Real-Time Water Quality Deployment Report

Voisey's Bay Network

August 15 to
September 24, 2012

Newfoundland Labrador

Government of Newfoundland & Labrador
Department of Environment and Conservation
Water Resources Management Division

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Contents

General

- Department of Environment and Conservation staff monitors the real-time web pages regularly.
- This deployment report discusses water quality related events occurring at four stations in the Voisey's Bay Network; Upper Reid Brook, Tributary to Lower Reid Brook, Lower Reid Brook and Camp Pond Brook.
- On August 15, 2012, Vale Environment and ENVC employees together deployed real-time water quality monitoring instruments at the four real time stations in the Voisey's Bay network for a period of 40 days. Instruments were removed by Vale Environment employees for cleaning and calibration on September 24.

Quality Assurance and Quality Control

- 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.
  - ► At deployment and removal, a QAQC Instrument is temporarily deployed along side the Field Instrument. Values for temperature, pH, conductivity, dissolved oxygen and turbidity are compared between the two instruments**.** Based on the degree of difference between parameters recorded by the Field Instrument and QAQC Instrument at deployment and at removal, a qualitative statement is made on the data quality (Table 1).

Table 1: Ranking classifications for deployment and removal

	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

- It should be noted that the temperature sensor on any instrument is the most important. All other parameters can be broken down into three groups: temperature dependant, temperature compensated and temperature independent. Because the temperature sensor is not isolated from the rest of the instrument the entire instrument must be at the same temperature before the sensor will stabilize. The values may take some time to climb to the appropriate reading; if a reading is taken too soon it may not accurately portray the water body.

- Deployment and removal comparison rankings for the Voisey's Bay Network stations deployed from August 15 to September 24, 2012 are summarized in Table 2.

Table 2: Comparison rankings for Voisey's Bay Network stations, August 15– September 24, 2012

Station Voisey's Bay	Date	Action	Comparison Ranking				
			Temperature	pH	Conductivity	Dissolved Oxygen	Turbidity
Upper Reid Brook (62884)	Aug 15, 2012	Deployment	Excellent	n/a*	Excellent	Excellent	Excellent
	Sep 24, 2012	Removal	Excellent	Good	Excellent	Excellent	Excellent
Tributary to L. Reid B. (62886)	Aug 15, 2012	Deployment	Excellent	n/a*	Excellent	Excellent	Excellent
	Sep 24, 2012	Removal	Excellent	Excellent	Good	Good	Excellent
Lower Reid Brook (62887)	Aug 15, 2012	Deployment	Excellent	n/a*	Excellent	Excellent	Excellent
	Sep 24, 2012	Removal	Excellent	Excellent	Good	Good	Excellent
Camp Pond Brook (62885)	Aug 15, 2012	Deployment	Excellent	n/a*	Excellent	Excellent	Excellent
	Sep 24, 2012	Removal	Excellent	Excellent	Good	Good	Excellent

*Field instrument was slow to stabilize resulting in false rankings, see explanations below

- At the station at Upper Reid Brook, all parameters ranked 'excellent' at deployment except for pH. pH was not ranked at deployment because of slow response time by the field instrument. The field instrument read a value of 5.98 while the QAQC instrument read a value of 6.96, yielding a 'marginal' ranking. By the time the first transmission occurred, pH had already increased to 6.72 on the field instrument yielding a ranking of 'good'.

  At removal, temperature, specific conductivity dissolved oxygen, and turbidity ranked 'excellent' and pH ranked 'good'.

- At the station on the Tributary to Lower Reid Brook, all parameters ranked 'excellent' at deployment except for pH. pH was not ranked at deployment because of slow response time by the field instrument. The field instrument read a value of 6.11 while the QAQC instrument read a value of 7.03, yielding a 'marginal' ranking. By the time the first transmission occurred, pH had already increased to 6.74 on the field instrument yielding a ranking of 'good'.

  At removal, temperature, pH, and turbidity ranked 'excellent' while specific conductivity and dissolved oxygen ranked 'good'.

- At the station on Lower Reid Brook, all parameters ranked 'excellent' at deployment except for pH. pH was not ranked at deployment because of slow response time by the field instrument. The field instrument read a value of 6.10 while the QAQC instrument read a value of 7.65, yielding a 'poor' ranking. By the time the first transmission occurred, pH had already increased to 7.15 on the field instrument yielding a ranking of 'good'.

  At removal, temperature, pH, and turbidity ranked 'excellent' while specific conductivity and dissolved oxygen ranked 'good'.

- At the station on Camp Pond Brook, all parameters ranked 'excellent' at deployment except for pH. pH was not ranked at deployment because of slow response time by the field instrument. The field instrument read a value of 6.63 while the QAQC instrument read a value of 7.15, yielding a 'fair' ranking. By the time the first transmission occurred, pH had already increased to 7.06 on the field instrument yielding a ranking of 'excellent'.

  At removal, temperature, pH, and turbidity ranked 'excellent' while specific conductivity and dissolved oxygen ranked 'good'.

Data Interpretation

- The following graphs and discussion illustrate significant water quality-related events from August 15 to September 24 in the Voisey's Bay Real Time Water Quality Monitoring Network.
- With the exception of water quantity data (stage), all data used in the preparation of the graphs and subsequent discussion below adhere to this stringent QAQC protocol. Water Survey of Canada is responsible for QAQC of water quantity data. Corrected data can be obtained upon request.

Upper Reid Brook (Outlet from Reid Pond)

- Water temperature ranges from 8.04 °C to 18.06°C during the deployment period (Figure 1).
- Water temperature is decreasing throughout the deployment period. This trend is expected given the cooling ambient air temperatures late in the summer season into the fall (Figure 2).
- Water temperature fluctuates diurnally. Average water temperature is 13.32°C for the deployment period.
- There are a couple of events near the beginning of the deployment period that show water temperature increasing dramatically for a period of one or two days. These events correspond with exceptionally warm air temperatures experienced in the area at the same time (Figure 2).

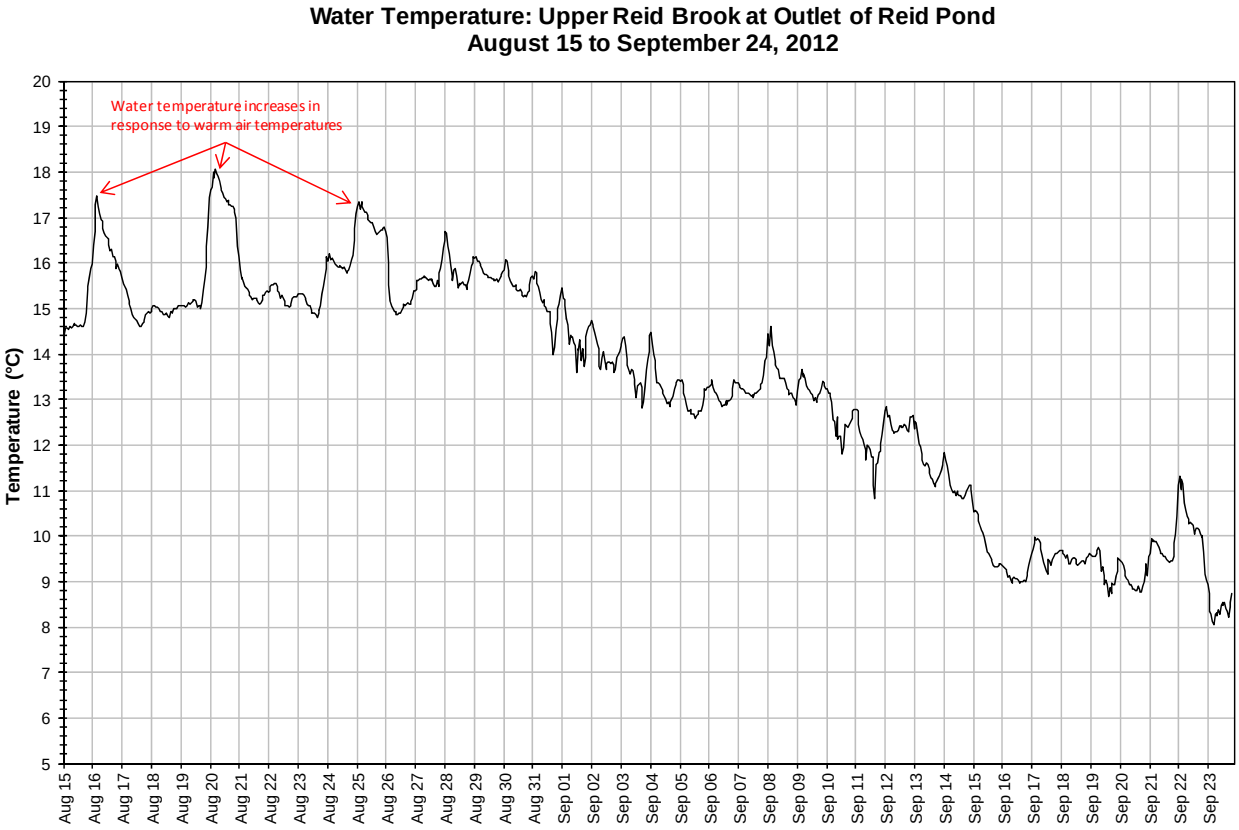

Figure 1: Water temperature at Upper Reid Brook

- Average daily air and water temperatures are generally decreasing throughout the deployment period (Figure 2). Increases and decreases in air temperature are reflected in water temperatures. Air temperatures generally increase and decrease faster while water temperatures increase and decrease more slowly over time.
- Average daily air temperatures are unusually warm September 10, 13 & 22.

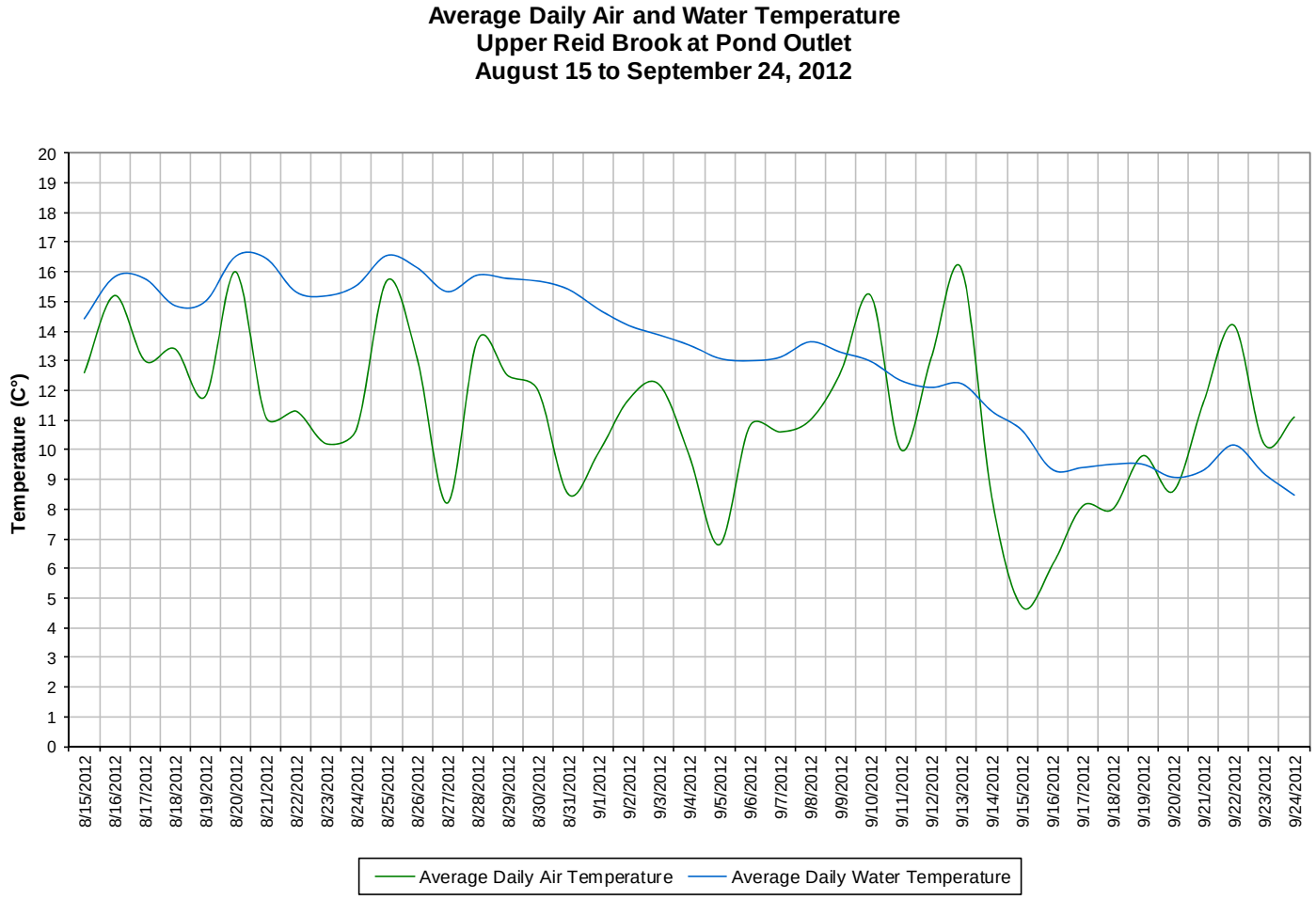

Figure 2: Average daily air and water temperatures at Upper Reid Brook

(weather data recorded at Nain)

- pH ranges between 6.73 and 7.28 pH units (Figure 3). pH is generally stable throughout the deployment period.
- There is a decrease in pH from September 15-16. This decrease corresponds with a rainfall event recorded on September 15-16. This decrease is occurring first at this station. There is a decrease in pH at all other station in the network (downstream) the following day. The decrease is indicated in red on Figure 3.
- All values are within the recommended range as suggested by the CCME Guidelines for the Protection of Aquatic Life (> 6.5 and <9.0 pH units). Guidelines are indicated in blue on Figure 3.

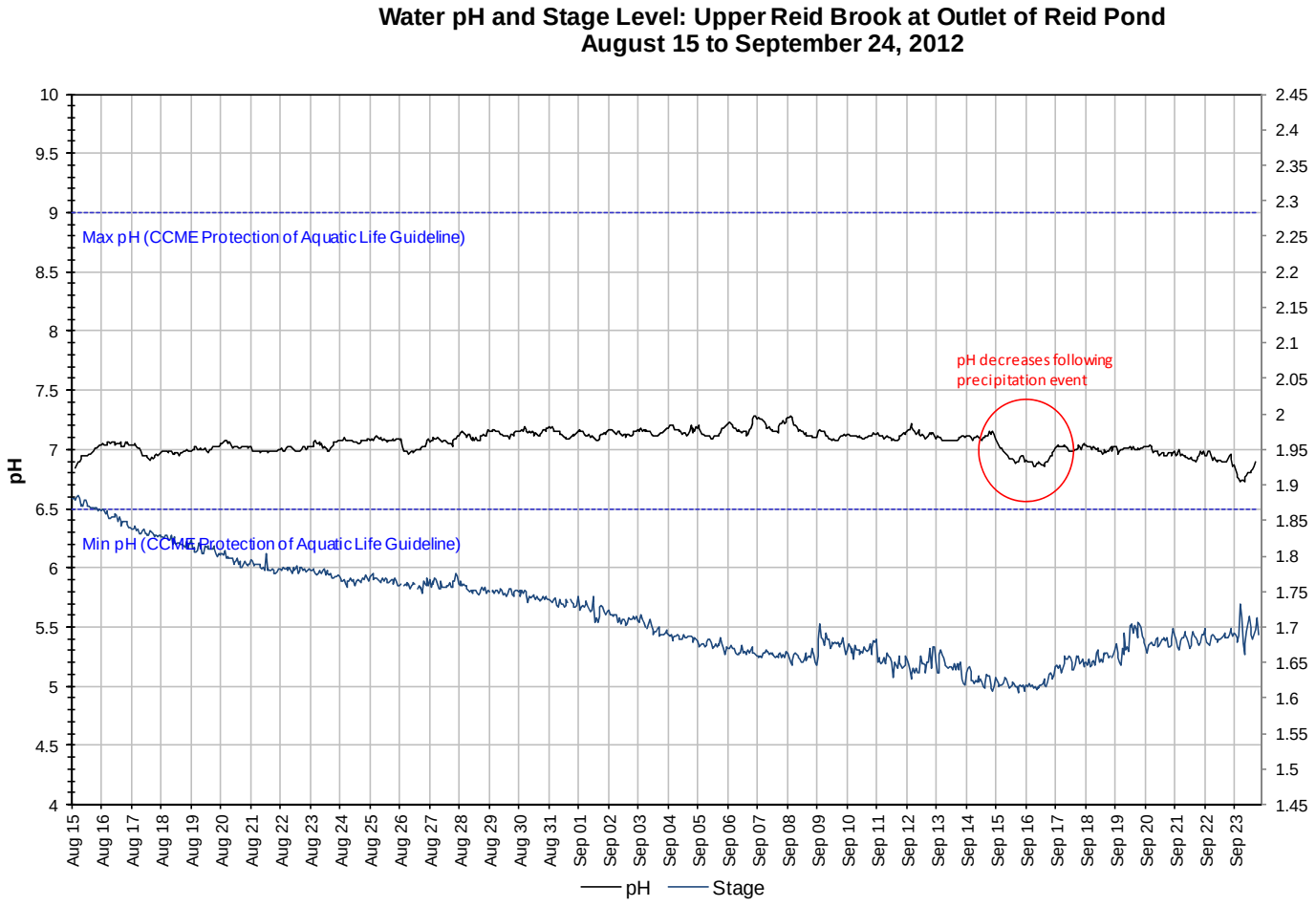

Figure 3: pH and stage level at Upper Reid Brook

- Specific conductivity values range from 11.2µS/cm to 12.2µS/cm during the deployment period (Figure 4).
- Specific conductivity remains very low and extremely stable throughout the deployment period with minimal fluctuation (±1.0µS/cm) regardless of the changing water level. This trend is typical and expected as the flow from this station is directly from a stable lake environment.

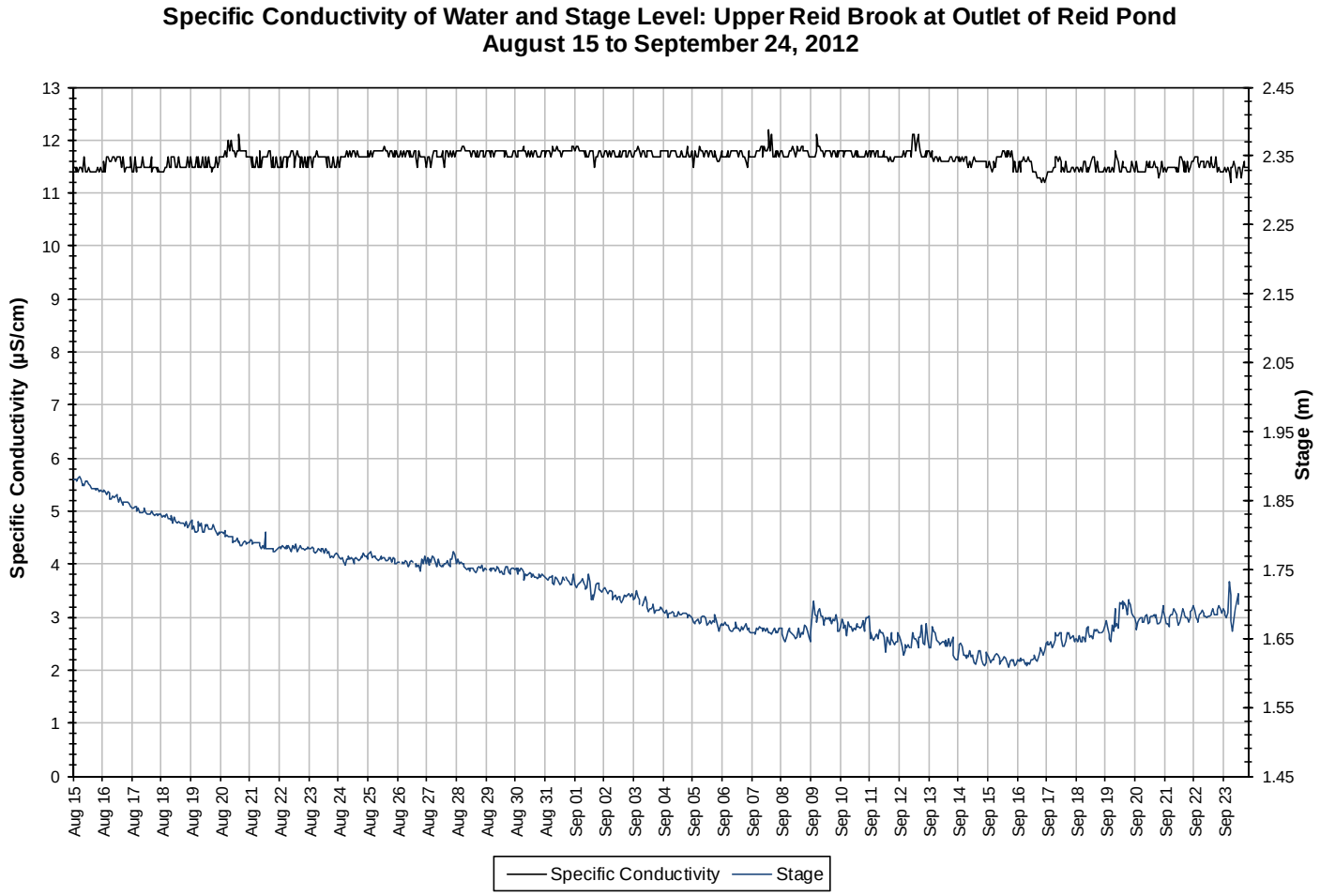

Figure 4: Specific conductivity and stage level at Upper Reid Brook

- Dissolved oxygen content ranges between 9.67mg/L and 11.26mg/L. The saturation of dissolved oxygen ranges from 94.8% to 104.9% (Figure 5).
- All values are above both the minimum CCME Guideline for the Protection of Cold Water Biota at Other Life Stages (6.5mg/l) and Early Life Stages (9.5mg/l). The guidelines are indicated in blue on Figure 5. The average dissolved oxygen value is 10.33mg/l.
- Dissolved oxygen content is increasing throughout much of the deployment period. This trend is expected given the decreasing water and air temperatures. There is a decrease in dissolved oxygen near the beginning of the deployment period which corresponds with increased water and air temperatures on August 20. This event is highlighted on Figure 5 in red.

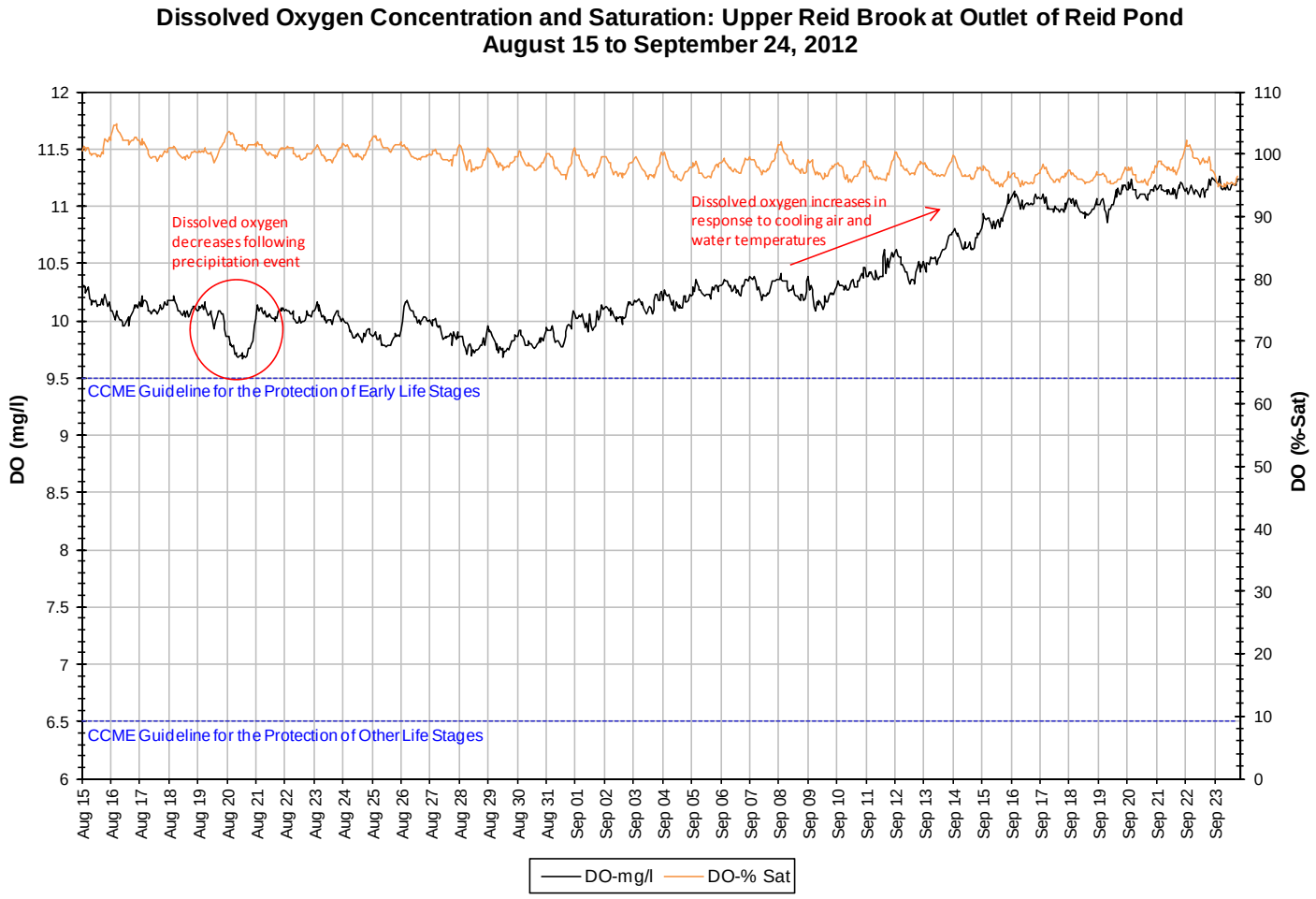

Figure 5: Dissolved oxygen and percent saturation at Upper Reid Brook

- Turbidity at this station remained at 0NTU for the entire deployment period except for one instance when turbidity reached 37.1NTU for a period of 1 hour (Figure 6). This trend is not unusual for this station as the water flowing from the lake is typically very clean, clear and cold.

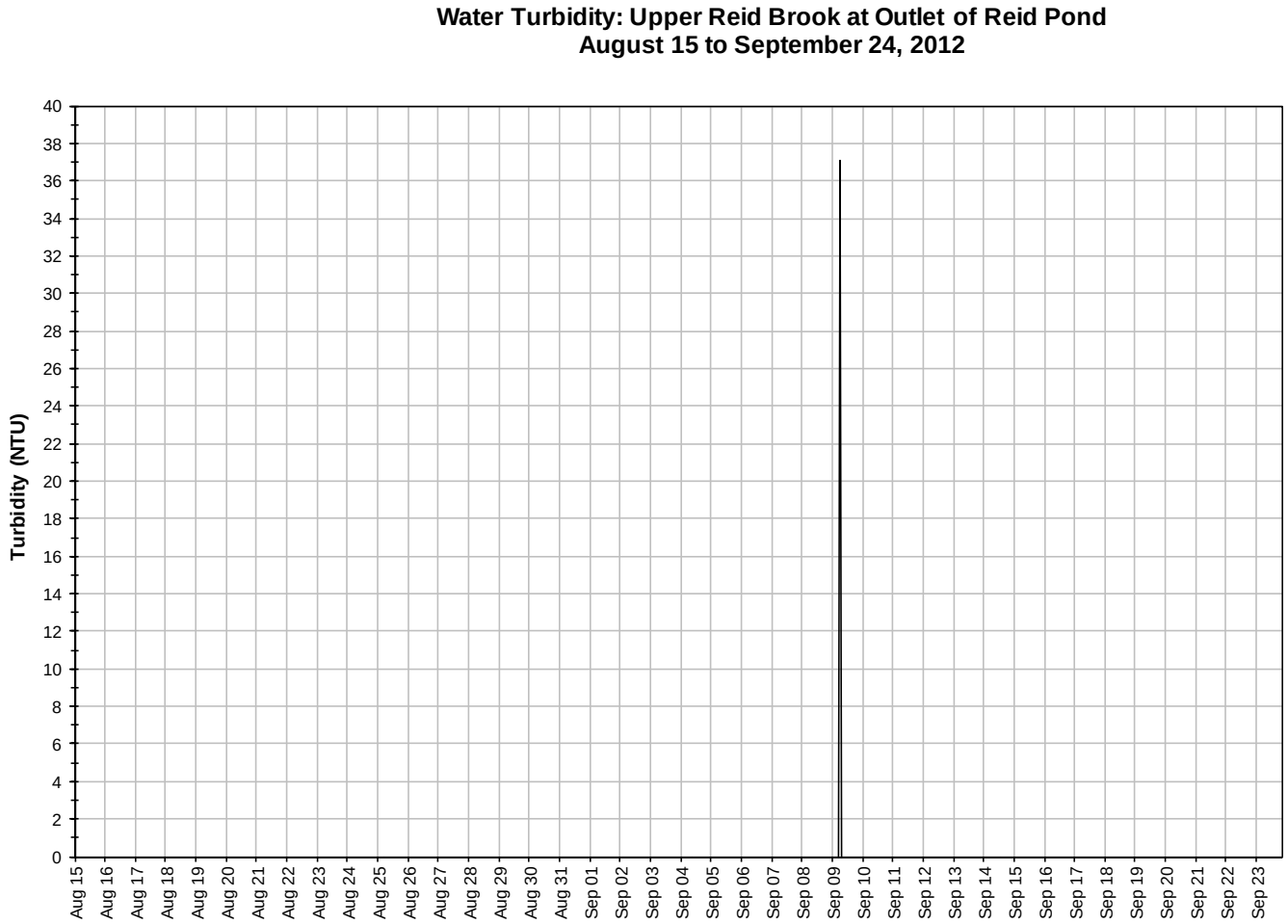

Figure 6: Turbidity at Upper Reid Brook

- Stage and precipitation are graphed below to show the relationship between rainfall and water level (Figure 7). Stage is generally decreasing during the deployment period. Stage ranges between 1.61m and 1.89m, a difference of 0.28m. Precipitation events are frequent but generally low in magnitude.

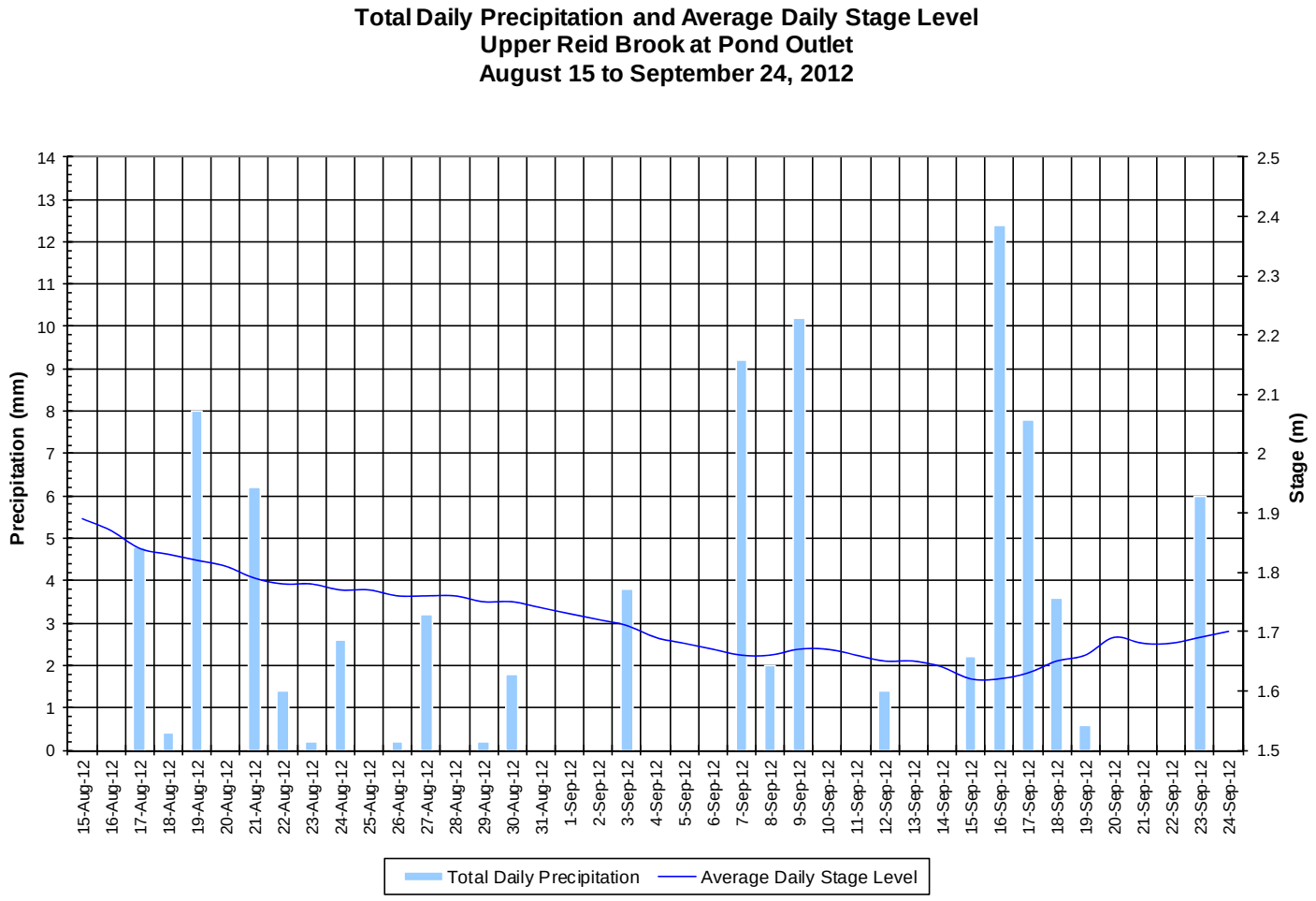

Figure 7: Daily precipitation and average daily stage level at Upper Reid Brook

(weather data recorded at Nain)

Tributary to Lower Reid Brook

- Water temperature ranges from 5.30 °C to 16.30°C during the deployment period (Figure 8).
- Water temperature is generally decreasing throughout the deployment period. This trend is expected given the cooling ambient air temperatures late in the summer season into the fall (Figure 9).
- Water temperature fluctuates diurnally. Average water temperature is 11.00°C for the deployment period.
- At the beginning of September, water temperature increases from ~7°C to over 12°C for a number of days before decreasing again almost a week later. This increase in water temperature corresponds with a period of seasonably warm air temperatures recorded in the area and is also noticeable at stations on Lower Reid Brook and Camp Pond Brook.

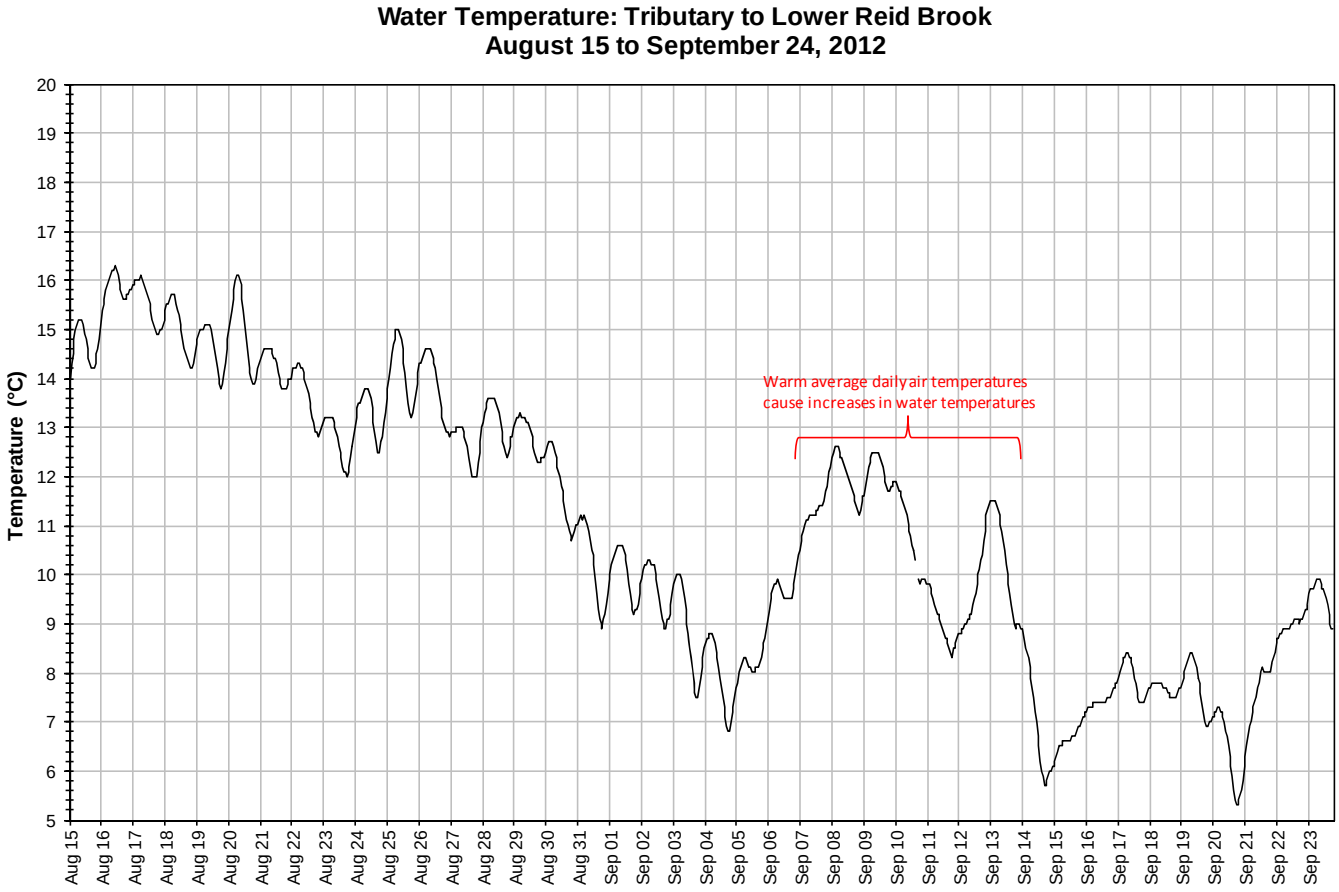

Figure 8: Water temperature at Tributary to Lower Reid Brook

- Average daily air and water temperatures are decreasing throughout the deployment period (Figure 9). Increases and decreases in air temperature are reflected in water temperatures. Air temperatures generally increase and decrease faster while water temperatures increase and decrease more slowly over time.
- Average daily air temperatures are unusually warm September 10, 13 & 22.

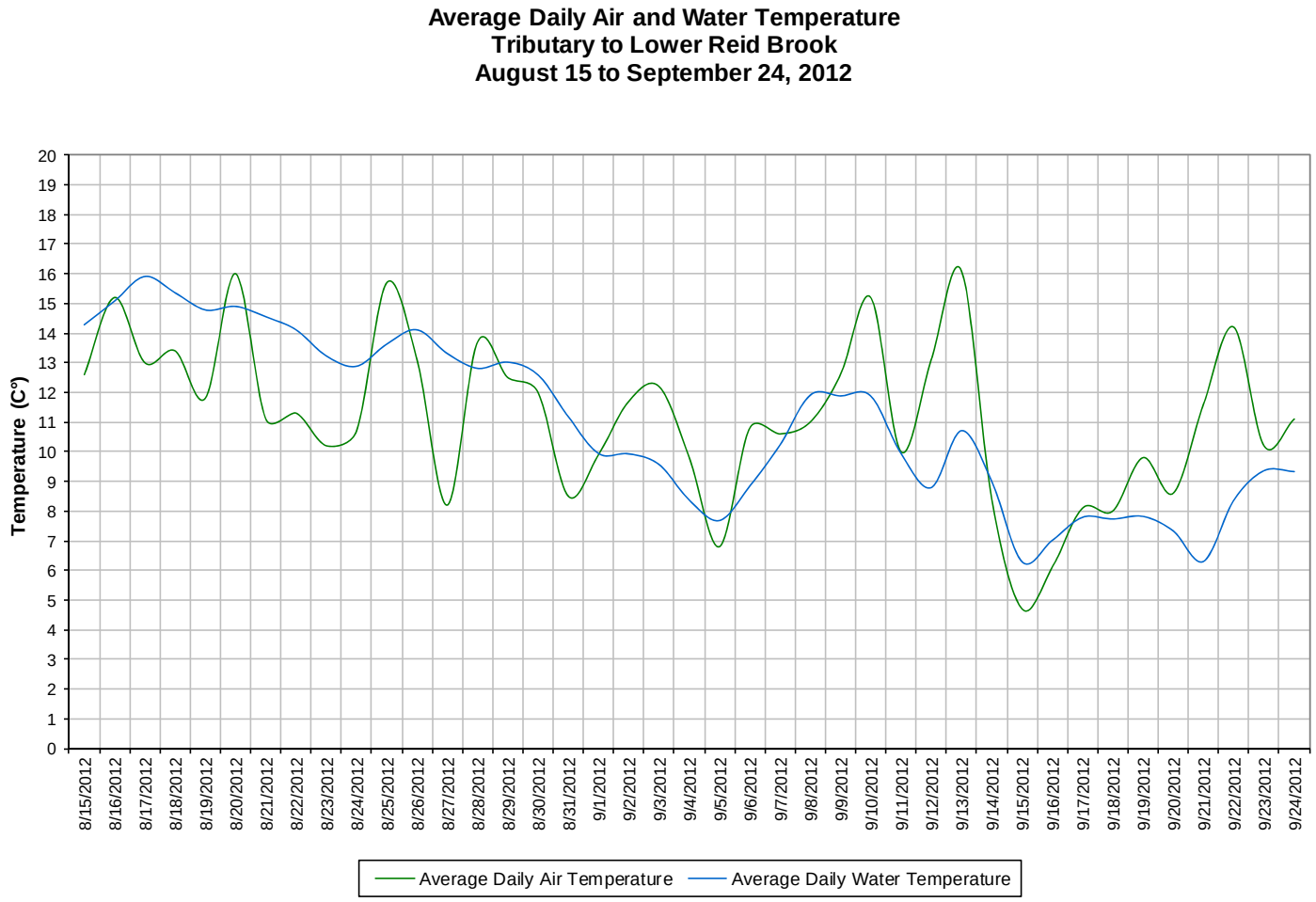

Figure 9: Average daily air and water temperatures at Tributary to Lower Reid Brook

(weather data recorded at Nain)

- pH ranges between 6.57 and 7.08 pH units (Figure 10). pH is generally stable throughout the deployment period fluctuating daily, except for a significant decrease on September 16-17.
- The decrease on September 16-17 corresponds with a substantial rainfall event on September 15-16. pH recovers (increases) to background levels shortly after the rainfall event over September 17-18. This decrease in pH occurs at all stations in the network. This event is indicated in red on Figure 10.
- All values are within the recommended range for pH as suggested by the CCME Guidelines for the Protection of Aquatic Life (>6.5 and <9.0 pH units). Guidelines are indicated in blue on Figure 10.

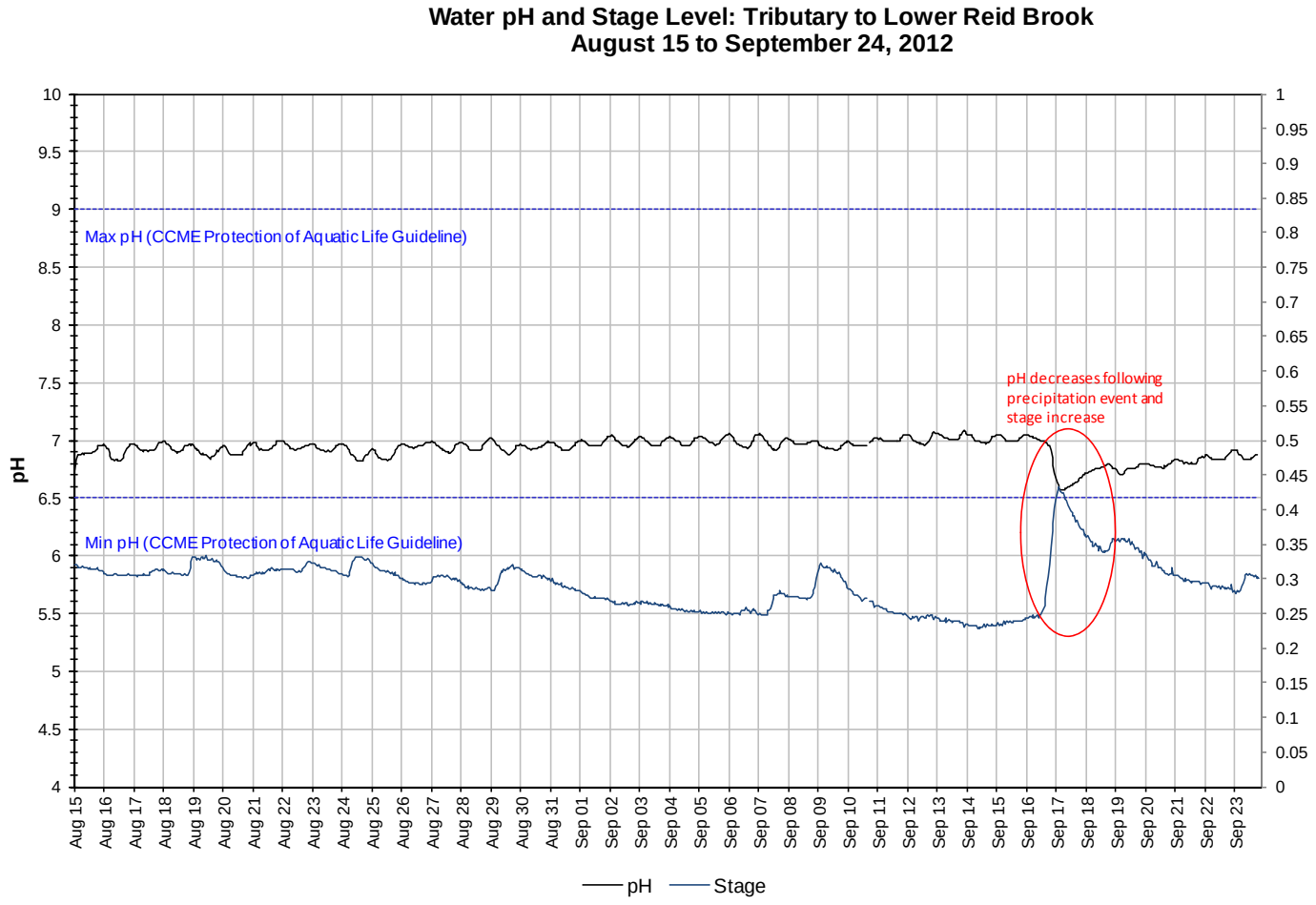

Figure 10: pH and stage level at Tributary to Lower Reid Brook

- Specific conductivity ranges between 28.8µS/cm and 41.4µS/cm, and increases slightly throughout the deployment period (Figure 11).
- Stage is included in Figure 11 to illustrate the inverse relationship between conductivity and water level. Stage is changing throughout the deployment period with several increases caused by rainfall. Specific conductivity changes with the varying water level. As stage increases, specific conductivity generally decreases due to the dilution of dissolved solids in the water column. Inversely, as stage decreases, specific conductivity increases as the concentration of dissolved solids increases.
- This trend is exceptionally clear with the values collected from this station during the deployment period. The specific conductivity values almost appear to mirror changes in stage level. This trend is highlighted in red on Figure 11.

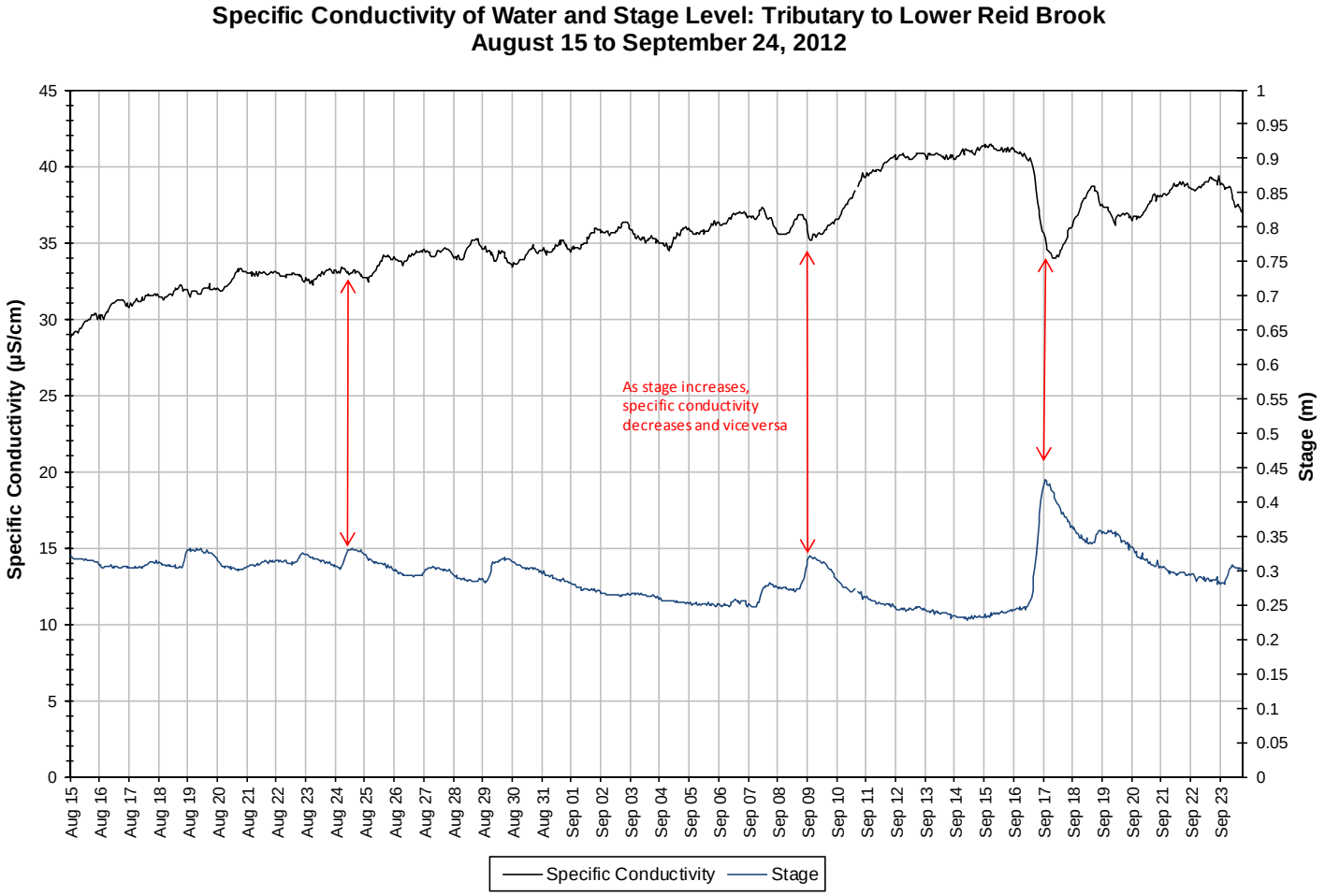

Figure 11: Specific conductivity and stage level at Tributary to Lower Reid Brook

- Dissolved oxygen content ranges between 9.39g/L and 12.17mg/L. The saturation of dissolved oxygen ranges from 92.5% to 98.9% (Figure 12).
- All values are above the minimum CCME Guideline for the Protection of Cold Water Biota at Other Life Stages (6.5mg/l) and most values are above the guideline for Early Life Stages (9.5mg/l). The guidelines are indicated in blue on Figure 12. Average dissolved oxygen value was 10.57mg/l.
- Dissolved oxygen content is generally increasing throughout the deployment period. This trend is expected given the cooling water temperatures during the late summer and fall seasons (Figure 8 & 9). Dissolved oxygen content and percent saturation fluctuate diurnally.
- Near the end of the deployment period, there are a number of occasions when dissolved oxygen content decreases sharply and increases again the follow day. These fluctuations correspond with unseasonably warm air temperatures recorded in the area and increases in water temperature (Figure 8).

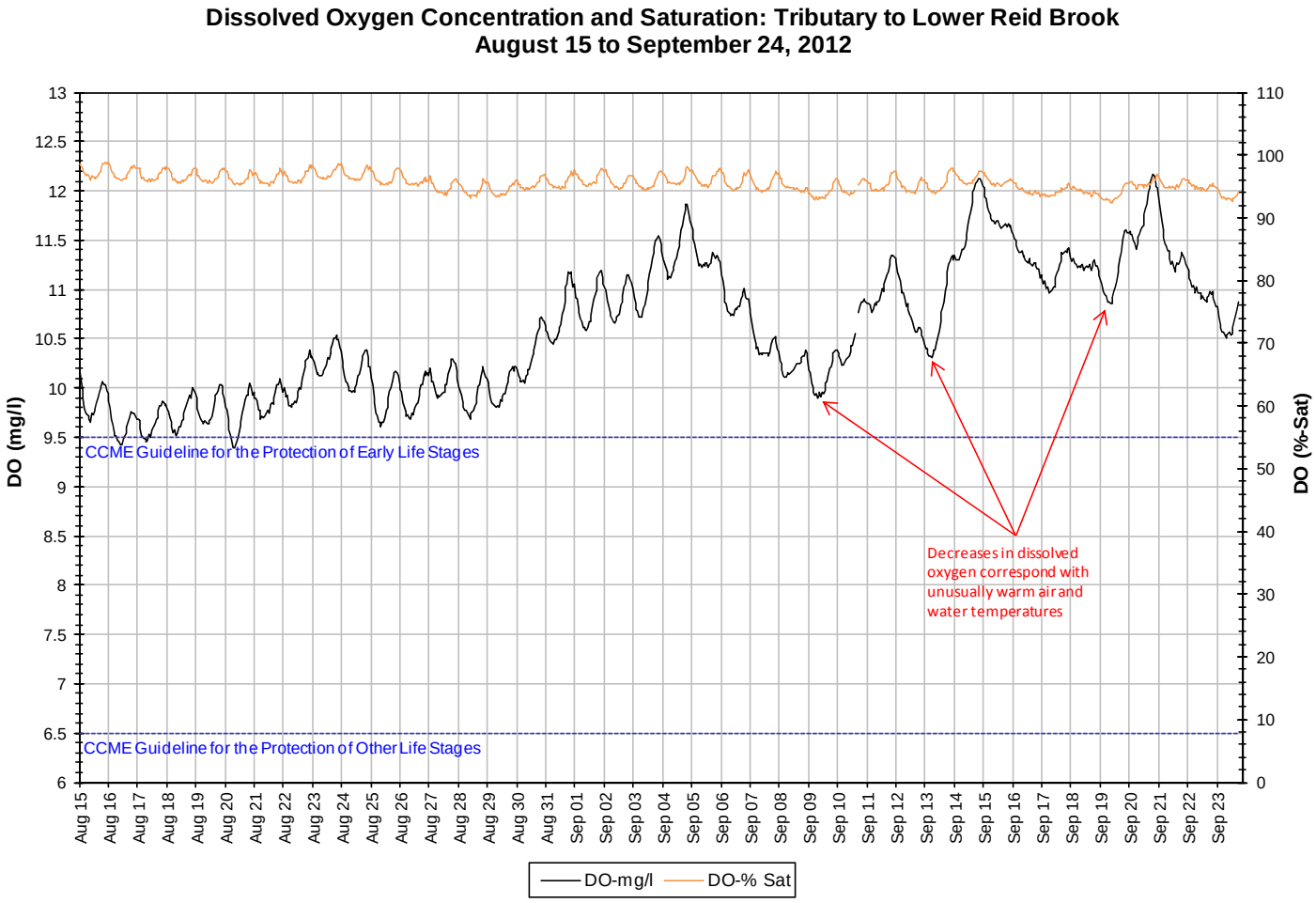

Figure 12: Dissolved oxygen and percent saturation at Tributary to Lower Reid Brook

- Turbidity ranges between 0 and 160NTU throughout the deployment period (Figure 13). A median value of 0NTU indicates there is no natural background turbidity value for this deployment period.
- There are a number of short-lived turbidity increases in the first 3 weeks of the deployment period from August 15 to September 3 which is not an uncommon trend at this station. From September 4-12, turbidity values are >0NTU and variable. On average turbidity values are <18NTU, however, turbidity values do increase to as high as 160NTU during this time. After September 12 until the end of the deployment period, November 4, turbidity generally remains at 0NTU, again with short lived, low magnitude events which is the typical trend for this station.
- The period of turbidity increases from September 4-12 may in part be caused by frequent rainfall events. Rainfall events are recorded in the area on September 3, 7, 8, & 9. Rainfall events may not explain the full reason behind the long period of turbidity fluctuations. It cannot be determined at this time what caused these increases. These events are highlighted in red on Figure 13.

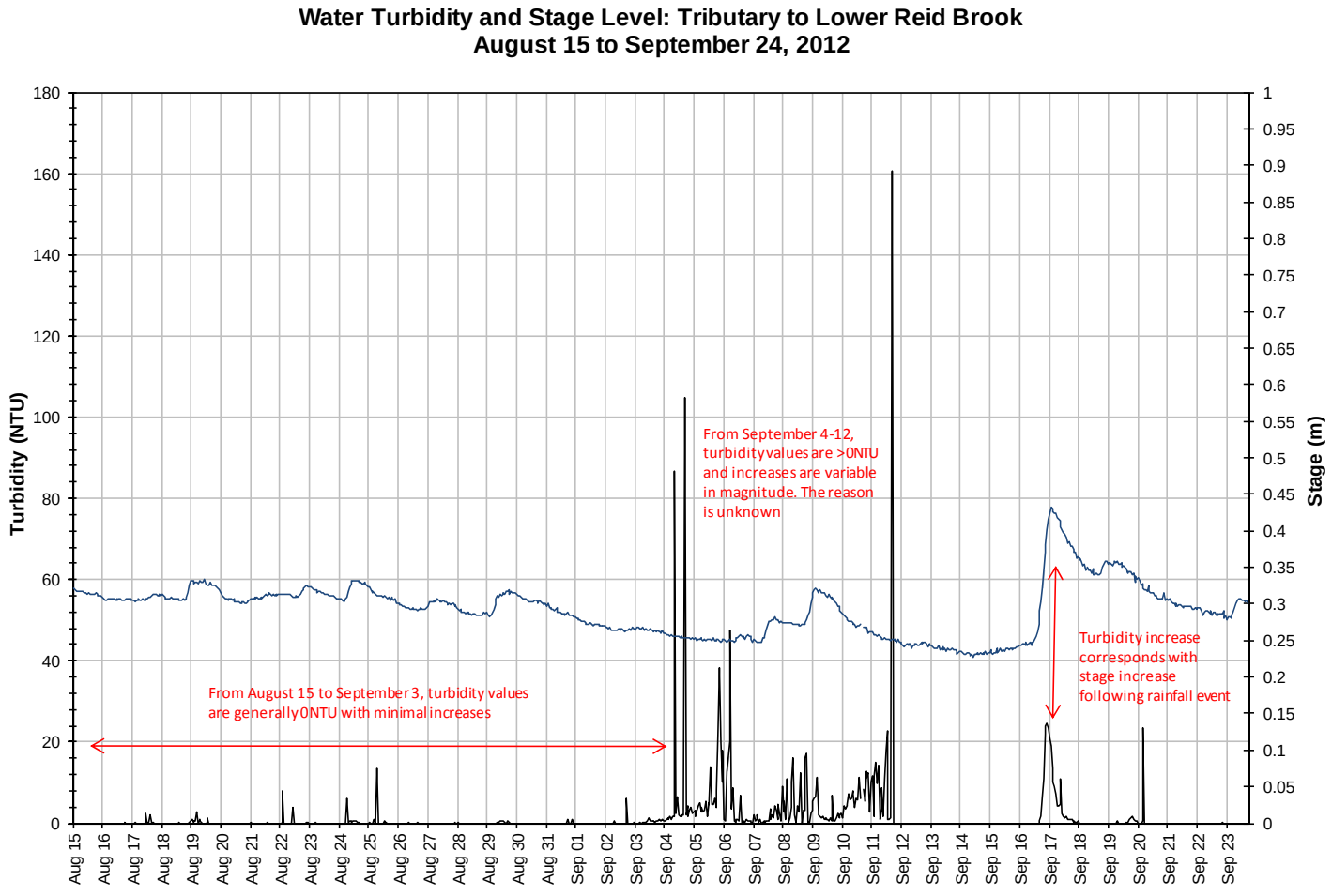

Figure 13: Turbidity and stage level at Tributary to Lower Reid Brook

- Stage and precipitation are graphed below to show the relationship between rainfall and water level (Figure 14). Stage is generally stable for the deployment period, decreasing slightly. Stage increases near the end of the deployment period. Stage fluctuates between 0.23m and 0.43m, a difference of 0.20m.
- Precipitation events are frequent but generally low in magnitude.

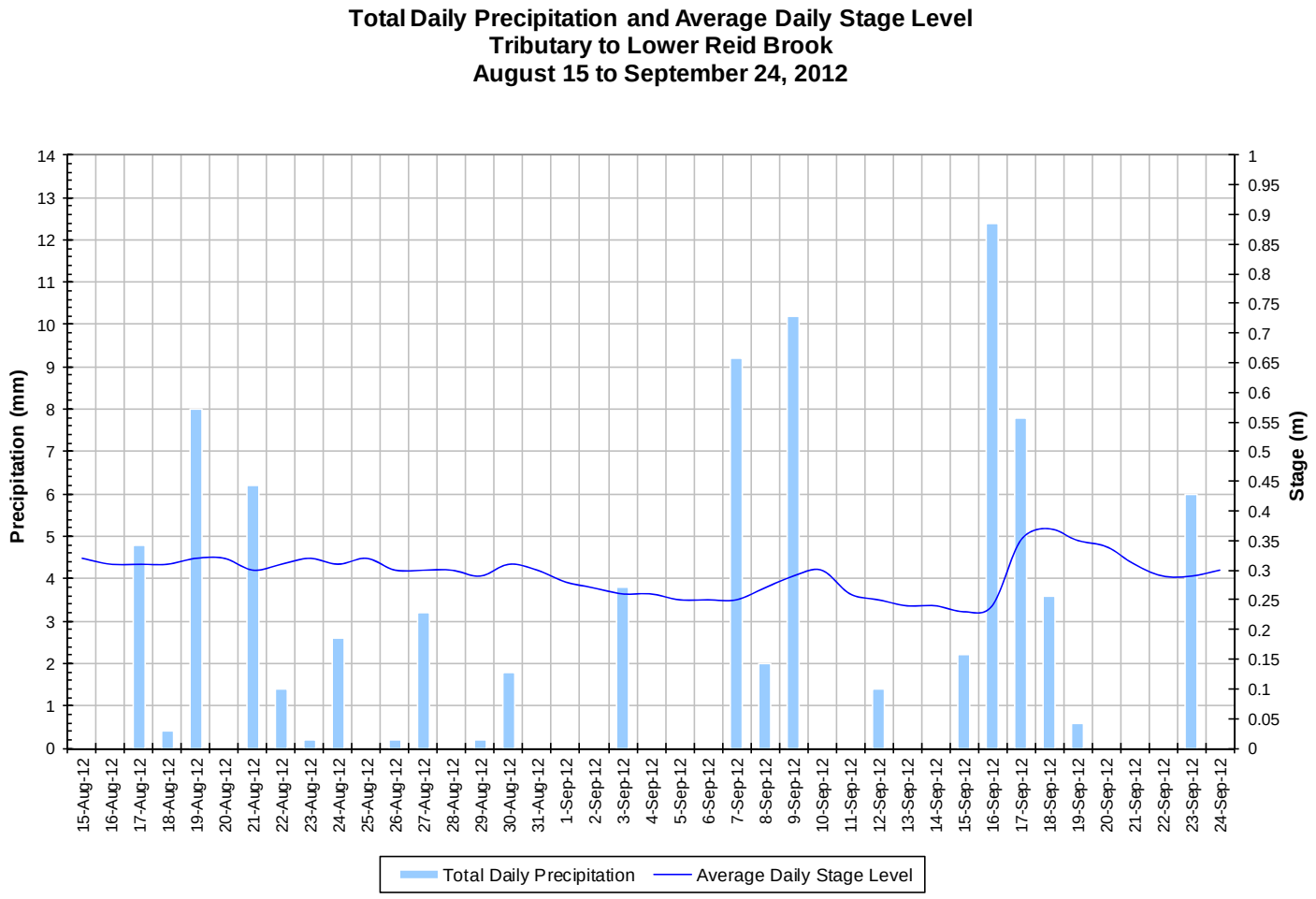

Figure 14: Daily precipitation and average daily stage level at Tributary to Lower Reid Brook (weather data recorded at Nain)

Lower Reid Brook

- Water temperature ranges from 5.46 °C to 16.81°C during the deployment period (Figure 15).
- Water temperature is decreasing throughout the deployment period. This trend is expected given the cooling ambient air temperatures late in the summer season and into the fall (Figure 16).
- Water temperature fluctuates diurnally. Average water temperature is 11.50°C for the deployment period.
- Water temperature increases around September 4-8 from ~7°C to greater than 14°C. This increase in water temperature corresponds with a period of seasonably warm air temperatures recorded in the area and is also noticeable at stations on Tributary to Lower Reid Brook and Camp Pond Brook .

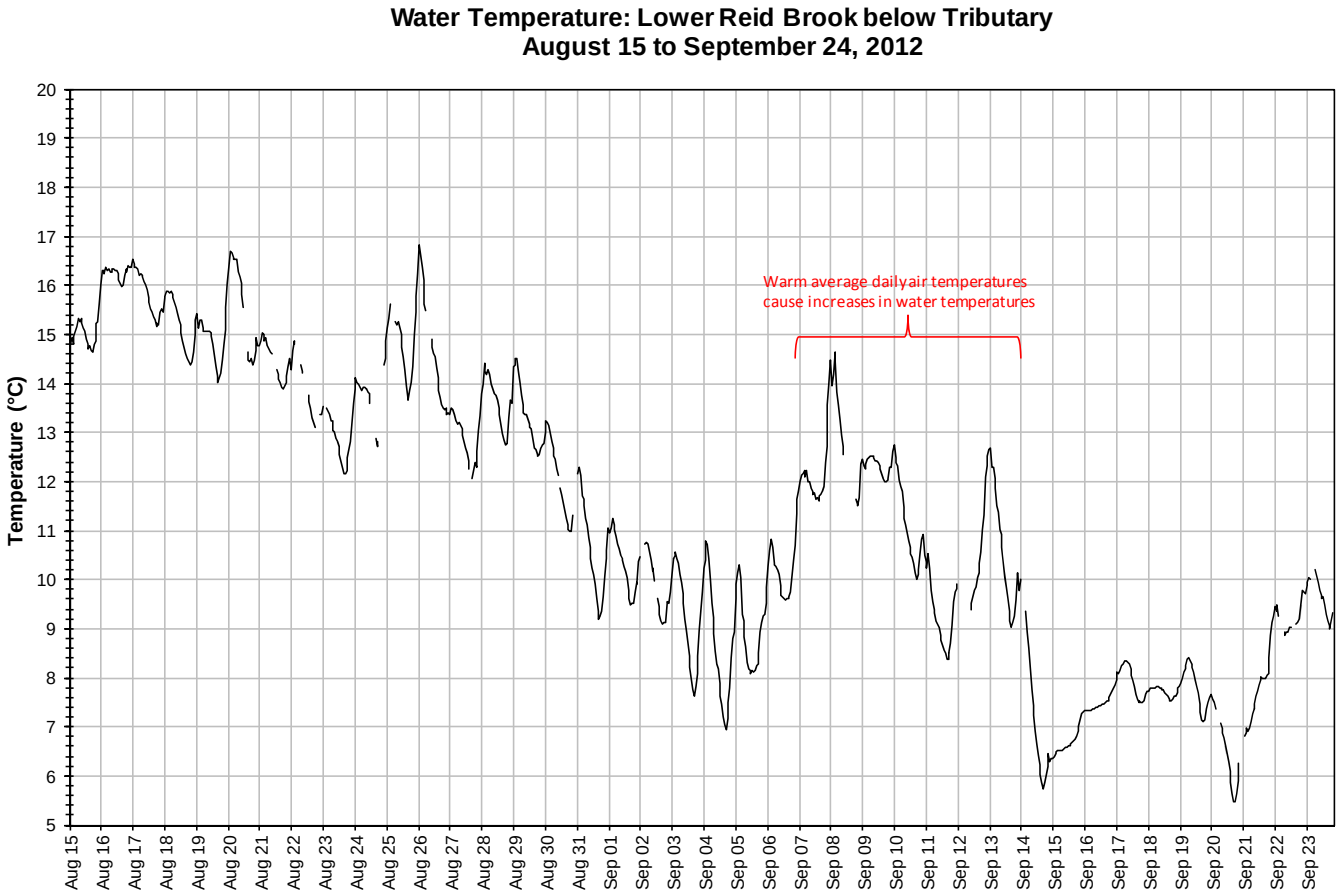

Figure 15: Water temperature at Lower Reid Brook

- Average daily air and water temperatures are generally decreasing throughout the deployment period (Figure 16). Increases and decreases in air temperature are reflected in water temperatures. Air temperatures generally increase and decrease faster while water temperatures increase and decrease more slowly over time.
- Average daily air temperatures are unusually warm September 10, 13 & 22.

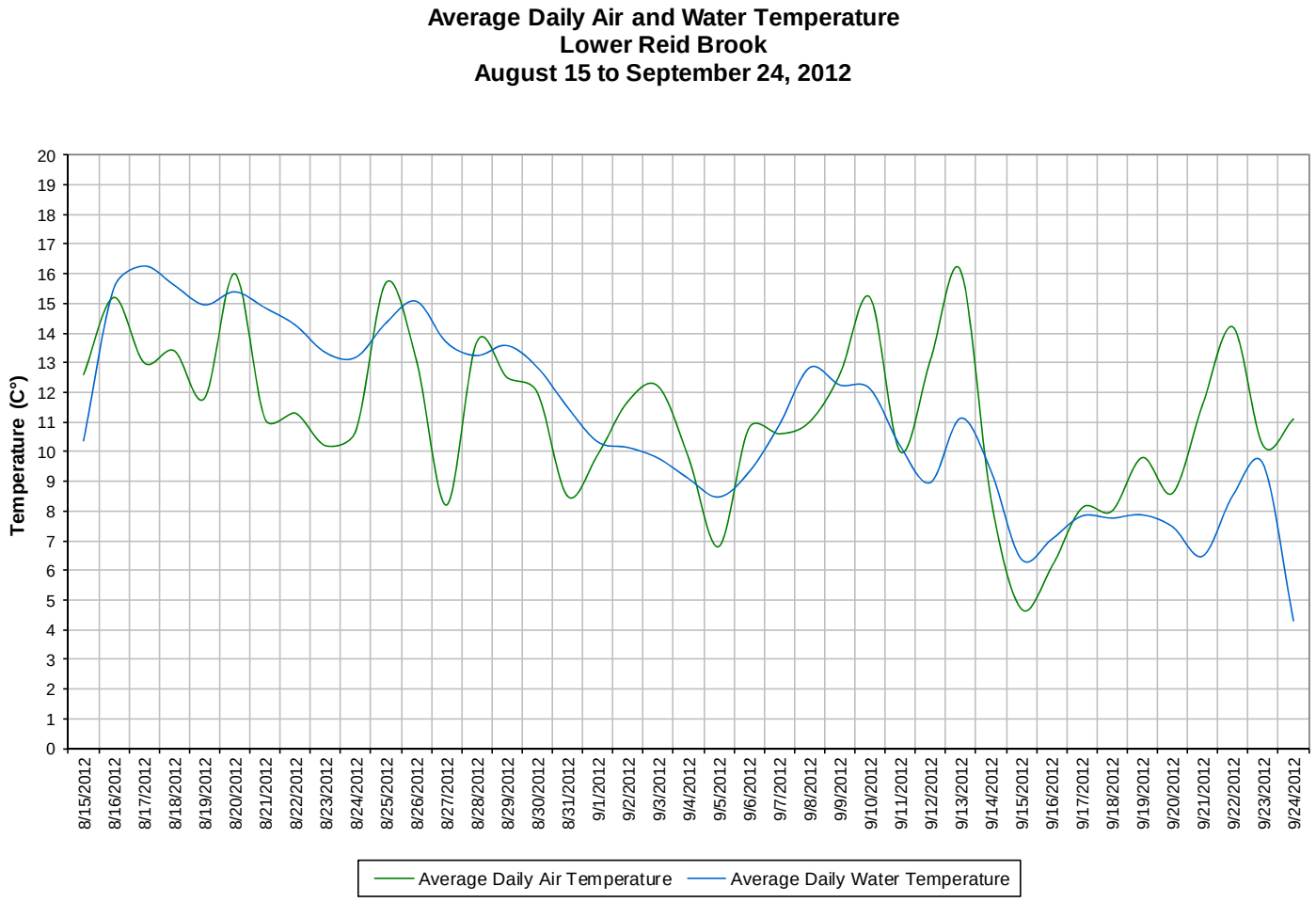

Figure 16: Average daily air and water temperatures at Lower Reid Brook

(weather data recorded at Nain)

- pH generally ranges between 6.98 and 7.49 pH units and fluctuates daily (Figure 17).
- There is one instance when pH increase above this generally trend to 7.83 pH units for a period of 1 hour. The short lived increase on August 21 cannot be explained with confidence and may be due to sensor error.
- There is a decrease in pH on September 16-17. This decrease is noticeable at other stations in the network and corresponds with a significant rainfall event from September 15-16. These events are indicated in red on Figure 17.
- All values are within the recommended range for pH as suggested by the CCME Guidelines for the Protection of Aquatic Life (>6.5 and <9.0 pH units). Guidelines are indicated in blue on Figure 17.

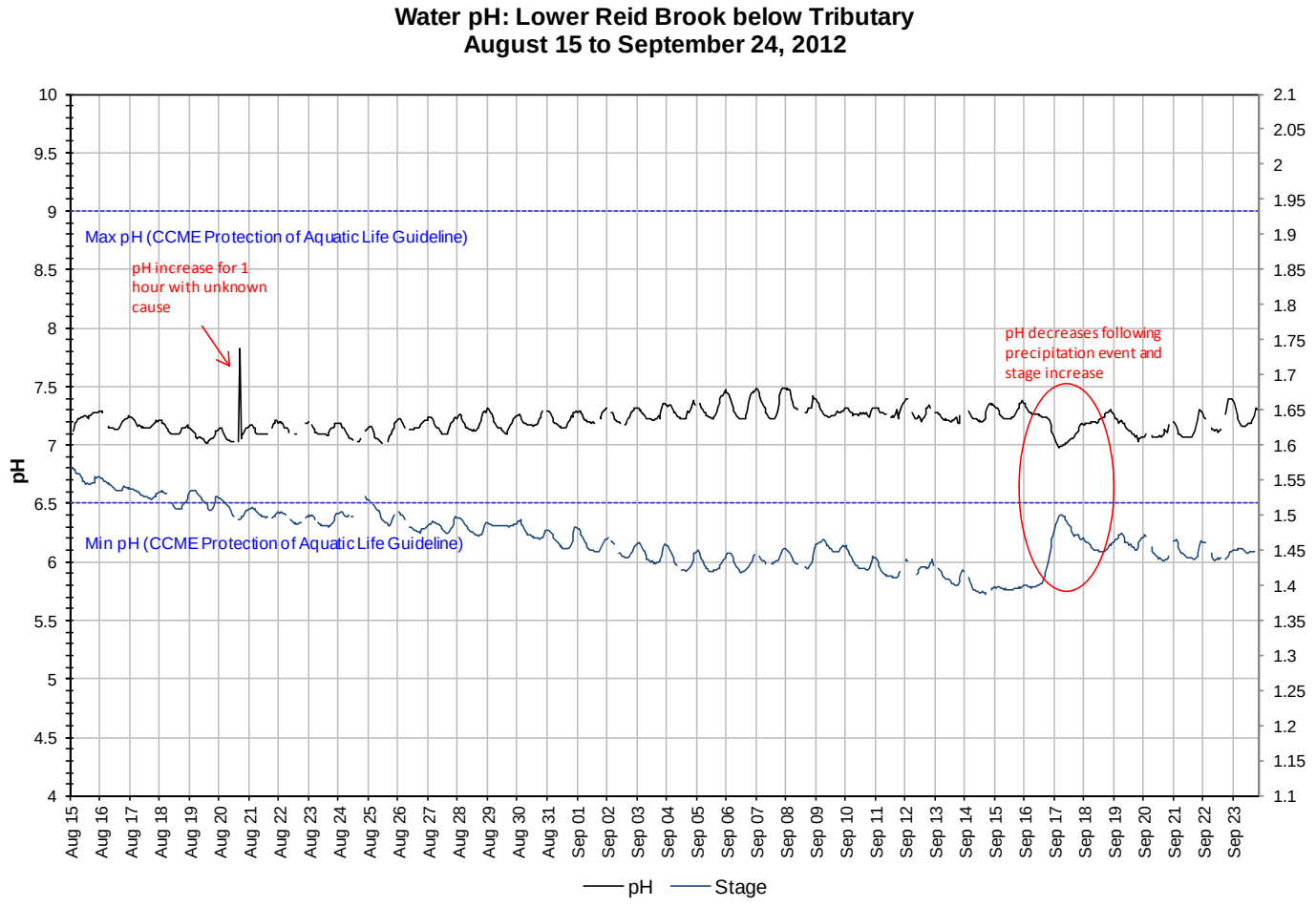

Figure 17: pH and stage level at Lower Reid Brook

- Specific conductivity generally ranges between 25.5µS/cm and 40.1µS/cm (Figure 18).
- Specific conductivity is increasing throughout the deployment period from ~25 µS/cm up to 40.1 µS/cm. On September 7, specific conductivity drops from ~35 µS/cm to 25.5 µS/cm for a period of one hour. The cause of this sudden decrease is unknown and likely insignificant due to its short duration. This event is highlighted in red on Figure 18.
- Stage is included in Figure 18 to illustrate the inverse relationship between conductivity and water level. Stage is decreasing slightly throughout the deployment period while specific conductivity is increasing. Generally, as stage decreases, specific conductivity typically increases due to the rise in concentration of dissolved solids in the water column. Inversely, as stage increase, specific conductivity decreases as the dilution of dissolved solids occurs. This trend is highlighted in red on Figure 18.

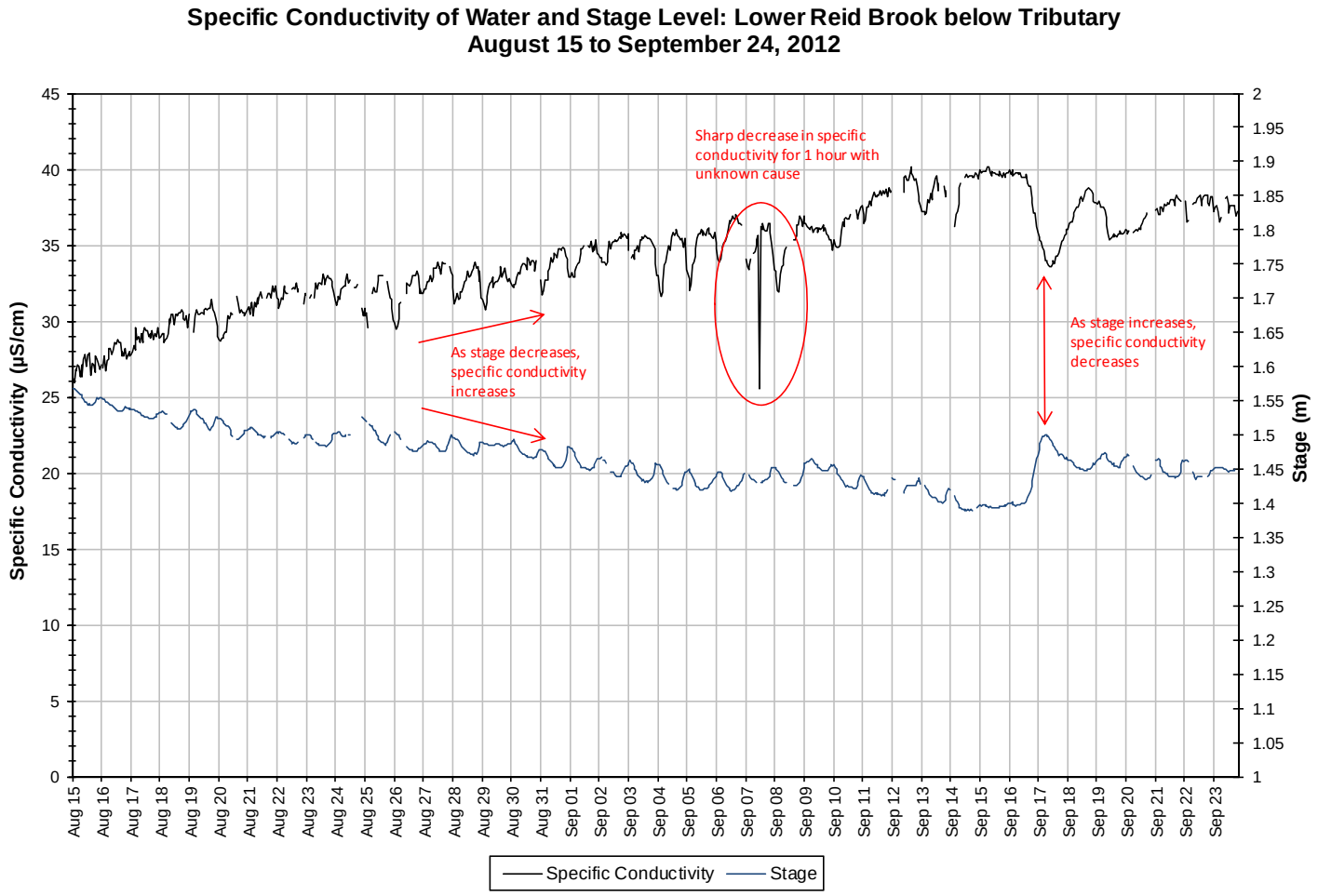

Figure 18: Specific conductivity and stage level at Lower Reid Brook

- Dissolved oxygen content ranges between 9.37g/L and 12.25mg/L. The saturation of dissolved oxygen ranges from 93.1% to 102.9% (Figure 19).
- All values are above the minimum CCME Guideline for the Protection of Cold Water Biota at Other Life Stages (6.5mg/l) and most values are above the guideline for Early Life Stages (9.5 mg/l). The guidelines are indicated in blue on Figure 19. Average dissolved oxygen content is 10.56mg/l.
- Dissolved oxygen content is fluctuating daily and shows an increasing trend for much of the deployment period. This trend is expected given the cooling water and air temperatures (Figure 16). Dissolved oxygen content and percent saturation fluctuate diurnally.
- Near the end of the deployment period, there are a number of occasions when dissolved oxygen content decreases sharply and increases again the follow day. These fluctuations correspond with unseasonably warm air temperatures recorded in the area and increases in water temperature.

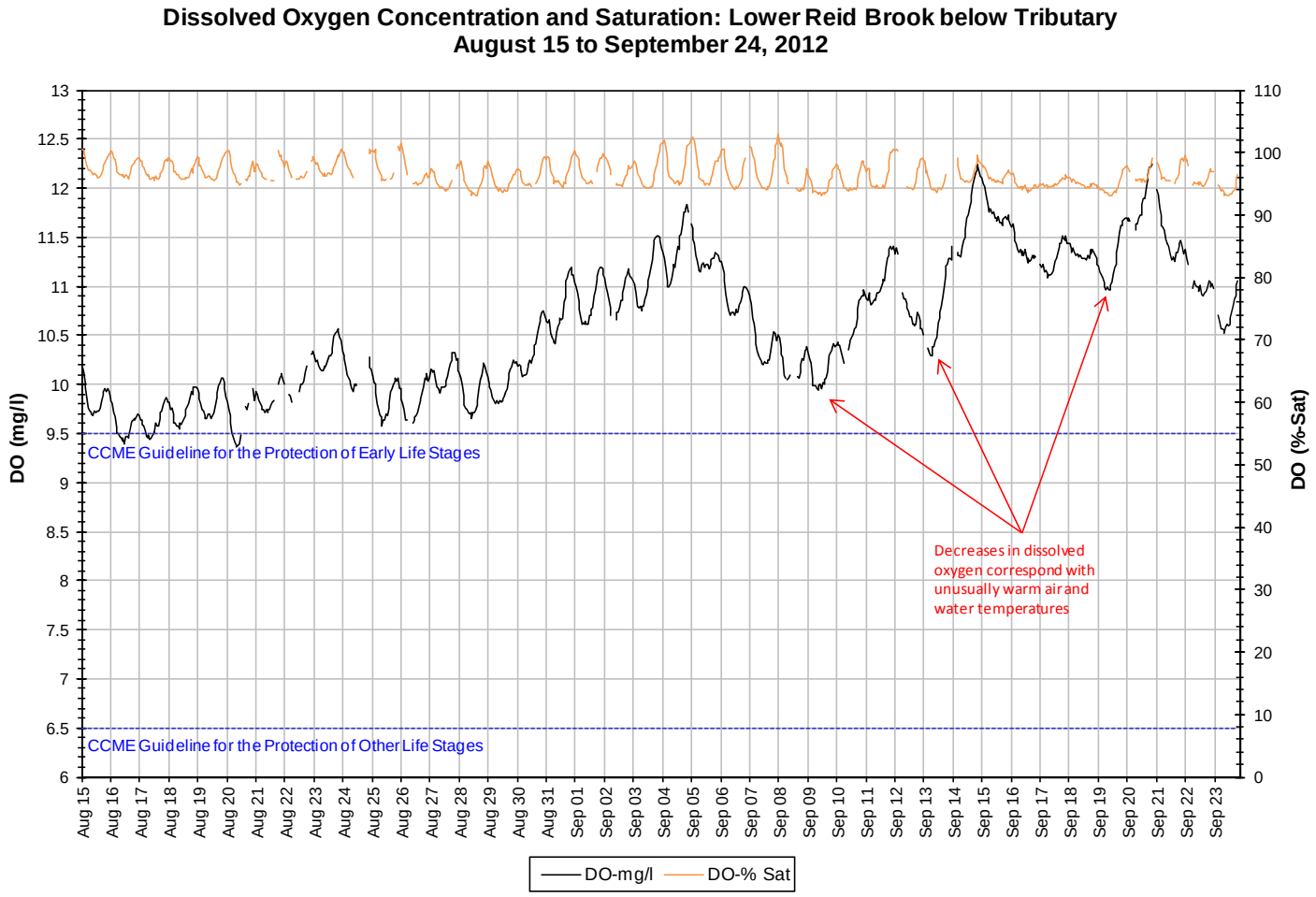

Figure 19: Dissolved oxygen and percent saturation at Lower Reid Brook

- Turbidity ranges between 0 and 18.7NTU throughout the deployment period (Figure 20). A median value of 0.0 indicates there is no natural background turbidity data for this deployment period.
- Turbidity remains at 0NTU for much of the deployment period with a few short-lived low magnitude increases. There are numerous rainfall events throughout the deployment period some of which correspond with these increases however, not all rainfall events recorded lead to turbidity increases. These events are highlighted in red on Figure 20.

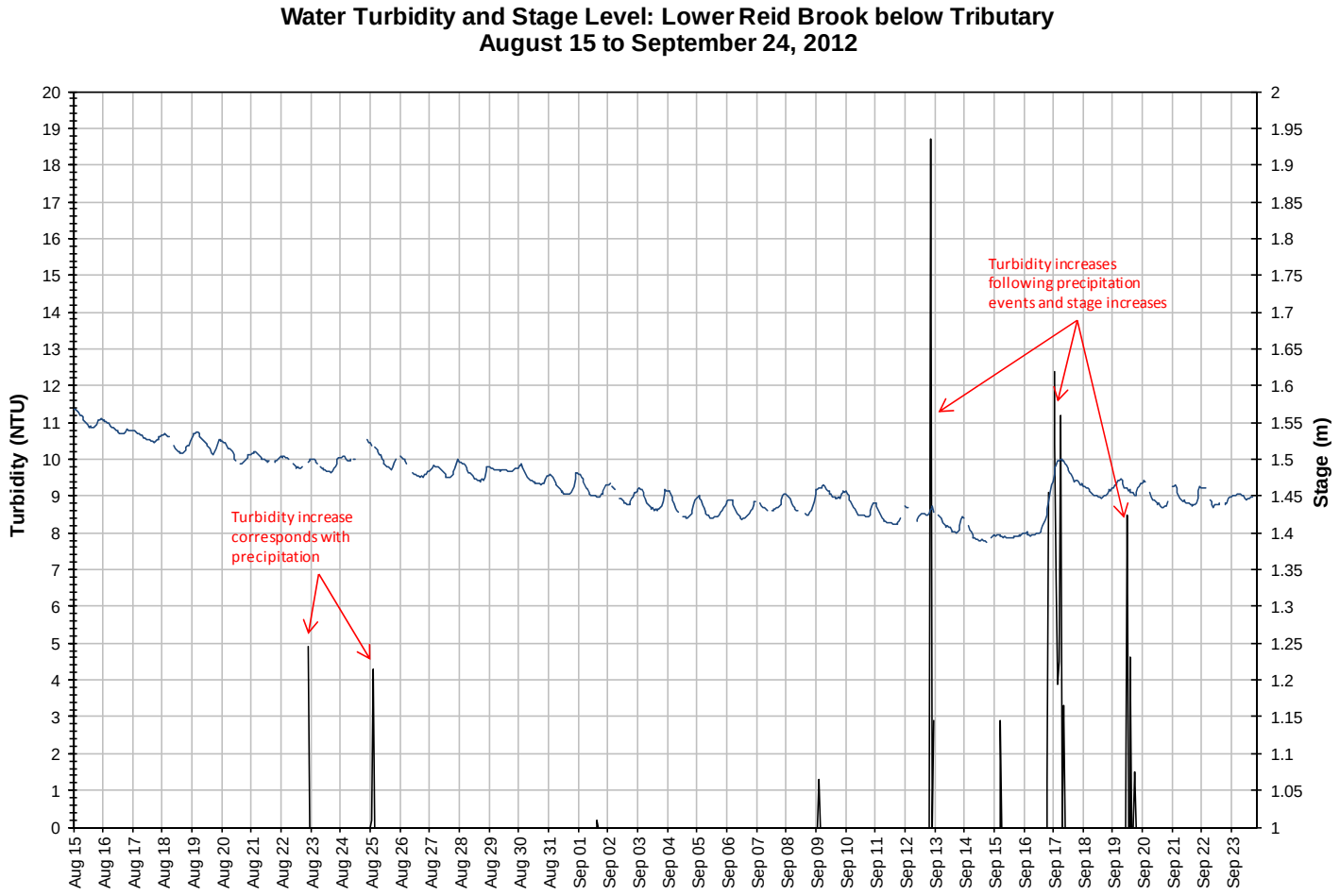

Figure 20: Turbidity and stage level at Lower Reid Brook

- Stage and precipitation are graphed below to show the relationship between rainfall and water level (Figure 21). Stage is generally stable for much of the deployment period, decreasing slightly. Stage ranges between 1.39m and 1.50m, a difference of 0.11m.
- Precipitation events are frequent and generally low in magnitude.

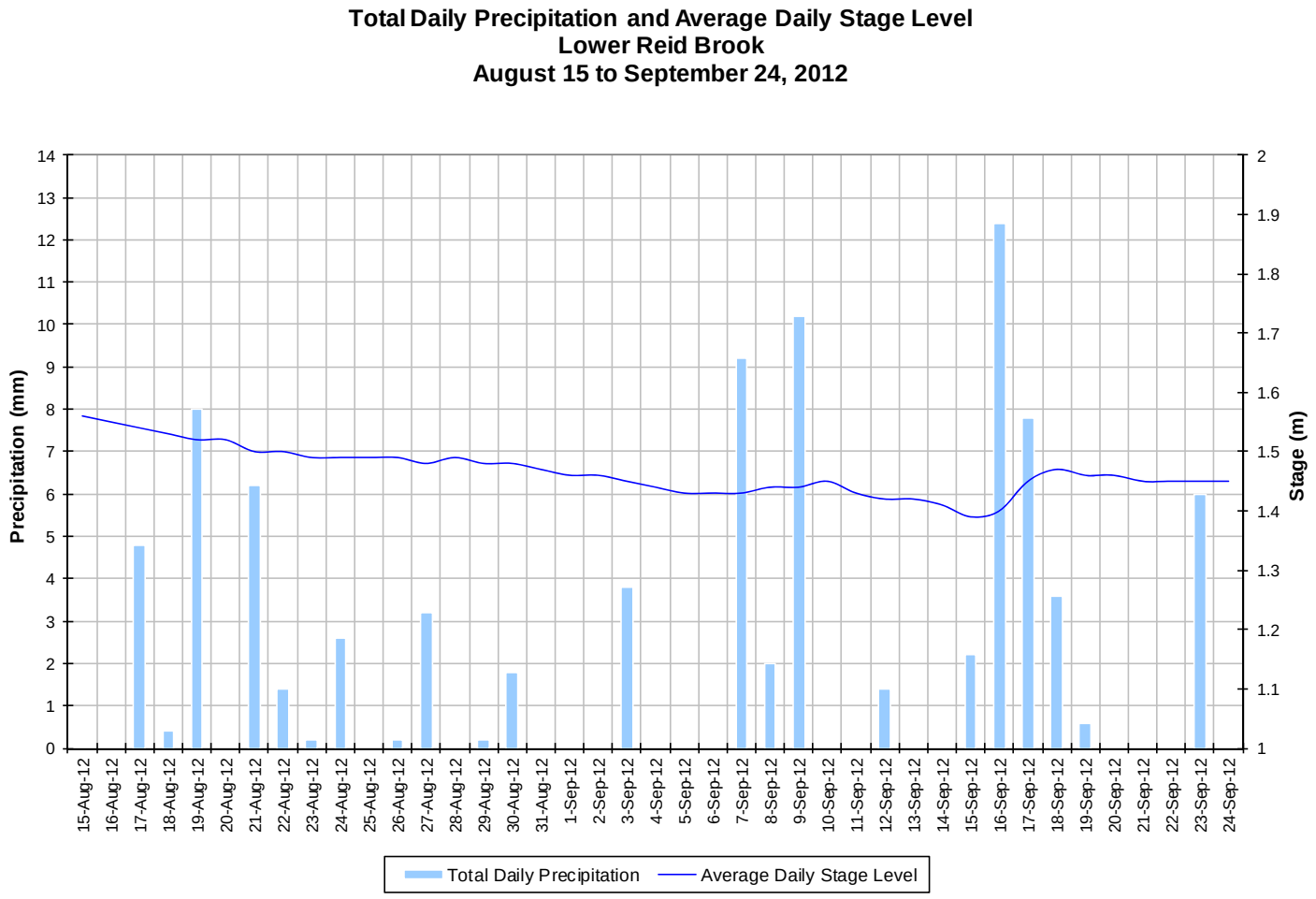

Figure 21: Daily precipitation and average daily stage level at Lower Reid Brook

(weather data recorded at Nain)

Camp Pond Brook

- A transmission error at this station caused data transfer to cease on September 13. By the time the instrument was retrieved on September 24, the problem persisted and the data transmission error would continue into the next deployment period. Data from the instruments internal log file is used to supplement transmitted data for Figures 22-27 and for discussions. There is no stage data available at this time for the entire deployment period. There are no daily averages available after September 13 until the end of the deployment period.

- Water temperature ranges from 6.33 ^{o}C to 20.67^{o}C during the deployment period (Figure 22).
- Water temperature is generally decreasing throughout the deployment period. This trend is expected given the cooling ambient air temperatures late in the summer season and into the fall (Figure 23).
- Water temperature fluctuates diurnally. Average water temperature is 13.72°C for the deployment period.
- There is a noticeable increase in water temperature around the middle of September which corresponds with unusually warm air temperatures recorded in the area (Figure 23). This increase is also noticeable at stations on Tributary to Lower Reid Brook and Lower Reid Brook.

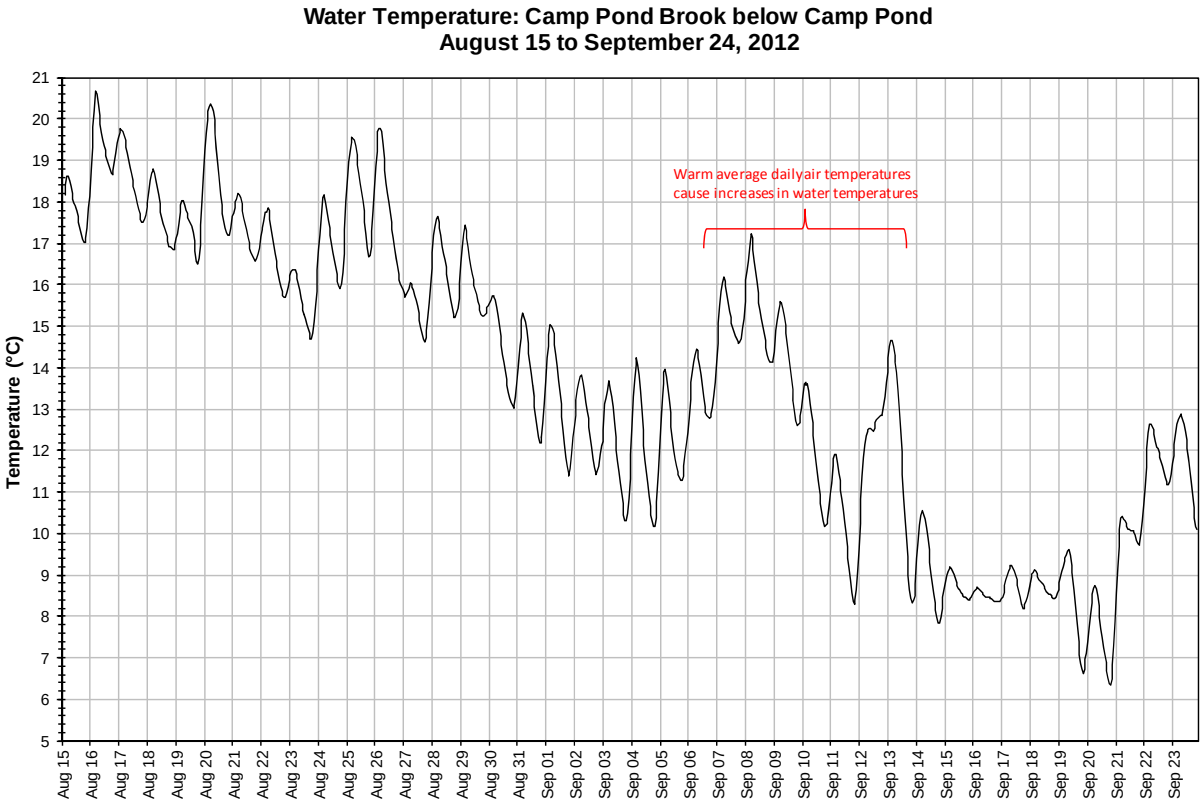

Figure 22: Water temperature at Camp Pond Brook

- Average daily air and water temperatures are generally decreasing throughout the deployment period (Figure 23). Fluctuations in average daily air temperatures are reflected by slight changes in water temperature. Air temperatures generally increase and decrease faster while water temperatures increase and decrease more slowly over time.
- Average daily air temperatures are unusually warm September 10, 13 & 22.

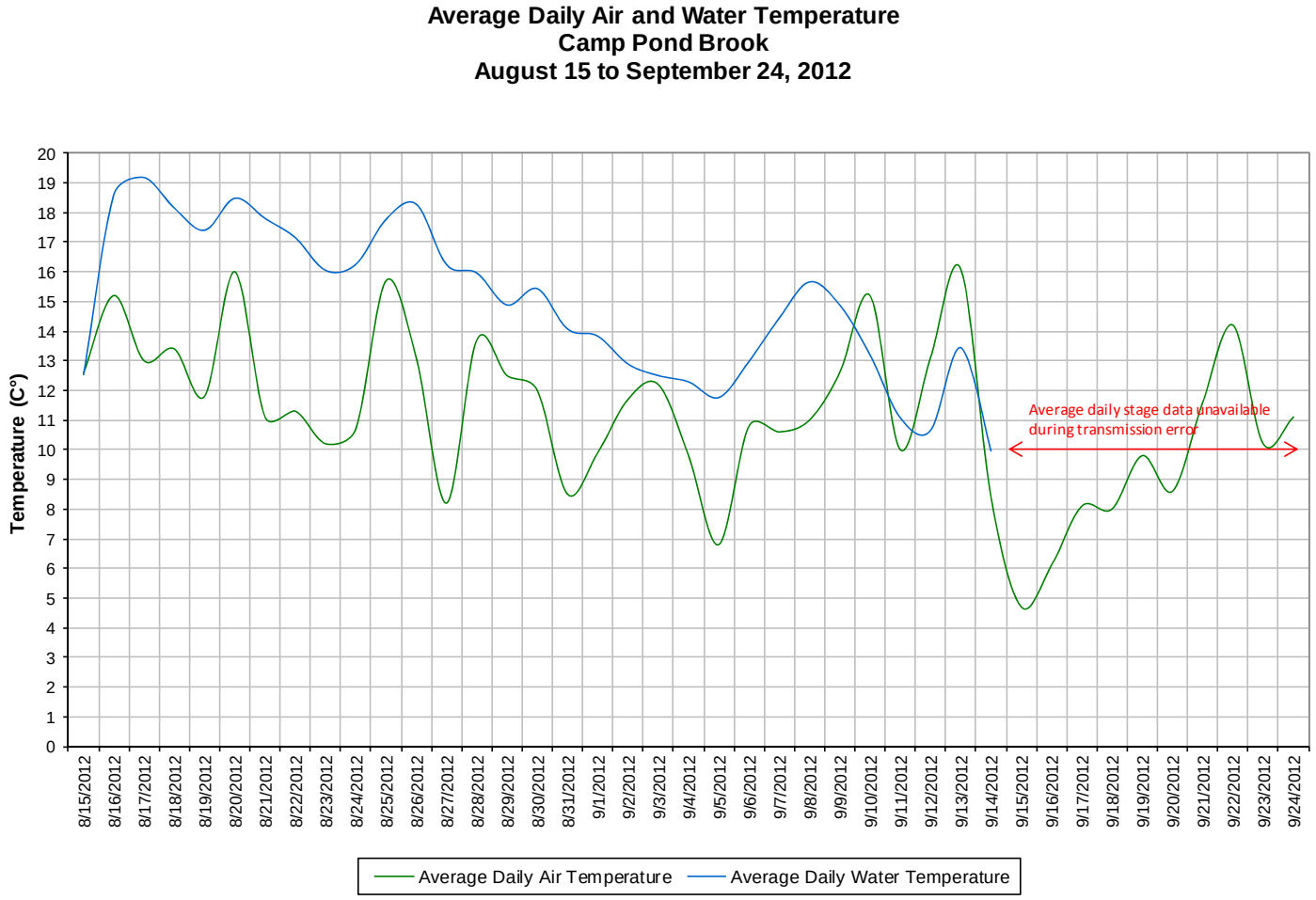

Figure 23: Average daily air and water temperatures at Camp Pond Brook

(weather data recorded at Nain)

- pH ranges between 6.93 and 7.38 pH units (Figure 24). pH values are stable with daily fluctuations throughout the deployment period.
- There is a slight decrease in pH on September 16-17 which corresponds with a significant rainfall event on September 15-16. The decrease in pH is also noticeable at all other stations in the network. This event is highlighted in red on Figure 24.
- All values are within the recommended range for pH as suggested by the CCME Guidelines for the Protection of Aquatic Life (>6.5 and <9.0 pH units).The guidelines are indicated in blue on Figure 24.

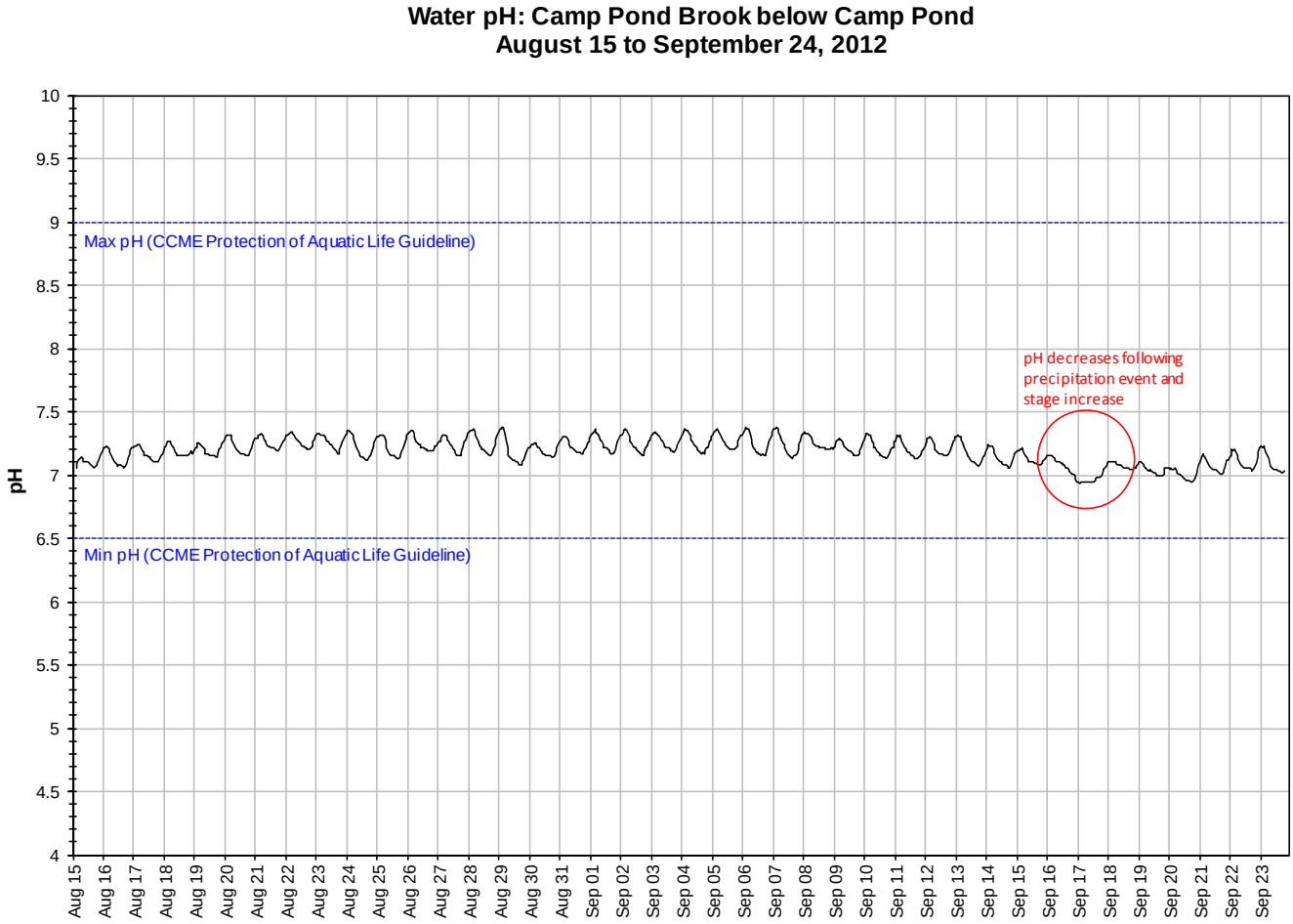

Figure 24: pH and stage level at Camp Pond Brook

- Specific conductivity ranges from 30.0µS/cm to 50.0µS/cm during the deployment period (Figure 25). Specific conductivity is only recorded to 1 decimal place in the log file. Stage level data is unavailable for this deployment period due to the transmission error.
- Specific conductivity is very stable through much of the deployment period with a slight increase. There is an increase on September 16-17 which corresponds with a rainfall event lasting 4 days from September 15-18. There are a number of increases
- Stage is usually included in Figure 25 to illustrate the inverse relationship between conductivity and water level. Typically, an increase in stage level can cause the specific conductivity to decrease by diluting the concentrations of dissolved solids present in the water column. However, at this station, historical trends show there is an increase in specific conductivity when stage increases. It can be assumed that stage increased during the significant rainfall event on September 15-18. This event (and others) is indicated in red on Figure 25.

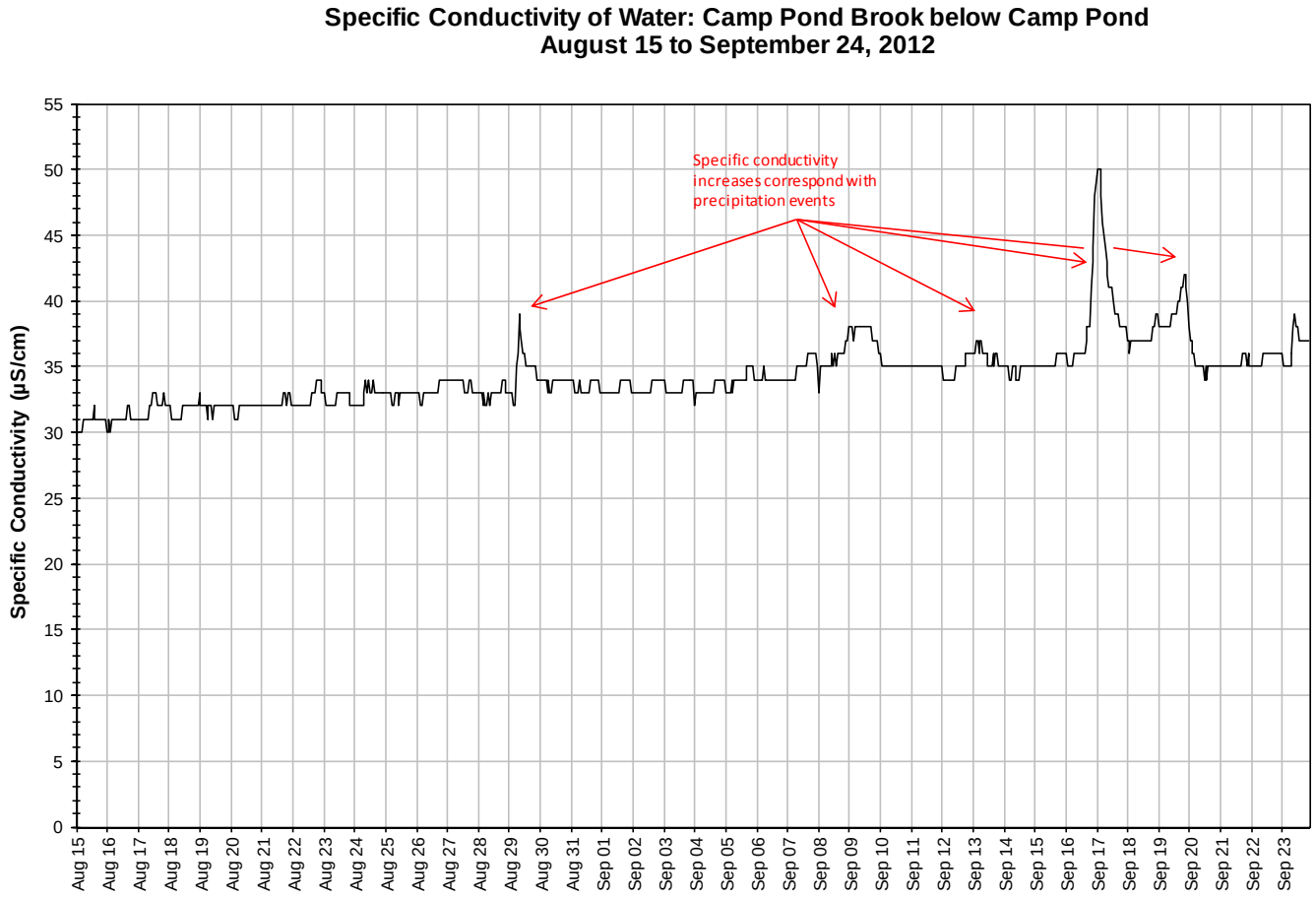

Figure 25: Specific conductivity and stage level at Camp Pond Brook

- Dissolved oxygen content ranges between 8.73mg/L and 11.67mg/L. The saturation of dissolved oxygen ranges from 89.0% to 100.5% (Figure 26).
- All values are above the minimum CCME Guideline for the Protection of Cold Water Biota at Other Life Stages (6.5mg/l). For the first half of the deployment period, most values are just below the minimum guideline for Early Life Stages (9.5mg/l). After September 1, dissolved oxygen rises above this guideline and remains there for most of the rest of the deployment period. Guidelines are indicated in blue on Figure 26. Average dissolved oxygen content is 9.85mg/l.
- Dissolved oxygen content is fluctuating daily and shows an increasing trend for much of the deployment period. This trend is expected given the cooling water and air temperatures (Figure 23). Dissolved oxygen content and percent saturation fluctuate diurnally.
- Near the end of the deployment period, there are a number of occasions when dissolved oxygen content decreases sharply and increases again the follow day. These fluctuations correspond with unseasonably warm air temperatures recorded in the area and increases in water temperature.

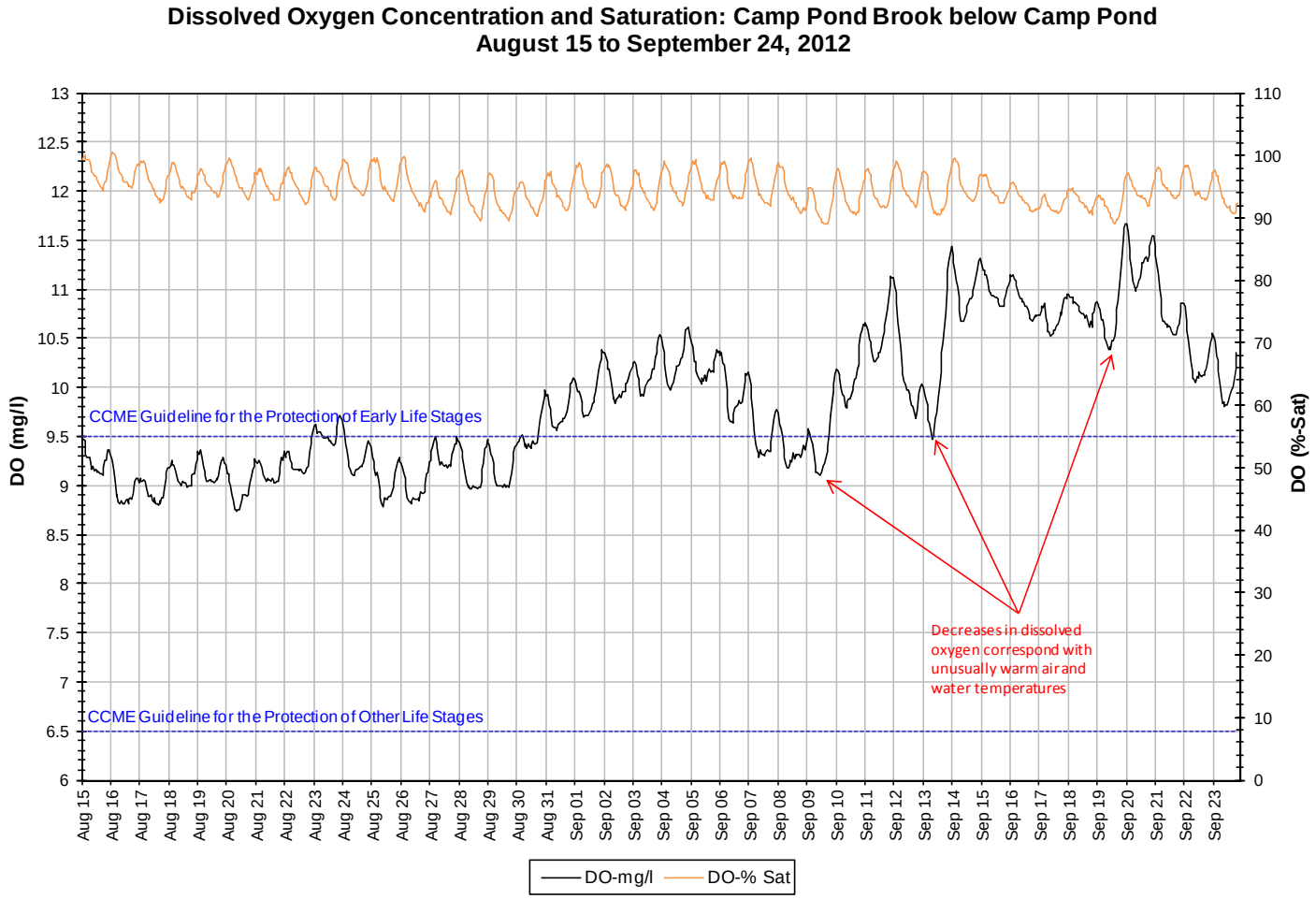

Figure 26: Dissolved oxygen and percent saturation at Camp Pond Brook

- Turbidity ranges between 0.0NTU to 25.8NTU (Figure 27). A median value of 0.0NTU indicates there is no consistent natural background turbidity value at this station for this deployment period.
- There a number instances when turbidity increases above 0NTU and for different lengths of time (1 hour to 3 days). Many of the increases correspond with rainfall events recorded in the area and show a typical pattern of sharp increases followed by a recovery period of hours to days during which turbidity is slowly decreasing to base line conditions which at this station is 0NTU. These events are highlighted in red on Figure 27.

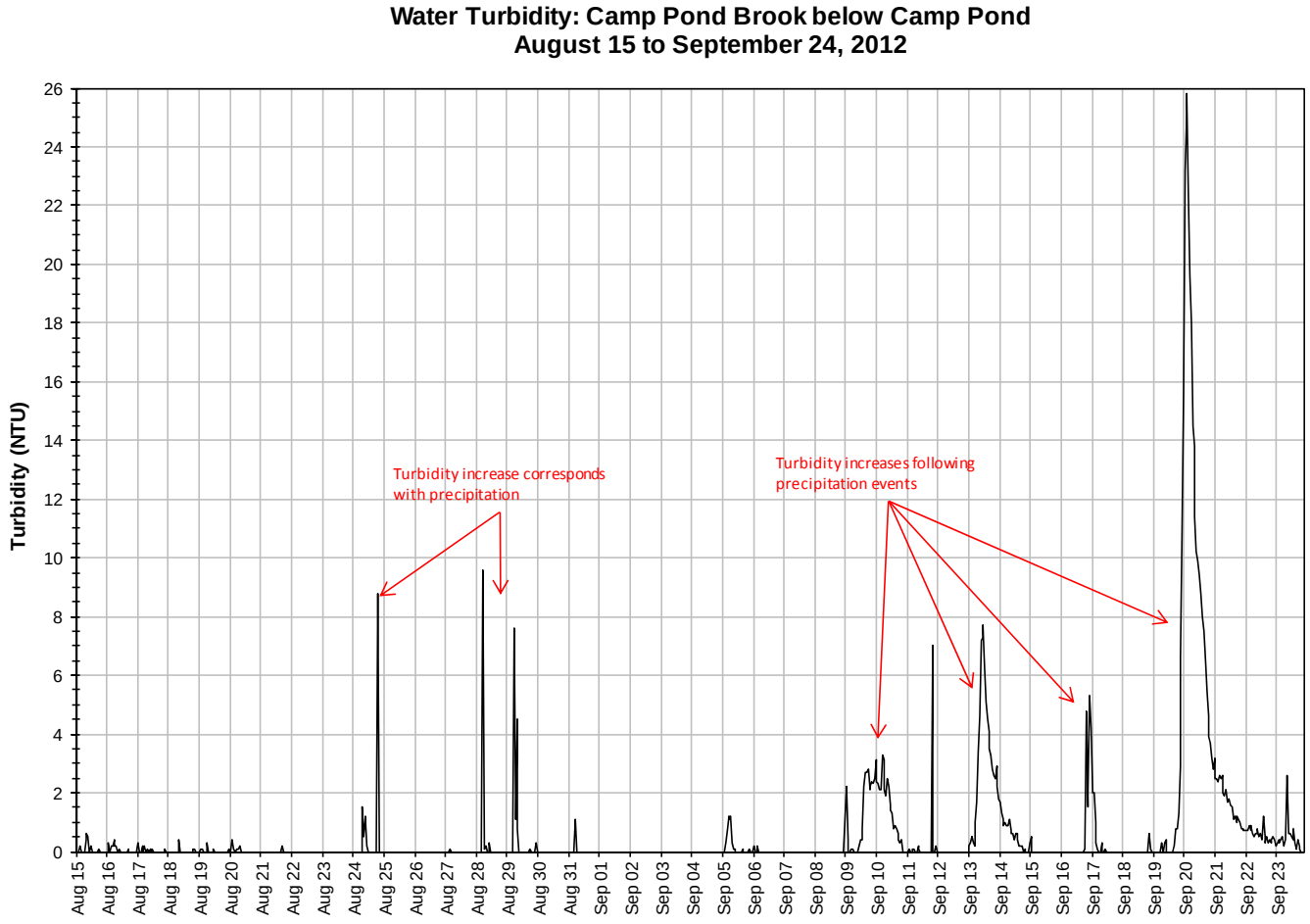

Figure 27: Turbidity at Camp Pond Brook

- Stage and precipitation are graphed together to show the relationship between rainfall and water level (Figure 28). Stage level data is mostly unavailable for the duration of deployment period.
- Precipitation events are frequent but generally low in magnitude.

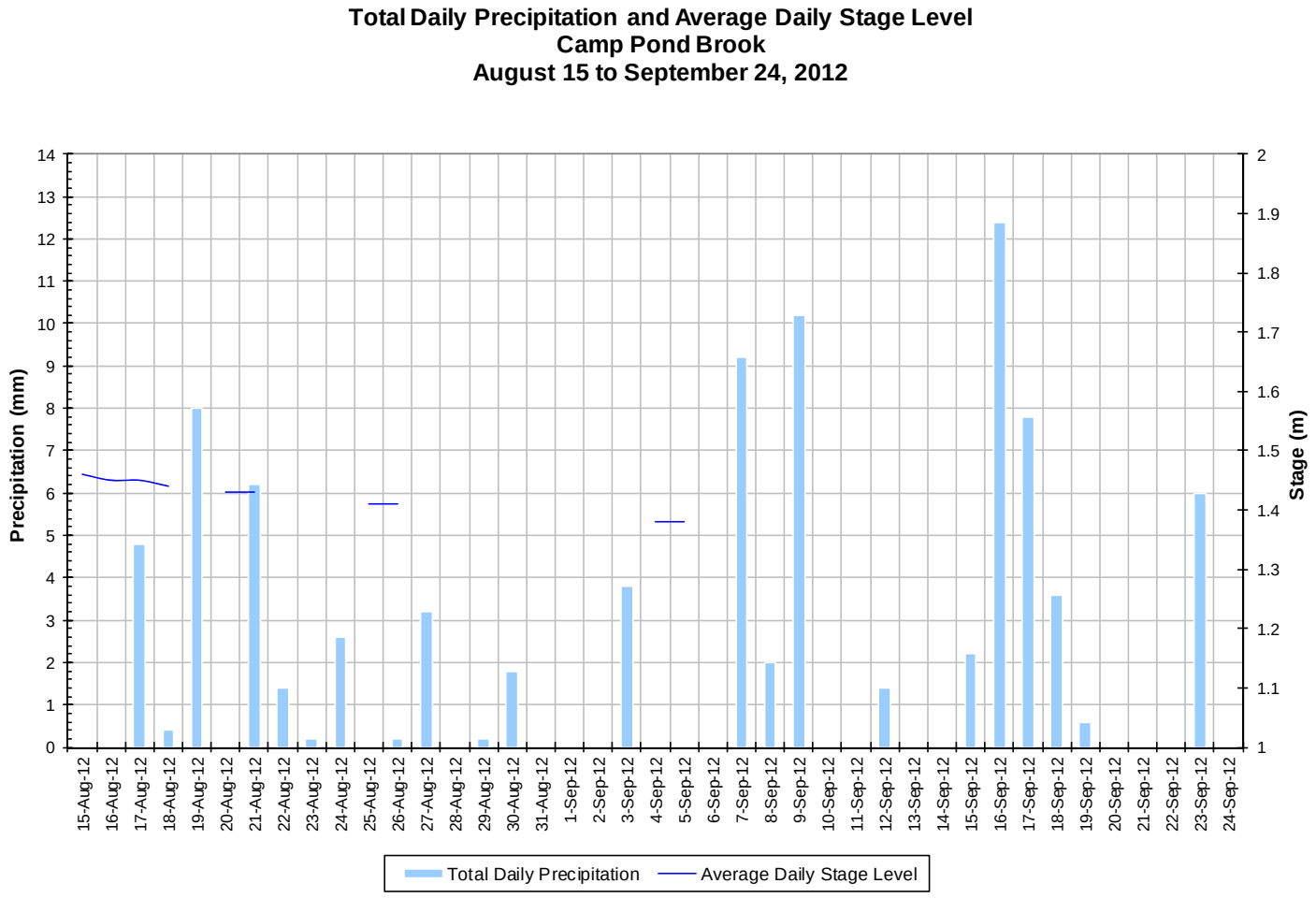

Figure 28: Daily precipitation and average daily stage level at Camp Pond Brook (weather data recorded at Nain)

Conclusions

- Instruments at water quality monitoring stations in the Voisey's Bay Network were deployed from August 15 to September 24, 2012, a period of 40 days.

Summary by Station

- At Upper Reid Brook, water temperature decreased throughout the deployment period. pH was generally neutral and stable except for one notable decrease during a rainfall event. Specific conductivity was low and stable which is very typical for this station. Dissolved oxygen fluctuated in response to the changing air and water temperatures. Turbidity generally remained at 0NTU. Stage levels were consistently decreasing with a slight increase near the end of the deployment period.
- At Tributary to Lower Reid Brook, temperature and dissolved oxygen fluctuated diurnally and in response to cooling air temperatures and frequent precipitation events. pH and specific conductivity fluctuated in response to changing water levels. A decrease in pH and specific conductivity corresponded with precipitation events recorded in the area. Turbidity was mainly 0NTU throughout the deployment period except for a few short lived increases that corresponded well with rainfall events. Between September 4 & 12, turbidity values are slightly increased and events are more frequent. Stage levels generally decreased throughout the month however increased sharply during and following rainfall events.
- At Lower Reid Brook, temperature and dissolved oxygen also fluctuated diurnally as well as in response to cooling air temperatures and frequent rainfall. pH and specific conductivity fluctuated in response to changing water levels. A decrease in pH and specific conductivity corresponded with precipitation events recorded in the area. Turbidity remained mostly at 0NTU except for a few increases that corresponded with rainfall events. Stage levels were also similar to those at the station on the tributary to Lower Reid Brook, where water levels decreased consistently for most of the deployment period, increasing slightly at the end.
- At Camp Pond Brook, log file data was retrieved from the instruments internal log file to fill in data gaps caused by a transmission error. Water temperatures generally decreased while dissolved oxygen values increased during the deployment period. Both parameters fluctuated in response to cooling water temperatures and frequent rainfall events. pH and specific conductivity values were mostly stable but also fluctuated with changing water levels most times corresponding with rainfall events. Specific conductivity did not show a typical inverse relationship with changing water levels caused by precipitation input. Instead of seeing specific conductivity decrease during precipitation events as expected, specific conductivity increased. This trend has been noted at this station in the past. Turbidity events were rare, short and low in magnitude. Stage data is unavailable for much of the deployment period due to a long lasting transmission error.

Summary by Parameter

- Temperature averaged between 11.00°C (Tributary) and 13.72°C (Camp Pond Brook) at the 4 stations in the Voisey's Bay Network. Temperature decreased at all stations throughout the deployment period with notable increases at all stations on September 10 and 13 when air temperatures were exceptionally warm. Water temperature is most stable at the Upper Reid Brook station because of the lake environment from which the water flows.

- pH values averaged between 6.93 (Tributary) and 7.21 (Lower Reid Brook) pH units across the network. All values recorded were within the recommended range as stated by the CCME Guideline for the Protection of Aquatic Life. A decrease in pH occurs at all stations in mid-September. This decrease, noticed first at Upper Reid Brook on Sept 15 corresponds with a significant rainfall event on September 15-16. pH increases again in the days following the precipitation event, pH fluctuated diurnally at all stations but is less noticeable at Upper Reid Brook due to the lake environment which the water flows from.
- At Tributary to Lower Reid Brook, Lower Reid Brook and Camp Pond Brook stations, specific conductivity averaged between 33.9µS/cm (Lower Reid Brook) and 35.6µS/cm (Tributary). Values at Upper Reid Brook were considerably lower averaging 11.7µS/cm. These lower values are expected from this pristine station at the outflow from Reid Pond. Values at this station tend not to fluctuate a lot even with changing stage levels. At Tributary to Lower Reid and Lower Reid Stations, specific conductivity displayed a clear inverse relationship with stage level, with values decreasing when stage level increased. At Camp Pond Brook, even with missing stage data, specific conductivity increased sharply during and following precipitation events. This is a trend normally seen at this station.
- Dissolved oxygen levels averaged between 9.87mg/l (Camp Pond Brook) and 10.57mg/l (Tributary). All values recorded at these stations were above the minimum CCME Guideline for the Protection of Aquatic Life at Other Life Stages (6.5mg/l) and most values were above the guideline for Early Life Stages (9.5mg/l). Dissolved oxygen content fluctuated diurnally and in response to changing water temperatures at all stations throughout the deployment period. Water and air temperatures increases on September 10 & 13 resulted in decreases in dissolved oxygen most notably at the stations on the Tributary to Lower Reid Brook, Lower Reid Brook and Camp Pond Brook. Dissolved oxygen content at Upper Reid Brook is more stable.
- Median turbidity values are 0NTU at all stations indicating there is generally no background turbidity in the network streams. Turbidity events were rare at the stations on Upper Reid Brook and Lower Reid Brook. At the Tributary to Lower Reid station, from September 4-12, turbidity events were more frequent and higher in magnitude. At Camp Pond Brook, short lived turbidity events were more frequent, sharp increases followed by slowed decreases (recovery period). Usually, these increases corresponded well with rainfall events recorded in the area.
- Stage generally remained stable, decreasing slightly throughout the deployment period at all stations with an increase at the end following a large rainfall event. Stage level data at Camp Pond Brook is mostly unavailable for this deployment period. Total stage fluctuation ranged anywhere from 28cm (Upper Reid Brook) to just 11cm (Lower Reid Brook) over the deployment period. Precipitation events were frequent but usually low in magnitude.

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Appendix 1: Weather Data – Environment Canada Historical Climate Database