



Real-Time Water Quality Annual Report 2017

Iron Ore Company of Canada
Labrador West Network

June 11 to
October 24, 2017



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

Contents

Acknowledgements	4
Introduction	5
Maintenance and Calibration	7
Quality Assurance and Quality Control	7
Data Interpretation	10
Wabush Lake Network	10
Dumbell Stream.....	18
Pumphouse Stream	26
Conclusions	35
Path Forward.....	36
Appendix 1	37
Appendix 2	38

Acknowledgements

The Real-Time Water Quality Monitoring Program (RTWQ) at Wabush Lake is fully funded by the Iron Ore Company of Canada (IOC). The program is made successful by a joint partnership between IOC, Environment and Climate Change Canada (ECCC), and the Newfoundland & Labrador Department of Municipal Affairs and Environment (MAE).

Various individuals from each sector have been diligently involved to ensure this program is a successful operation including, various WRMD staff (MAE), Jody Wentzell (IOC) and various WSC staff (ECCC). In addition to these managers, there have been a team of individuals who work together to ensure the day to day operations of these stations are providing quality data. Maria Murphy (MAE) was responsible for these water quality stations during 2017. Responsibilities included deployment and removal of instruments, maintenance and calibration of the instruments and preparation of monthly deployment reports. Brenda Congram (MAE) is acknowledged for her assistance during deployment and removal procedures in 2017. Tara Clinton and Ryan Pugh are acknowledged for their role in performing Performance Testing and Evaluation (PTE) and in-house servicing of the instruments during Winter 2017-2018.

ECCC staff are essential in the operation of the data logging/communication aspect of the network. Staff of the Meteorological Service of Canada Division – Water Survey of Canada, visit the stations regularly to ensure that the data logging and data transmitting equipment is working properly. ECCC is also the lead on dealing with stage and flow issues.

Introduction

- The real-time water quality monitoring network on Wabush Lake was established during the summer of 2007, a partnership between the Newfoundland & Labrador Department of Municipal Affairs and Environment (MAE) and the Iron Ore Company of Canada (IOC).
- This network consisted of two water quality/quantity stations, one located downstream of the IOC tailings disposal area and one located upstream of the same area.
- The official names of these two stations are *Wabush Lake at Dolomite Road* and *Wabush Lake at Lake Outlet*, hereafter referred to as the Dolomite Road station and the Julienne Narrows station.
- On June 8th, 2016, an additional station was commissioned under this agreement. This station is located at *Dumbell Stream above Dumbell Lake*, hereafter referred to as Dumbell Stream.
- On June 12th, 2017 a new station was commissioned under this agreement. This station is located at *Pumphouse Stream above Drum Lake*, hereafter referred to as Pumphouse Stream. This is the first year of operations for this station.
- These stations measure water quality parameters including water temperature, pH, specific conductivity, dissolved oxygen and turbidity, as well as water quantity parameters stage, and flow. Measurements are recorded on an hourly basis during the deployment period.

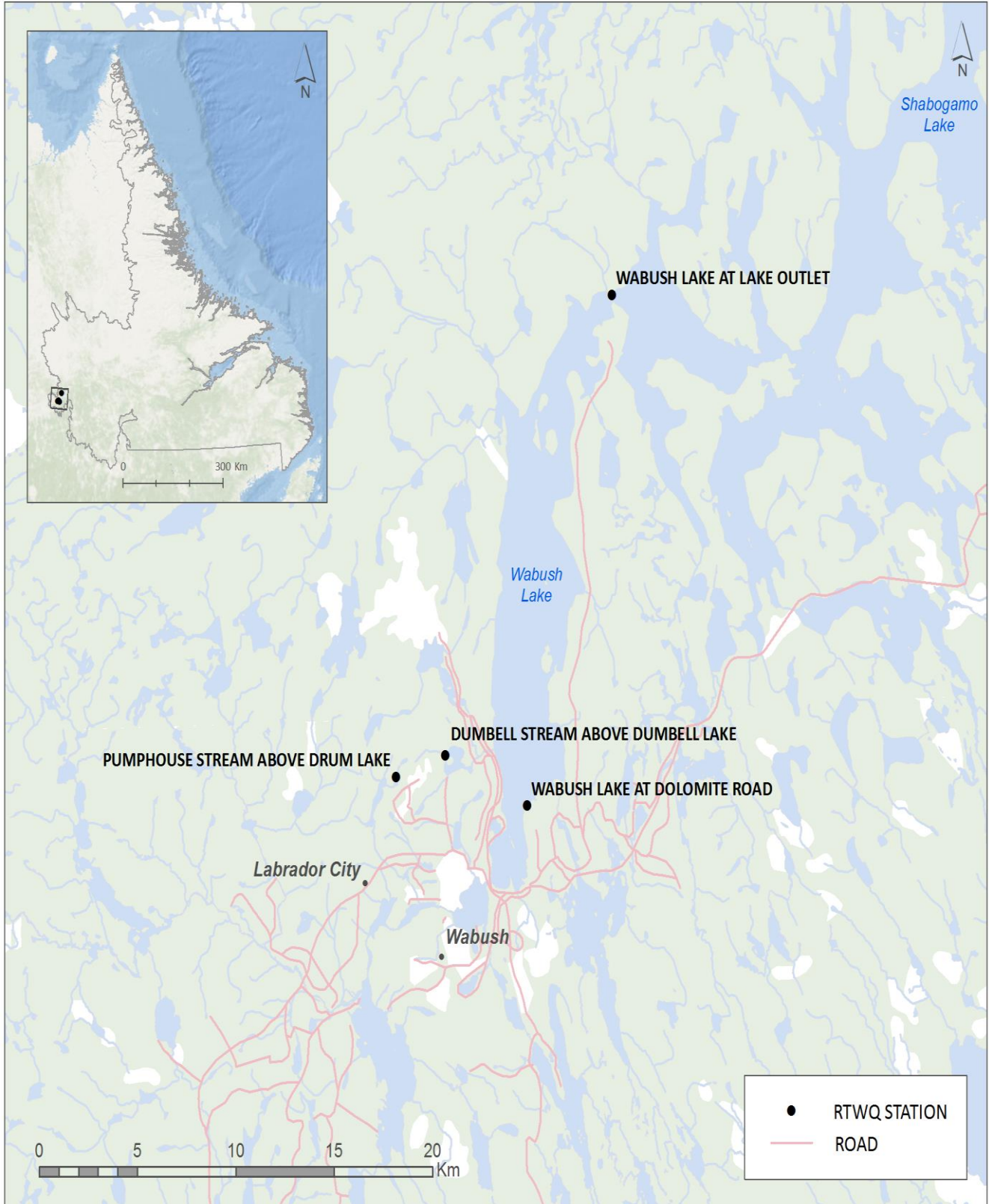


Figure 1: RTWQ Monitoring Stations in Labrador West

- Initial deployment in 2017 was between June 11th and 13th and instruments were removed for the winter season on October 23rd at Dolomite Road and Julienne Narrows, and October 24th at Dumbell and Pumphouse Steams. The following report depicts and discusses water quality events throughout this time period.
- The purpose of this network is to monitor, process, and distribute water quality/quantity data to IOC, MAE and ECCC, for assessment and management of water resources, as well as to provide an early warning for any potential or emerging water issues. Any necessary mitigative measures can then be implemented in a timely manner.
- MAE provides IOC with monthly and annual deployment reports.
- It is important to note that unless otherwise stated on the graphs, small gaps in data are due to the removal of the instrument for maintenance and calibration.

Maintenance and Calibration

- To ensure accurate data collection, maintenance and calibration of the water quality instrumentation are performed preferably on a monthly basis.
- Maintenance includes a thorough cleaning of the instrument and replacement of any small sensor parts that are damaged or unsuitable for reuse. Once the instrument is cleaned, MAE staff carefully calibrate each sensor attachment for pH, specific conductivity, dissolved oxygen and turbidity.
- Installation and removal dates for the 2017 season are summarized in the table below.

Table 1: Water quality instrument deployment start and end dates for 2017

Installation	Removal	Deployment duration (days)
June 11-13	July 18-19	35-37
July 19-20	Sept 12-13	53-55
Sept 12-13	October 23-24	40-41

Quality Assurance and Quality Control

- As part of the Quality Assurance and Quality Control protocol (QA/QC), 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 QA/QC Sonde is temporarily deployed adjacent to the Field Sonde. 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 Sonde

and QA/QC Sonde at deployment and at removal, a qualitative statement is made on the data quality (Table 2).

Table 2: Ranking classifications for deployment and removal

Parameter	Rank				
	Excellent	Good	Fair	Marginal	Poor
Temperature (°C)	<=+/-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 sonde is the most important. All other parameters can be broken down into three groups: temperature dependant, temperature compensated and temperature independent. As the temperature sensor is not isolated from the rest of the sonde, the entire sonde 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 IOC water quality stations for the three deployment periods from June 11th to October 24th, 2017 are summarized in Table 3.
- For additional information and explanations of ranking including “N/A” rankings, please refer to the monthly deployment reports.

Table 3: Comparison rankings for IOC RTWQ stations June 11 – October 24, 2017

	Date		Temperature	pH	Specific Conductivity	Dissolved Oxygen	Turbidity
Dolomite Road	11-Jun-17	Deployment	Good	Excellent	Excellent	Fair	Excellent
	18-Jul-17	Removal	Good	Good	Excellent	Good	N/A
	19-Jul-17	Deployment	Excellent	Good	Excellent	Marginal	Excellent
	13-Sep-17	Removal	Excellent	Excellent	Marginal	Good	Excellent
	13-Sep-17	Deployment	Good	Excellent	Good	Good	Excellent
	23-Oct-17	Removal	Good	Good	Poor	Fair	Excellent
Julienne Narrows	13-Jun-17	Deployment	Excellent	Excellent	Excellent	Fair	Good
	18-Jul-17	Removal	Good	Good	Good	Fair	Poor
	20-Jul-17	Deployment	Excellent	Good	Fair	Fair	Excellent
	12-Sep-17	Removal	Good	Excellent	Excellent	Excellent	Excellent
	12-Sep-17	Deployment	Good	Good	Fair	Excellent	N/A
	23-Oct-17	Removal	Fair	Fair	Good	Excellent	N/A
Dumbell Stream	12-Jun-17	Deployment	Excellent	Excellent	Good	Good	Excellent
	19-Jul-17	Removal	Good	Excellent	Good	Excellent	Excellent
	19-Jul-17	Deployment	Excellent	Good	Excellent	Excellent	Excellent
	13-Sep-17	Removal	Excellent	Excellent	Fair	Marginal	Excellent
	13-Sep-17	Deployment	Good	Excellent	Fair	Poor	Excellent
	14-Oct-17	Removal	Good	Good	Excellent	Good	Excellent
Pumphouse Stream	12-Jun-17	Deployment	Excellent	Excellent	Good	Good	Excellent
	19-Jul-17	Removal	Excellent	Good	Good	Excellent	Fair
	19-Jul-17	Deployment	Excellent	Excellent	Excellent	Excellent	Excellent
	13-Sep-17	Removal	Good	N/A	Fair	Fair	Poor
	13-Sep-17	Deployment	Excellent	Good	Good	Fair	Good
	24-Oct-17	Removal	Excellent	Good	Poor	Marginal	Excellent

Data Interpretation

- The following graphs and discussion illustrate water quality-related events from June 11th to October 24th, 2017 at the four IOC RTWQ stations.
- 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 QA/QC protocol. Water Survey of Canada is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.
- Weather data is collected from a weather station near Moosehead Lake.
- There is a small gap in data at Dolomite Road. This is due to power loss.

Wabush Lake Network

- Water temperature ranged from 3.80 to 18.00°C at Julienne Narrows during the 2017 deployment season. The median value was 12.10 °C (Figure 2).
- Water temperature ranged from 4.20 to 18.50°C at Dolomite Road during the 2017 deployment season. The median value was 13.70 °C (Figure 2), which is higher than Julienne Narrows. Water temperature is typically higher at Dolomite Road than Julienne Narrows.

**Water Temperature: Wabush Lake Network
June 13 to October 23, 2017**

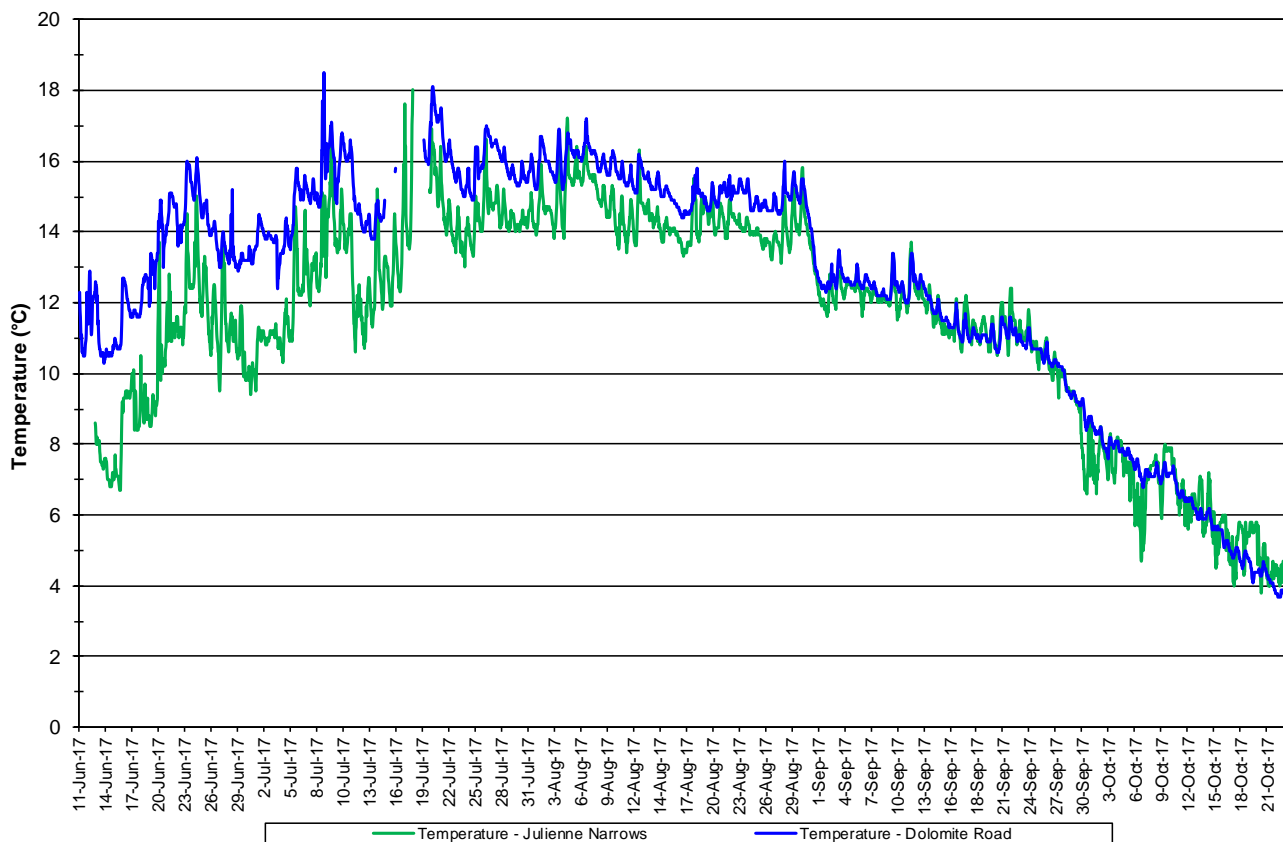


Figure 2: Water Temperature – Wabush Lake Network

- Water temperature values show a typical seasonal trend, warm in the summer and decreasing into the fall season. Water temperature fluctuations correspond moderately well with the ambient air temperature. Weather data was collected at Moosehead Lake (Figure 3).

**Average Daily Air and Water Temperature: Wabush Lake Network
June 11 to October 23, 2017**

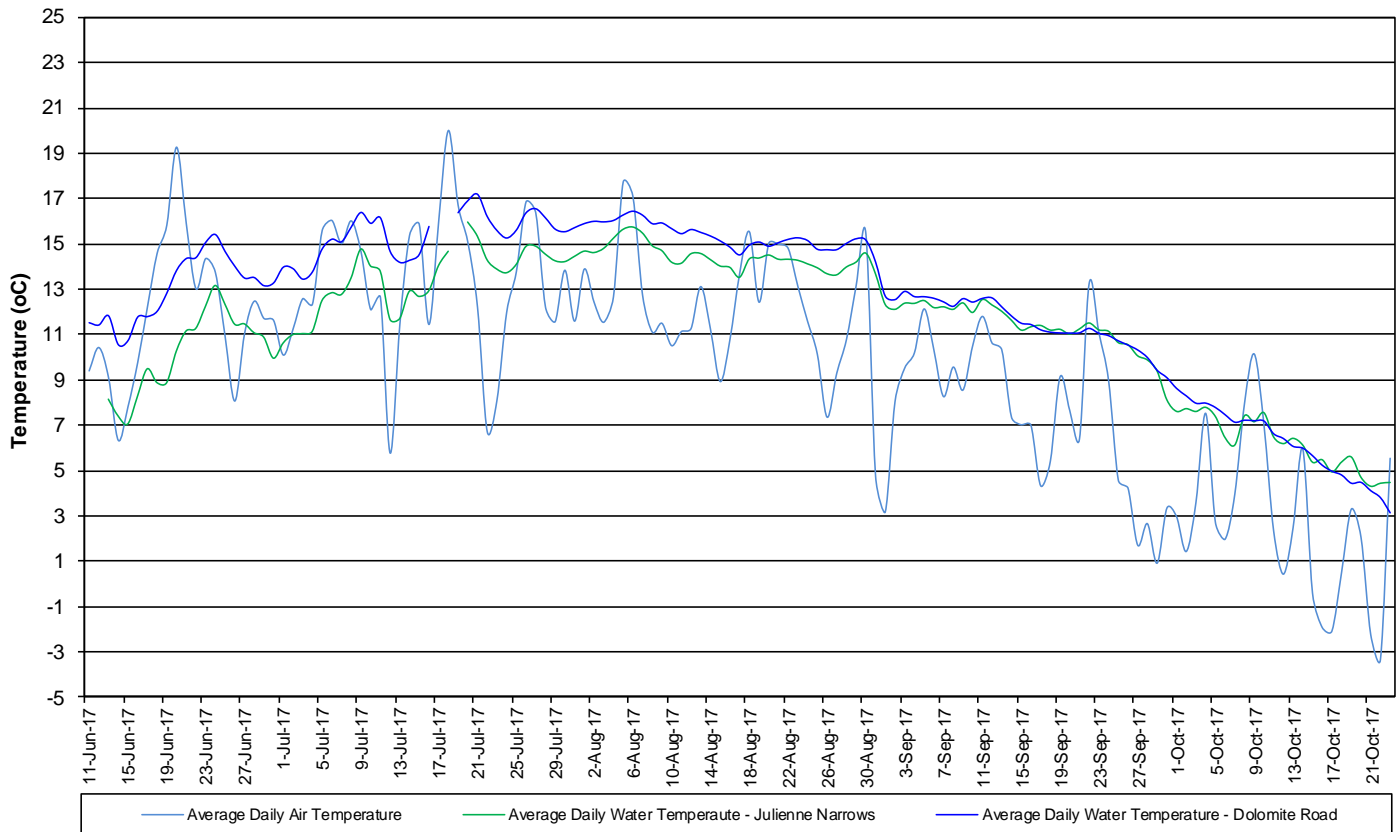


Figure 3: Water and Air Temperature – Wabush Lake Network

- pH ranged from 7.50 to 8.28 pH units at Julienne Narrows and from 7.12 to 8.08 pH units at Dolomite Road (Figure 4) during the 2017 deployment season. The median pH was 7.89 and 7.51 units respectively.
- At both stations, pH increases slightly until the middle of August with daily fluctuations. Peaks are observed during late afternoon and early evening.
- All values during the deployment are within the CCME Water Quality Guidelines for the Protection of Aquatic Life (between 6.5 and 9 pH units).

**Water pH and Stage: Wabush Lake Network
June 13 to October 23, 2017**

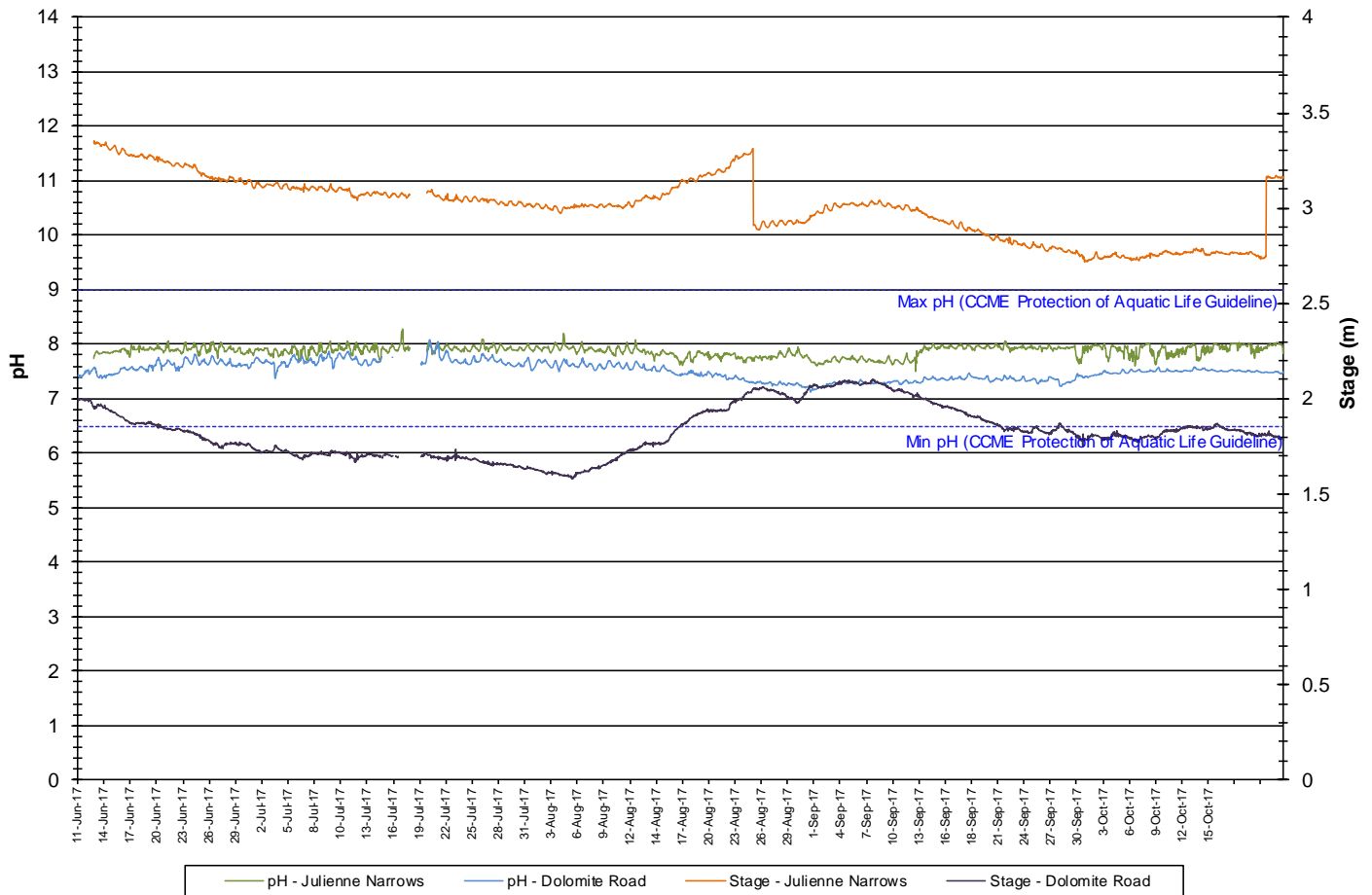


Figure 4: Water pH and Stage – Wabush Lake Network

- Throughout the 2017 deployment season, specific conductivity ranged from 58.1 to 118.0 $\mu\text{S}/\text{cm}$ at Julienne Narrows and from 37.1 to 63.4 $\mu\text{S}/\text{cm}$ at Dolomite Road (Figure 5).
- Daily fluctuations are evident at the Julienne Narrows station. This can be attributed to varying contributions of iron ore tailings deposited into Wabush Lake upstream of Julienne Narrows and downstream of Dolomite Road. This can also explain the difference in specific conductivity levels between the two stations.
- At Julienne Narrows, conductivity fluctuated greatly during the deployment season.
- At Dolomite Road, conductivity increases during the beginning of the deployment season before decreasing in late August.
- 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 QA/QC protocol. Water Survey of Canada is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.

**Specific Conductivity and Stage: Wabush Lake Network
June 13 to October 23, 2017**

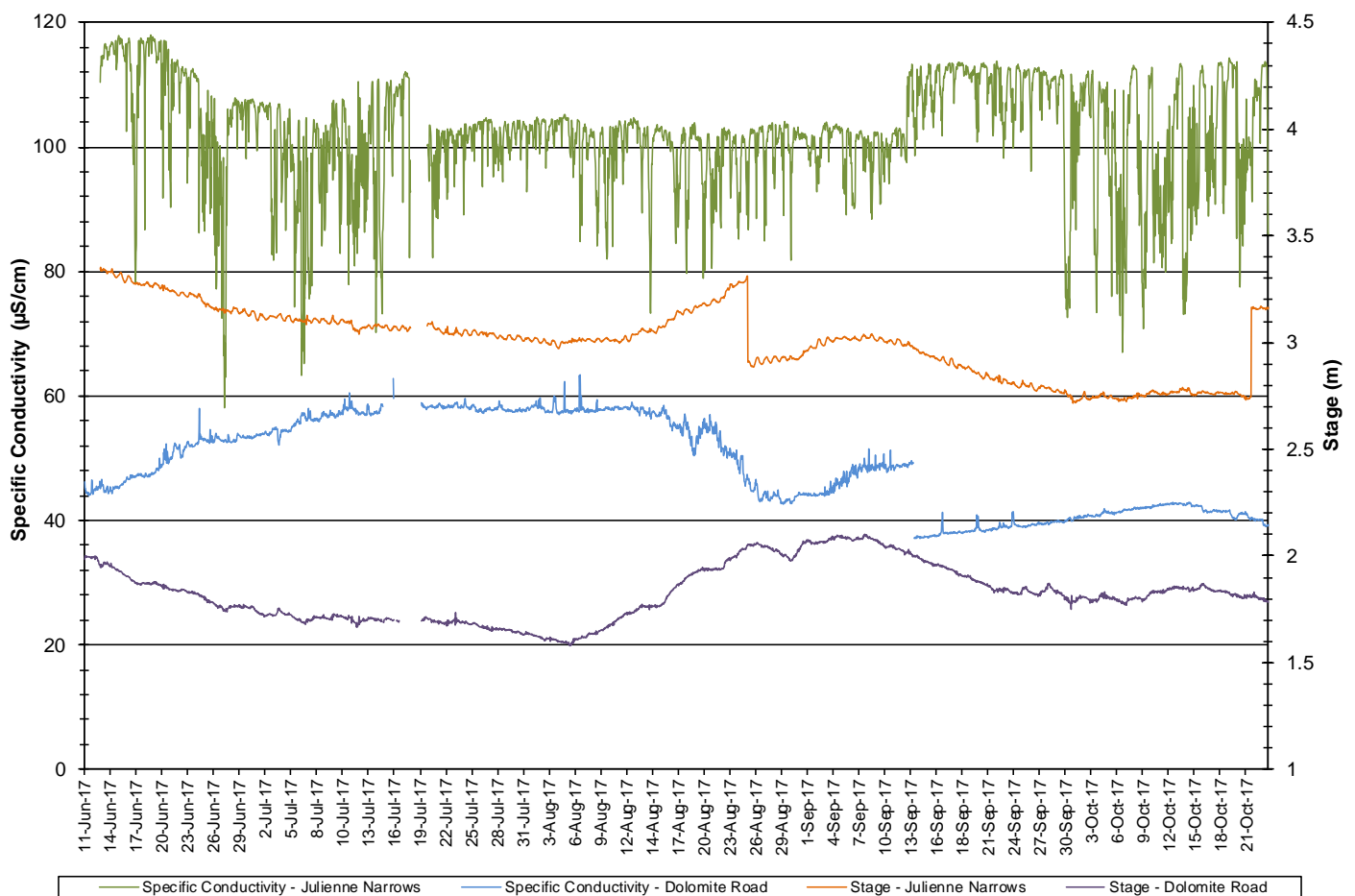


Figure 5: Specific Conductivity and Stage – Wabush Lake Network

- Dissolved oxygen ranged from 85.3 to 110.7% saturation and 8.92 to 11.65 mg/l with a median value of 9.94 mg/L at Julienne Narrows (Figure 6).
- Dissolved oxygen ranged from 77.6 to 108.2% saturation and 8.83 to 10.82 mg/l with a median value of 9.51 mg/L at Dolomite Road (Figure 6).
- Dissolved oxygen fluctuated daily at both stations with decreases observed at night.
- Dissolved oxygen decreases during the summer months when water temperatures are highest. Oxygen levels then gradually increase during the last deployment of the season as water temperatures decrease into fall.
- All values were above the CCME Water Quality Guideline for the Protection of Aquatic Life for Cold Water Biota at Other Life Stages of 6.5 mg/l. The majority of values recorded were above the minimum CCME Water Quality Guideline for the Protection of Aquatic Life for Cold Water Biota at Early Life Stages of 9.5 mg/l. The guidelines are indicated in blue on Figure 6.

**Dissolved Oxygen and Percent Saturation: Wabush Lake Network
June 13 to October 23, 2017**

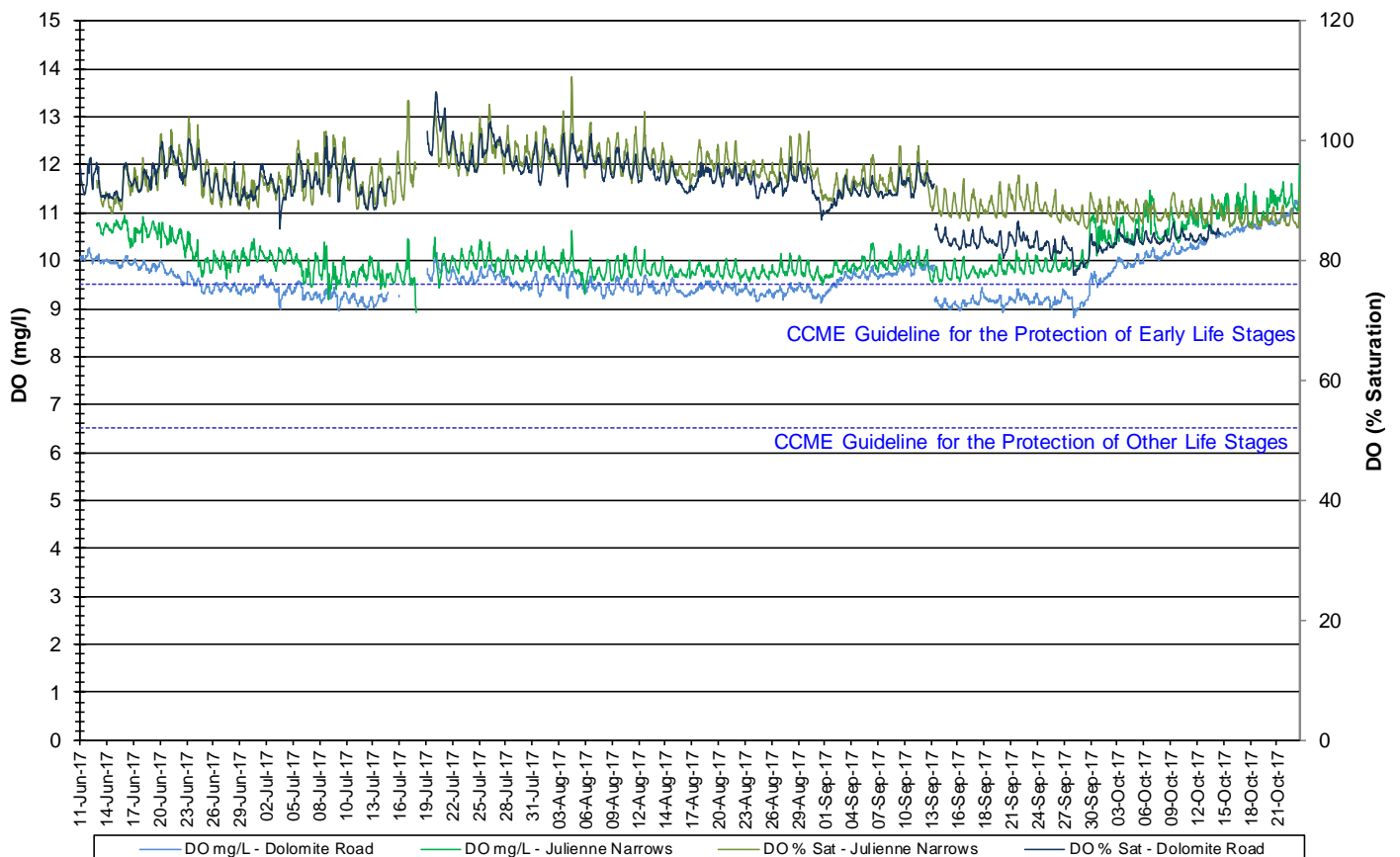


Figure 6: Dissolved Oxygen and Percent Saturation – Wabush Lake Network

- At the Julienne Narrows station, turbidity values ranged from 0.0 to 134.4 NTU with a median value of 0.0 NTU (Figure 7a) indicating low background turbidity.
- During the last month of the deployment season, there is some level of turbidity at all times.

**Water Turbidity: Julienne Narrows
June 13 to October 23, 2017**

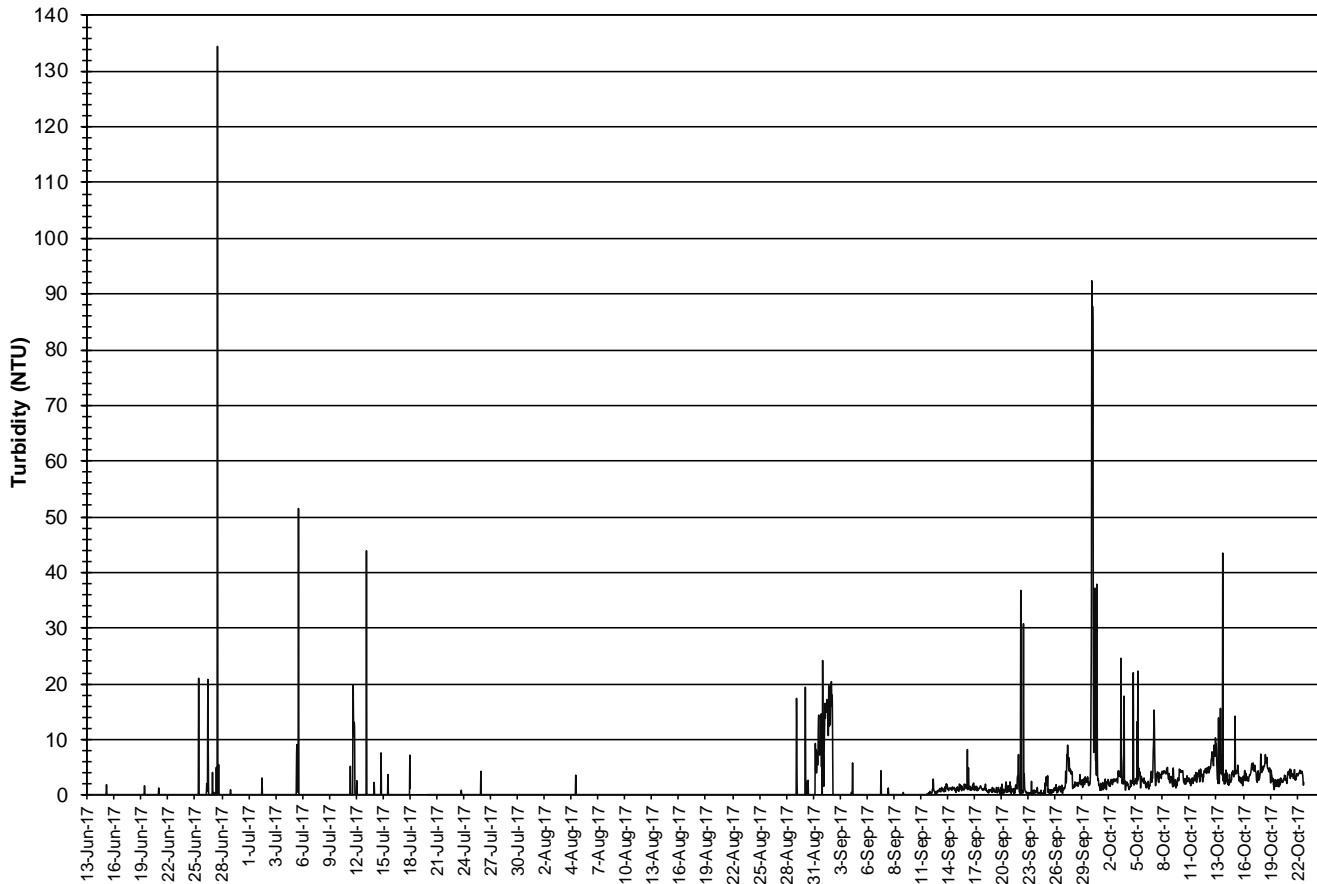


Figure 7a: Water Turbidity - Julienne Narrows

- At the Dolomite Road station, turbidity values ranged from 0.0 to 4.6 NTU, with a median value of 0.0 NTU (Figure 7b).
- Turbidity readings higher than 0NTU occur occasionally and are of short duration.

**Turbidity and Precipitation : Dolomite Road
June 11 to October 23, 2017**

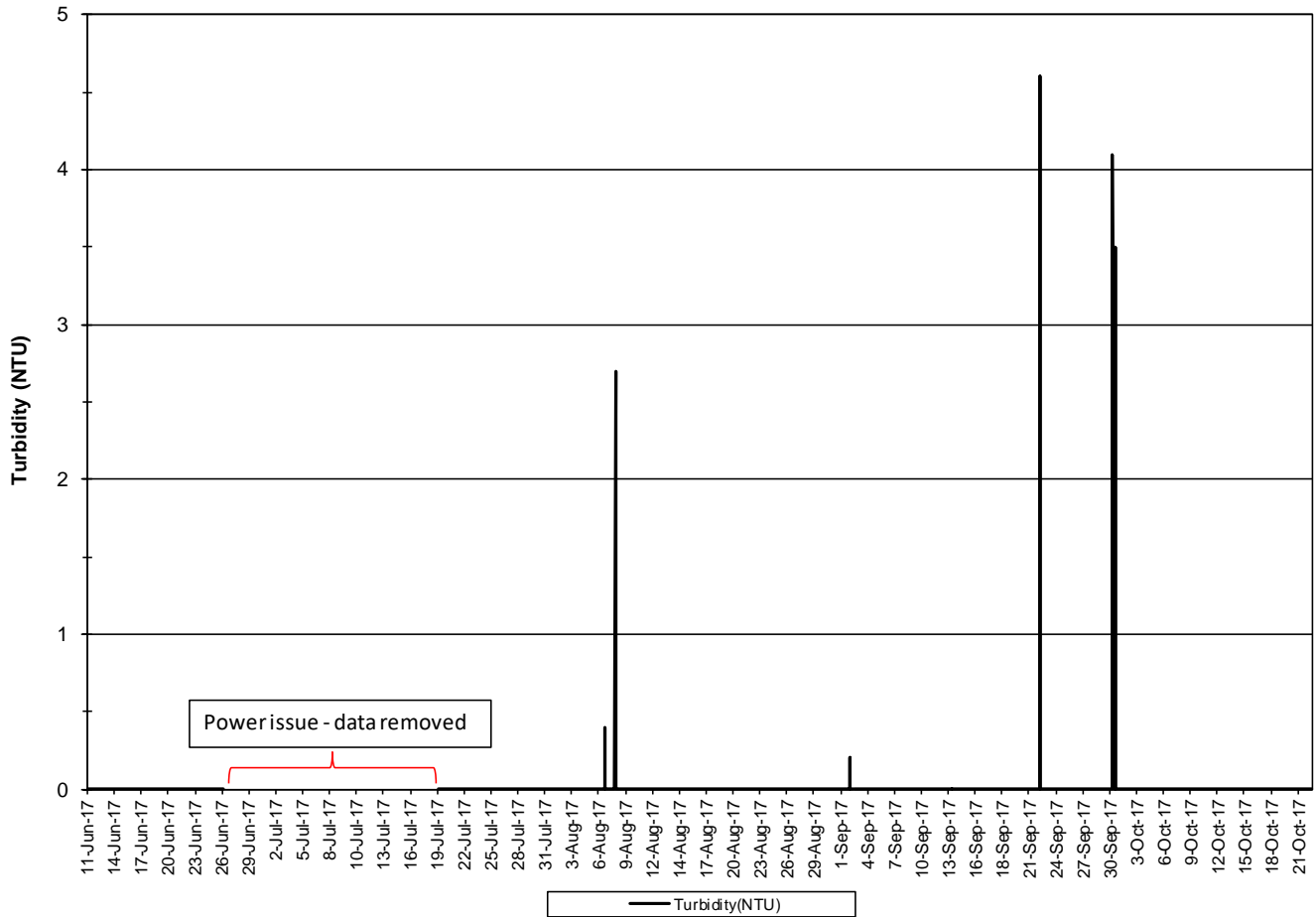


Figure 7b: Water Turbidity - Dolomite Road

- Stage and precipitation are graphed below to show the relationship between rainfall and water level at Julienne Narrows and Dolomite Road (Figure 8).
- Stage decreases at both stations until the beginning of August. Stage then increases for the next month before decreasing again. The sharp decrease in August and increase in October at Julienne Narrows are equipment corrections by WSC.
- 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 QA/QC protocol. Water Survey of Canada is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.

**Daily Precipitation and Average Daily Stage Level: Wabush Lake Network
June 13 to October 23, 2017**

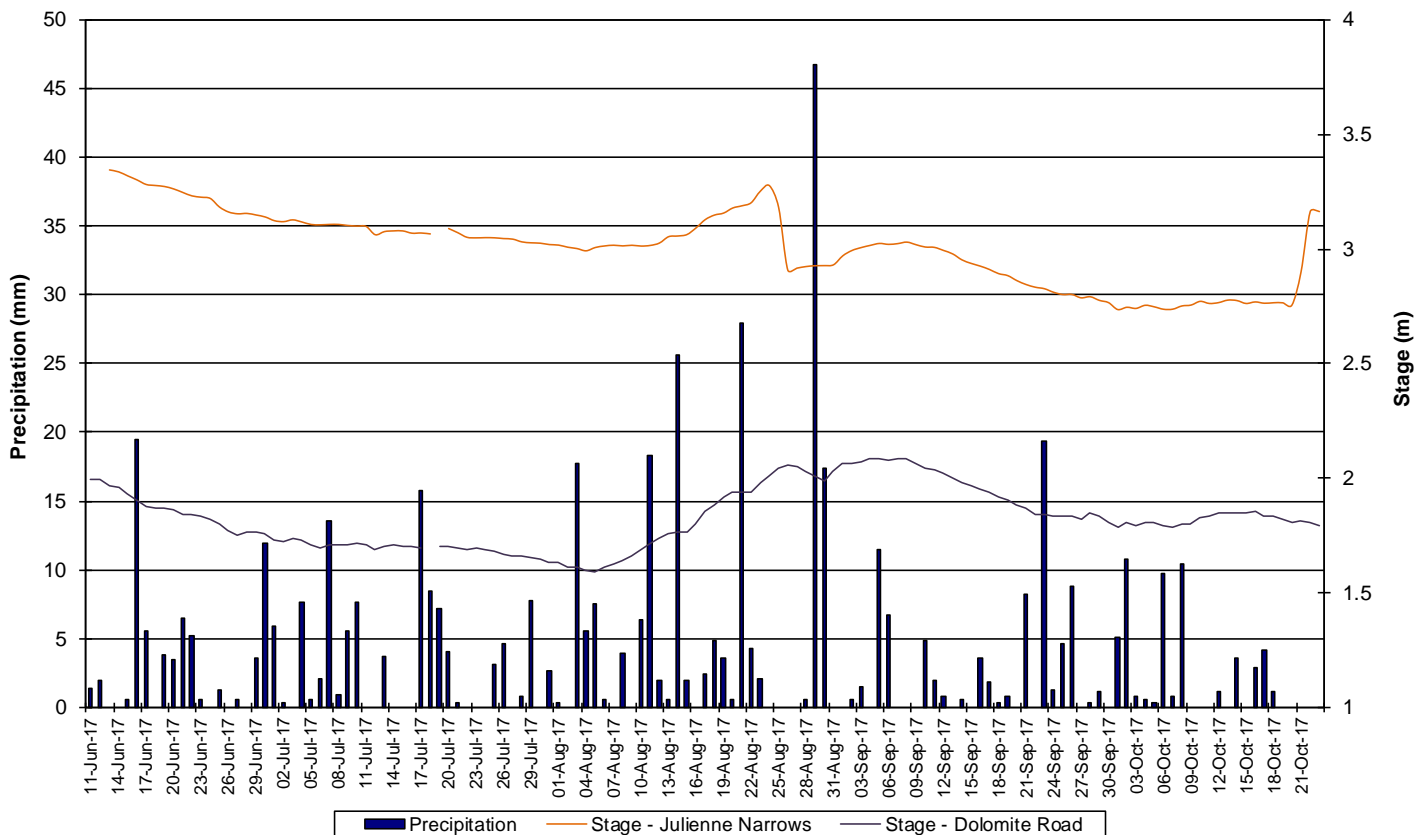


Figure 8: Stage and Precipitation - Wabush Lake Network

Dumbell Stream

- Water temperature ranged from 0.23 to 9.89°C at Dumbell Stream during the 2017 deployment season. The median value was 4.48 °C (Figure 9).

**Water Temperature : Dumbell Stream above Dumbell Lake
June 12 to October 24, 2017**

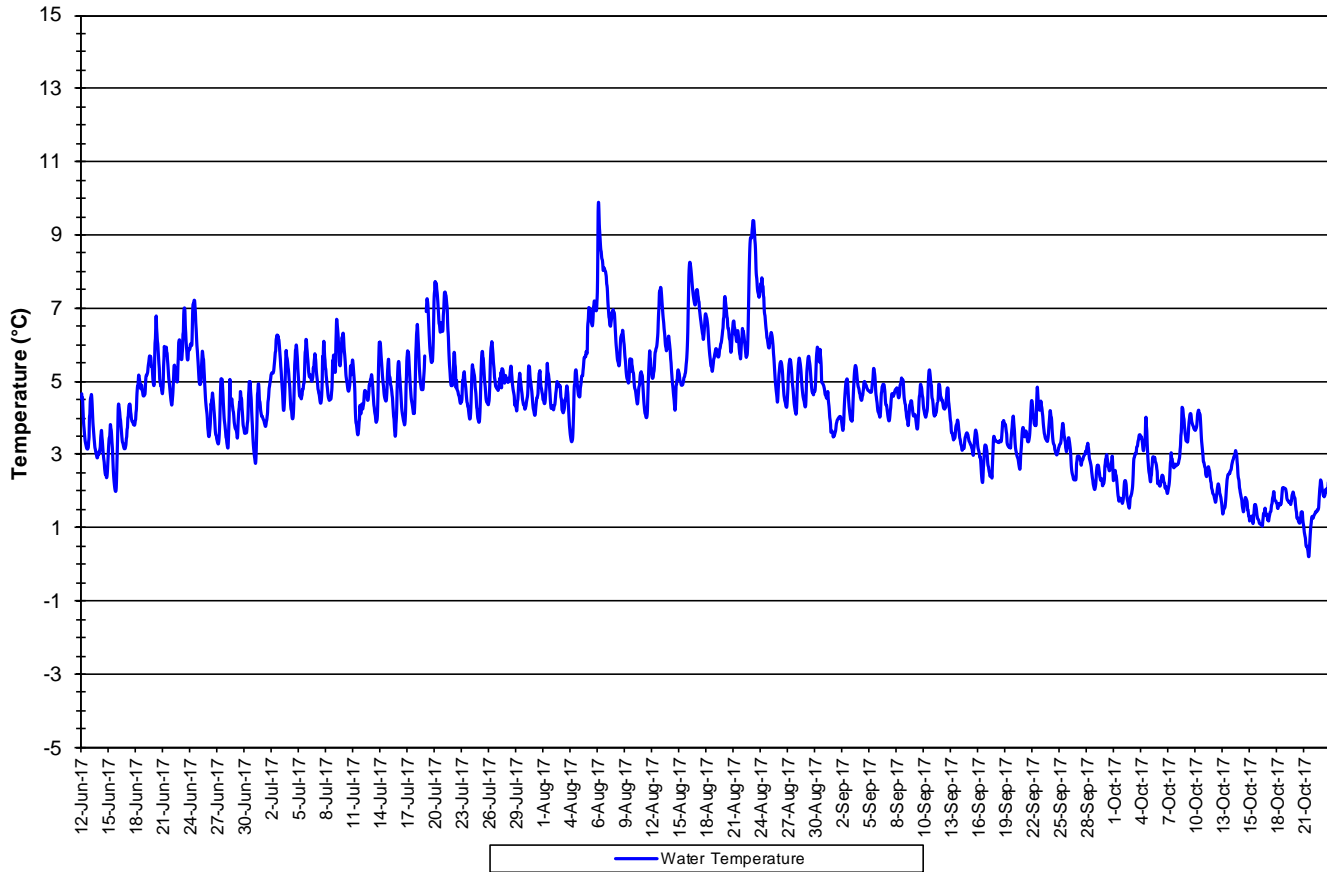


Figure 9: Water Temperature – Dumbell Stream

- Water temperature decreases as air temperatures cool into the fall. Water temperature at this station remains within a small range throughout the season and is impacted less than the other stations by air temperature values (Figure 10). Weather data was collected at Moosehead Lake.

**Average Daily Air and Water Temperature: Dumbell Stream
June 12 to October 24, 2017**

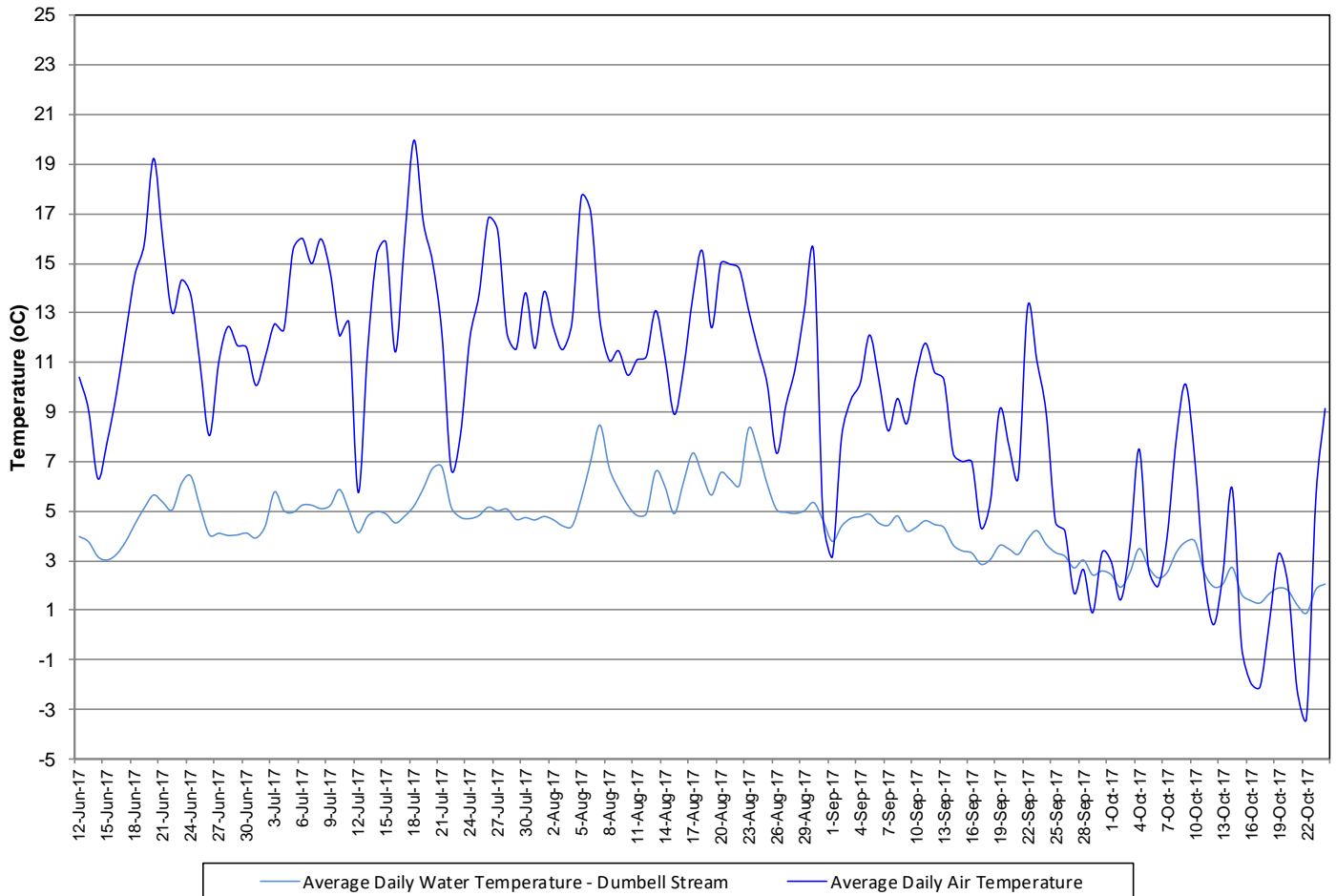


Figure 10: Water and Air Temperature – Dumbell Stream

- pH ranges from 7.23 to 7.89 pH units at Dumbell Stream (Figure 11). The median pH is 7.63 units.
- pH fluctuates daily. Peaks are observed during late afternoon and into early evening.
- All values during the deployment are within the CCME Water Quality Guidelines for the Protection of Aquatic Life (between 6.5 and 9 pH units).
- There is a slight increase at the start of each deployment period as the sensor acclimates.
- There are three noticeable decreases in pH in August, they occur during high precipitation events. This is a very small stream and is very susceptible to fluctuations during precipitation events.

**Water pH and Stage : Dumbell Stream above Dumbell Lake
June 12 to October 24, 2017**

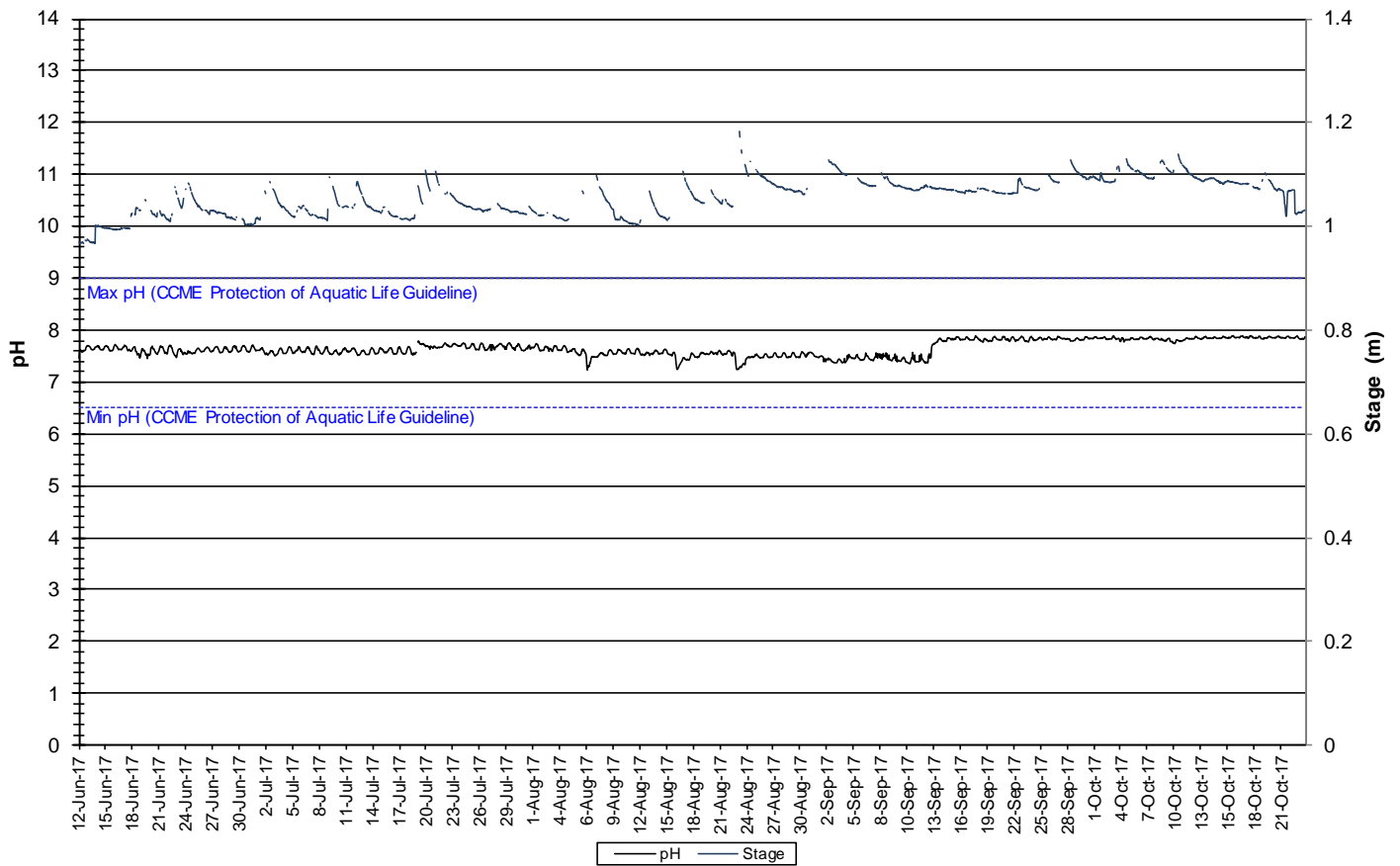


Figure 11: Water pH and Stage – Dumbell Stream

- Throughout the 2017 deployment season, specific conductivity ranged from 42.0 to 75.4 $\mu\text{S}/\text{cm}$ at Dumbell Stream (Figure 12).
- Decreases in specific conductivity frequently correspond to increases in stage. As more water is added to the system from precipitation, the solids in the water are diluted, decreasing conductivity.
- Overall, specific conductivity increased very gradually throughout the deployment season, with periodic fluctuations related to stage.
- 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 QA/QC protocol. Water Survey of Canada is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.

**Specific Conductivity of Water and Stage: Dumbell Stream above Dumbell Lake
June 12 to October 24, 2017**

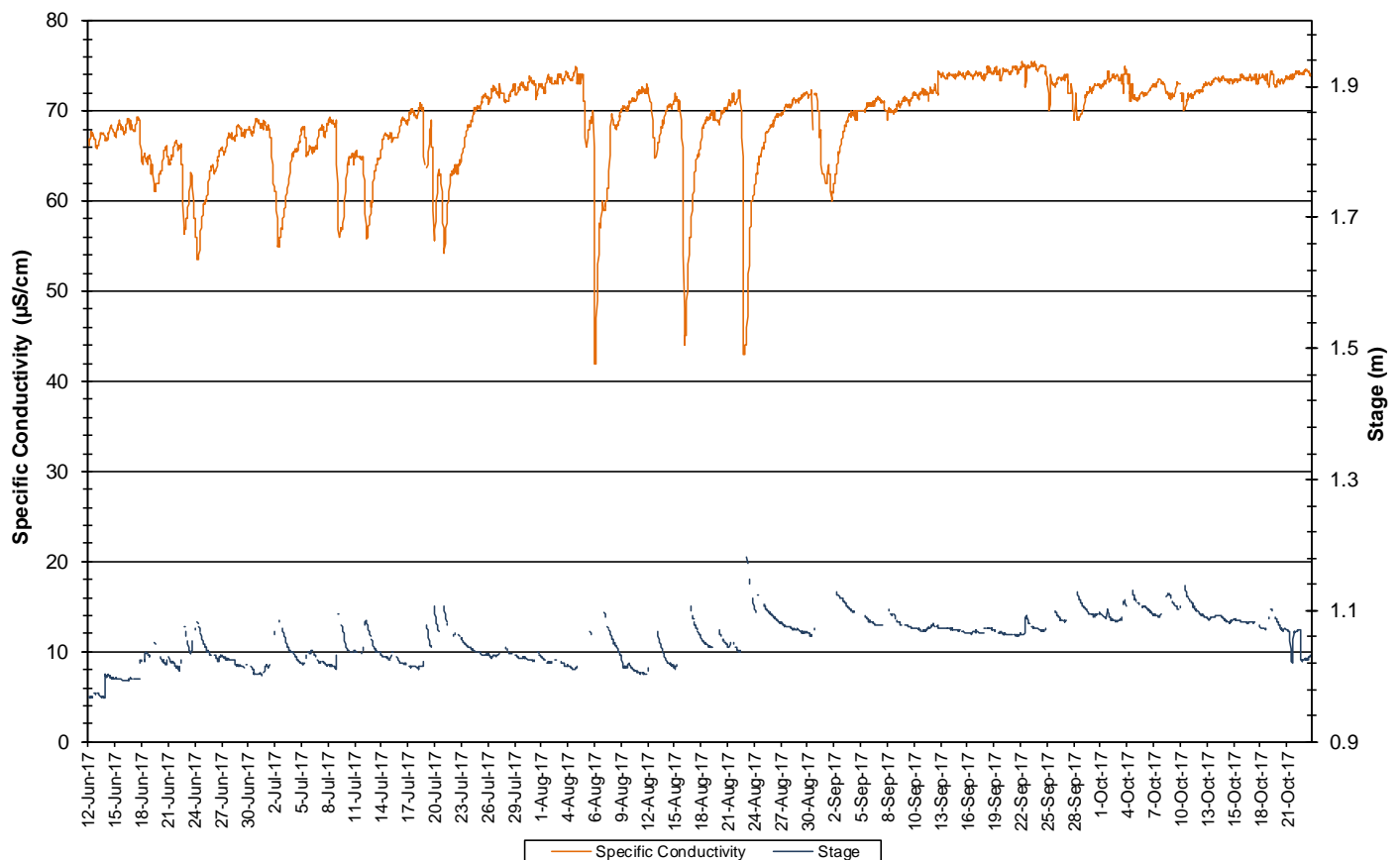


Figure 12: Specific Conductivity and Stage – Dumbell Stream

- Dissolved oxygen ranged from 84.6 to 90.5% saturation and from 9.68 to 12.96 mg/l, with a median value of 11.20 mg/l (Figure 13).
- Dissolved oxygen fluctuated daily with decreases observed at night.
- Dissolved oxygen increased during the later portion of the deployment season when water temperature was decreasing into the fall.
- All values were above the CCME Water Quality Guidelines for the Protection of Aquatic Life for Cold Water Biota at Other Life Stages (6.5 mg/l) and Early Life Stages (9.5 mg/l). The guidelines are indicated in blue on Figure 13.

**Dissolved Oxygen Concentration and Saturation : Dumbell Stream at Dumbell Lake
June 12 to October 24, 2017**

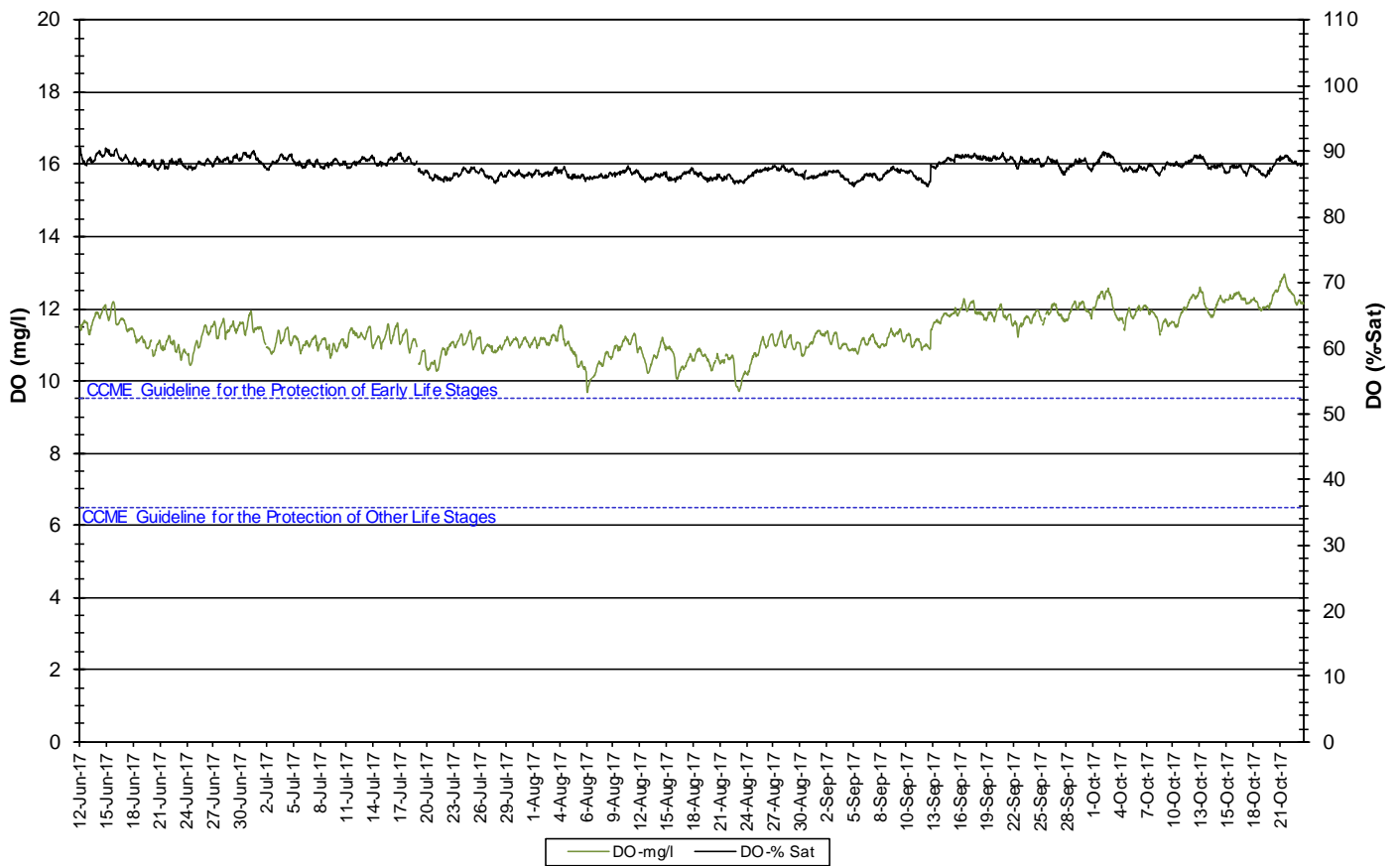


Figure 13: Dissolved Oxygen and Percent Saturation – Dumbell Stream

- Turbidity values range from 0.0 to 878.0 NTU, with a median value of 0.0 NTU (Figure 14a & 14b) indicating very low background turbidity.
- Turbidity readings greater than 0NTU occur occasionally and are of short duration.

**Water Turbidity: Dumbell Stream above Dumbell Lake
June 12 to October 24, 2017**

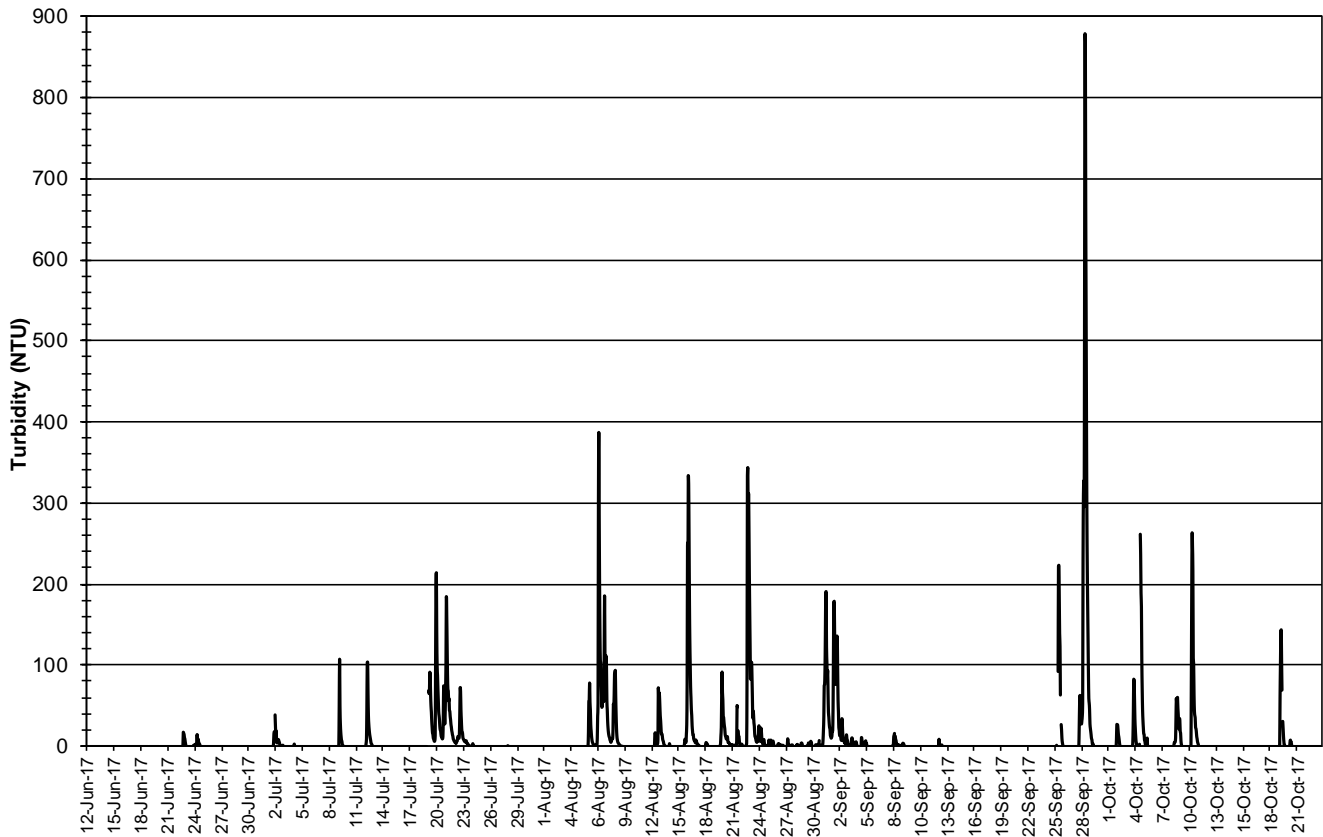


Figure 14a: Water Turbidity - Dumbell Stream

**Water Turbidity <400 NTU: Dumbell Stream above Dumbell Lake
June 12 to October 24, 2017**

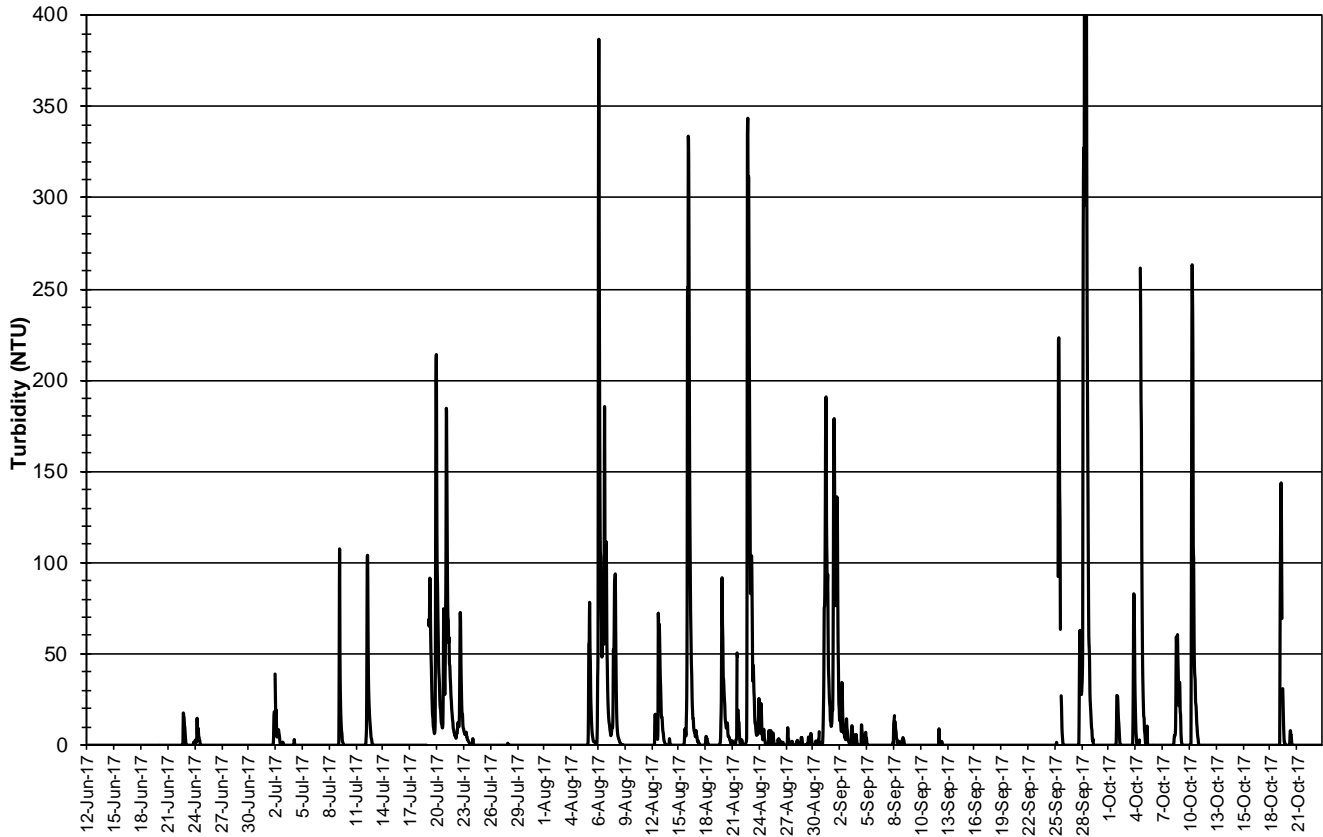


Figure 14b: Water Turbidity <400 NTU – Dumbell Stream

- Stage and precipitation are graphed below to show the relationship between rainfall and water level at Dumbell Stream (Figure 15). Precipitation has a direct effect on stage at this location.
- Stage gradually increases over the course of the deployment season, with spikes noted during and after precipitation events.
- 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 QA/QC protocol. Water Survey of Canada is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.

**Daily Precipitation and Average Daily Stage Level: Dumbell Stream
June 12 to October 24, 2017**

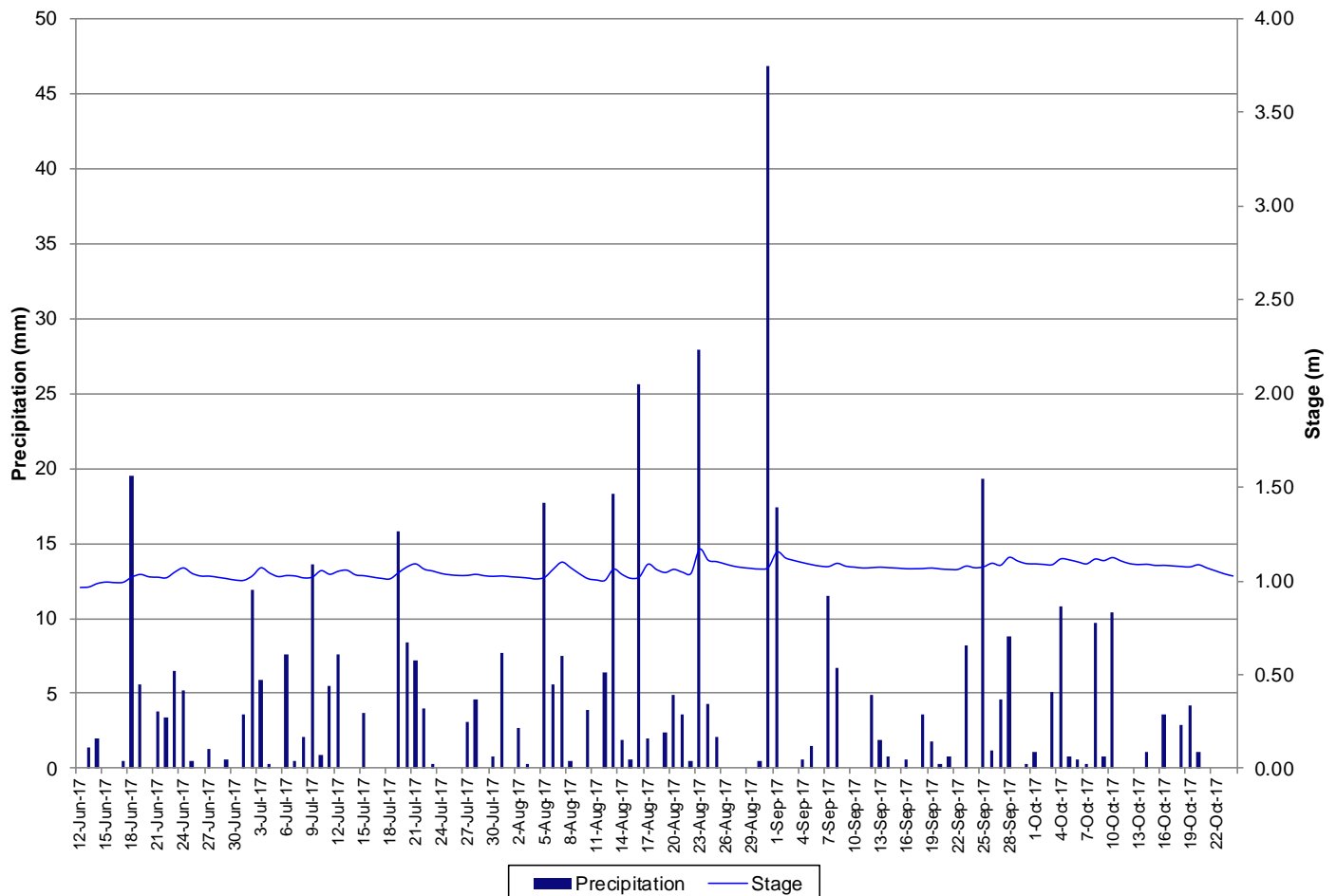


Figure 15: Stage and Precipitation – Dumbell Stream

Pumphouse Stream

- Water temperature ranged from 0.17 to 18.10°C at Pumphouse Stream during the 2017 deployment season. The median value was 11.20 °C (Figure 16).

**Water Temperature: Pumphouse Stream above Drum Lake
June 12 to October 24, 2017**

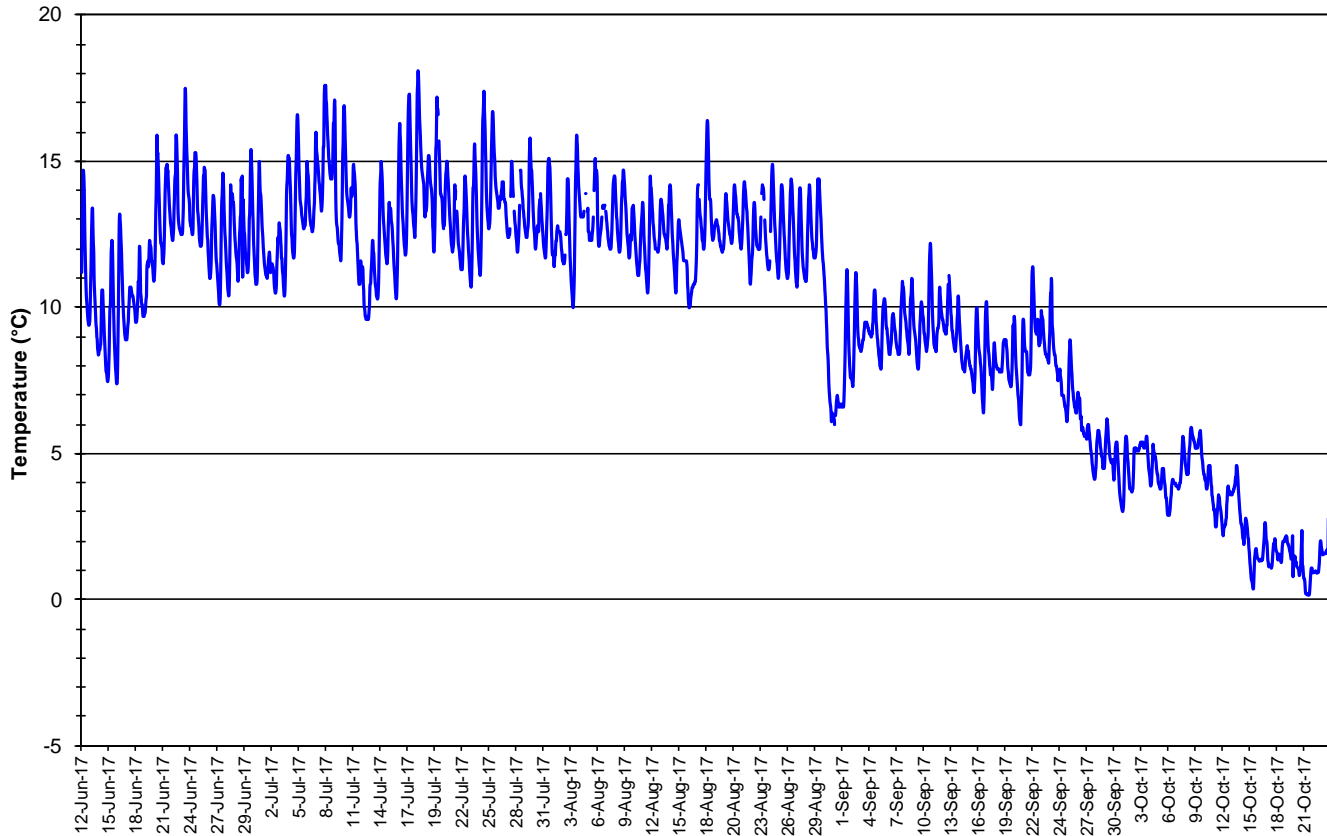


Figure 16: Water and Air Temperature – Pumphouse Stream above Drum Lake

- Water temperature corresponded closely with air temperature fluctuations, decreasing steadily after August as air temperature cooled in to the fall (Figure 17).

**Average Daily Air and Water Temperature: Pumphouse Stream
June 12 to October 24, 2017**

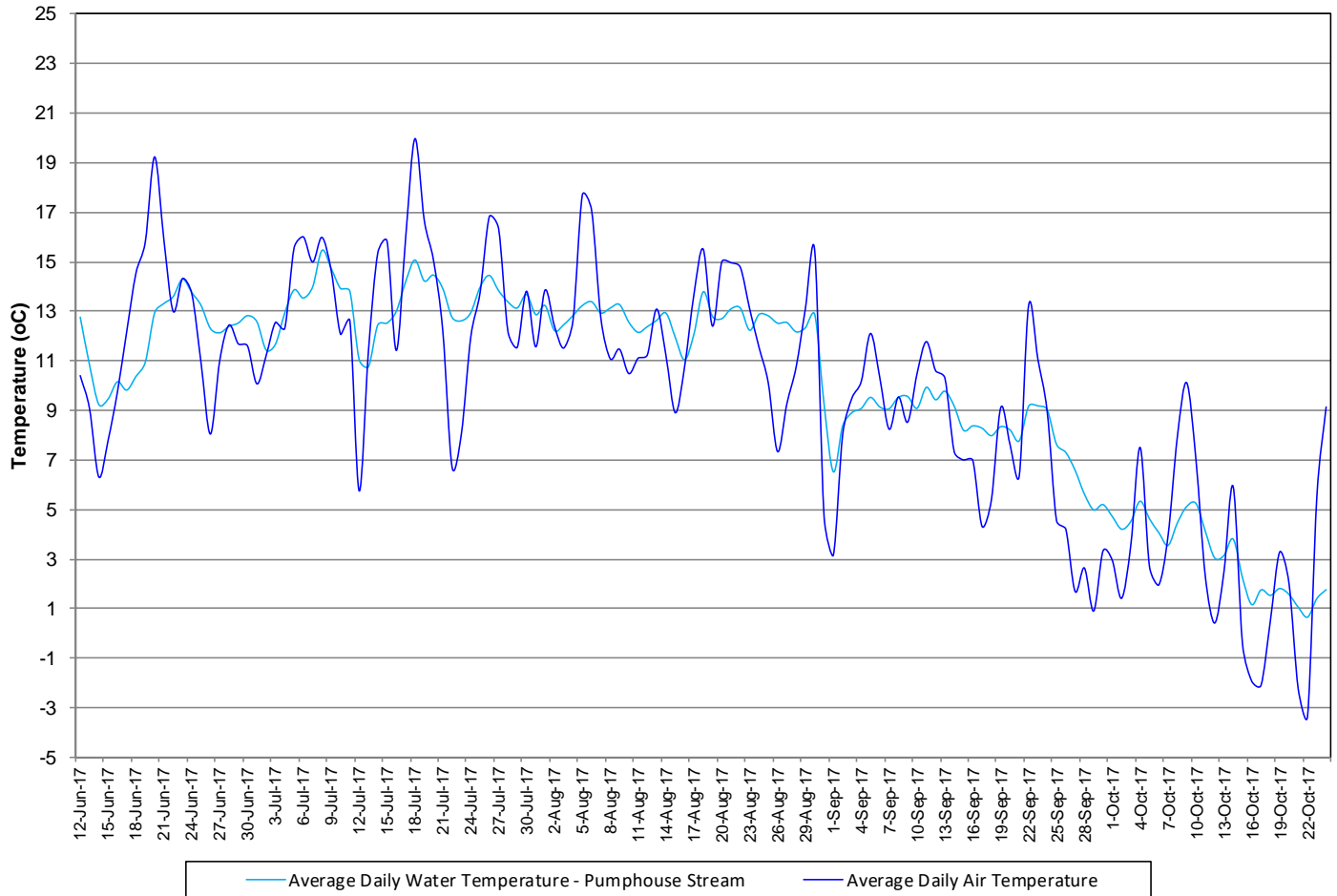


Figure 17: Water and Air Temperature – ~~Dumbell Stream~~Pumphouse

- pH ranged from 6.88 to 7.48 pH units at Pumphouse Stream (Figure 18). The median pH was 7.18 units.
- pH fluctuated daily. Peaks were observed during late afternoon into the early evening. Fluctuations recorded near the end of September could be due to dewatering activities taking place in the pond above this stream.
- A large portion of this data was removed due to sensor drift.
- All remaining values during the deployment season are within the CCME Water Quality Guidelines for the Protection of Aquatic Life (between 6.5 and 9 pH units).

**Water pH and Precipitation: Pumphouse Stream above Drum Lake
June 12 to October 24, 2017**

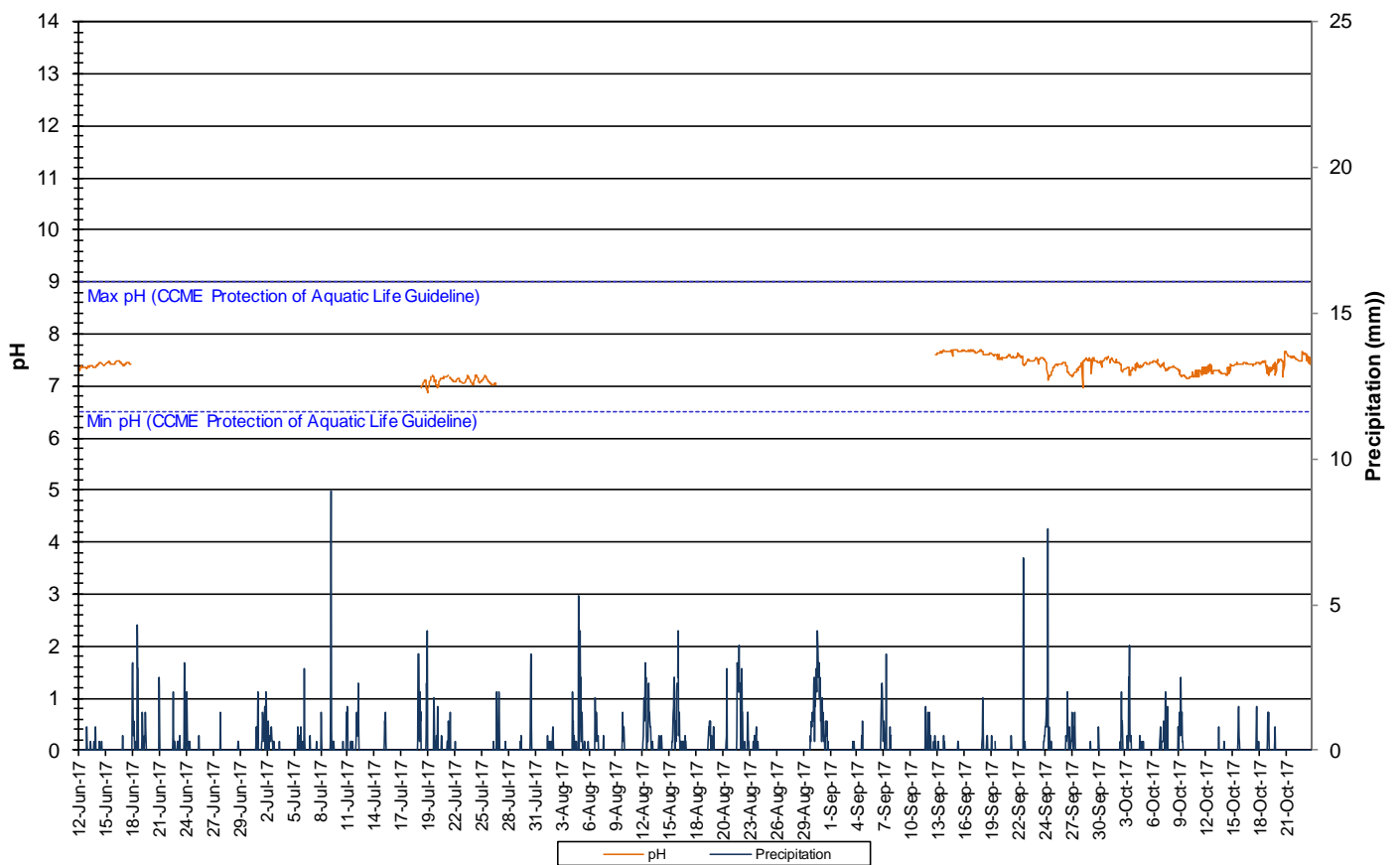


Figure 18: Water pH and Stage – Pumphouse Stream above Drum Lake

- Throughout the 2017 deployment season, specific conductivity ranged from 44.3 to 136.0 $\mu\text{S}/\text{cm}$ at Pumphouse Stream (Figure 19).
- Drops in specific conductivity frequently correspond to increases in stage. As more water is added to the system from precipitation, the solids in the water are diluted, decreasing conductivity. There was a large correction applied to stage at this station, so conductivity is graphed with precipitation to show their corresponding effect.
- 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 QA/QC protocol. Water Survey of Canada is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.

**Specific Conductivity of Water and Precipitation: Pumphouse Stream above Drum Lake
June 12 to October 24, 2017**

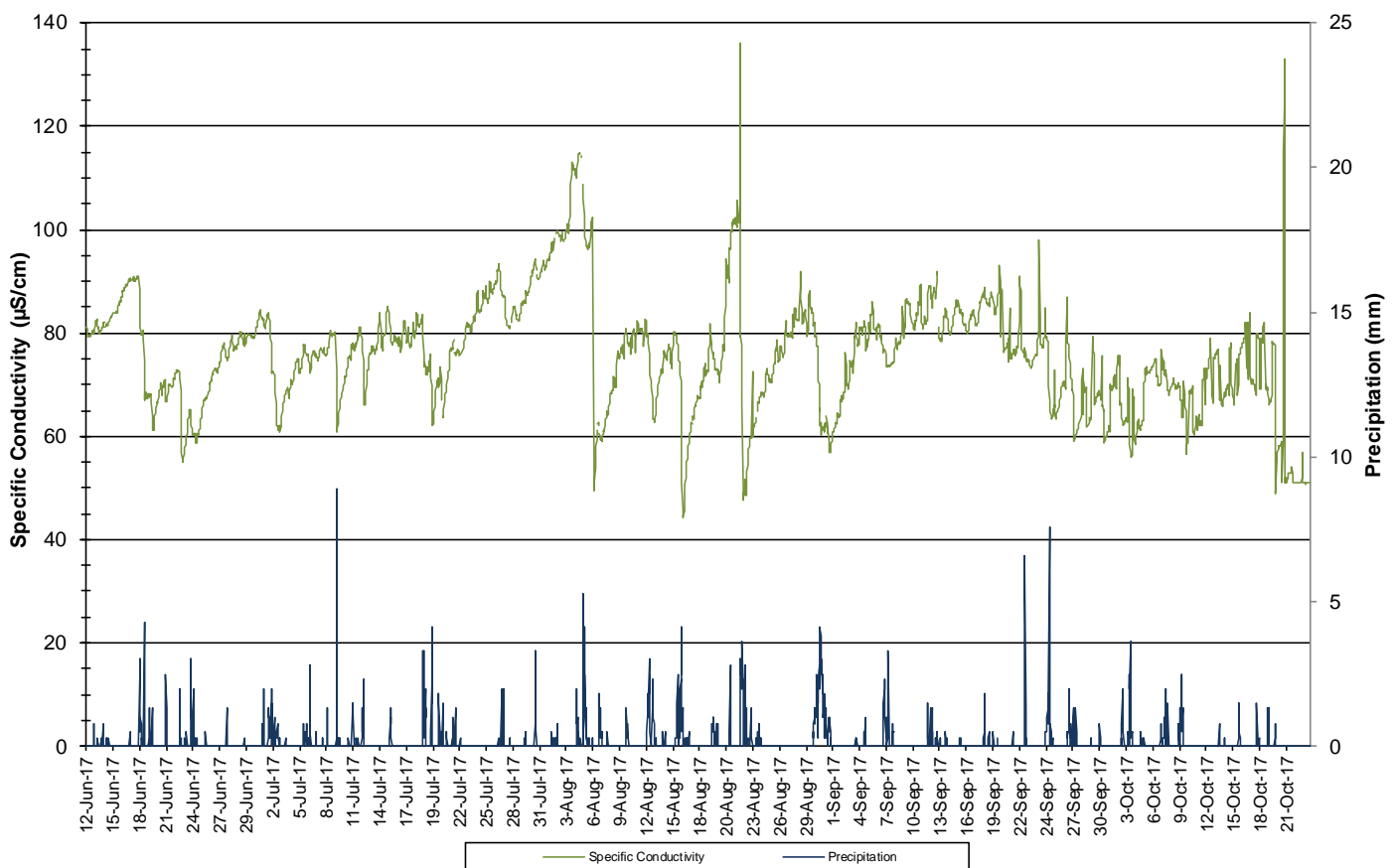


Figure 19: Specific Conductivity and Precipitation – Pumphouse Stream above Drum Lake

- Dissolved oxygen ranged from 62.2 to 96.0% saturation and 6.84 to 13.59 mg/l with a median value of 8.65 mg/l (Figure 20).
- Dissolved oxygen fluctuated daily with decreases observed at night.
- Dissolved oxygen increased during the later portion of the deployment season when water temperature was decreasing into the fall. This is a normal seasonal trend.
- All values were above the CCME Water Quality Guideline for the Protection of Aquatic Life for Cold Water Biota at Other Life Stages of 6.5 mg/l. Most values recorded were below the minimum guideline for early life stages of 9.5 mg/l until water temperatures dropped and oxygen levels began to rise in September. The guidelines are indicated in blue on Figure 20.

**Dissolved Oxygen Concentration and Saturation : Pumphouse Stream above Drum Lake
June 12 to October 24, 2017**

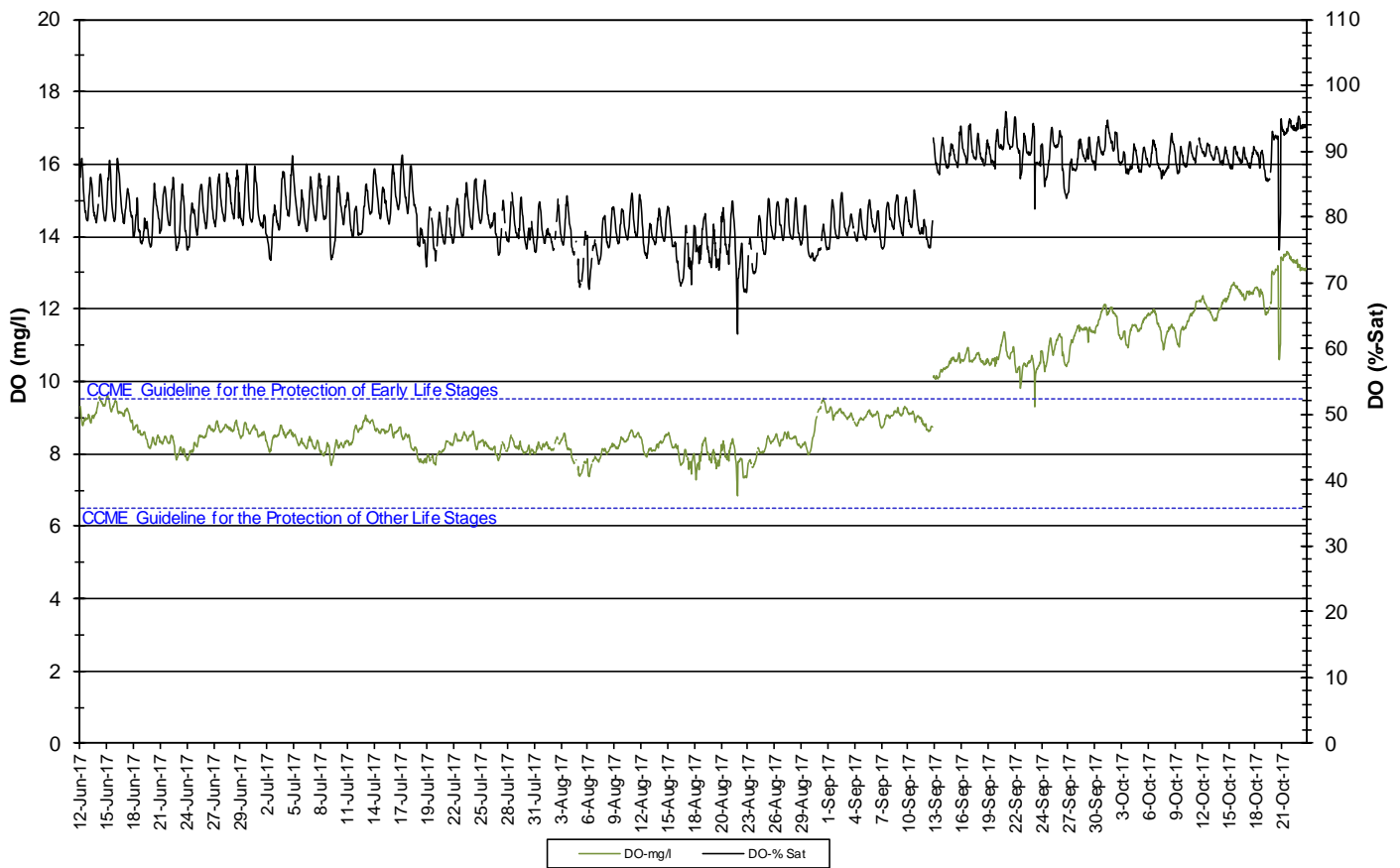


Figure 20: Dissolved Oxygen and Percent Saturation – Pumphouse Stream above Drum Lake

- Turbidity values range from 0.0 to 1925.0 NTU, with a median value of 2.7 NTU (Figure 21a & 21b).
- High turbidity readings later in the deployment season could be caused by dewatering activities in the pond above this stream.

**Water Turbidity and Precipitation : Pumphouse Stream above Drum Lake
June 12 to October 24, 2017**

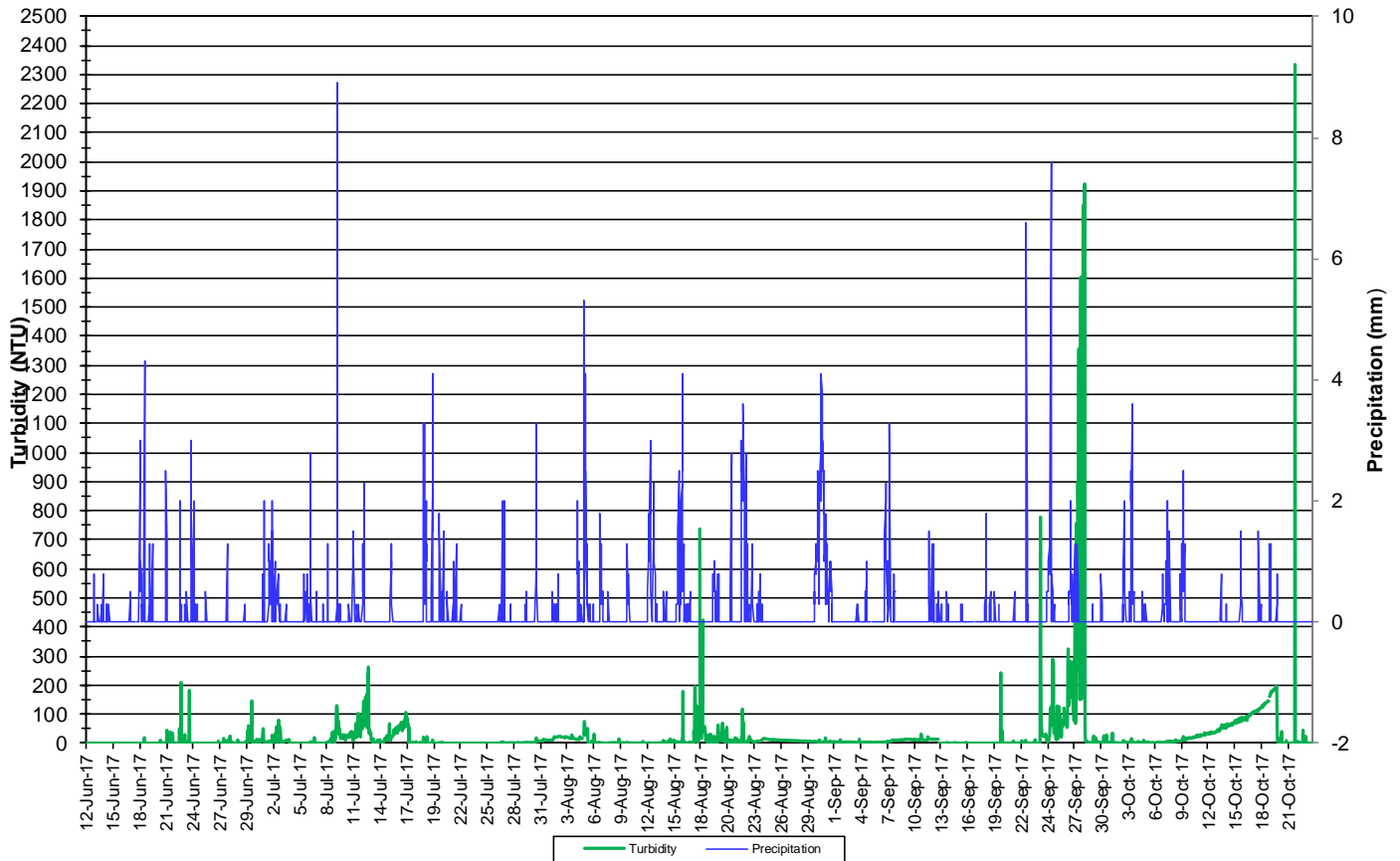


Figure 21a: Turbidity and Precipitation – Pumphouse Stream above Drum Lake

**Water Turbidity <140 NTU and Precipitation : Pumphouse Stream above Drum Lake
June 12 to October 24, 2017**

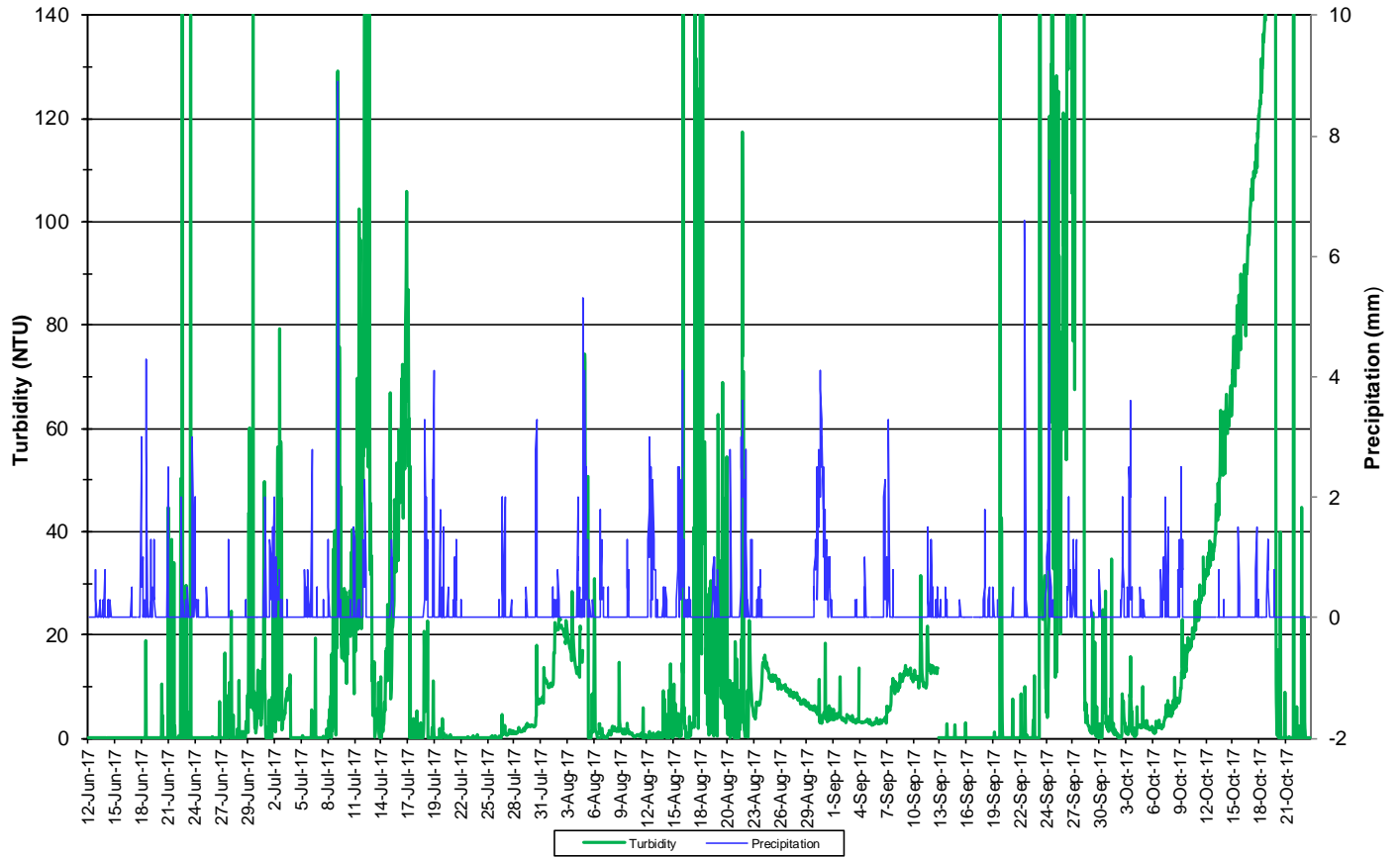


Figure 21b: Turbidity <140 NTU and Precipitation – Pumphouse Stream above Drum lake

- Stage and precipitation are graphed below to show the relationship between rainfall and water level at Pumphouse Stream (Figure 22a and 22b).
- There was a correction applied to stage data at this station. The two sets of data are graphed separately to show the fluctuations more clearly.
- Stage shows a slight and gradual increase over the June to August time period, with fluctuations noted during and after precipitation events (Figure 22a).
- Stage decreases during September, before increasing again into October (Figure 22b).
- 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 QA/QC protocol. –Water Survey of Canada is responsible for QA/QC of water quantity data. Corrected data can be obtained upon request.

**Daily Precipitation and Average Daily Stage Level: Pumphouse Stream
June 12 to August 24, 2017**

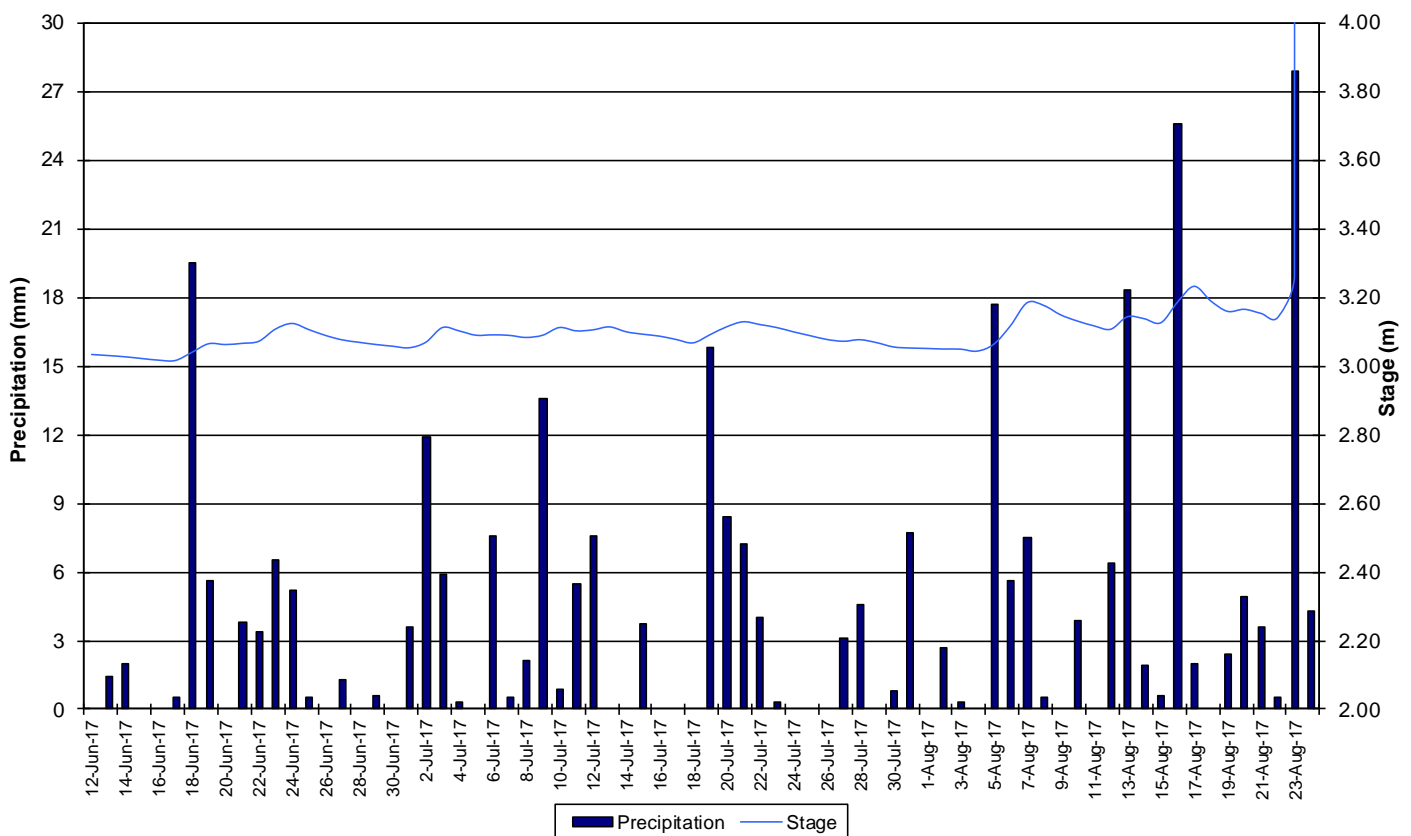


Figure 22a: Stage and Precipitation June 12 to August 24, 2017 – Pumphouse Stream above Drum Lake

**Daily Precipitation and Average Daily Stage Level: Pumphouse Stream
August 24 to October 24, 2017**

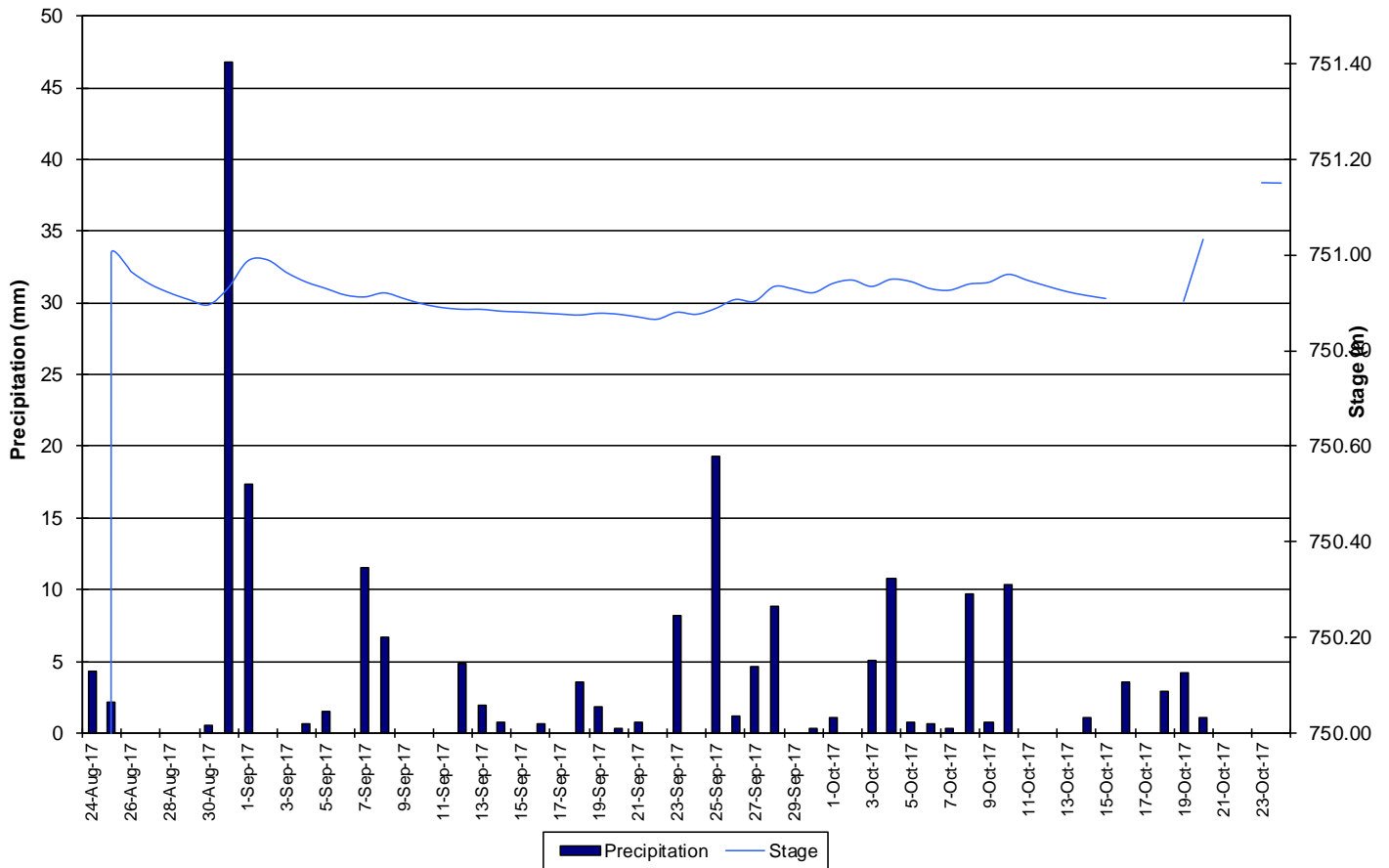


Figure 22b: Stage and Precipitation August 24 to October 24, 2017 – Pumphouse Stream above Drum Lake

Conclusions

- Instruments at the water quality monitoring stations in Labrador West were deployed on June 11th, 12th and 13th and removed by October 24th, 2017. They were then removed for the winter season.
- Instruments were deployed for periods of 35 to 55 days before maintenance and calibration.
- In most cases, weather related events or increases/decreases in water level could be used to explain the fluctuations.
- Most values recorded were within ranges as suggested by the CCME Water Quality Guidelines for the Protection of Aquatic Life.
- The instruments performed well in 2017 except for a few minor issues. These instruments will undergo PTE's during the winter.
- Water temperature followed the seasonal trend of increasing during the summer and decreasing into the fall. Water temperature corresponded closely with air temperature at all stations except Dumbell.
- All pH values were within the acceptable range of the CCME Water Quality Guidelines for Protection of Aquatic Life. There was a large portion of data removed from the Pumphouse Stream dataset, due to sensor drift.
- Specific conductivity differed between the two Wabush Lake stations. This can be attributed to varying concentrations of iron ore tailings, which are deposited into Wabush Lake downstream of Dolomite Road and upstream of Julienne Narrows. Dumbell Stream and Pumphouse Stream are small streams in which conductivity values responded to increases in stage with corresponding decreases in values.
- For the minimum CCME Water Quality Guideline for the Protection of Aquatic Life for Cold Water Biota at Early Life Stages of 9.5 mg/l, the majority of values at the two Wabush Lake stations were above the guideline. At Dumbell Stream, all values were above this guideline. At Pumphouse Stream, the majority of values were below this guideline.
- All values were above the CCME Water Quality Guideline for the Protection of Aquatic Life for Cold water Biota at Other Life Stages of 6.5 mg/l at all stations.
- Turbidity values varied greatly between the two Wabush Lake stations with values remaining lower at Dolomite road. Turbidity fluctuations at Dumbell Stream can mostly be attributed to precipitation events. High turbidity level later in the season at Pumphouse Stream could be due to dewatering activities in the pond above this stream.

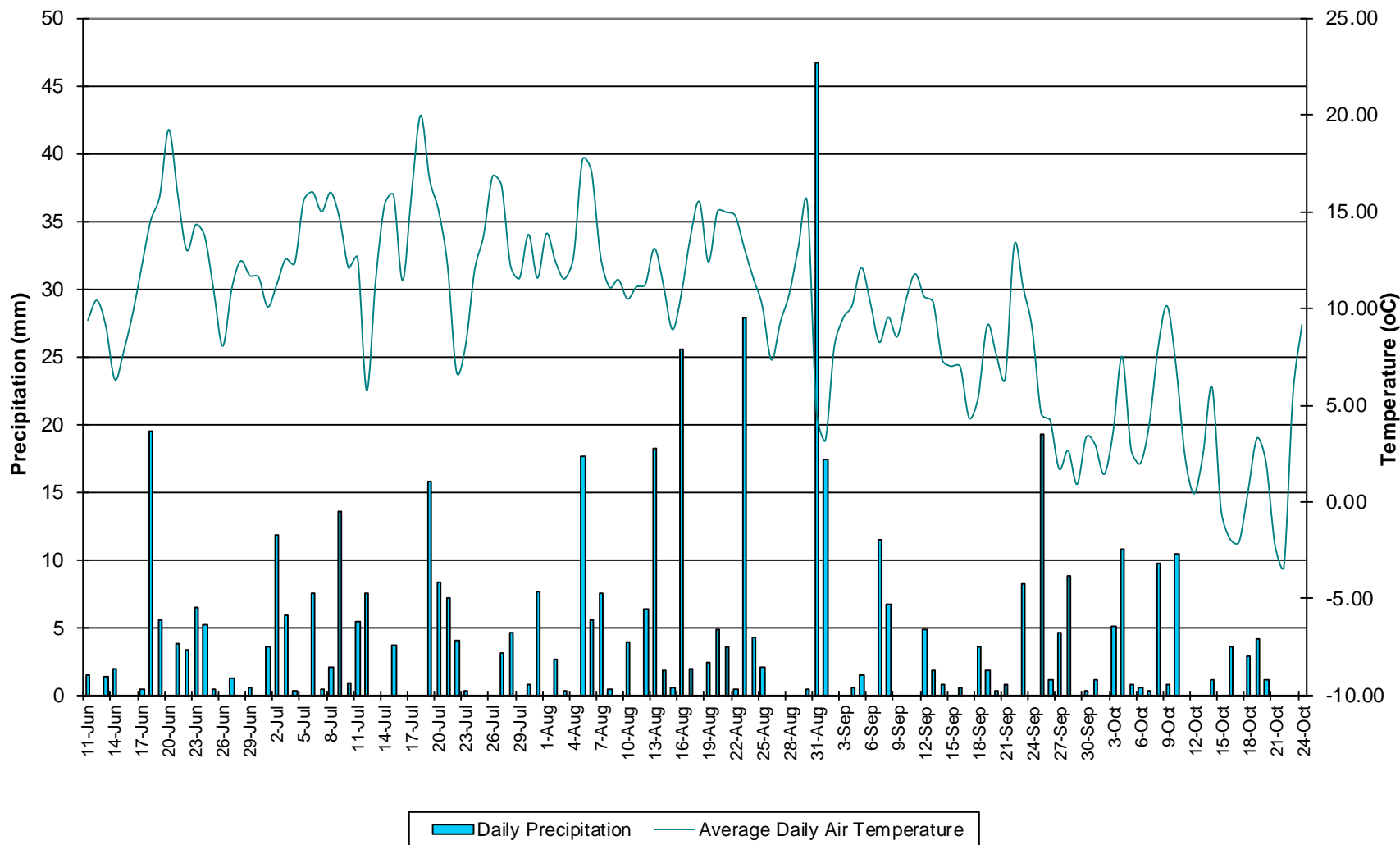
Path Forward

- All field instruments will undergo Proficiency, Testing, and Evaluation (PTE) during the winter of 2017-2018. MAE will inform IOC of any instrument performance issues.
- MAE staff will deploy real time water quality instruments in spring 2018 when ice conditions allow and perform regular site visits throughout the 2018 deployment season for calibration and maintenance of the instruments.
- If necessary, deployment techniques will be evaluated and adapted to each site, ensuring secure and suitable conditions for RTWQ monitoring.
- MAE will update IOC staff on any changes to procedures with handling, maintenance and calibration of the real-time instruments.
- MAE will continue to work on its Automatic Data Retrieval System, to incorporate new capabilities in data management and data display.
- Open communication will continue to be maintained between MAE, ECCC and IOC employees involved with the agreement, in order to respond to emerging issues on a proactive basis.
- IOC will continue to be informed of data trends and any significant water quality events in the form of email and/or monthly deployment reports, when the deployment season begins. IOC will also receive an annual report, summarizing the events of the deployment season.

Prepared by:
Maria Murphy
Department of Municipal Affairs and Environment
Water Resources Management Division
Phone: 709.896.7981

Appendix 1

**Average Daily Air Temperature and Daily Precipitation: Moosehead Lake
June 11 to October 24, 2017**



Appendix 2
Pumphouse Stream above Drum Lake
Photos

