Coalition for Equitable Water Flow

Climate Change, the Trent-Severn Waterway and the Reservoir Lakes

Presentation to Environment Haliburton Enviro-Cafe

Oct. 11, 2016

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Presentation Overview

Coalition for Equitable Water Flow

- What is CEWF and an Overview of the Trent-Severn Waterway (TSW).
- Water level and flow variability in recent years in the TSW reservoir area.
- The 2016 experience.
- Climate change projections for the TSW.
- Climate Change implications for water management.

CEWF Background

Coalition for Equitable Water Flow

- A Volunteer Organization established in 2006 to provide input to - **Panel on the Future of the Trent Severn Waterway** (2007)
- Aims to represent the interests of more than 30,000 waterfront property owners on **"Reservoir" and "Flow-Through" (RaFT)** lakes in Haliburton and Northern Peterborough Counties
- **32 Member Lake Associations** representing 91% of the TSW's reservoir lake storage capacity (reservoirs with no association = 3%)
- Sub-watersheds included:
  - **Gull, Burnt & Mississagua Rivers plus Nogies, Eels & Jack's Creeks**
- In 2016 entered a new partnership with 6 local municipalities in Haliburton and Peterborough Counties, **the Upper Trent Water Management Partnership (UTWMP).**

CEWF Objectives

Coalition for Equitable Water Flow

- To promote an **Integrated Approach to Water Management at the Watershed Level**
- To maintain **dialogue with TSW management**
- To promote **shared information and understanding of Water Management issues/practices**
- To promote **approaches to ensure safe navigation, access to waterfront property, economic sustainability and the avoidance of negative environmental and economic impacts for residents on the Reservoir and Flow Through (RAFT) lakes.**

The Trent Watershed & the Trent-Severn Waterway

Coalition for Equitable Water Flow

- Trent River watershed is the largest in Southern Ontario with drainage area of 12,530 sq. km. covering 3 sub-watersheds.
  - The Haliburton Sector Reservoir Lakes – (3,320 sq. km.)
  - The Kawartha Lakes & Otonabee River - (4,862 sq. km.)
  - Rice Lake, the Trent River & Crowe River – (4,348 sq. km.)
- Main feature of the watershed is the Trent-Severn Waterway which stretches 386 km from Georgian Bay to Lake Ontario and includes 45 locks from #1 Trenton to #45 Port Severn.

Trent-Severn Waterway National Historic Site of Canada

The Trent-Severn Watershed

(Source: Parks Canada Water Levels Website)

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Reservoir & Flow-Through (RAFT) Lakes

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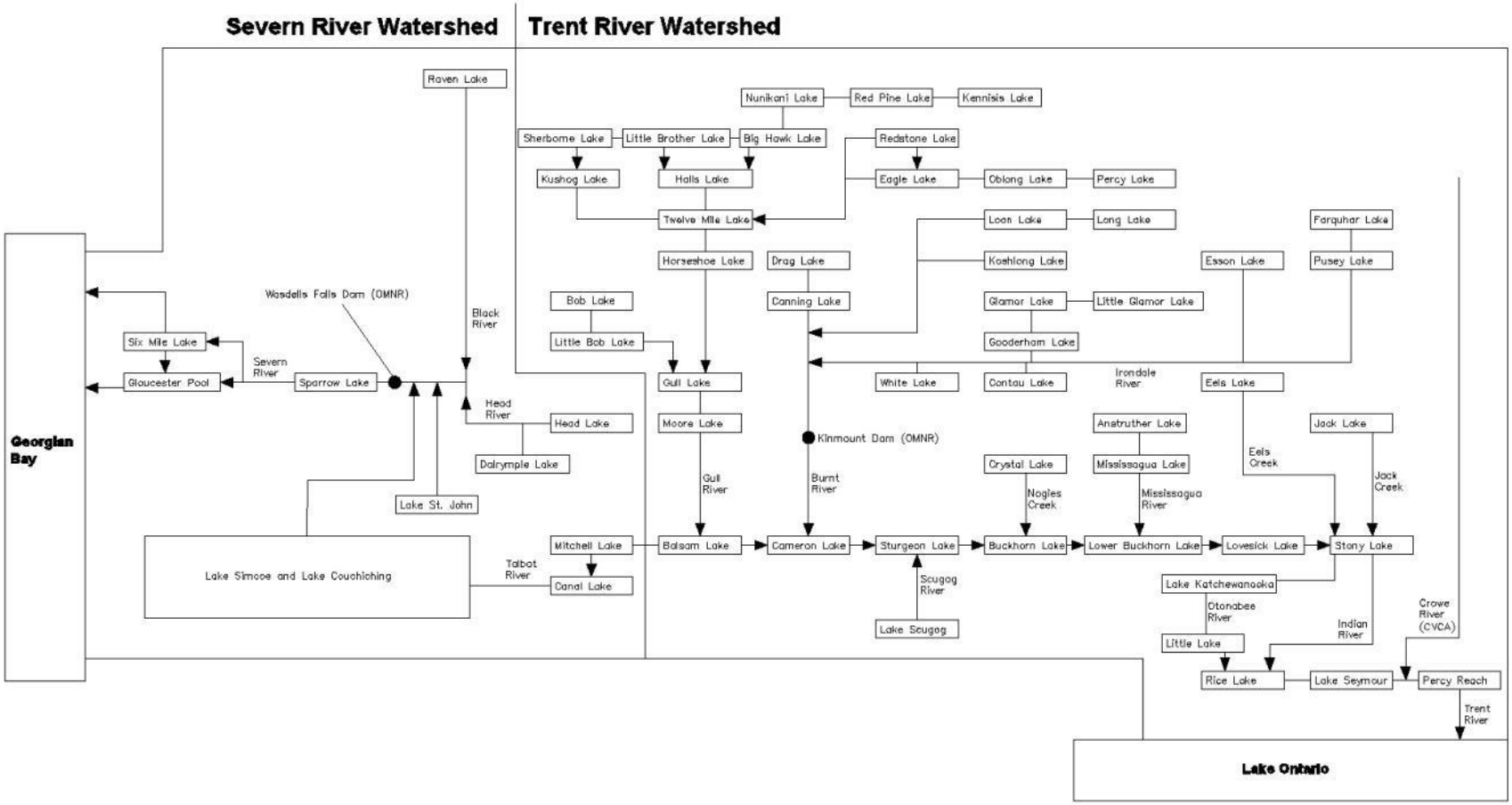
- In the “Haliburton Sector” (Haliburton County and northern Peterborough County) there are 35 reservoirs - 17 in the Gull River system, 13 in the Burnt River System, and 5 in the central area including the Mississauga chain of lakes, Anstruther , Eels, Jacks and Crystal lakes. There are also 6 reservoirs in the Crowe River basin.
- The reservoir systems are complex to manage with seasonal water level changes of up to 10 feet (3.4 m) combined with severe flow constraints at some points (e.g. Minden, Peterborough)
- There are also challenges to maintaining navigable water levels on connecting rivers and flow-through lakes (e.g. Shadow Lake, the Maple Lake chain, and Mississagua R.) and minimum flows and levels for fisheries management.

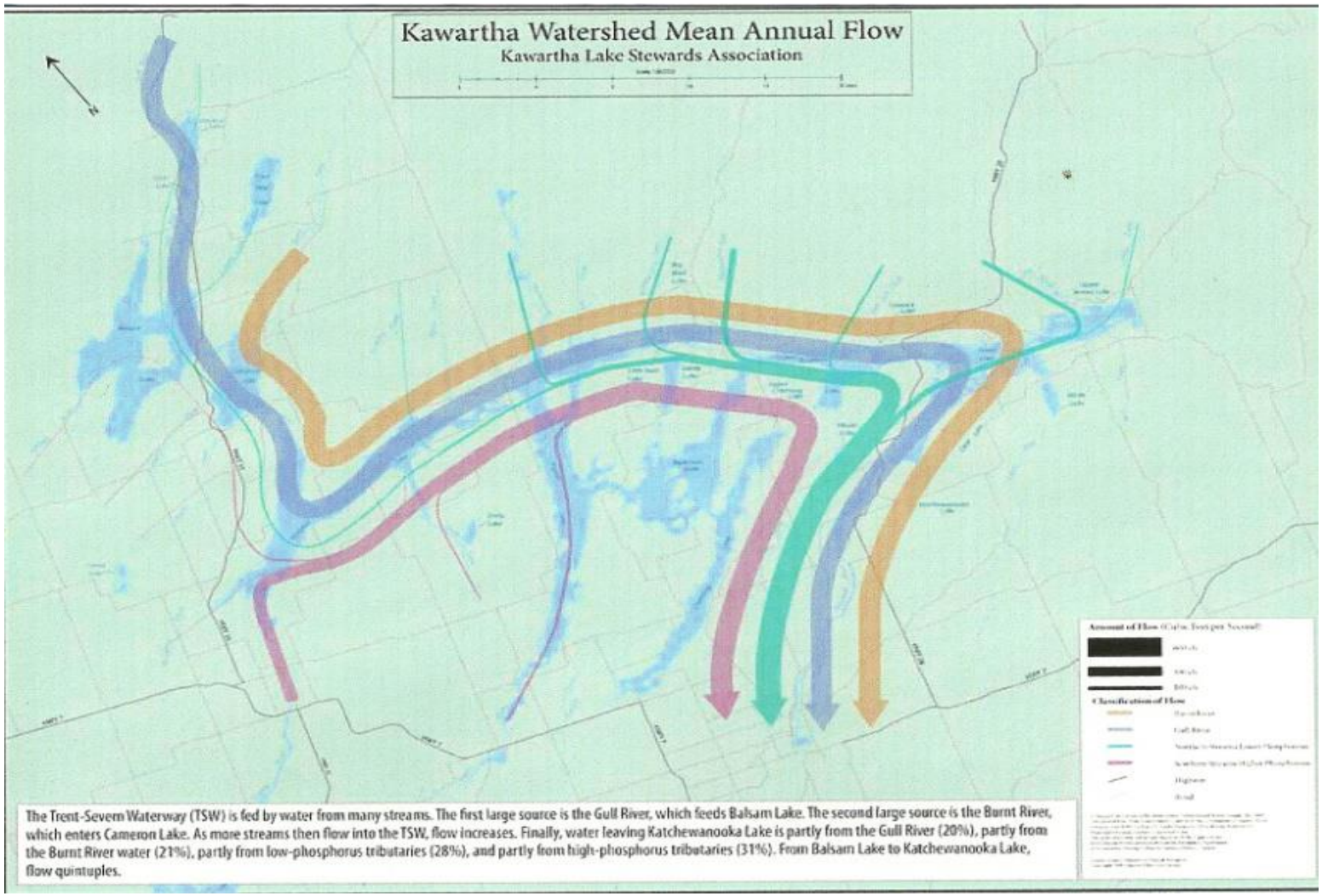
Trent-Severn Waterway, Water Management Program - Flow Chart



Kawartha Lakes Annual Flow

(20% Gull R, 21% Burnt R, 28% Central Reservoirs, and 31% from the South)

Source KLSA 2009



Key Water-Flow & -Level Constraints

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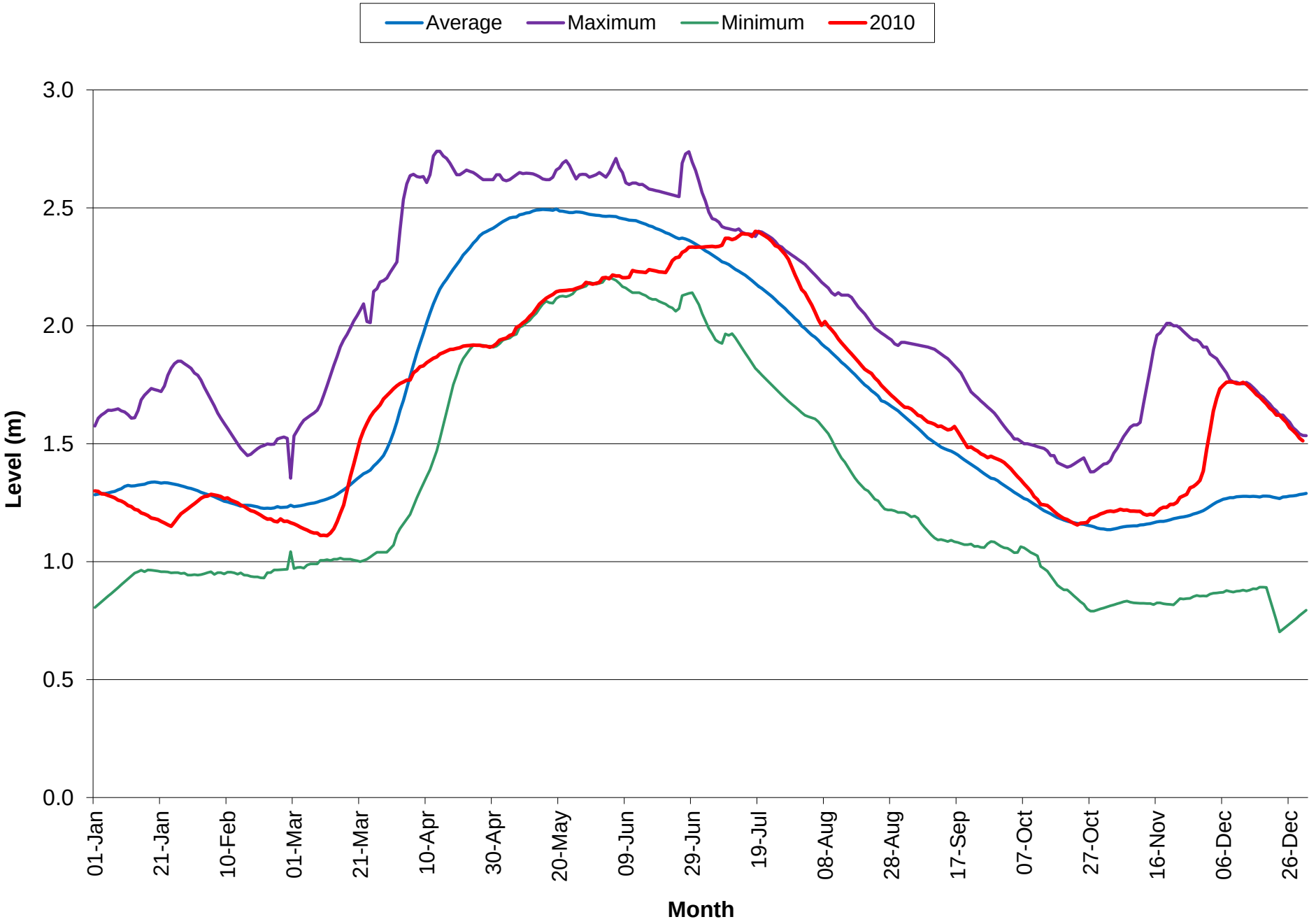
- **TSW priorities public safety** (flood management and water supply) **and canal navigation;**
- **Minimum flow at Peterborough** for water supply and sewage treatment;
- Maintaining the **Canal Regulations draught limits** is understood to govern the drawdown from the reservoirs;
- **MNR Fisheries constraints** in spring (walleye) and fall (lake trout) based on limited data for many lakes;
- **The reservoirs are not a flood control system** particularly in late spring and early summer!

Recent Water Level History: No Two Years the Same!

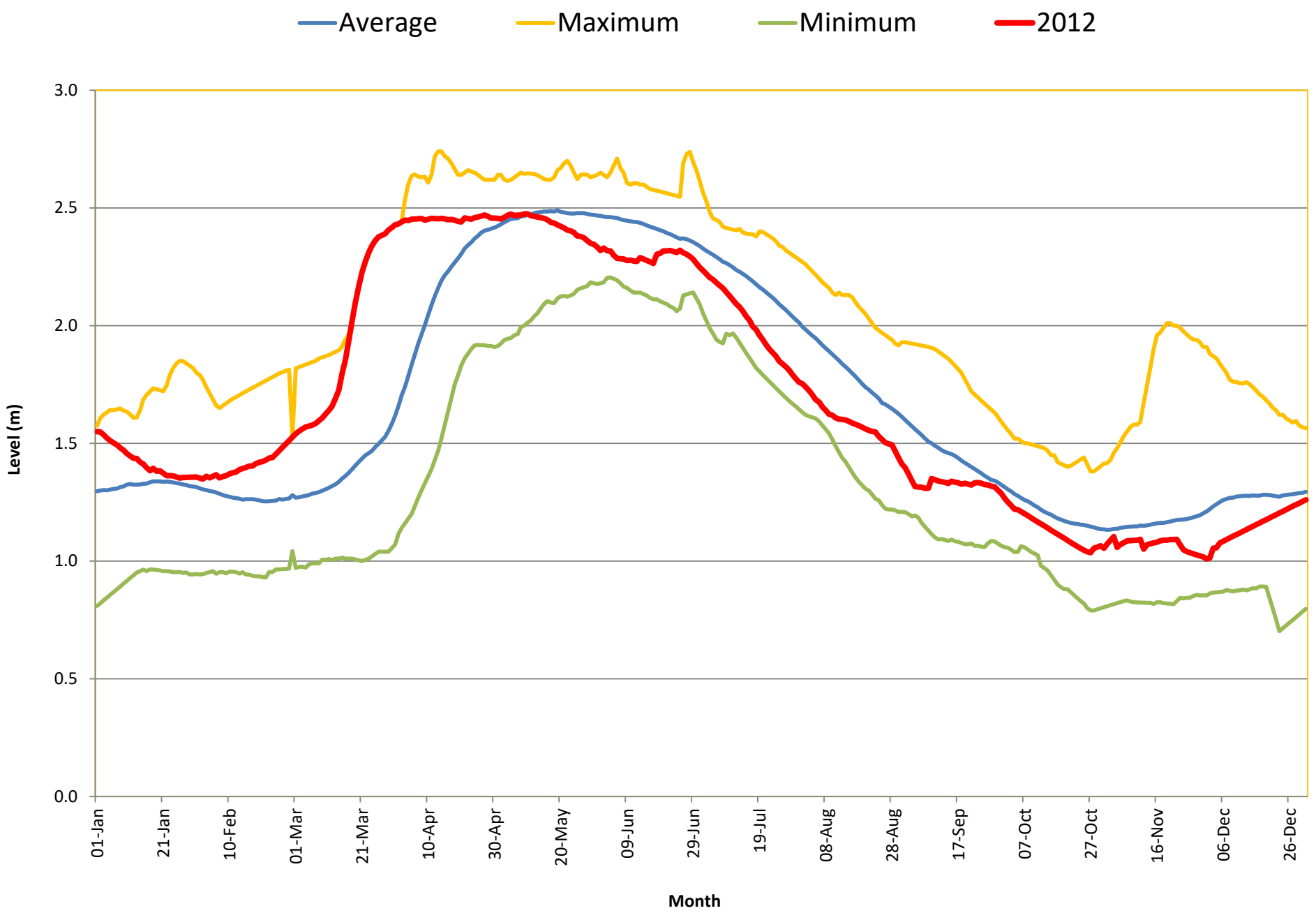
Coalition for Equitable Water Flow

- **2009** - normal year except for very **high water as ice went out** causing shoreline and crib damage
- **2010** - very little spring runoff and **reservoirs did not fill until late July or early Aug.**
- **2012** – reservoirs filled early but **much lower than average water levels beginning at end of June**
- **2013** very high spring levels and **extreme flooding (Minden)** and seasonally **very high November/December levels** resulted from extreme rainfall events.
- **2014 late ice out**, **high water in May** followed by extreme rain in late June **and above average levels throughout summer and into fall** - issues with shoreline damage, loon nests and lake trout spawning.
- **2015 very low levels in February** with extreme cold and light snowpack followed by dry spring and **very slow filling of southern reservoirs.**
- **2016** limited snowpack followed by **extreme rainfall in March and very high reservoir levels and ice damage**, followed by **extreme drought and outstanding water management.**

Mississagua Lake Levels



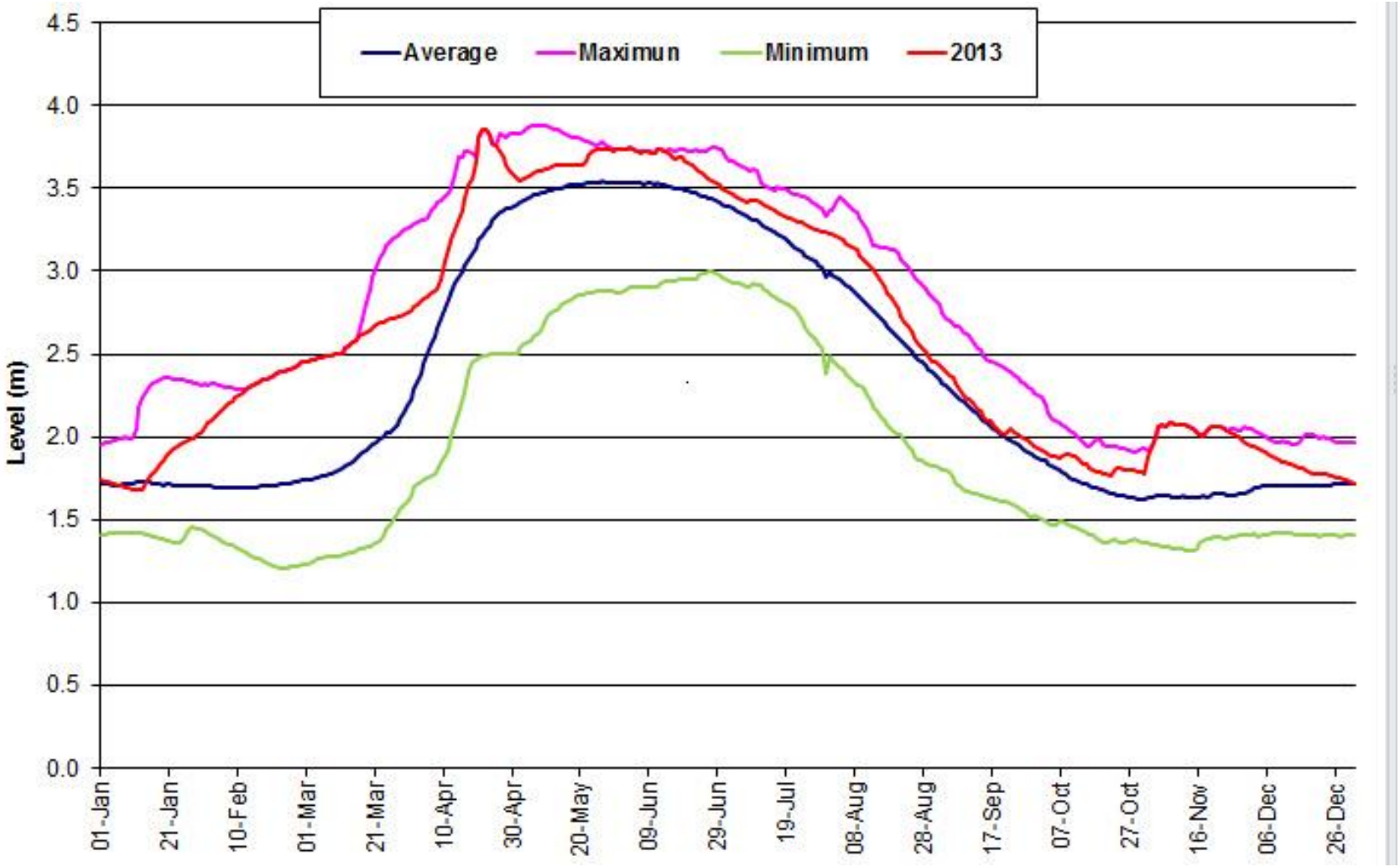
Mississagua Lake Levels 2012



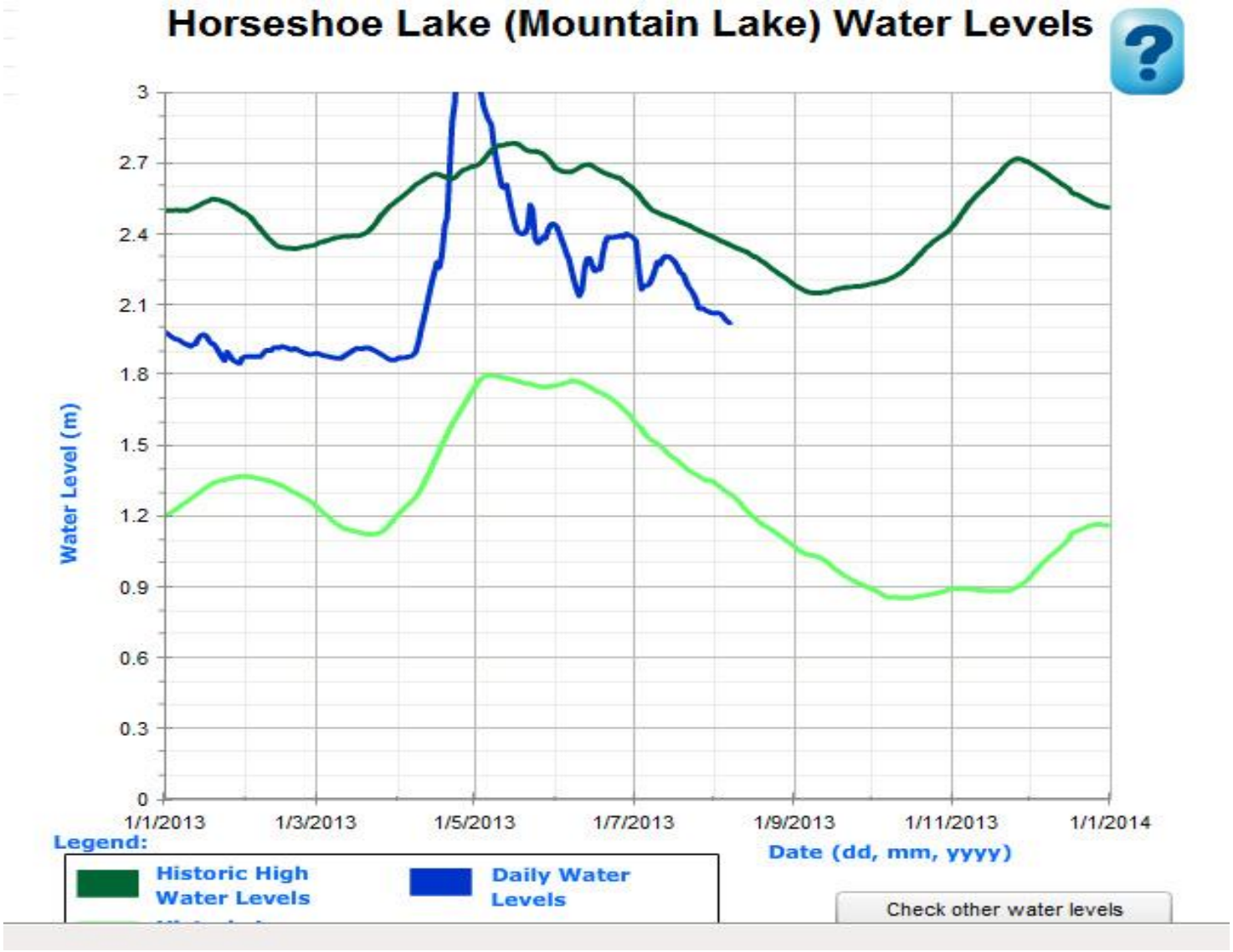
2013 Was a year of Extreme Rainfall Events Spring and Fall

- Early April reservoirs filling and at near normal levels and then 2 extreme rainfall events!!!
- **April 17, 18 and 19** – about 1 inch of rain central lakes but up to **3 inches over Haliburton on to still frozen ground** caused extreme flooding on some reservoirs in Gull and Burnt River systems and in Minden.
- **May 20, 21 and 22** – more than 1 inch of rain in central lakes and again **3 inches over Haliburton** causing more high levels on reservoirs but controlled flows and minimal flooding.
- **October** had double normal rainfall resulting in seasonal record high water levels on many reservoirs.

Eels Lake Water levels 2013



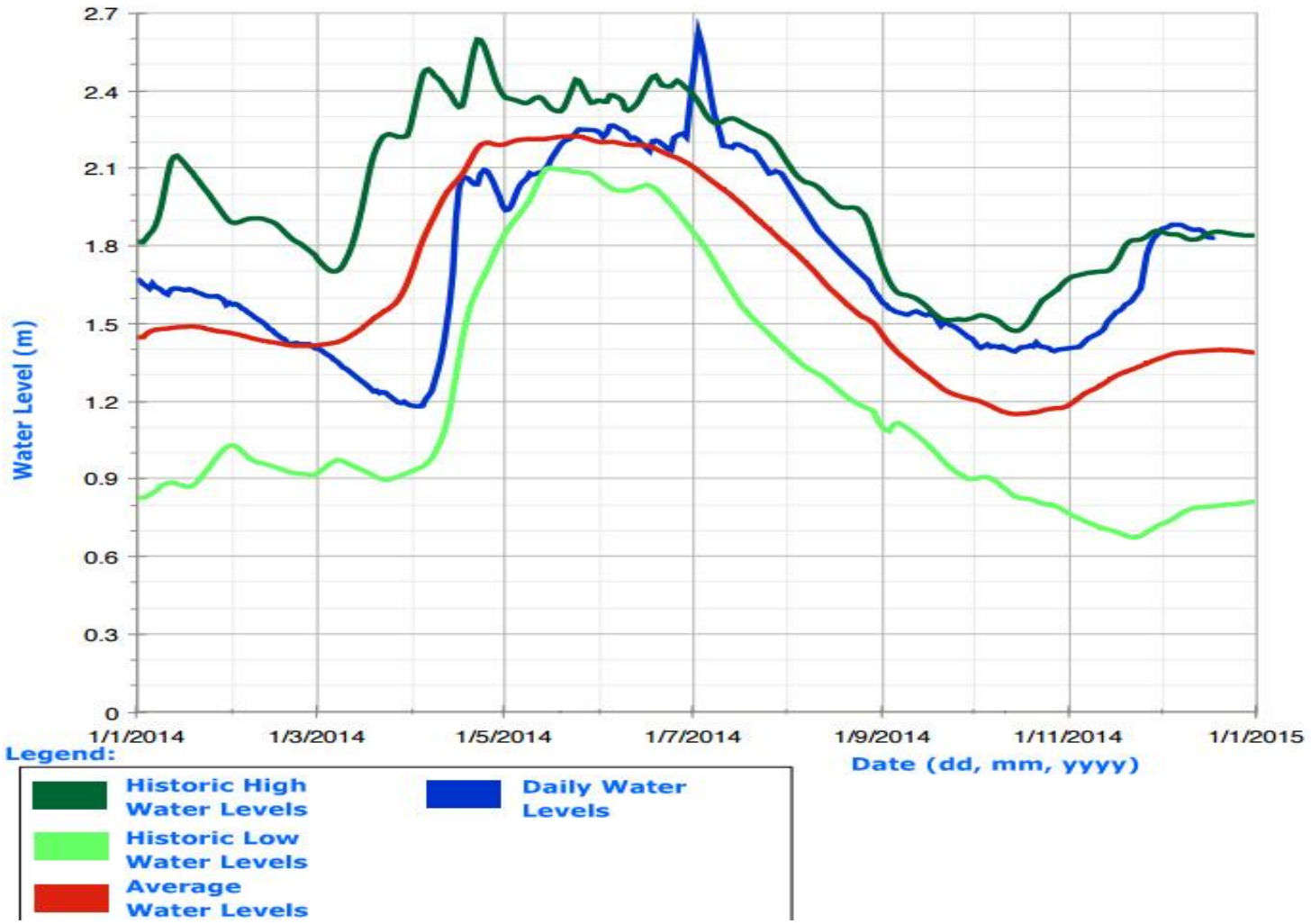
2013


Horseshoe Lake (Mountain Lake) Water Levels
Water Level (m)
3
2.7
2.4
2.1
1.8
1.5
1.2
0.9
0.6
0.3
0
1/1/2013
1/3/2013
1/5/2013
1/7/2013
1/9/2013
1/11/2013
1/1/2014
Date (dd, mm, yyyy)
Legend:
Historic High Water Levels
Daily Water Levels
Check other water levels

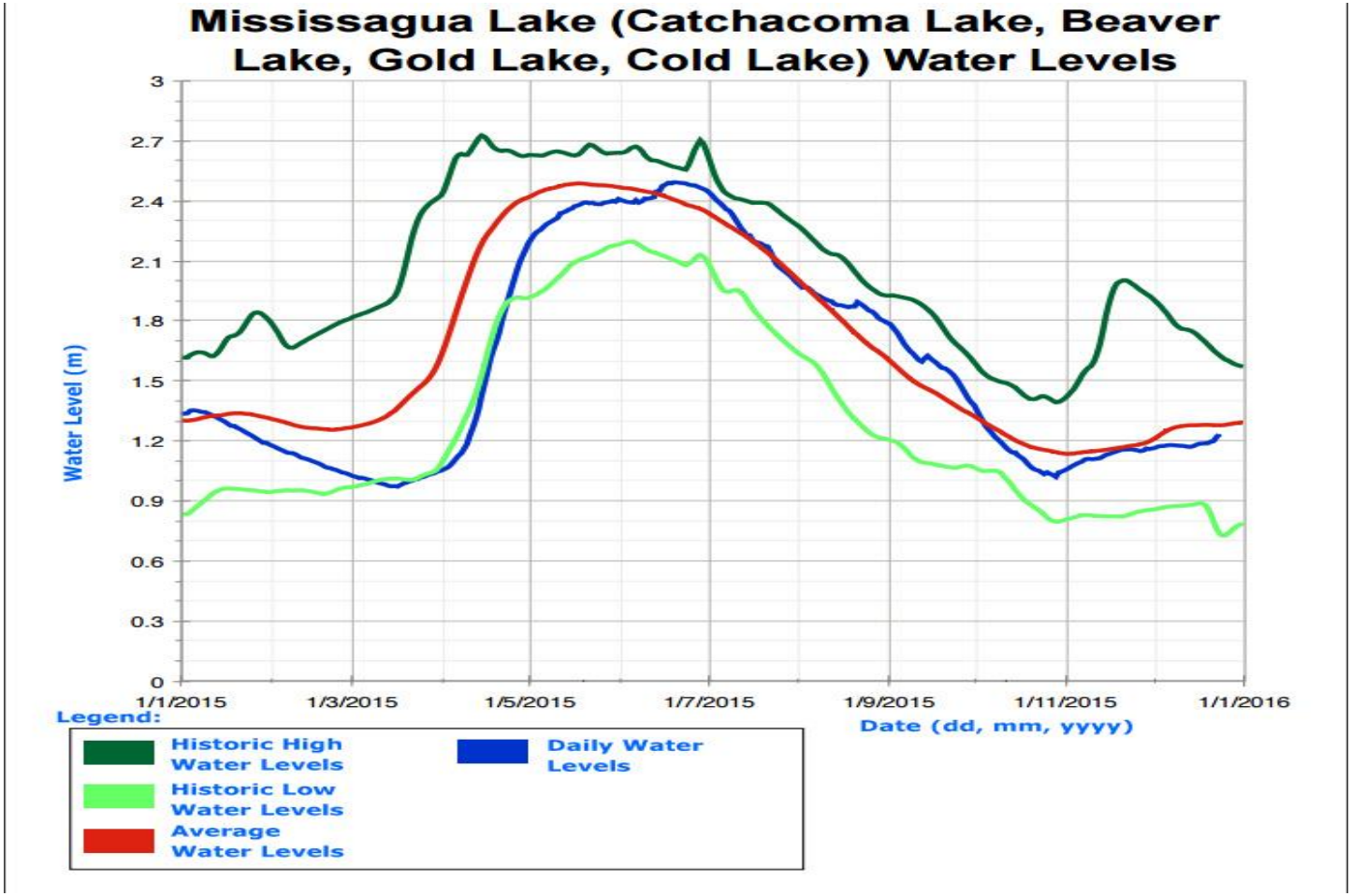
Horseshoe Lake April 2013

Minden Flooding April 2013

Drag Lake Water Levels 2014



Mississagua Lake Levels 2015



2016 A Year Of Weather and Some Water Level Extremes

Coalition for Equitable Water Flow

Spring – Record or Near Record High Water with Ice

- After relatively warm winter with early melt extreme rainfall and high lake levels at end of March.

Late Spring and summer extreme drought across entire Trent Basin

- Very low rainfall from April 15 to August 12 led TSW to apply minimum flows and water conservation across the whole Trent system, reservoirs as well as the canal and connecting rivers and lakes. The result was we avoided potential extreme drawdown on reservoirs.

Spring 2016 Water Levels

Coalition for Equitable Water Flow

- Relatively warm Winter with less snow than normal and early runoff. We welcomed TSW actions to partially fill reservoirs beginning in early March.
- BUT - March precipitation at Haliburton was 171mm or 238% of the normal 72mm, and 97mm fell in last 8 days of the month with some areas getting 125mm.
- The result was lake levels reached record or near record highs with ice on the lakes. But Minden was not flooded as in 2013.
- Communications from MNRF, TSW and Municipalities much better than in 2013 and reposted by CEWF.
- Remember - the reservoirs are not a flood control system and almost no system can handle 97 to 125 mm of rain in 8 days.

Parks Canada Parcs Canada

Canada

Parks Canada
Ontario Waterways

Trent-Severn Waterway
National Historic Site of Canada

CEWF AGM
September 10th, 2016

When to Fill

Is there enough snow on the ground to fill the lakes?

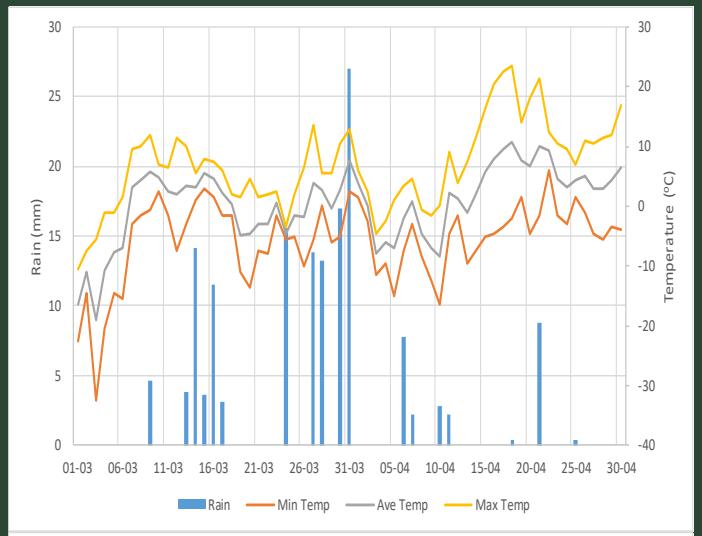
How much time before the beginning of the season?

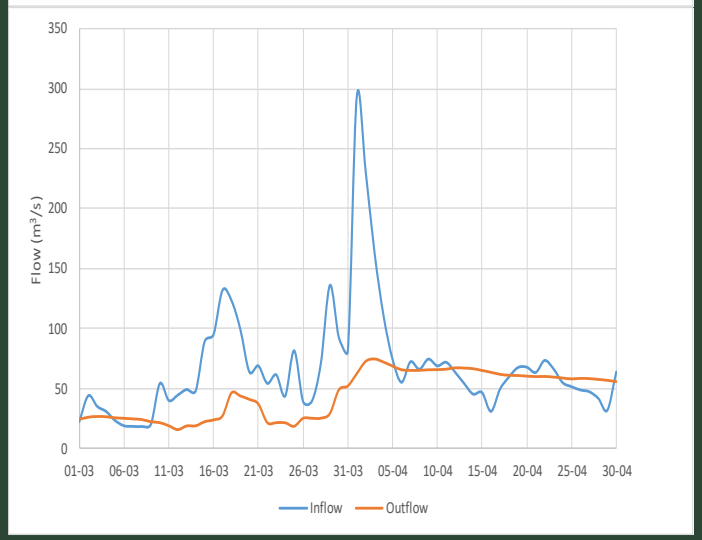
What is the upstream watershed area?

2016 – Spring

- March 1st, Snow less than average indicating that lakes would not fill
- Early March, Gradual increase of water levels by log manipulation
- Late March Colorado Low Forecast
  - 4 days out 5 to 10 mm
  - 3 days out 10 to 15 mm
  - 2 days out 15 to 20 mm
  - 1 day out 25 to 35 mm
  - Actual 50 + mm

2016 – Gull River

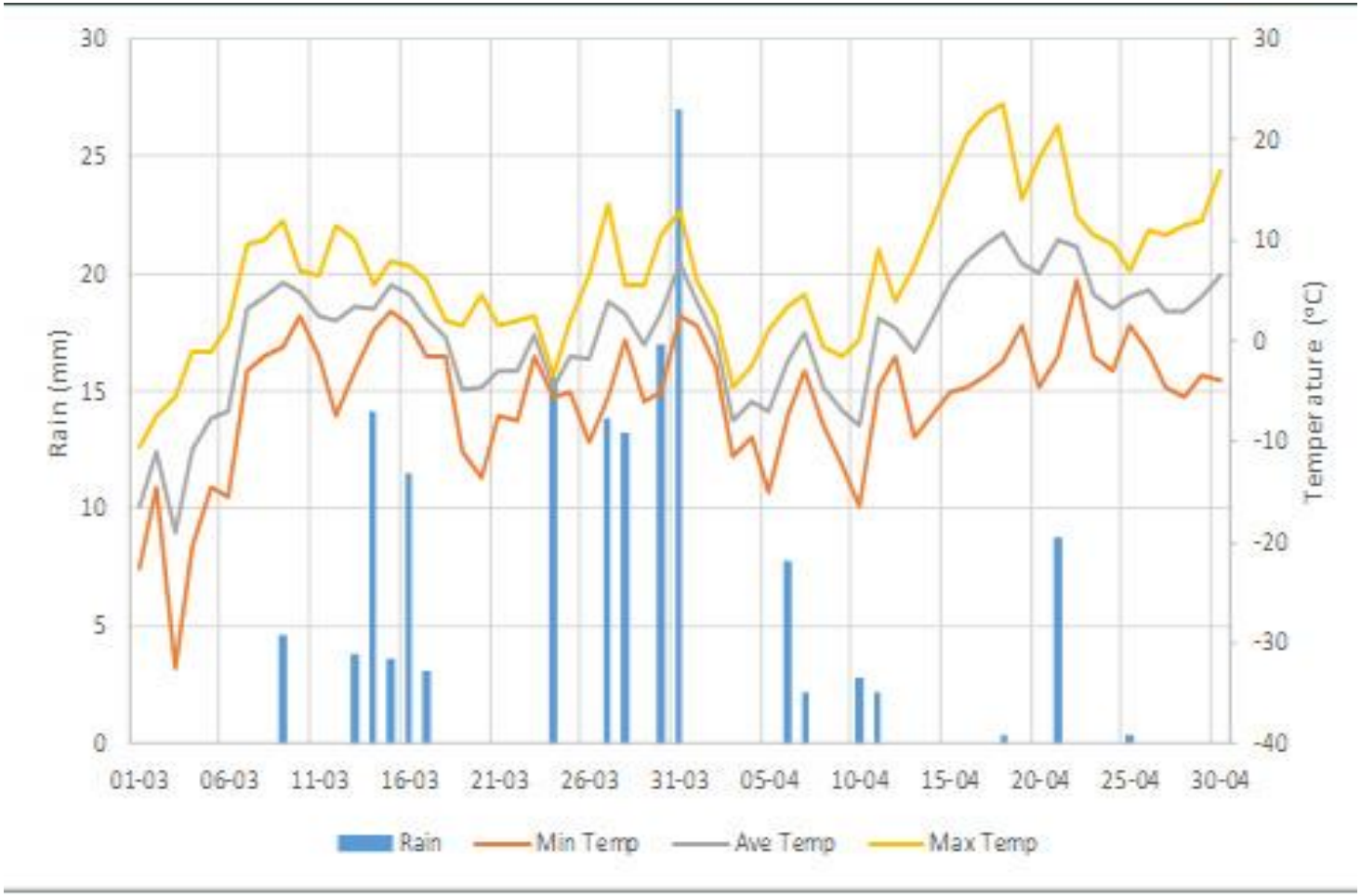




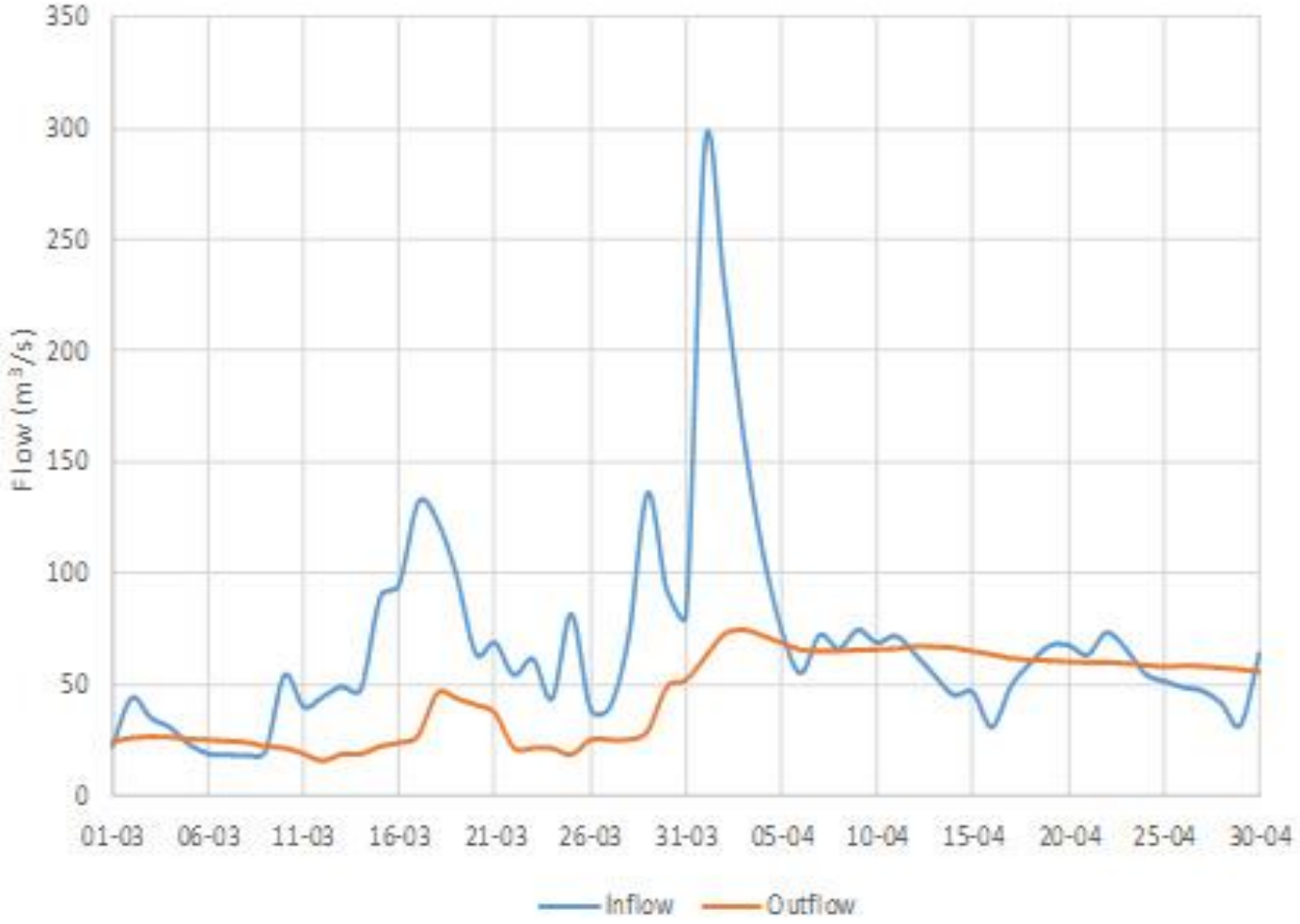
- Rain
- Temperature
- Inflow
- Outflow

2016 Gull River Rainfall and Temperature – March and April

Source: Parks Canada



2016 Gull River Inflow and Outflow – March and April (Source: Parks Canada)



Spring and Summer 2016
Drought over the Trent Basin

Coalition for Equitable Water Flow

Precipitation Totals May to August

May 1 to August 12

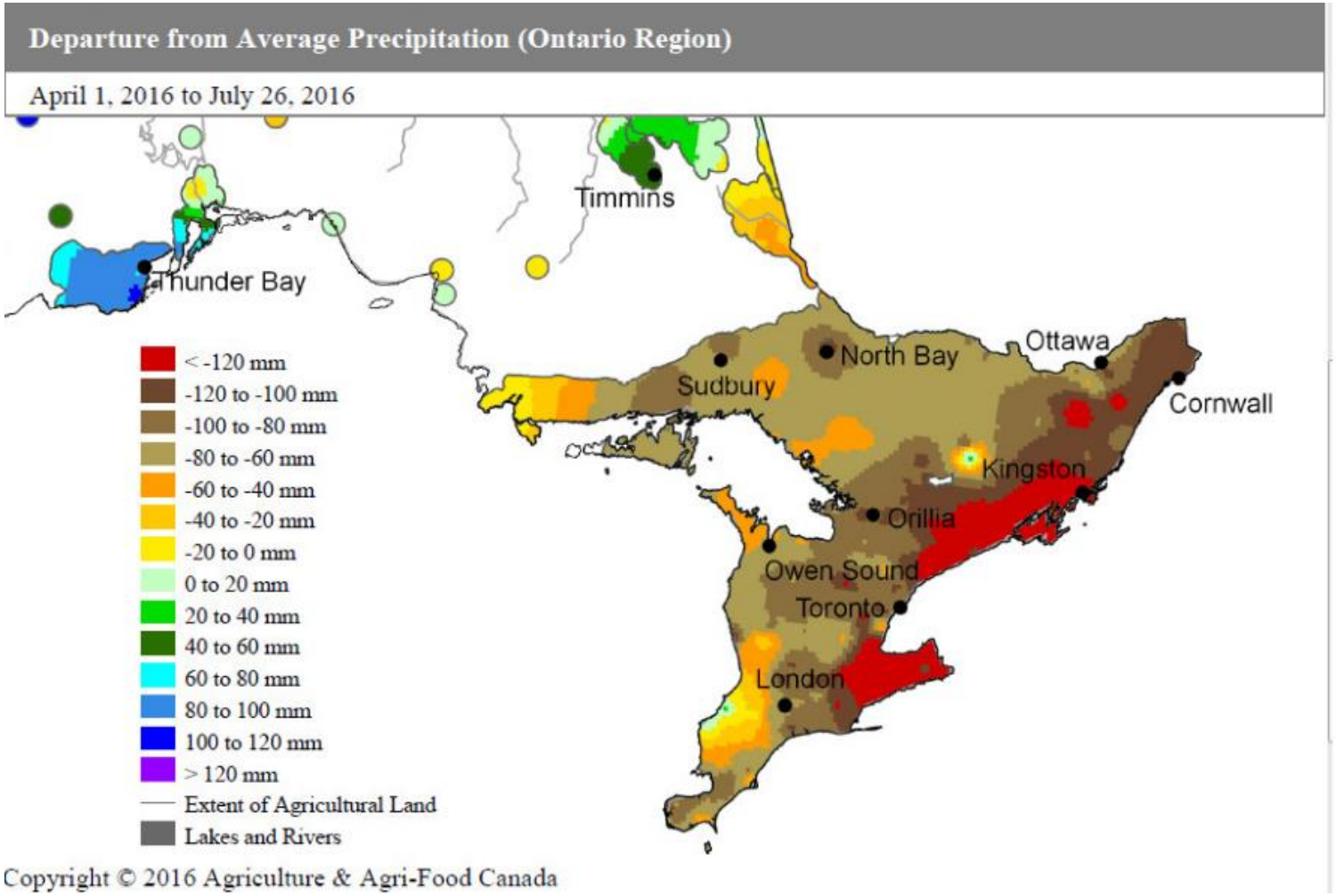
Precipitation Station	Normal mm	Actual mm	Difference from Normal mm	Actual as % of Normal
Trenton	262.8	106.4	-156.4	40%
Peterborough	270.5	83.5	-187.0	31%
Haliburton	304.1	178.2	-125.9	59%

May 1 to August 31

Precipitation Station	Normal mm	Actual mm	Difference from Normal mm	Actual as % of Normal
Trenton	298.9	200.6	-98.3	67%
Peterborough	309.0	122.1	-186.9	40%
Haliburton	343.6	338.6	-5.0	99%

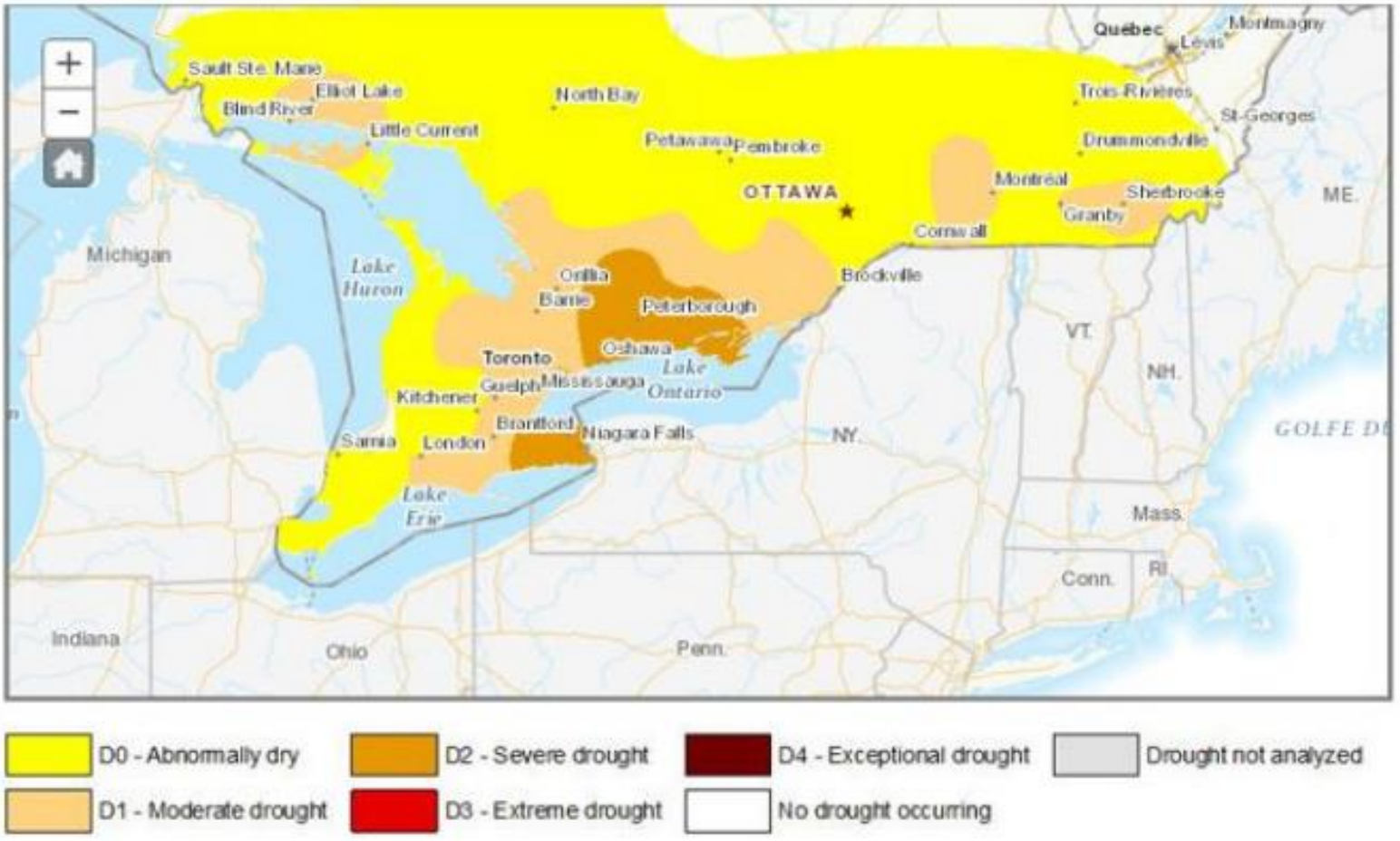
Rainfall Deficit Below the Average April 1 to July 26

Coalition for Equitable Water Flow



The Weather Network Drought Analysis May 1 to August 10

Coalition for Equitable Water Flow

- 

Integrated Water Management in Drought Conditions 2016

Coalition for Equitable Water Flow

The TSW strategy avoided potentially record low reservoir levels and masked the drought for many on the TSW

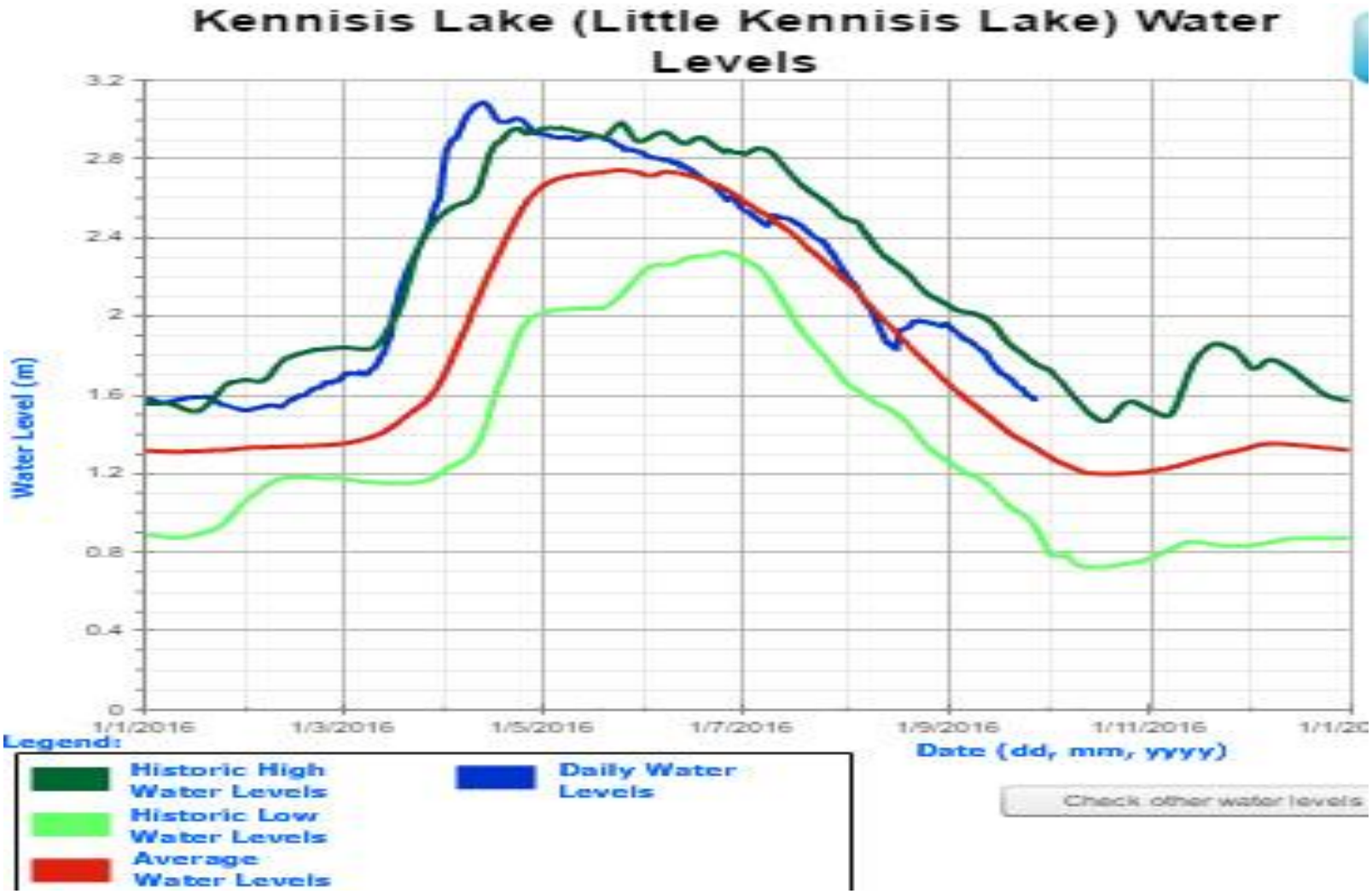
- High Spring reservoir levels keeping extra storage allowed for normal or near normal water levels on most reservoirs through July.
- Based on long range forecasts, TSW also maintained storage in all major lakes on the Waterway (Kawarthas and Rice Lake) with minimum flows on Otonabee and Trent Rivers.
- Lack of rain and minimum flows on the Gull and Burnt systems drained levels and resulted in lower levels than on the Central Lakes.
- Draw down for the Waterway began in June but extreme draw was not forecast until August 8.
- Then the rains came. >150 mm at Haliburton in last 2 weeks of August.

Integrated Water Management and August Rainfall 2016

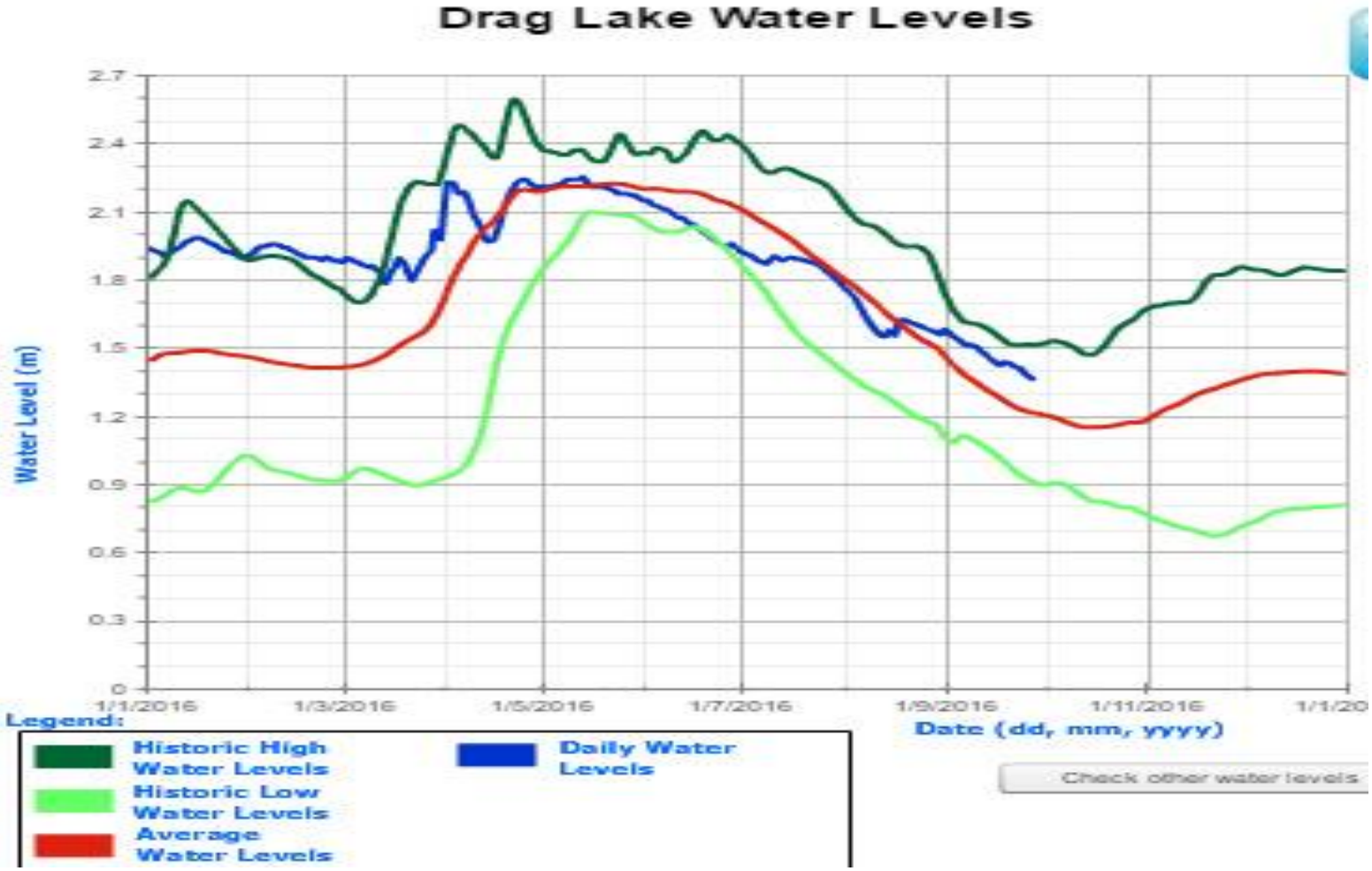
Coalition for Equitable Water Flow

- As of August 8th TSW was forecasting major drawdown.
- Central Lakes were the highest and facing the most rapid draw. For example Eels Lake was going to fall more than 0.5m in two weeks after high levels all summer.
- Widespread rains came beginning Saturday August 13 and combined with rain on Tuesday16th some areas in the northern TSW area received massive amounts of rainfall – Maple Lake 137 mm and Jackson's Point 161mm.
- Reservoirs rose, logs replaced (Sunday Aug 14), flooding avoided, and we celebrated outstanding water levels for late August.
- **We avoided a potential summer water level disaster!**
- BUT NOW from Sept. 1 to Oct. 7 Haliburton has had only 52mm of rain vs 125mm normal – **The drought has returned!**

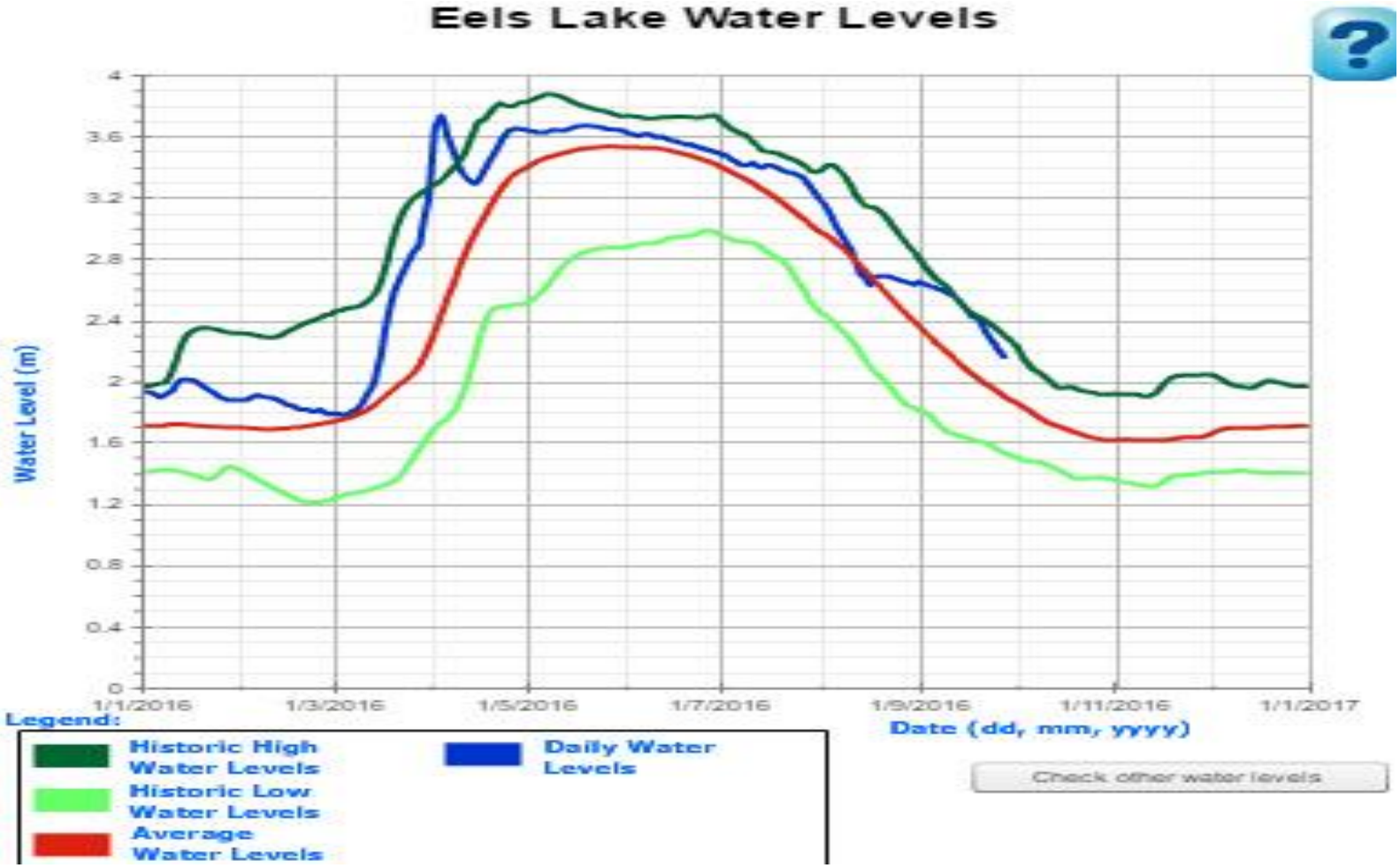
2016 Water Levels Gull River Reservoirs



2016 Water Levels Burnt River Reservoirs



2016 Water Levels Central Lakes Reservoirs



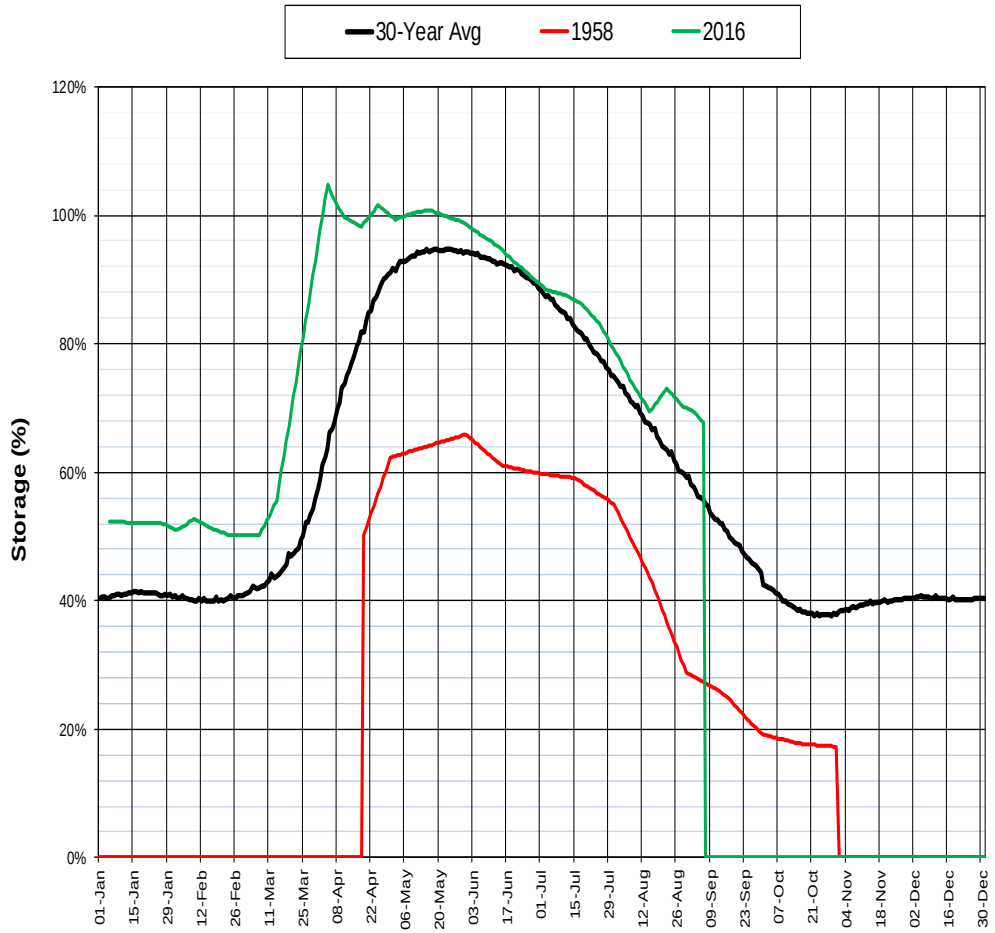
High Water turns to Drought

- After the last large rainfall in the end of March things dried up quickly.
- Based on the observed watershed response and the seasonal forecast; flows on the Otonabee River were taken to minimum by May 31st.
- Kawartha Lakes were overfilled and left high to maximise the amount of water stored.
- For a significant duration levels were able to be maintained based on minimum flows on the Burnt and Gull Rivers

Drawing Water and Equal %

- Minimum low flows resulted in lower levels on the Burnt and Gull Rivers.
- Equal percentage was completed on a chain by chain basis until more water was needed.
  - Maple Lake
  - Gull
  - Gelert
  - Irondale
  - All Lakes
- No minimum flow is required for the Central Lakes

Haliburton Storage



Notes:

High in the spring

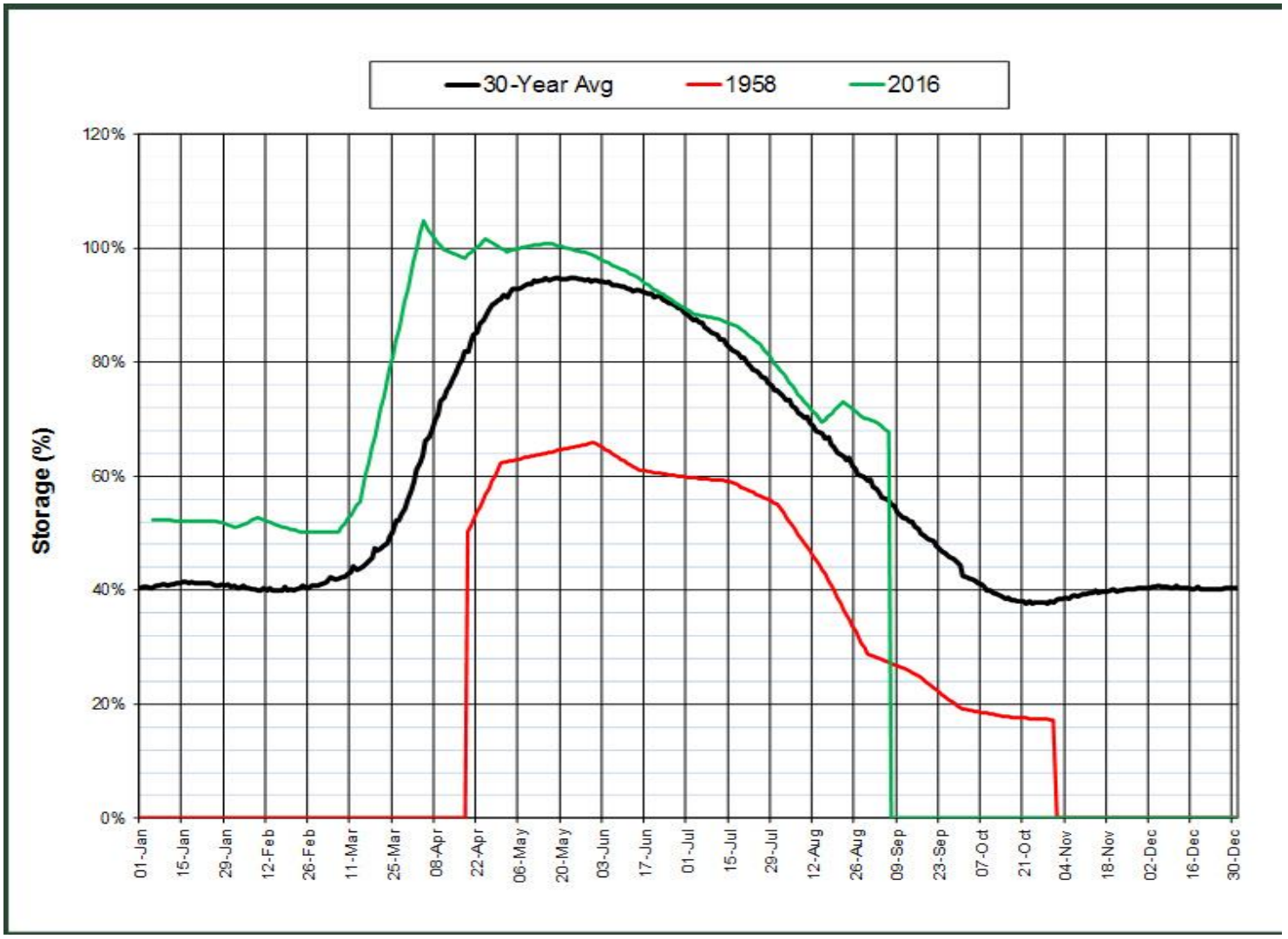
Average or above average for most of the time

Large rain event mid-August prevented the drop below average

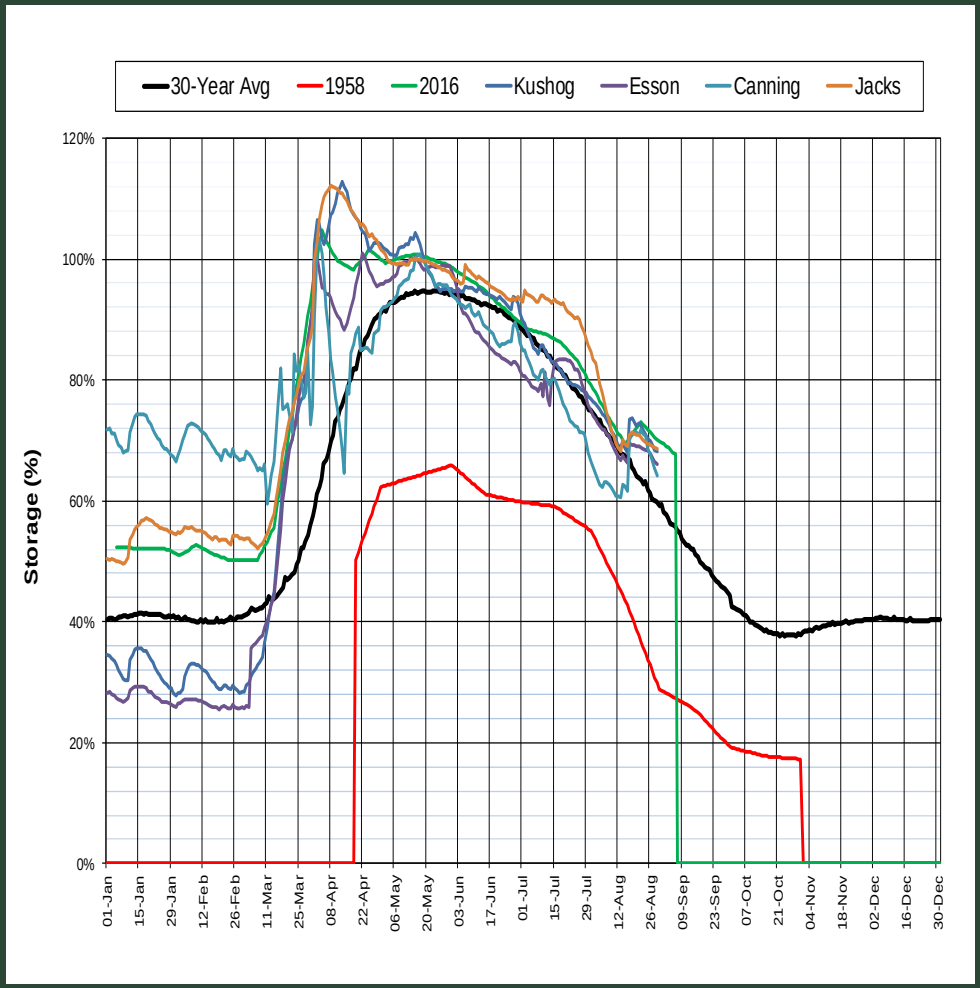
Haliburton Sector Reservoir Storage

Total Storage 43,800 ha-m 54% Gull, 17% Burnt and 28% Central lakes

Source: Parks Canada



Storage Comparison

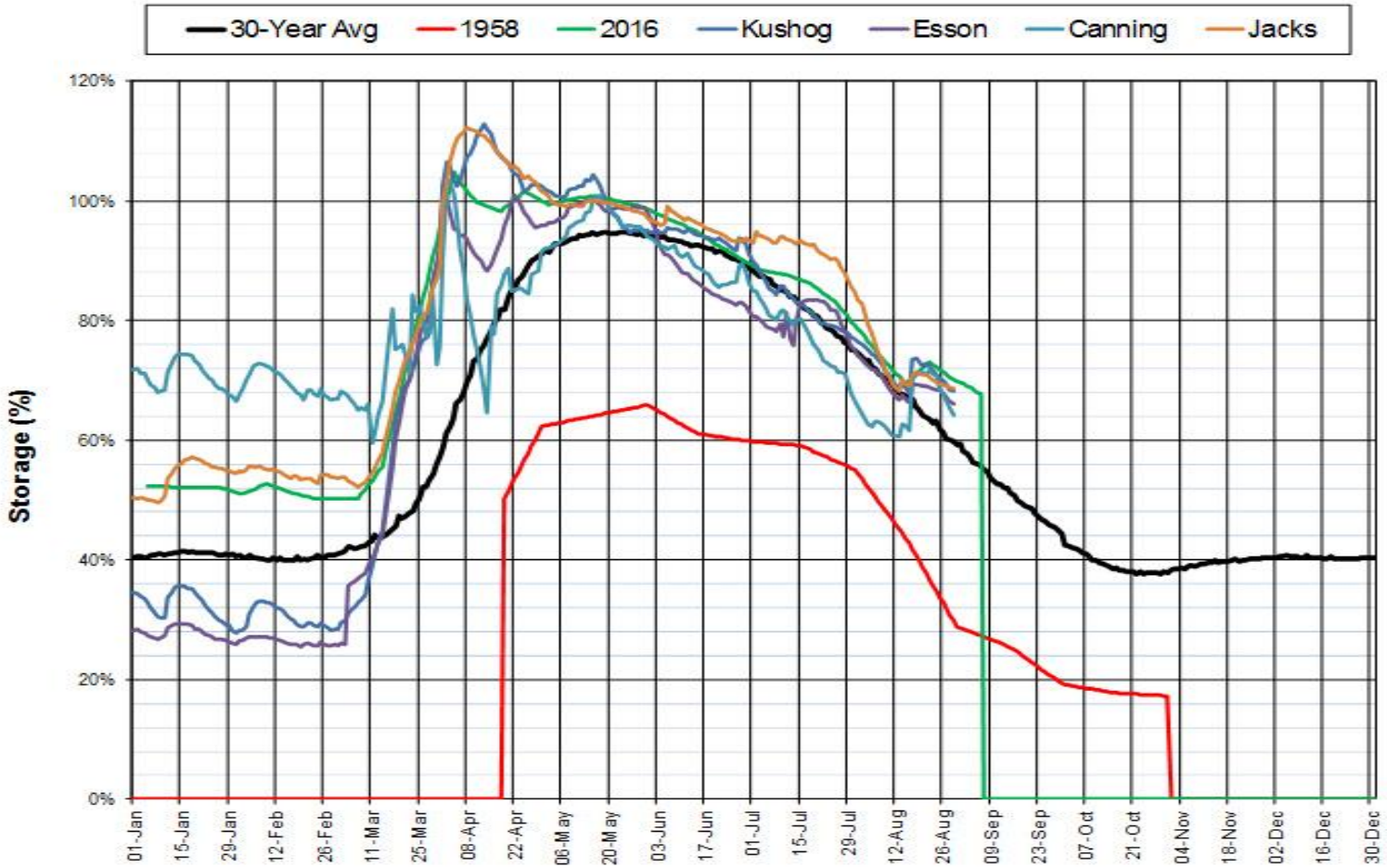


Notes:

The highest percentage lake gets a higher outflow

Lowest lakes get priority if there is a chance to refill them

2016 Reservoir Storage for Selected Lakes (Source: Parks Canada)

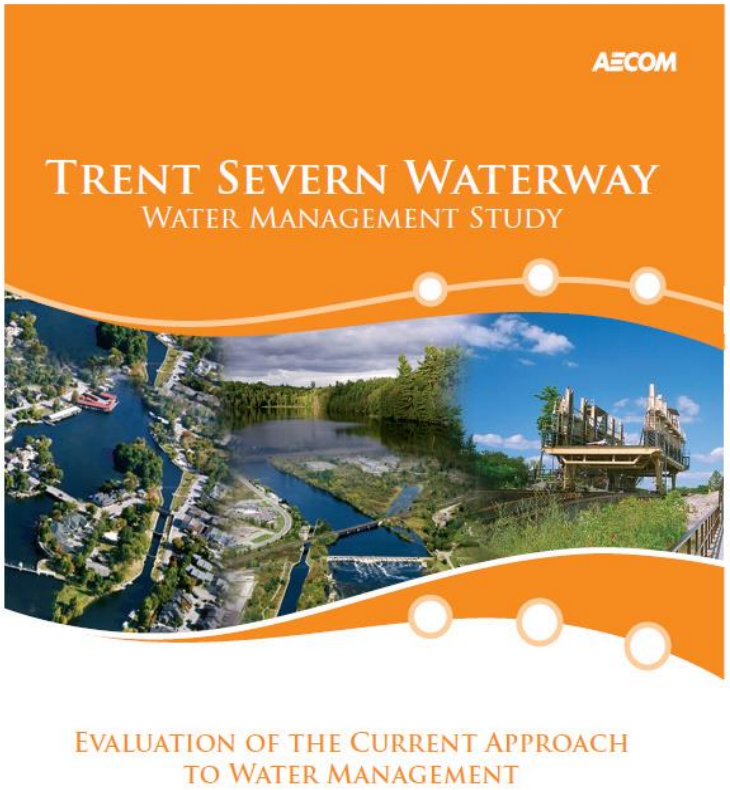


What are the Climate Change Projections for the TSW?

Coalition for Equitable Water Flow

- There are multiple research efforts and reports underway and/or available.
- Three reports are particularly relevant to Climate Change impacts on the TSW:
  1. ***AECOM TSW Water Management Study 2011 (4 volumes)***
  2. ***Kawartha Conservation Two Recent Reports on Climate Change 2015 and 2016***
  3. ***Muskoka Watershed Council 2016***
- A new report from FOCA/MNRF is also interesting.

AECOM TSW Water Management Study 2011 (4 volumes)



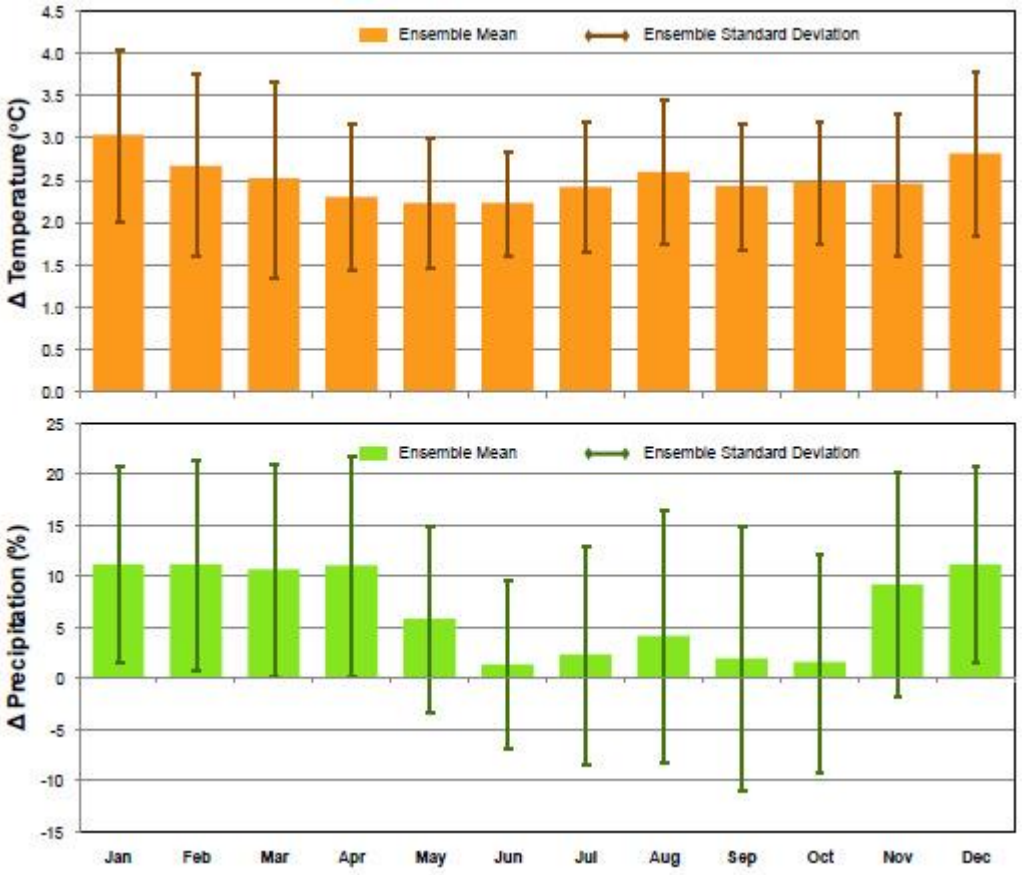
AECOM TSW Water Management Study 2011

Peterborough selected as the representative Climate Station for the Trent Basin

- **Analysis of Past trends in Temperature and Precipitation 1921-1950 vs 1971-2000**
  - No clear Change trend in temperature
  - Average Annual precipitation up about 6%
- **Looking Forward to 2041-2070 based on 23 Global Climate Models (GCMs)**
  - Clear increase in average annual temperature +2.5C +/- 0.7C
  - Less clear increase for precipitation up 6% +/-4% BUT Winter increase much clearer up 11% +/-6%.

AECOM TSW Water Management Study 2011

Projected Climatic Change in Monthly Temperature and Precipitation between 2041-2071 vs 1961-1999

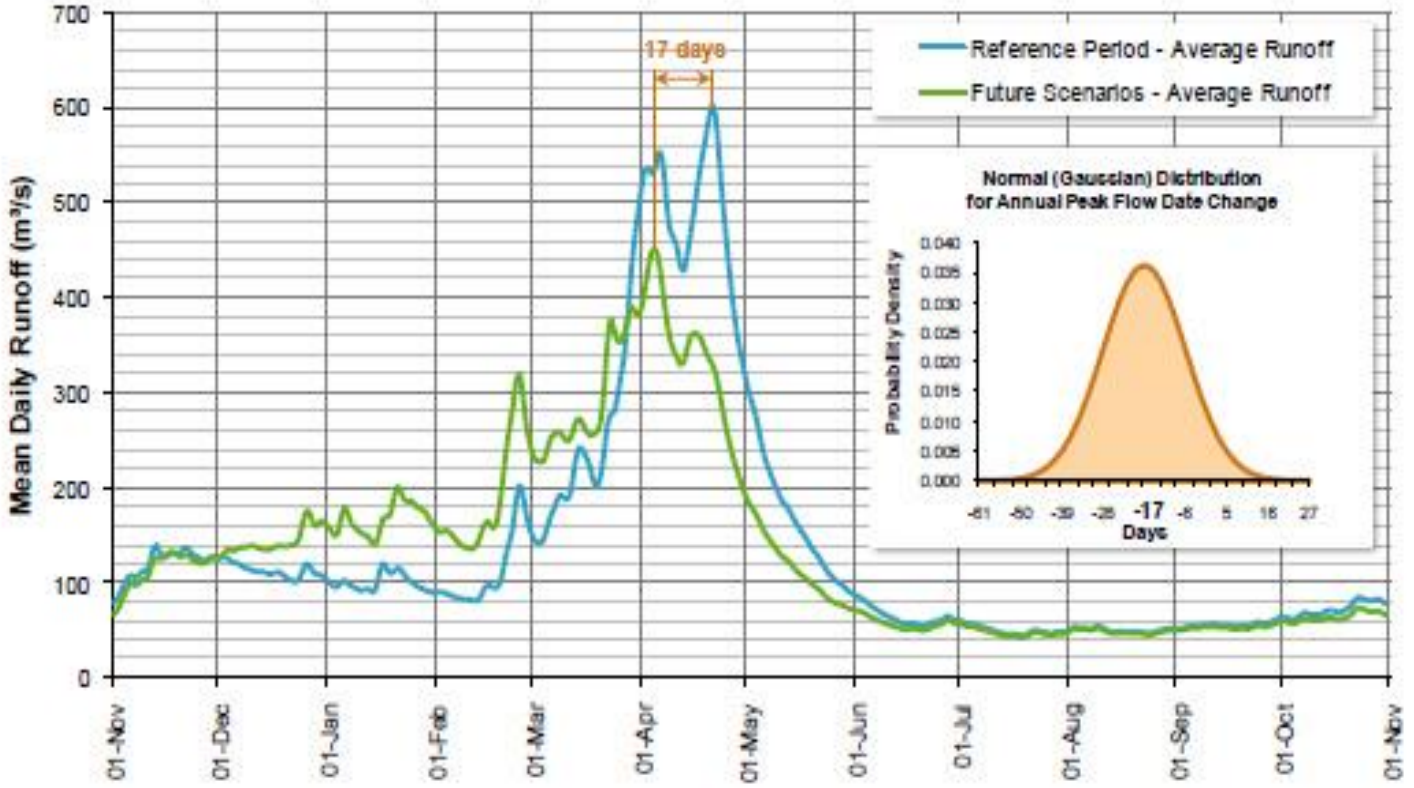


AECOM TSW Water Management Study 2011

Projected Average Mean Daily Runoff for

Future Period 2041-2071 vs Reference Period 1970-1999

Figure 4-6 - Ensemble Average Mean Daily Runoff for the Future scenarios (2041–2070) and Mean Daily Runoff for the Reference Period (1970–1999)



AECOM TSW Water Management Study 2011

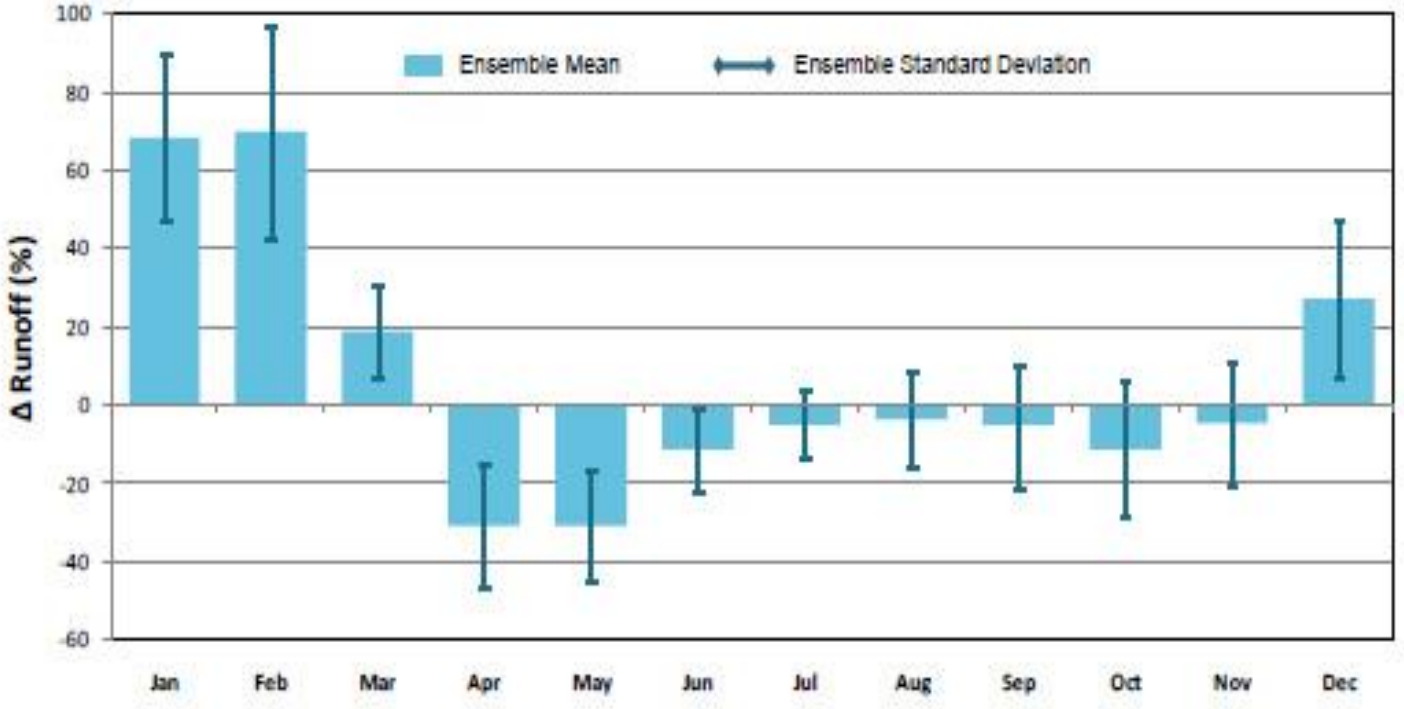
- **AECOM Predictions for future Runoff patterns 2041-2071**
  - Winter flows increased and more variable with likely winter floods
  - Magnitude of spring freshet reduced but period extended
  - Mean annual peak 17 days earlier
  - Summer-fall flows remain similar to reference period

AECOM TSW Water Management Study 2011

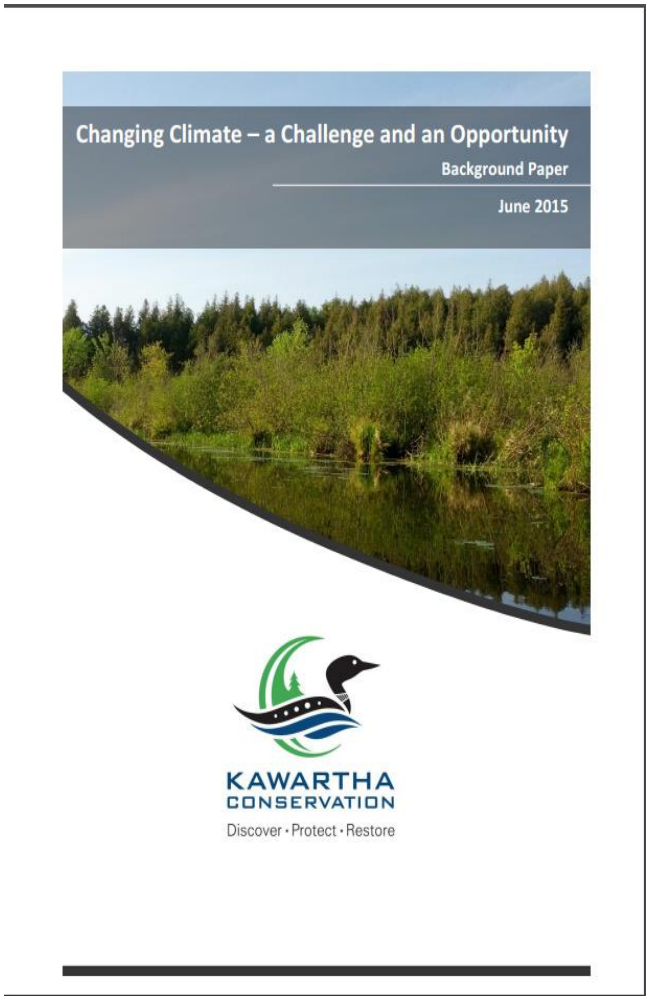
Projected Change in Average Mean Daily Runoff for

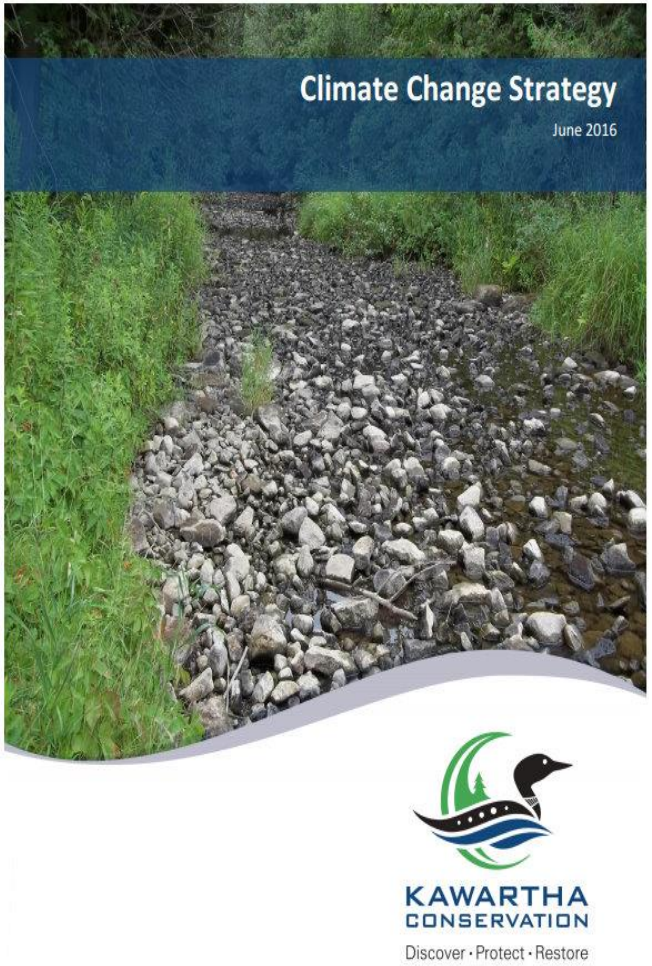
Future Period 2041-2071 vs Reference Period 1970-1999

Figure 4-7 - Ensemble Averaged Runoff Change by Month between the Future Period (2041–2070) and the Reference Period (1970–1999)



Kawartha Conservation Two Recent Reports on Climate Change 2015 and 2016





Kawartha Conservation's Two Recent Reports on Climate Change 2015 and 2016

- ***These reports rely on an MNRF and Canadian Forest Service Report from 2007 of climate change projections for Ontario, and on recent observations from the Kawartha Conservation area which includes Crystal lake and Nogies Creek, and Shadow lake and the downstream Gull River, as well as the City of Kawartha Lakes and beyond.***
- **Already observed changes include:**
  - A warming trend in temperatures especially in winter,
  - An increased number of intense and extreme precipitation events, and
  - An increased number of extreme weather events.

Kawartha Conservation's Two Recent Reports on Climate Change 2015 and 2016

- **Observed and expected changes in water availability and distribution:**
  - Increased winter and spring runoff with increased threats of mid-winter and spring flooding (e.g. Gull and Burnt Rivers in 2013 and 2014),
  - Spring freshet earlier and generally lower,
  - Summer and fall low flows are lower and last longer,
  - More intense precipitation increases the risk of flooding especially in urban areas (Peterborough 2002 and 2004).

Muskoka Watershed Council 2016

Muskoka Watershed Council 2016 Climate Change Projections

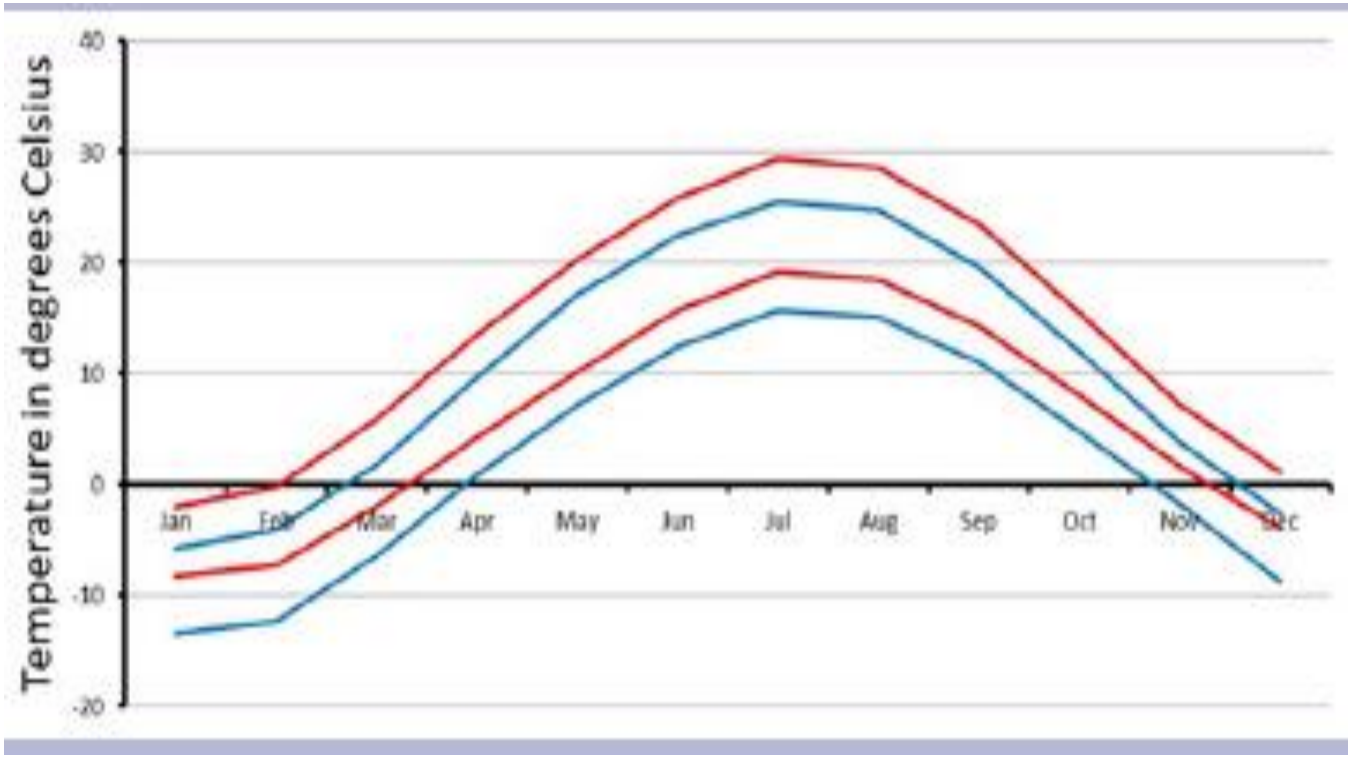
May be the most relevant projections for TSW reservoir areas given our northern location and alignment with Georgian Bay

- **Based on 19 Global Climatic Models projections for 2050**
  - Increase of 3 to 4 degrees C in average daily temperatures (change greatest at night and in winter)
  - 10% increase in annual precipitation but mostly in November to April period
  - Anticipate fewer but more intense storms with longer periods between rain events.

Muskoka Watershed Council 2016

Change in Mean Daily Maximum and Minimum Temperatures - Projections for 2041-2070 Red Lines vs 1971-2000 Blue Lines

(Change is greater in winter)



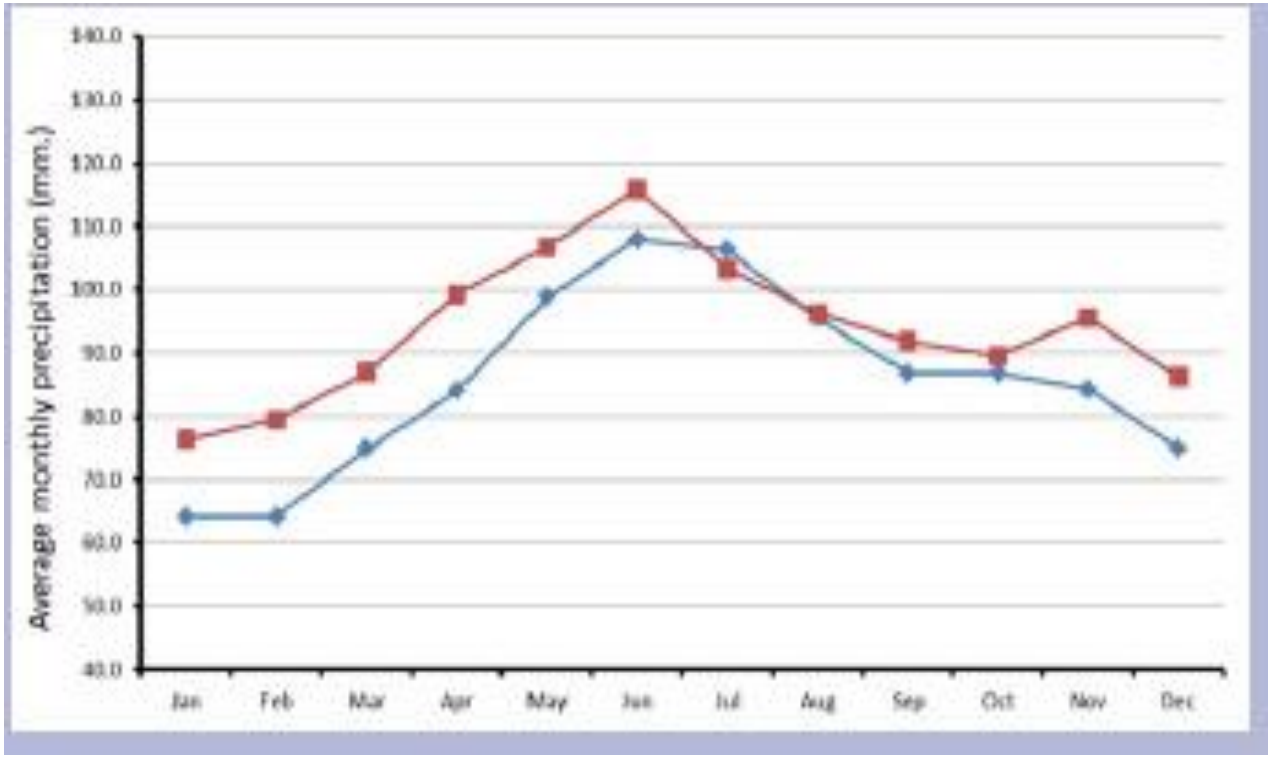
Muskoka Watershed Council 2016

Change in Mean Monthly Precipitation

Projections for 2041-2070 Red Lines

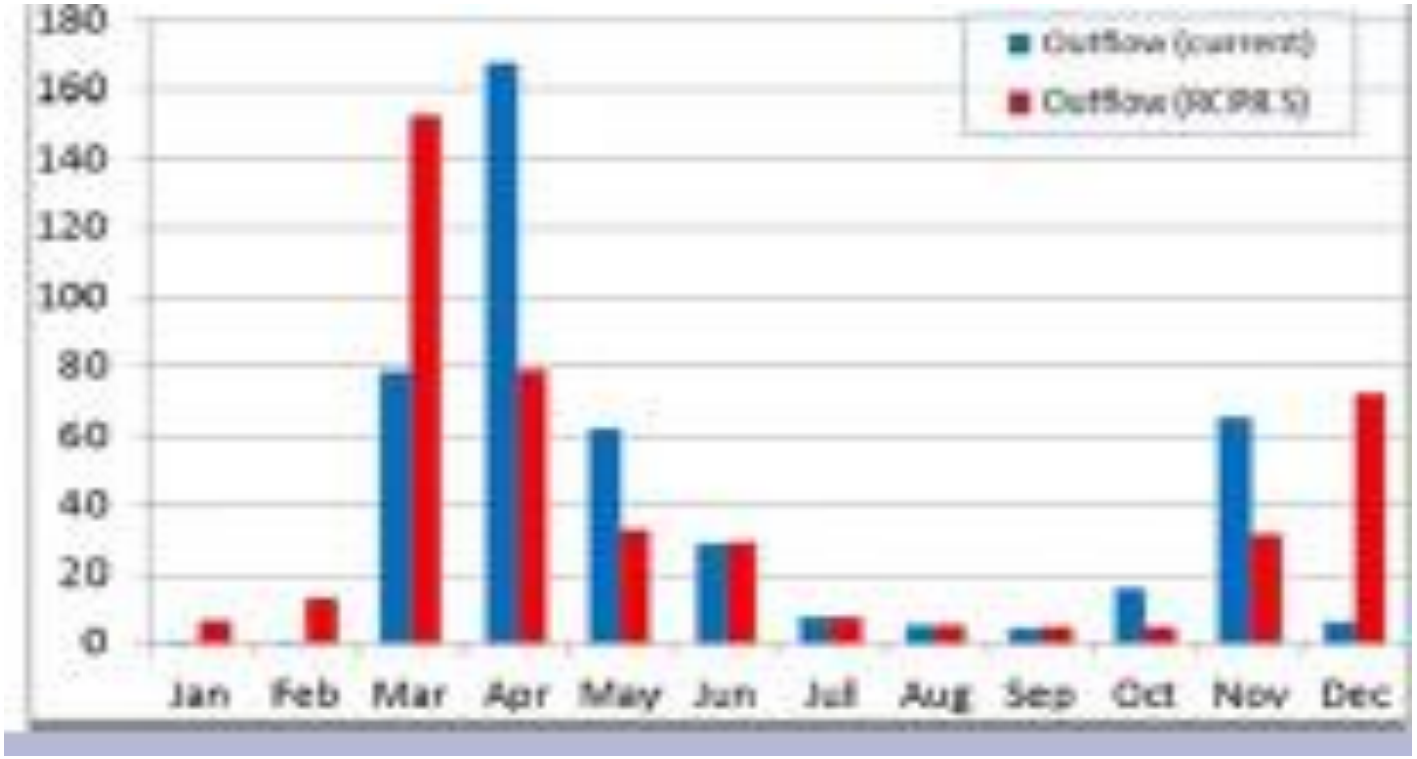
vs 1971-2000 Blue Lines

(+17% in November to April period and only +3.7% in other months)



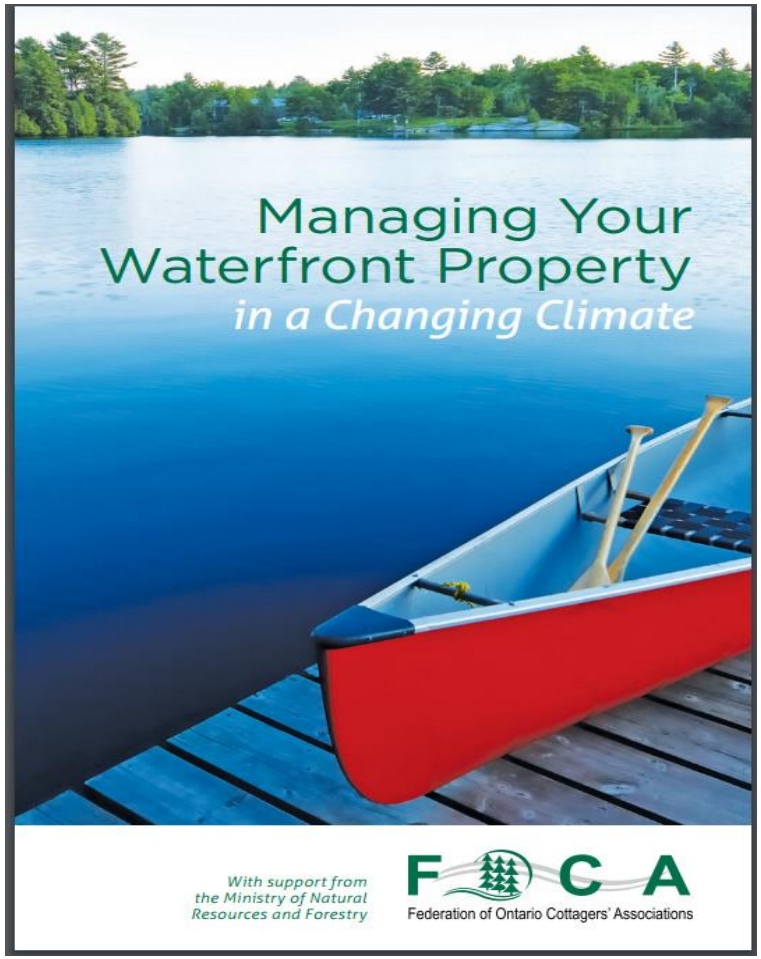
Muskoka Watershed Council 2016

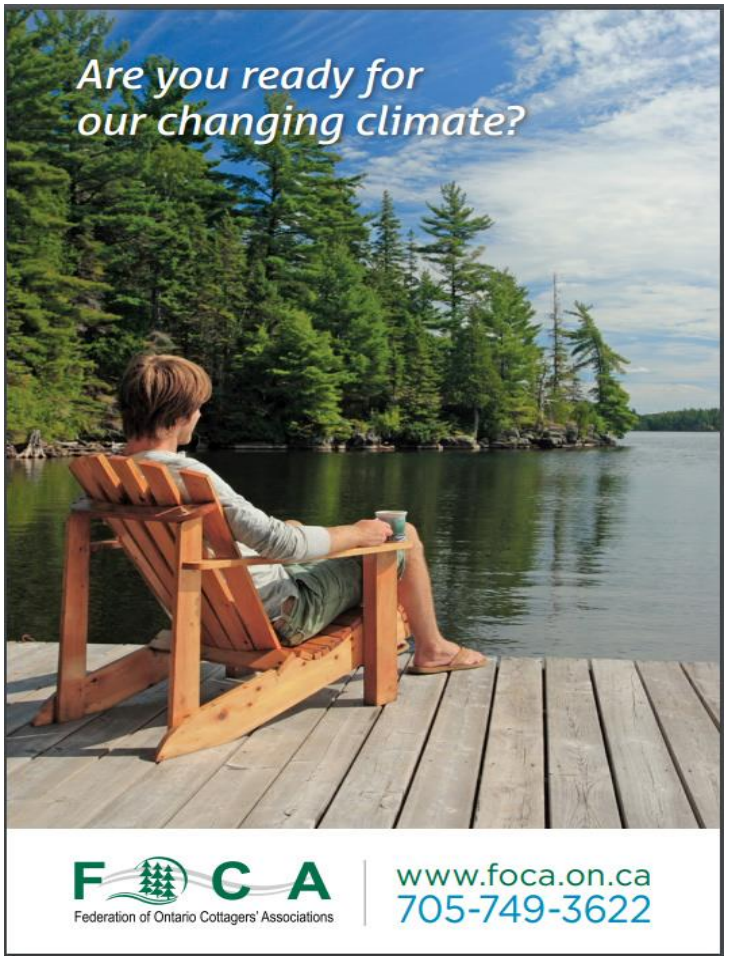
Change in Projected Runoff (mm over basin)
for 2041-2070 Red Bars vs 1971-2000 Blue Bars



A New Report from FOCA Fall 2016

(Available on FOCA Website)





FOCA/MNRF Report

Report based on MNRF Observations of and projections for Climate Change in Ontario.

- Report has a broad focus on likely impacts on the cottage experience including:
  - Species ranges shift north – including fish, trees and other plants, and birds.
  - Invasive species, insect pests and diseases may be advantaged.
  - Increased frequency of extreme events including drought, flooding, high winds and ice storms.
  - Less predictable and dangerous ice conditions on lakes.

Summary of Climate Change Implications for Water Management

Coalition for Equitable Water Flow

Winter and Spring

- Warmer winter temperatures and significant increase in winter precipitation including significant rain events will lead to more runoff in winter and early spring, and the need to replace logs in winter to capture winter runoff to fill reservoirs while ice on lakes.
- The “new normal” will be higher risk of winter flooding, earlier spring runoff with lower peak but possibly with ice on lakes.
- BUT extreme spring rain events like 2013 and 2016 will lead to overfilled reservoirs and possible flooding with ice still in place as in recent experience.

Summary of Climate Change Implications for Water Management

Coalition for Equitable Water Flow

Summer and Fall

- More of our rainfall will be in more frequent major storm events.
- Water Conservation to offset possible drought conditions may increase risk that extreme rainfall events will lead to flooding when reservoirs and the Kawartha Lakes are held at higher levels as in 2016.
- With warmer summers, higher temperatures will cause more evaporation from the large Kawartha Lakes and the demand for reservoir water may be greater.
- In drought conditions minimum flow constraints will drawdown all lakes in the Gull and Burnt systems as experienced on the Burnt in July 2016.

CEWF's Initiatives Towards Adaptation to Changing Conditions in the TSW Reservoir Area

- Ensure the 2016 drought management experience is fully evaluated and captured in TSW protocols and documentation.
- **Help educate residents to changing winter/spring conditions** and increasing likelihood of high water conditions with ice on lakes.
- Encourage **lake specific data collection** on potential impacts of flooding and extreme low water levels.
- Advocate for a TSW led **climate change study and strategy for the entire Trent Basin** identifying social and economic, as well as environmental impacts.
- Continue to advocate for **planning for integrated water management** across the entire Trent Basin.

Coalition for
Equitable
Water Flow

Questions and Discussion