Real-Time Water Quality Deployment Report

Rattling Brook Network

June 21, 2013 to July 25, 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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2013-06-21 to 2013-07-25

General

- Department of Environment and Conservation staff monitors the real-time web pages consistently.
- A fault in the Dissolved Oxygen sensor at Plant Discharge station left a gap in data for the final week of deployment. The sensor will be replaced before the next deployment.

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	June 21, 2013	Deployment	Excellent	Excellent	Excellent	Poor	Excellent
	July 25, 2013	Removal	Fair	Good	Excellent	NA	Excellent
Rattling Brook below Bridge	June 21, 2013	Deployment	Good	Excellent	Excellent	Excellent	Excellent
	July 25, 2013	Removal	Fair	Good	Excellent	NA	Good
Rattling Brook below Plant Discharge	June 21, 2013	Deployment	Excellent	Fair	Excellent	Fair	Excellent
	July 25, 2013	Removal	Marginal	Excellent	Excellent	NA	Good

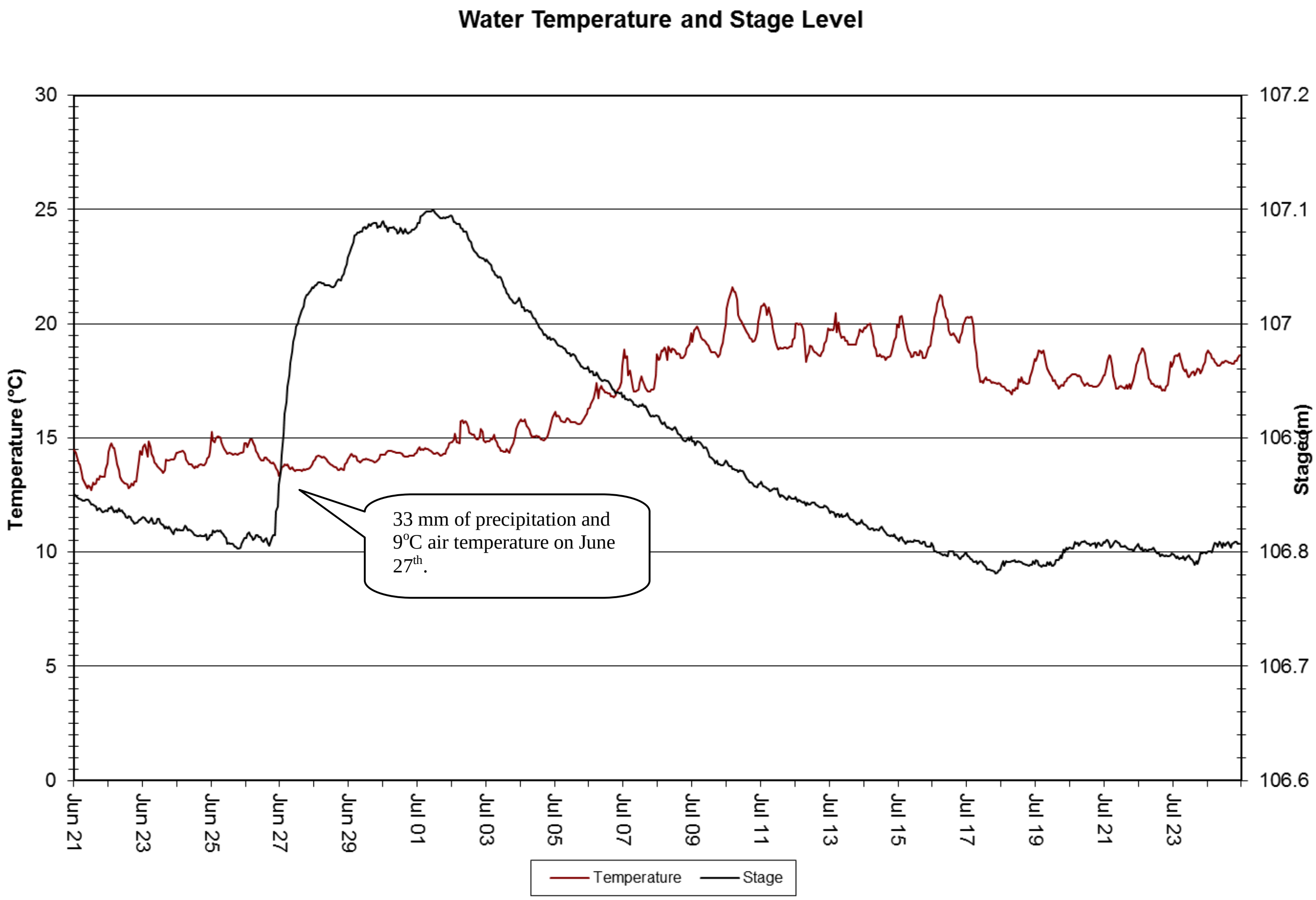
- A “Poor” ranking was assigned to dissolved oxygen upon deployment at Rattling Brook Big Pond. Despite this, based on experience, the data quality was felt to be good. Though the QAQC instrument calibrated well and functioned normally that day, DO seems to have been unusually high according to that sensor.

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.

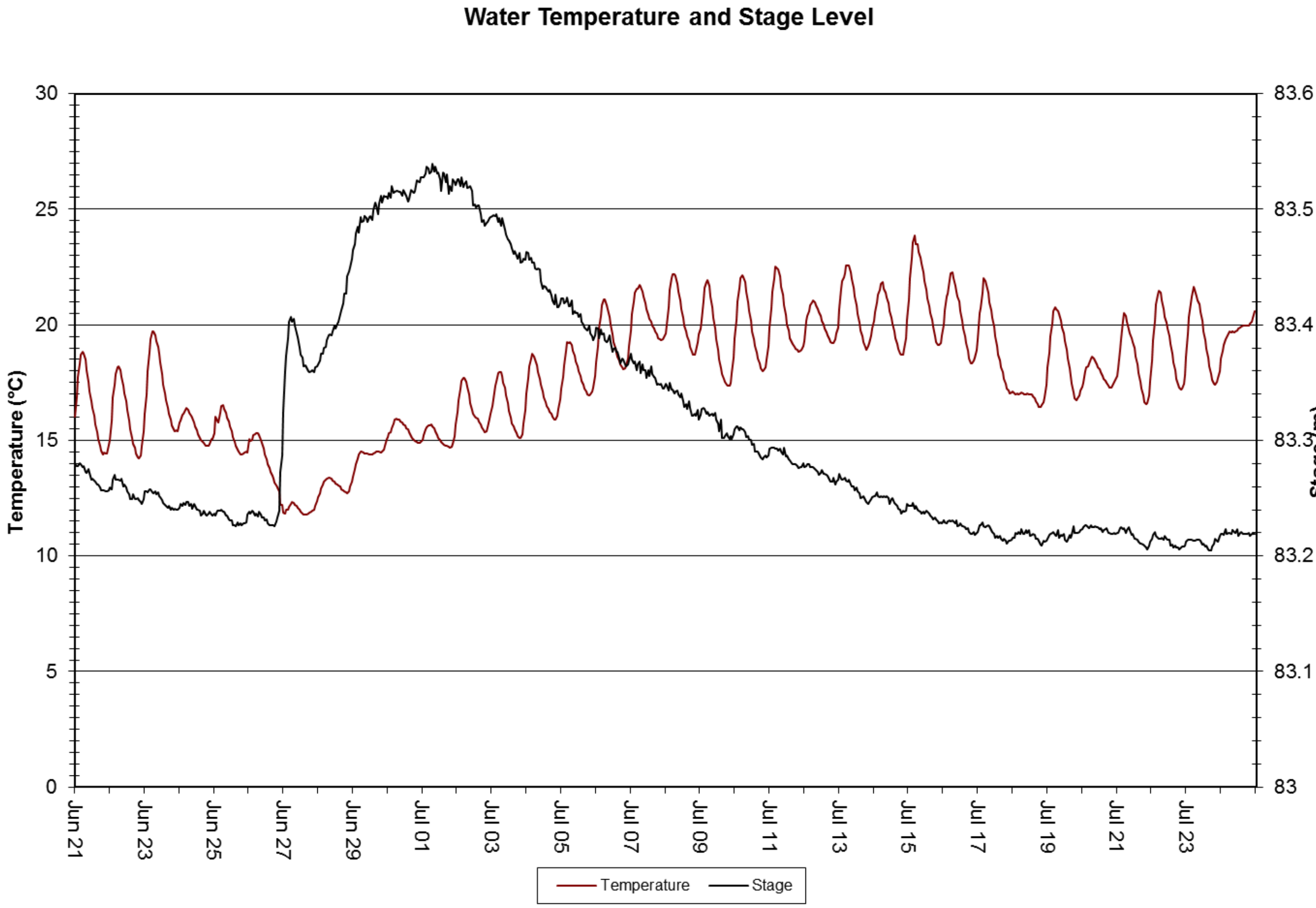
Figure 1: Water Temperature at Rattling Brook Big Pond



Parameter	Max	Min	Median
Temperature('C)	21.58	12.70	17.18

- Water temperature increased continually through the deployment period into late July. A period of heavy rain between June 26 and June 30 depressed daily temperature cycles for several days and raised the water level by 28.1 cm.

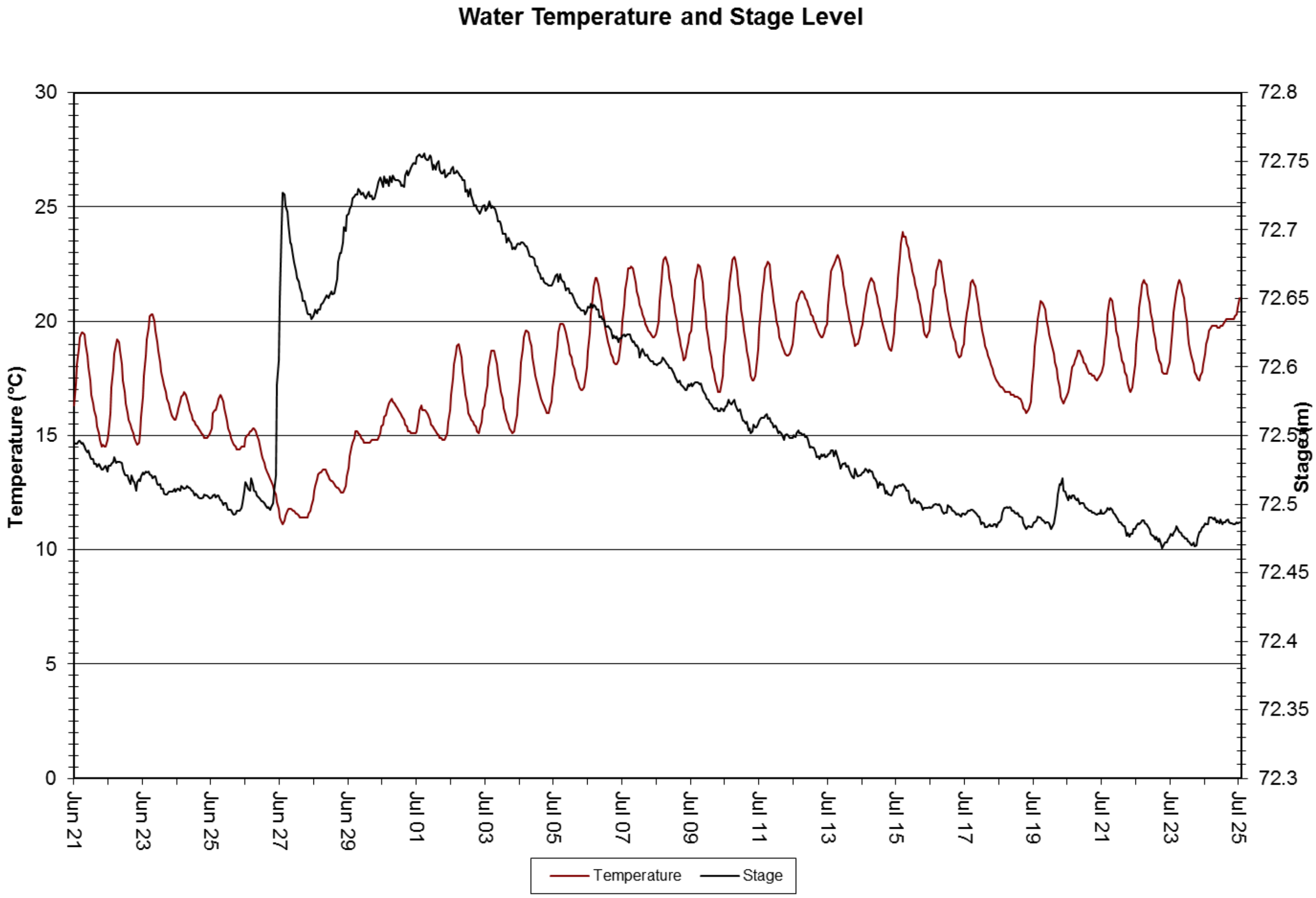
Figure 2: Water Temperature at Rattling Brook below Bridge



Parameter	Max	Min	Median
Temperature('C)	23.87	11.79	17.99

- Daily temperature cycles are much more evident downstream at Bridge station, even during the rain observed from June 26 to June 30. The initial heavy rains and low air temperature caused a decline in water temperature that took several days to recover.

Figure 3: Water Temperature at Rattling Brook below Plant Discharge



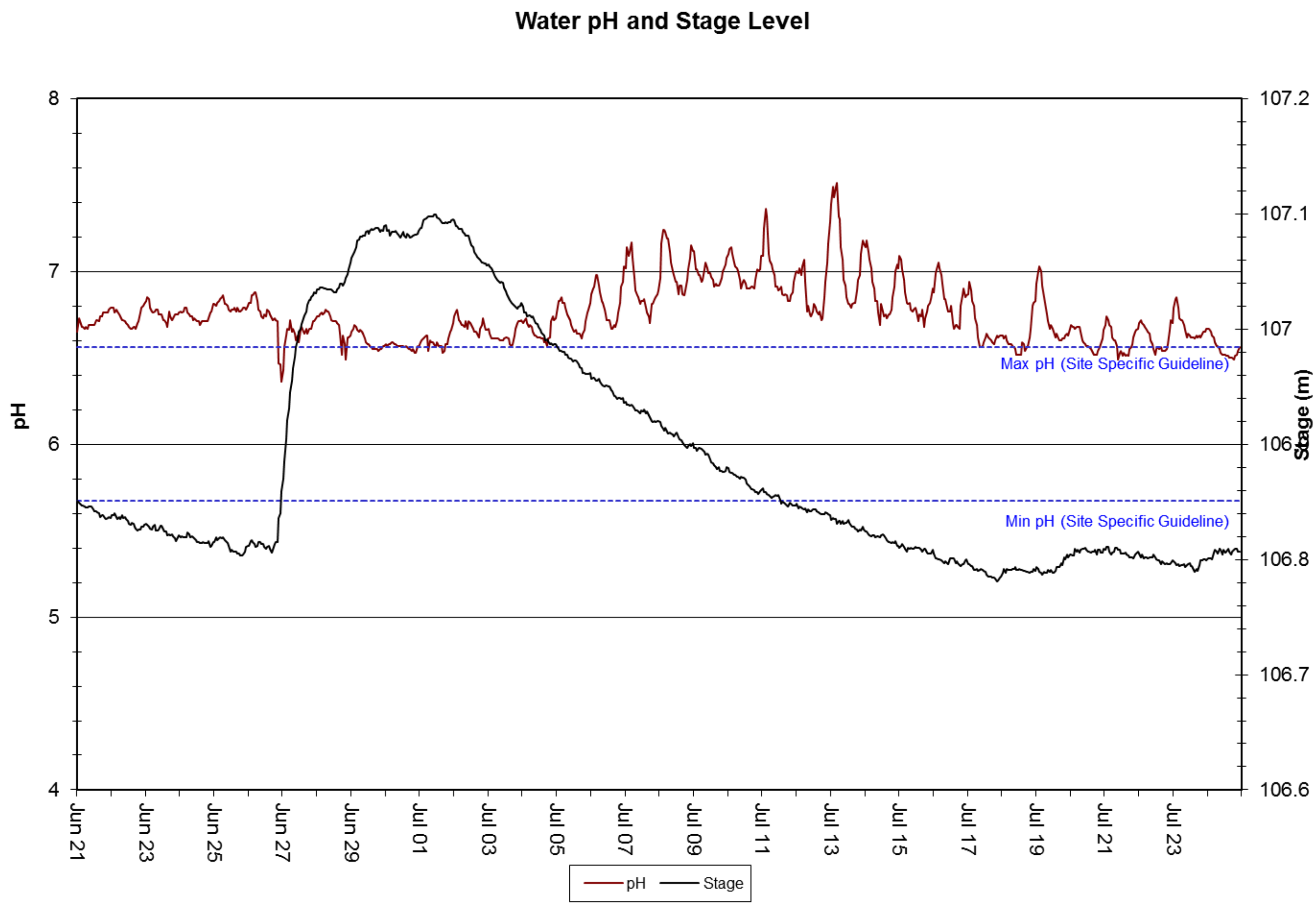
Parameter	Max	Min	Median
Temperature('C)	23.90	11.10	18.20

- Water temperatures show a slightly larger range at Plant Discharges station compared to Bridge station and also tended to be slightly warmer with a median temperature of 18.20^{o}C versus 17.99^{o}C.

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.

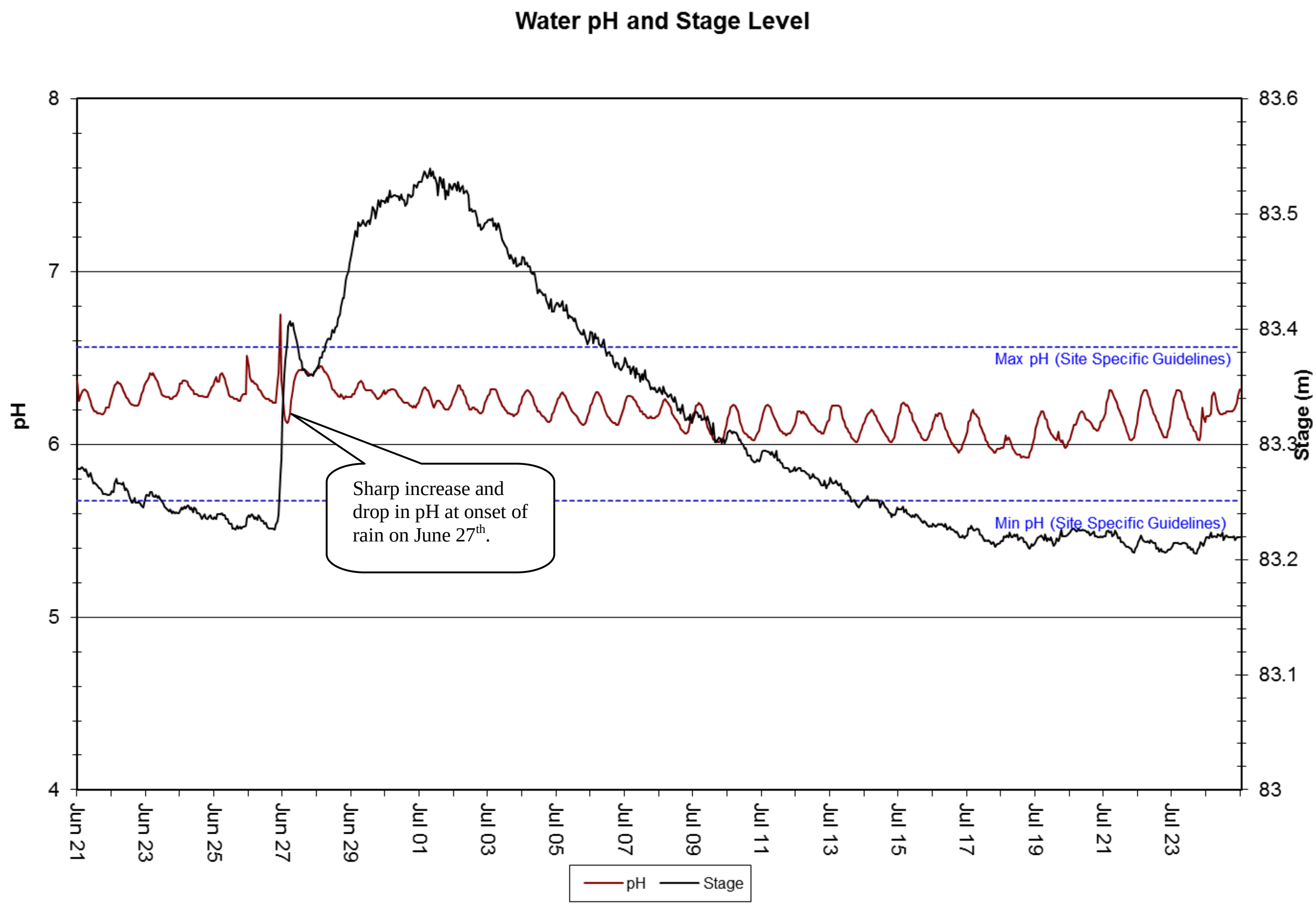
Figure 4: pH at Rattling Brook Big Pond



Parameter	Max	Min	Median
pH	7.51	6.36	6.72

- pH at Big Pond station tended to resided above the Site Specific Guideline for the Rattling Brook network for much of this deployment. Peak pH levels were attained during periods with the warmest air temperature and no rain – such as the time between July 5th and July 13th. Following a few sporadic days of rain, pH levels decline.

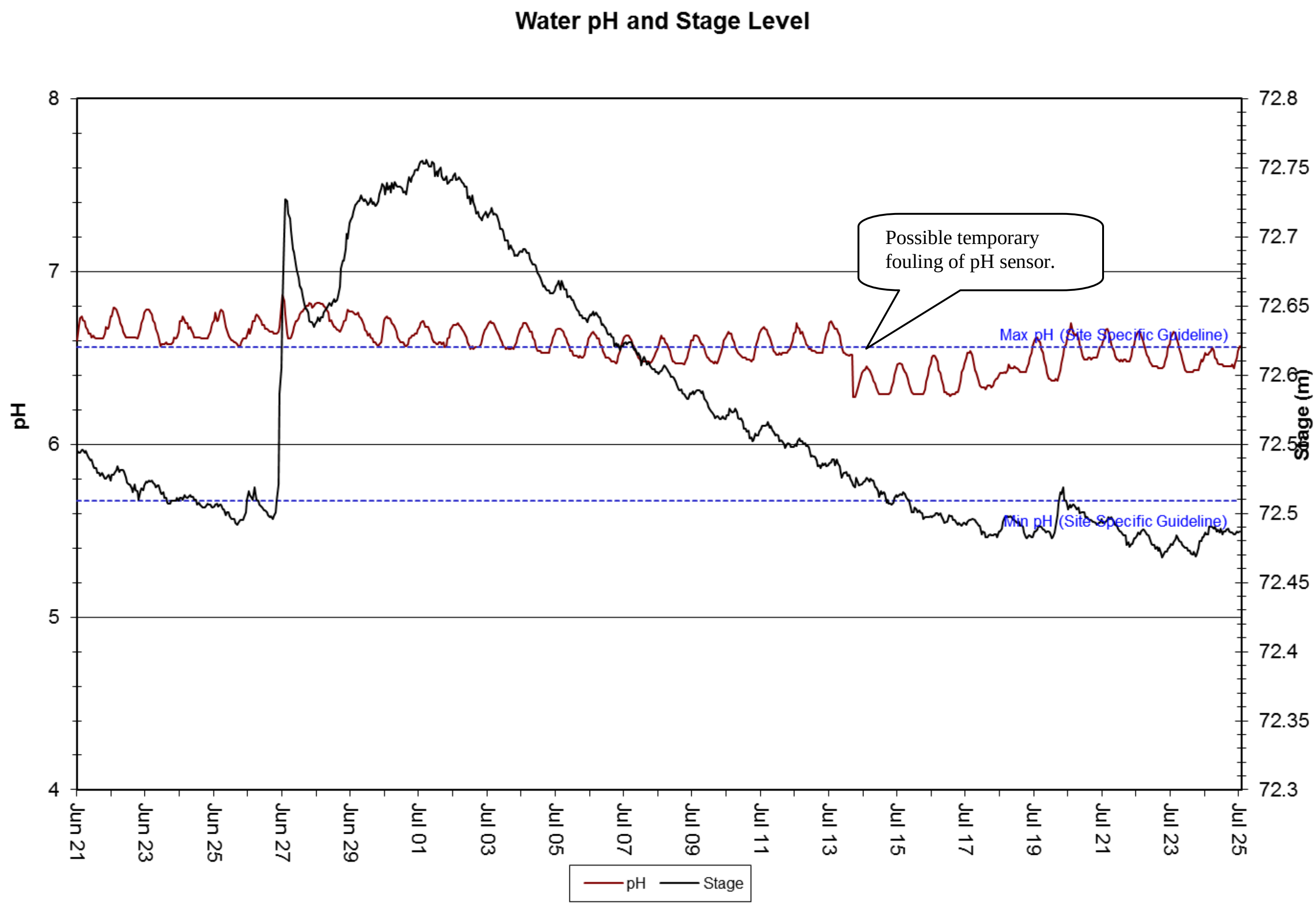
Figure 5: pH at Rattling Brook below Bridge



Parameter	Max	Min	Median
pH	6.75	5.92	6.20

- pH levels fell mostly within the Site Specific guidelines at Bridge station for this deployment period. A sharp peak and subsequent drop in pH was noticed at the onset of precipitation on June 27th. A large peak may have been caused by an initial sediment-laden surge of water through Rattling Brook which was washed away with incoming waters.

Figure 6: pH at Rattling Brook below Plant Discharge



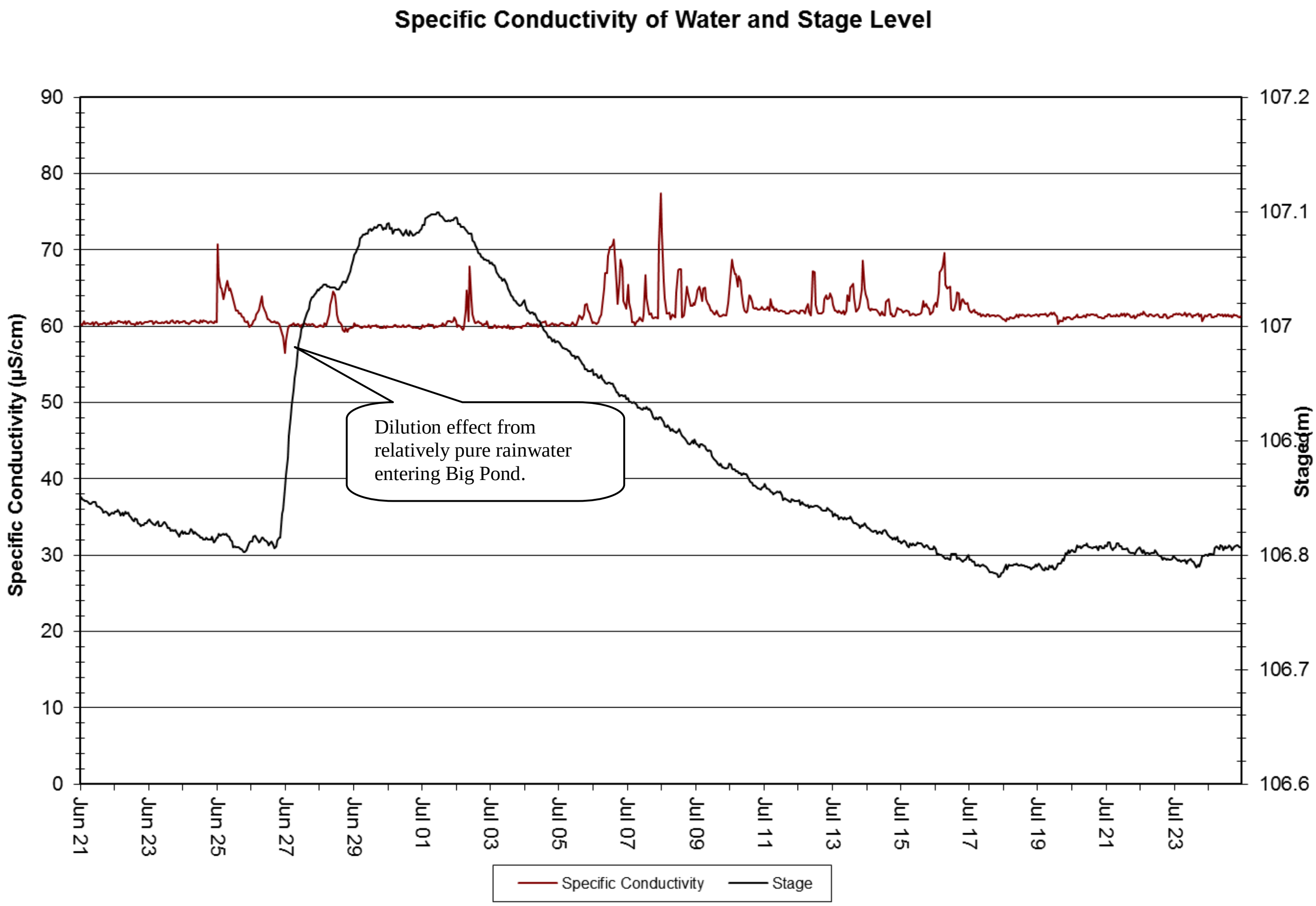
Parameter	Max	Min	Median
pH	6.86	6.27	6.58

- pH levels at Plant Discharge station straddled the upper bounds of the Site Specific Guidelines during this deployment period, but tended to be more alkaline than upstream at Bridge station with a median pH of 6.58 versus 6.20.
- A rapid drop in pH was observed between July 13 and 14. This was not seen upstream at Bridge station and may be related to a very local occurrence such as sudden fouling of the pH sensor. Interestingly, pH values did recover towards the end of the deployment period.

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^{o}C to allow comparison across variable temperatures.

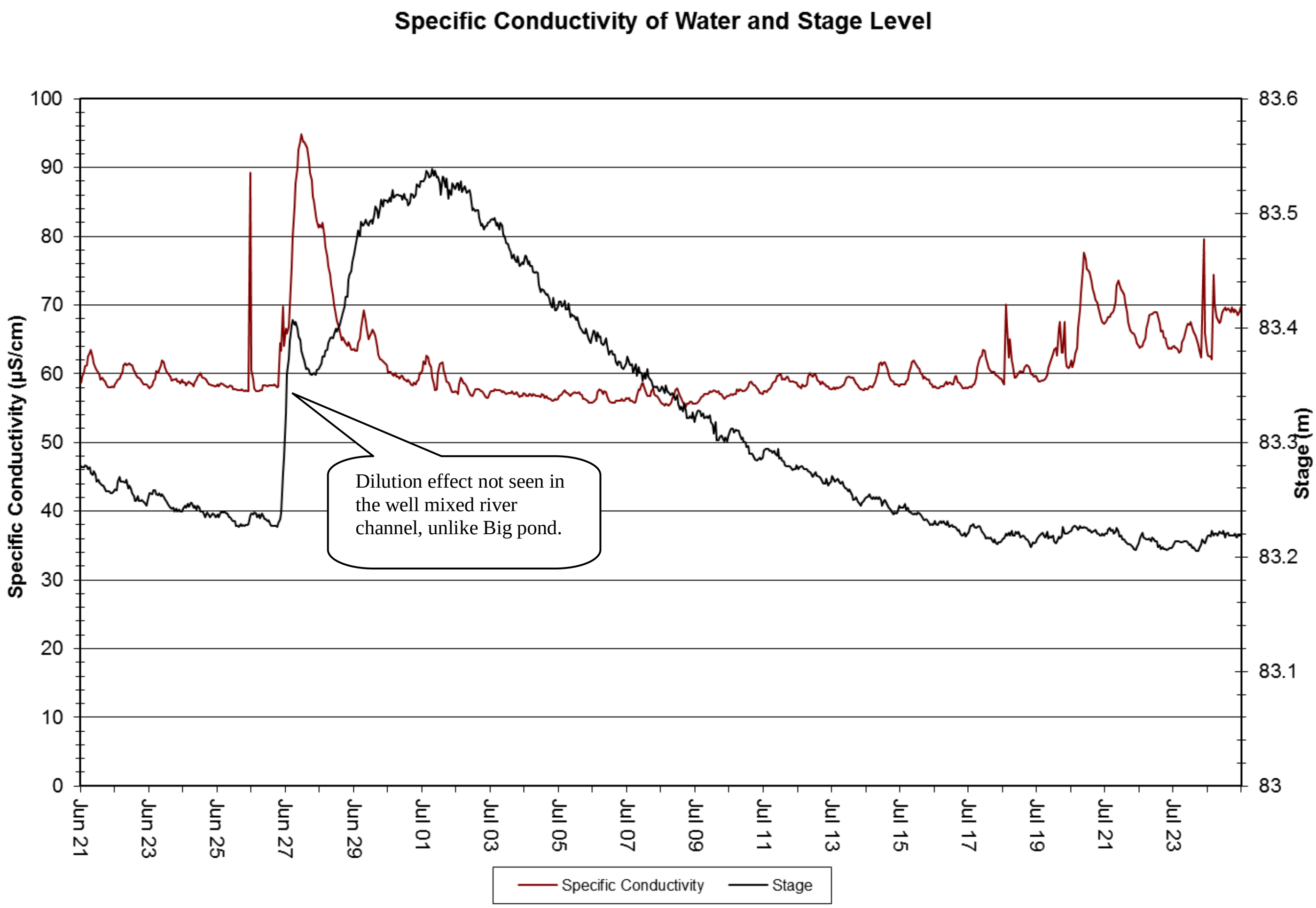
Figure 7: Specific Conductivity at Rattling Brook Big Pond



Parameter	Max	Min	Median
Specific Conductivity (µS/cm)	77.4	56.5	61.3

- A slightly upward trend was seen in conductivity during the deployment period at Big Pond station. Values were found to be somewhat variable between July 6 and July 17 which is associated with the warmest air temperatures during the deployment period.

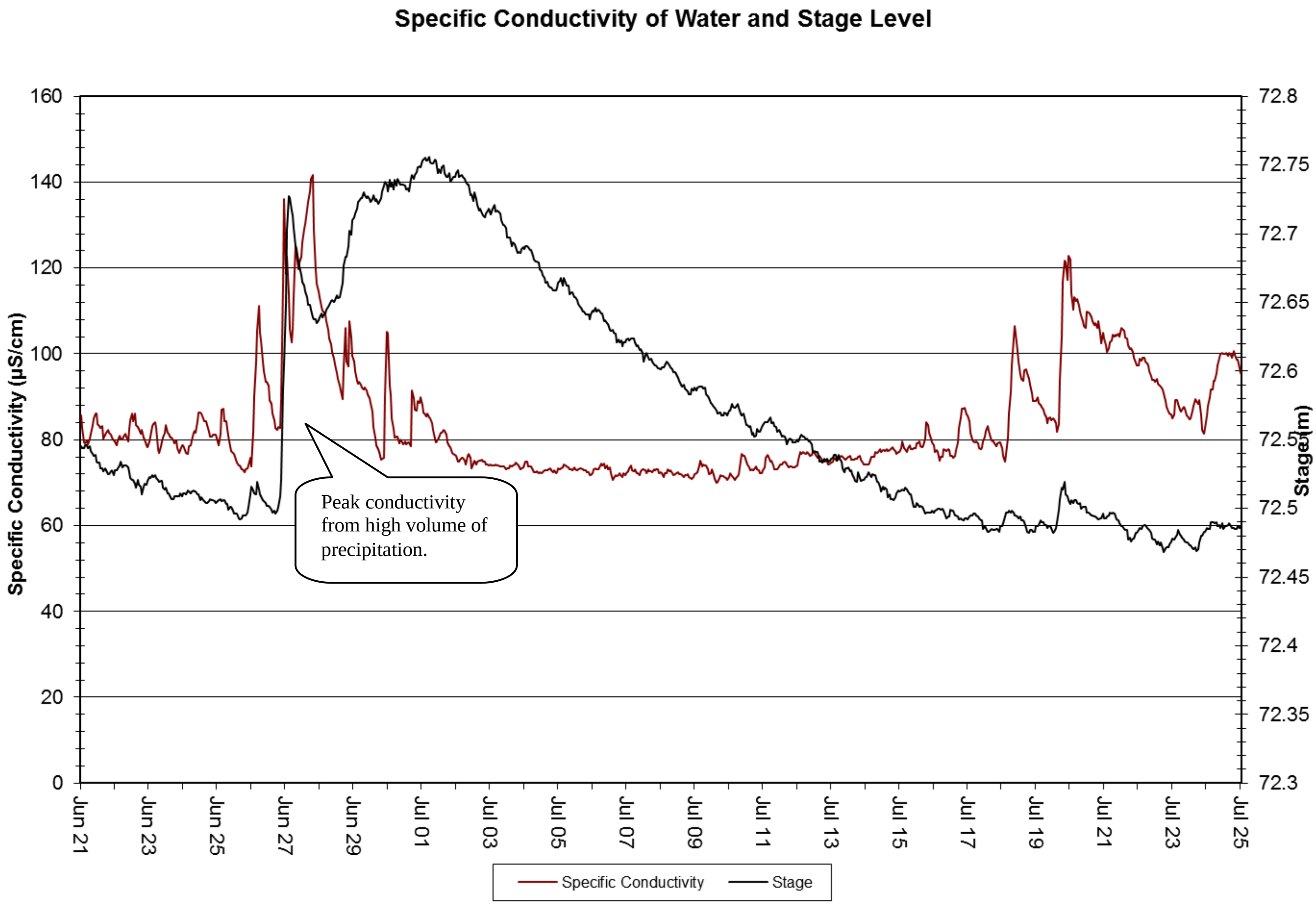
Figure 8: Specific Conductivity at Rattling Brook below Bridge



Parameter	Max	Min	Median
Specific Conductivity (µS/cm)	94.8	55.2	58.9

- During this deployment period, conductivity at Bridge station was of a similar magnitude as Big Pond station with a higher degree of daily variation.

Figure 9: Specific Conductivity at Rattling Brook below Plant Discharge



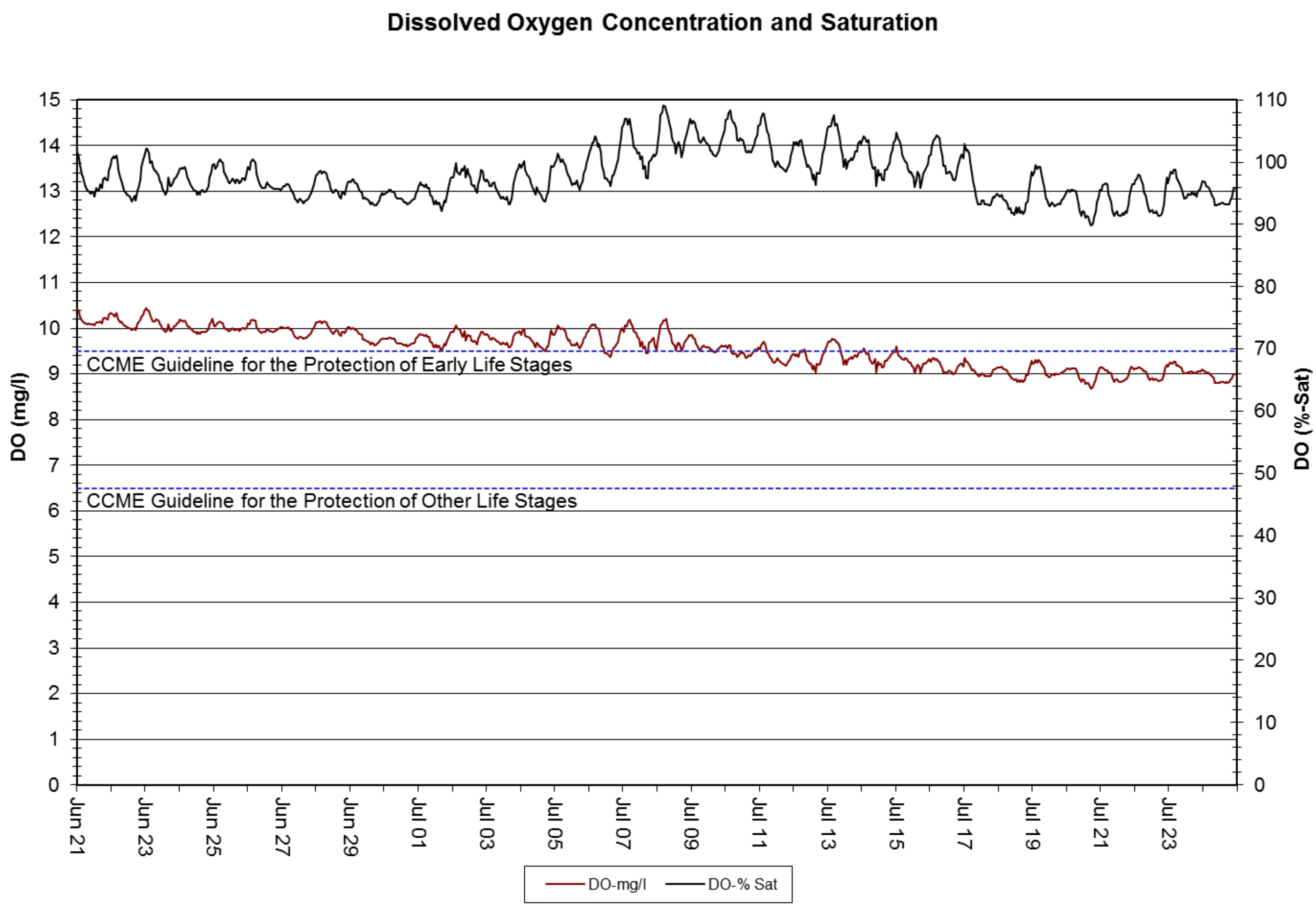
Parameter	Max	Min	Median
Specific Conductivity (µS/cm)	141.7	70.0	79.3

- As expected, conductivity at Plant Discharge station was higher than the levels observed upstream at Bridge station. During rain events, inflow from a drainage ditch is common and carries suspended solids, increasing conductance.

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.

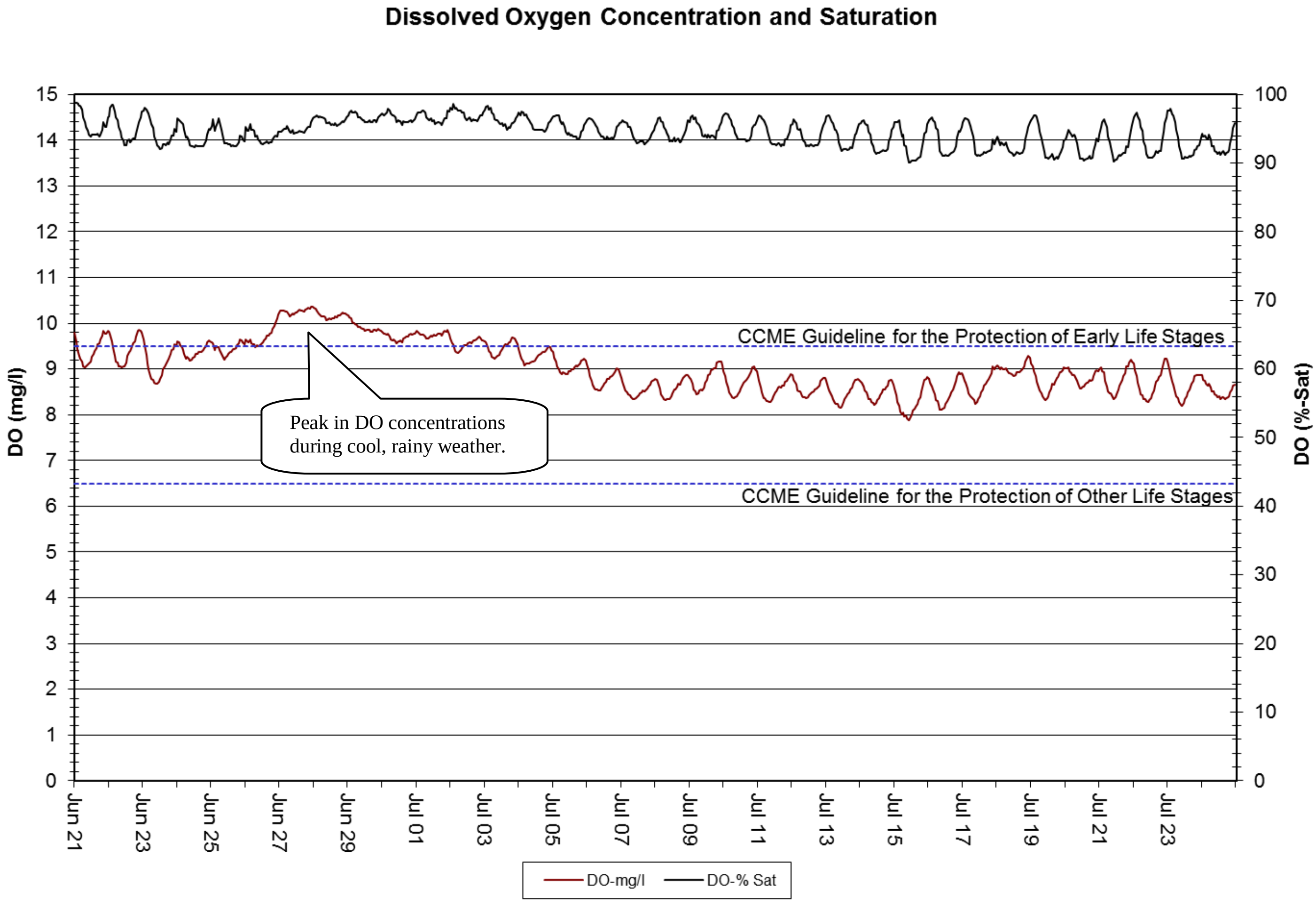
Figure 10: Dissolved Oxygen at Rattling Brook Big Pond



Parameter	Max	Min	Median
Dissolved Oxygen (%-Sat)	109.1	89.8	97.2
Dissolved Oxygen (mg/l)	10.44	8.68	9.63

- Big Pond dissolved oxygen levels are more regular and stable than those seen downstream at Bridge and Plant Discharge stations. The concentration of dissolved oxygen did not consistently fall below the upper CCME guideline value of 9.5 mg/l until July 9th due to ambient air temperatures.

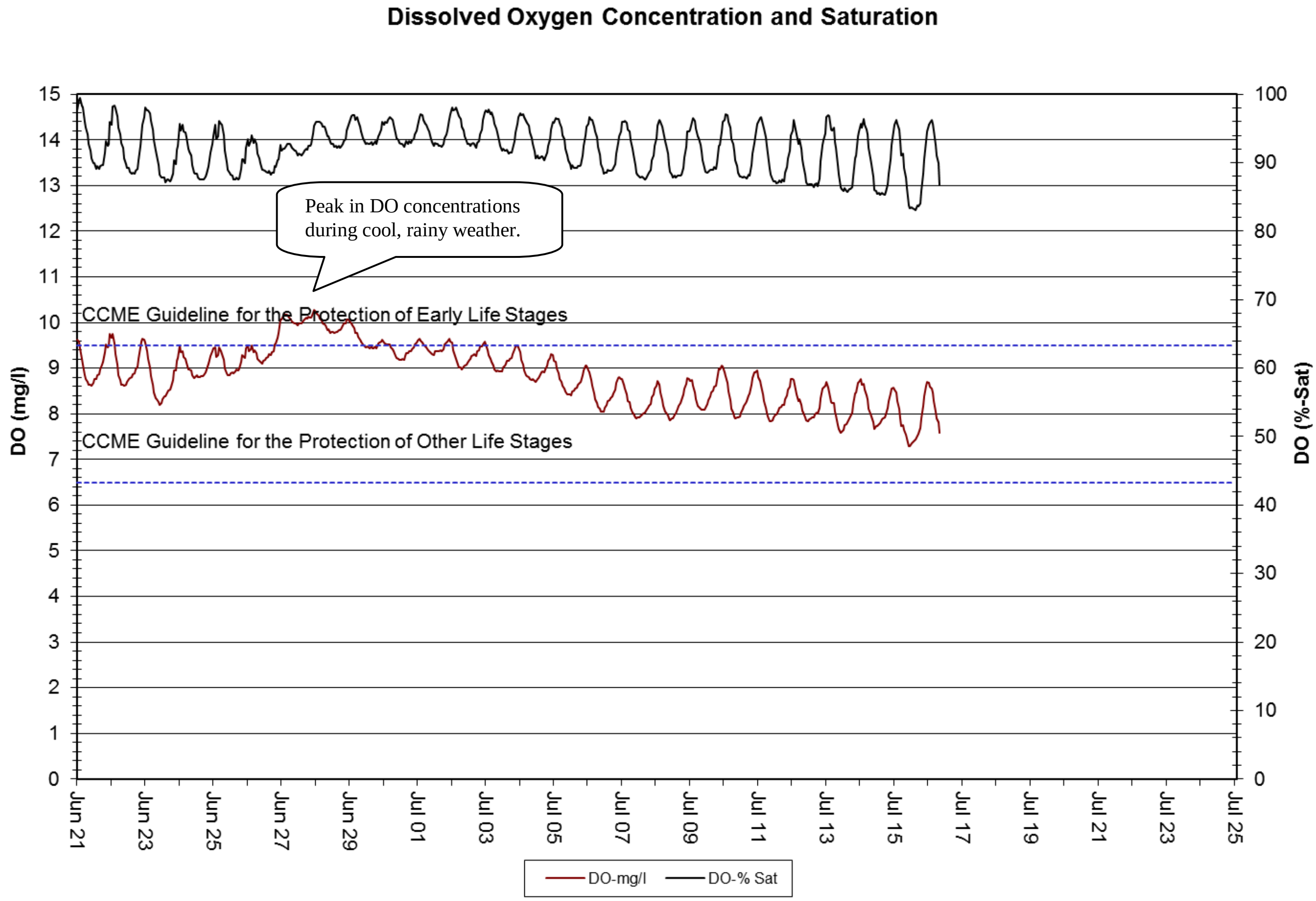
Figure 11: Dissolved Oxygen at Rattling Brook below Bridge



Parameter	Max	Min	Median
Dissolved Oxygen (%-Sat)	98.8	90.1	94.6
Dissolved Oxygen (mg/l)	10.36	7.88	8.94

- Dissolved oxygen concentrations began to consistently fall below the upper CCME guideline values in June – much sooner than the cooler waters at Big Pond. A general downward trend is expected to continue into the summer until waters begin to decline towards the end of August or early September.

Figure 12: Dissolved Oxygen at Rattling Brook below Plant Discharge



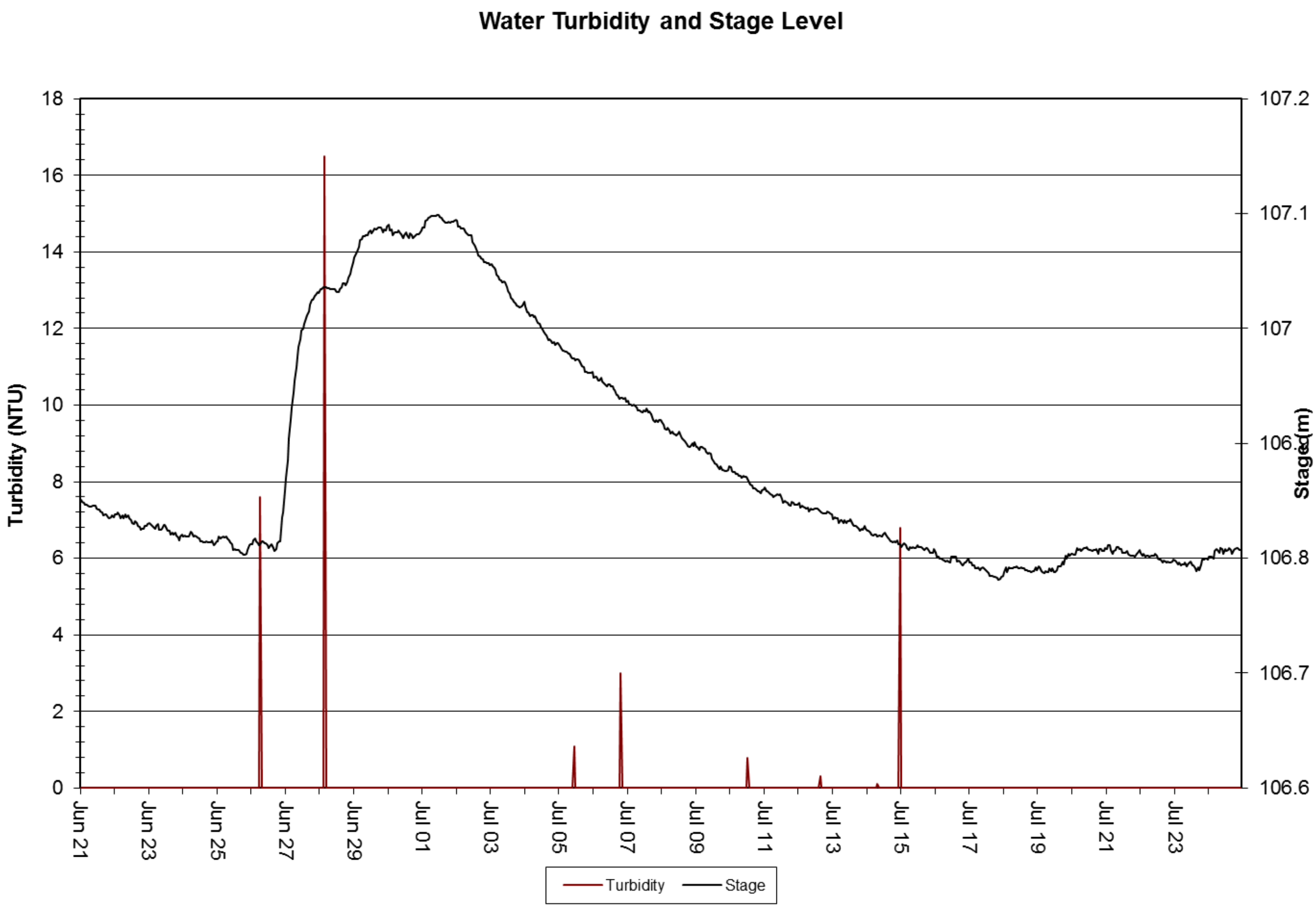
Parameter	Max	Min	Median
Dissolved Oxygen (%-Sat)	99.4	83.1	92.4
Dissolved Oxygen (mg/l)	10.27	7.28	8.84

- A fault in the DO sensor resulted in a gap for the last week of deployment.
- As water warms while travelling down the Rattling Brook system, less oxygen can be held in the water column. Therefore, DO concentrations at Discharge station fell below the upper CCME guideline before Bridge station. The downward trend in oxygen concentration is not expected to reverse until late August or September.

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.

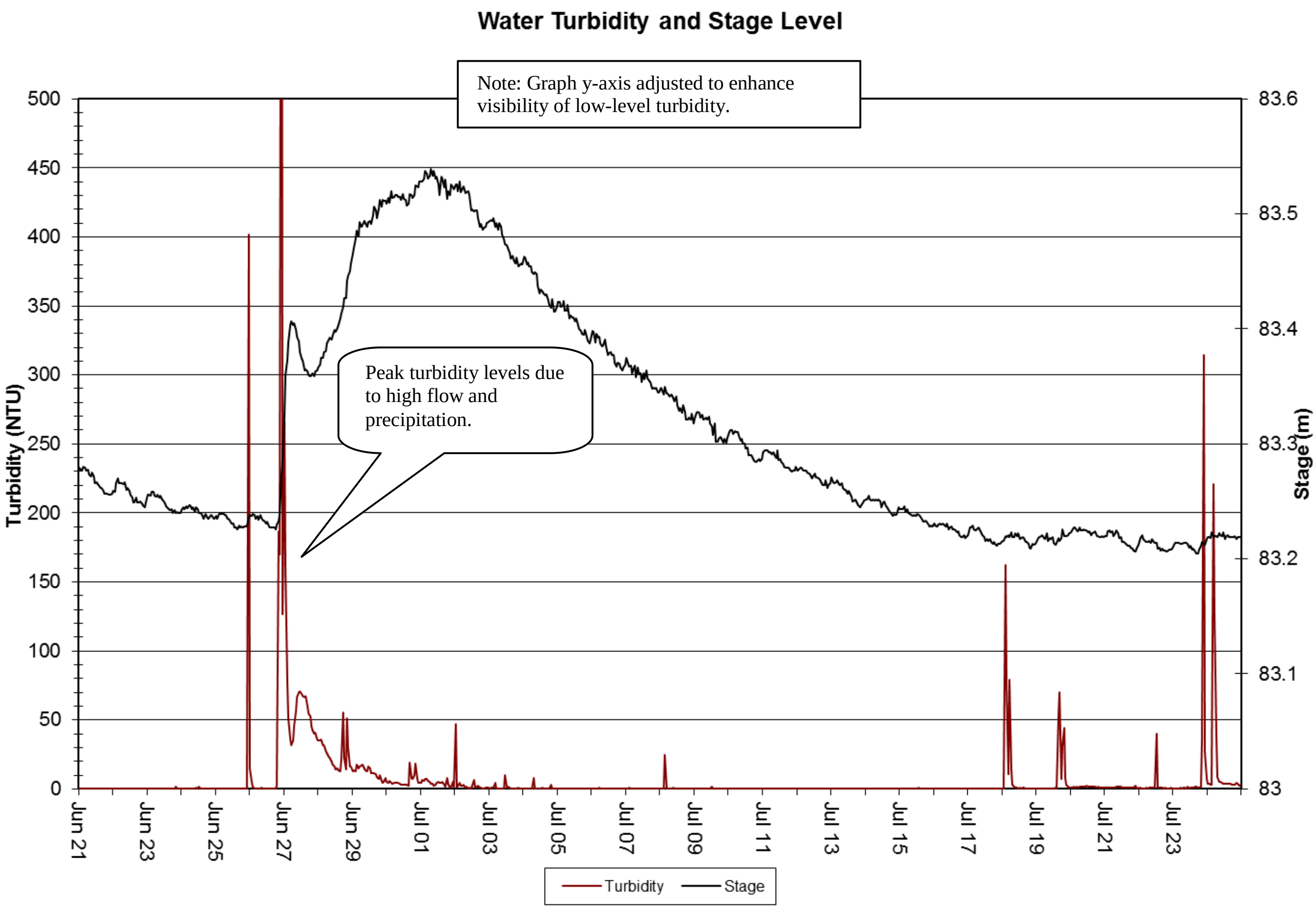
Figure 13: Turbidity at Rattling Brook Big Pond



Parameter	Max	Min	Median
Turbidity (NTU)	16.5	0.0	0.0

- Turbidity was found to be consistently low at Big Pond station with intermittent peaks. Two spikes early in the deployment occur during unsettled weather. Each peak, however, is an instantaneous measurement of 7.6 NTU and 16.5 NTU, respectively. With such isolated readings, it is difficult to decisively claim a turbidity event, as these peaks could be caused by a temporary sensor obstruction.

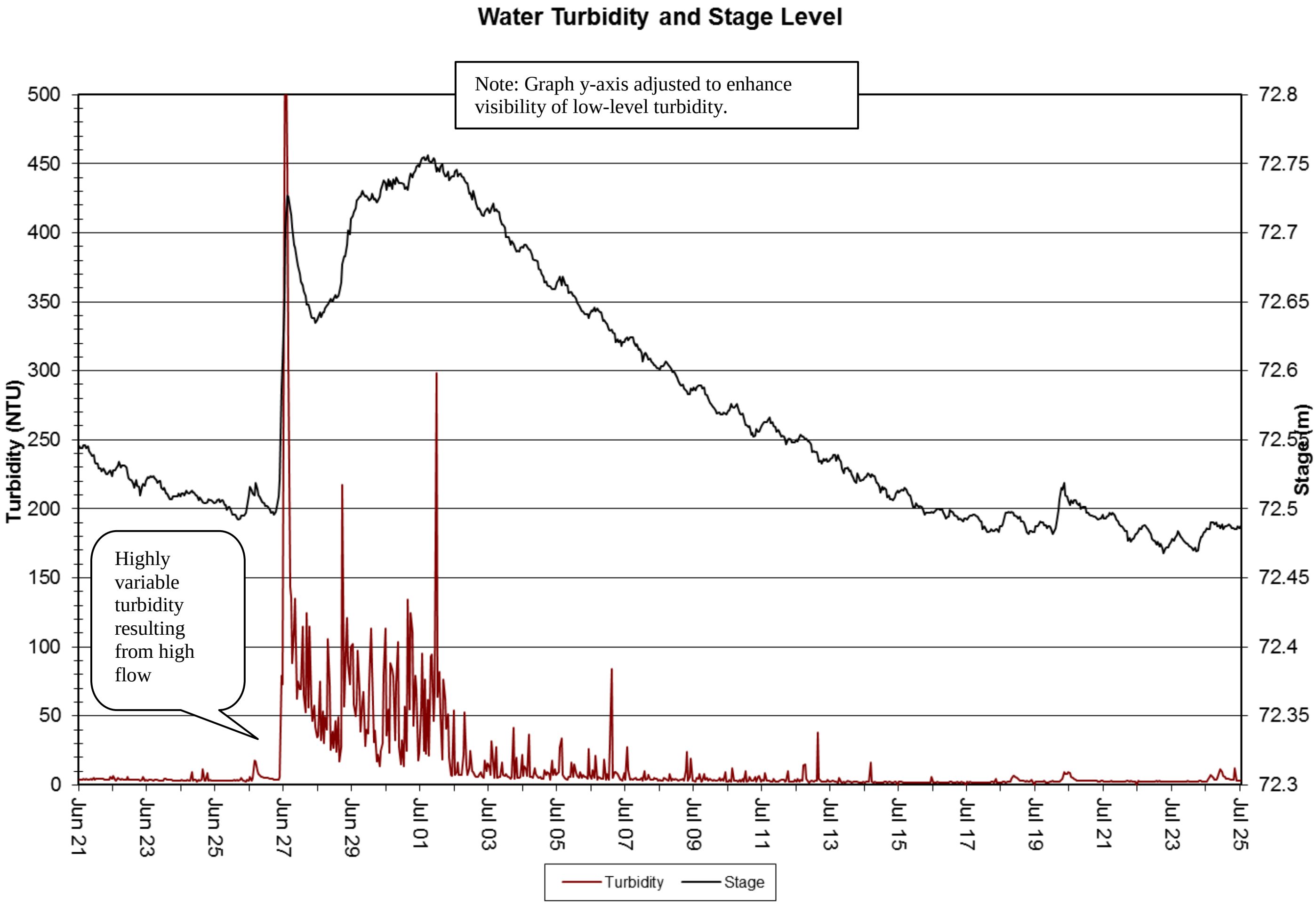
Figure 14: Turbidity at Rattling Brook below Bridge



Parameter	Max	Min	Median
Turbidity (NTU)	998.0	0.0	0.0

- This deployment period marks the first time median turbidity at Bridge station has fallen to 0.0 NTU since the deployment period 2012-07-04 to 2012-08-23 (approximately one year ago).
- Turbidity peaked during the heavy precipitation early in this deployment period and once again towards the end of deployment when additional rain was encountered.

Figure 15: Turbidity at Rattling Brook below Plant Discharge



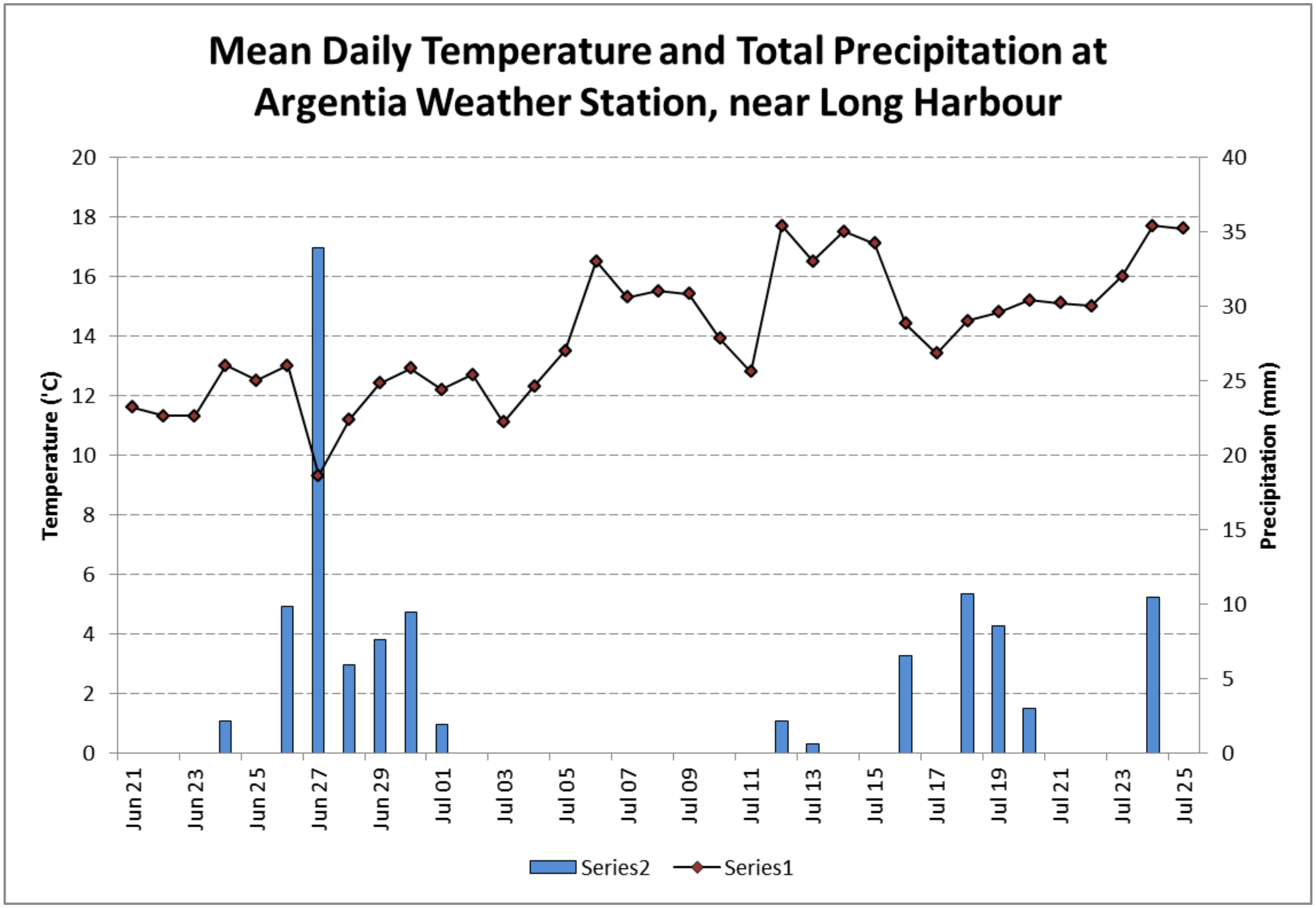
Parameter	Max	Min	Median
Turbidity (NTU)	580.0	0.0	3.6

- Like the low turbidity values seen upstream at Bridge station, levels at Plant Discharge station are the lowest encountered since the deployment of 2012-07-04 to 2012-08-23.

Conclusions

- A DO sensor failure at Plant Discharge station resulted in the loss of data for the final week of deployment. This will be rectified prior to the next deployment.
- Turbidity levels at Bridge and Plant Discharge station are the lowest seen since before in-stream work at Forgotten Pond was undertaken. Levels have been slowly declining since the work finished in the fall of 2012. While high flows are expected to generate large peaks for some time, background turbidity levels are approaching 0 NTU.

Appendix



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