

# The DROUGHT INDICATOR Report

January to December ~ 2017



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Prepared for: Otonabee Region Water Response Team

Prepared by: Gordon Earle

Water Resources Technologist

Otonabee Conservation

## **INTRODUCTION**

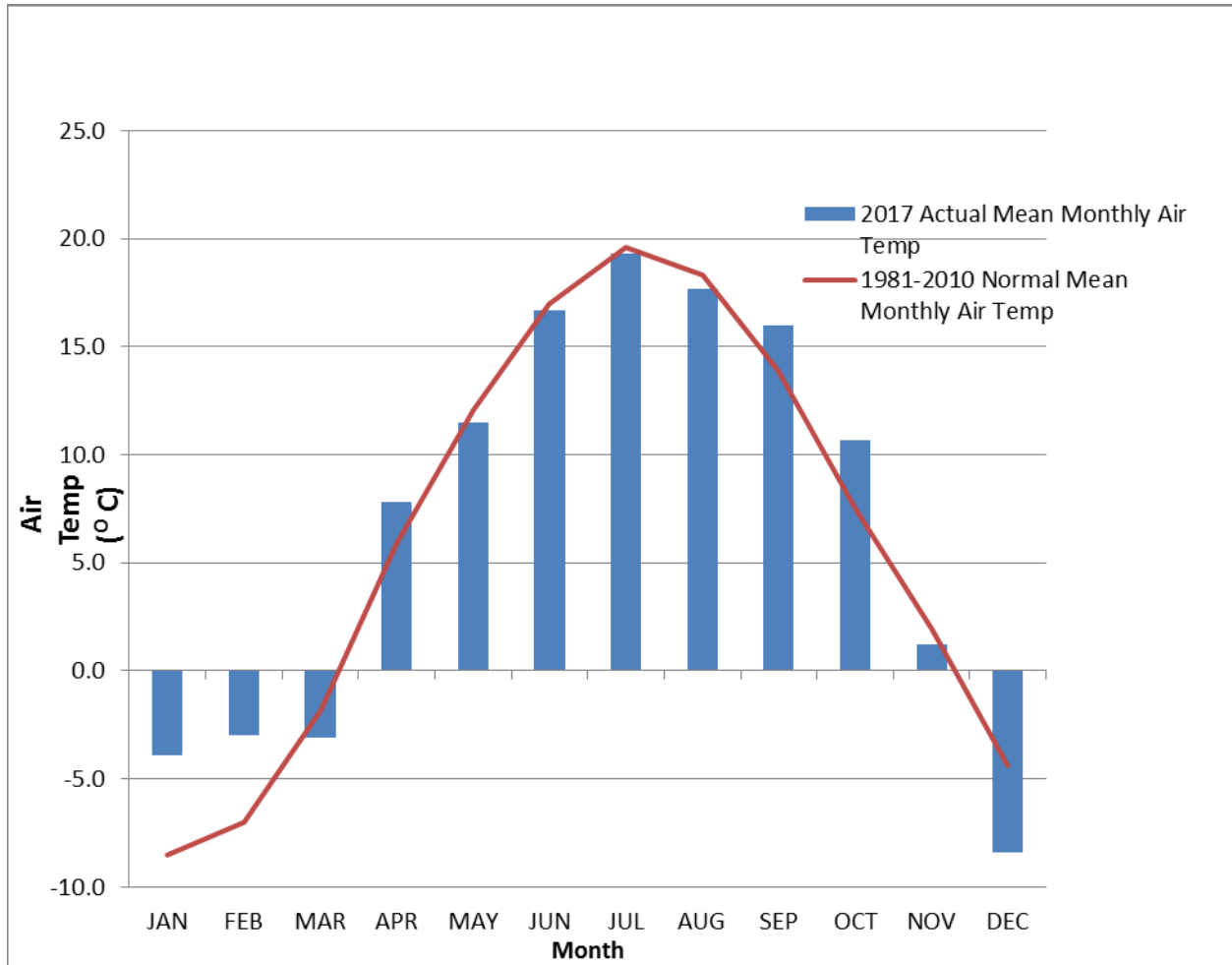
### **Drought Monitoring and Early Warning**

Drought is a normal, recurring, slow-onset or “creeping”, natural hazard that can have economic, social and environmental consequences. The challenge to reducing or avoiding the impacts of drought on local economies, people and the environment is to recognize drought before the region is in the middle of one, and then, deliver that information to local water managers and water users in a timely manner.

In response to this challenge, the Ontario Ministry of Natural Resources and Forestry (MNRF) developed the Ontario Low Water Response Program. This program provides a framework for drought monitoring and early warning that utilizes objective measures of current climate and hydrologic conditions in relation to the historical record.

The following sections of this report compare the Otonabee Region 2017 observations of mean monthly air temperature, total monthly precipitation receipts and average monthly surface water flow with their historical or normal averages. In addition, and where applicable, the current conditions are presented in relation to the MNRF’s Low Water Response Program early warning indicators of drought (Level 1, 2 and 3).

## AIR TEMPERATURE



**FIGURE 1:** Mean monthly air temperature (°C) observed at Environment Canada's meteorological monitoring station located at Peterborough Airport for 2017 compared with the 30-year normal (1981-2010) air temperature (°C).

### **First Quarter**

During the first quarter of 2017 (January, February and March), the average daily air temperature was -3.3 °C, which is 2.5°C warmer than normal. Excluding March when the average daily air temperature was colder than normal, January and February were, on average, approximately 100% warmer than normal.

### **Second Quarter**

The second quarter of the year (April, May and June) began 33% warmer than normal, but then returned to near normal temperatures through the months of May and June at 95% and 98% of normal, respectively.

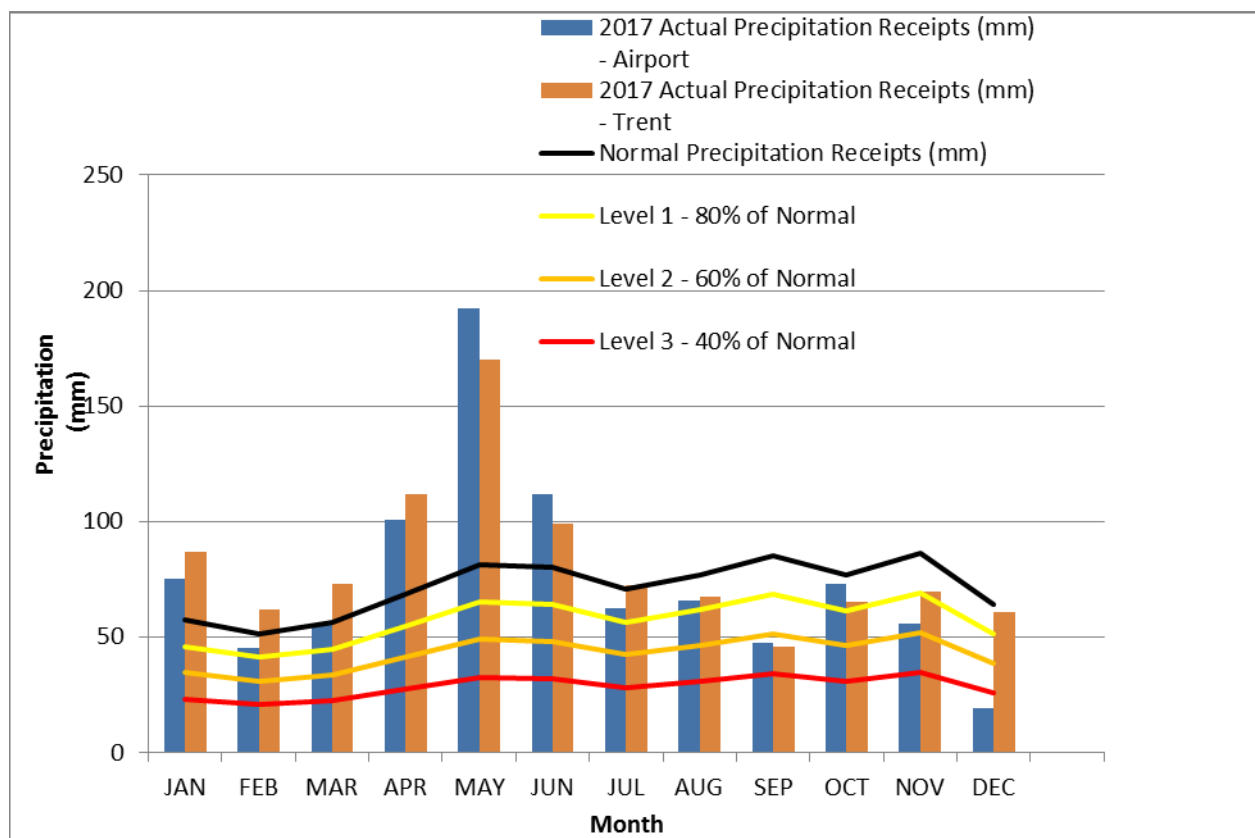
### Third Quarter

The average daily air temperature during July and August was near normal. September, however, averaged 2.1 °C above the normal average daily air temperature for the month.

### Fourth Quarter

October continued the trend for warmer than normal average daily air temperatures, while November saw average daily air temperatures drop below normal. Colder than normal air temperatures deepened in December. On average, the air temperature during the last month of 2017 was 4 °C colder than normal.

#### ONE-MONTH PRECIPITATION RECEIPTS



**FIGURE 2:** 2017 total monthly precipitation (millimeters) receipts compared with the 30-year normal (1981-2010) and the Level 1 (80% of normal), Level 2 (60% of normal) and Level 3 (40% of normal) meteorological drought indicator thresholds.

## **First Quarter**

The winter (January, February) of 2017 was forecast to be wetter than normal driven by the influence of La Nina, and the meteorological station located at Trent University did indeed record above normal precipitation receipts during January and February. The Peterborough Airport station, however, reported above normal receipts only during the month of January. While February precipitation receipts at Peterborough Airport were less than normal, they were above the Level 1 Drought indicator threshold of 80% of normal.

In March, precipitation receipts were normal at the Peterborough Airport meteorological station, and 29% above normal at Trent University. Of particular importance was the widespread 35 millimeters of rain that fell during the last week of March because this precipitation was received when the ground was unfrozen, and thereby would have had a significant impact on soil moisture.

## **Second Quarter**

The second quarter of 2017 (April, May, June) saw the region drenched with unexpected and unpredicted rain brought by multiple, widespread storms. Both Trent University and Peterborough Airport monitoring stations recorded well above normal precipitation in each of the three months. At the Peterborough Airport weather station, rain was recorded on a total of 50 days between April 01st and June 30<sup>th</sup> 2017. Peterborough was especially wet in April and May 2017 when 292.7 mm of rain fell, which was over 7 times more than the 40.1 mm that fell in April and May 2016, and almost double the 30-year average of 150.1. As a result of this widespread and prolonged drenching, any lingering drought concerns among area residents and businesses were eliminated.

## **Third Quarter**

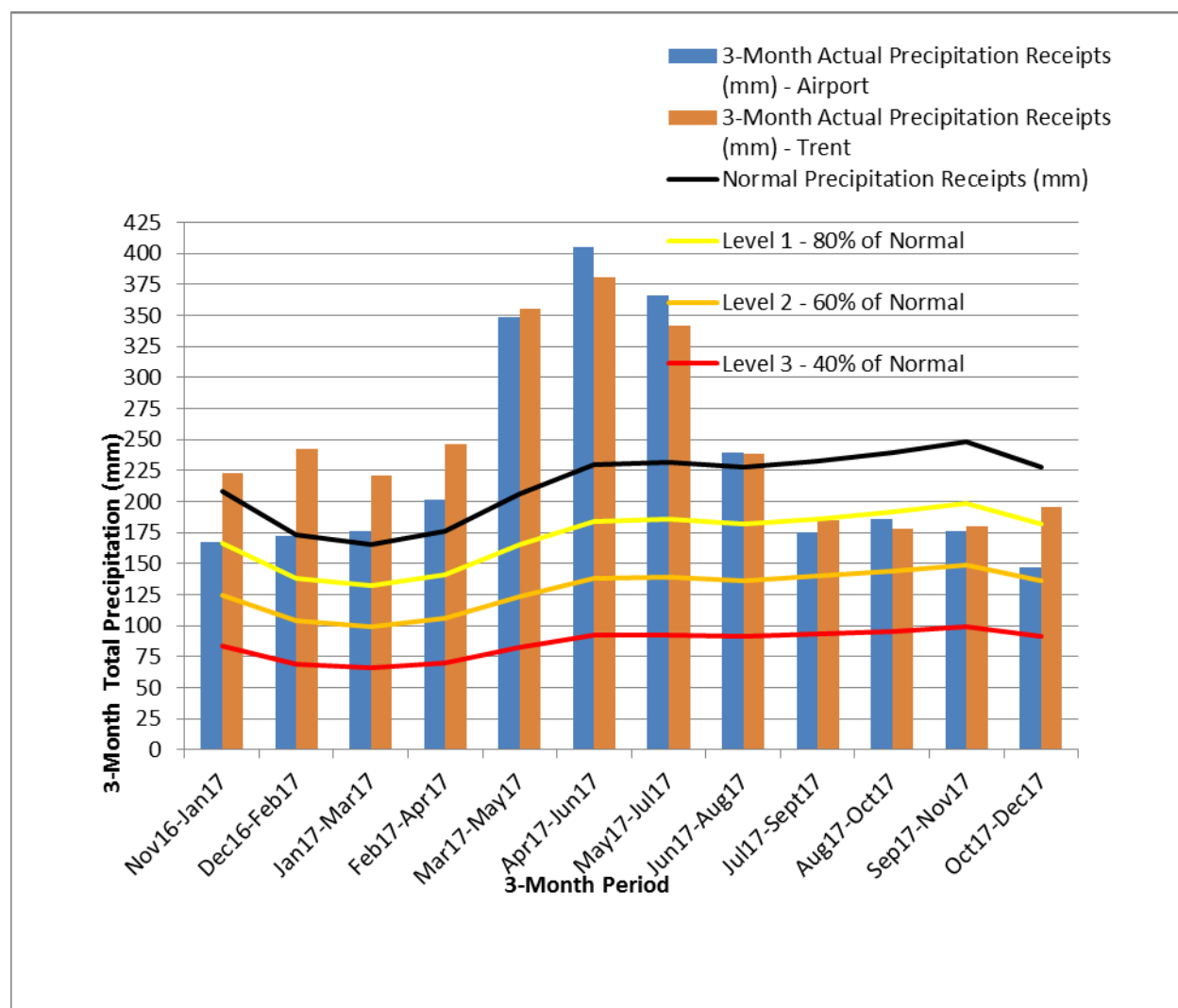
In July, rainfall receipts at Trent University were normal, while precipitation recorded at Peterborough Airport was below normal, but not significantly below normal. Therefore, there was not a return to drought concerns in July.

During August, the region began to experience drier conditions. August rainfall receipts recorded by both meteorological monitoring stations at Peterborough Airport and Trent University were below normal, but were nonetheless above the 80% of normal Level 1 drought threshold. September saw even drier conditions develop. Peterborough Airport and Trent University monitoring stations reported 56% and 53% of normal precipitation, respectively. That said, for many people in the region, the drier than normal conditions observed in August and September was a welcomed change following a very wet spring and early summer.

## Fourth Quarter

Precipitation receipts improved during October, but the trend for below average precipitation nonetheless continued. Precipitation recorded at the Peterborough Airport and Trent University meteorological monitoring stations in October were 95% and 85% of normal, respectively. November was drier than the previous month with Peterborough Airport reporting 64% of normal precipitation receipts, and Trent University recording 80% of normal. In December, the weather observing stations recorded variable precipitation receipts with Peterborough Airport reporting 18.9 mm (29% of normal precipitation) and Trent University measuring 60.6 mm (94% of normal).

### 3-MONTH PRECIPITATION RECEIPTS



**FIGURE 3:** Actual 3-month precipitation totals (millimeters) compared with the 30-year normal (1981-2010) 3-month totals and meteorological drought indicator values.

## **First Quarter**

During the 3-month period ending January 31<sup>st</sup> 2017, the total precipitation receipts indicated that drought conditions were border-line Level 1. In February and March, the 3-month total precipitation amounts continued to increase reaching normal to above-normal levels. This marked a clear and significant improvement from the persistent drought conditions observed in 2016.

## **Second Quarter**

2017 was especially wet during the months of April, May and June when a total of 404.7 millimeters of rainfall was recorded at Environment Canada's Peterborough Airport, which is more than 5 times the 71.8 millimeters that fell in the same 3 months in 2016. Similarly, Trent University recorded a total of 381.1 mm of rainfall during the 3-month period ending June 30<sup>th</sup> 2017, whereas the same 3 months in 2016 yielded 112.8 millimeters. These significantly wetter than normal conditions in the spring and early summer of 2017 reportedly contributed to a delay in seeding agricultural lands, as well as delays in crop development, due to a high to very high soil moisture content. In addition, the widespread and well above average rainfall experienced during the spring and early summer of 2017 resulted in not only wet fields, but also caused area watercourses and waterbodies to exceed their normal confines.

## **Third Quarter**

Despite below average rainfall receipts in both July and August, the precipitation totals for the 3-month periods ending July 31<sup>st</sup> and August 31<sup>st</sup> both showed ample precipitation. This is because both of these three month periods continued to reflect the regional wide "50 days of rain" received in the spring and early summer.

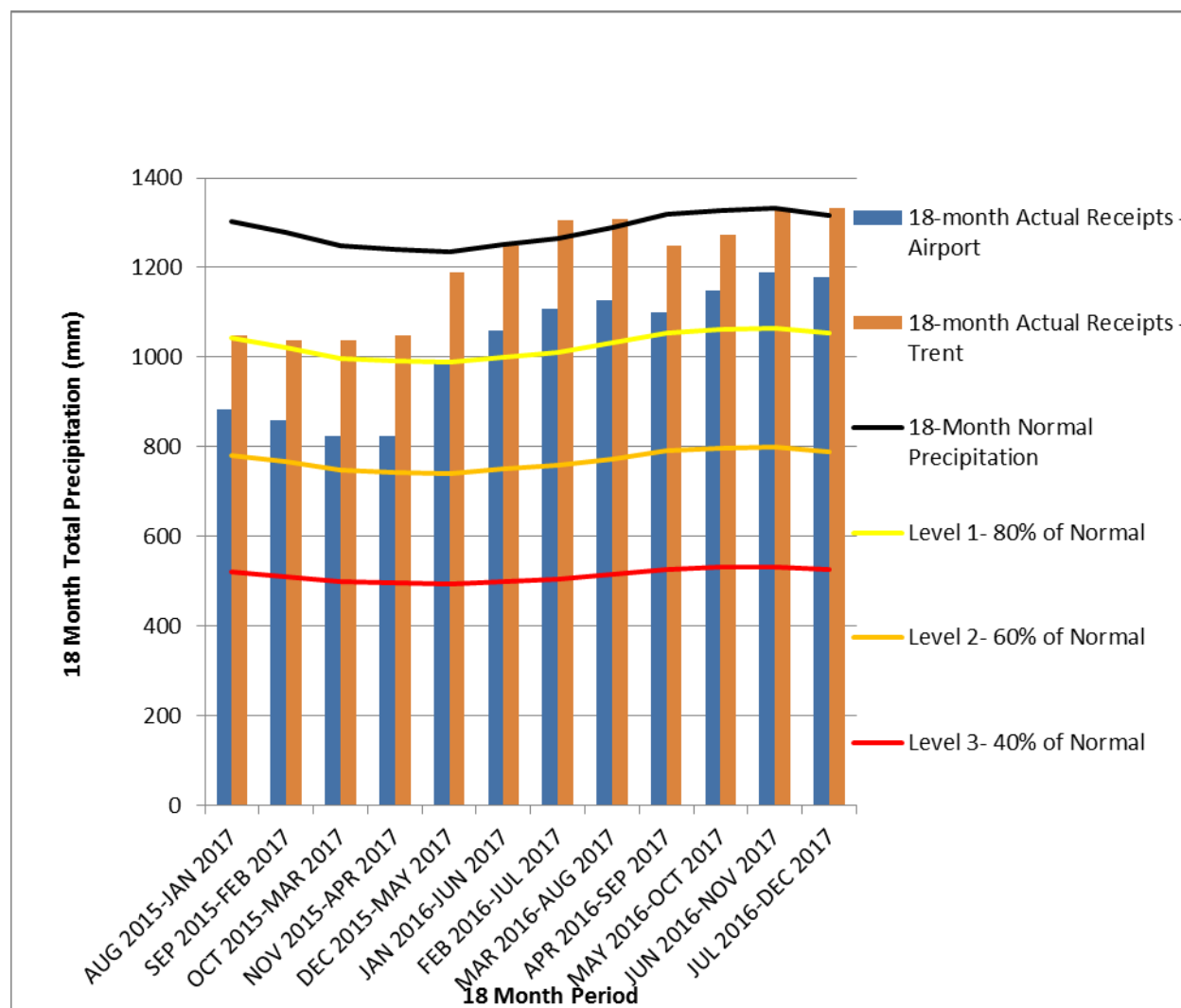
The 3-month period ending September 30<sup>th</sup> indicated the region was beginning to experience drier conditions. Total 3-month precipitation receipts observed at Peterborough Airport and Trent University were between 75% and 79% of normal. Although these 3-month total precipitation receipts are below the Level 1 drought threshold of 80%, no drought was declared largely because the impact would have been minimal owing to the water-based recreational and agricultural growing seasons nearing their end. Indeed, the arrival of warm and dry conditions during September, and there continuation through October, reportedly helped area agriculturalists with harvesting.

## **Fourth Quarter**

Watershed conditions continued to be dry during the fourth quarter. Peterborough Airport saw a total of 186.1 mm in the 3 months ending October 31<sup>st</sup> (77.8% of normal), and Trent

University recorded 178 mm (74.4% of normal). Precipitation received in the 3 months ending November 30<sup>th</sup>, was also in the mid-seventy percent of normal range, whereas December values reflected more variability.

### 18-MONTH PRECIPITATION RECEIPTS



**FIGURE 4:** Actual 18-month precipitation totals (millimeters) received compared with the 30-year normal (1971-2000) 18-month totals and the Level 1, Level 2 and Level 3 drought indicator values.

### **First Quarter**

2016 ended with the meteorological station at Peterborough Airport reporting the July 01<sup>st</sup> 2015 to December 31<sup>st</sup> 2016, 18-month precipitation total, at 65% of normal, and the Trent University station reporting 74% of normal. Both of these values were below the Level 1 Drought threshold, but above the Level 2 Drought threshold. The 18-month precipitation totals during the first quarter of 2017 indicated improving conditions, but also persisted in reflecting the effect of the prolonged and deep drought conditions experienced during 2016.

### **Second Quarter**

The 18-month period ending April 30th 2017 indicated no clearly discernible improvement or worsening of watershed conditions from those observed during the first quarter of 2017. However, as a result of the “50 days of rain” experienced in the spring and early summer of 2017, there was a clear change reflected in the 18-month precipitation totals for the periods ending May 31<sup>st</sup> and June 30<sup>th</sup> 2017. That is, 18-month precipitation totals recorded at both Peterborough Airport and Trent University meteorological monitoring stations showed conditions trending above the Level 1 drought threshold (80% of normal) toward normal.

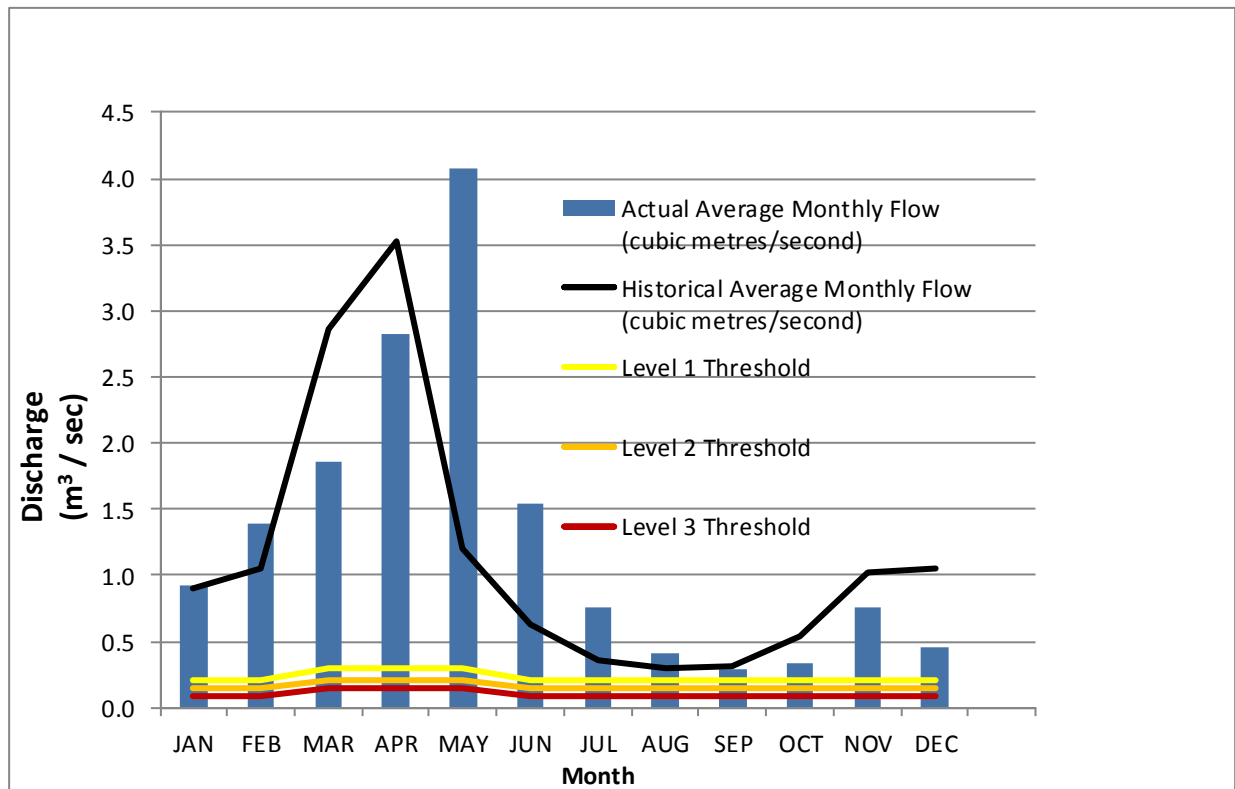
### **Third Quarter**

Improving 18-month total precipitation values continued throughout the third quarter with the exception of a slight deterioration reflected in the April 01<sup>st</sup> 2015 to September 30<sup>th</sup> 2017, 18-month period.

### **Fourth Quarter**

The final three months of the year saw increasingly improving 18-month precipitation totals.

## STREAM FLOWS – JACKSON CREEK



**FIGURE 5:** 2017 average monthly streamflow observed on Jackson Creek compared with the 40-year (1962-2002) average monthly streamflow and the Level 1, Level 2 and Level 3 drought indicator values.

### **First Quarter**

In the last two months of 2016 (November and December), Jackson Creek flowed at 18 and 31 percent of long-term historical averages, respectively. Therefore, Jackson Creek, which had, in 2016, experienced hydrologic drought for 6 months from June through to November, inclusive, still had not fully recovered before last year's end.

In the first month of 2017, average monthly flows / levels on Jackson Creek had returned to normal, and during the following month (February) had risen above normal. Flows and levels continued to rise in March, but did not reach the long-term historical average for the month.

### **Second Quarter**

April flows on Jackson Creek remained below normal, but nonetheless well above drought stage. This was reflective of the relatively gentle freshet experienced along all the tributaries to

the Otonabee River. May and June, however, were a different story. Owing to the “50 days of rain”, flows along Jackson Creek well exceeded normal flows / levels during May and June. May 2017 flows were more than 3 times stronger than the long-term historical average flow on Jackson Creek for the month of May, and June flows were more than 2 times the historical average for the same month. What’s more, June 2017 flows averaged 10 times higher than what they were in June 2016, the beginning of a 6-month hydrologic drought on Jackson Creek.

### **Third Quarter**

The third quarter began with Jackson Creek flows still well above normal. July averaged more than 2 times the long-term historical average flow, and a multiple of 10 times more than the average July 2016 flow.

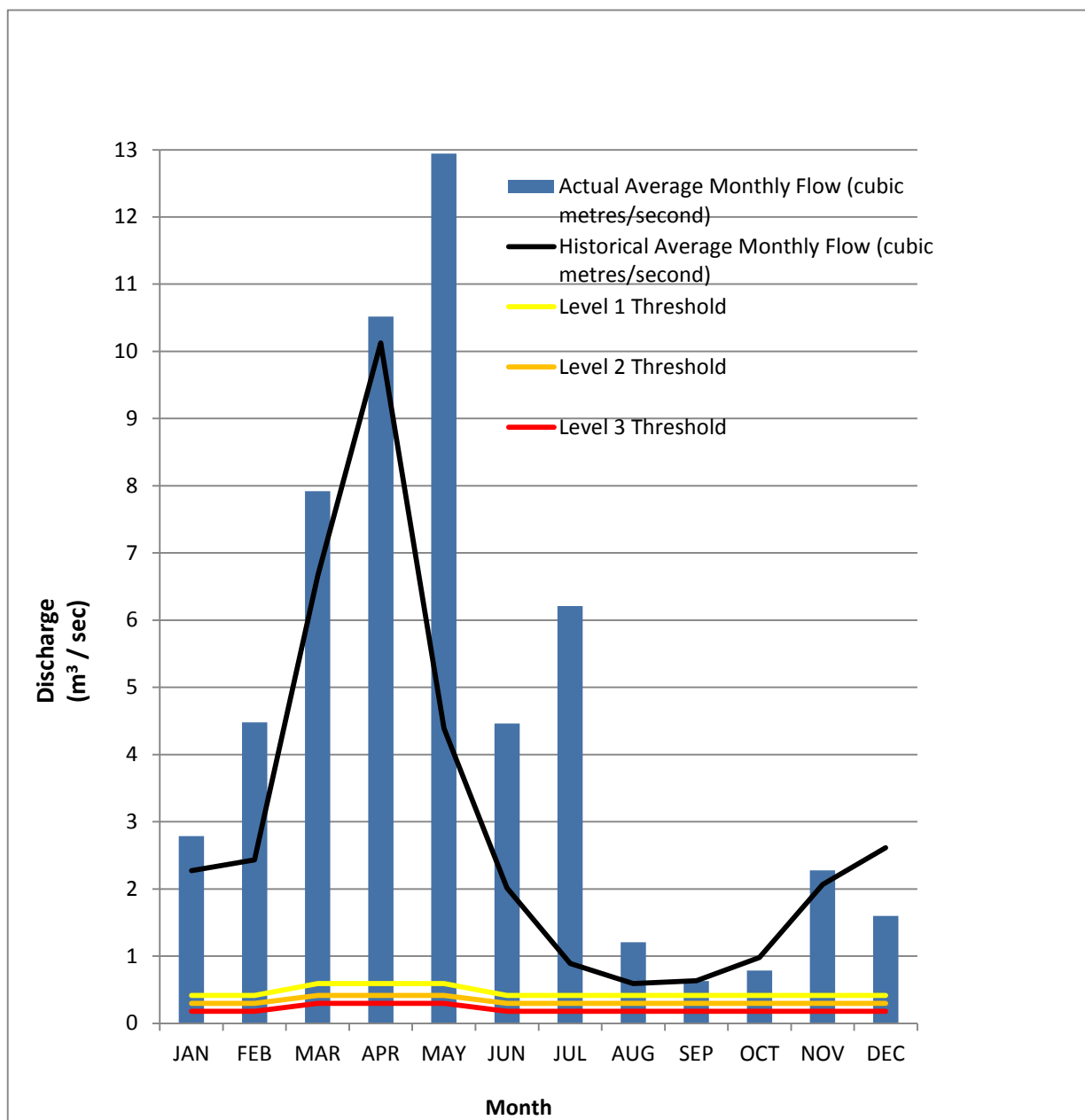
During August there was a decline in average monthly flow. The average rate was, however, still above normal.

In September, because of significantly warmer and drier conditions than normal, the average monthly flow rate in Jackson Creek dropped to 10% below the long-term historical average for the same month.

### **Fourth Quarter**

Below average flows continued in Jackson Creek throughout the last quarter of 2017. Flows were, however, well above the hydrologic drought threshold.

## STREAMFLOWS – OUSE RIVER



**FIGURE 6:** 2017 average monthly streamflow observed on Ouse River compared with the 40-year (1962-2002) average monthly streamflow and drought indicator values.

During 2017, Ouse River flows were not markedly unlike the flows of Jackson Creek, thereby demonstrating that the region was free from hydrologic drought conditions throughout the year. The Ouse River experienced above normal flows during each of the first eight months of 2017. In September, flows dropped below the long-term historical average, and remained depressed until November, before again dipping below average in December.

## **CONCLUSION**

There was no drought declaration during the first quarter of 2016, but a lack of precipitation, below normal stream flows and an increased number of mean temperature anomalies in the second quarter of 2016 led the Otonabee Region Water Response Team (WRT) to declare a Level 1 drought on June 17, 2016. Then, as the warm air temperatures and precipitation deficits continued, a Level 2 drought was declared on July 12th. Continued precipitation and temperature anomalies deepened the drought and its economic, social and environmental consequences, and meant that the Level 2 drought continued to be in effect throughout the rest of 2016.

A largely warmer and wetter than normal last month of 2016 and first 2 months of 2017 resulted in steadily improving conditions, but these months were also characterized by frozen ground and snow accumulation preventing significant change in soil moisture. Therefore, the WRT opted to continue the Level 2 drought until, at the very least, winter had ended. Then, in March, as the snow melted and the ground thawed, precipitation receipts were normal to above normal. Of particular note was the receipt of 35 millimeters of rain in the last week of March. The rain in the last week of March was important because it was delivered by multiple widespread events arriving when the ground was unfrozen, and therefore, this 35 mm of rain had a significant positive impact on soil moisture.

Strong precipitation receipts throughout the first quarter of 2017 combined with continuously improving stream flows, diminished the WRT's moisture concerns, and led the group to end the Level 2 drought status at a meeting held April 18<sup>th</sup>, 2017. Then, in the spring and early summer of 2017, and as a result of "50 days of rain", the low water conditions experienced by area residents and businesses in 2016 were largely forgotten as concerns turned to high water and flooding. When normal to below-normal moisture conditions arrived in July and August, the change was welcomed by many area residents and businesses.

Continued below average precipitation receipts during the last 4 months of the year (September, October, November, December) were not concerning because this deficit occurred at the end of the water-based recreational and agricultural growing seasons in the region, and the beginning of frozen ground conditions and snow accumulation. That is, precipitation deficits during the last 4 months of 2017 did not have significant economic, social or environmental consequences.

**THE END**