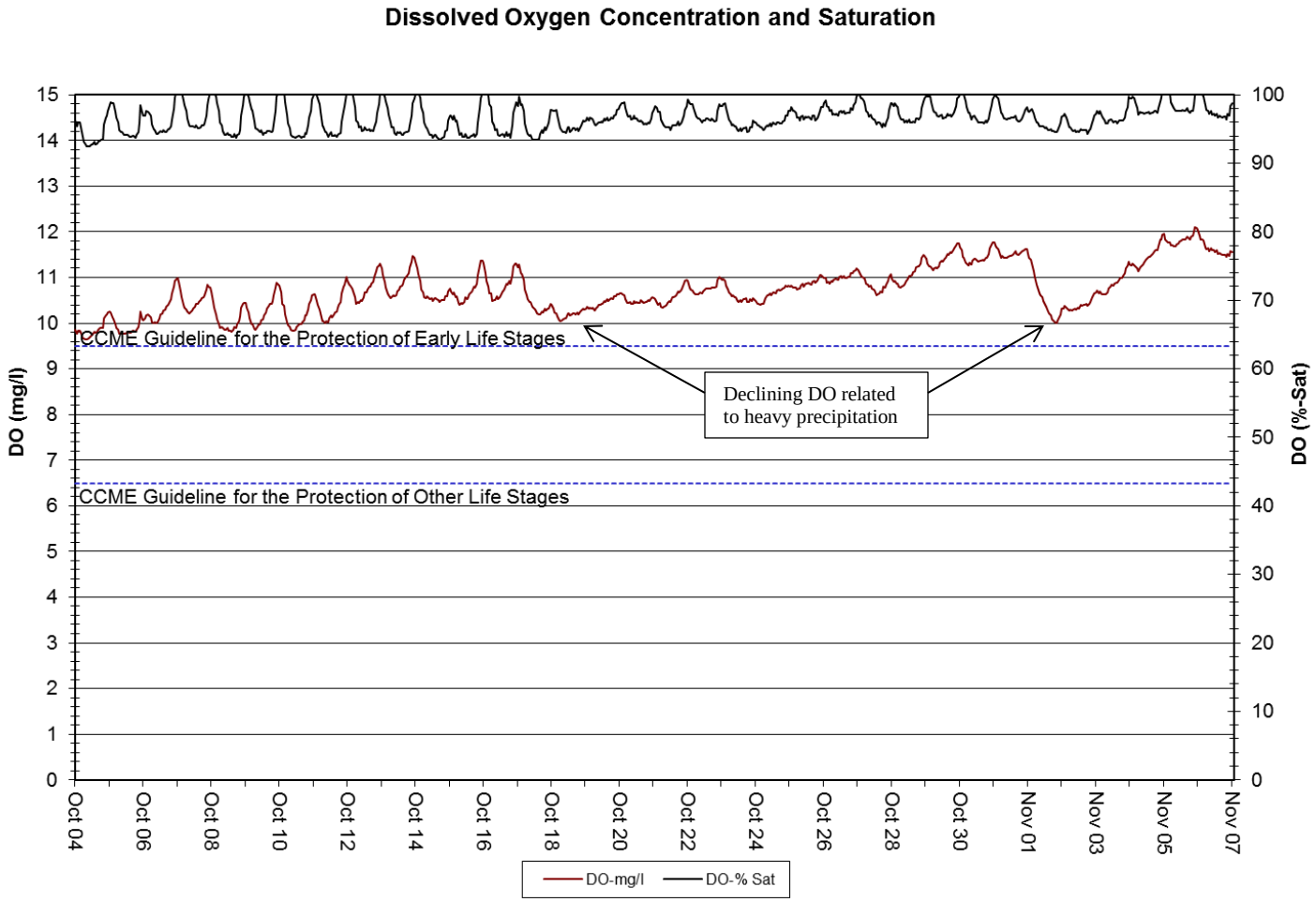
Figure 11: Dissolved Oxygen at Rattling Brook below Bridge from October 4 to November 7, 2013



Parameter	Max	Min	Median
Dissolved Oxygen (%-Sat)	101.0	95.1	97.2
Dissolved Oxygen (mg/l)	11.88	9.78	10.73

- All dissolved oxygen values were found to be above the minimum CCME guidelines for the protection of cold water biota. Oxygen concentrations greater than 9.5 mg/l are typical for this time of the year as water temperature falls to the annual low.
- Two instances of declining DO were seen on October 17th and November 1st during heavy precipitation.

Figure 12: Dissolved Oxygen at Rattling Brook below Plant Discharge from October 4 to November 7, 2013



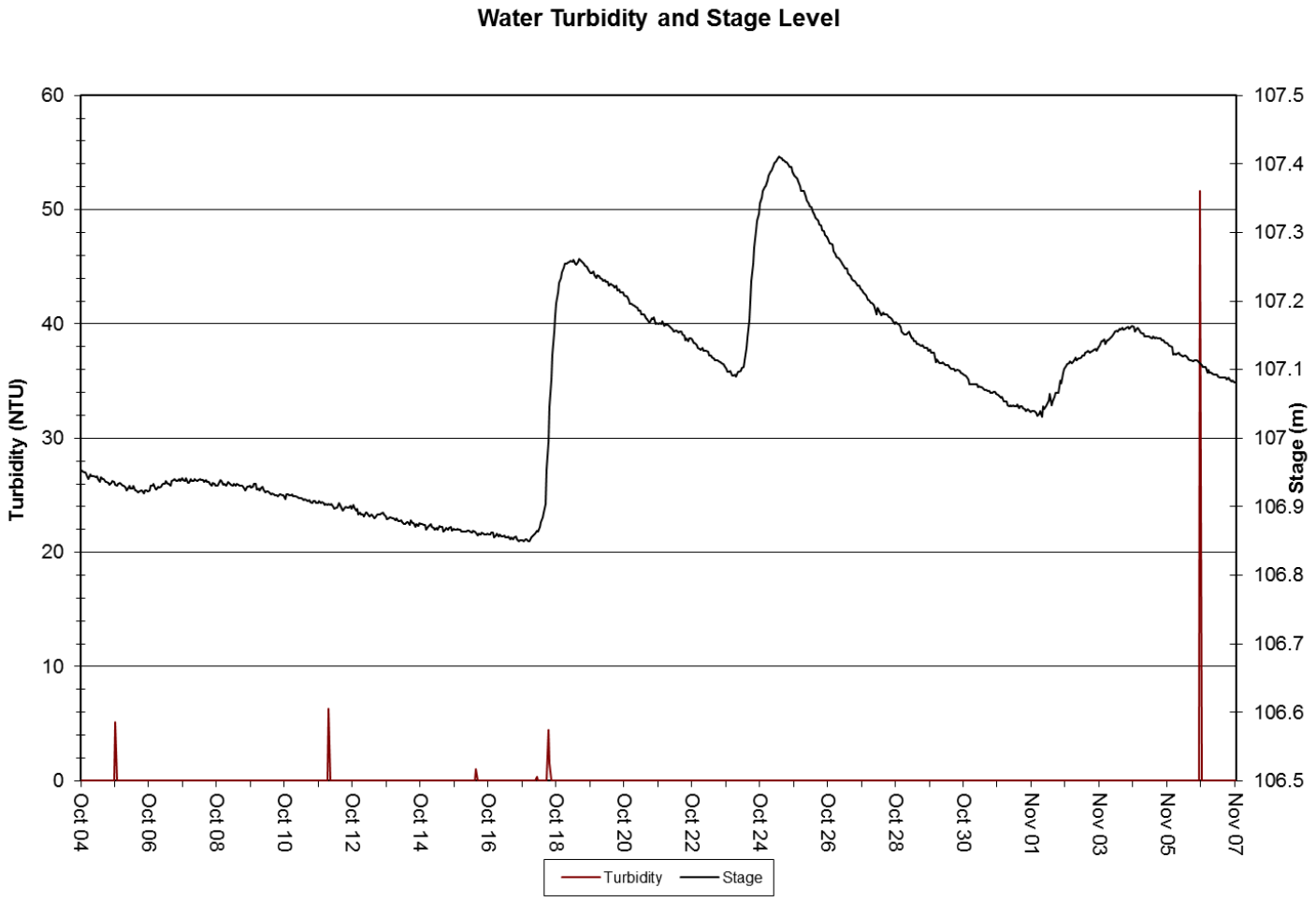
Parameter	Max	Min	Median
Dissolved Oxygen (%-Sat)	101.5	92.4	96.4
Dissolved Oxygen (mg/l)	12.11	9.64	10.66

- Oxygen concentration was greater than the minimum CCME guideline for the protection of aquatic life for the duration of this deployment. DO levels are expected to remain high until water temperatures begin to warm in March, 2014.

Turbidity

Turbidity is typically caused by fine suspended solids such as silt, clay, or organic material. Consistently high levels of turbidity tend to block sunlight penetration into a waterbody, discouraging plant growth. High turbidity can also damage the delicate respiratory organs of aquatic animals and cover spawning areas.

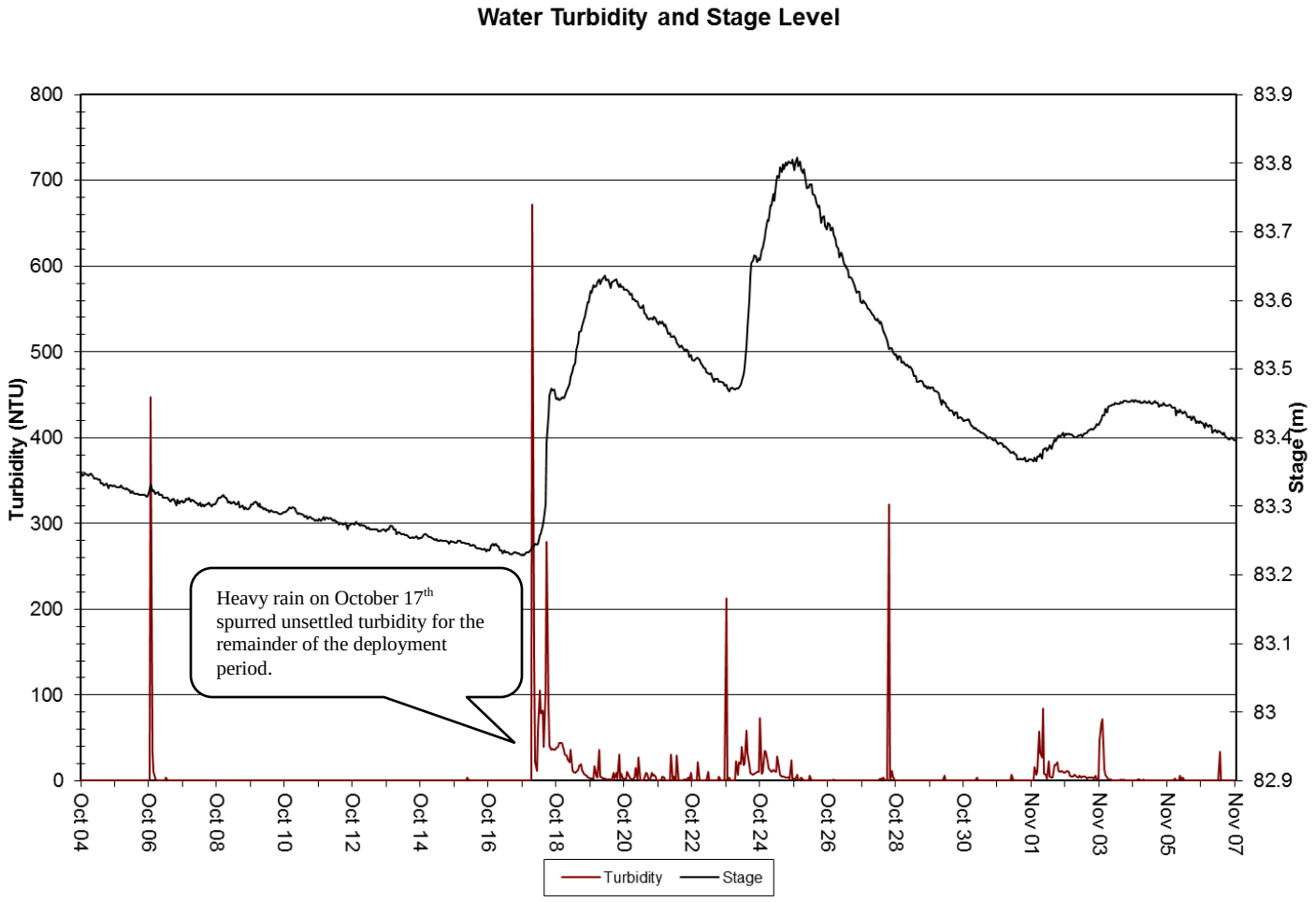
Figure 13: Turbidity at Rattling Brook Big Pond from October 4 to November 7, 2013



Parameter	Max	Min	Median
Turbidity (NTU)	51.6	0.0	0.0

- Low turbidity levels are typical of Big Pond with periodic short-term peaks that generally resolve within an hour. The turbidity spike seen on November 6th may be a false observation caused by a temporary blockage of the sensor or a very localised disturbance near the instrument.

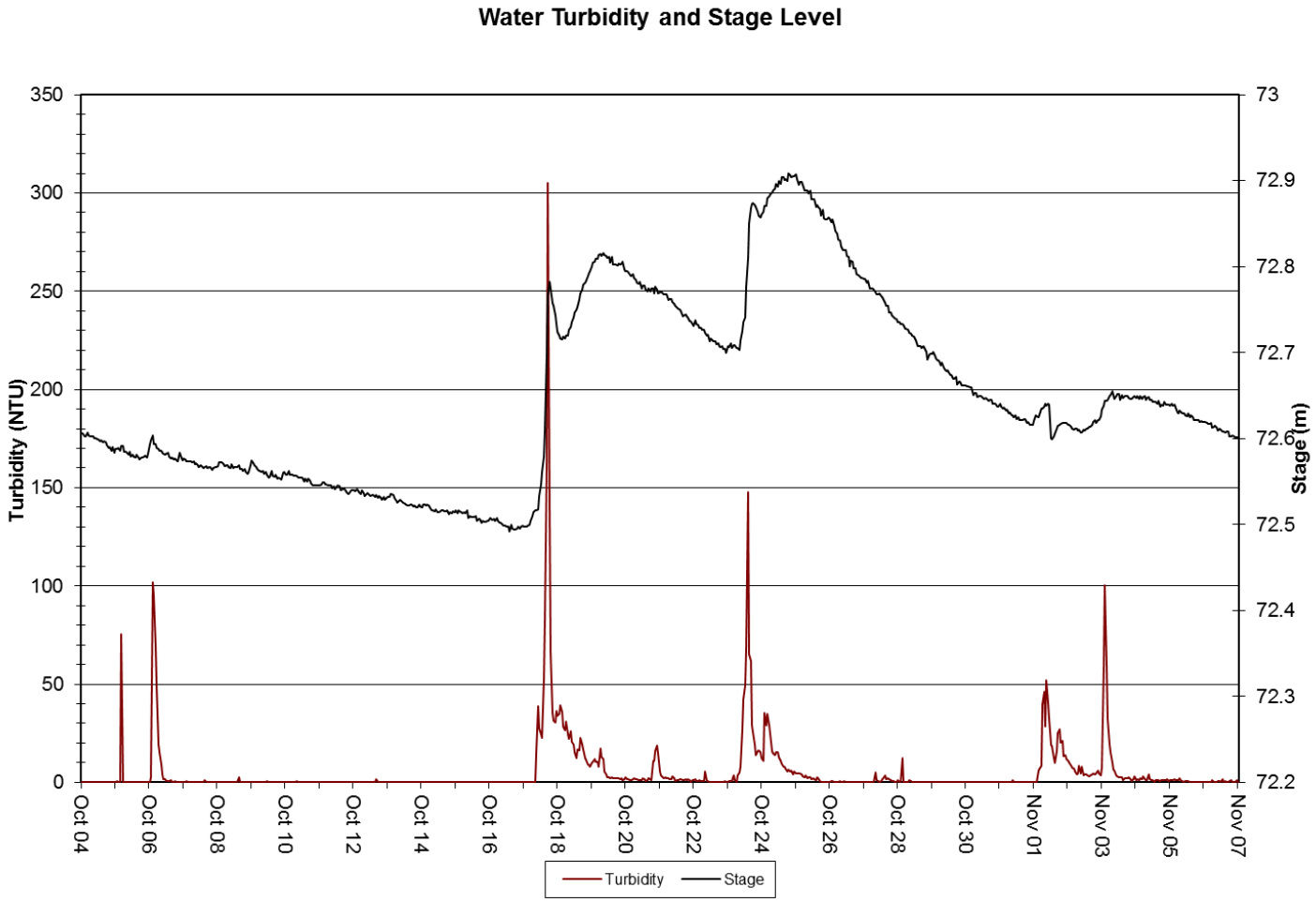
Figure 14: Turbidity at Rattling Brook below Bridge from October 4 to November 7, 2013



Parameter	Max	Min	Median
Turbidity (NTU)	672.0	0.0	0.0

- A comparison of the above graph with the graph of total precipitation found in the Appendix shows that, prior to almost 40 mm of precipitation on October 17th, turbidity was consistently low. Heavy rains spurred the release of silt and sediment from the banks of Rattling Brook resulting in variable and unsettled conditions within the river system.

Figure 15: Turbidity at Rattling Brook below Plant Discharge from October 4 to November 7, 2013



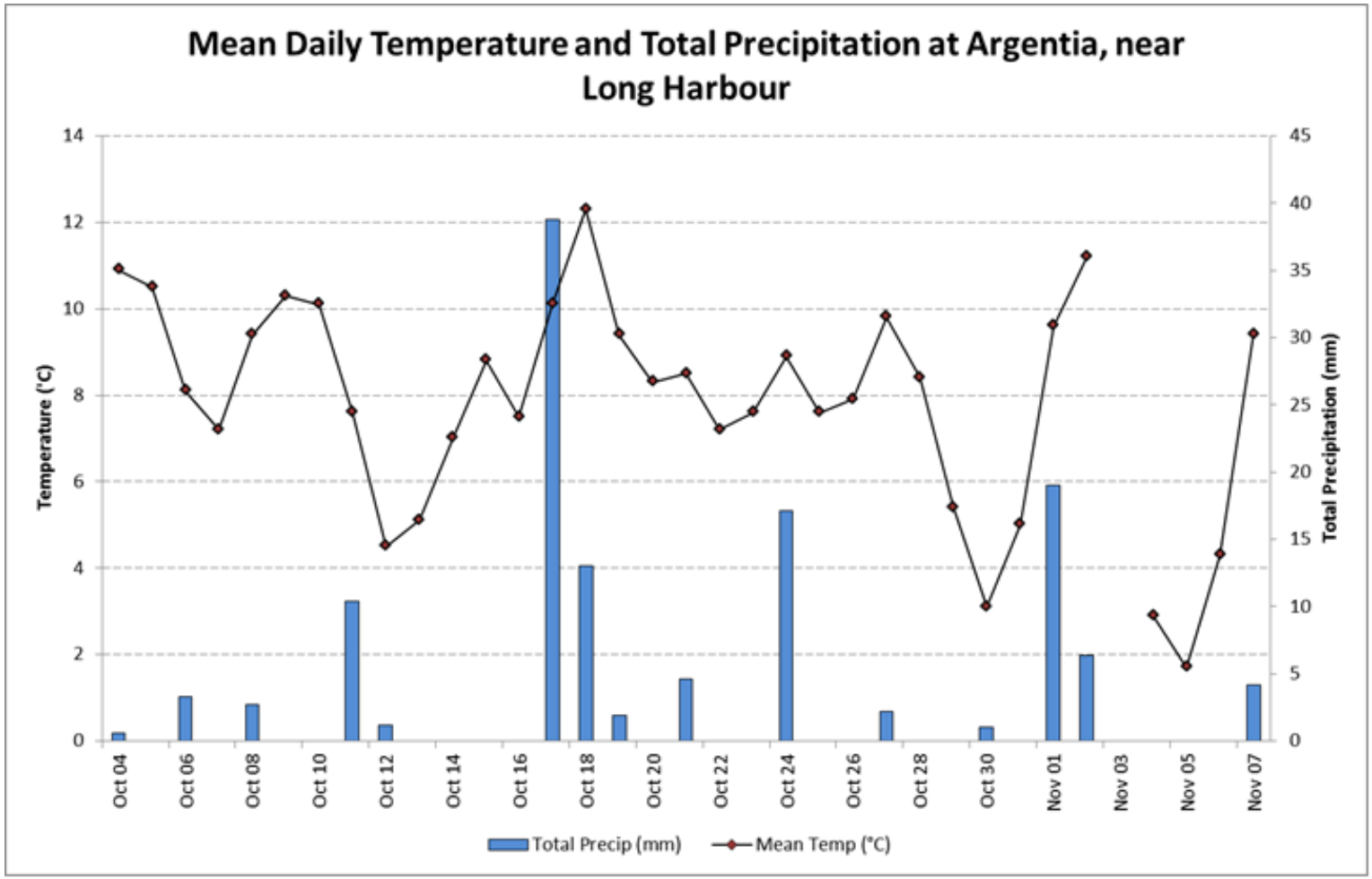
Parameter	Max	Min	Median
Turbidity (NTU)	304.9	0.0	0.0

- Continuing the declining trend in turbidity levels at Plant Discharge station, this deployment marks the first times since March 2011 where median turbidity levels were 0.0 NTU. All turbidity peaks present can be closely associated with rainfall events outlined in the Appendix. Turbidity events are seen to resolve within a few days – slightly longer than turbidity events observed during the initial monitoring in 2009. Further improvements are expected over time.

Conclusions

- All water quality parameters fall within the expected ranges for this time of year. No concerns are noted at this time.

Appendix



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