Real-Time Water Quality Deployment Report

Rattling Brook Network

July 26th, 2013 to August 22nd, 2013

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

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2013-07-26 to 2013-08-22

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	July 26, 2013	Deployment	NA	Excellent	Excellent	Fair	Excellent
	August 22, 2013	Removal	Excellent	Good	Excellent	Excellent	Excellent
Rattling Brook below Bridge	July 26, 2013	Deployment	NA	Good	Excellent	Good	Good
	August 22, 2013	Removal	Good	Good	Excellent	Excellent	Excellent
Rattling Brook below Plant Discharge	July 26, 2013	Deployment	NA	NA	NA	NA	NA
	August 23, 2013	Removal	NA	Excellent	Excellent	Good	Excellent

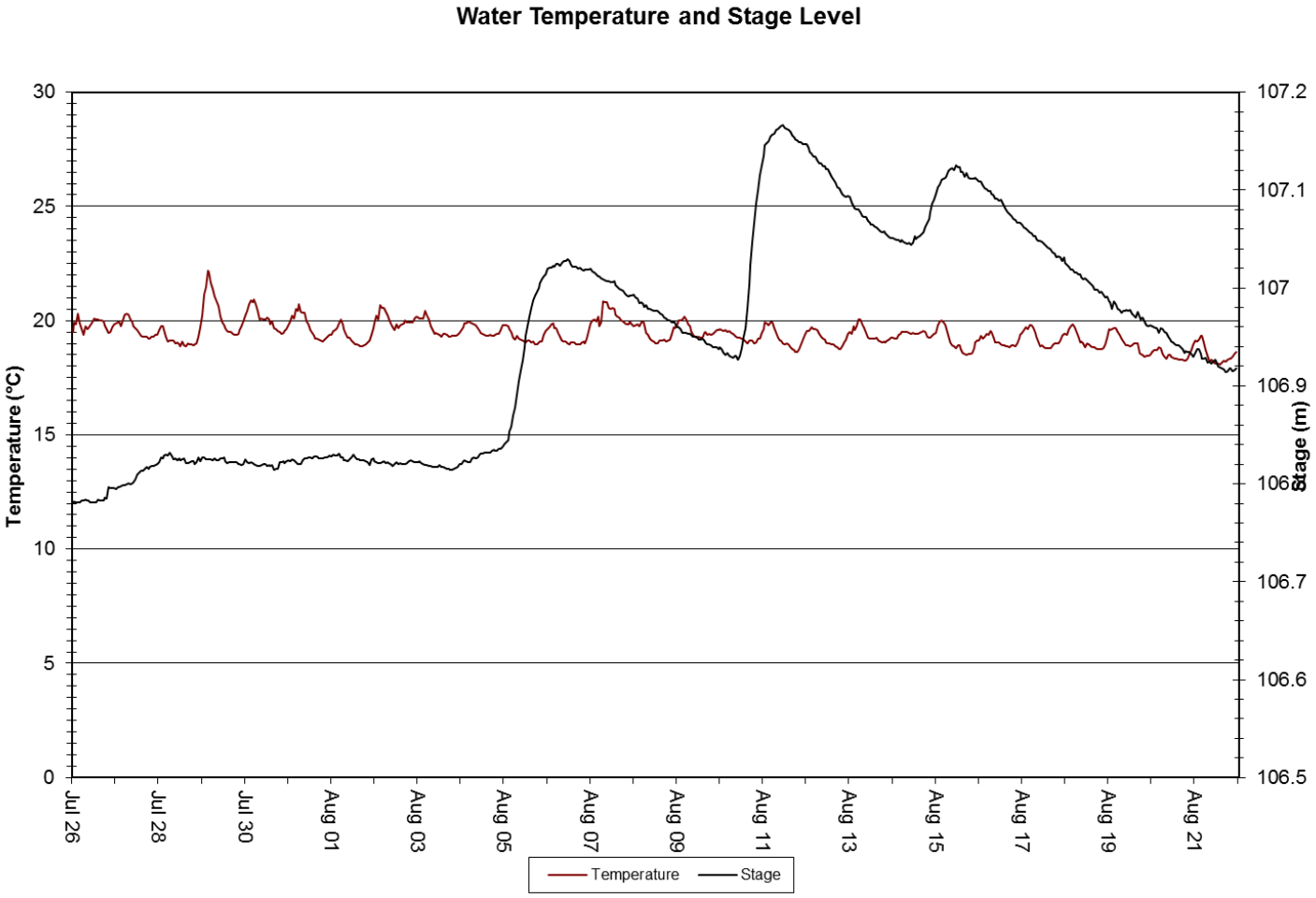
- Note: Instrument s/n 43679 was used as the QAQC sonde during deployment of Big Pond and Bridge stations, but was deployed as the Field sonde at Plant Discharge station due to a fault with the regular instrument at Plant Discharge station. After investigation of the data, it appears that 43679 tends to read temperatures lower than actual values. This resulted in unfairly poor rankings of temperature at Big Pond and Bridge. Possible impact on other temperature-compensated sensors may have occurred since dissolved oxygen rankings are lower across the deployments than normal. Specific conductivity doesn't appear to have been impacted.

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.

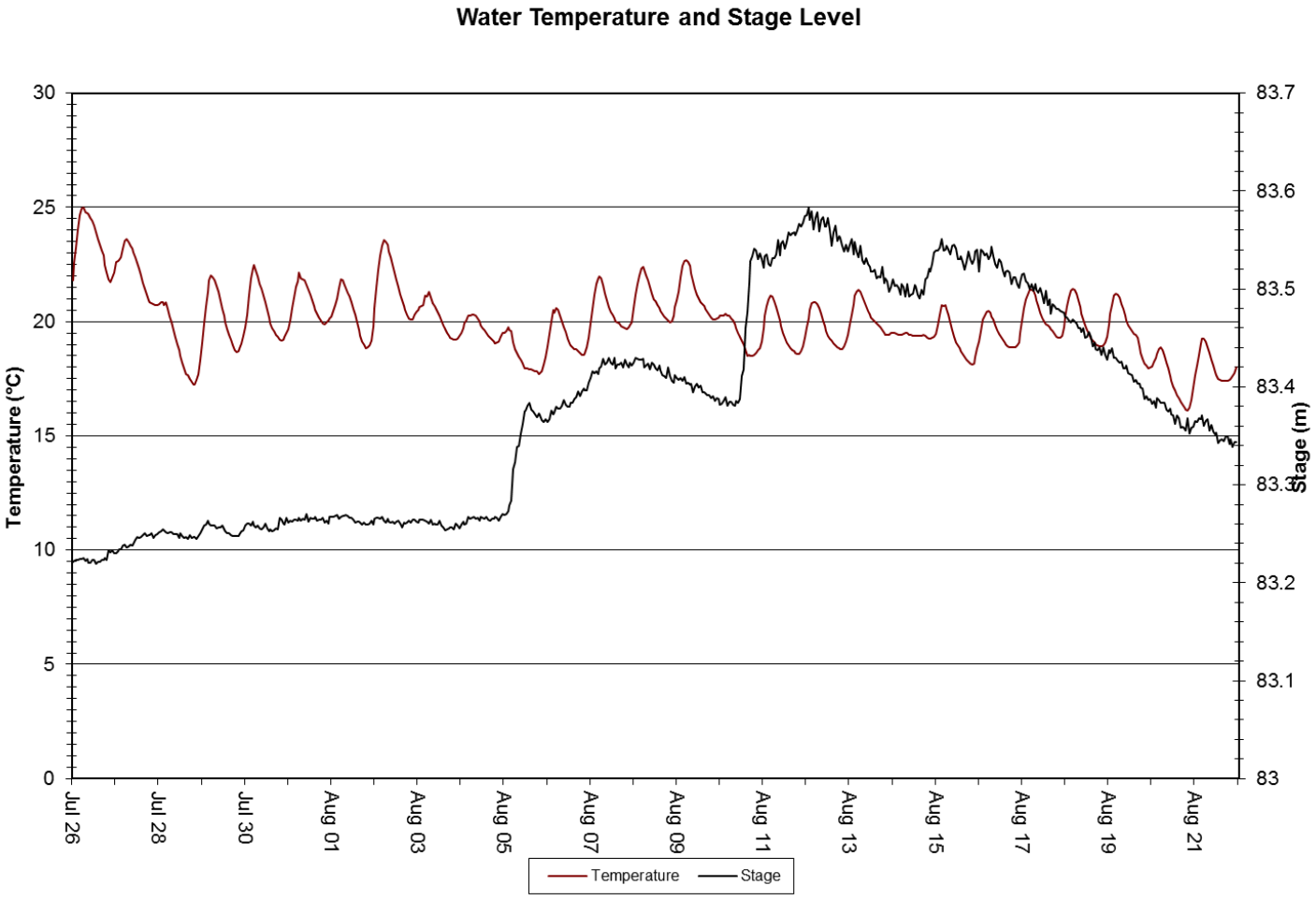
Figure 1: Water temperature at Rattling Brook Big Pond from July 26 to August 22, 2013



Parameter	Max	Min	Median	Mean
Temperature('C)	22.17	18.09	19.38	19.41

- A slight downward trend in water temperature was observed during this deployment period, beginning the decline into cooler fall months. A general increasing trend is not expected until late February, 2014.

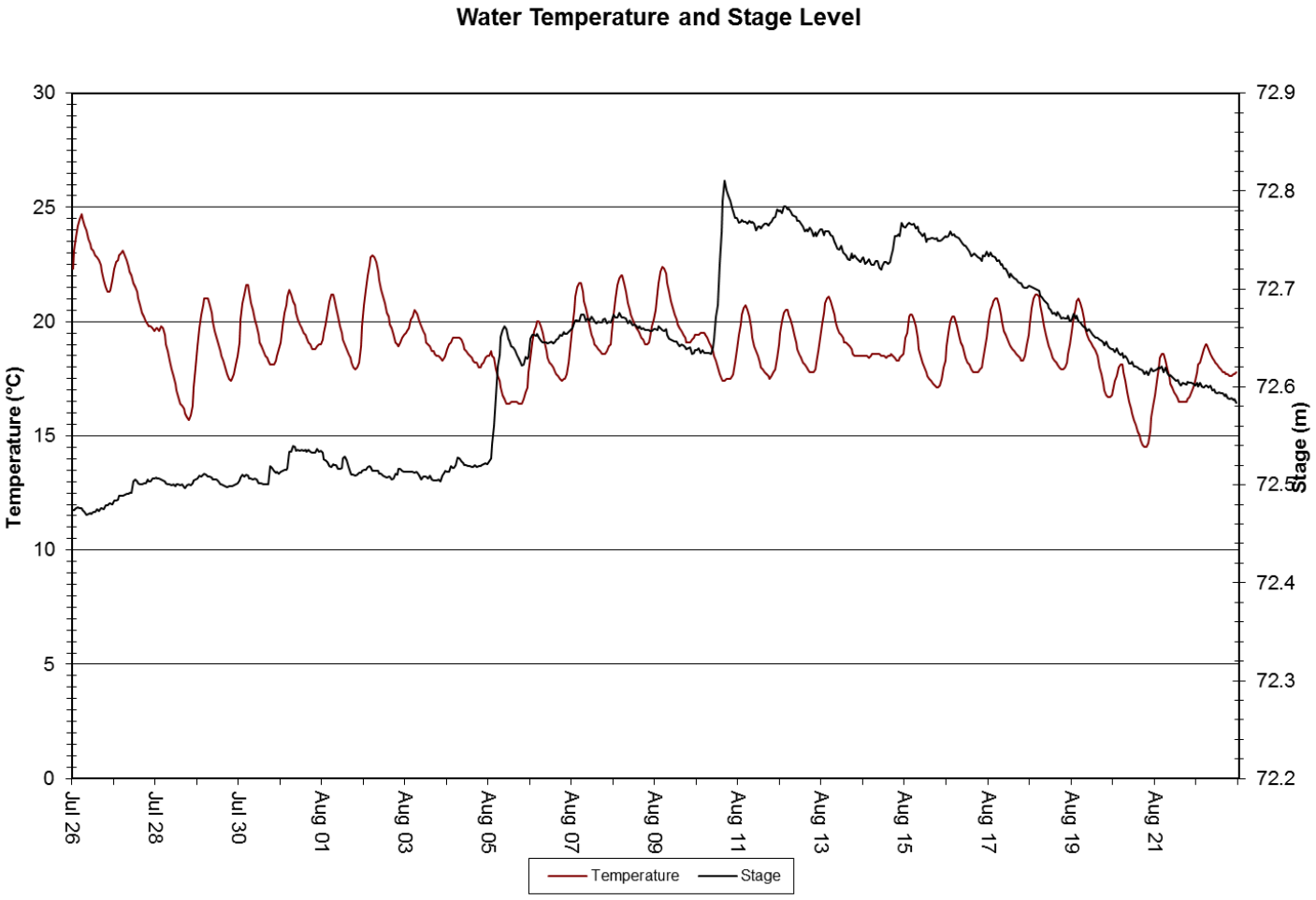
Figure 2: Water temperature at Rattling Brook below Bridge from July 26 to August 23, 2013



Parameter	Max	Min	Median	Mean
Temperature('C)	24.98	16.12	19.93	20.03

- As observed at Big Pond station, water temperature at Bridge station has also initiated its downward trend. In general, however, water temperature was slightly higher at this station compared to Big Pond.

Figure 3: Water temperature at Rattling Brook below Plant Discharge from July 26 to August 22, 2013



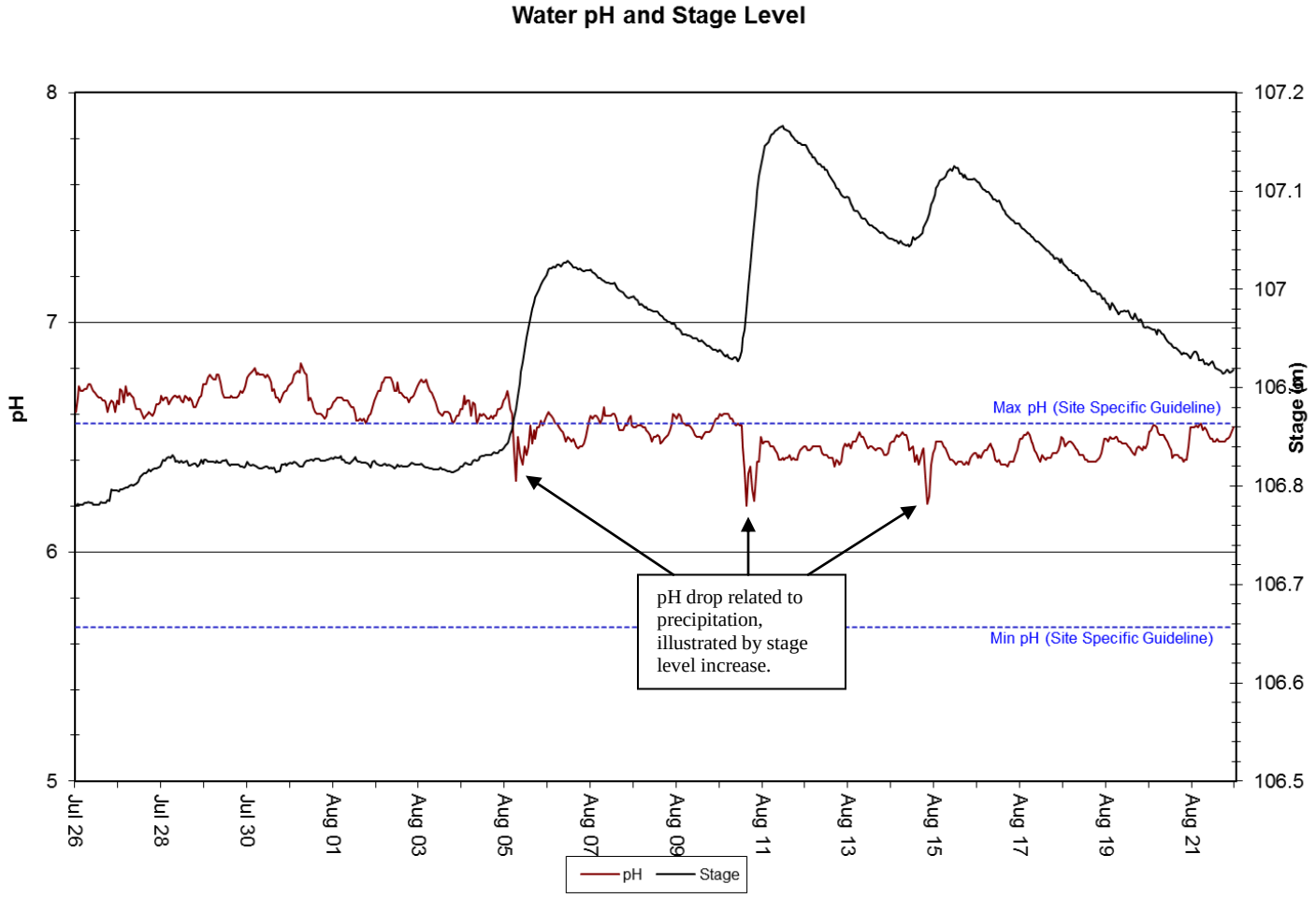
Parameter	Max	Min	Median	Mean
Temperature('C)	24.70	14.50	19.00	19.13

- Cooler water temperatures were observed at Plant Discharge station compared to both Big Pond and Bridge stations. Such a difference in water temperature may be explained by the wide, shallow, and braided section of river about 150 m upstream of the station. A greater interaction with cool air would allow for greater temperature exchange, resulting in lower water temperature.

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.

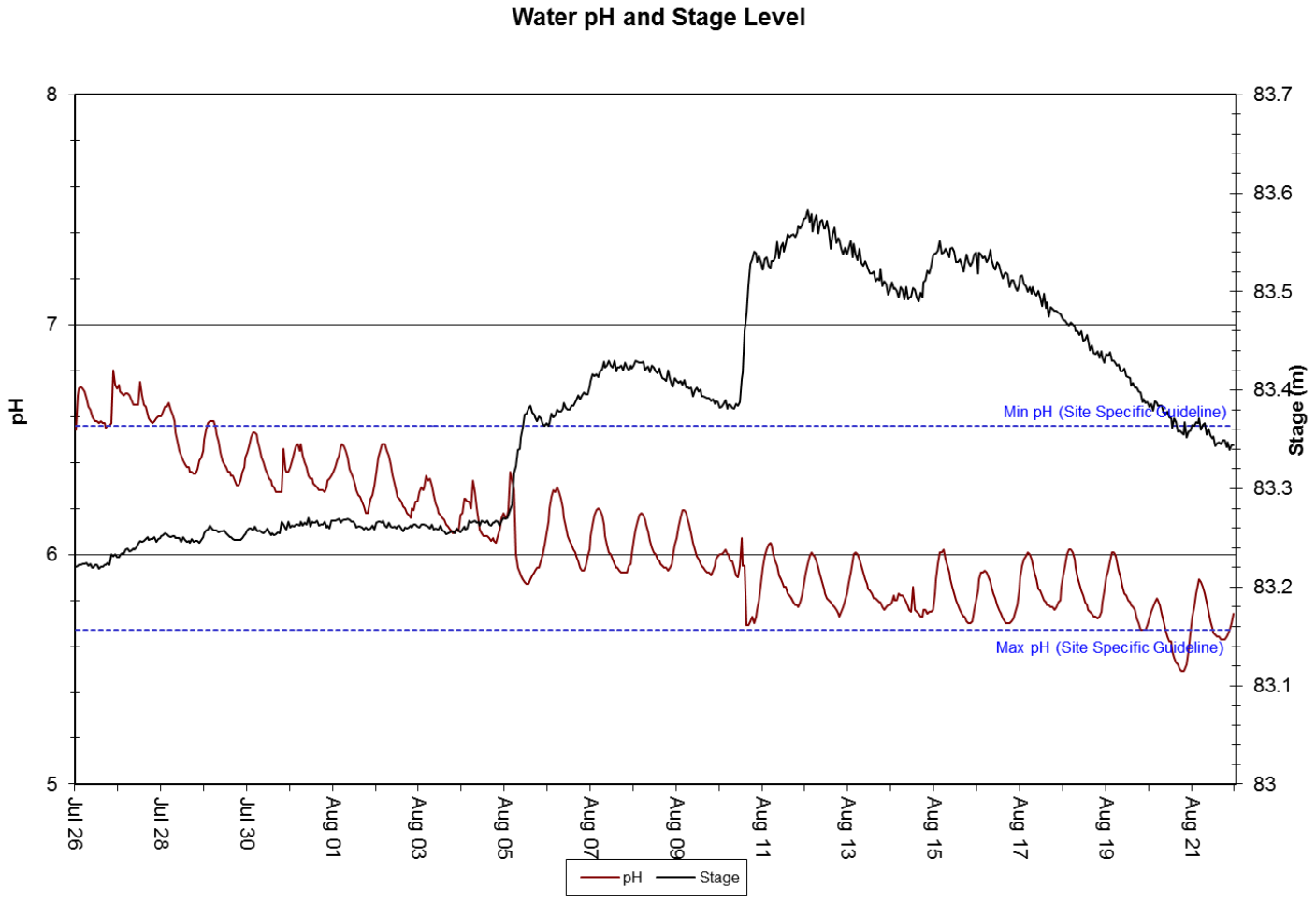
Figure 4: pH at Rattling Brook Big Pond from July 26 to August 22, 2013



Parameter	Max	Min	Median	Mean
pH	6.82	6.20	6.54	6.55

- Over the course of the deployment period, pH decreased from slightly above the Site Specific Guideline to within the guideline range by the end of the time period.
- pH fell sharply around August 5th during a period of heavy rain – approximately 32 mm. Two additional instances of this behavior were observed on August 10th and 14th.

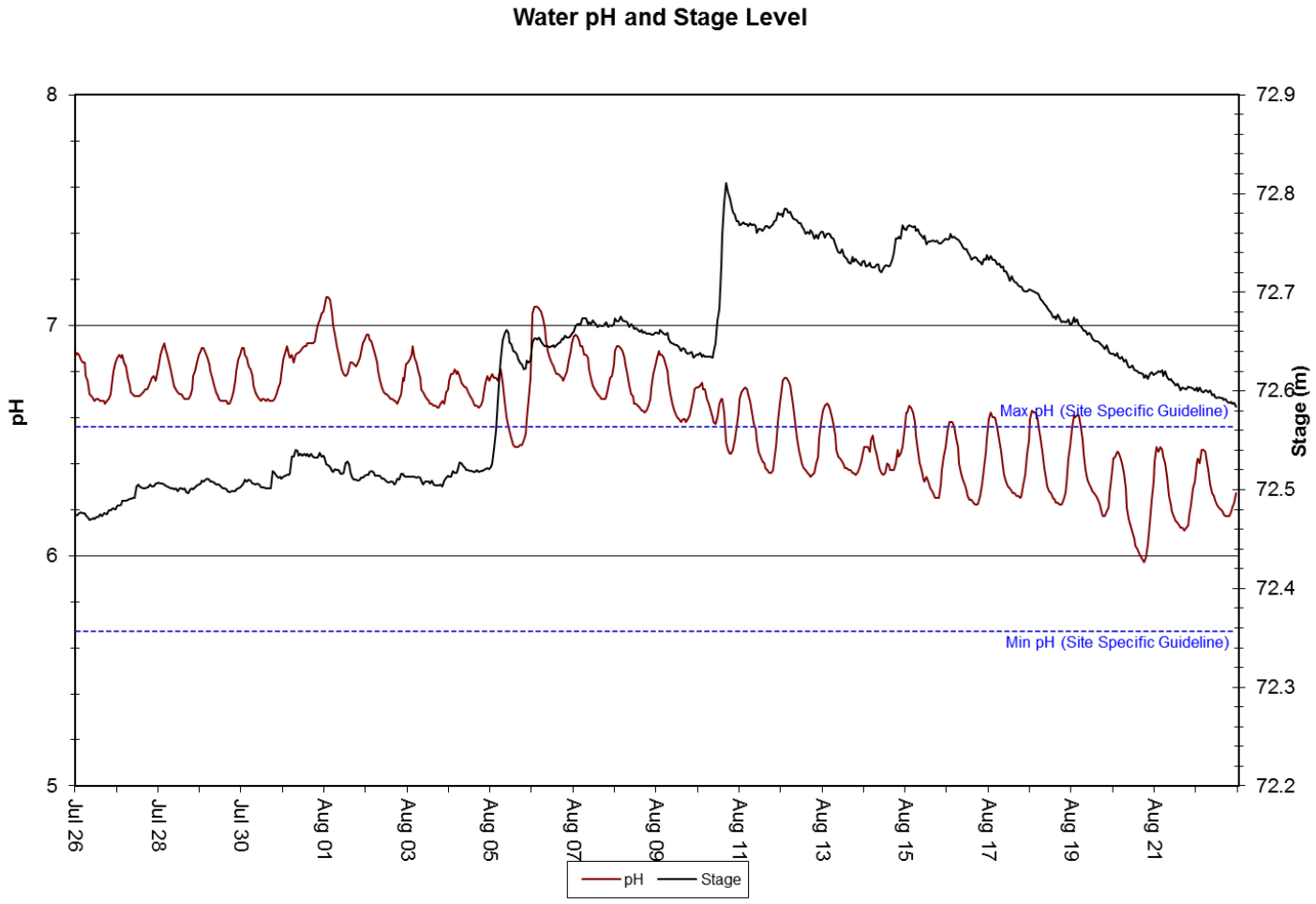
Figure 5: pH at Rattling Brook below Bridge from July 26 to August 23, 2013



Parameter	Max	Min	Median	Mean
pH	6.80	5.49	6.00	6.07

- pH fell from above the upper SSG to within the SSG range over the course of the deployment period. Overall, pH was found to be slightly more acidic at Bridge station compared to Big Pond, however, the explanation likely rests in the difference between a riverine and a lake environment.

Figure 6: pH at Rattling Brook below Plant Discharge from July 26 to August 22, 2013



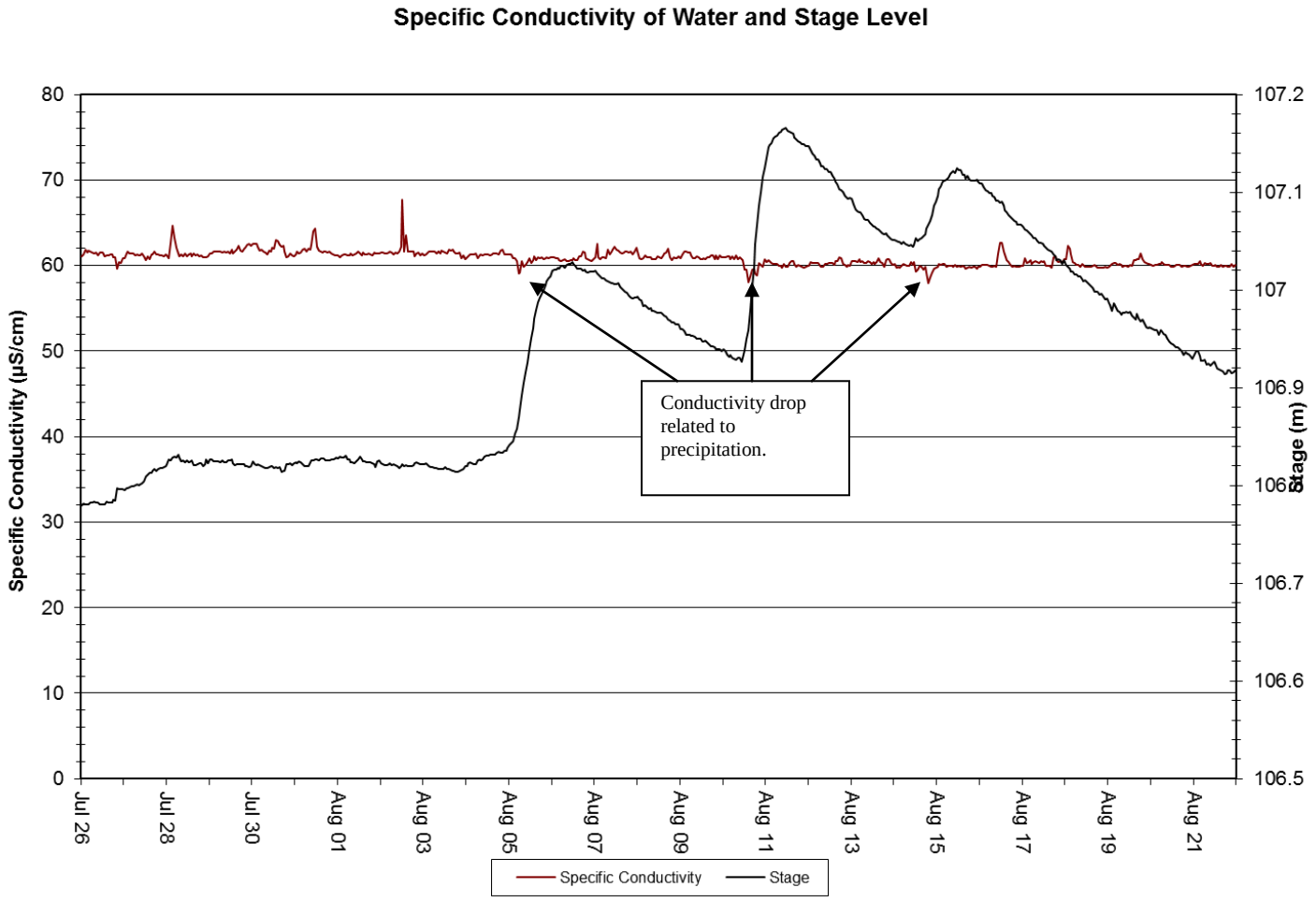
Parameter	Max	Min	Median	Mean
pH	7.12	5.97	6.66	6.60

- pH at Plant Discharge station didn't begin to descend until after the first week of August. Following that time, pH fell below the upper SSG and remained within the guideline range until the end of the deployment.
- Comparison of pH to Big Pond and Bridge stations indicates that pH is typically more alkaline at Plant Discharge station.

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.

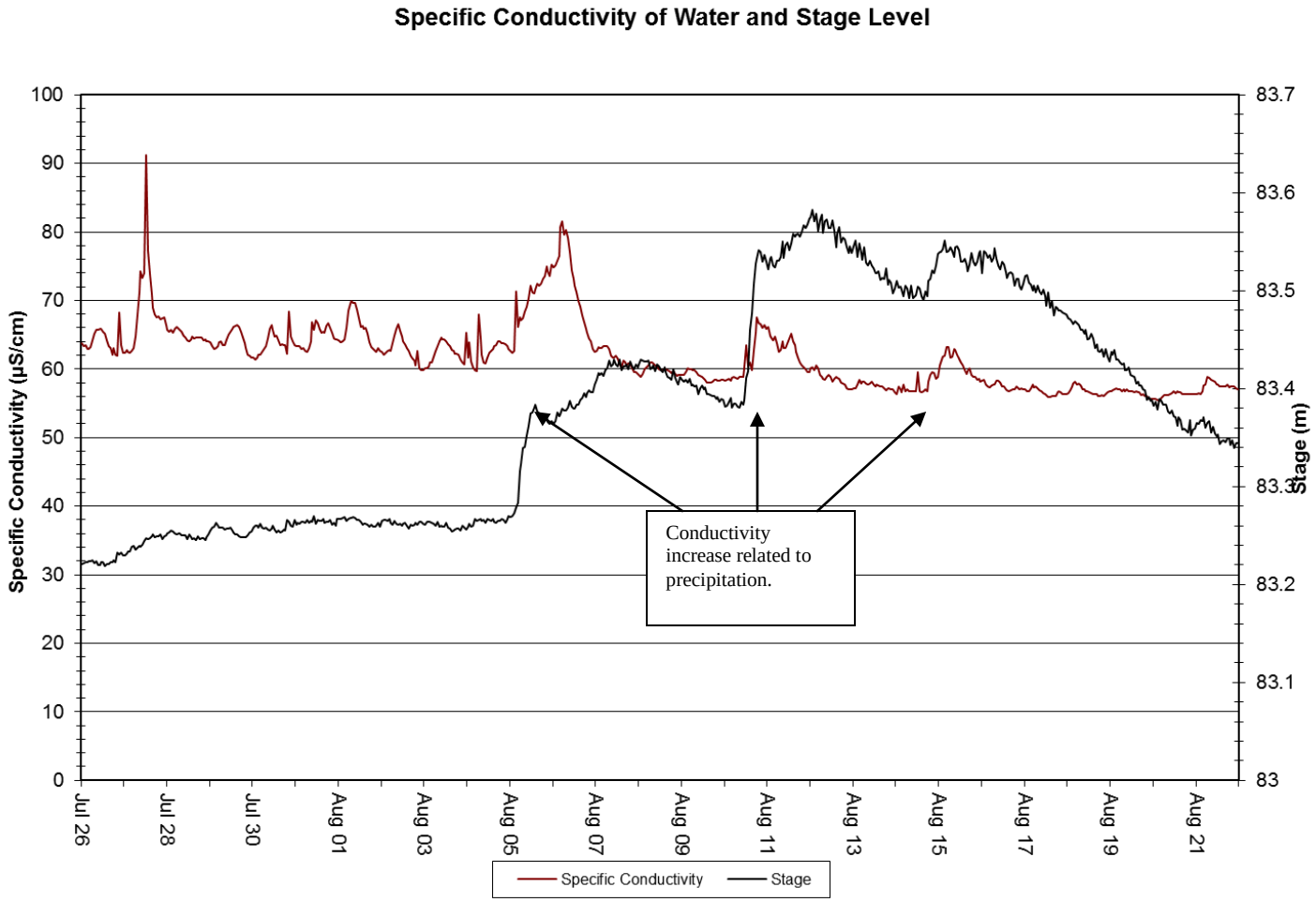
Figure 7: Specific Conductivity at Rattling Brook Big Pond from July 26 to August 22, 2013



Parameter	Max	Min	Median	Mean
Specific Conductivity (µS/cm)	67.7	57.9	60.9	60.8

- A very marginal decline in conductivity was observed in conductivity at Big Pond station. This is probably related to the increasing water level (stage) during the same time period. As freshwater moves into the Big Pond system, the concentration of total dissolved solids goes down.

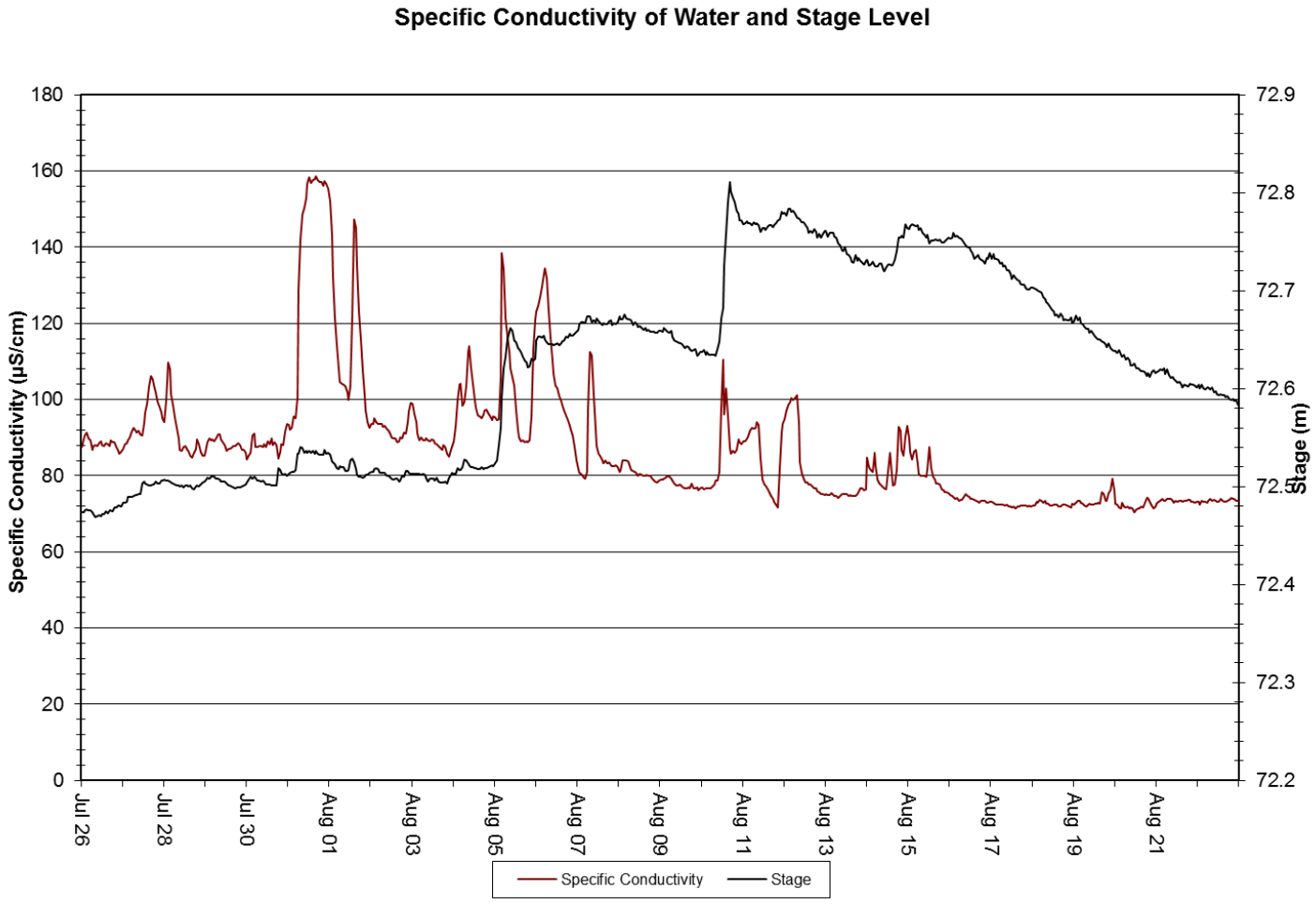
Figure 8: Specific Conductivity at Rattling Brook below Bridge from July 26 to August 23, 2013



Parameter	Max	Min	Median	Mean
Specific Conductivity (µS/cm)	91.2	55.4	61.0	61.7

- Conductivity tends to fluctuate a great deal more at Bridge station compared to Big Pond due to the extra influence of overland flow from nearby unvegetated areas and lingering effects from the completed work at Forgotten Pond.
- Contrary to the characteristic of declining conductivity during precipitation at Big Pond, at Bridge station the behavior is reversed: precipitation results in conductivity spikes. This is a direct result of sediment-laden water entering the river channel and stream bed sediments lofted during high flow. Peaks tend to require many hours to return to normal as flow resides.

Figure 9: Specific Conductivity at Rattling Brook below Plant Discharge from July 26 to August 22, 2013



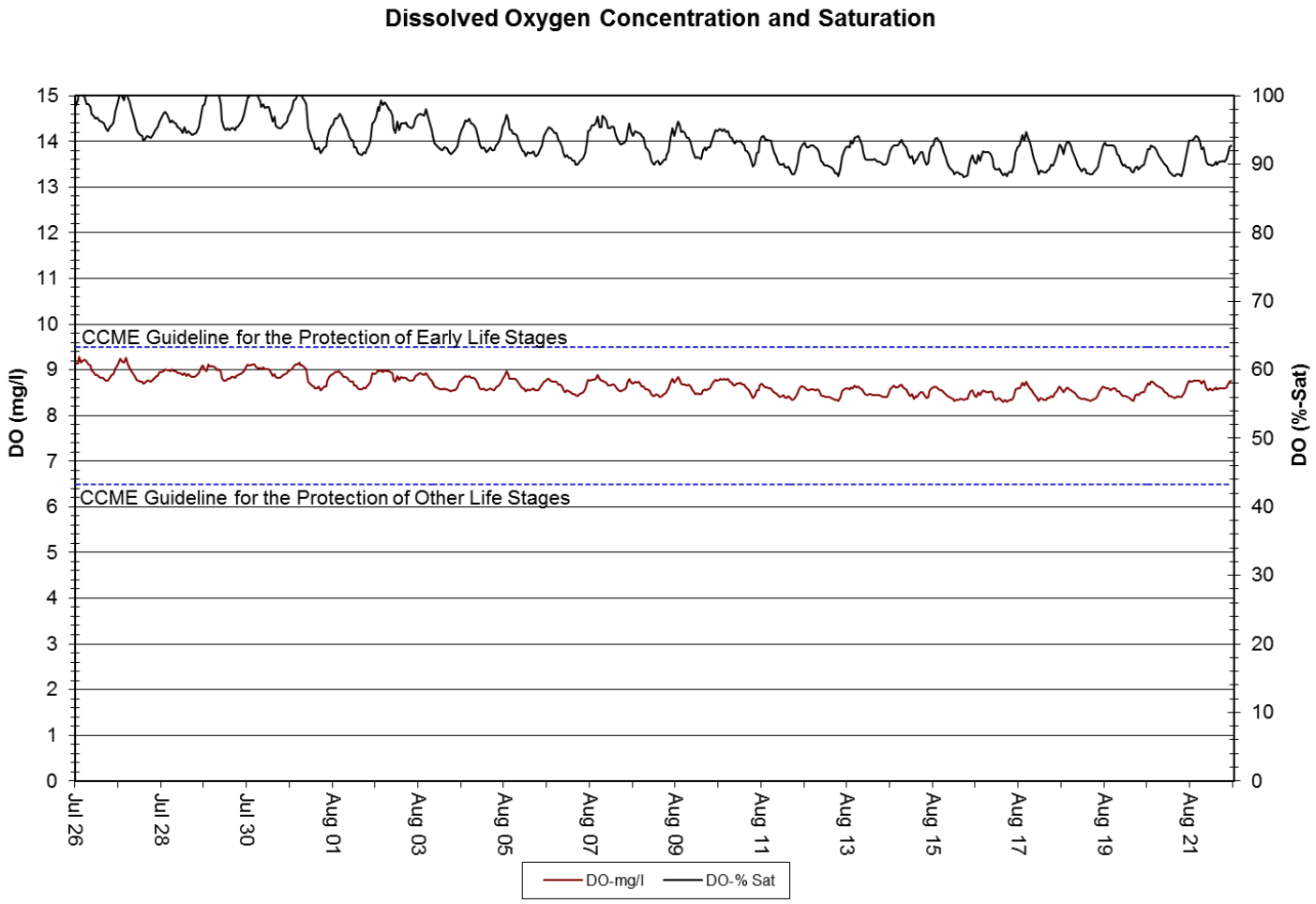
Parameter	Max	Min	Median	Mean
Specific Conductivity (µS/cm)	158.7	70.3	85.3	87.5

- Downstream at Plant Discharge station, conductivity was even higher than Bridge station as a result of additional inflow from unvegetated areas and sedimentation pond effluent. Peaks in conductivity also tend to be of a much larger magnitude.

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 July 26 to August 22, 2013

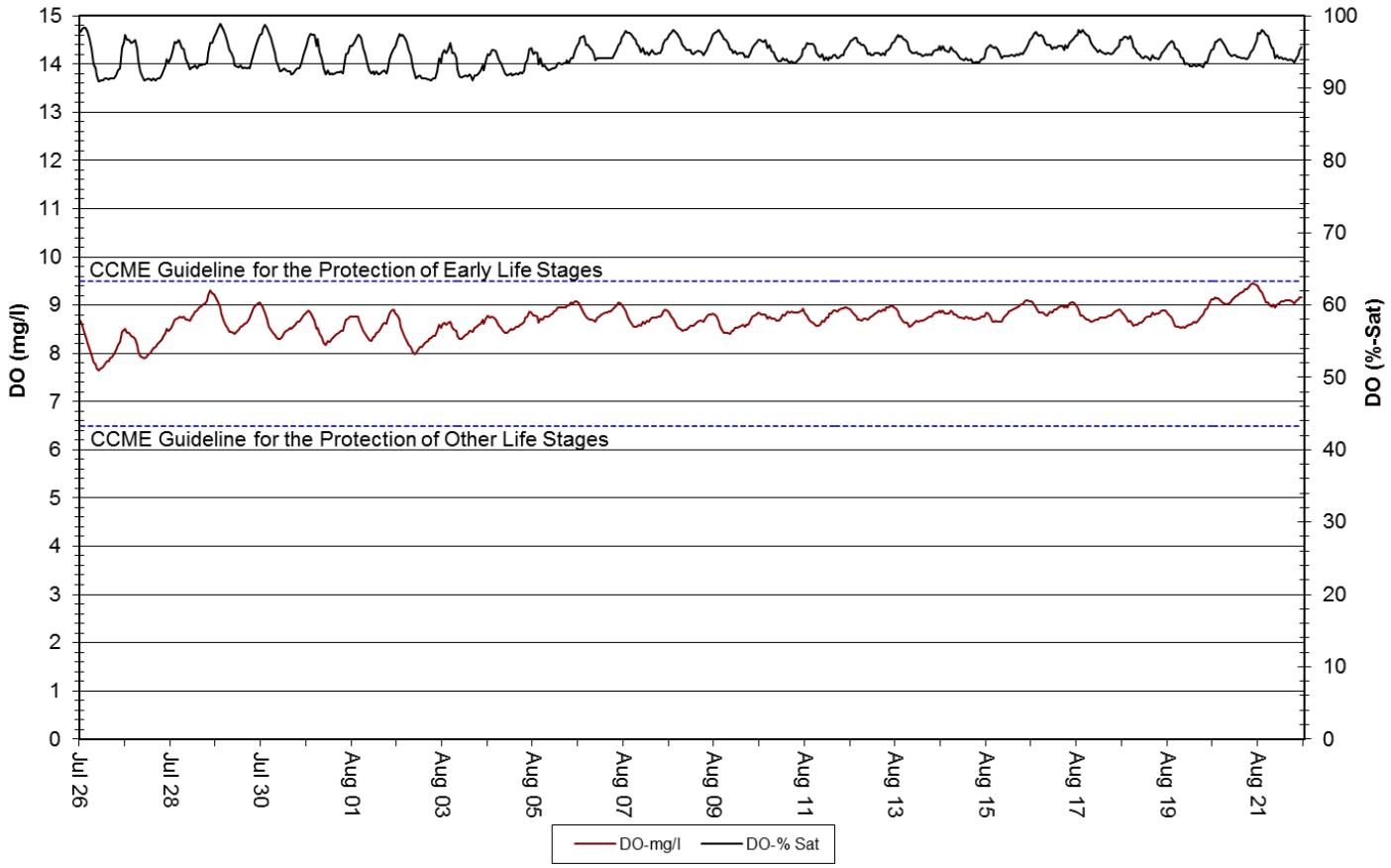


Parameter	Max	Min	Median	Mean
Dissolved Oxygen (%-Sat)	103.2	88.1	92.8	93.3
Dissolved Oxygen (mg/l)	9.28	8.29	8.63	8.67

- Dissolved oxygen concentration continued a very slight decline over the course of the deployment period at Big Pond station, despite the simultaneous decline in water temperature. Near the final week of deployment, however, a slight increase in DO does seem to be apparent.

- During the deployment period, DO was consistently below the CCME guideline for the protection of early life stage biota. This is the norm for late summer when early life stages have typically developed into less sensitive life stages.

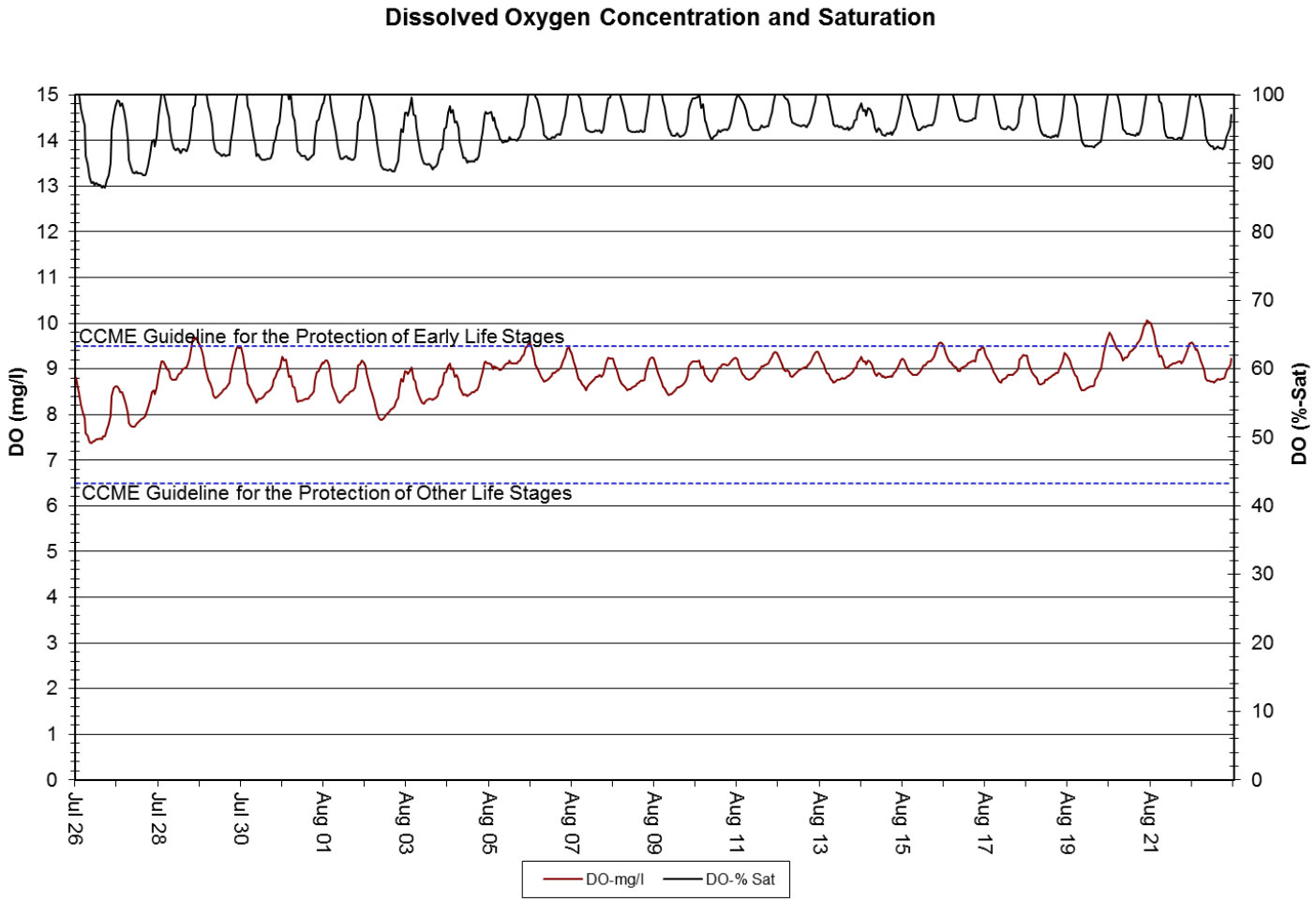
Figure 11: Dissolved Oxygen at Rattling Brook below Bridge from July 26 to August 23, 2013



Parameter	Max	Min	Median	Mean
Dissolved Oxygen (%-Sat)	98.9	90.9	94.8	94.7
Dissolved Oxygen (mg/l)	9.45	7.65	8.73	8.70

- In the flowing environment of Bridge station, DO was found to be slightly higher than at Big Pond station. Also, the increasing trend in DO was more consistent across the whole deployment period. Similar to Big Pond, all DO values were less than the CCME guideline for early life stages, as expected for this time of year.

Figure 12: Dissolved Oxygen at Rattling Brook below Plant Discharge from July 26 to August 22, 2013



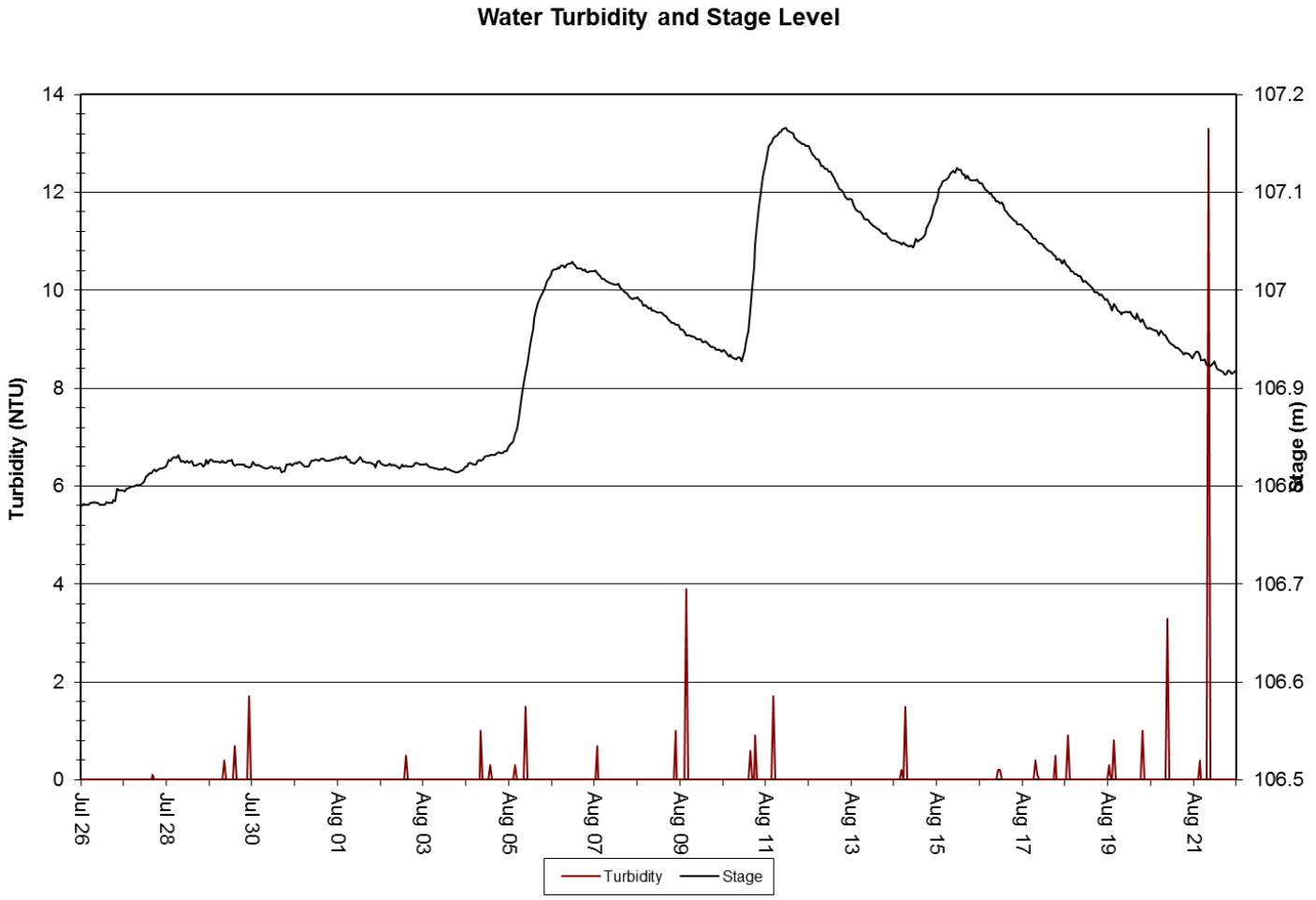
Parameter	Max	Min	Median	Mean
Dissolved Oxygen (%-Sat)	103.0	86.4	95.4	95.8
Dissolved Oxygen (mg/l)	10.06	7.38	8.90	8.87

- The most obvious upward trend in dissolved oxygen concentration was observed at Plant Discharge station with some instances of DO concentration rising above the CCME guideline for early life stage biota.
- At times, vigorous water flow resulted in DO saturation rising above 100% saturation.

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.

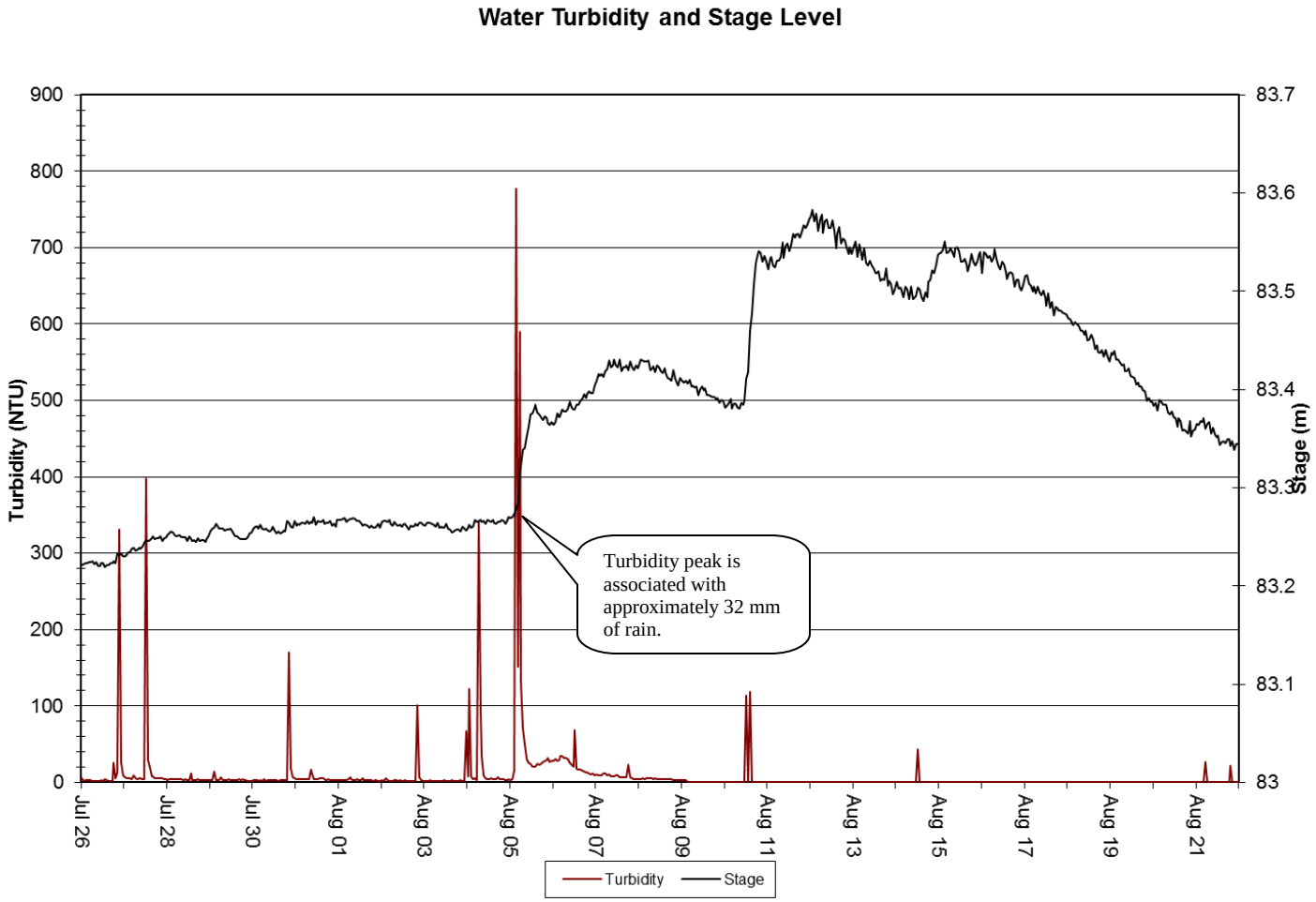
Figure 13: Turbidity at Rattling Brook Big Pond from July 26 to August 22, 2013



Parameter	Max	Min	Median	Mean
Turbidity (NTU)	13.3	0.0	0.0	0.1

- Turbidity at Big Pond station was found to be mostly clear with periodic instances of low-level turbidity. Peaks in turbidity are generally correlated with precipitation events. Rain events are typically accompanied by wind and wave action which mobilizes sediments near the shore, temporarily increasing turbidity levels.

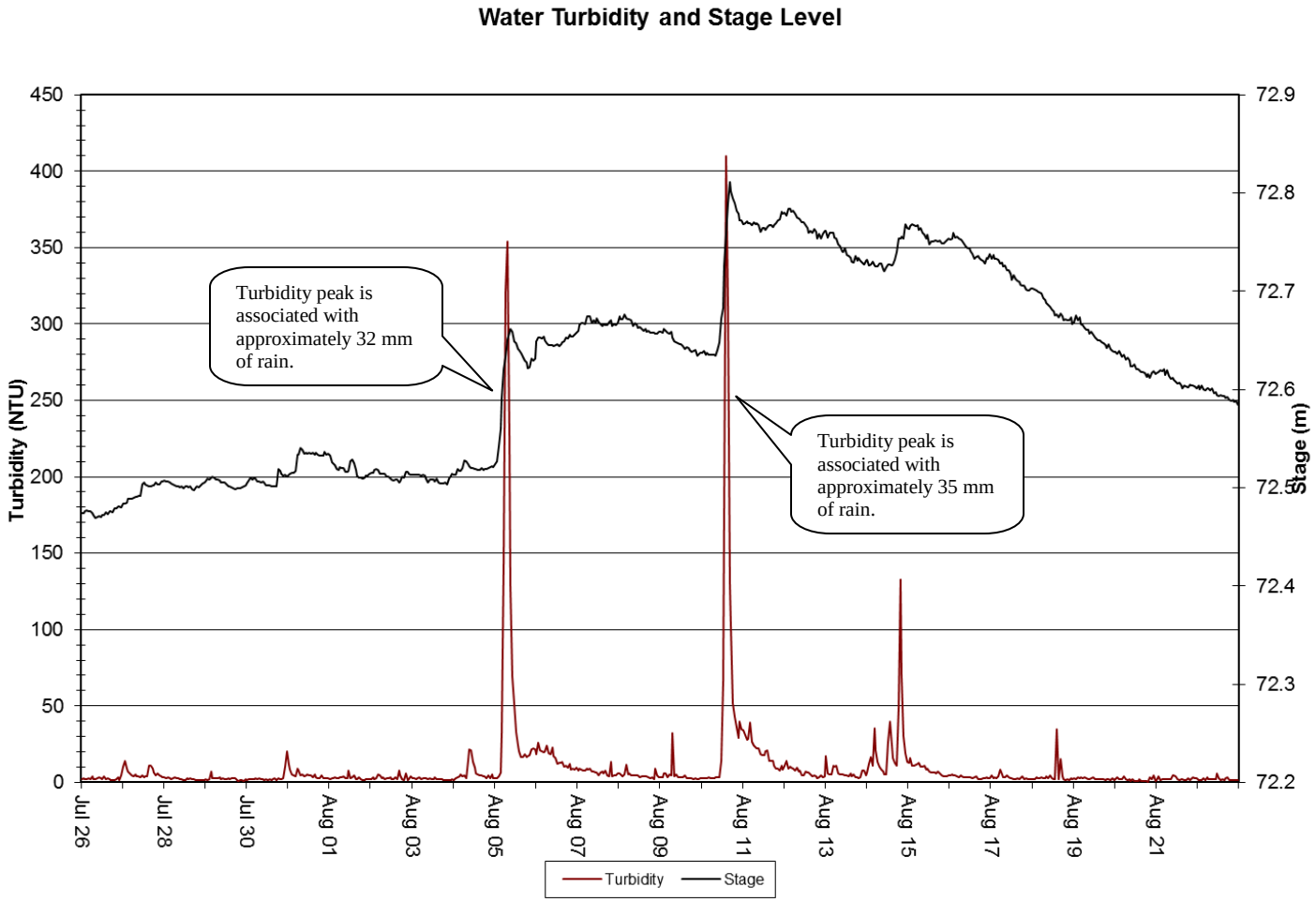
Figure 14: Turbidity at Rattling Brook below Bridge from July 26 to August 23, 2013



Parameter	Max	Min	Median	Mean
Turbidity (NTU)	777.0	0.0	1.9	9.2

- A downward trend in background turbidity levels was seen during this deployment period. Although background levels were low at the initiation of the deployment, they declined to zero by the end of the deployment.
- Most instances of turbidity peaks are associated with high flow events.

Figure 15: Turbidity at Rattling Brook below Plant Discharge from July 26 to August 22, 2013



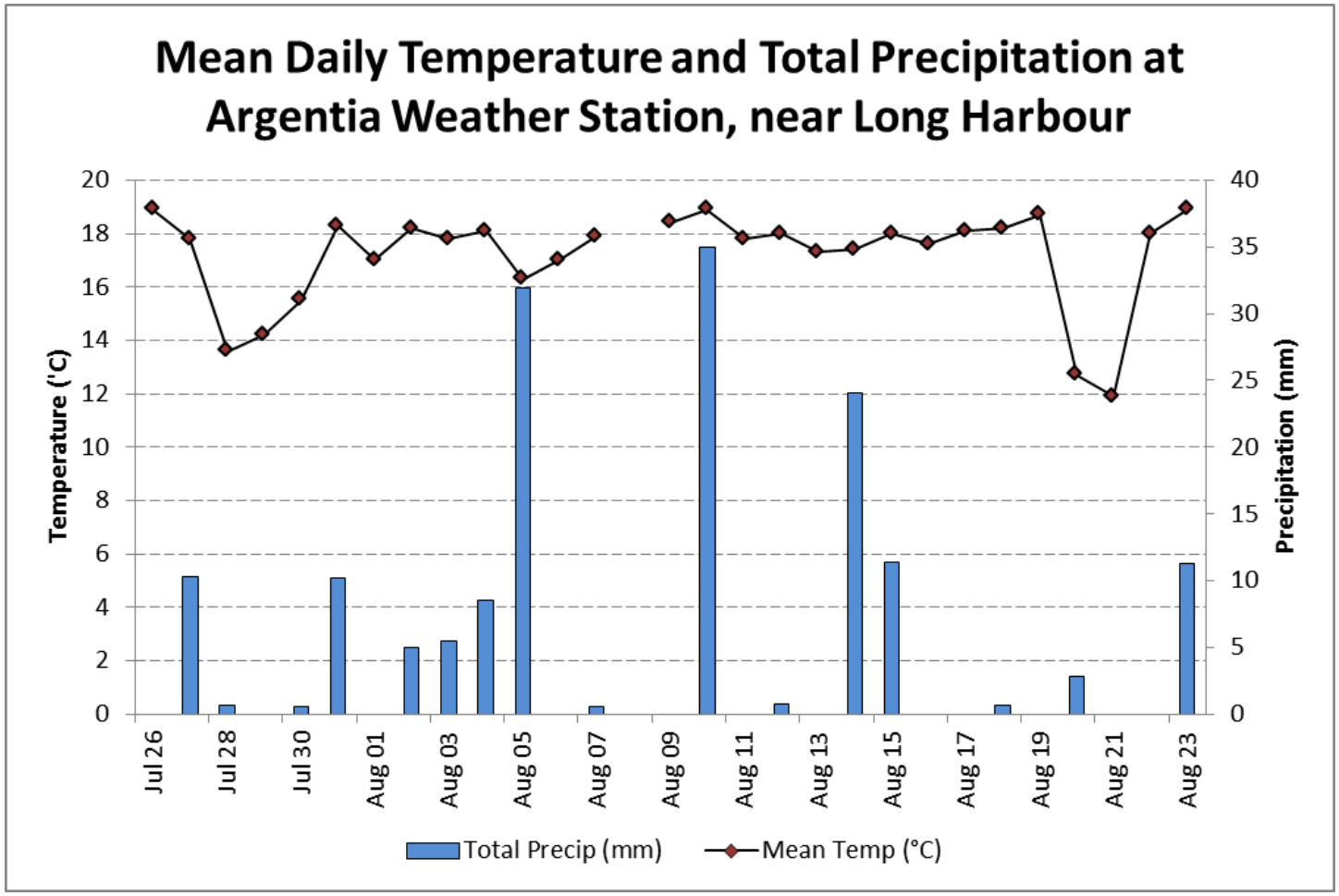
Parameter	Max	Min	Median	Mean
Turbidity (NTU)	410.0	0.4	3.4	10.1

- Background turbidity levels were steady during this deployment period and were typically higher than levels found upstream at Bridge station. Two major peaks were observed as opposed to a single peak at Bridge station. The second peak suggests that there is a greater propensity for silt-laden water to enter Rattling Brook in lower reaches.

Conclusions

- All water quality parameters were found to be within seasonal norms and no concerns were noted.
- Turbidity peaks are expected to increase through the fall season as windy and rainy weather conditions move through the area. Additionally, the hurricane systems should be expected and adequate preparations should be made.

Appendix



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