Real-Time Water Quality Deployment Report

Rattling Brook Network

August 23, 2013 to October 3, 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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2013-08-23 to 2013-10-03

General

- Department of Environment and Conservation staff monitors the real-time web pages consistently.
- A datalogger outage occurring from mid-to-late September at Big Pond station resulted in a gap of stage level data. Water quality data was retrieved from the log file onboard the Hydrolab and backfilled to close the hole.

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

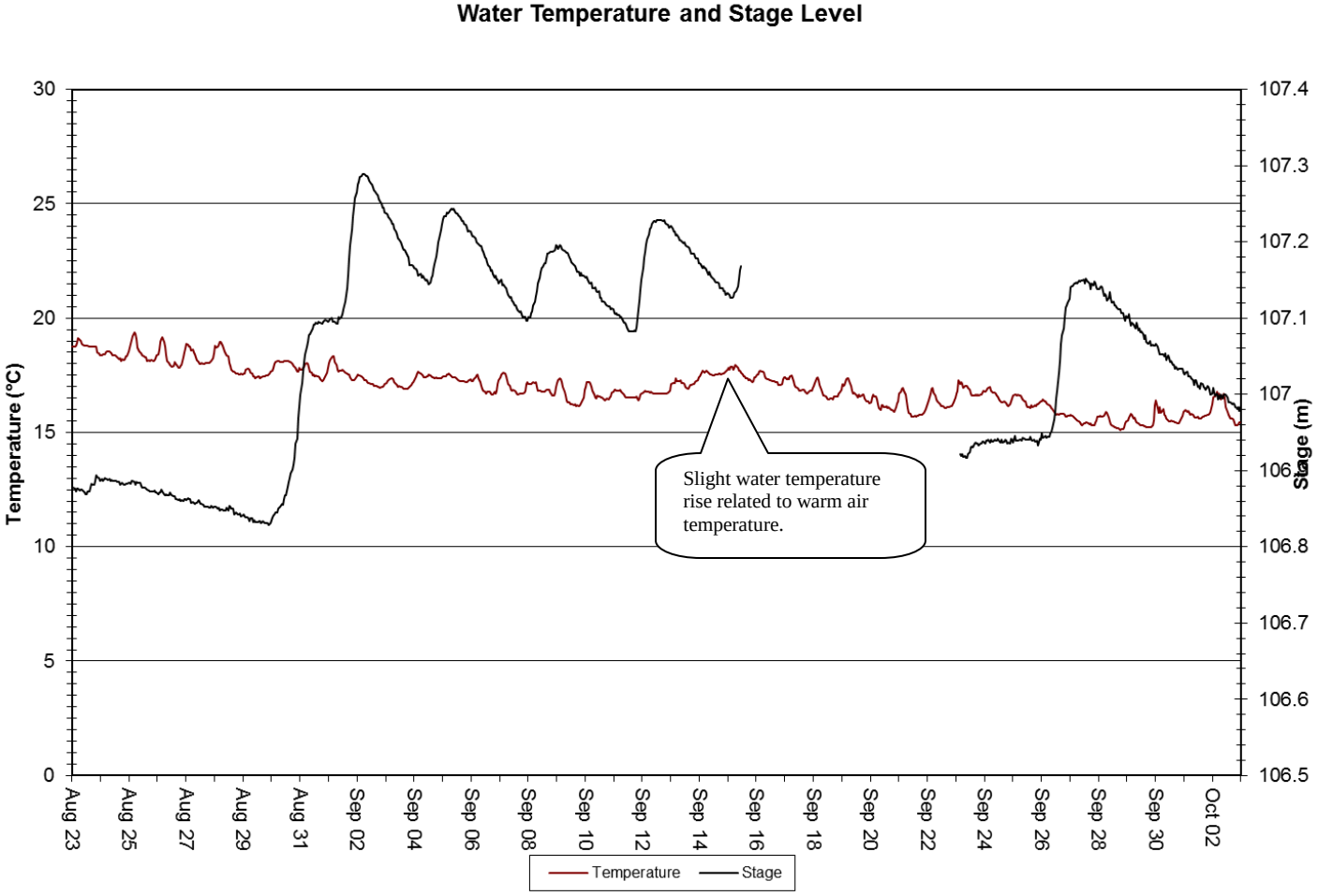
Station	Date	Action	Comparison Ranking				
			Temperature	pH	Conductivity	Dissolved Oxygen	Turbidity
Rattling Brook Big Pond	August 23, 2013	Deployment	Excellent	Good	Excellent	Excellent	Excellent
	October 3, 2013	Removal	Excellent	Good	Good	Excellent	Excellent
Rattling Brook below Bridge	August 23, 2013	Deployment	Excellent	Excellent	Excellent	Excellent	Excellent
	October 3, 2013	Removal	Excellent	Fair	Good	Excellent	Excellent
Rattling Brook below Plant Discharge	August 23, 2013	Deployment	Excellent	Excellent	Excellent	Excellent	Excellent
	October 3, 2013	Removal	Excellent	Good	Good	Excellent	Excellent

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.

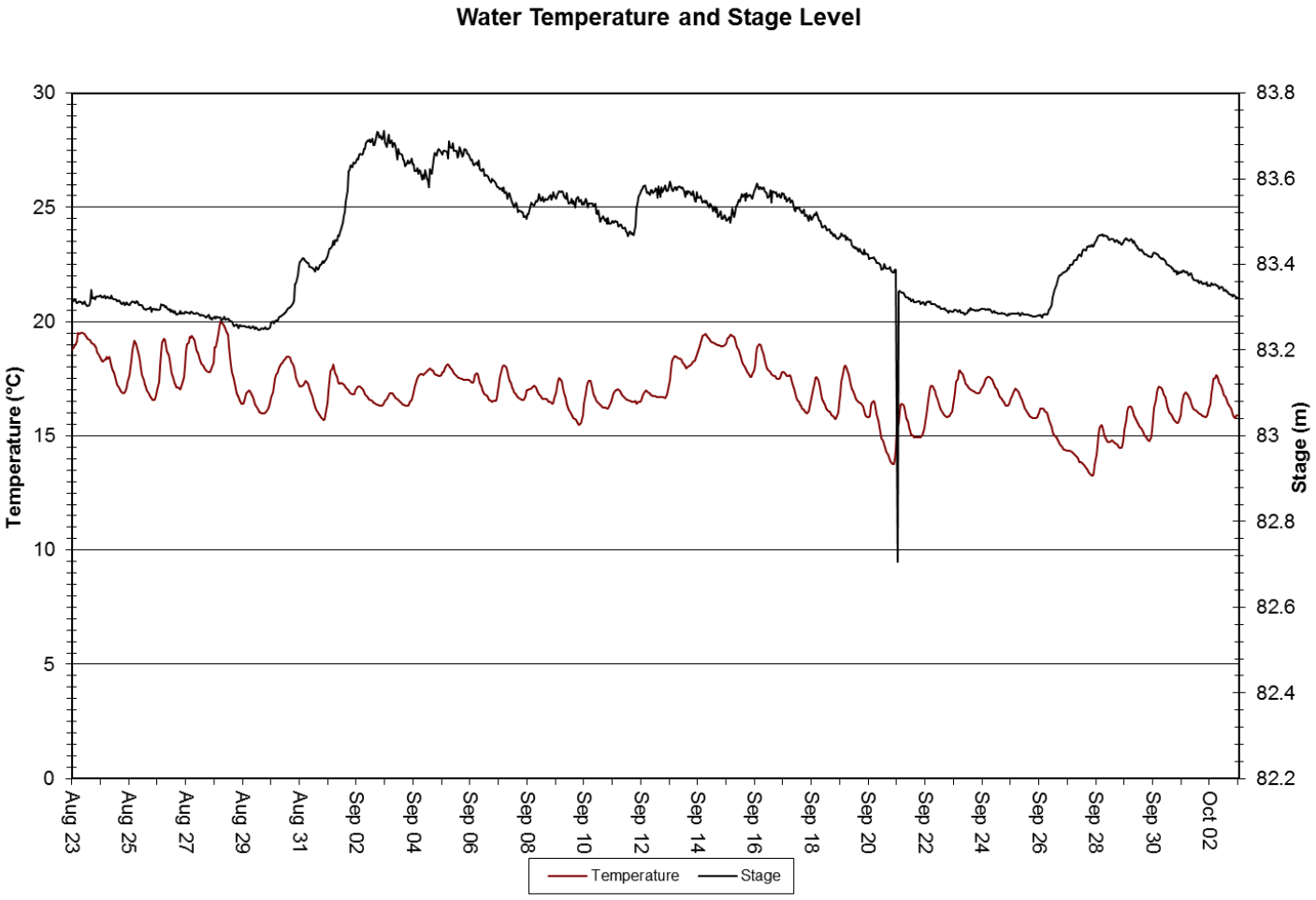
Figure 1: Water Temperature at Rattling Brook Big Pond



Parameter	Max	Min	Median
Temperature('C)	19.38	15.12	16.98

- Water temperature at Big Pond station continued to decline throughout the deployment period with a marginal rise mid-deployment related to rising air temperatures.
- At this time of year, Big Pond station possesses a great deal of energy (heat) that is lost as water travels downstream and interfaces more and more with cool fall air. To this end, Big Pond cools slowly while Plant Discharge station cools quickly.

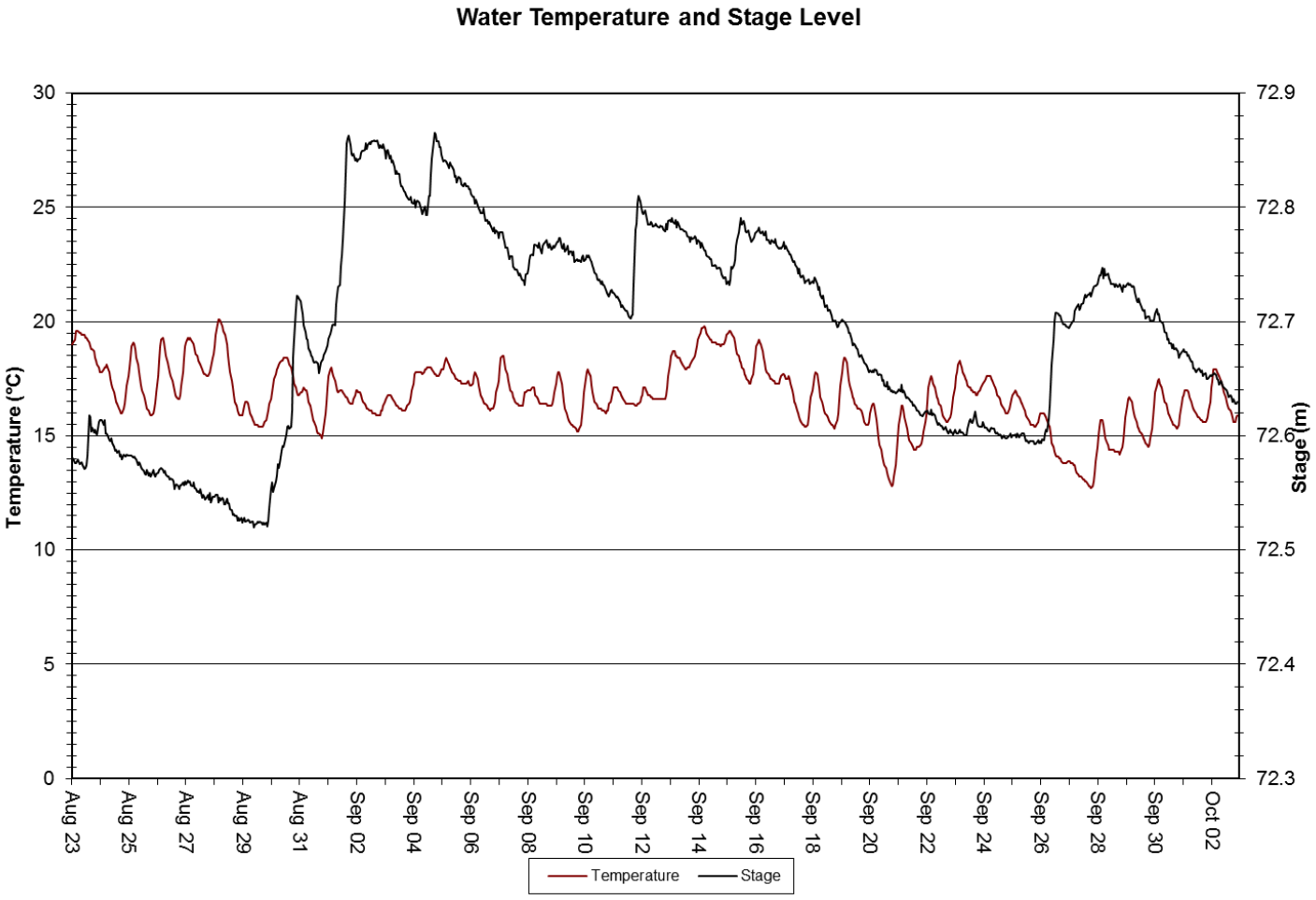
Figure 2: Water Temperature at Rattling Brook below Bridge



Parameter	Max	Min	Median
Temperature('C)	20.02	13.26	16.88

- Water temperature declined throughout the deployment period at Bridge station with a slight increase mid-deployment related to warm air temperatures.
- More extreme water temperatures were observed at Bridge station compared to Big Pond station, though median temperature was slightly lower at Bridge station.

Figure 3: Water Temperature at Rattling Brook below Plant Discharge



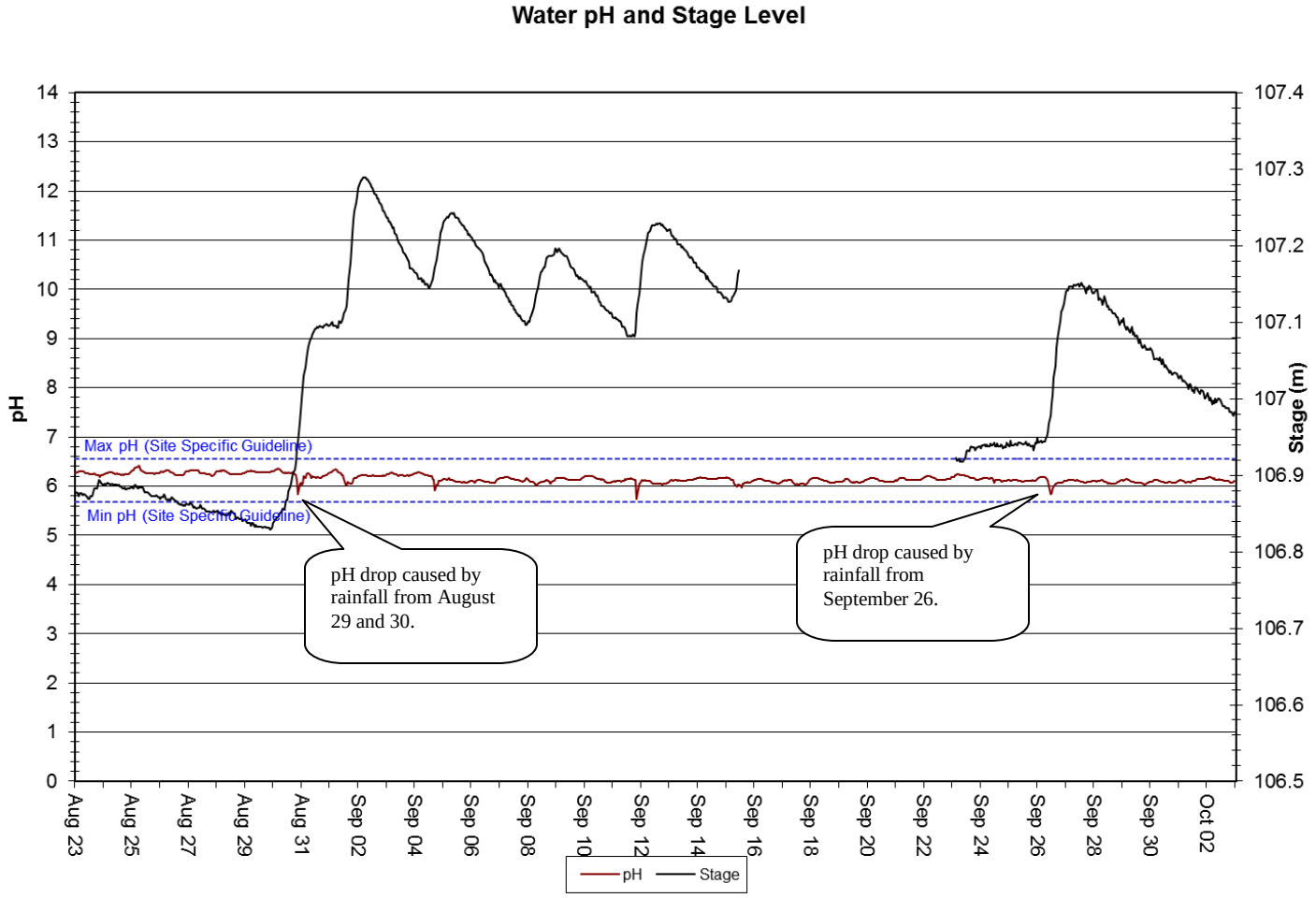
Parameter	Max	Min	Median
Temperature('C)	20.10	12.70	16.70

- Daily temperature cycles at Plant Discharge station are much more exaggerated than the same cycles seen upstream. This is echoed by the even greater extreme water temperatures at Plant Discharge station compared to Bridge and Big Pond stations.

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.

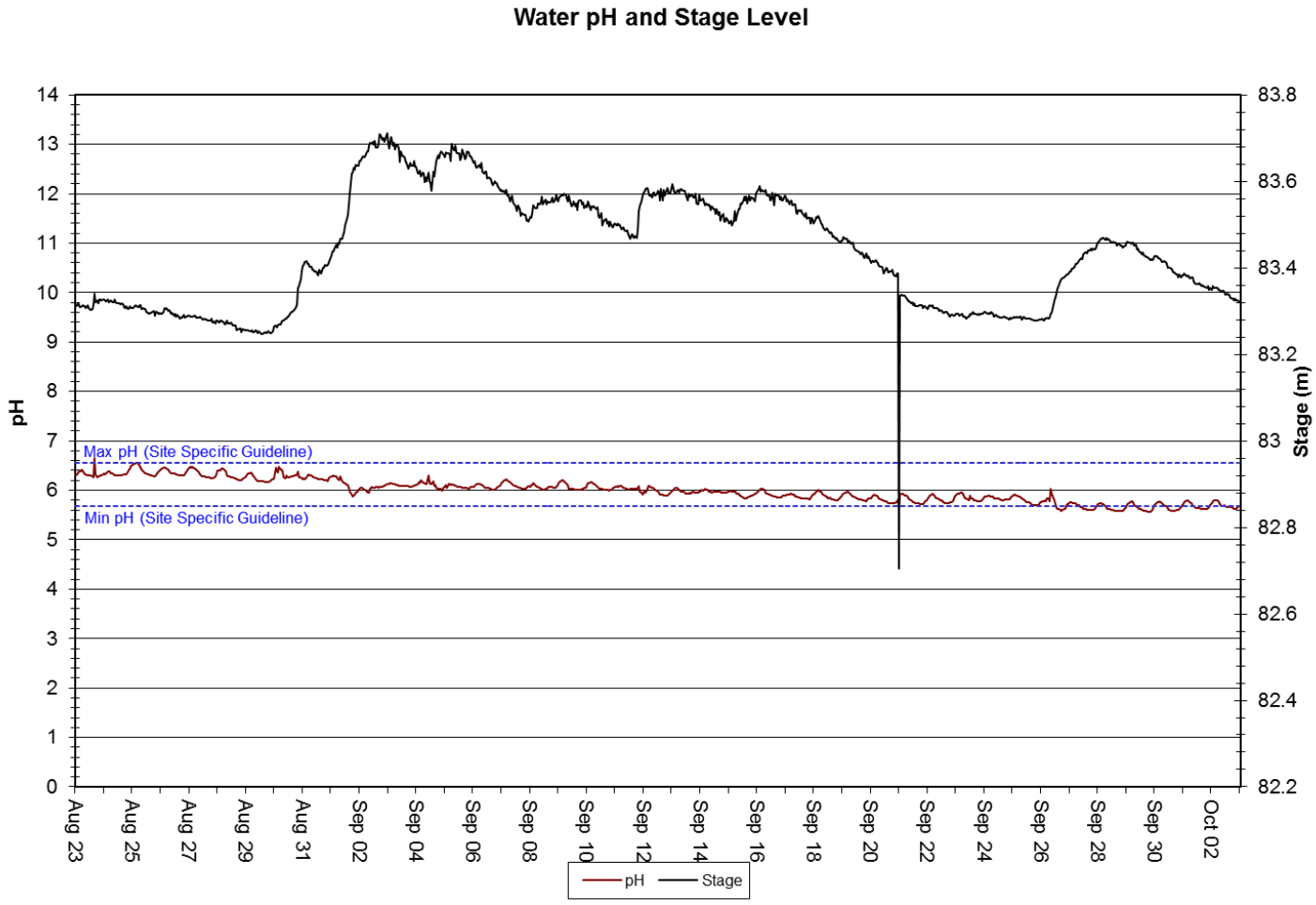
Figure 4: pH at Rattling Brook Big Pond



Parameter	Max	Min	Median
pH	6.41	5.74	6.13

- pH levels at Big Pond station showed a small decline over the course of the deployment period with some instances of perturbation caused by rainfall, as seen on August 30th and September 26th.
- All values fell within the site specific guidelines for the Rattling Brook system.

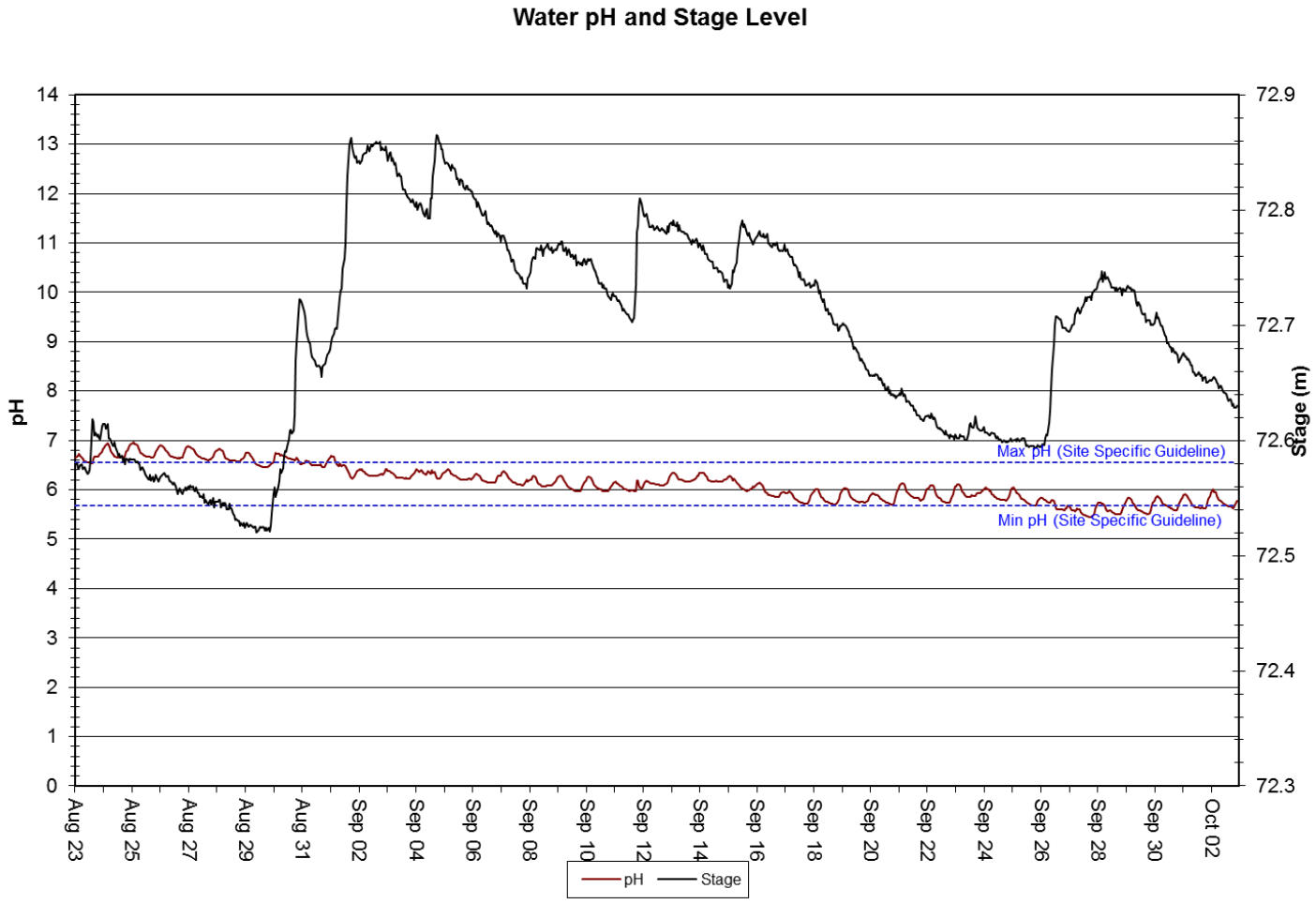
Figure 5: pH at Rattling Brook below Bridge



Parameter	Max	Min	Median
pH	6.66	5.56	5.99

- pH values declined over the course of the deployment period but fell mainly within the site specific guidelines for most of the month. Median pH was lower than Big Pond station.

Figure 6: pH at Rattling Brook below Plant Discharge



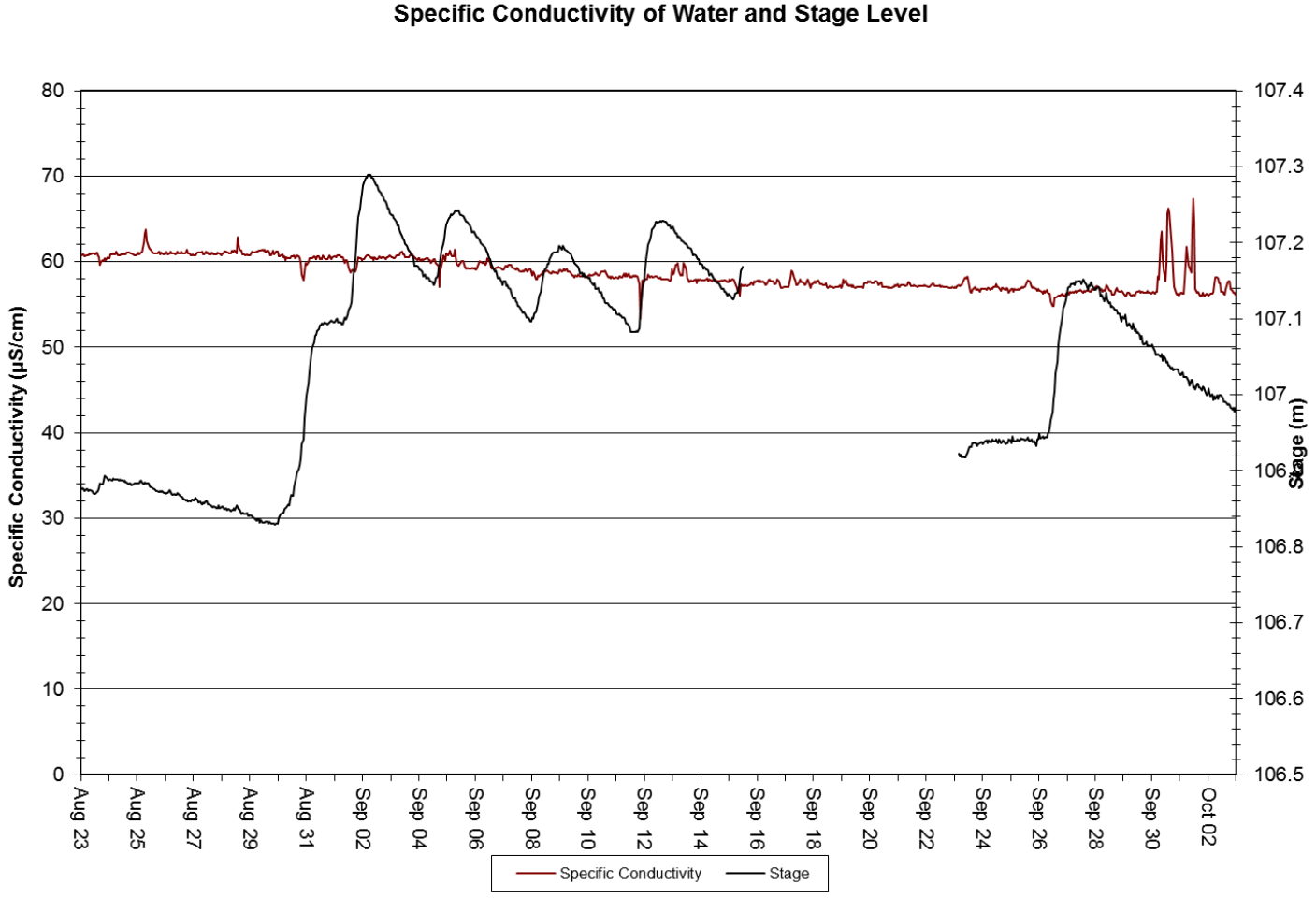
Parameter	Max	Min	Median
pH	6.96	5.45	6.11

- A declining trend in pH was observed at Plant Discharge station, though most values fell within the site specific guidelines for the Rattling Brook network.

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.

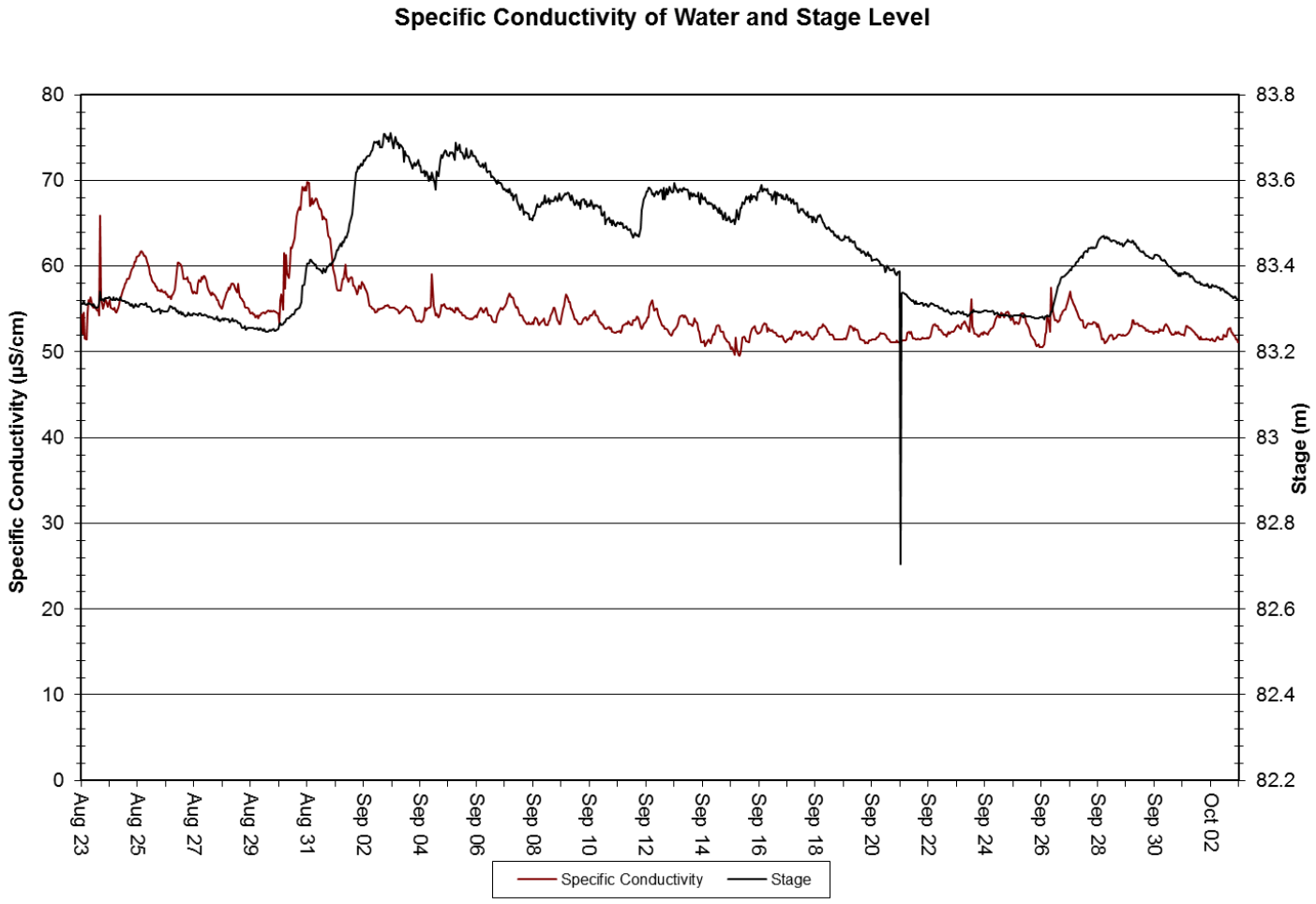
Figure 7: Specific Conductivity at Rattling Brook Big Pond



Parameter	Max	Min	Median
Specific Conductivity (µS/cm)	67.4	53.4	58.3

- Specific conductivity declined throughout the deployment period with few major perturbations. In instances where rainfall and stage level increase was encountered, an instantaneous drop in conductivity was observed with a recovery occurring within a few hours.

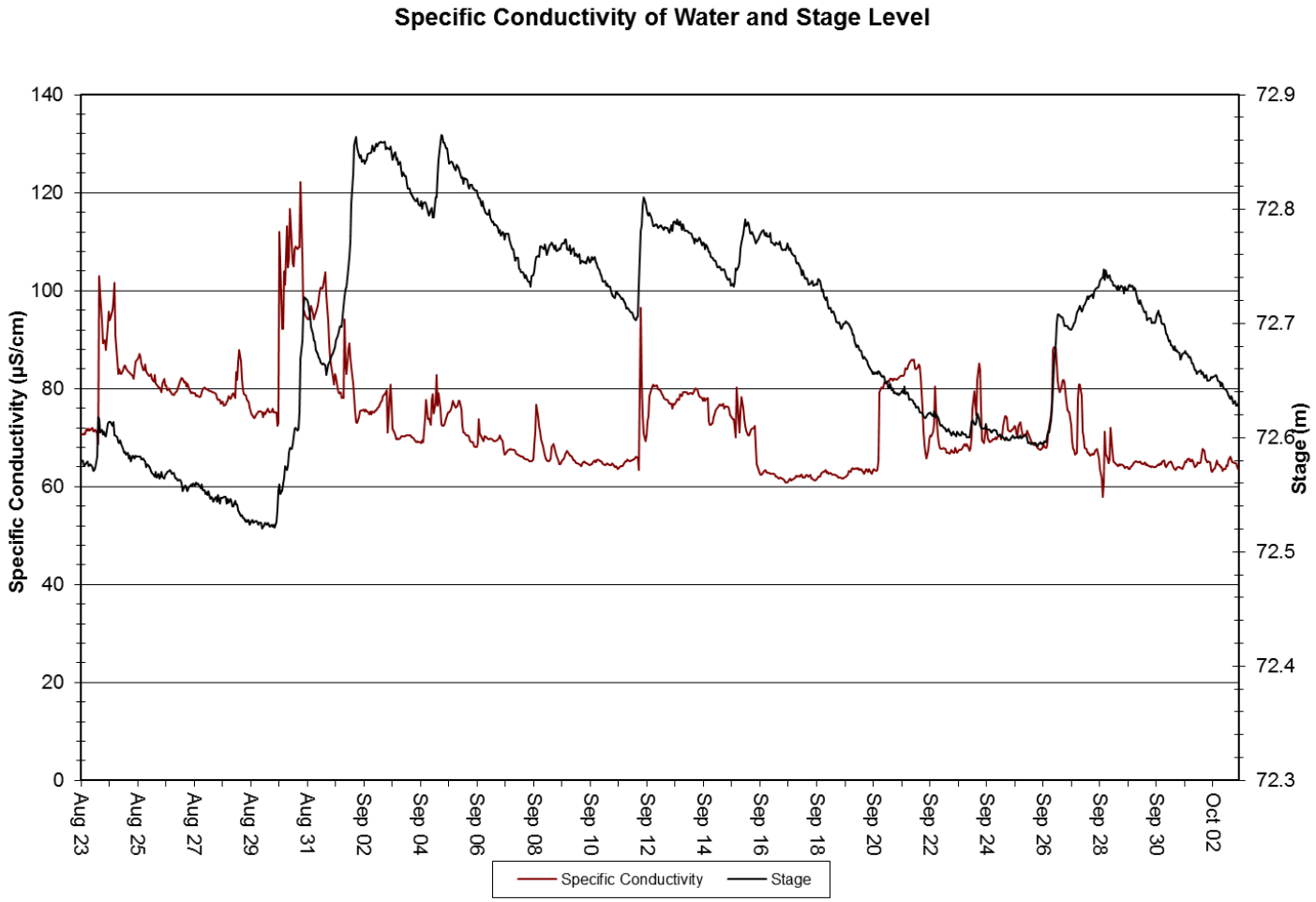
Figure 8: Specific Conductivity at Rattling Brook below Bridge



Parameter	Max	Min	Median
Specific Conductivity (µS/cm)	69.8	49.6	53.6

- Median conductivity tended to be lower at Bridge station than Big Pond station, though maxima and minima presented a broader range of values.

Figure 9: Specific Conductivity at Rattling Brook below Plant Discharge



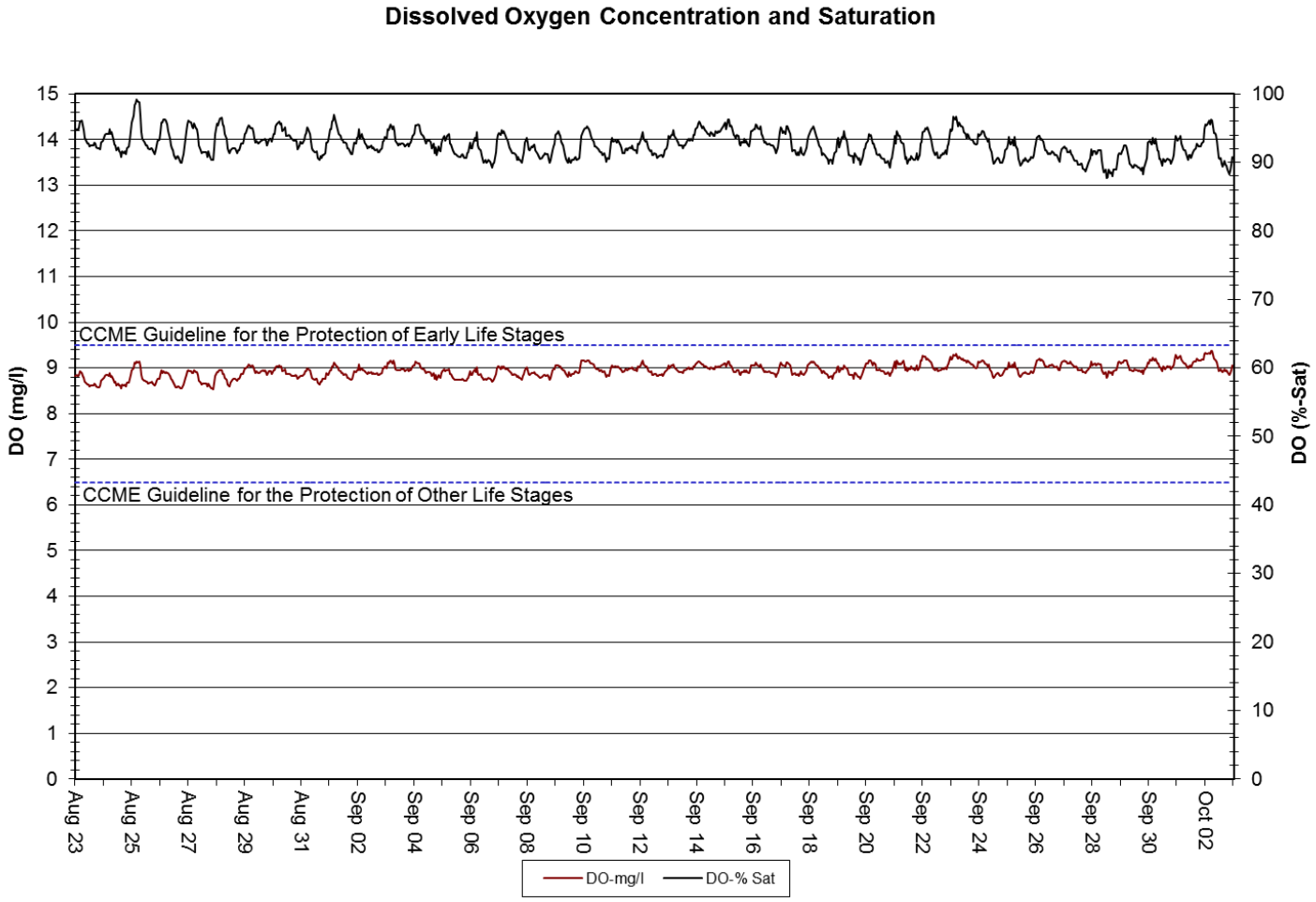
Parameter	Max	Min	Median
Specific Conductivity (µS/cm)	122.2	57.9	70.9

- Highly variable conductivity is characteristic of Plant Discharge station, likely as a result of effluent from nearby sedimentation ponds discharging into Rattling Brook upstream of the station. Conductivity is especially elevated during, and in the hours after, a heavy rainfall.

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.

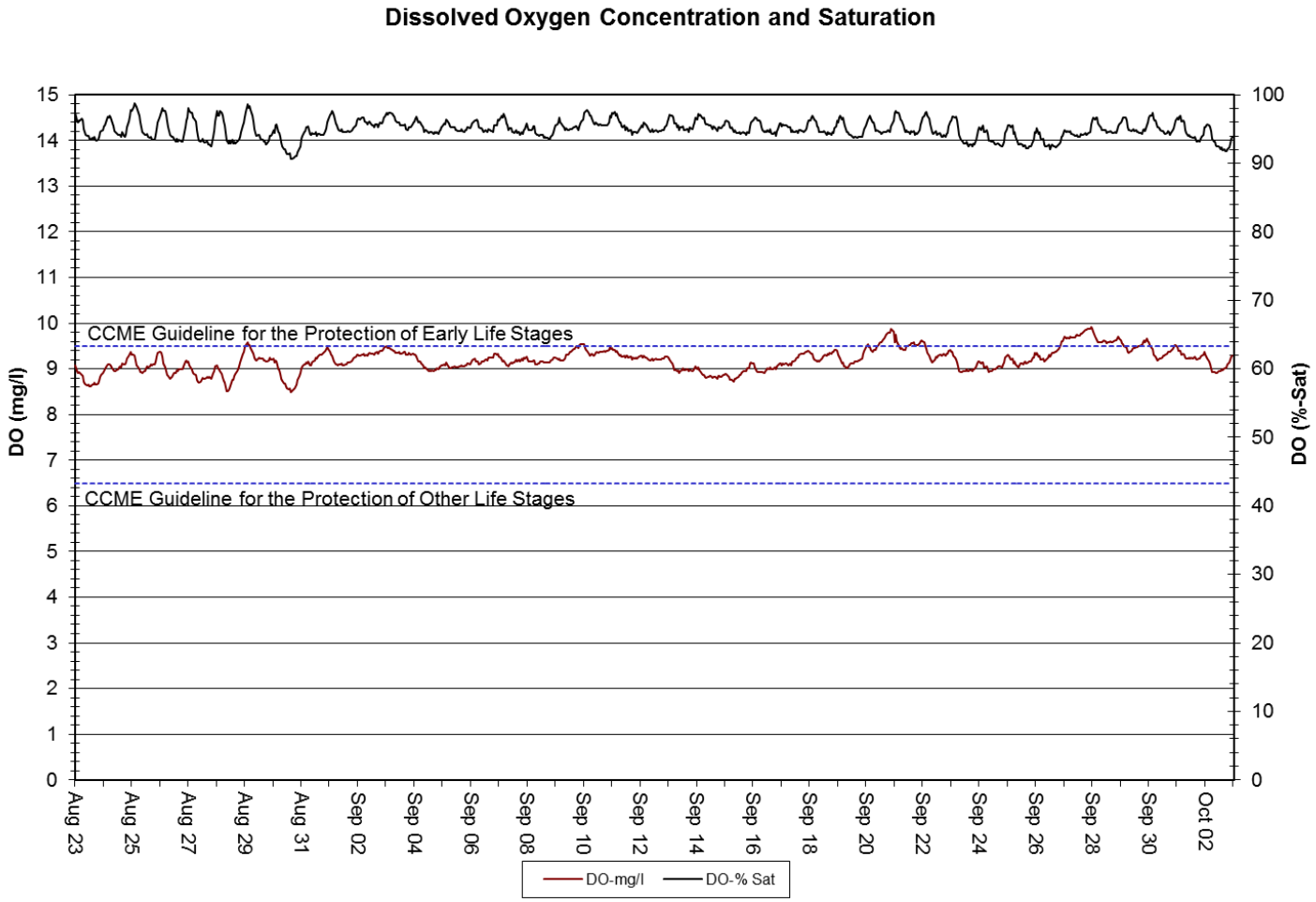
Figure 10: Dissolved Oxygen at Rattling Brook Big Pond



Parameter	Max	Min	Median
Dissolved Oxygen (%-Sat)	99.2	87.7	92.4
Dissolved Oxygen (mg/l)	9.38	8.52	8.94

- Oxygen concentration steadily increased during this deployment period as water temperature fell. All values were found to be above the CCME guideline for the protection of mature cold water biota. It is expected that concentrations will surpass 9.5 mg/l DO within the next few weeks.

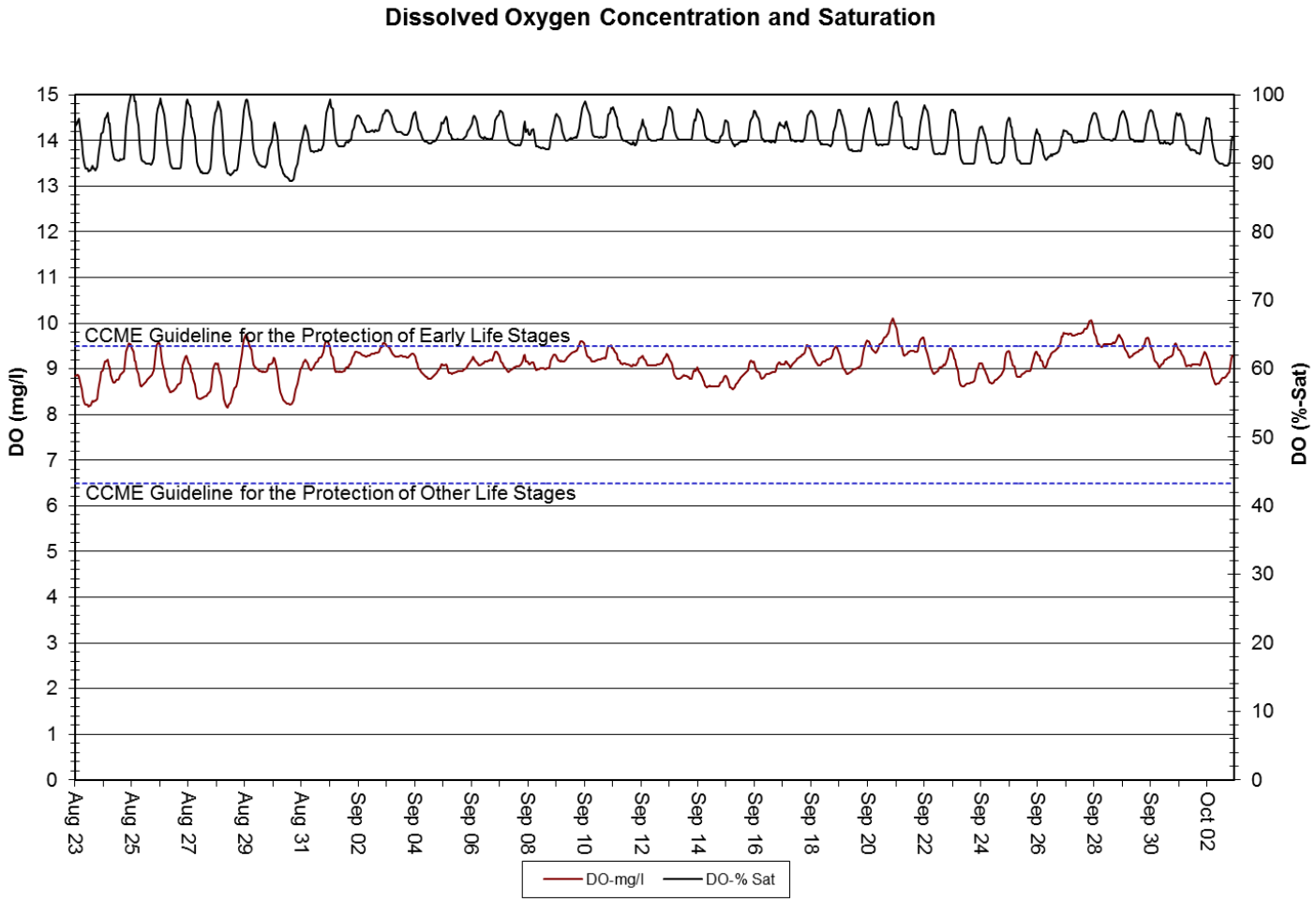
Figure 11: Dissolved Oxygen at Rattling Brook below Bridge



Parameter	Max	Min	Median
Dissolved Oxygen (%-Sat)	98.7	90.6	94.8
Dissolved Oxygen (mg/l)	9.91	8.49	9.20

- Like many water quality parameters, the maximum and minimum oxygen concentrations are more extreme in the river channel of the Rattling Brook system. Typically, however, oxygen is found at a higher concentration lower in the watershed than the still waters of Big Pond.

Figure 12: Dissolved Oxygen at Rattling Brook below Plant Discharge



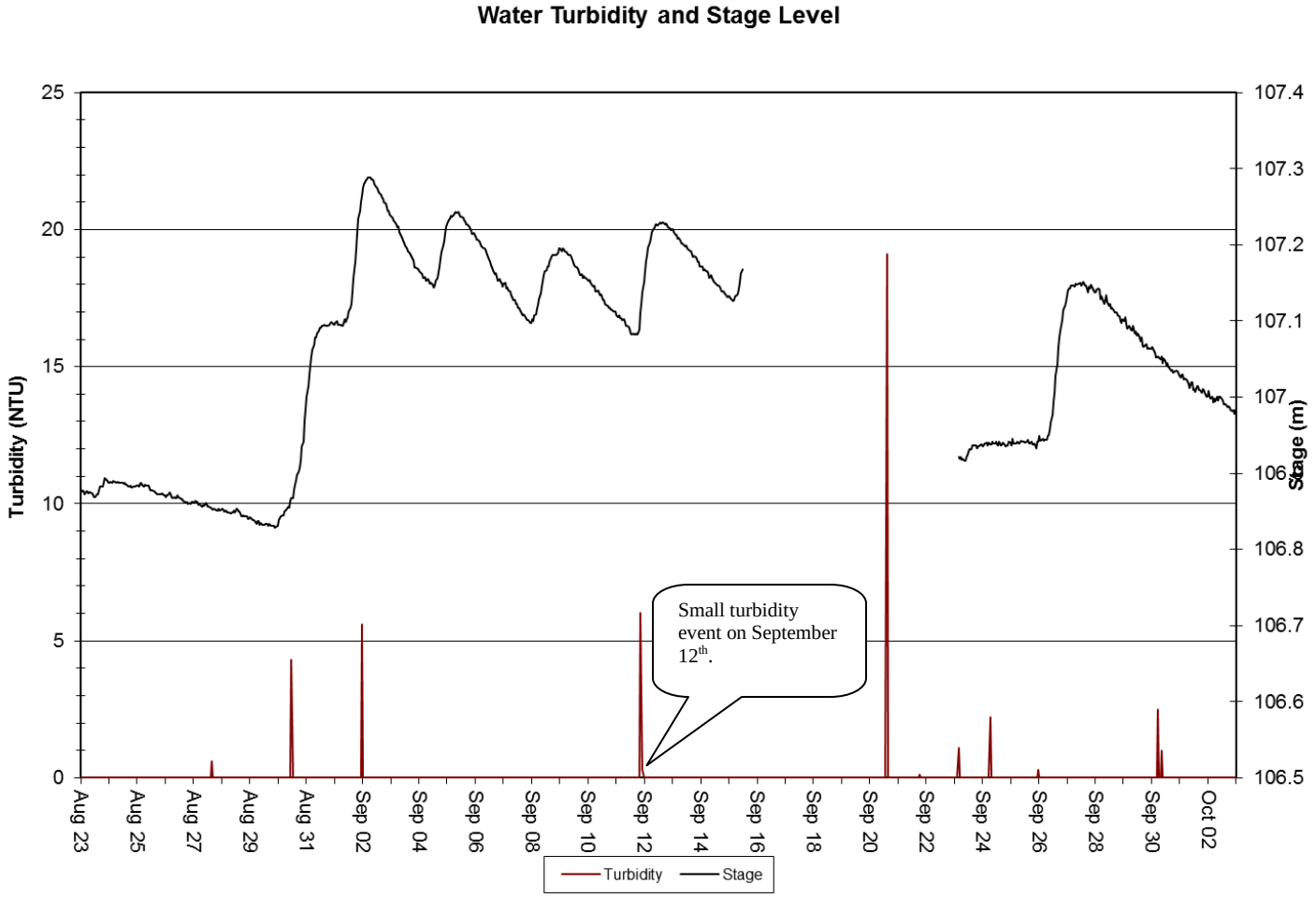
Parameter	Max	Min	Median
Dissolved Oxygen (%-Sat)	100.1	87.4	93.6
Dissolved Oxygen (mg/l)	10.10	8.15	9.11

- Though the extremes at Plant Discharge tend to be more extreme than Bridge station, oxygen concentrations tend to be marginally lower at Plant Discharge station. This may be due to slower and smoother flowing water downstream.

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.

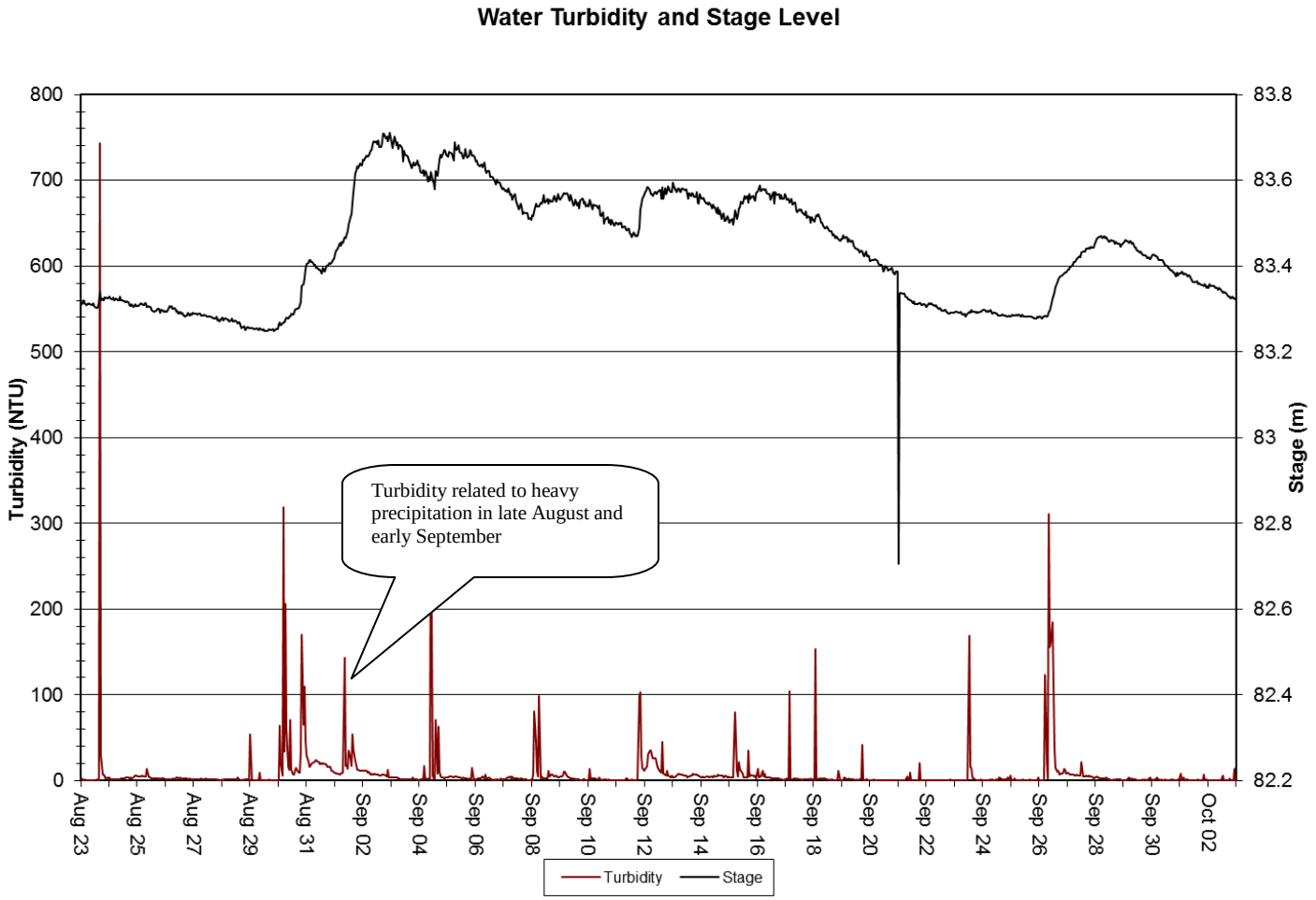
Figure 13: Turbidity at Rattling Brook Big Pond



Parameter	Max	Min	Median
Turbidity (NTU)	19.1	0.0	0.0

- Most turbidity events observed during this deployment period were of single instances above 0.0 NTU. These "peaks" are often caused by instantaneous blockage of the turbidity sensor and not related to actual turbidity conditions. On September 12th, however, a three hour period indicated the presence of turbidity during a period of wind and rain that likely generate rough water conditions.

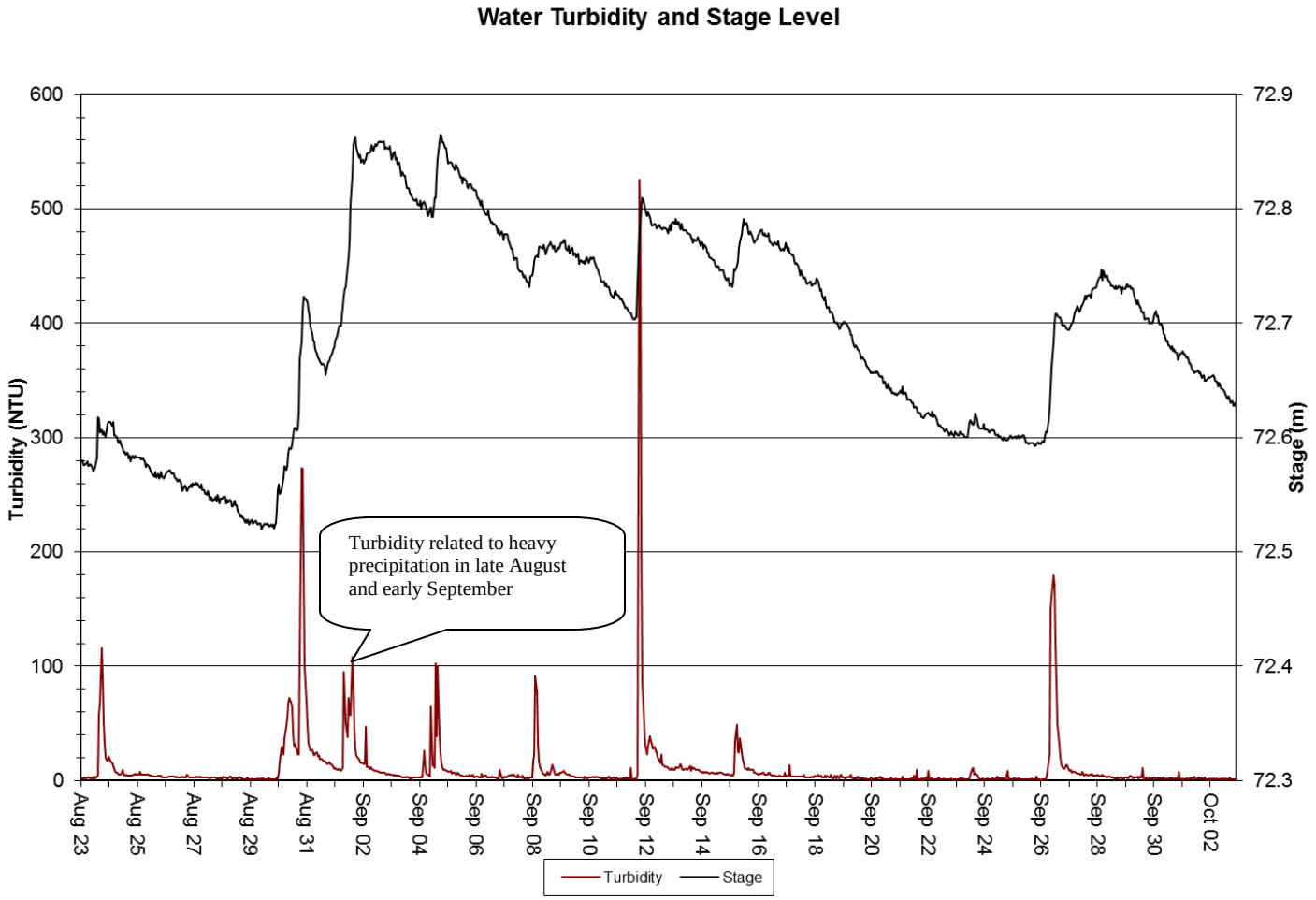
Figure 14: Turbidity at Rattling Brook below Bridge



Parameter	Max	Min	Median
Turbidity (NTU)	743.0	0.0	2.0

- Median turbidity was higher at Bridge station compared to Big Pond station as Bridge station is susceptible to silty overland flow from the construction areas of the nickel plant site. The median turbidity was generally low, with the occasional occurrence of 0.0 NTU values.
- A prolonged turbidity event was observed in late August as a result of heavy precipitation during several days of rain on August 28th to September 1st.

Figure 15: Turbidity at Rattling Brook below Plant Discharge



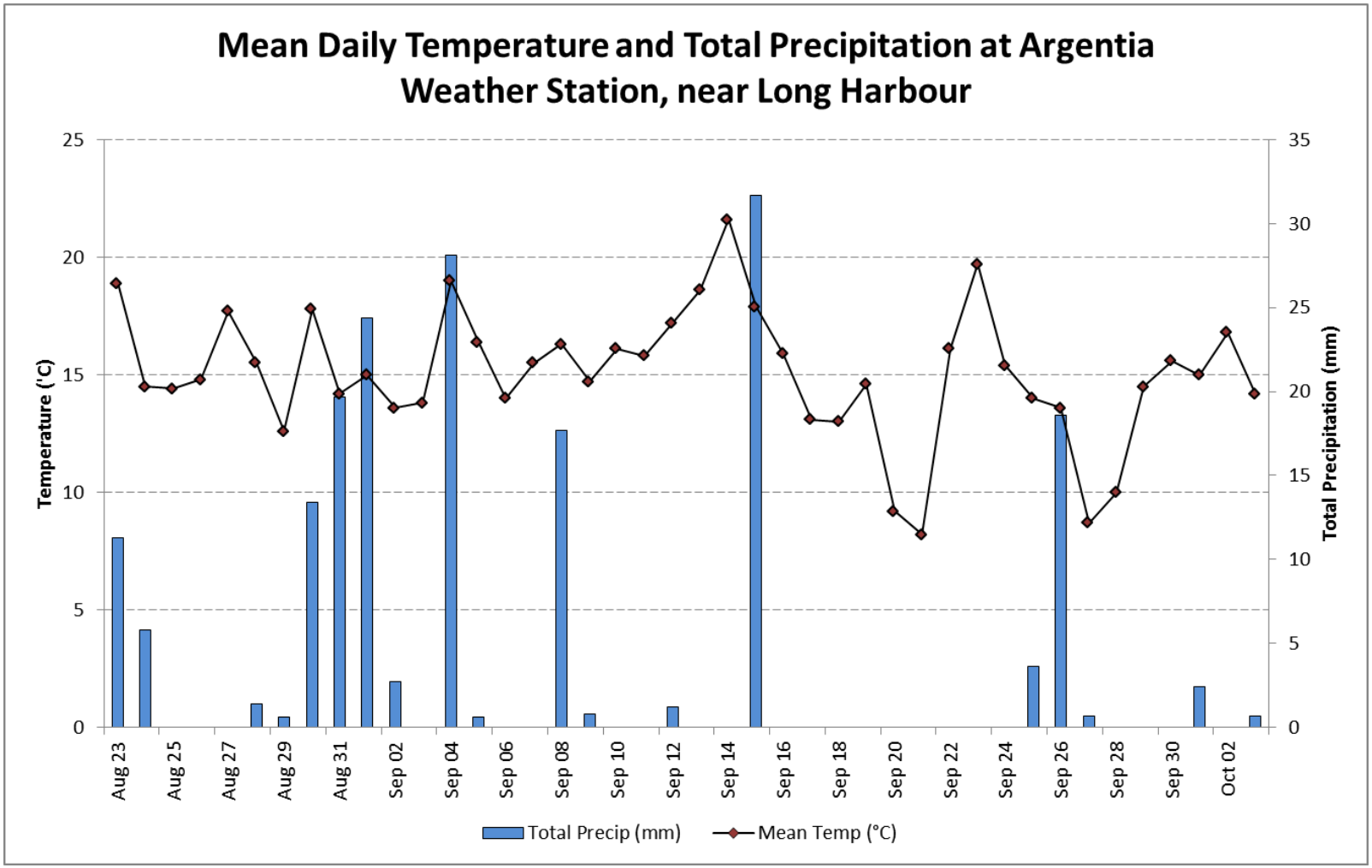
Parameter	Max	Min	Median
Turbidity (NTU)	526.0	0.3	3.5

- Though maximum turbidity was lower at Plant Discharge than at Bridge station, levels tended to be slightly higher here with a median value of 3.5 NTU, versus 2.0 NTU at Bridge. Plant Discharge station intercepts drainage from settling ponds on the construction site resulting in higher and more sustained turbidity during rainfall events.

Conclusions

- Water quality parameters are showing the characteristics expected during unsettled weather in the fall season: water temperature decline, dissolved oxygen increase and fluctuating conductivity and turbidity levels.
- A datalogger fault at Big Pond station was observed from September 16th to September 23rd. Following replacement of damaged equipment, communications were re-established.

Appendix



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