MLA 2017 SEMINAR SERIES – JUNE 11th

WATER LEVELS ON THE MUSKOKA LAKES AND HOW YOU CAN PROTECT YOUR PROPERTY

Chris Cragg, Chair WQ&E Committee

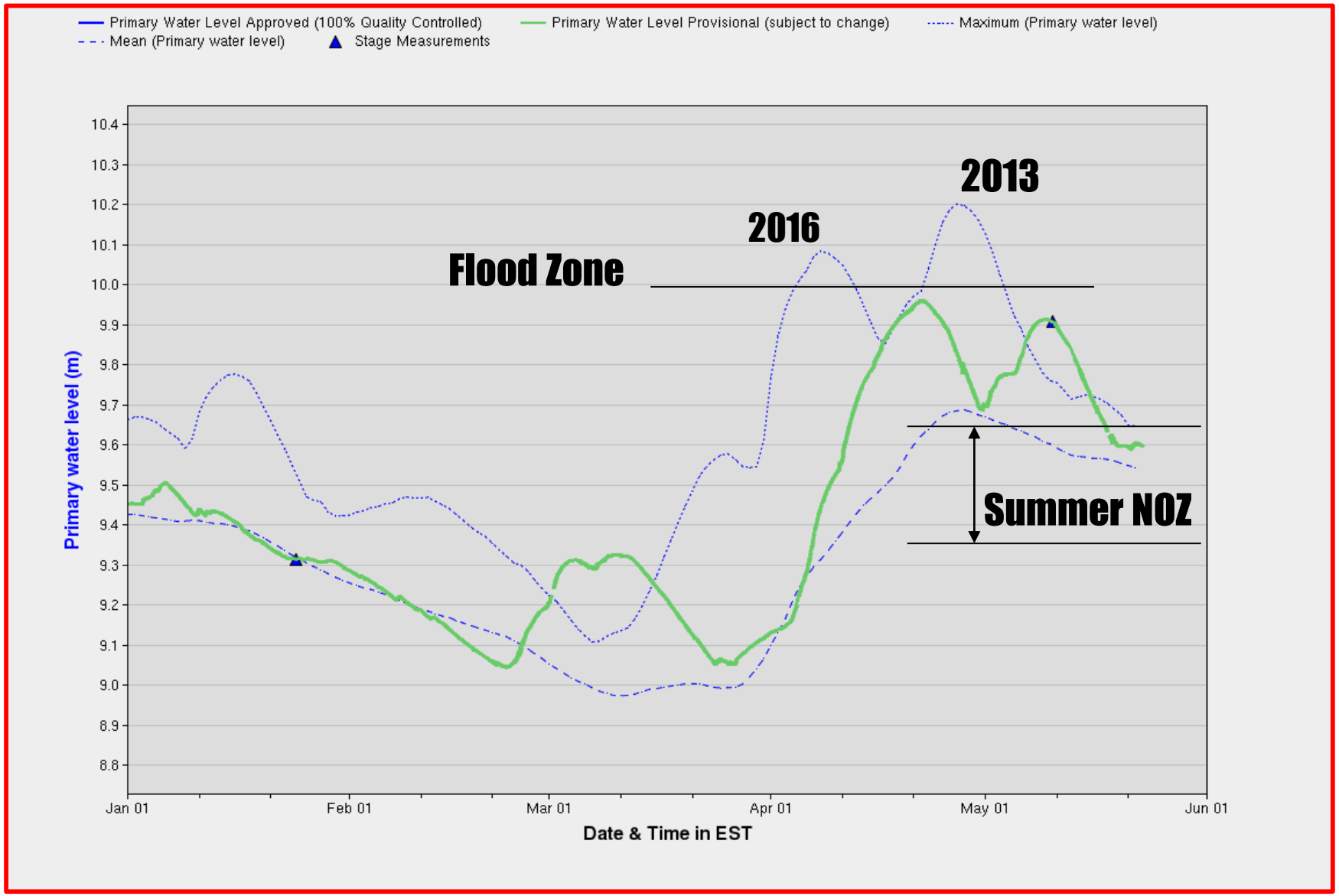
Seminar topics

- How high is your dock?
- Where does all the water come from?
- How are water levels managed?
- Have water levels always been low until recently?
- So what is different – Climate Change?
- What does the future hold?
- Can the system of management be changed?
- What can you do to protect your property ?

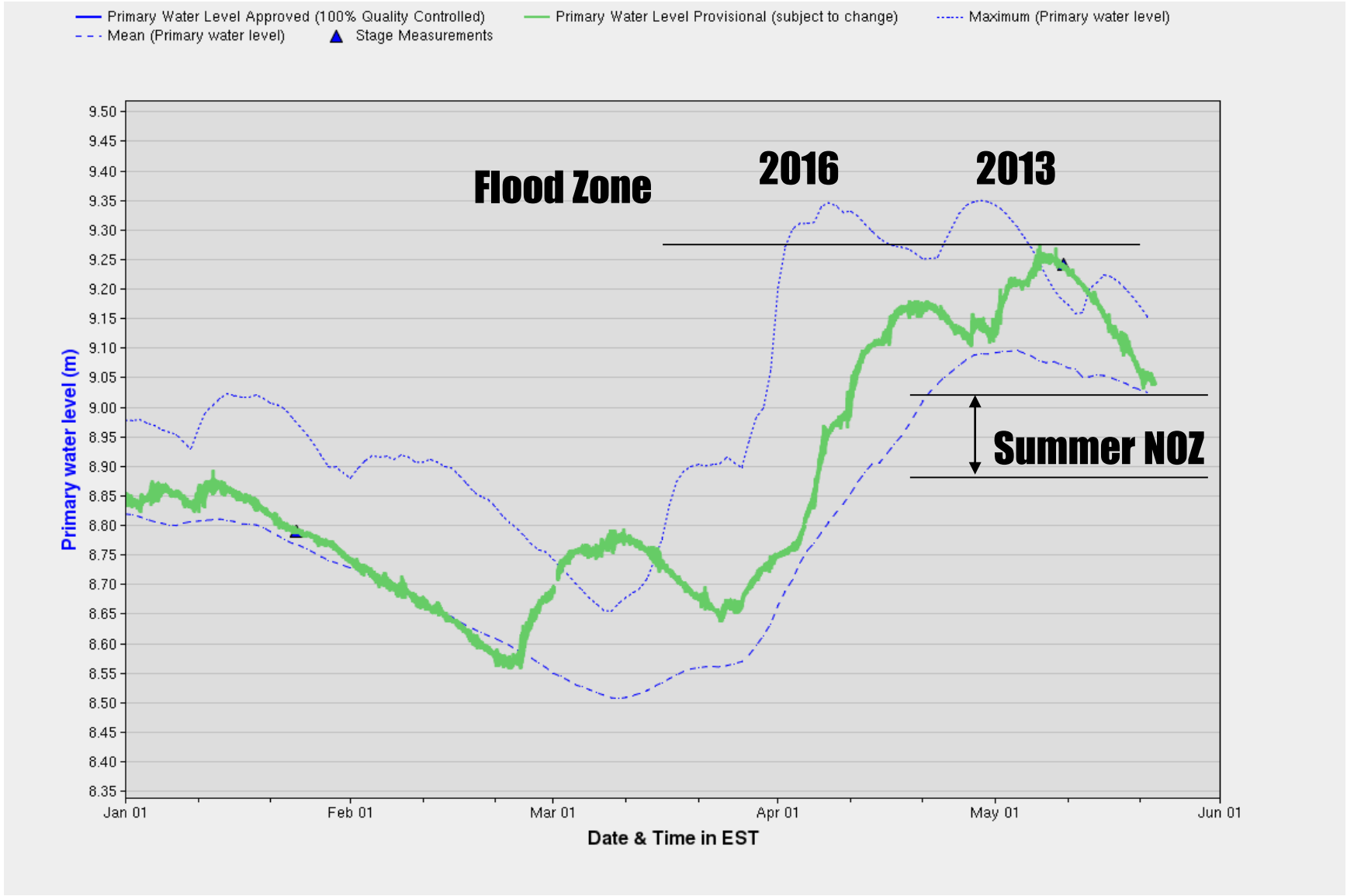
How high is YOUR dock ?

- First – a quiz: How many followed the MLA water level newsletters?
- How many already know the elevation of their dock/ boathouse?
- How many are on Lake Muskoka? On Lakes Rosseau & Joseph ? On Muskoka or Moon River ? On smaller lakes ?
- Follow your lake level on www.muskokawaterweb.ca & select water 101
- Summer Levels – Lake Muskoka 9.55m +/- [conversion 215.95m]
  - Lakes Rosseau & Joseph 8.95m +/- [conversion 217.12m]

Water Level History 2017 – Lake Muskoka



Water Level History 2017 – Lakes Rosseau & Joseph



MRWMP –

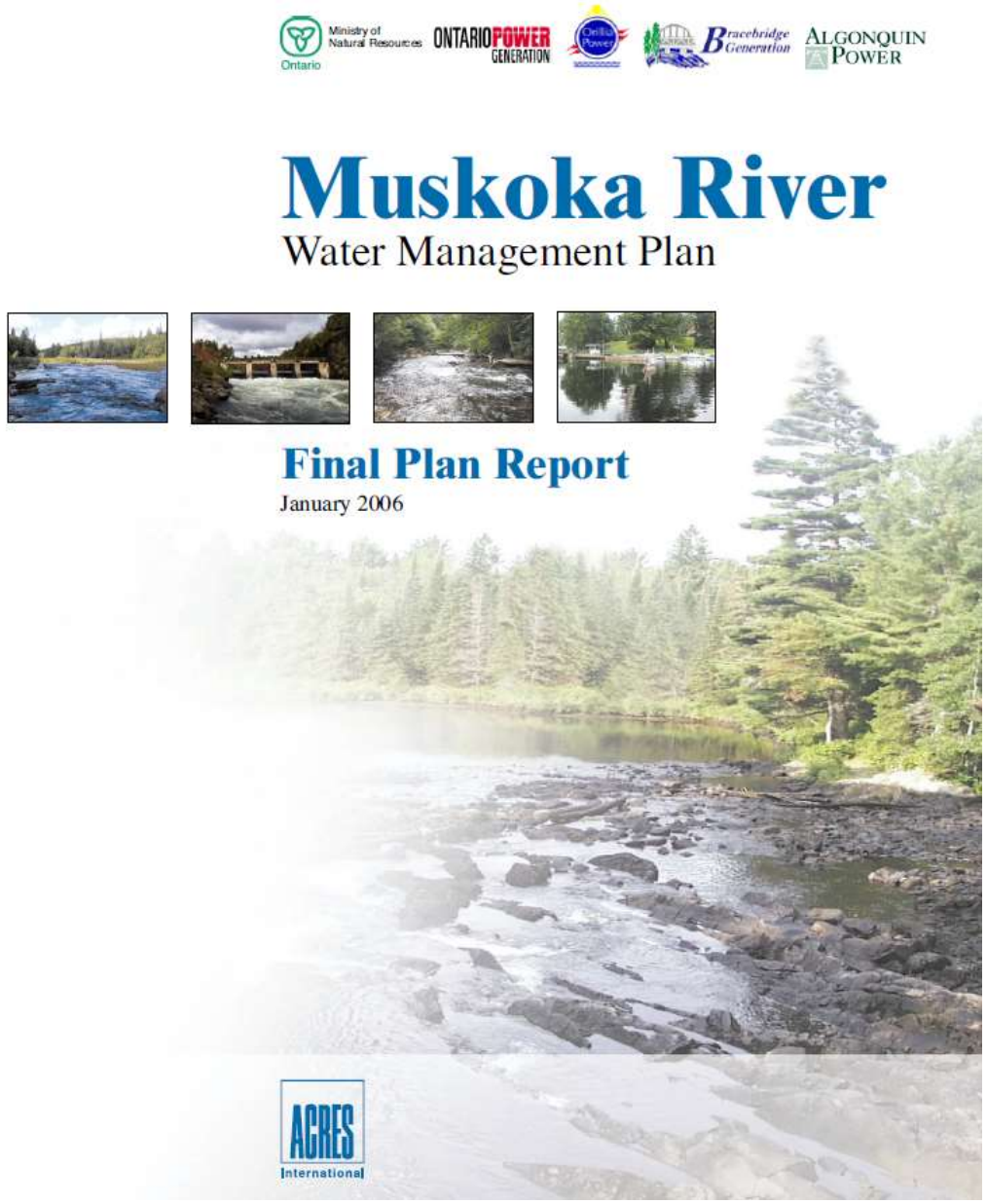
Muskoka River Water Management Plan

- THE control document for MNRF and power company operation of lake levels and flows on the Muskoka River

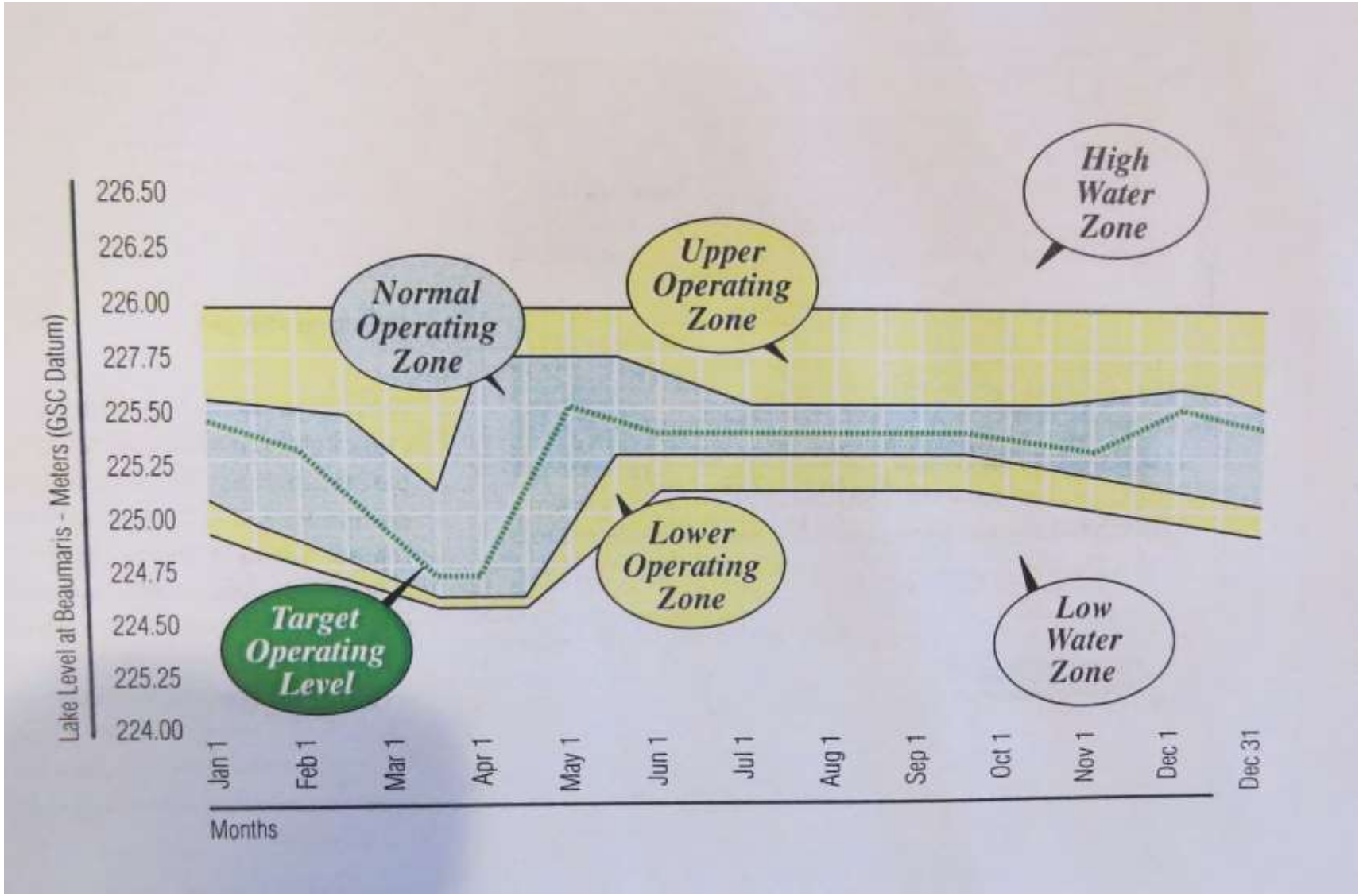
- Implemented 2006

- Rule Curves for each lake

-Previous control by Hackner-Holden agreement 1940, revised 1969



What is "Normal" – the Rule Curve [Muskoka River Water Management Plan]



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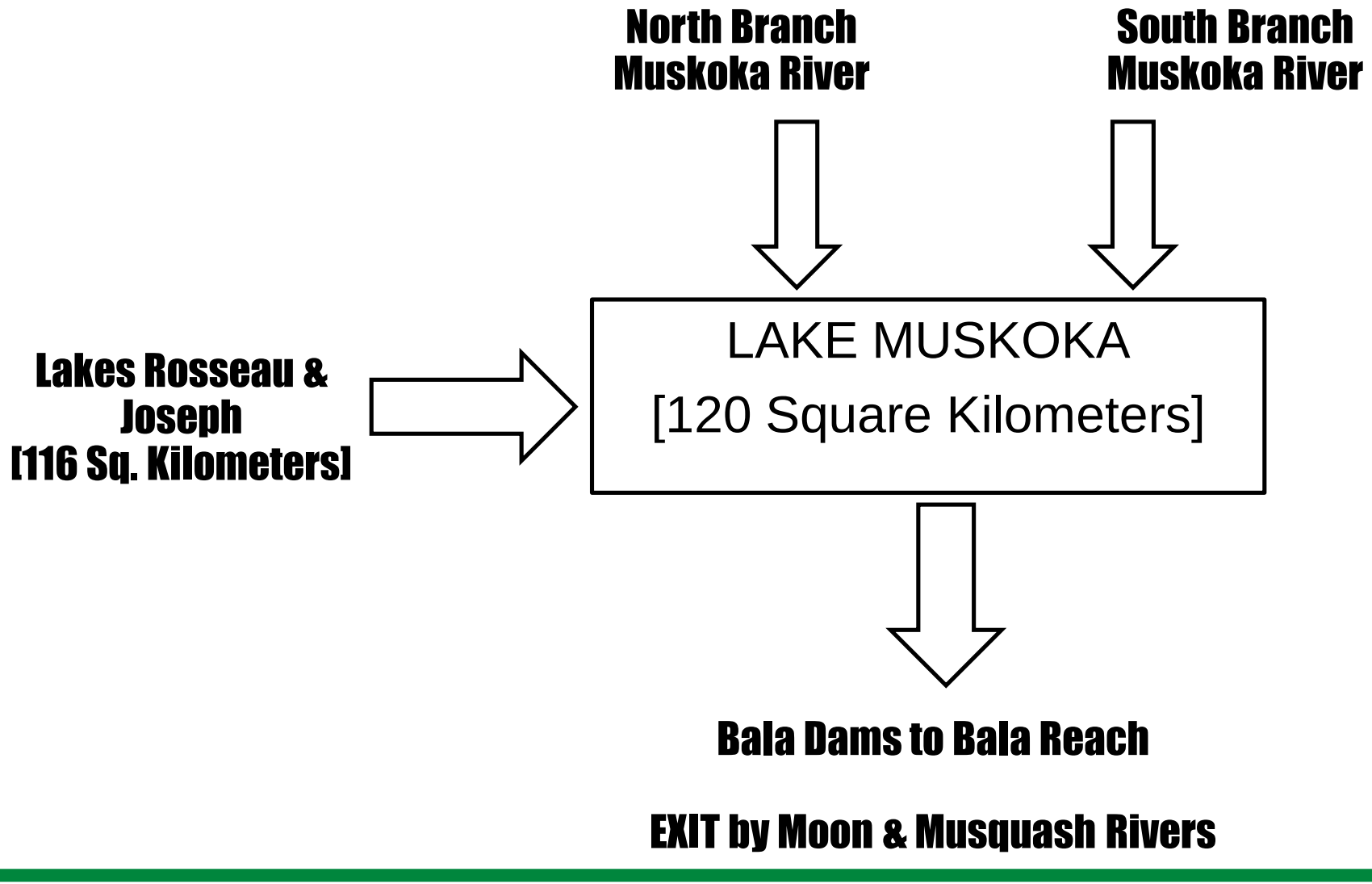
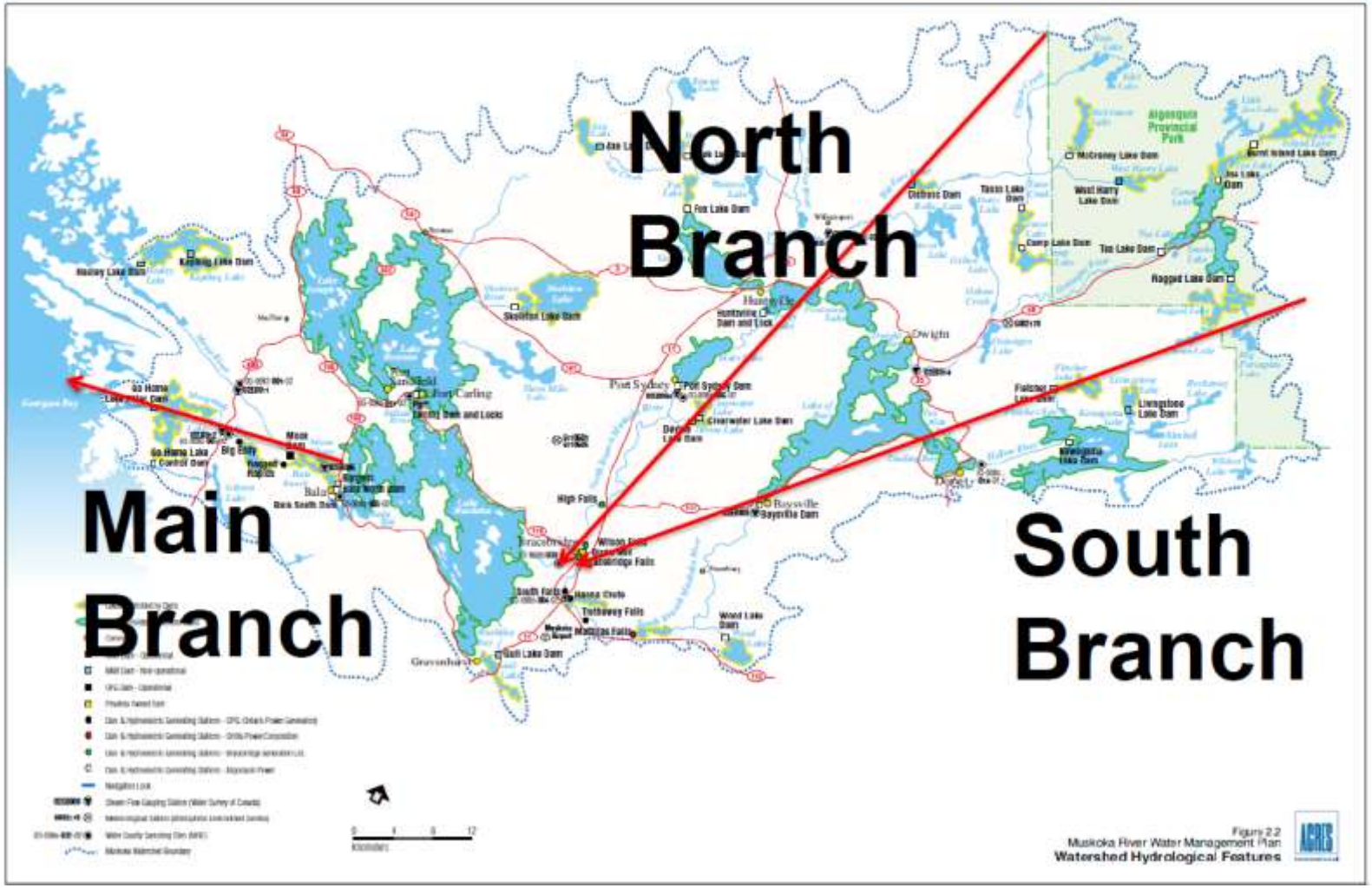
General View of a Watershed

Simplified Flow Diagram of the Muskoka River



Muskoka River Watershed Map

2016 Levels and Flows



Where does all the water come from ?

Lakes Muskoka, Rosseau & Joseph are part of

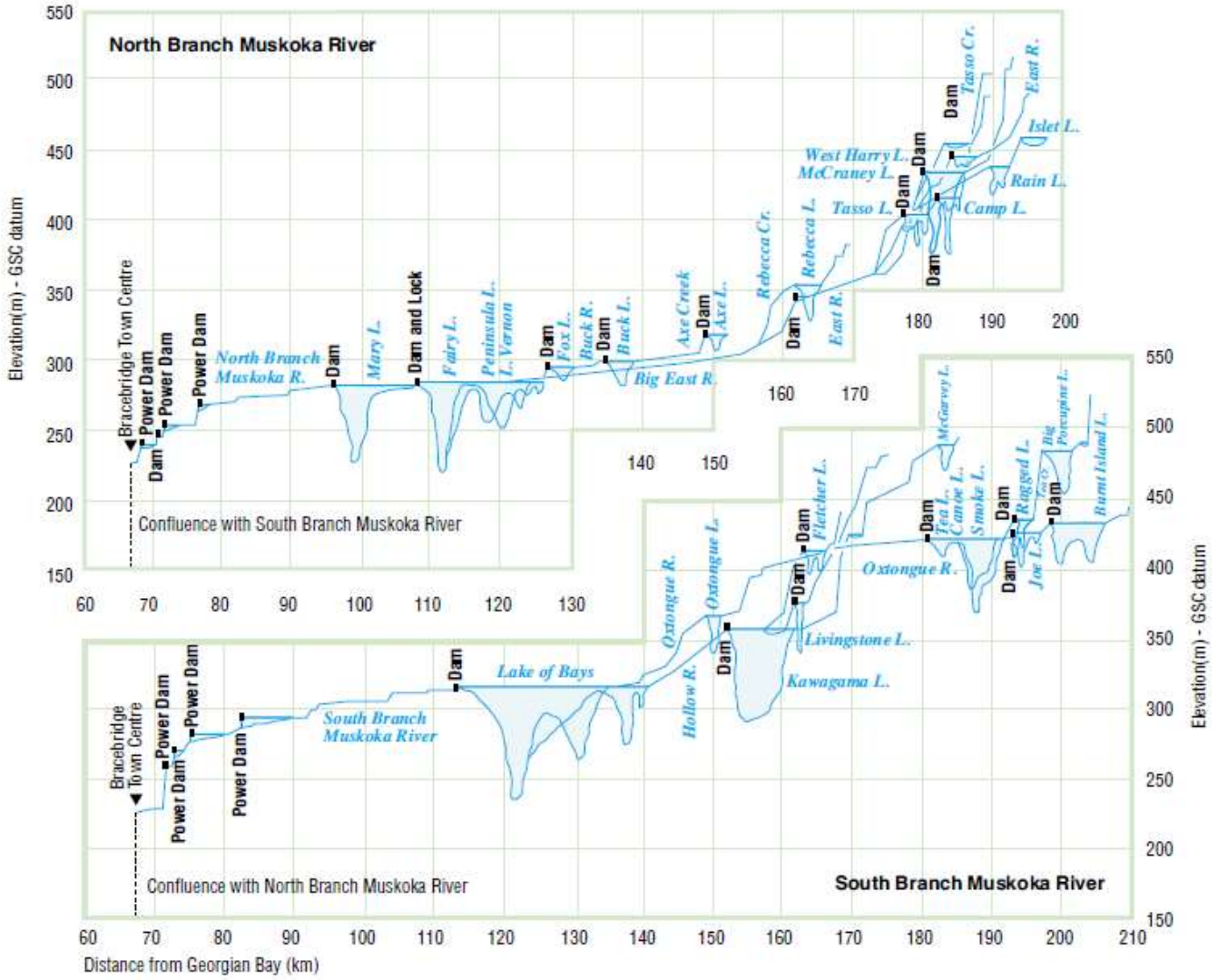
The Muskoka River Watershed [2,000 lakes]

Watershed Area 5,000 Square Kilometers, includes:

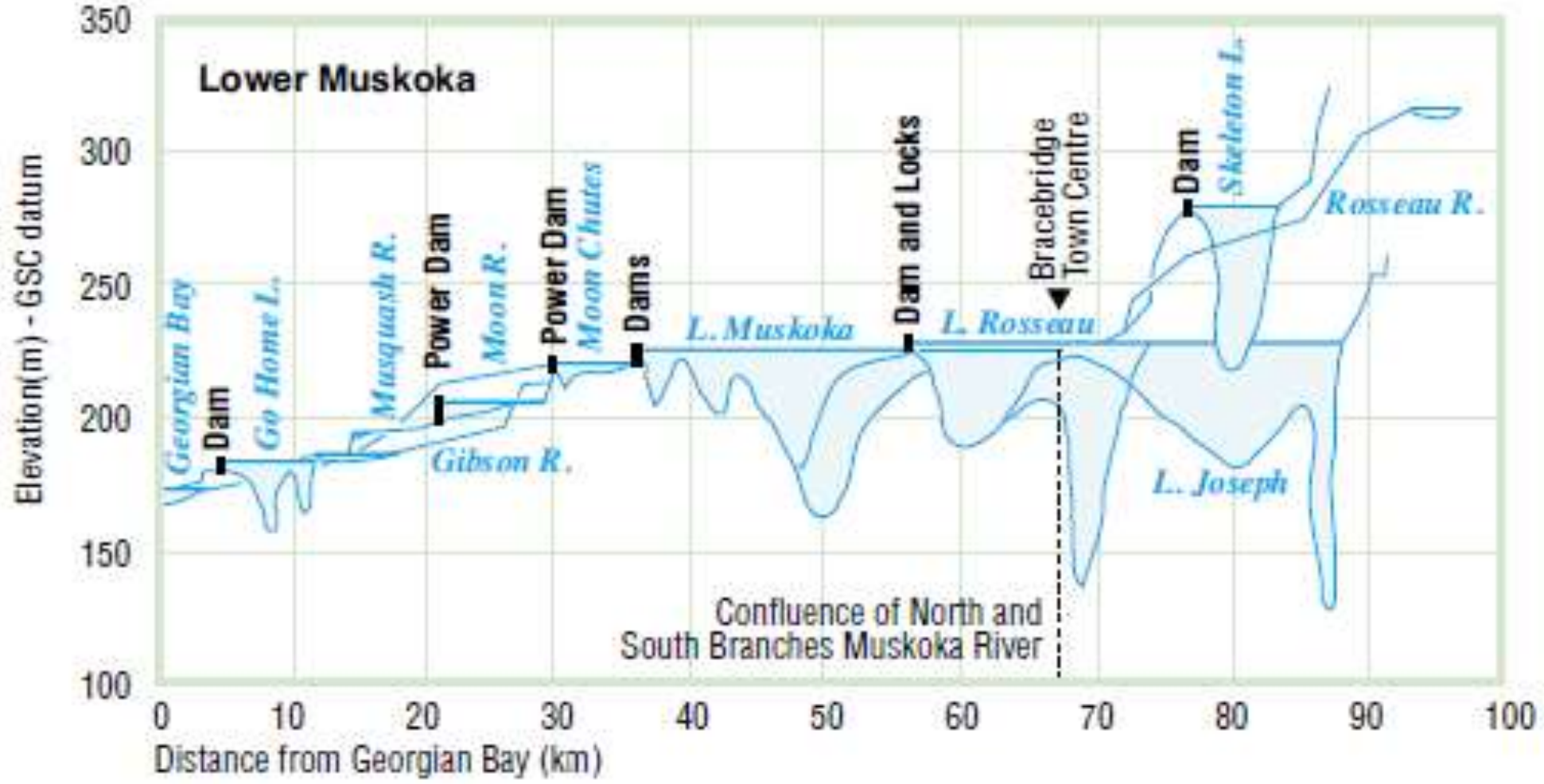
- North Muskoka River [1568 sq. km] from Algonquin Park
- South Muskoka River [1628 sq. km] from Algonquin Park
- Upper Lakes [sub-basin] – Rosseau & Joseph [800 sq.km]

- Flows 210 km and drops 300m to exit at Georgian Bay

Upper Muskoka River – Cross Section North & South Branches

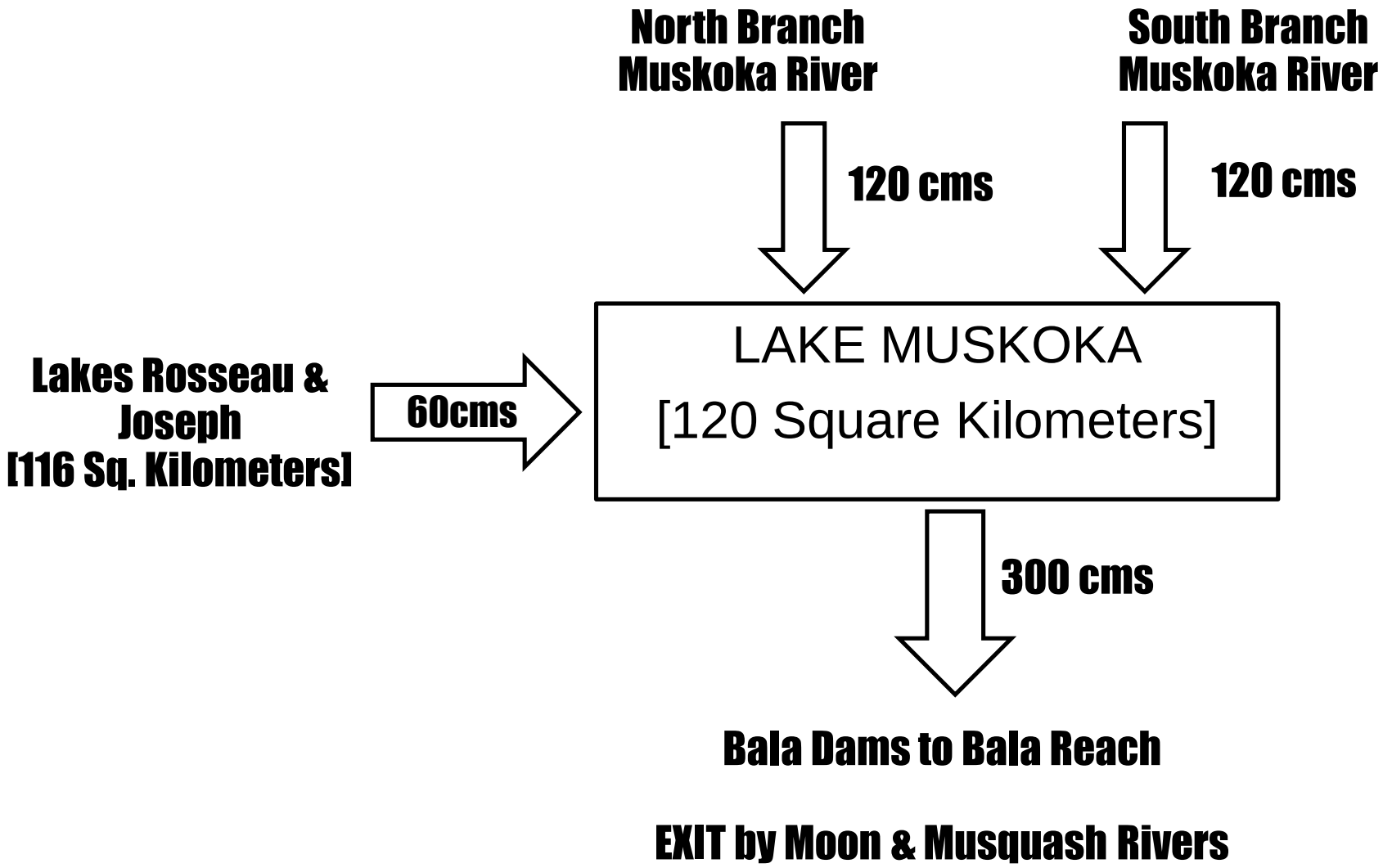


Lower Muskoka River – Cross Section



Simplified Flow Diagram of the Muskoka River

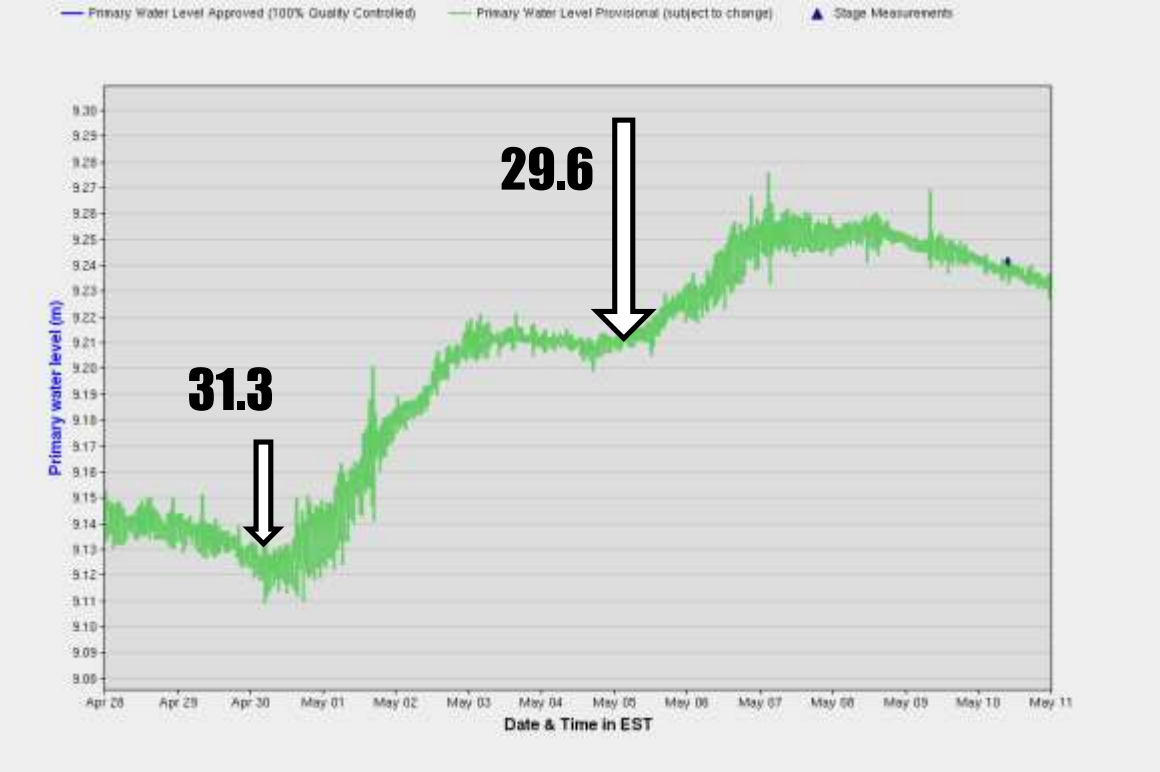
[Flood Flow Quantities]



Where does all the water come from ? [2]

- Muskoka gets over 1000mm/yr, wettest in the Province, including 300 cm snow
- Some soaks into the ground [50% in summer/ 20% in Spring], some is lost to evaporation/evapotranspiration but the rest runs off
- Most critical events for flooding are:
  - (a) heavy summer rainfall or
  - (b) rapid spring melt of heavy winter snow + spring rain

Lakes Rosseau & Joseph – response to rain



- Drainage Area = 800 Sq. Km.
- Lake Area = 116 Sq. Km.
- Runoff Coefficient = 0.5 – 0.8

- Ratio = 5.5 winter/3.4 summer

- Rainfall = 31.3 mm [2 days] translates into 17.2 cm rise

- Outfall = 45 cms = 3.3 cm/day
- Actual value = 1 – 1.5 cm/day

Flow Restrictions – why water cannot be moved faster

- Muskoka River from Bracebridge is long and windy
- Silt has built up at mouth of Muskoka River, slowing flow

- Locks and narrows at Port Carling [flow capacity about 45 – 60 cms]
- Narrows on Indian River downstream of Port Carling

- Three narrows between Main Lake Muskoka and Bala Bay [Wallis Cut; Jannock Narrows and Coulter Narrows cause a 12” – 18” backup

- Downsteam of Bala Reach the Moon Chutes limits flow above 85 cms

The Lake Effect Snow Machine

- Lately the Great Lakes have remained “open” through much of the winter
- Snow recipe = 100 km fetch over open water + 13 C water/air difference
- Snow streamers in direction of wind [over 300 cm snow per year]
- Water content of snow measured all winter by MNRF using snow cores [stations at Kiwanis, Big East, Norway Point, and Rosseau]

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Monitoring & Daily Dam Operations [Courtesy MNRF Parry Sound]

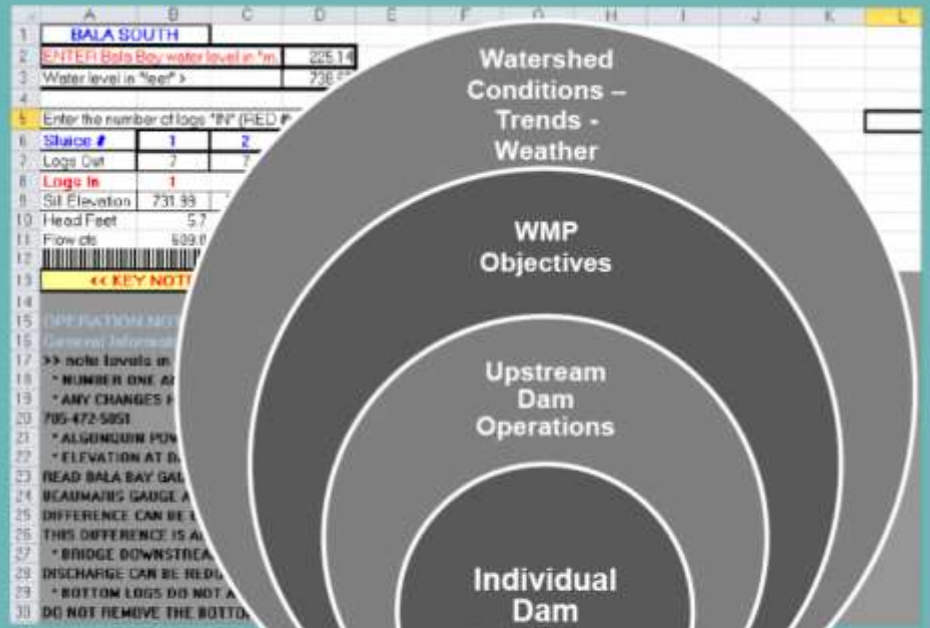
Ministry of Natural Resources

Ontario

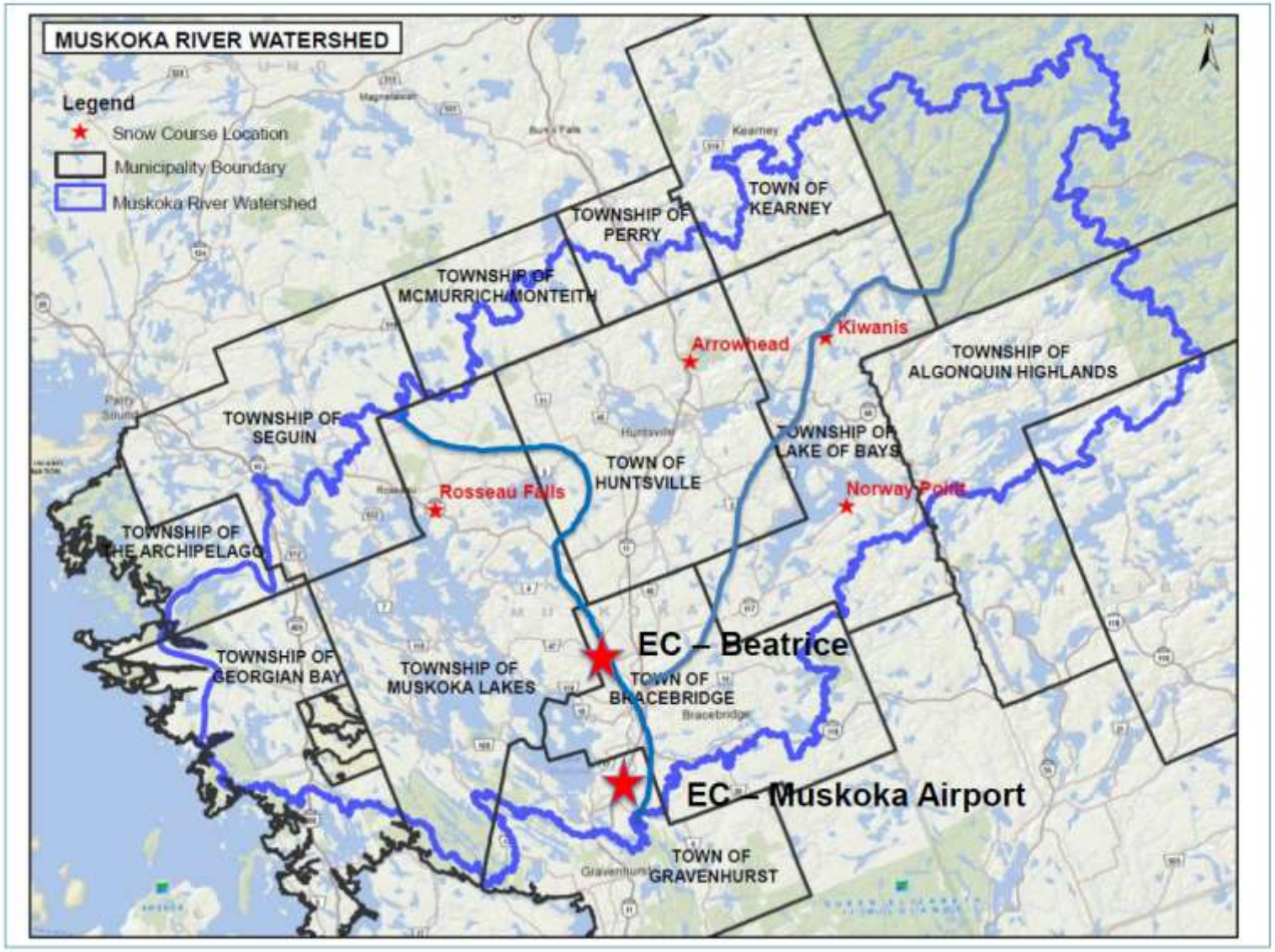
Natural. Valued. Protected.

Daily Planning Cycle: Monitoring and Dam Operations

- 24 lake gauges and 12 river gauges checked daily
- Weather from three sources recorded
- Water level and flow trends assessed against rule curve (WMP objective)
- Operational decision made and communicated to downstream partners
- Flood Forecasting and warning message issued if warranted



Muskoka River Watershed – snow & weather stations



WMP – How MNRF manages levels for SNOW

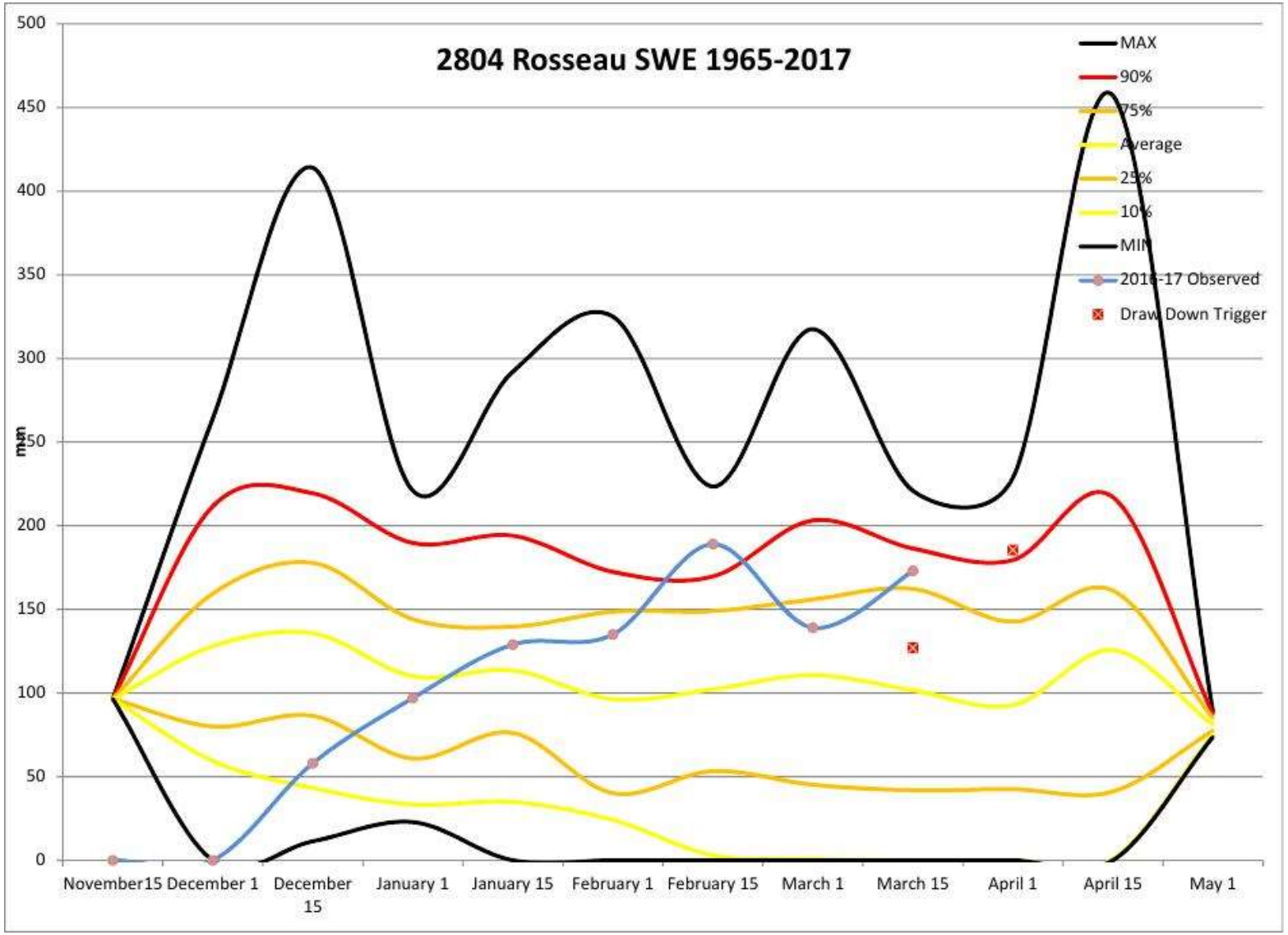
1 - If snow pack water content is >25% above normal on March 15 on the North Branch of the Muskoka River, lakes controlled by MNR will be lowered to the bottom of the NOZ.

2 - If snow pack water content is >50% above normal on March 15 on the South Branch of the Muskoka River, lakes controlled by MNR will be lowered to the bottom of the NOZ.

3 - If snow pack water content is >100% above normal on April 1 on both branches of the Muskoka River, lakes controlled by MNR will be lowered to the bottom of the LOZ.

Sample Snow Record – Winter 16/17 vs Past Data

Snow Water Equivalent mm



Date Measured

WMP – How to manage levels for RAIN

Rain

Similarly, frequent rain and/or high temperatures and/or frozen ground can contribute to abnormal runoff and/or flow events. The following additional provisions apply under those conditions:

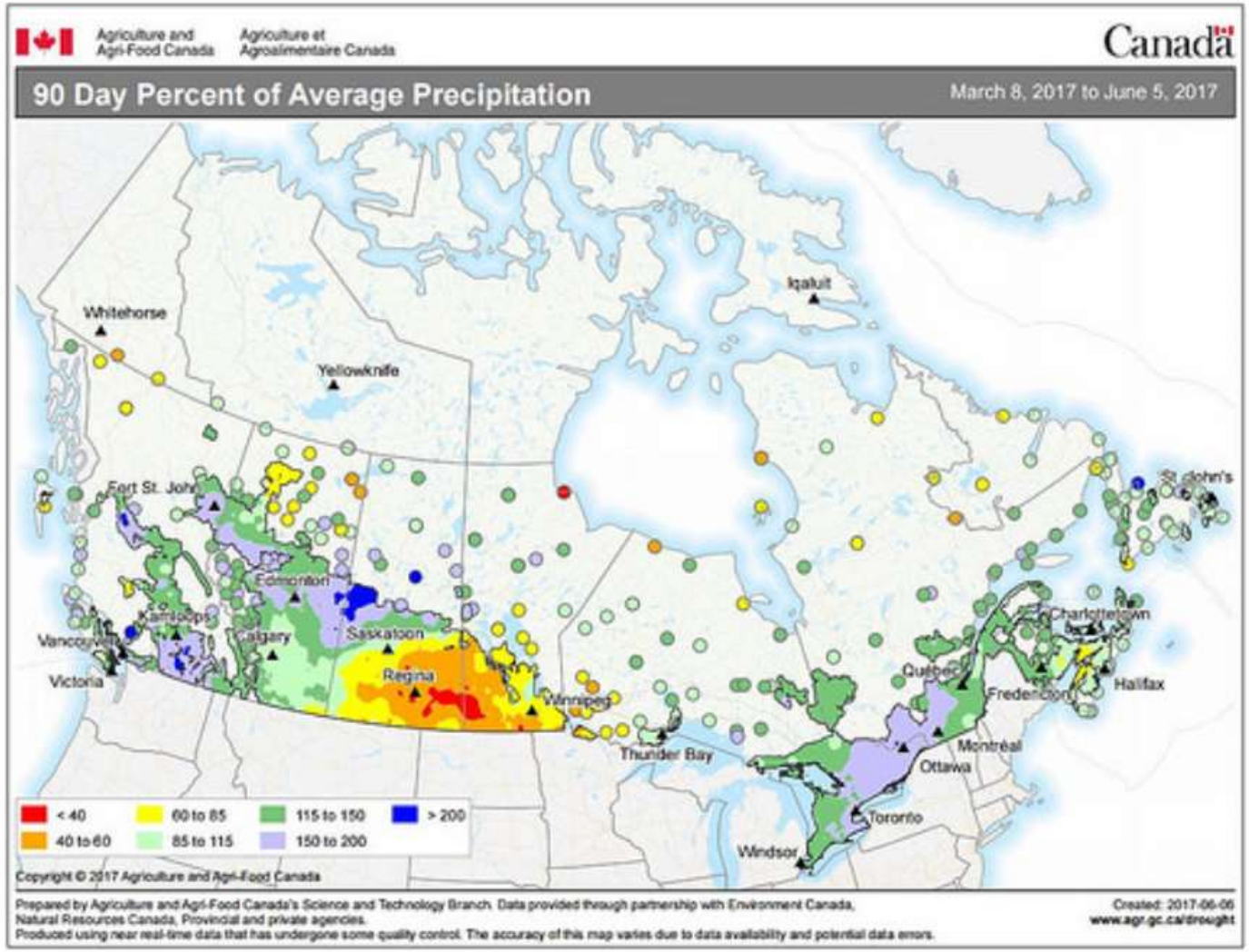
1 - On unfrozen ground, with 25 mm of rain in 1 day or 50 mm rainfall over several days and/or >10°C during the day for more than 2 days or above 0°C overnight for more than 2 days, lakes controlled by MNR will be lowered to the bottom of the NOZ.

2 - On frozen ground, with 25 mm of rain in 1 day or 25 mm rainfall over several days and/or >10°C during the day for more than 2 days or above 0°C overnight for more than 2 days, lakes controlled by MNR will be lowered to the bottom of the NOZ.

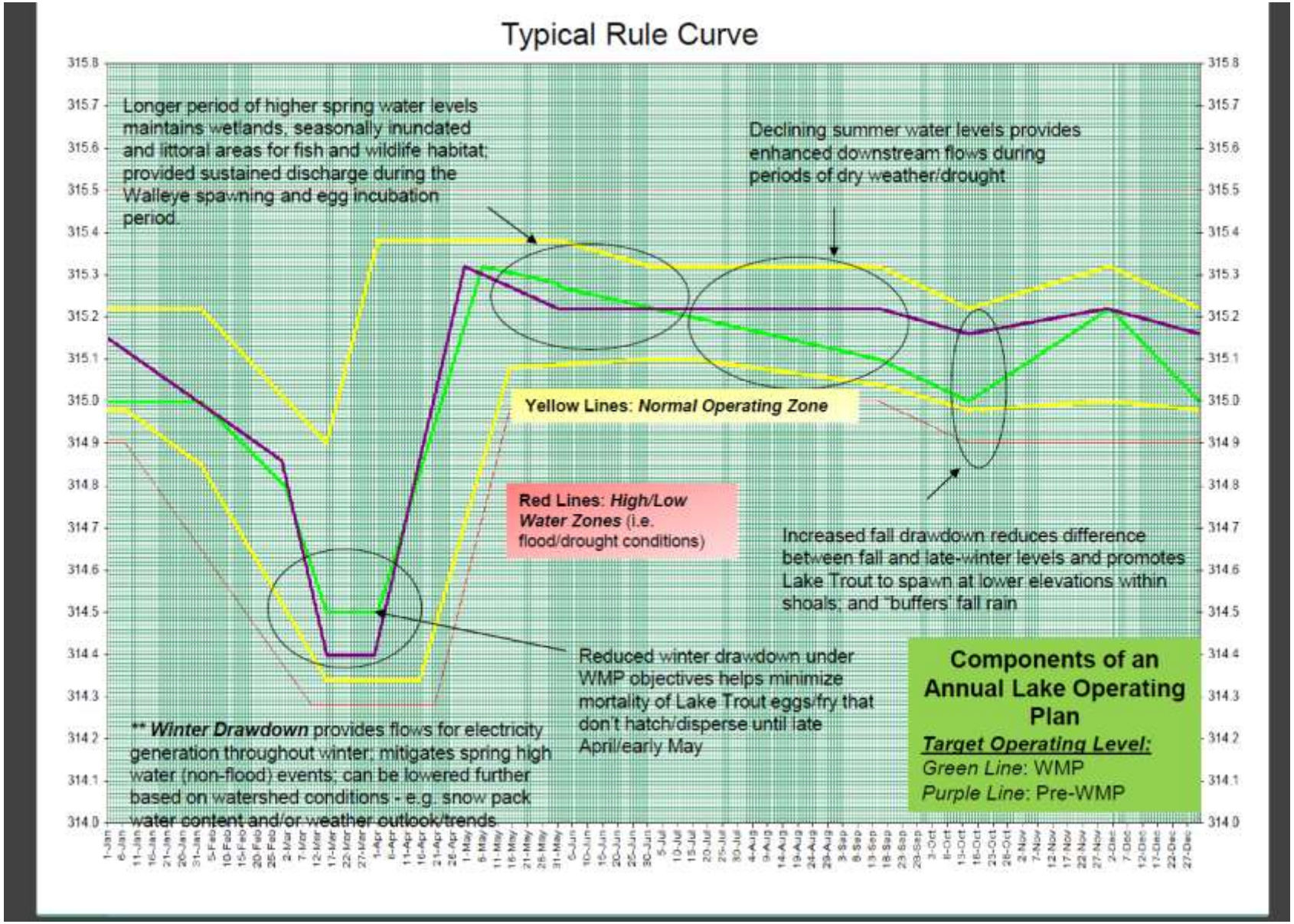
Precipitation Records 2007 – 2017 [Beatrice]

Month	2012	2013	2014	2015	2016	2017	Average	Median	Normal
							2008-2017	2008-2017	1981-2000
DEC	95	76	97	95	109	154	63	97	126
JAN	79	114	98	95	92	109	65	95	116
FEB	38	83	42	30	104	83	42	68	82
MAR	35	55	65	44	182	87	47	65	76
APR	49	175	92	89	64	155	62	95	78
MAY		123	104	74	56	130			99

Spring Rainfall 2017 – 115 to 200 % above Average



Typical Rule Curve – lake level vs date [courtesy MNRF Parry Sound]



Major Lakes & Control Dams on the Muskoka Watershed

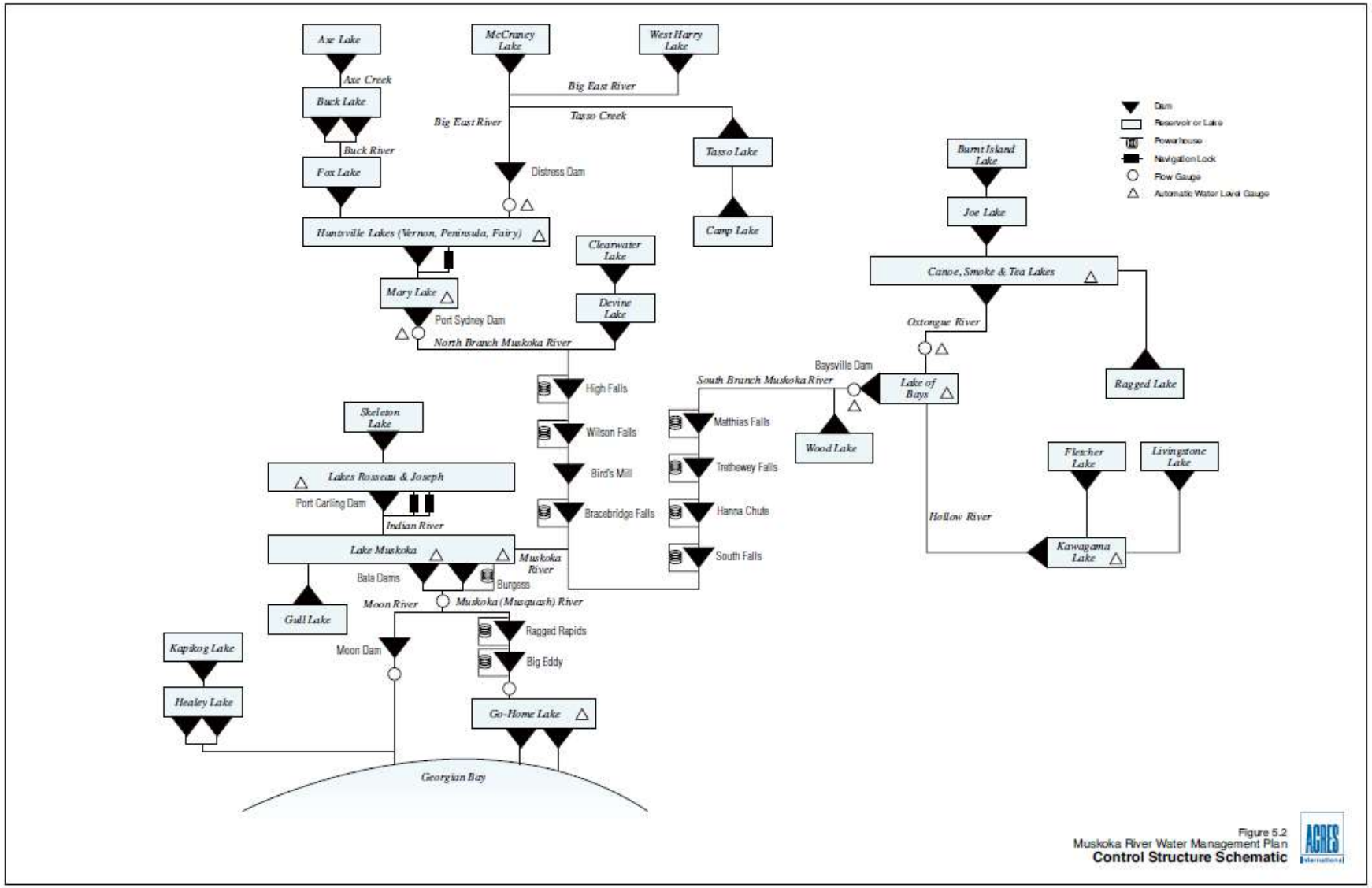


Figure 5.2
Muskoka River Water Management Plan
Control Structure Schematic

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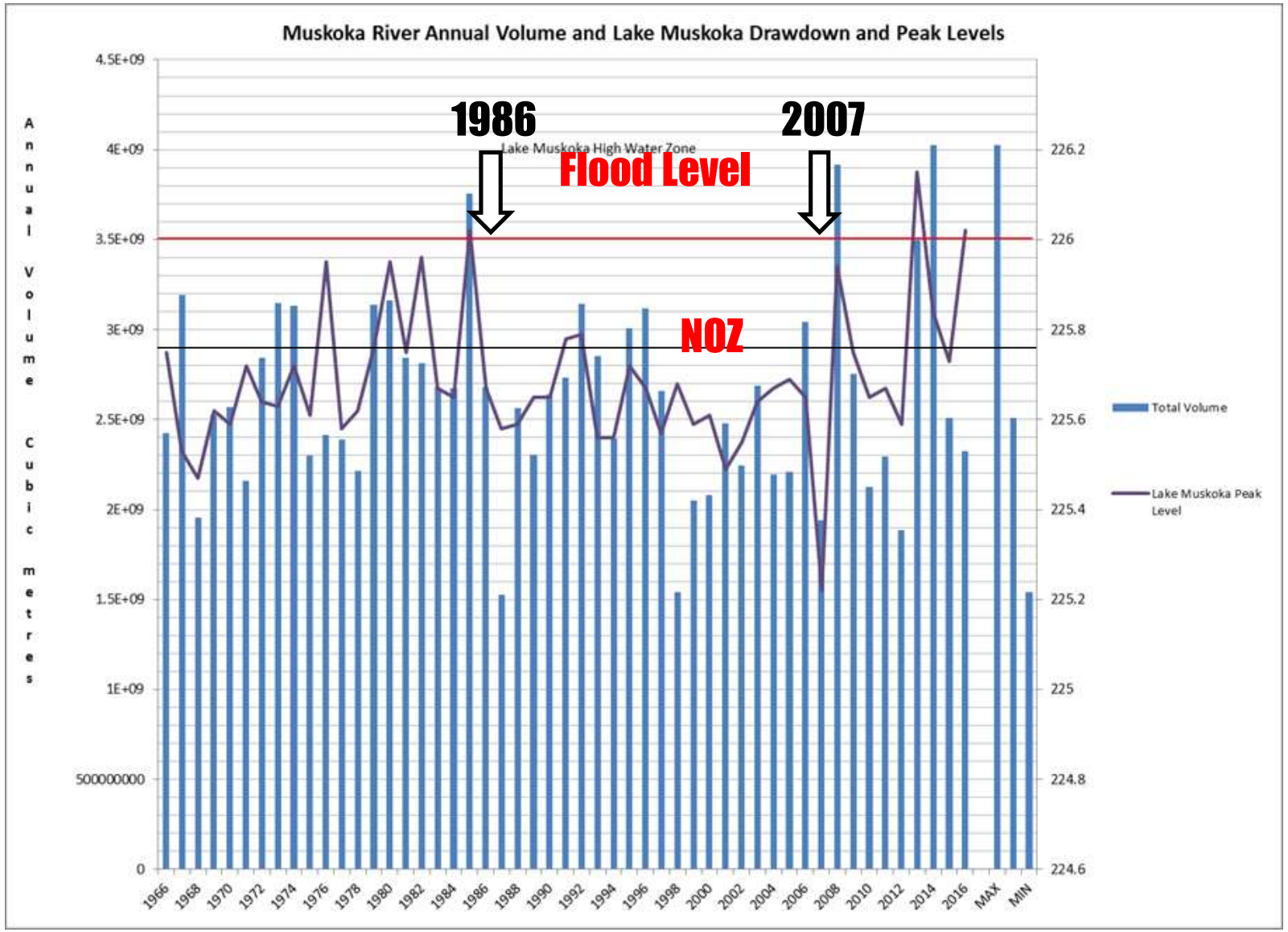
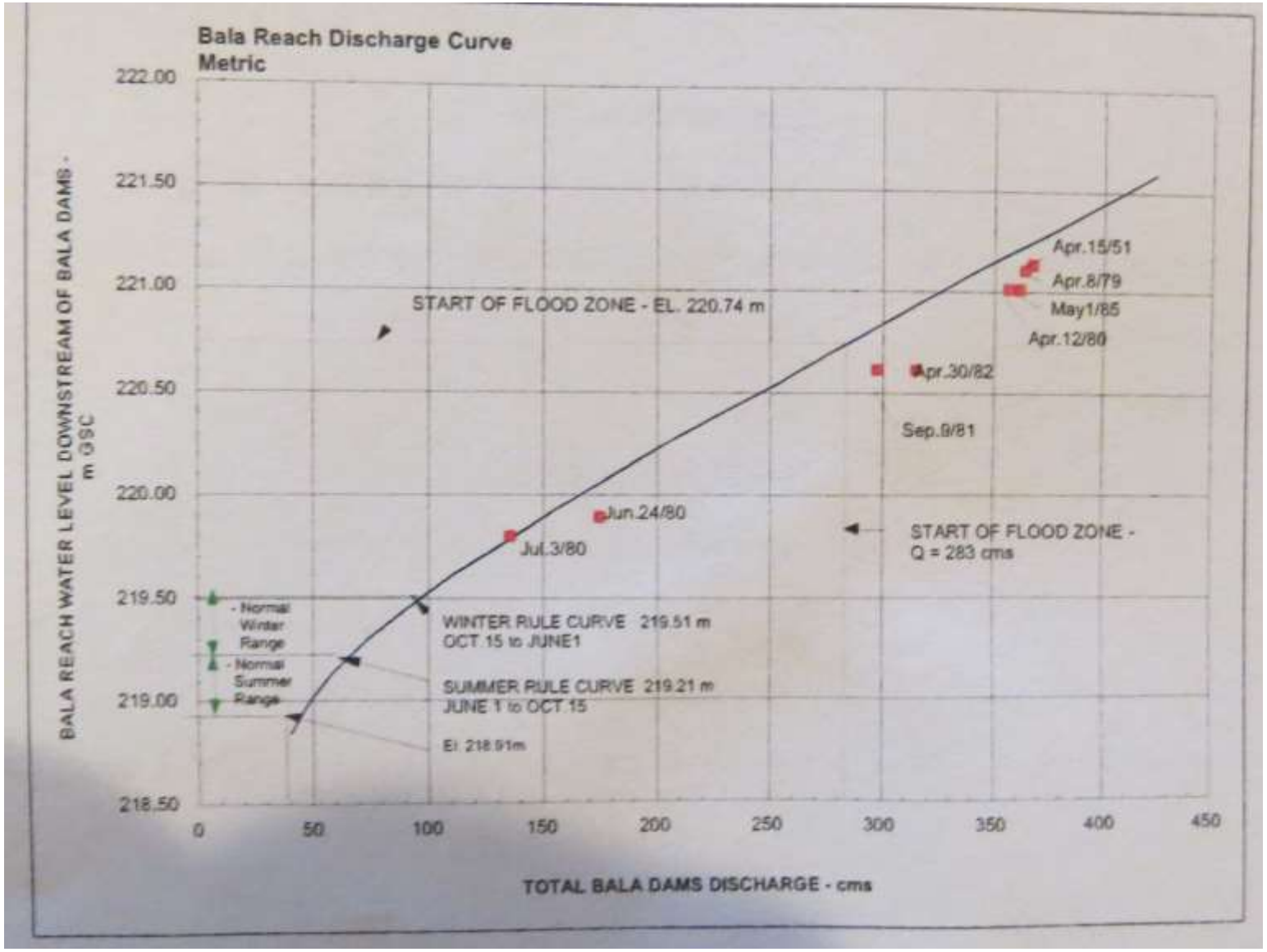
Have Water Levels only been high recently ? [MNRF Parry Sound]



Flows through Bala 1975 to 2006 [note high flows Top Right Corner] Fig 5.4



330 cms

1.8 m = 6 ft

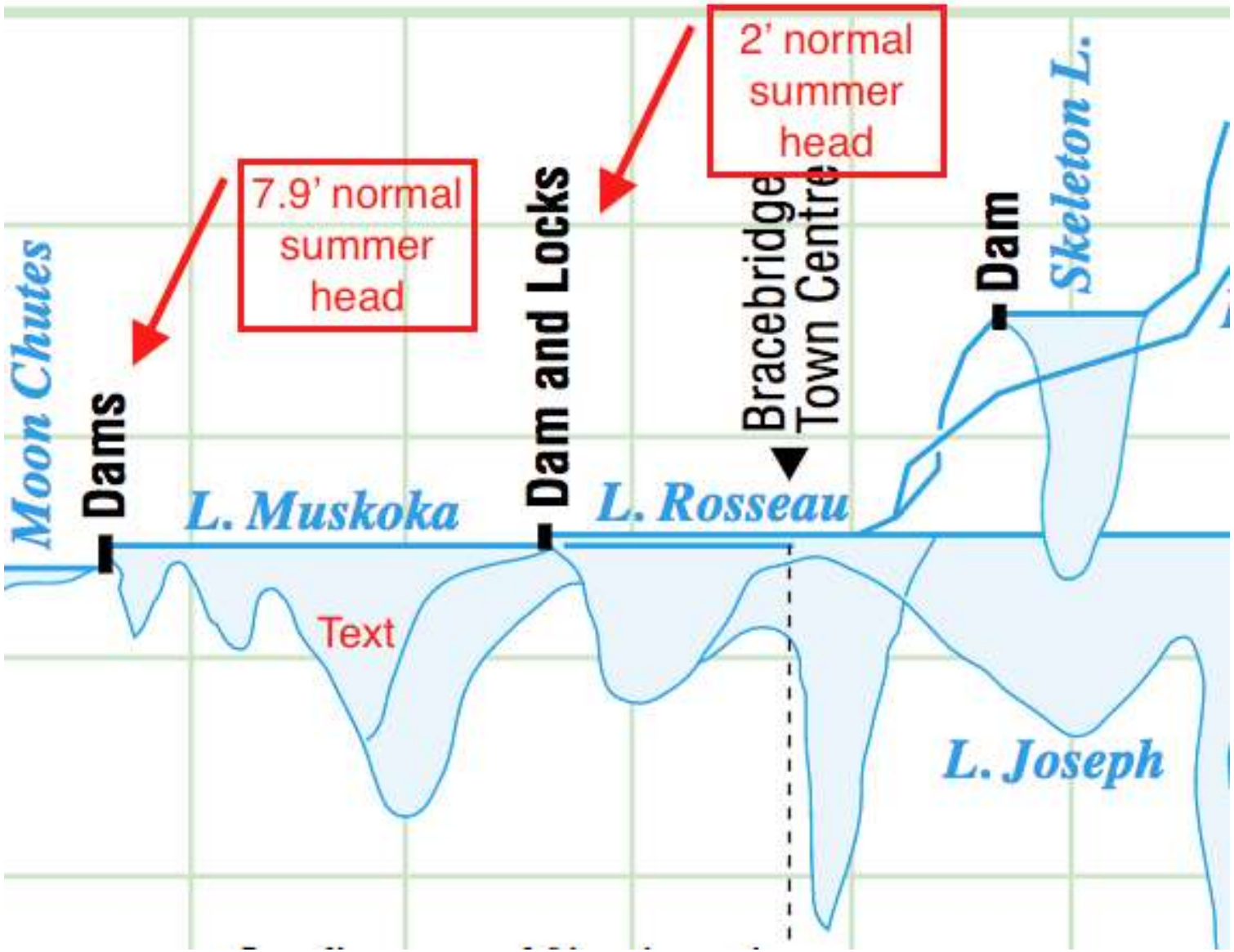
50 cms

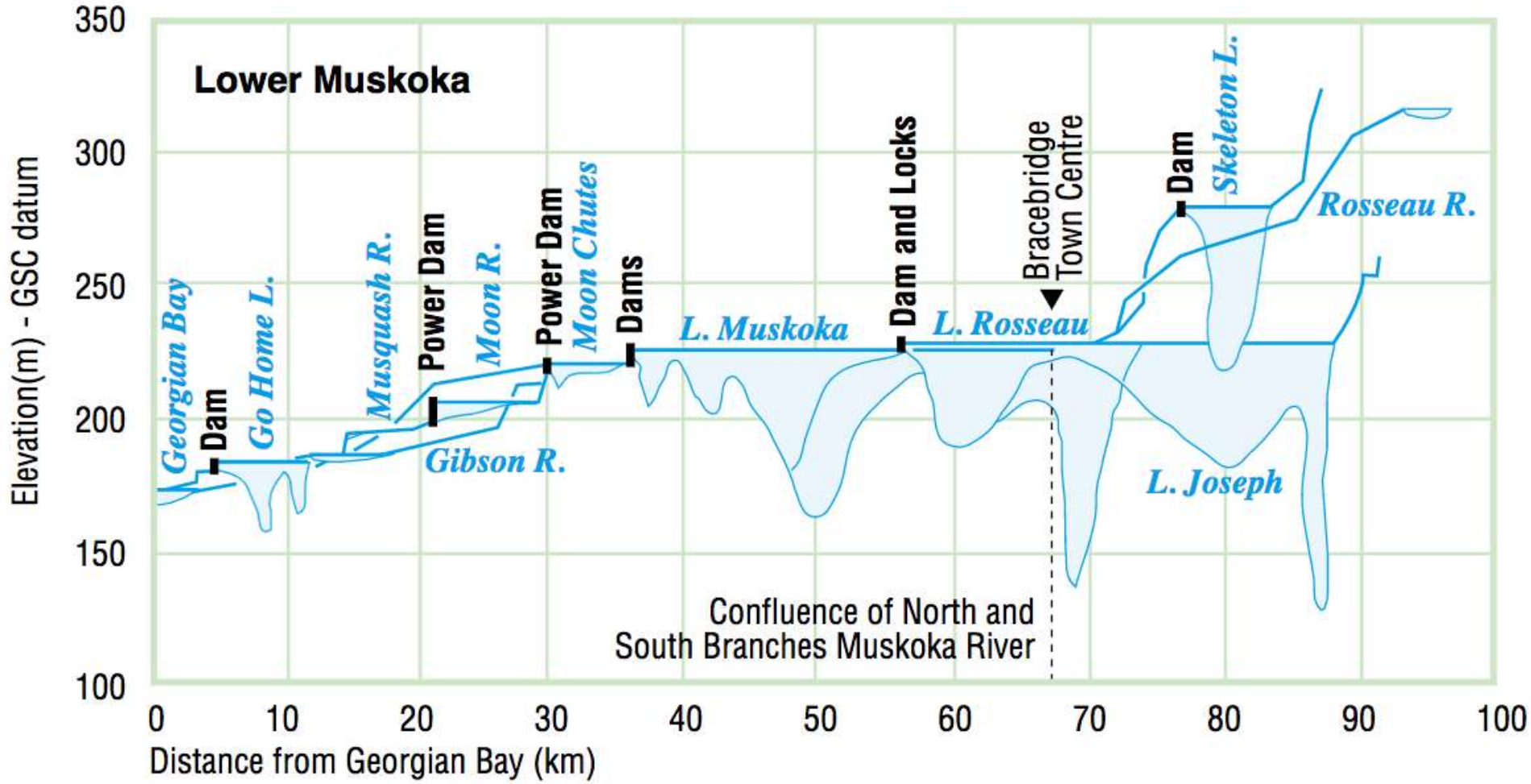
Historical Levels - Dams, Cuts and Locks [Ian Turnbull]

- 1871 Port Carling big locks
- 1871 Port Sandfield cut & Joe River blasting
- 1873 Bala north falls dam + 1878 south falls
- 1878 Huntsville (Brunel) locks and dam
- 1886 Canal between Peninsula & Fairy Lakes
- 1921 Port Carling small locks

Changes Made

- Before the locks and dam at Port Carling, natural Indian River fall was about 1’
- Before Port Sandfield cut and Joe River blasting, Lake Joseph was about 1 ½’ higher than Lake Rosseau
- After the combined works, Lakes Joseph and Rosseau at same level, about 2’ above Lake Muskoka


2' normal summer head
7.9' normal summer head
Moon Chutes
Dams
Dam and Locks
Bracebridge Town Centre
Dam
Skeleton L.
L. Muskoka
L. Rosseau
Text
L. Joseph


Lower Muskoka
Elevation(m) - GSC datum
350
300
250
200
150
100
0
10
20
30
40
50
60
70
80
90
100
Distance from Georgian Bay (km)
Georgian Bay
Dam
Go Home L.
Musquash R.
Power Dam
Gibson R.
Moon R.
Power Dam
Moon Chutes
Dams
L. Muskoka
Dam and Locks
L. Rosseau
Bracebridge
Town Centre
Dam
Skeleton L.
Rosseau R.
L. Joseph
Confluence of North and
South Branches Muskoka River

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Thanks to Watershed Council – IPCC Modelling has been done for Muskoka

Earlier Ice Out / Fewer Days of Ice Cover [MWC]

Adobe Reader Touch

detailed record of hydrology and water chemistry is available. Figures 3 and 4 provide information on current climate and hydrology at Harp Lake. Figure 9 provides current ice phenology, and Figure 10 shows number of days with and with-

out ice cover in the recent past for Harp and other monitored lakes in this part of Muskoka. Over the past three decades, the climate at Harp Lake has become significantly warmer, and the duration of the open-water season has correspondingly increased

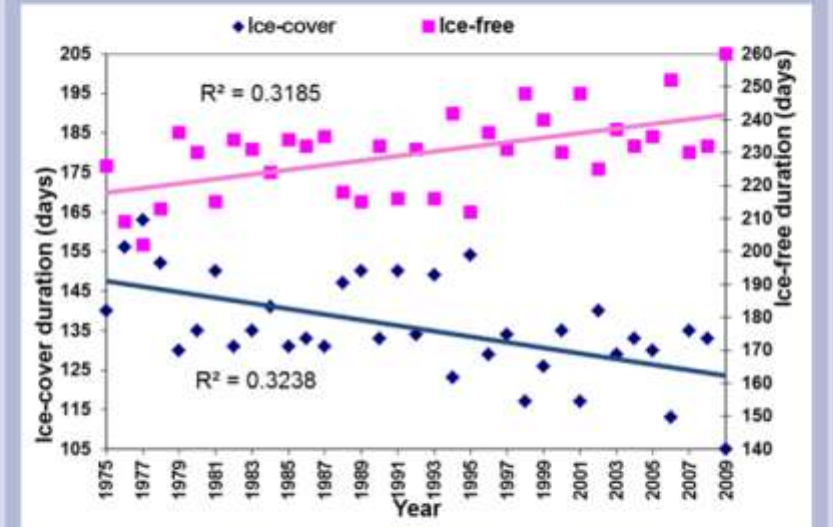

Figure 10. Duration of open-water and ice-covered seasons at Harp Lake from 1975 to 2009. The number of days each year that the lake is ice-covered (blue diamonds, left-hand axis) has reduced significantly over the 34-year period, while the duration of the open water season (pink squares, right-hand axis) has correspondingly expanded (also significantly). Figure based on Dorset Environmental Science Centre data.

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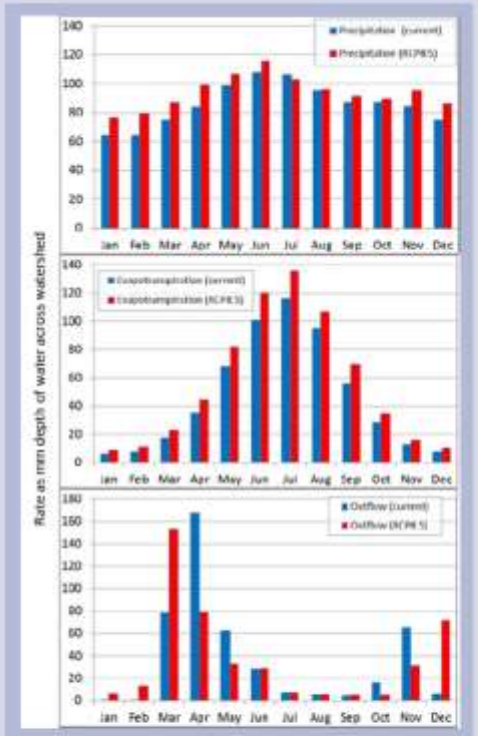


Figure 11. Seasonal pattern of precipitation, evapotranspiration, and outflow from the Harp Lake catchment during typical years under the present climate and that expected at mid-century under the RCP8.5 scenario. Quantities of all three are expressed as depth (mm) of equivalent volumes of water across the area of the watershed. Figure based on Dorset Environmental Science Centre data and output from the USGS hydrological model. Details in text.

2:03 PM
6/3/2017

Climate Change evidence at Barrie, Ontario [FOCA]

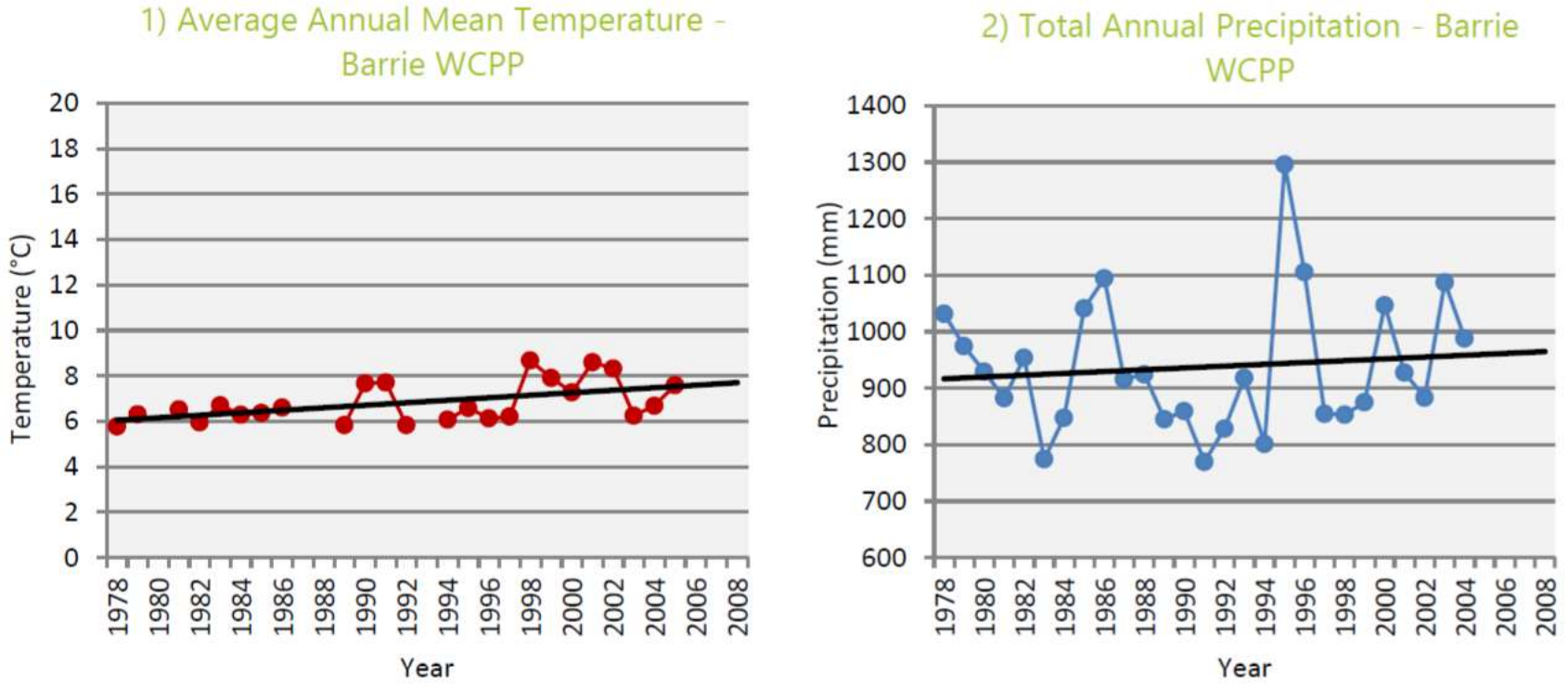
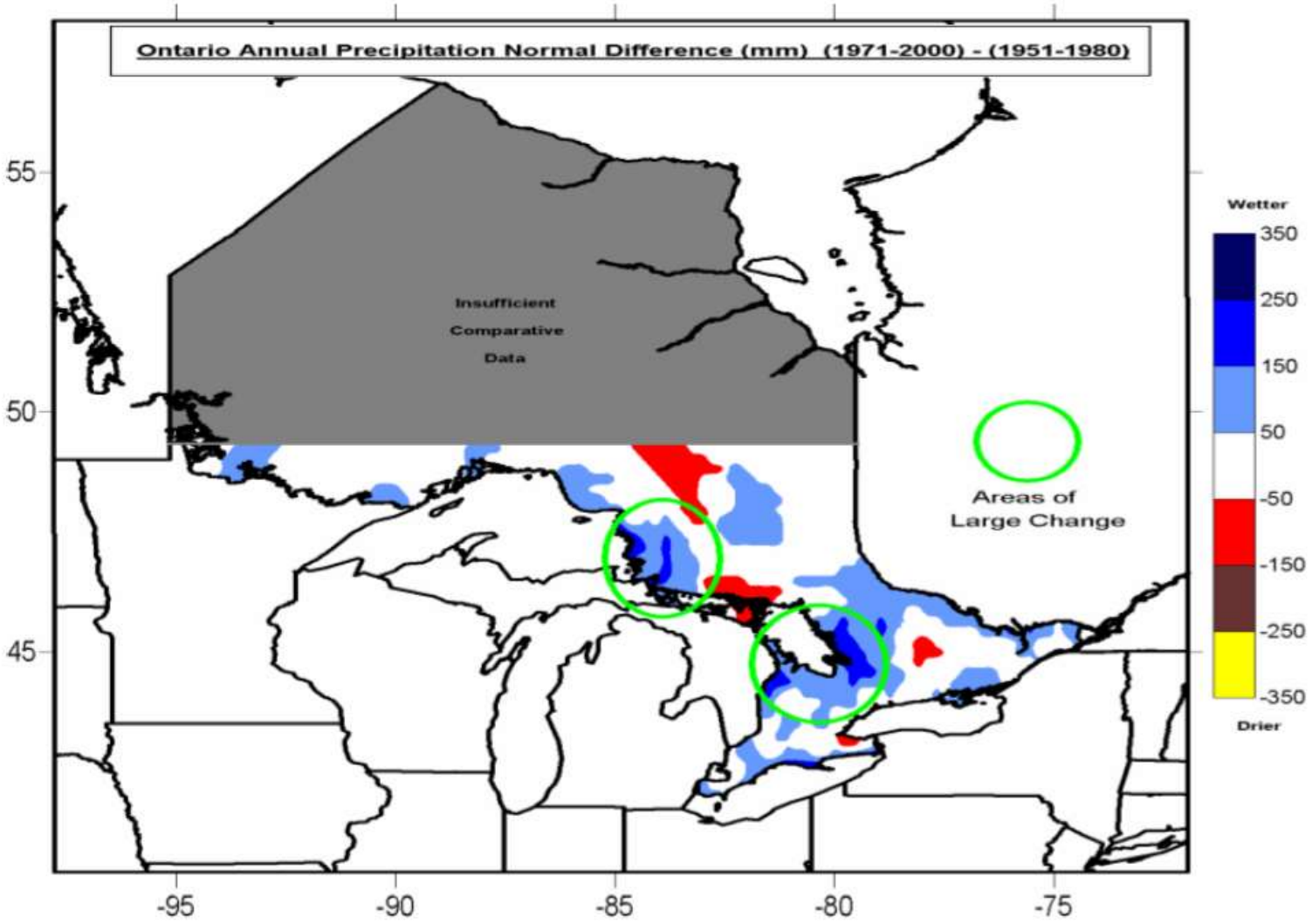


Figure 7: Barrie has seen a 1.5°C increase in average annual mean temperature and a total annual precipitation increase of 42 mm between 1979 and 2008.

The greatest increase in Precipitation is in Muskoka



Annual precipitation difference between two normals periods (1951-1980) and (1971-2000)

MWC Report – Major Conclusions / Water Management

- Increased Temperature +3 to +4 degrees C daily average
- Increased Precipitation + 10% annual with more in winter/spring

- Impact – 3 times winter/spring flows & ½ Summer flows
- Fewer ice in days
- Higher summer evaporation/ greater fire risk

- Suggested need to store water upstream to maintain summer lake levels
- Suggested increased spring flows

FOCA report on Climate agrees

Climate change is projected to accelerate

As our climate changes, the projected changes in temperature and precipitation that are most likely to affect shorelines and waterfront properties are:

- More frequent extreme weather events including heavy rain, wind and ice storms
- Drier soils in summer
- Increasing invasive species and new pathogens from southern climates
- Changing habitat ranges, particularly for species along the southern edge of Ontario
- Changing ecological processes that may affect shorelines in unknown ways (e.g. insect pollination, breeding, plant hardiness, wildlife interactions)
- Increased erosion of shorelines
- An earlier spring freshet
- More ice free days on inland lakes in the winter months
- Longer growing seasons
- More winter rain and earlier peak stream flows

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Climate Change – what does the future hold?

- MWC Report finding that winter flows will triple and summer flows half
- Earlier spring thaw
- More extreme weather

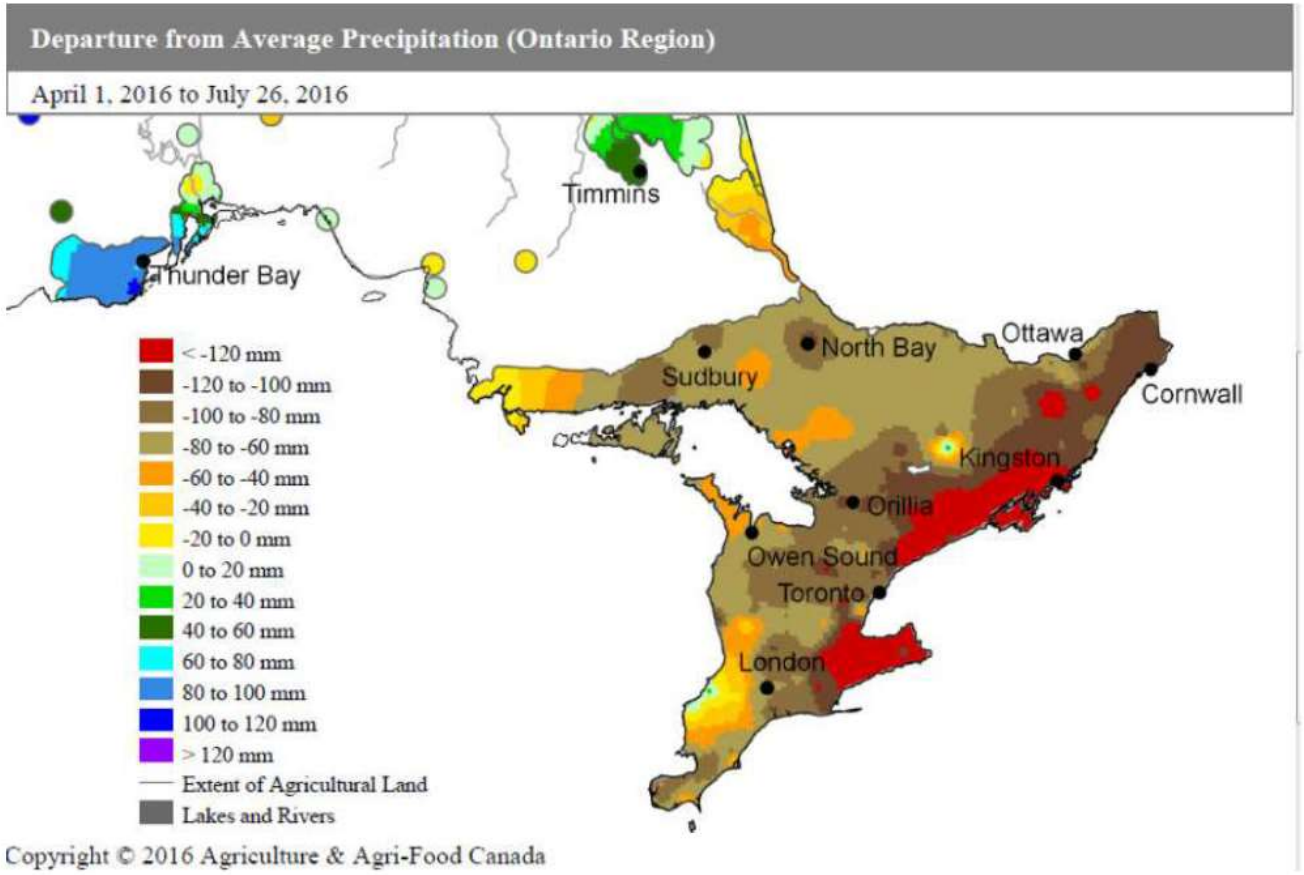
- Last year record drought in Ontario / 123 yr record in Trent Severn
- Need to store water upstream to provide summer flows/ no storage now

- Arctic warming causing Omega jet stream pattern [holds fronts stationary]
- Climate causing most major municipal concerns – graph
- Atmospheric rivers/ continental weather/ new El Nino this year

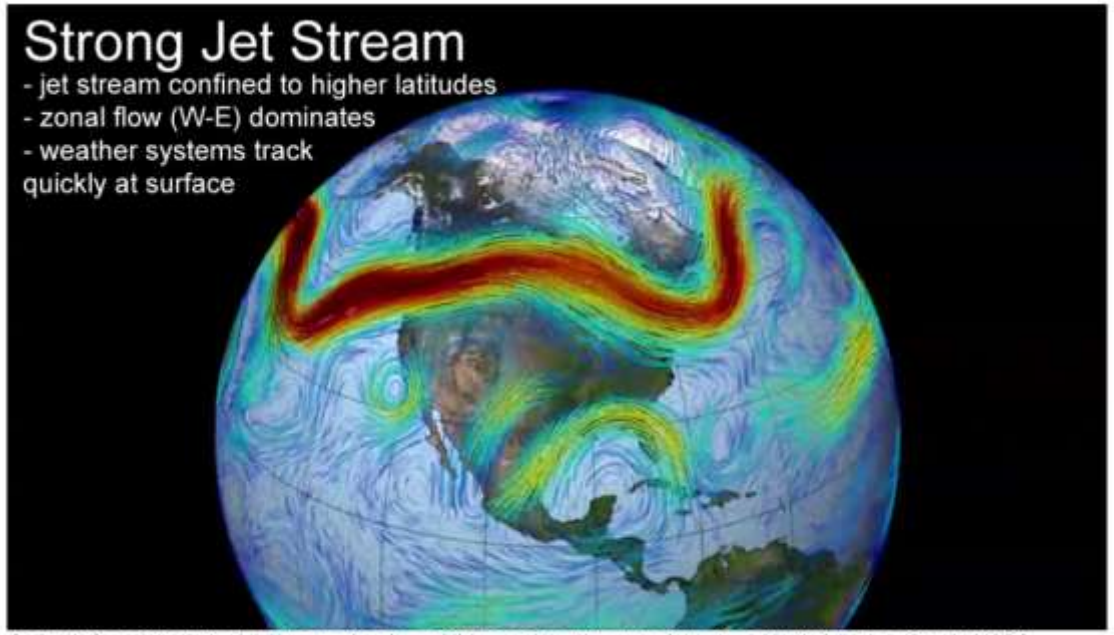
Drought – 123 yr record in Summer 2016

Rainfall Deficit Below the Average April 1 to July 26

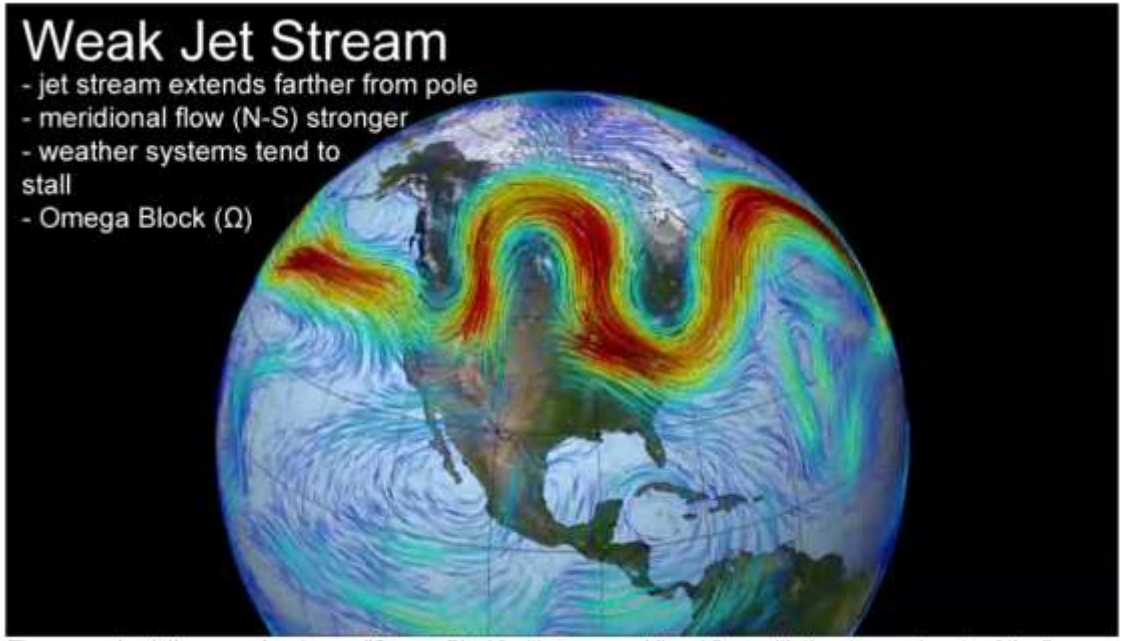
Coalition for Equitable Water Flow



Jet Stream – Omega Blocking Pattern [The Weather Network /NOAA]



A simulation of the polar jet stream, showing a fairly consistently strong jet across North America. Credit: NASA Goddard Scientific Visualization Studio/S. Sutherland

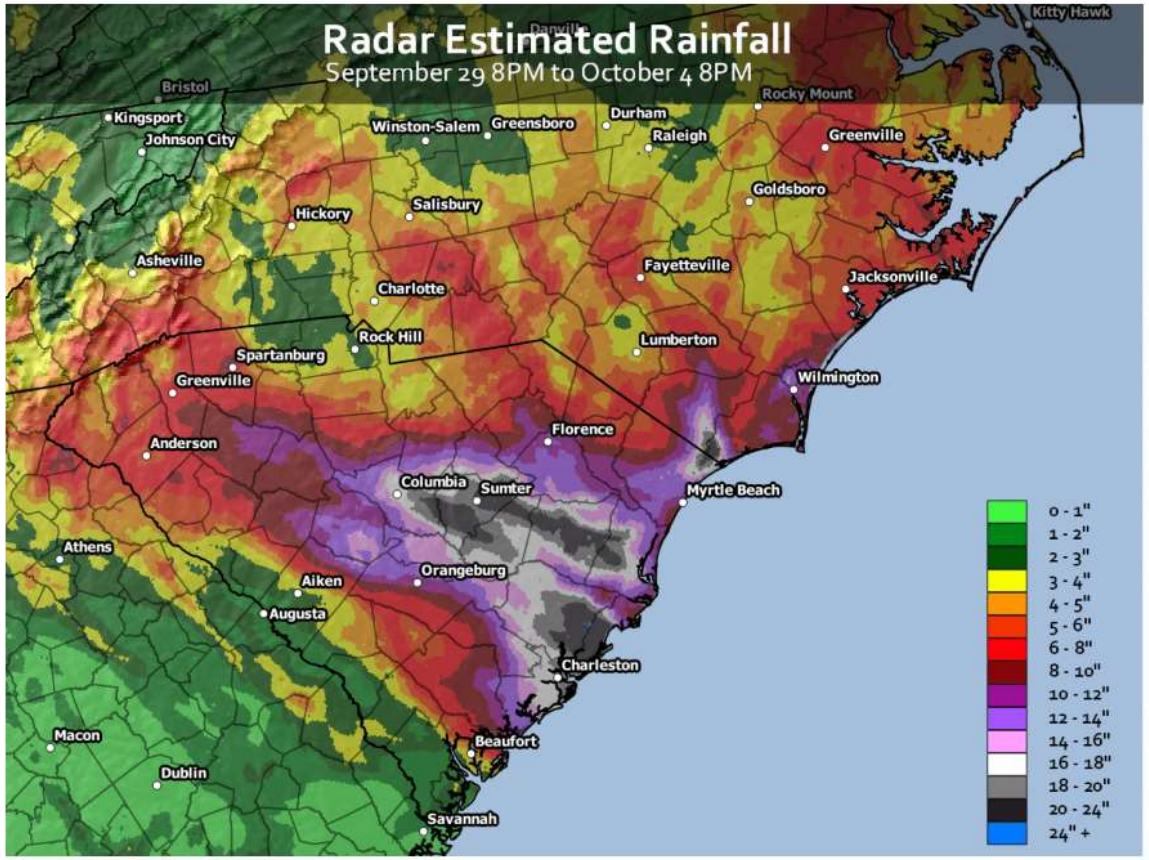


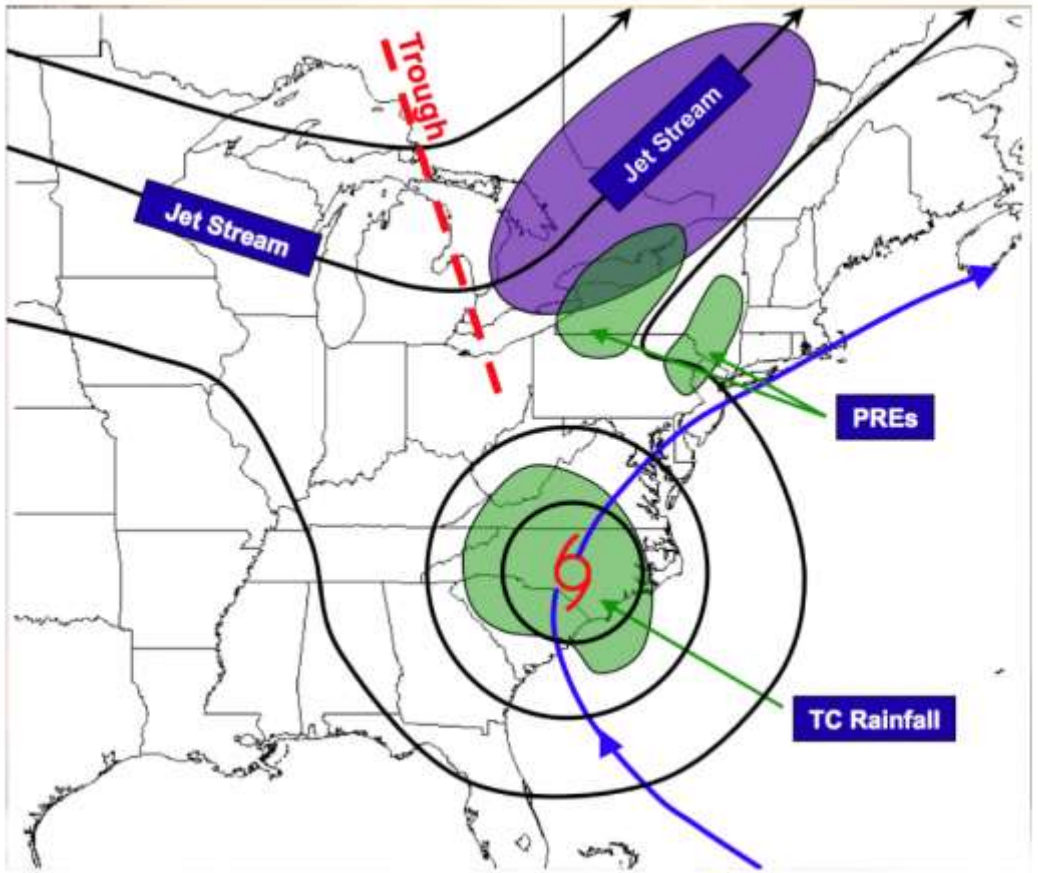
The same simulation now showing an "Omega Block" with more meridional flow, with the strongest parts of the flow (the "jets") split apart to the northern and southern mid-latitudes. Credit: NASA Goddard Scientific Visualization Studio/S. Sutherland

Global warming which is higher at the North Pole is disrupting the Jet Stream, causing an "Omega Blocking Pattern". This pattern holds weather fronts in place for days, delivering high rainfall.

Atmospheric River – South Carolina – Fall 2016 – 24” rain

[Washington Post]





(NOAA)

Note the PRE’s over Lake Ontario

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MLA's WLTF and Queen's Park lobby activity

- Three asks: (1) interim adjustment (2) review of WMP (3) MLA involved
- 2016 Damage survey
- History & time to change WMP
- QP lobbying April 2016 to present
- DMM & TML initiatives: Flood Plain Mapping grant

- Set backs – LRIA [cancelling 10 yr review], MPP Cabinet shuffle, new jr Minister / extended time to get up to speed, new contact through Policy Concepts [lobby firm], good response but sr attendees sidetracked by Pres. Trump [softwood lumber] and introduction of Bill 139 "Building Better Communities and Protecting Watersheds" [May30th]

Damage 2017

Ice Expansion & Steel Corrosion – NOT High Water !

Damage 2016

Wind Blown Ice on top of High Water

This was a two story boathouse 1 week prior to this picture being taken

Damage 2013

High Water – Well above flood zone

Ministry of Natural Resources & Forestry - Mandate

Ministry Interim Actual Expenditures 2014-2015. See details in Plans and reports section.

What we do

- sustainably manage Ontario's fish and wildlife resources
- lead the management of Ontario's Crown lands, water, oil, gas, salt and aggregates resources, including making Crown land available for renewable energy projects
- ensure the sustainable management of Ontario's Crown forests
- guide the management of Ontario's parks and protected areas
- protect people, property and communities from forest fires, floods and droughts
- develop and apply geographic information to help manage the province's natural resources

Contact us

Contact form

Tel: 1-800-667-1940

TTY: 1-866-686-6072

Ministry of Natural Resources and Forestry Information Centre
300 Water Street
Peterborough, Ontario K9J 8M5

Regional offices

Employee directory

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Protecting Your Property

1. Know where high water mark is on your property
2. Do NOT winter store any loose belongings below the high water mark +8”
3. Weight docks down with 45 gallon barrels
4. Protect shoreline structures against ice forces [controlled bubbling]
5. Tie off boats in case they float off winter supports
6. Locate boat lift controls 3 ft above dock level
7. Move electrical outlets to higher elevations, if potentially flooded
8. Relocate appliances and boathouse services [pump, water tanks] higher
9. Flood proof lower portions of boathouse wall to allow drying after soaking
10. Keep docks in good repair, so rot does not form around spikes & tie downs
11. Consider moving shoreline structures higher when rebuilding [20 yr life]

How to Protect your Property – Dock Barrels

Ice Expansion – 2017 Damage

Ice Expansion Forces - Irresistable

Table 1 – Ice Loads on Dams [after Comfort et al, 2006, Canadian Journal of Geotechnical Engineering]

Ice Loads Primarily Thermally Generated		Maximum Load	
Dam Name	Years of Record	kN/m	Kips/ft**
Paugan Dam, Hydro-Quebec	3	70	4.8
Outdoor Basin, National Research Council	1	47	3.2
Seven Sisters Dam, Manitoba Hydro	1	62	4.2
Pine Falls Dam, Manitoba Hydro	2	61	4.1
McArthur Falls Dam, Manitoba Hydro	2	85	5.8
Ice Loads Generated by Combination of Ice Temperature & Significant Water Level Change*			
Dam Name			
Arnprior Dam, Ontario Power Generation [OPG]	4	210	14.3
Otto Holden Dam, OPG – main reservoir	3	52	3.5
Otto Holden Dam, OPG – East Bay	2	65	4.4
Seven Sisters Dam, Manitoba Hydro	4	374	25.6
Churchill Falls Dam, Newfoundland Hydro	1	89	6.1

*Water level cycled 1 to 2 times per day; intermediate amplitude cycle 10 to 30 cm, large amplitude cycle 40 to 70 cm ** one Kip/ft = 1,000 pounds force per lineal foot of structure

Runoff From Your Property – The Hidden Factor

- What's in a number : 0.5 to 0.8 runoff coefficient ?
- The more that runs off & the faster it runs off – the quicker lake levels rise
- Stormwater runoff control benefits: slows runoff; decreases erosion; decreases pollutants carried into lake [fertilizer, dead organics,etc]
- Stormwater not just an urban issue – Low Impact Development, other control
- Value of preserving wetlands – slow runoff, filter erosion, filter contaminants

Credit Supporting Material

- MANY THANK YOU's For Materials:
  - Ian Turnbull
  - MNRF
  - Muskoka River Water Management Plan
  - Muskoka Watershed Council
  - FOCA [Federation of Ontario Cottagers Associations]
  - CEWF [Coalition for Equitable Water Flow]
  - Washington Post
  - The Weather Network