

GREAT LAKES WATER LEVELS

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USACE Detroit District
18 July 2019



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**US Army Corps
of Engineers.**



GREAT LAKES WATER LEVELS

1. Where are they now?
(and how did they get here?)
2. How do we forecast them?
3. Where will they be?



US Army Corps
of Engineers.



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US Army Corps
of Engineers.





Credit: Brian Allnutt, Curbed Detroit

US Army Corps
of Engineers.





Credit: Mark Breederland

~ 5ft difference between Jan 2008 and May 2019





05.07.2019

Credit



US Army Corps of Engineers.

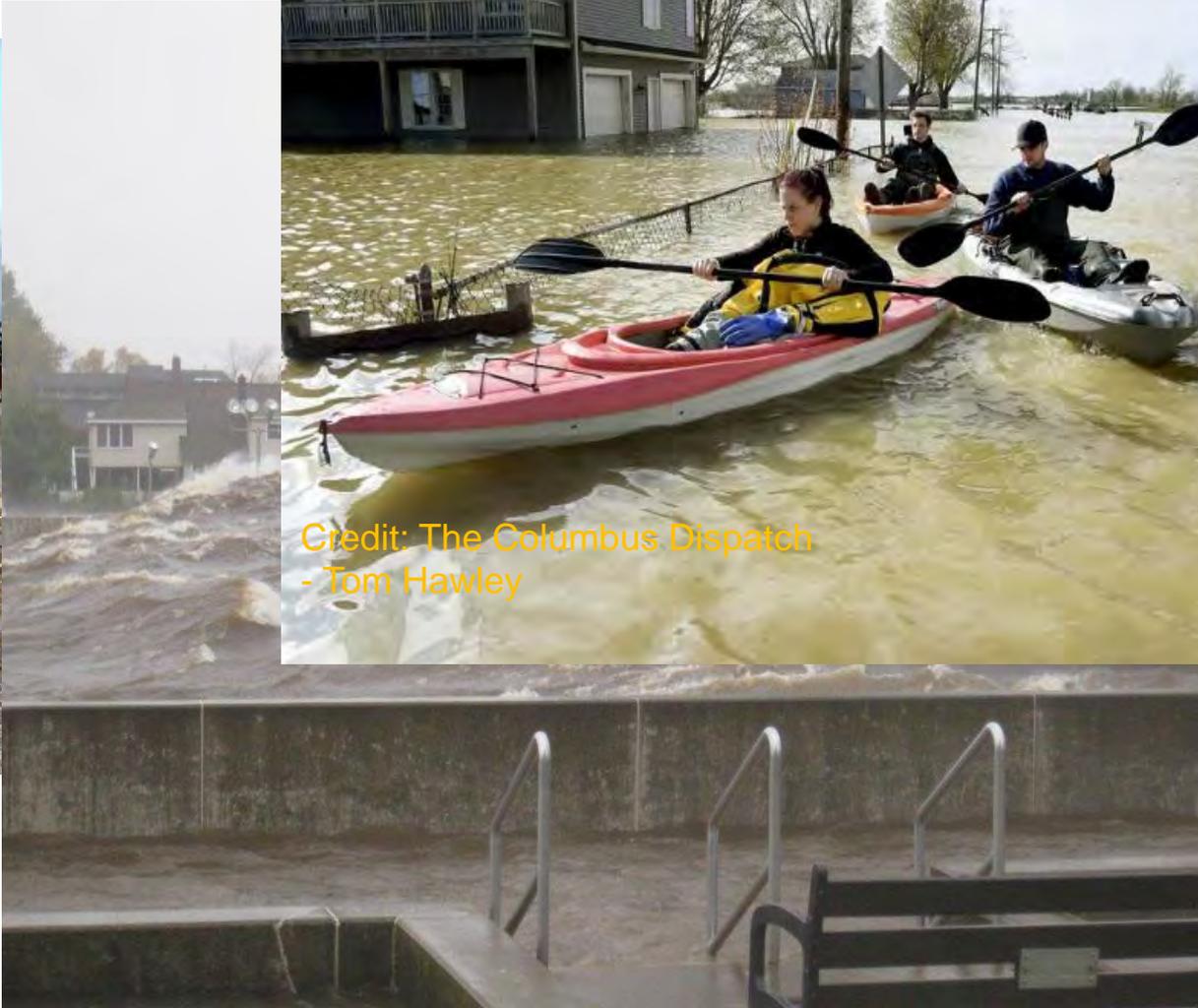




Credit: The Columbus Dispatch
- Tom Hawley



05.07.2019



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Credit: The C
- Tom Hawley



Credit: newyorkupstate.com
- Maureen Morgan Whelan



05.07.2019



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NOTES ABOUT WATER LEVELS

- Not a depth, but an elevation above sea level
- International Great Lakes Datum of 1985
- Michigan and Huron = One lake
- Lake-wide daily means → Lake-wide monthly means
- Based on still water, not influenced by meteorological forcing
- Based on a network of water level gauges
- Detroit District Corps of Engineers = keeper of official monthly water level statistics from 1918-2018
- Coordination occurs with Environment and Climate Change Canada



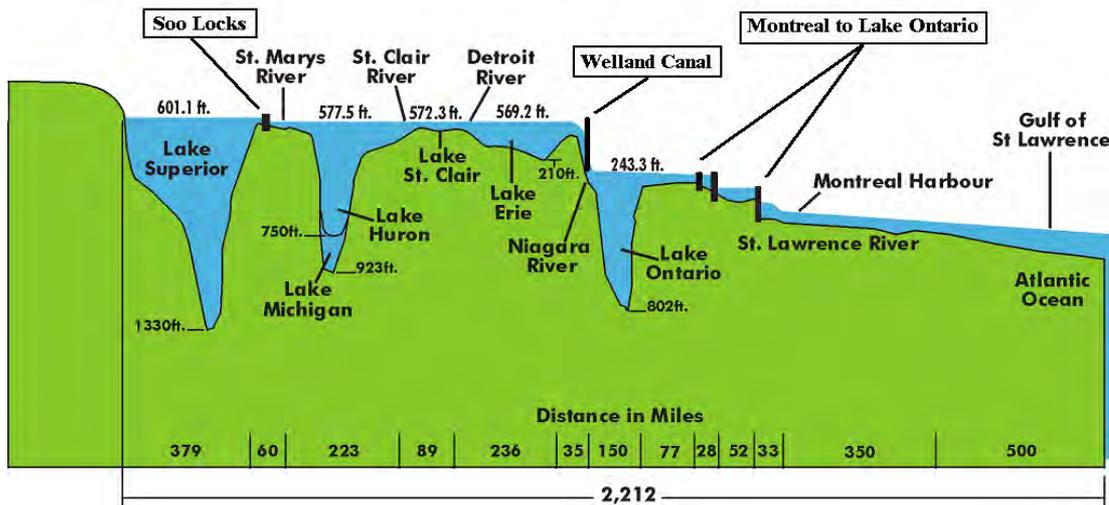
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MONITORING GREAT LAKES WATER LEVELS

The Great Lakes Basin

- 14,000 miles of shoreline
- 95,000 square miles of water
- 200,000 square miles of land
- 8 States & 2 Provinces



100 years of coordinated water level data

Forecasting since the 1950s

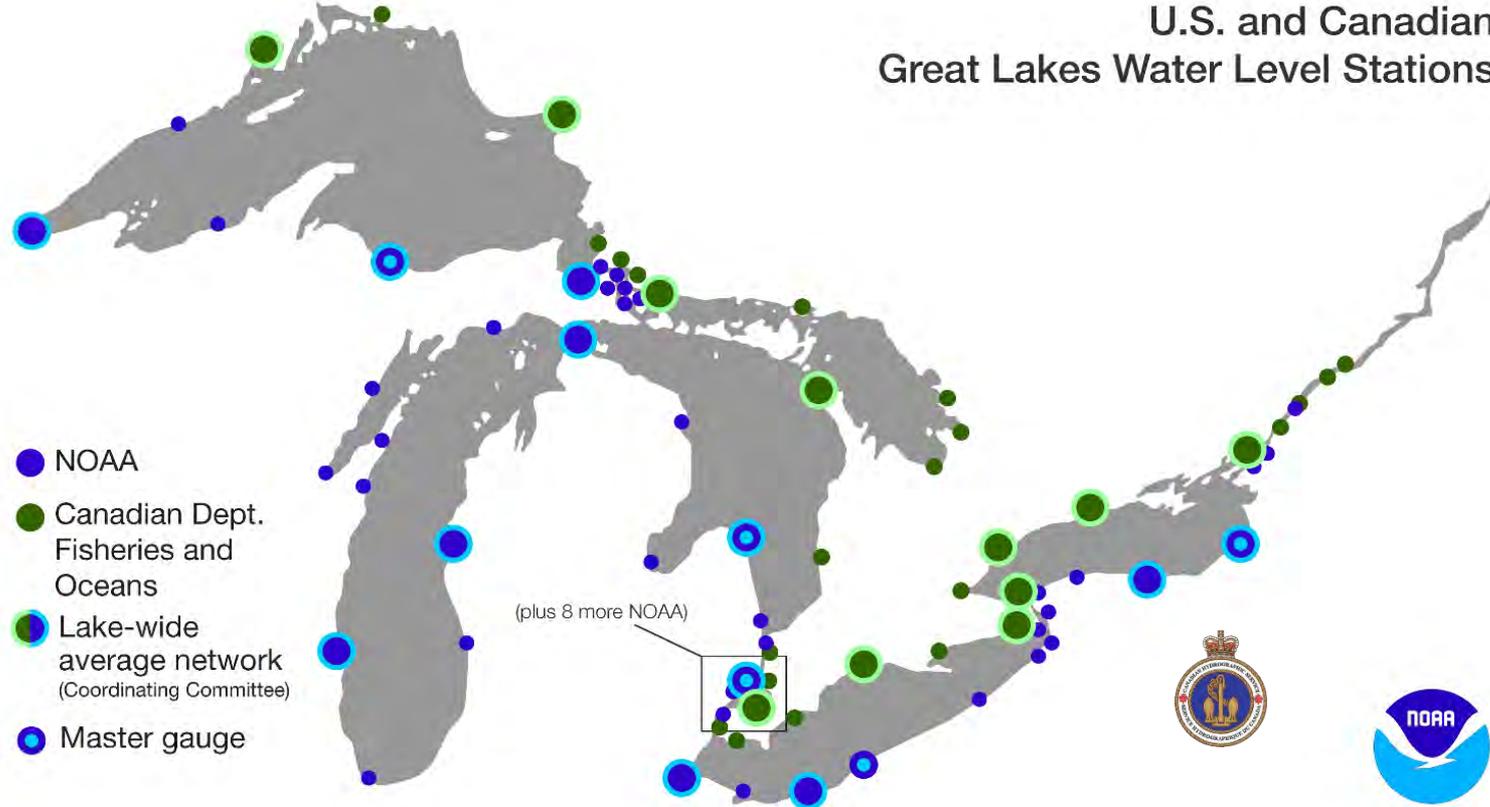


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MONITORING GREAT LAKES WATER LEVELS

U.S. and Canadian Great Lakes Water Level Stations



Daily Average Water Levels Based on Lake-Wide Average Network

- **Lake Superior:** Duluth, Marquette, Pt. Iroquois, Thunder Bay, Michipicoten
- **Lakes Michigan-Huron:** Harbor Beach, Ludington, Mackinaw City, Milwaukee, Tobermory, Thessalon
- **Lake St. Clair:** St. Clair Shores, Belle River
- **Lake Erie:** Toledo, Cleveland, Port Stanley, Port Colborne
- **Lake Ontario:** Oswego, Rochester, Toronto, Kingston, Port Weller, Cobourg



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Great Lakes Water Levels (Meters)



Great Lakes Water Levels

The United States Army Corps of Engineers collects and disseminates this water level data in cooperation with NOAA and the Canadian Hydrographic Service. All data are provisional and are referenced to IGLD 1985. Blanks indicate data that are missing or not yet available.

Date	Superior*	Michigan Huron*	St. Clair*	Erie*	Ontario*
	Daily Mean	Daily Mean	Daily Mean	Daily Mean	Adj. Daily Mean
01-JUL-2019	183.85	177.36	176.04	175.18	75.89
02-JUL-2019	183.85	177.37	176.04	175.17	75.88
03-JUL-2019	183.85	177.37	176.05	175.18	75.88
04-JUL-2019	183.85	177.37	176.05	175.17	75.87
05-JUL-2019	183.85	177.37	176.05	175.17	75.86
06-JUL-2019	183.85	177.37	176.06	175.17	75.86
07-JUL-2019	183.85	177.37	176.08	175.18	75.85
08-JUL-2019	183.85	177.37	176.08	175.16	75.84
09-JUL-2019	183.84	177.36	176.06	175.16	75.83
10-JUL-2019	183.84	177.37	176.05	175.14	75.82
11-JUL-2019	183.86	177.36	176.04	175.14	75.82
12-JUL-2019	183.84	177.37	176.04	175.14	75.81
13-JUL-2019	183.85	177.36	176.02	175.13	75.81
14-JUL-2019	183.85	177.36	176.04	175.13	75.80
15-JUL-2019	183.84	177.36	176.02	175.12	75.79
16-JUL-2019	183.86	177.37	176.02	175.11	75.78
Mean:	183.85	177.37	176.05	175.15	75.84

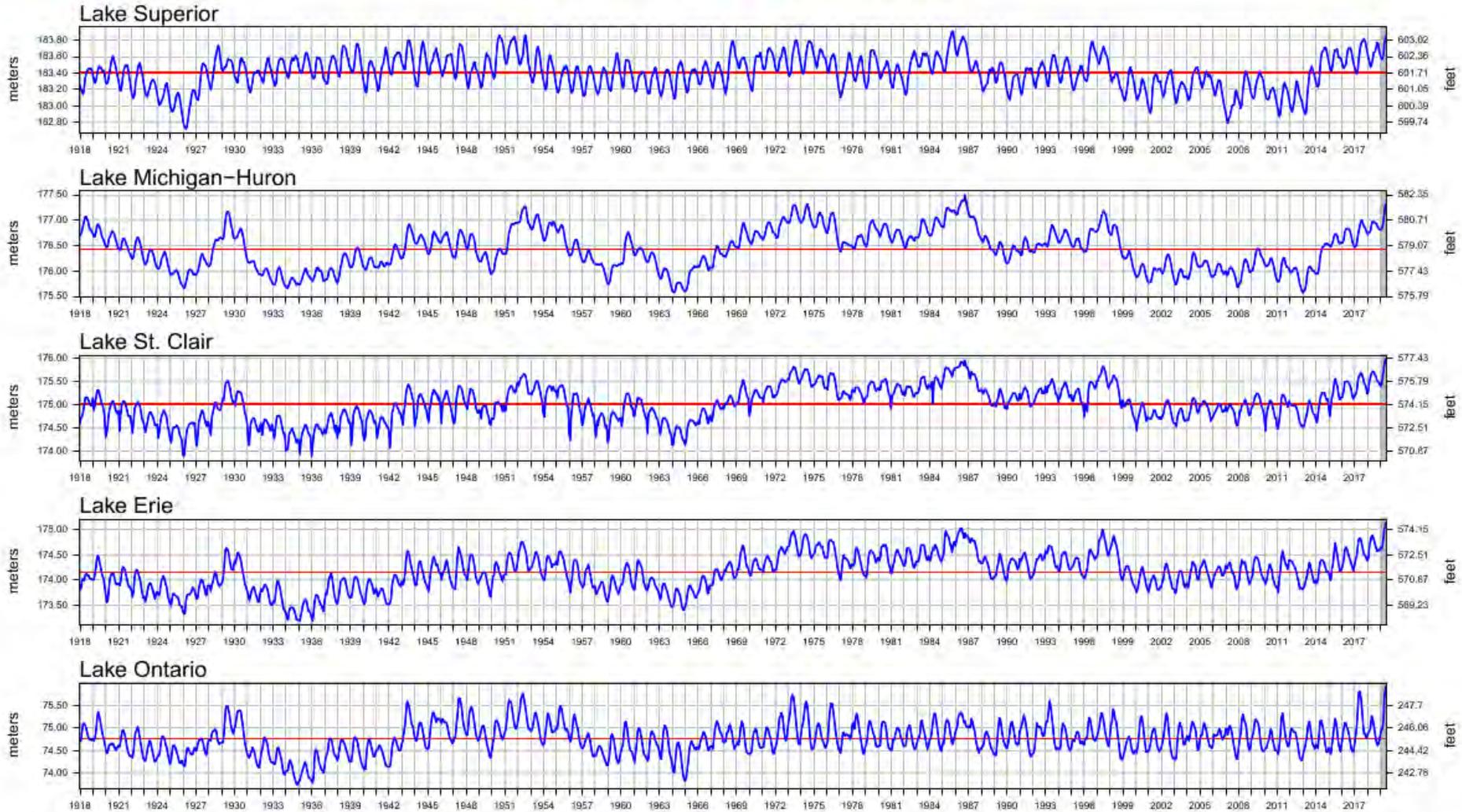
July Statistics	Historic Water Levels				
	Superior	Michigan Huron	St. Clair	Erie	Ontario
Avg Last Month	183.84	177.32	175.99	175.14	75.91
Avg Last Year	183.65	176.98	175.71	174.82	75.06
Minimum	182.96 (1926)	175.78 (1964)	174.50 (1934)	173.45 (1934)	74.14 (1934)
Maximum	183.82 (1950)	177.39 (1986)	175.93 (1986)	175.03 (1986)	75.69 (2017)
Long Term Avg**	183.51	176.58	175.20	174.33	75.01

* Mean Levels are calculated by averaging the best available gage data at report generation and are subject to change



Great Lakes Water Levels (1918–2019)

— Monthly Mean Level — Long Term Average Annual



The monthly average levels are based on a network of water level gages located around the lakes. Elevations are referenced to the International Great Lakes Datum (1985).

Water levels have been coordinated through 2018. Values highlighted in gray are provisional.

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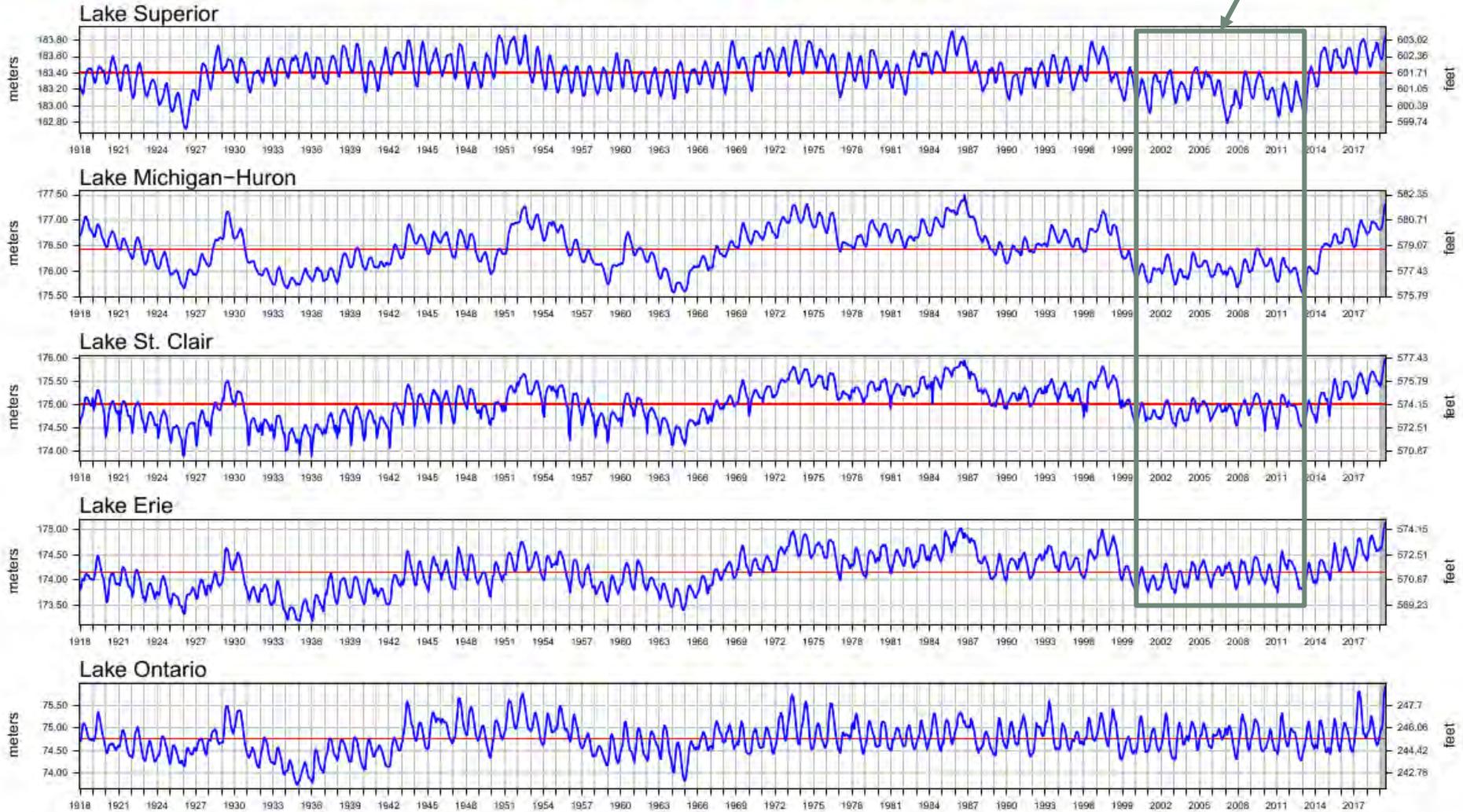




Great Lakes Water Levels (1918–2019)

— Monthly Mean Level — Long Term Average Annual

> 1 decade low water



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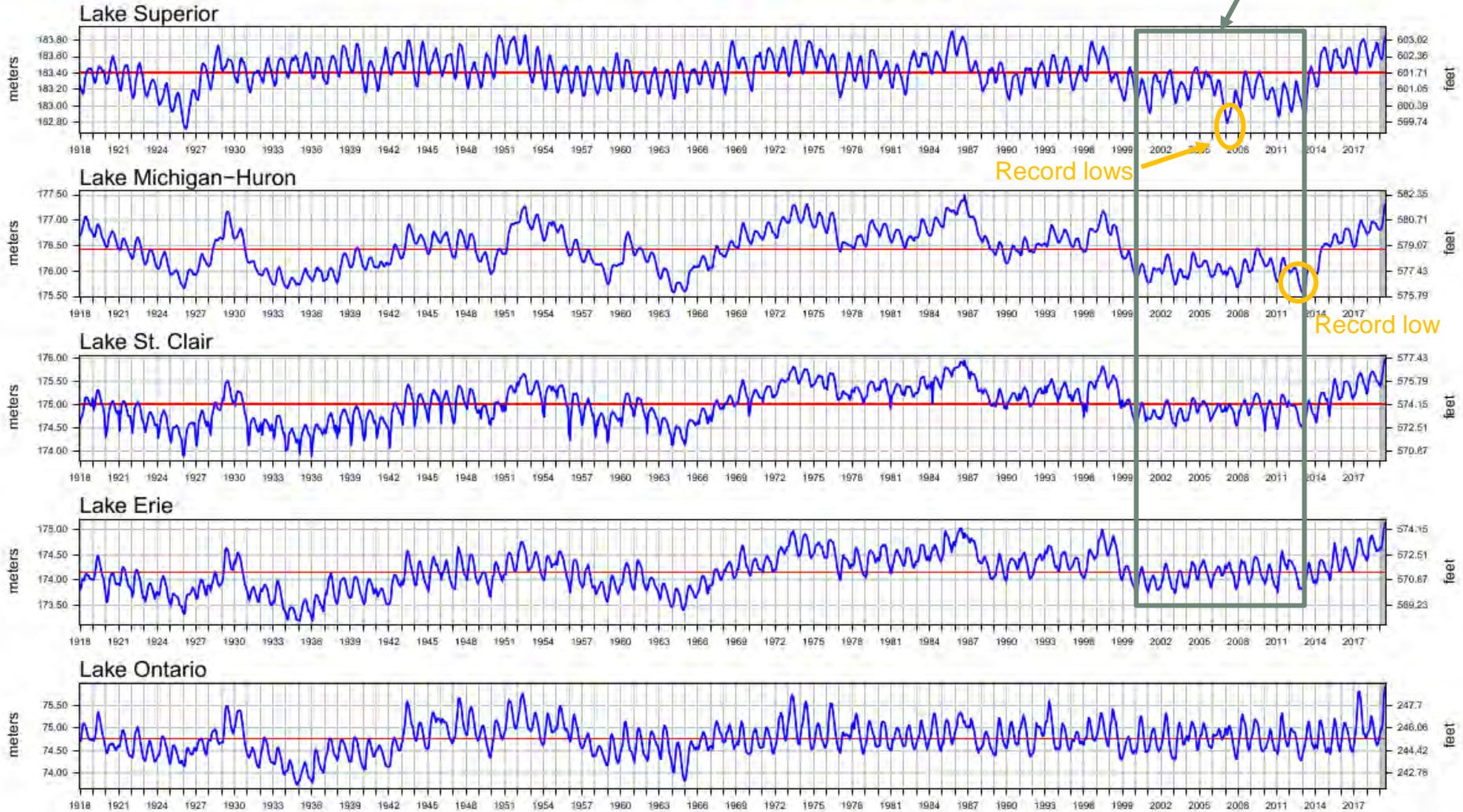




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LOW WATER IMPACTS

- Access issues
 - Boat docks, boat launches, and piers
- Navigation
 - Carry lighter loads
 - Groundings
- Increase in beach vegetation
- Increase dredging desired
- Less hydropower generation



Photo: National Geographic Blog Lisa Borre



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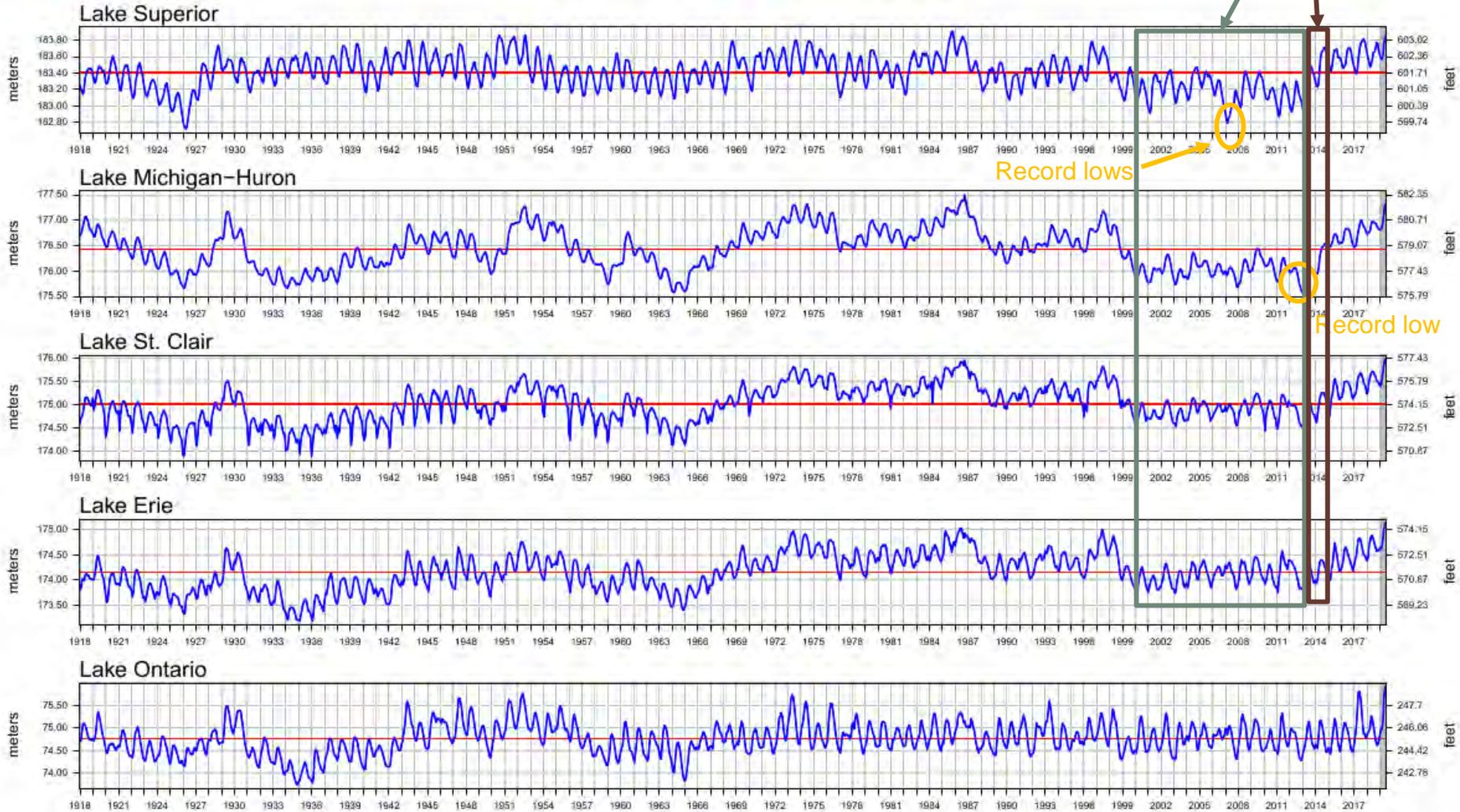


Great Lakes Water Levels (1918–2019)

— Monthly Mean Level — Long Term Average Annual

Record Rise

> 1 decade low water



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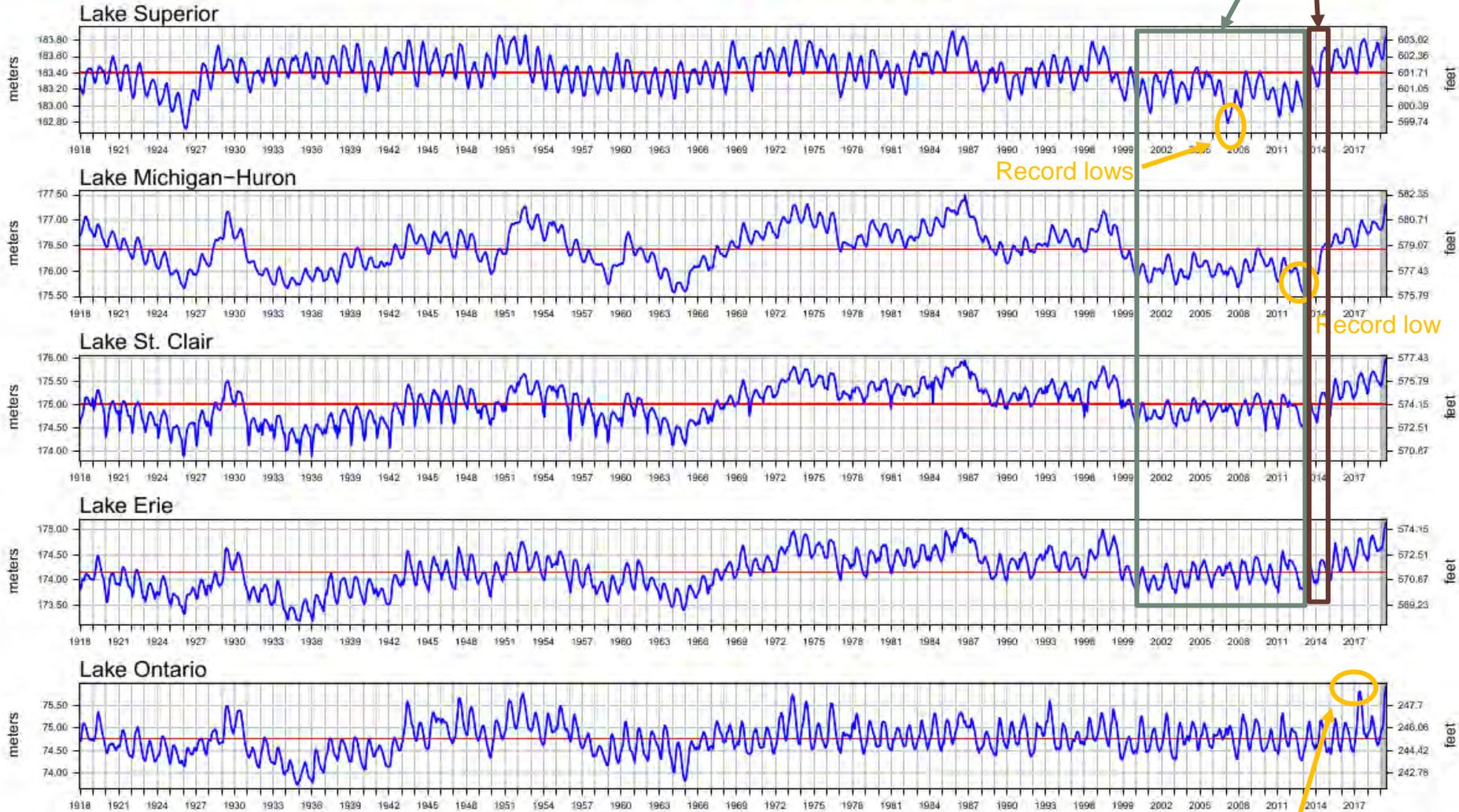


Great Lakes Water Levels (1918-2019)

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Record high



Great Lakes Water Levels (1918–2019)

— Monthly Mean Level — Long Term Average Annual

> 1 decade low water

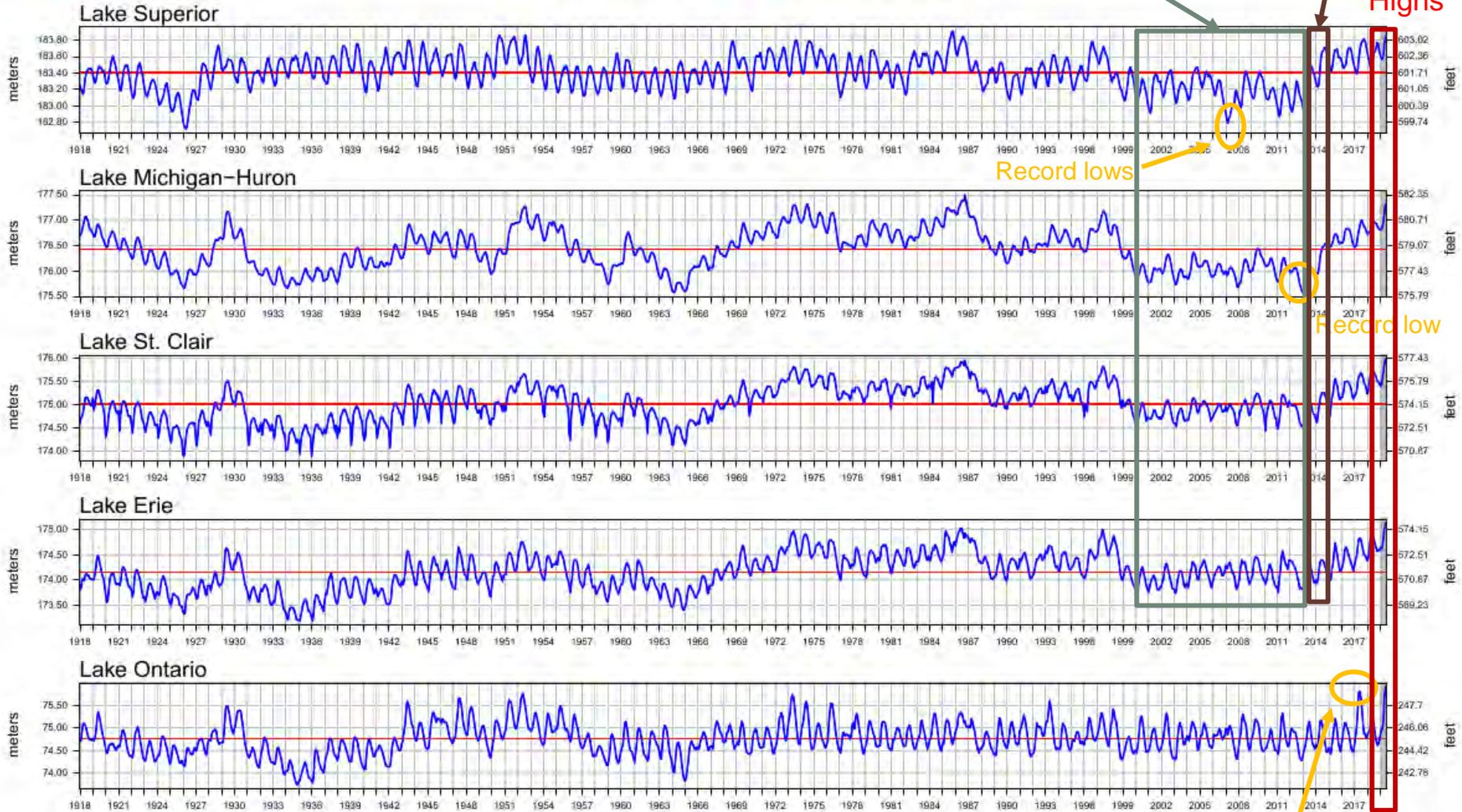
Record Rise

Record Highs

Record lows

Record low

Record high



The monthly average levels are based on a network of water level gages located around the lakes. Elevations are referenced to the International Great Lakes Datum (1985).

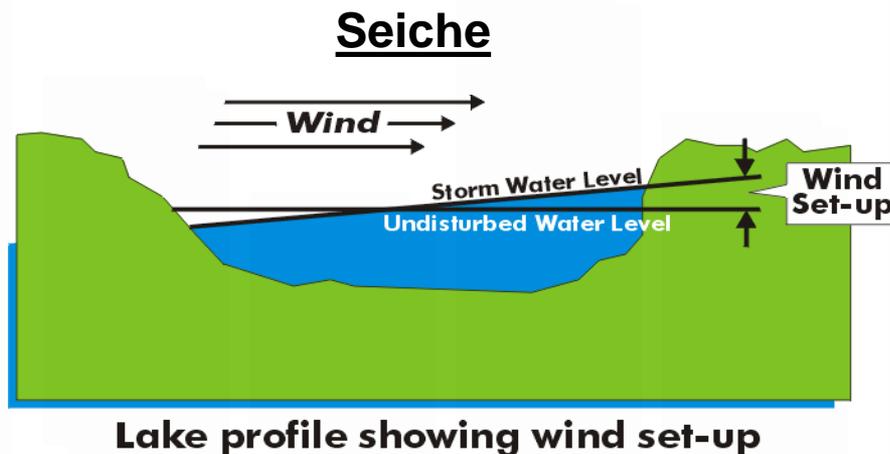
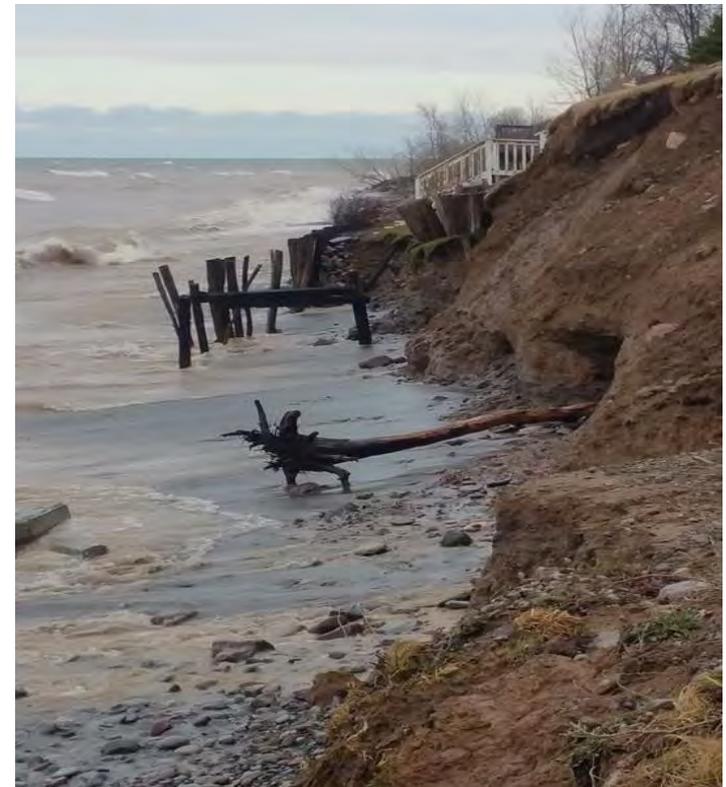
Water levels have been coordinated through 2018. Values highlighted in gray are provisional.

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HIGH WATER LEVEL IMPACTS

- Shoreline erosion
 - Less beach
- Property damage
- Greater impact from seiche (wind) events
- Ice jams produce greater chance for flooding

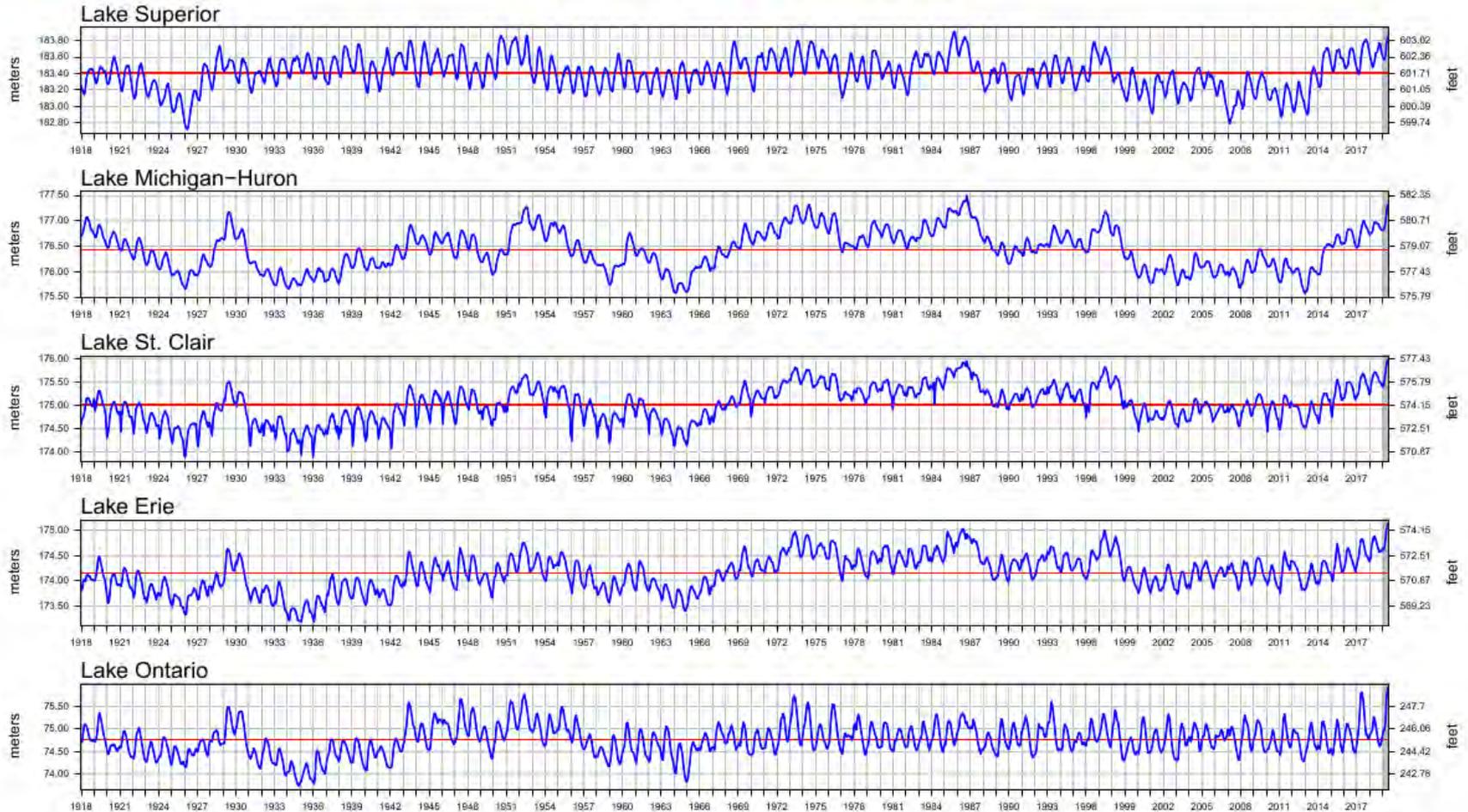


FACTORS IMPACTING WATER LEVELS



Great Lakes Water Levels (1918–2019)

— Monthly Mean Level — Long Term Average Annual



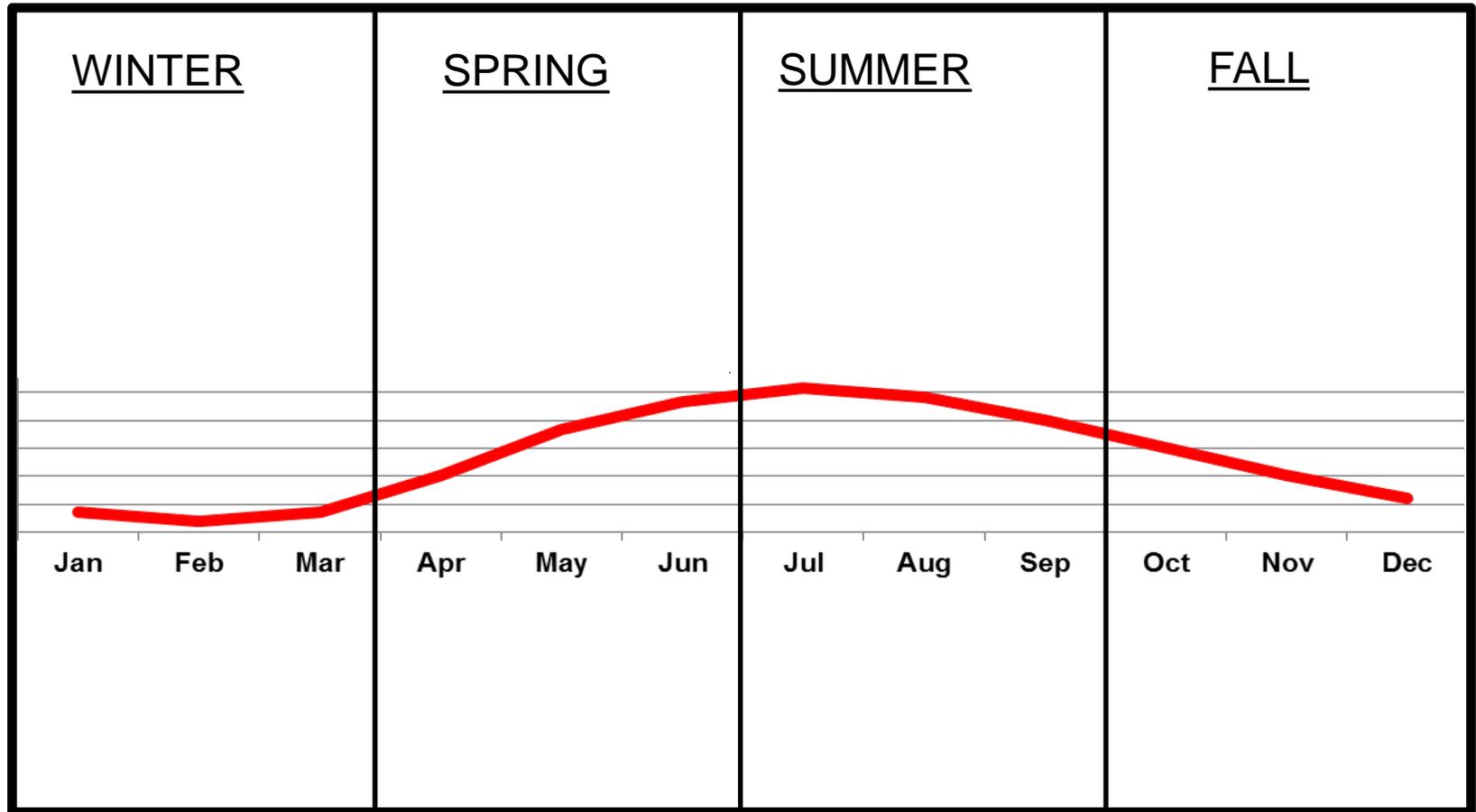
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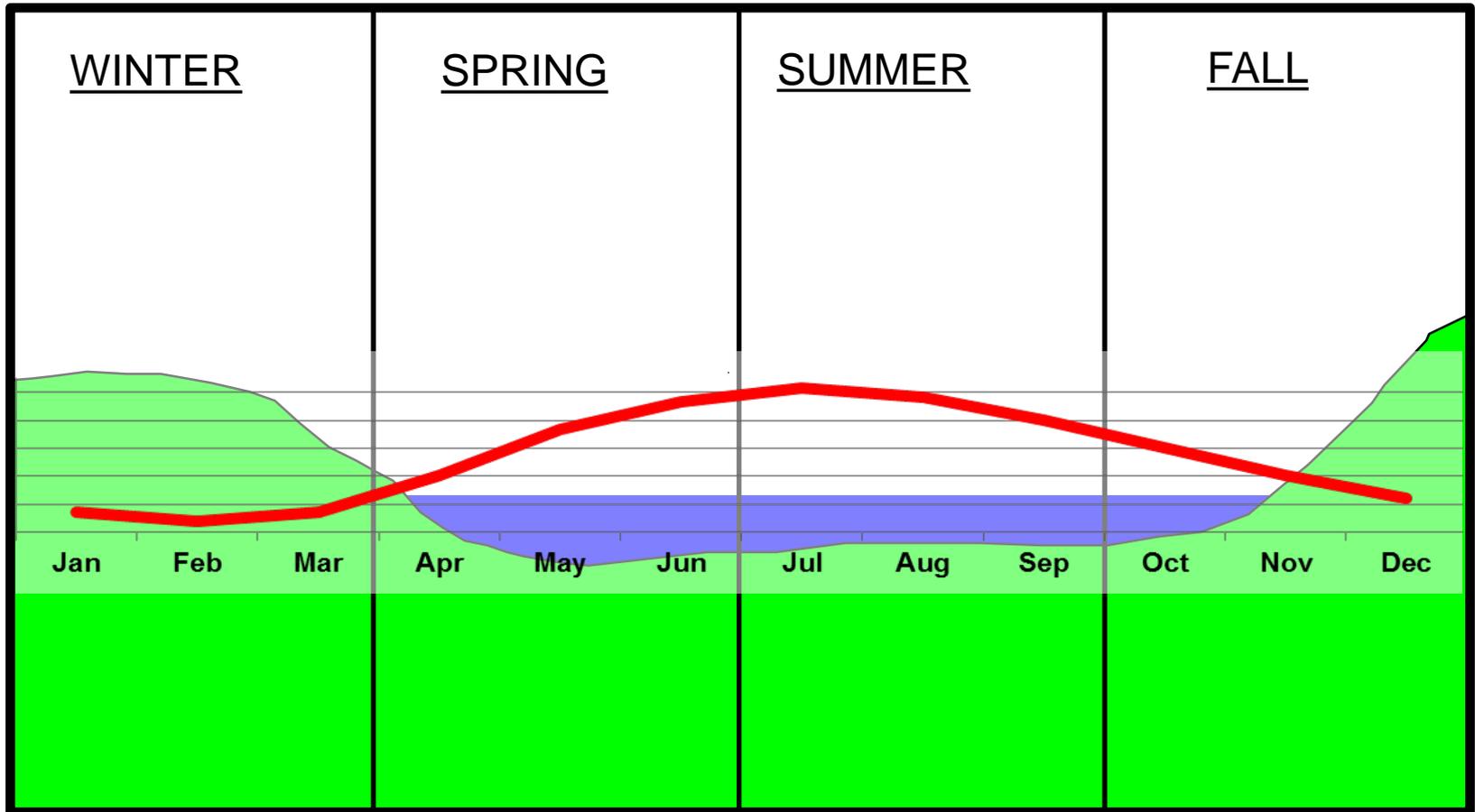
FACTORS IMPACTING WATER LEVELS



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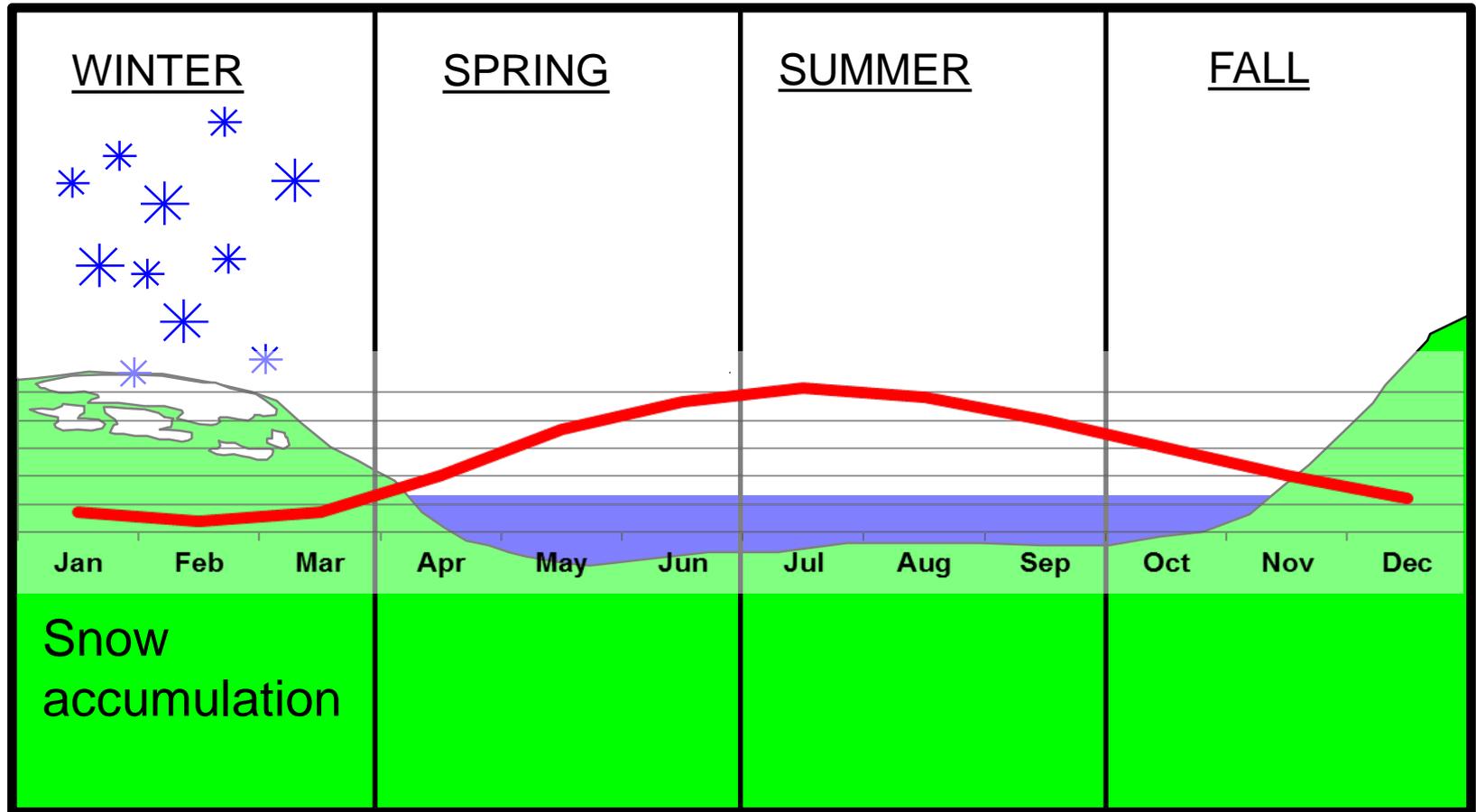
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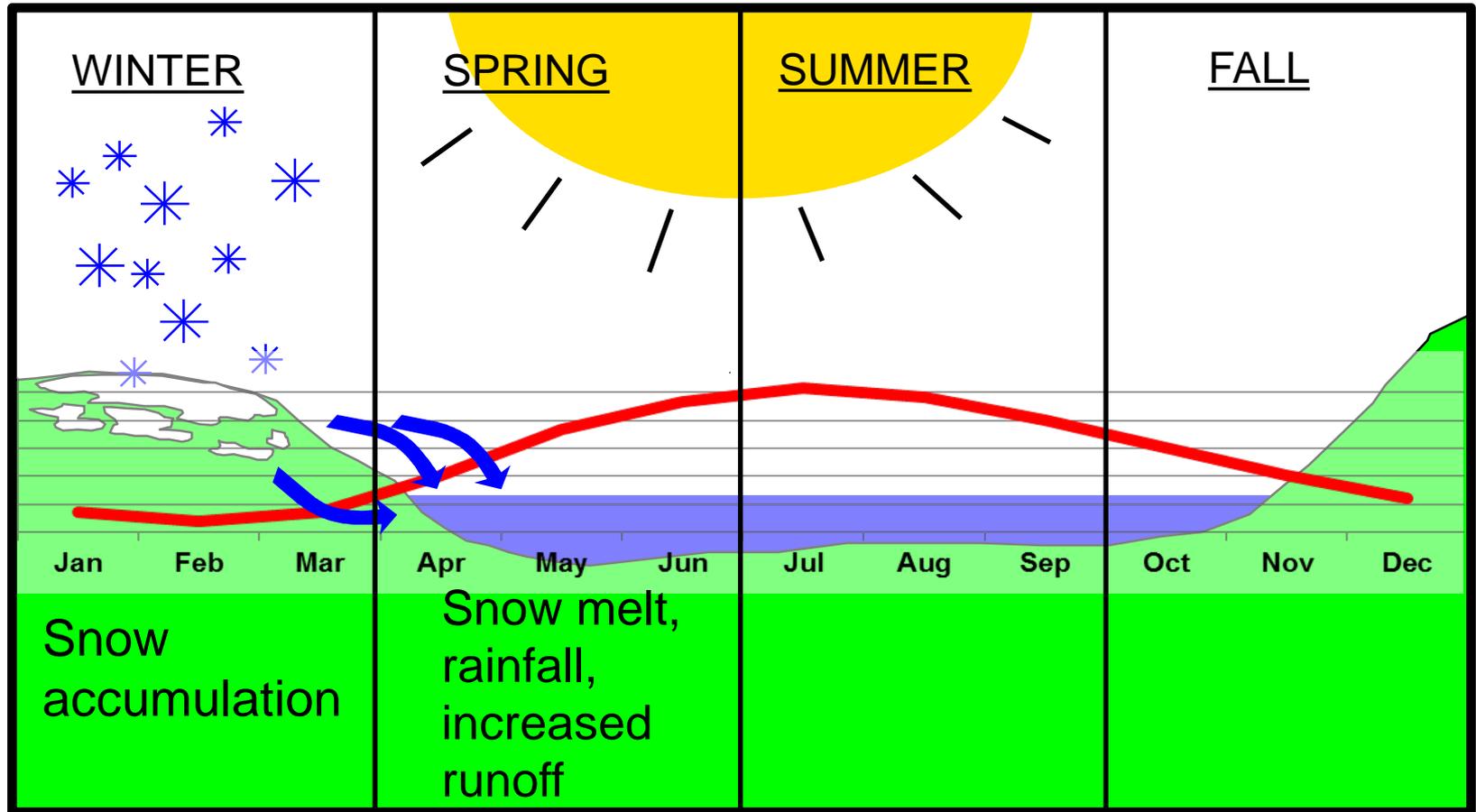
FACTORS IMPACTING WATER LEVELS



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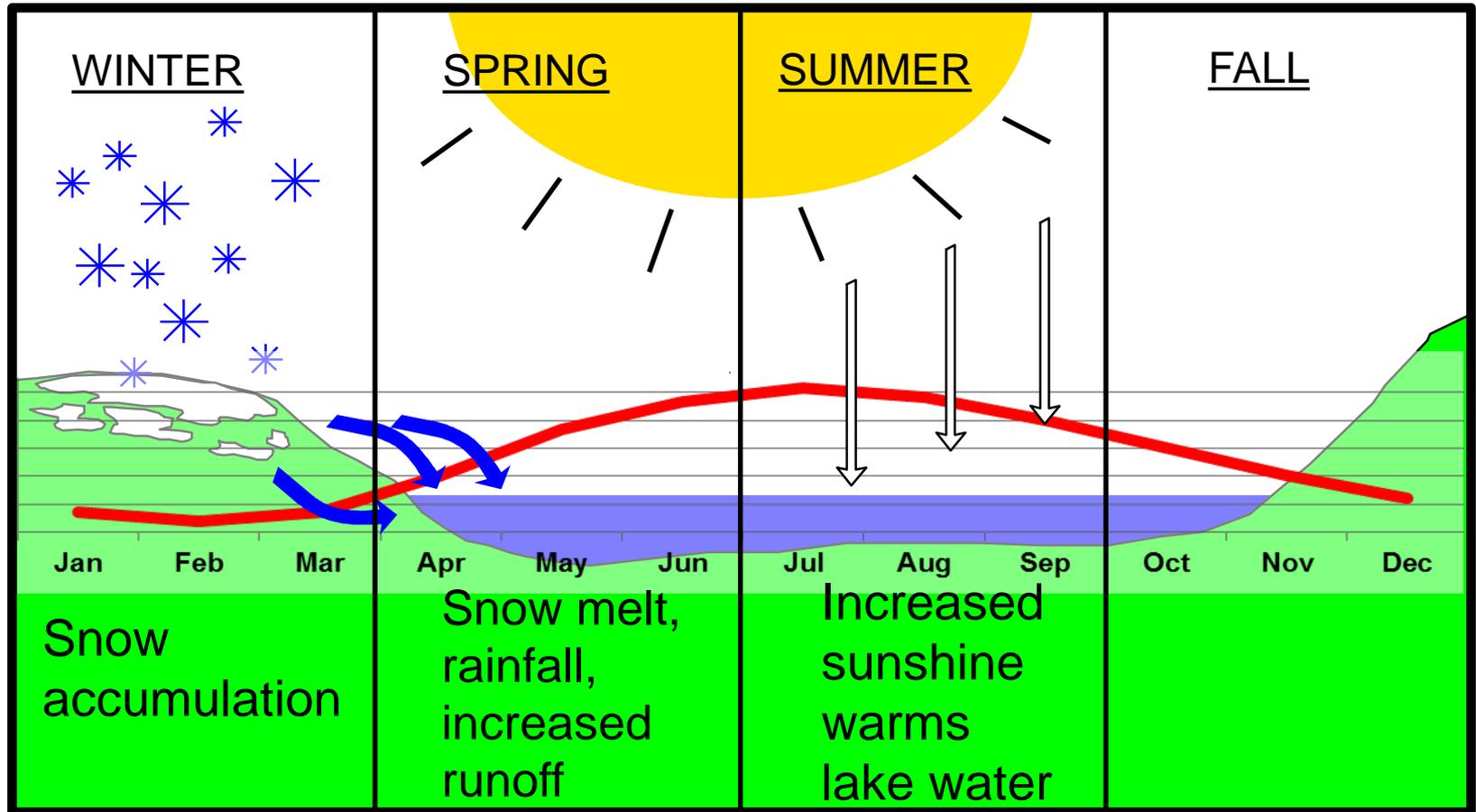
FACTORS IMPACTING WATER LEVELS



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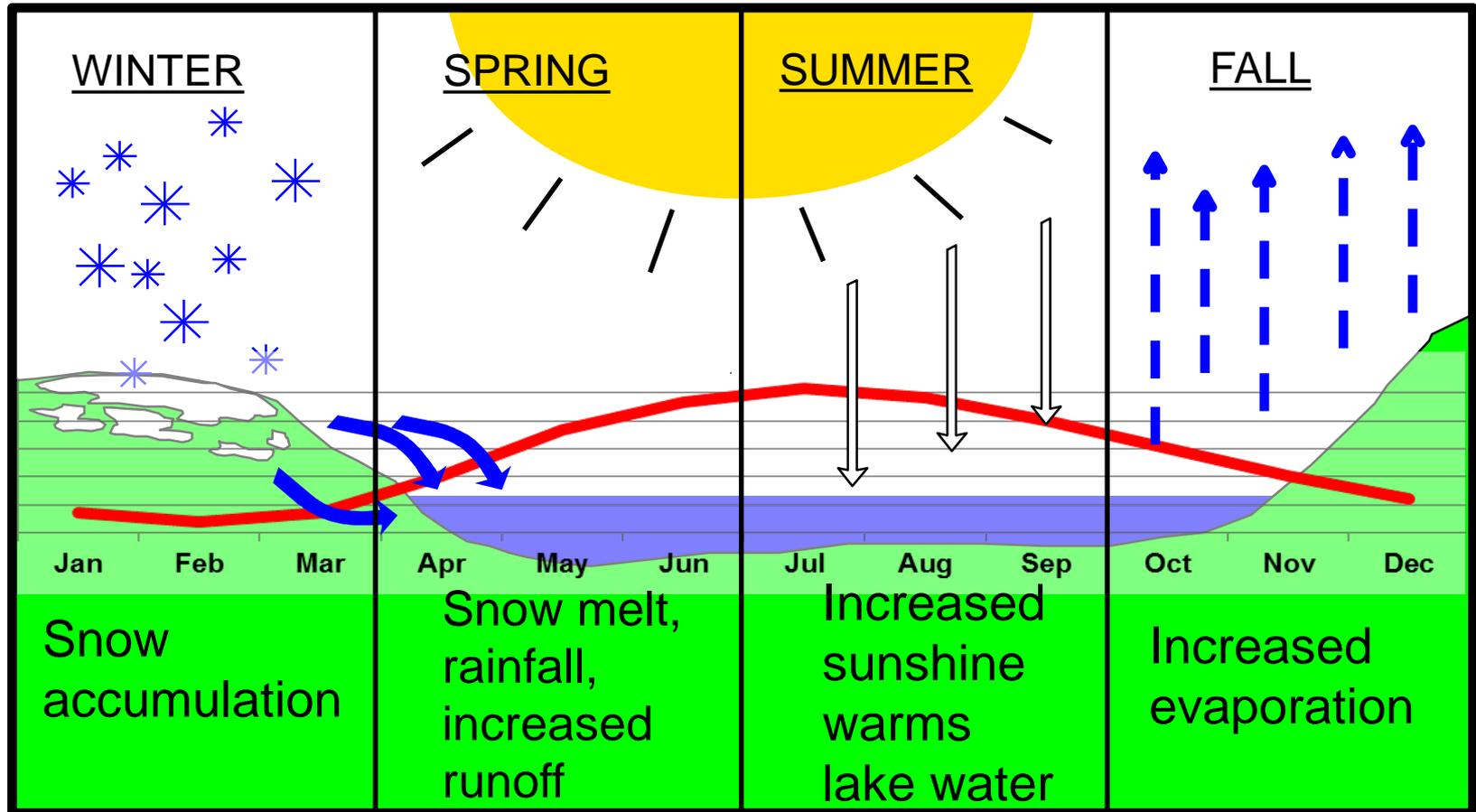
FACTORS IMPACTING WATER LEVELS



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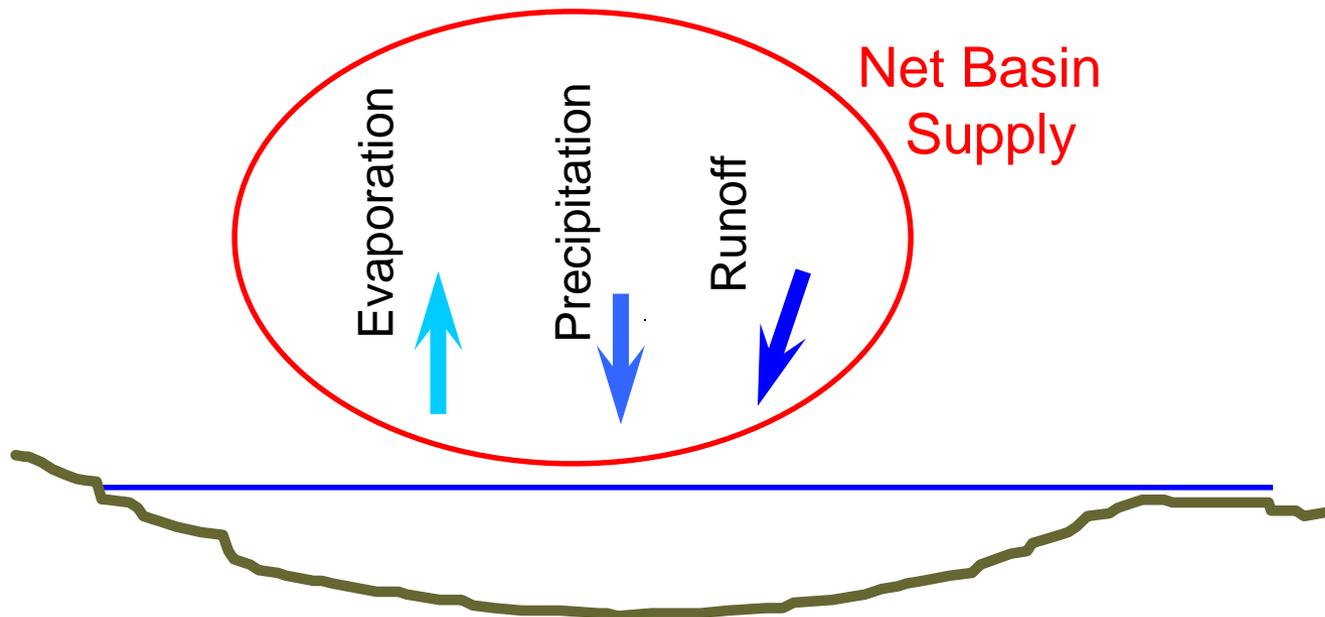
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of Engineers.



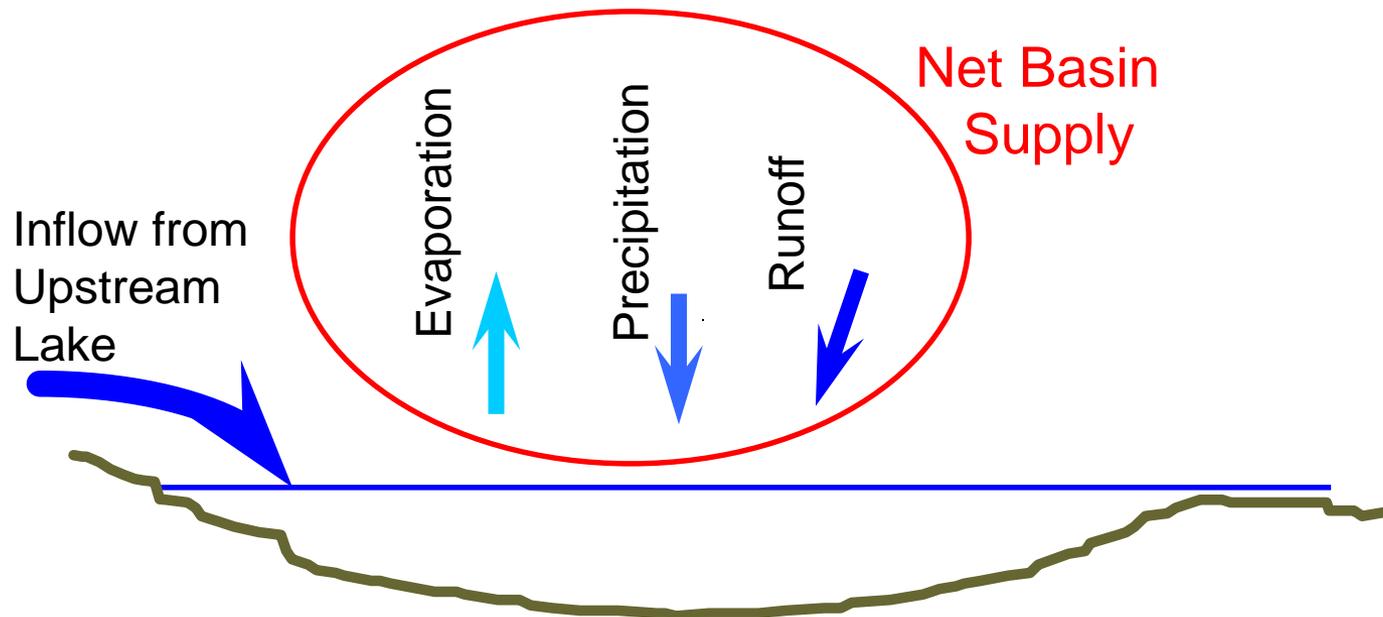
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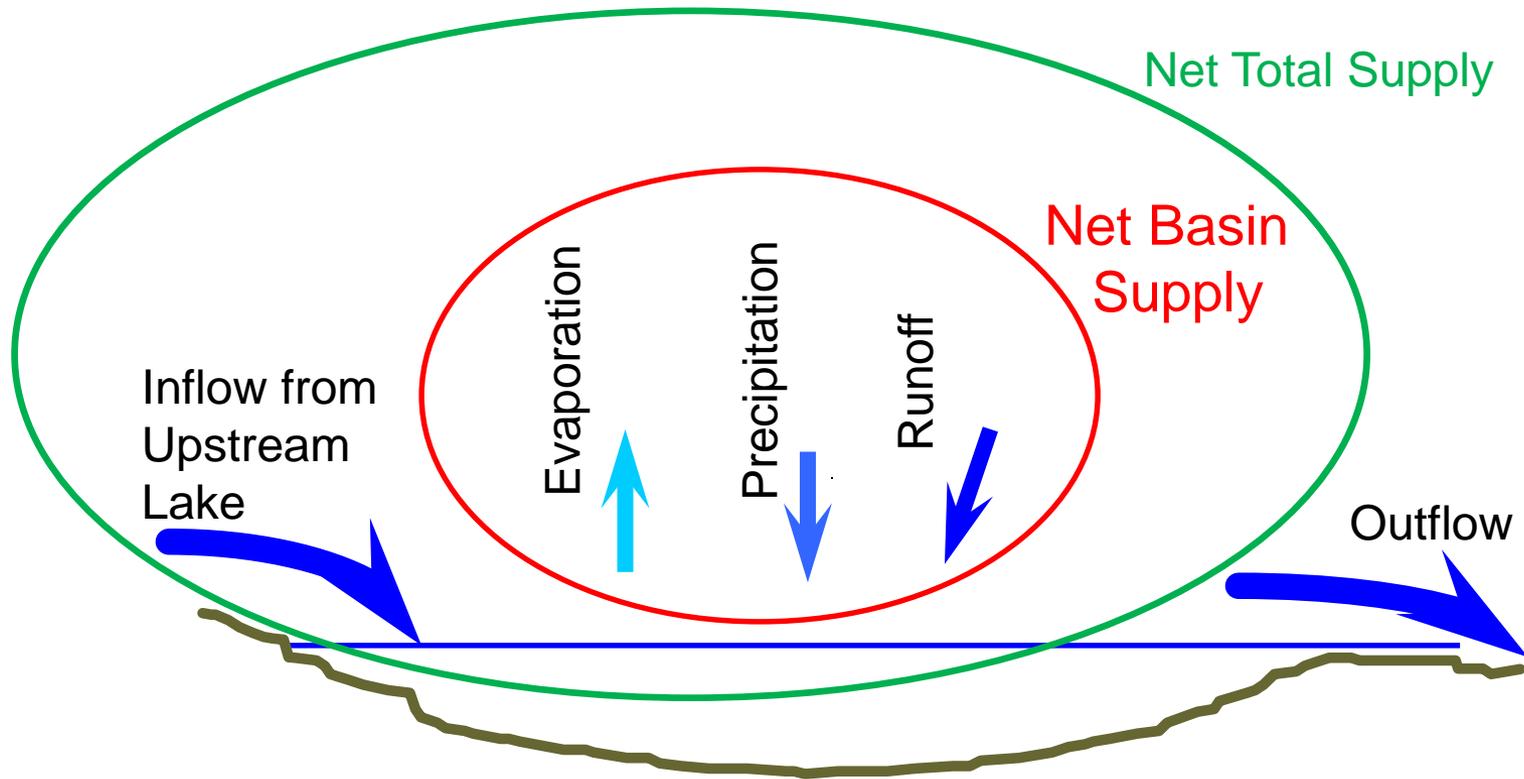
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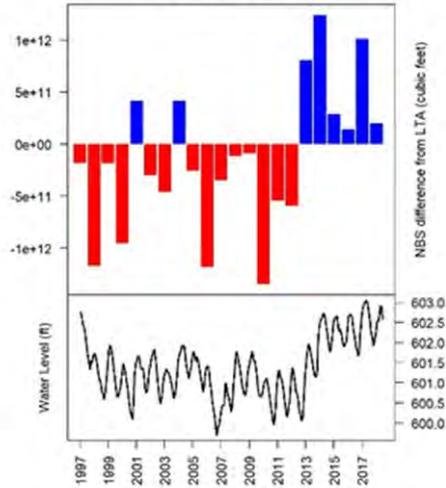


FACTORS IMPACTING WATER LEVELS

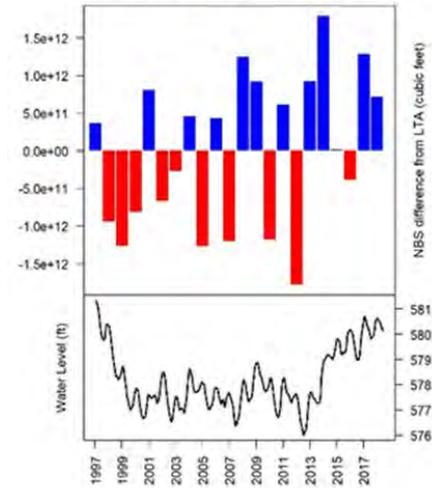


CONSECUTIVE YEARS OF ABOVE AVERAGE NET BASIN SUPPLY

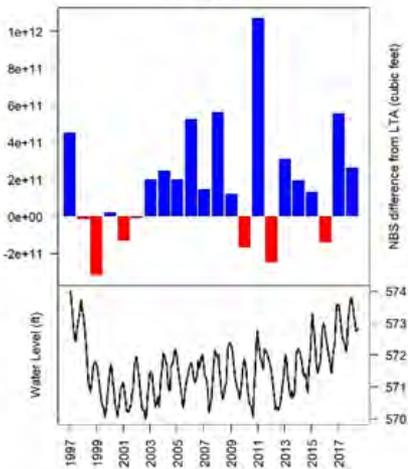
Lake Superior



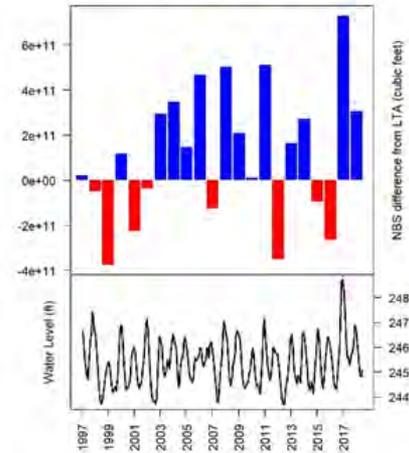
Lake Michigan-Huron



Lake Erie



Lake Ontario



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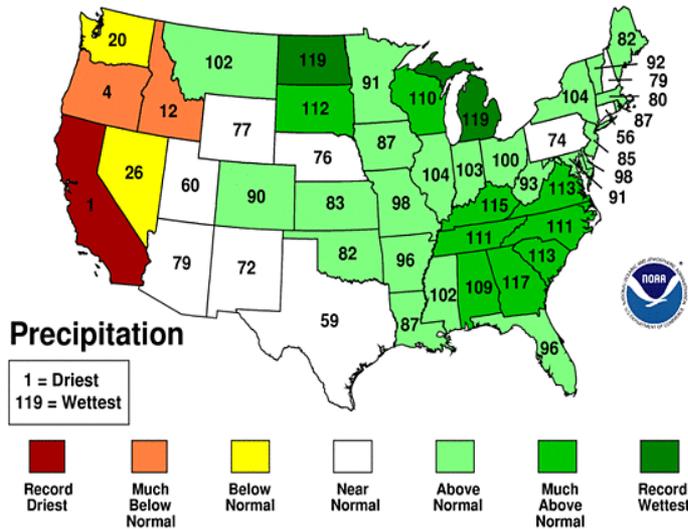
WET 2013, COLD AND SNOWY 2014

- 2013 was the wettest year on record for the state of Michigan

- 2013 was followed by a well above average wet 2014

January-December 2013 Statewide Ranks

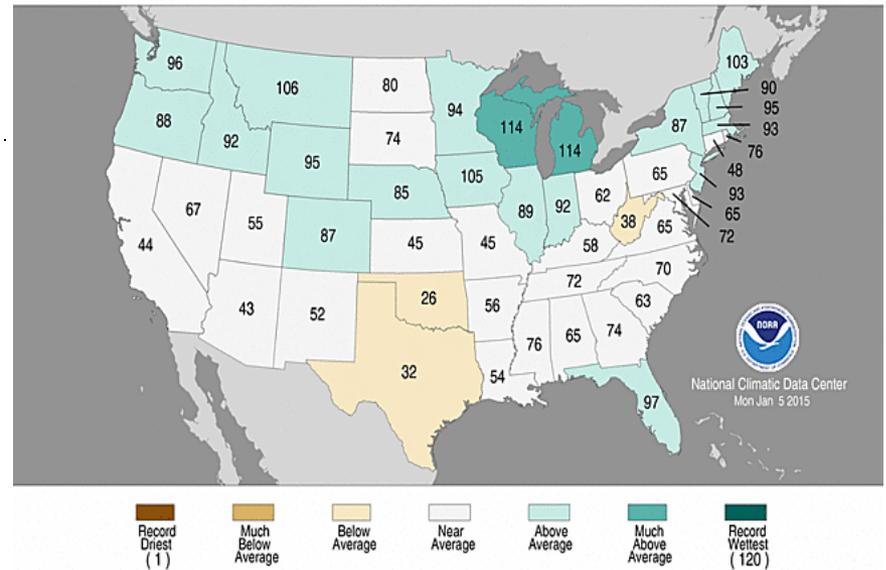
National Climatic Data Center/NESDIS/NOAA



Statewide Precipitation Ranks

January-December 2014

Period: 1895-2014



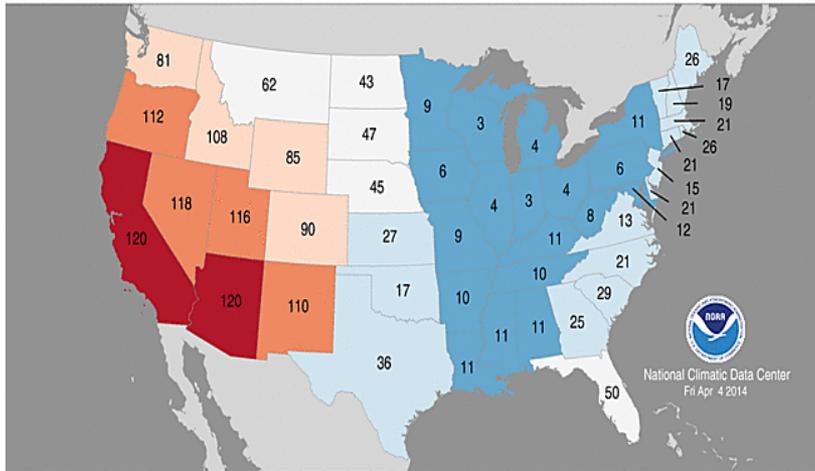
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of Engineers.**



WET 2013, COLD AND SNOWY 2014

- Below average air temperatures during the winter of 2014

Statewide Temperature Ranks
January–March 2014
Period: 1895–2014



- Near record high ice cover throughout the Great Lakes in 2014

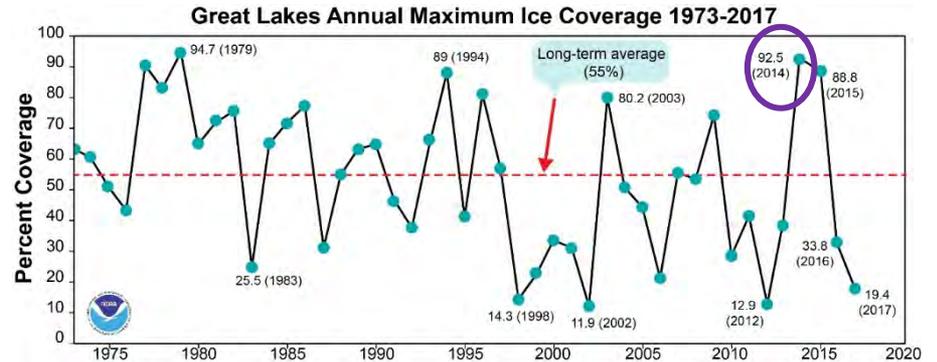


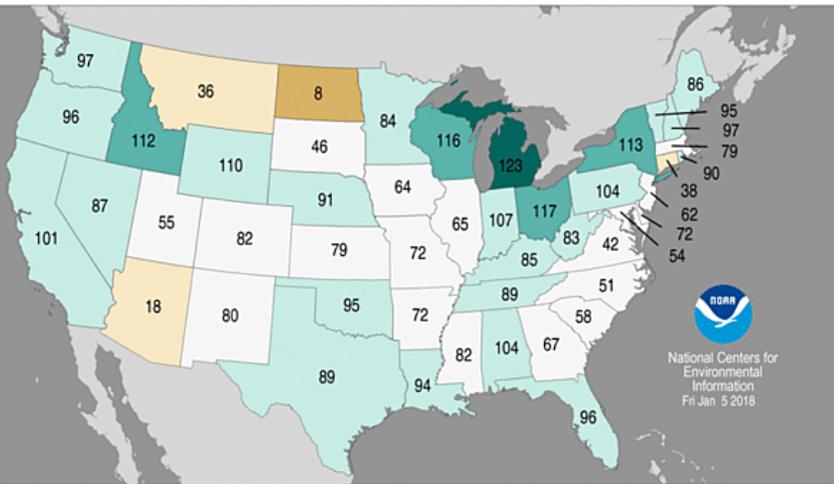
Photo credit: NASA



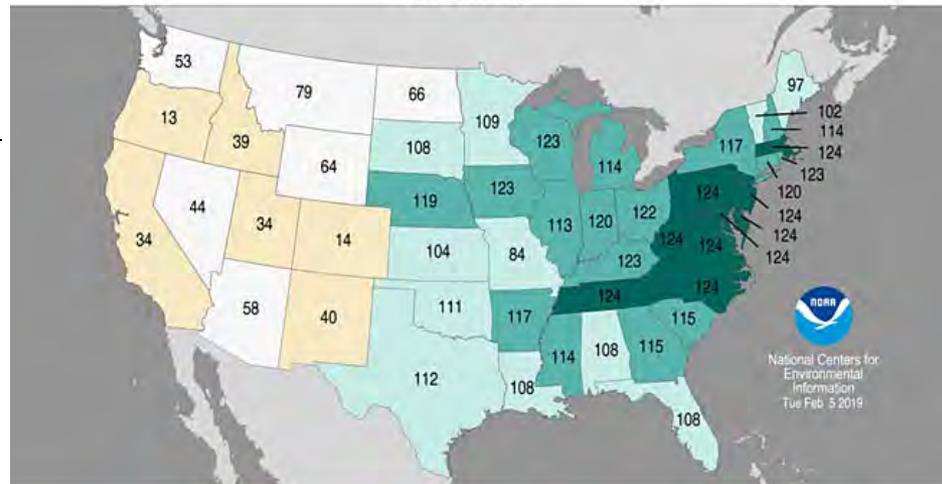
Wet again in 2017 and 2018

- 2017 was again wettest year on record in Michigan
- 2018 was again one of the wettest years on record

Statewide Precipitation Ranks
January–December 2017
Period: 1895–2017



Statewide Precipitation Ranks
January–December 2018
Period: 1895–2018



Record Driest (1)
Much Below Average
Below Average
Near Average
Above Average
Much Above Average
Record Wettest (123)

Record Driest (1)
Much Below Average
Below Average
Near Average
Above Average
Much Above Average
Record Wettest (124)



WET AGAIN IN 2017 AND 2018

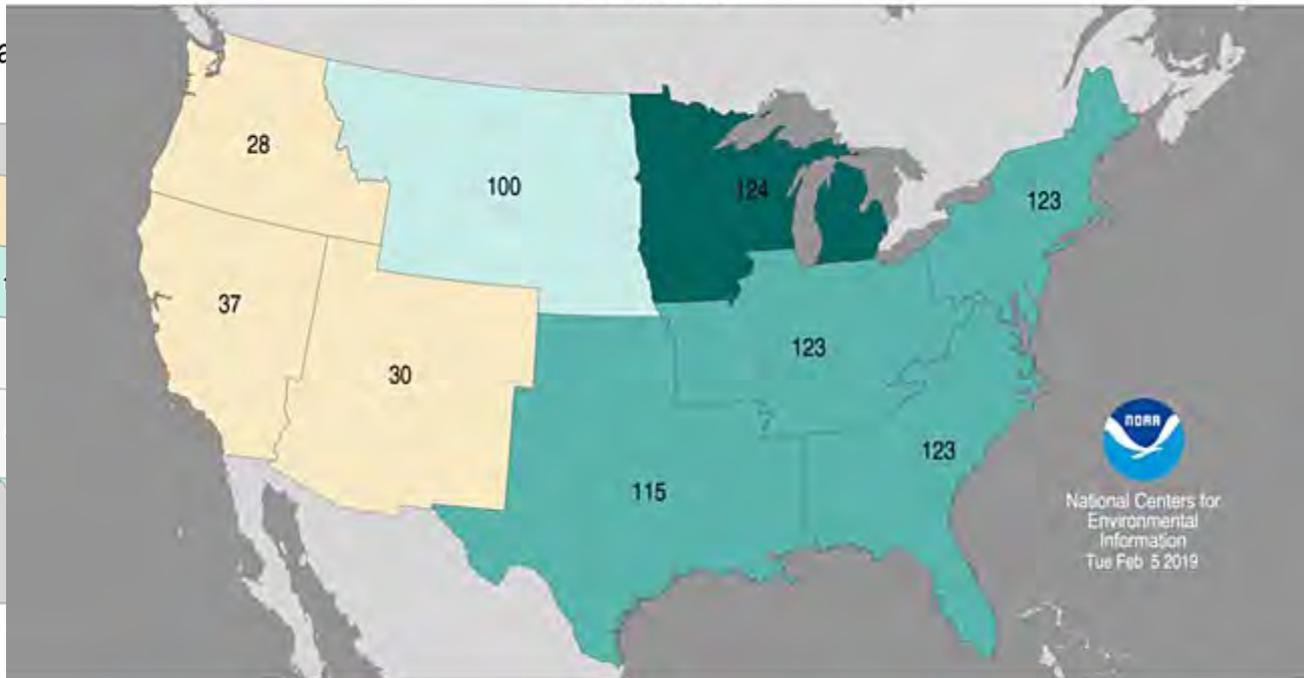
- 2017 was again

2018 was again one of the wettest years on

Regional Precipitation Ranks

January–December 2018

Period: 1895–2018



National Centers for Environmental Information
Tue Feb 5 2019

National Centers for Environmental Information
Tue Feb 5 2019

Record Driest (1)
Much Below Average

Record Driest (1) Much Below Average Below Average Near Average Above Average Much Above Average Record Wettest (124)

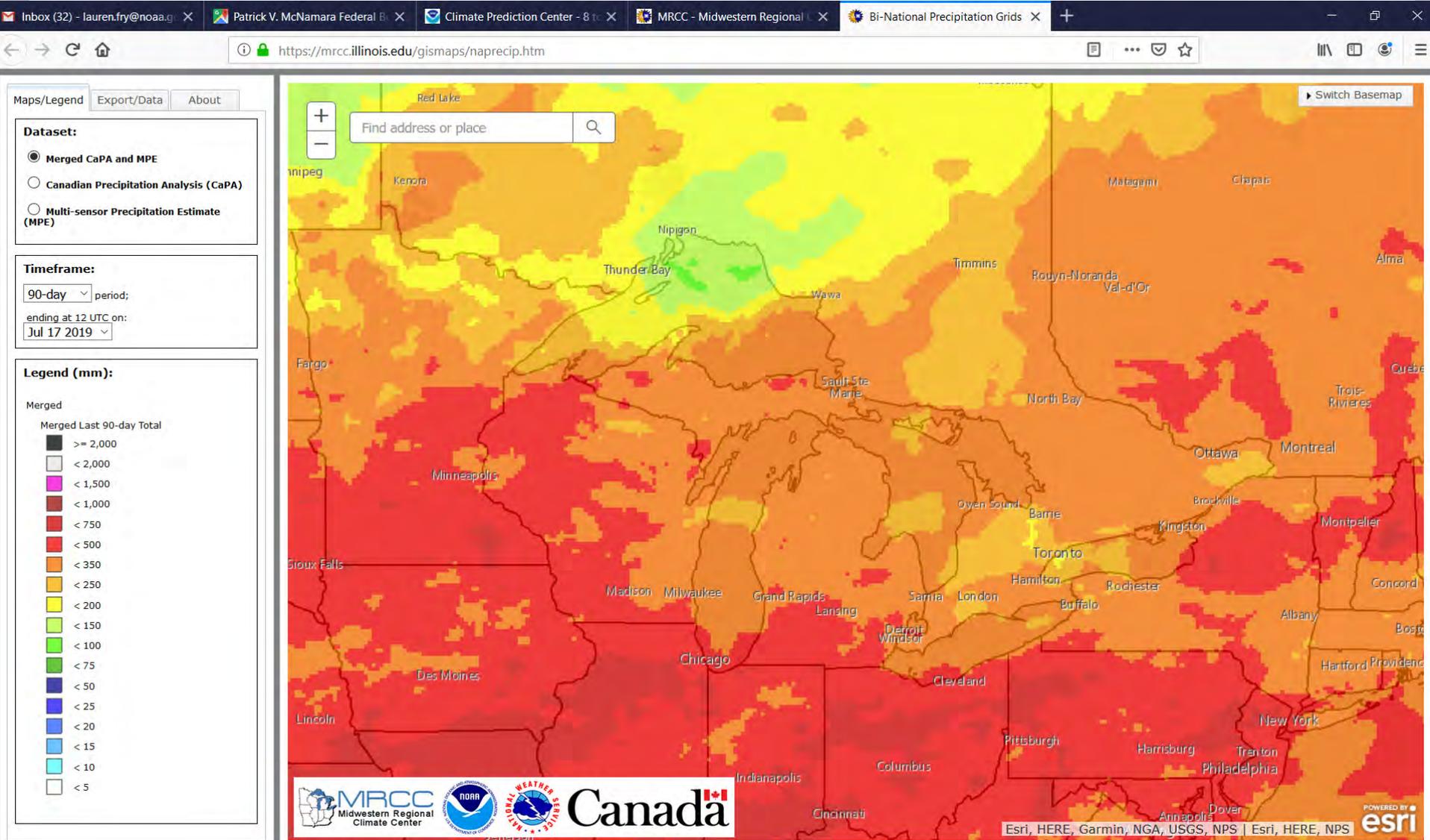
Much Above Average Record Wettest (124)



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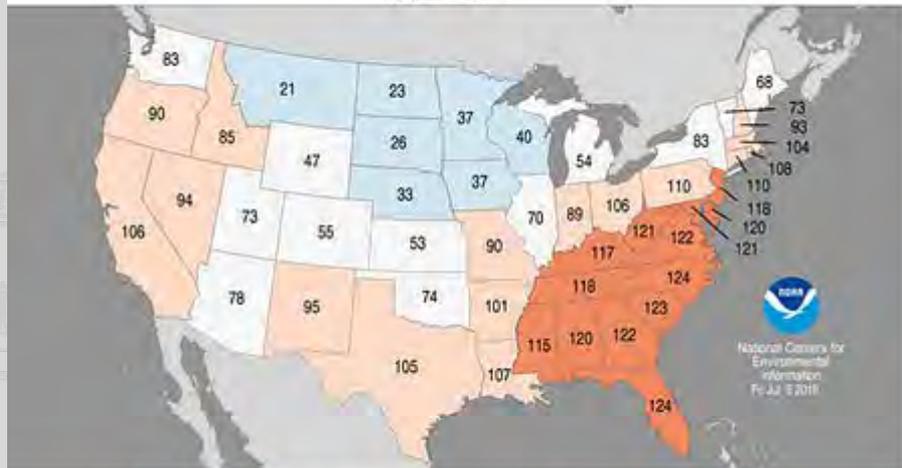


AND NOW, 2019...

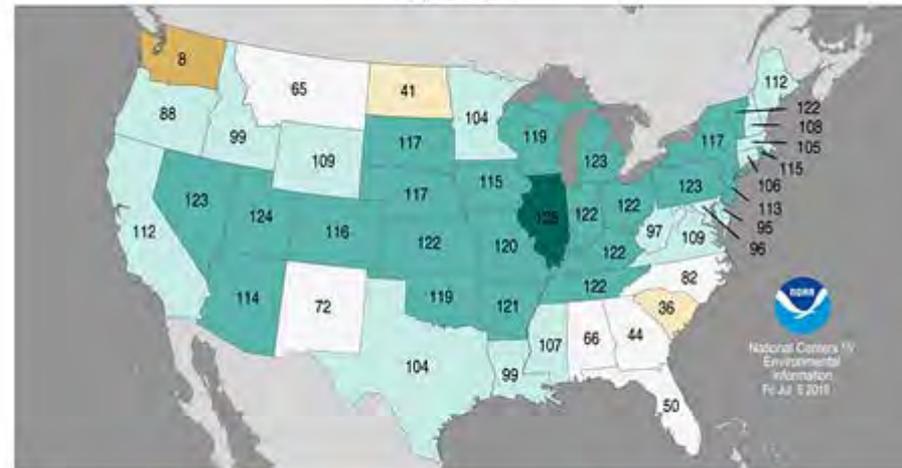


AND NOW, 2019...

Statewide Minimum Temperature Ranks
January–June 2019
Period: 1895–2019



Statewide Precipitation Ranks
January–June 2019
Period: 1895–2019



US Army Corps of Engineers.



AND NOW, 2019...

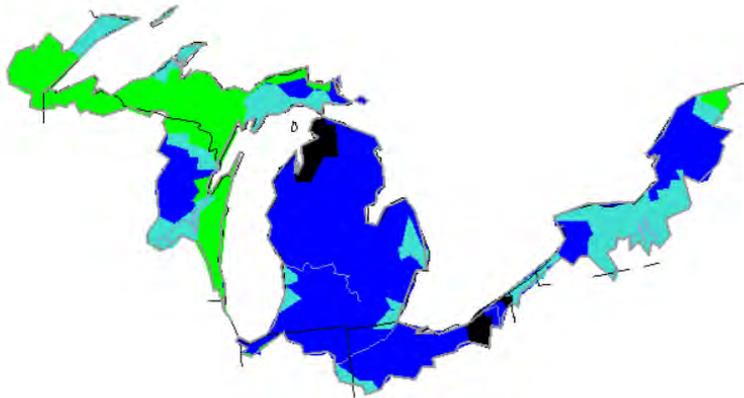
April



May



June



Explanation - Percentile classes								
Low	<10	10-24	25-75	76-90	>90	High	No Data	
	Much below normal	Below normal	Normal	Above normal	Much above normal			



Source: waterwatch.usgs.gov



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of Engineers.



GREAT LAKES WATER LEVELS

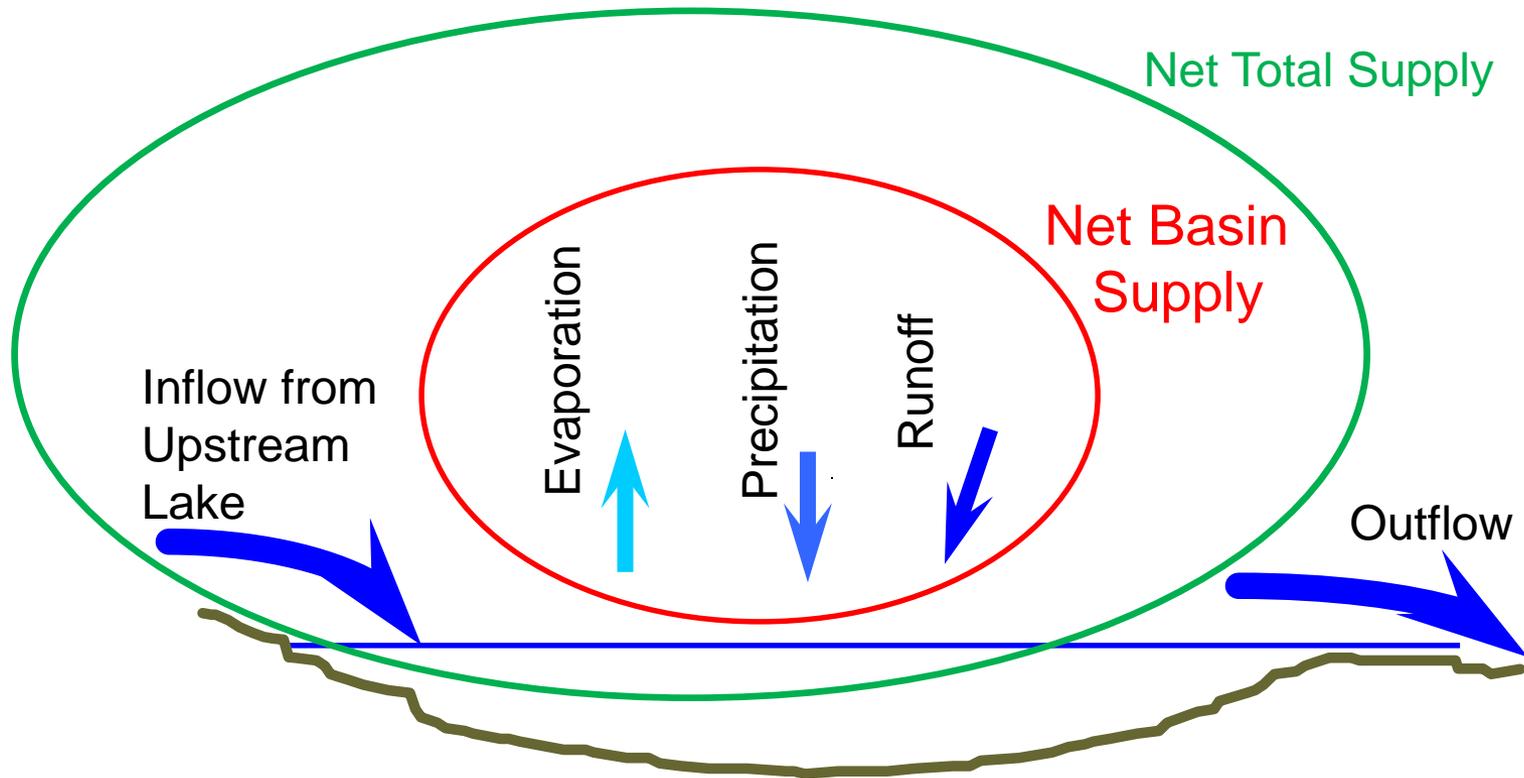
1. Where are they now?
(and how did they get here?)
2. How do we forecast them?
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HOW DO WE FORECAST WATER LEVELS?

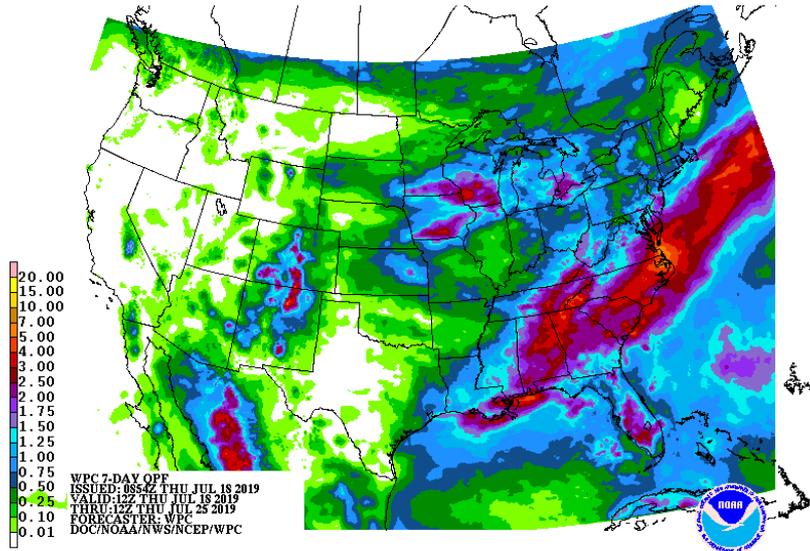


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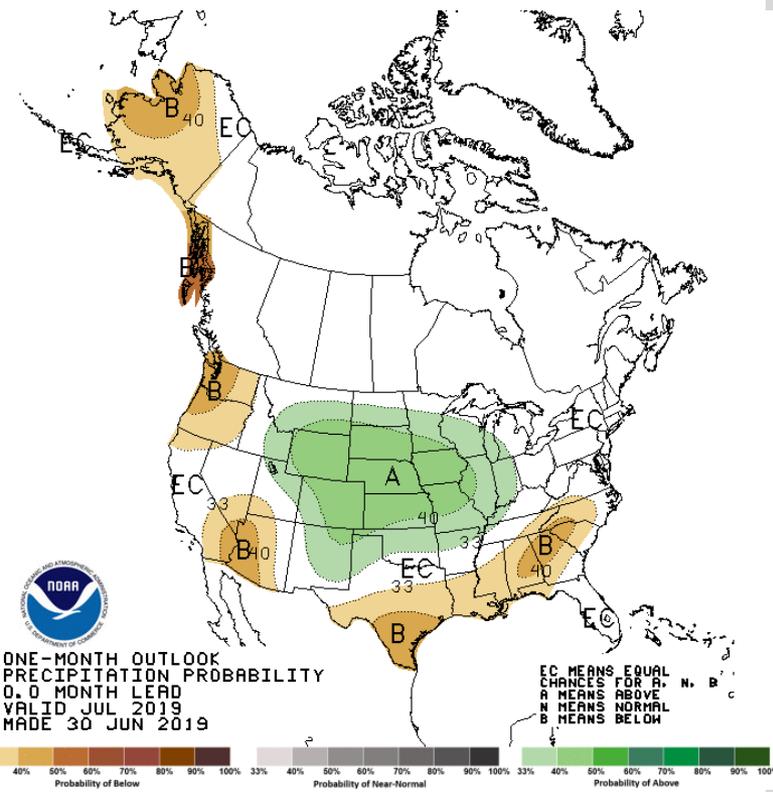


FORECASTED PRECIPITATION

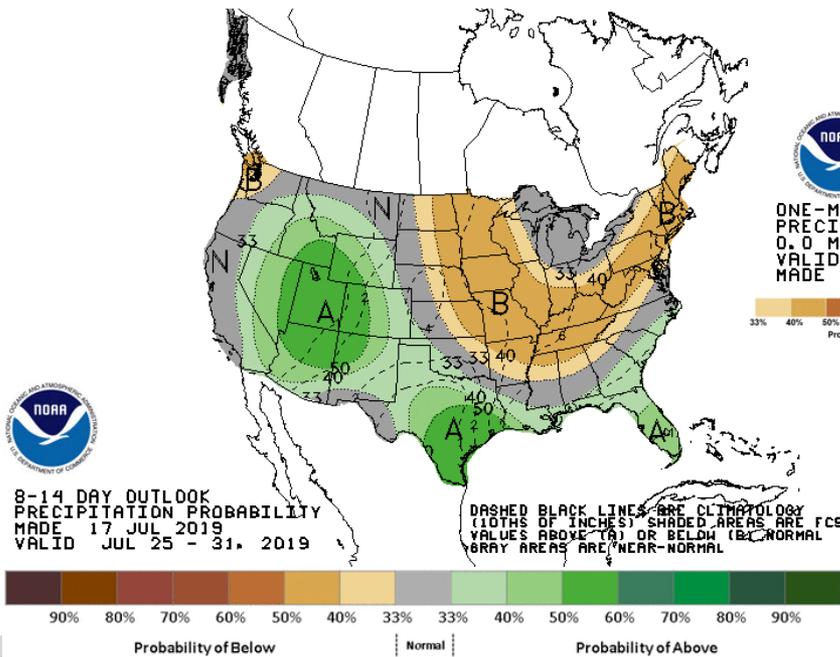
7 Day QPF



July Precipitation



8-14 Day Precipitation Forecast

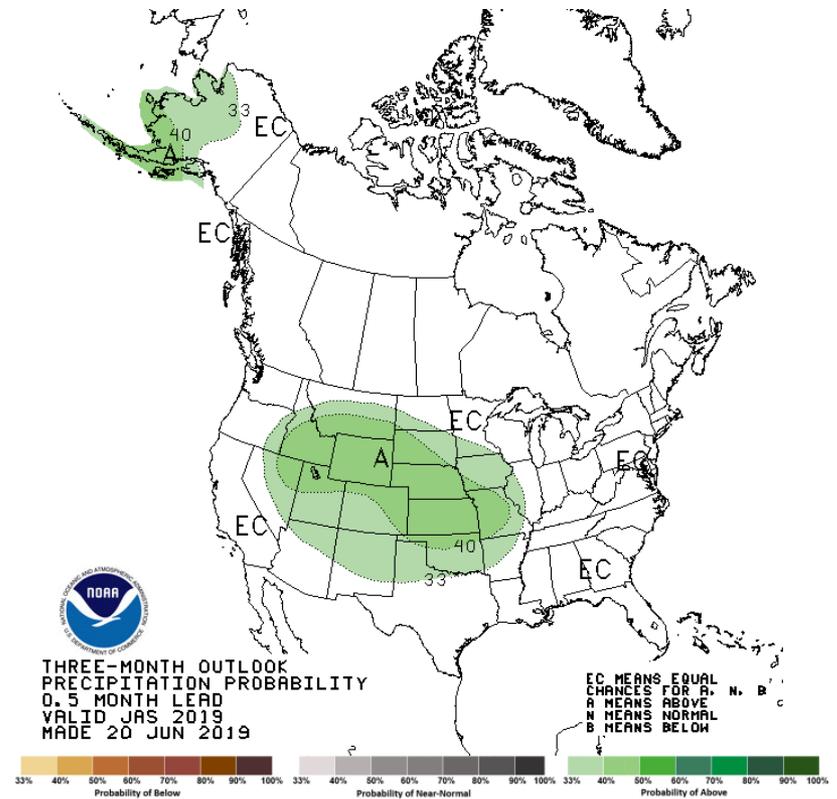
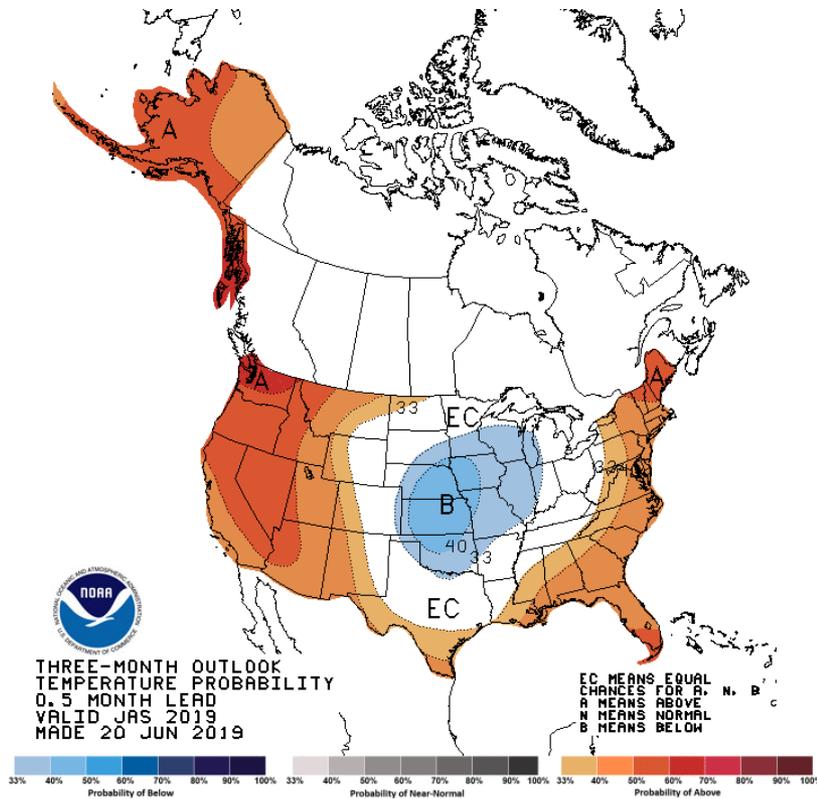


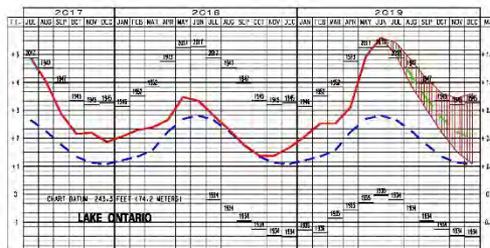
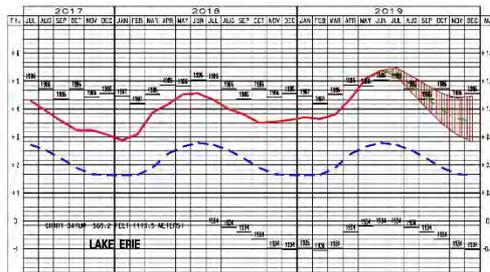
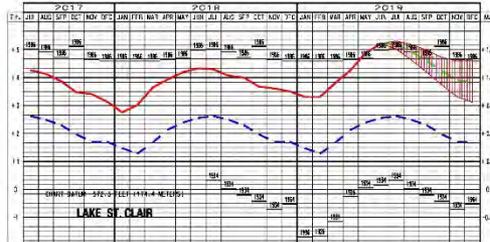
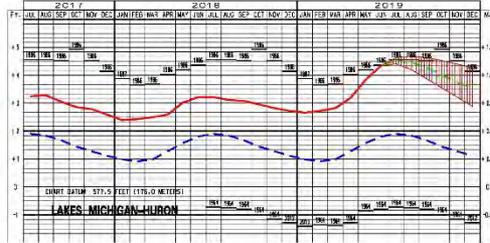
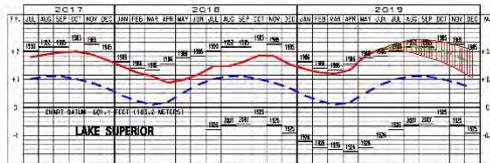
CLIMATE FORECASTS SUMMER/FALL 2019

(July, August, September)

Temperature

Precipitation





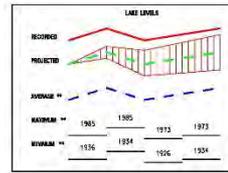
US Army Corps of Engineers
Detroit District

MONTHLY BULLETIN OF LAKE LEVELS FOR THE GREAT LAKES

JULY 2019

Monthly mean water levels for the previous year and the current year to date are shown as a solid line on the hydrographs. A projection for the next six months is given as a dashed line. This projection is based on the present condition of the lake basin and anticipated future weather. The shaded area shows a range of possible levels over the next six months dependent upon weather variations. Current and projected levels (solid and dashed lines) can be compared with the 1918-2018 average levels (dotted line) and extreme levels (shown as bars with their year of occurrence). The legend below further identifies the information on the hydrographs.

LEGEND



The levels on the hydrographs are shown in both feet and meters above (+) or below (-) Chart Datum. Chart Datum, also known as Low Water Datum, is a reference plane on each lake to which water depth and Federal navigation improvement depths on navigation charts are referred.

All elevations and plots shown in this bulletin are referenced to International Great Lakes Datum 1985 (IGLD 1985). IGLD 1985 has its zero base at Rimouski, Quebec near the mouth of the St. Lawrence River (approximate sea level).

JUNE MEAN LAKE LEVELS

(IGLD 1985)

	Superior	Mich-Huron	St. Clair	Erie	Ontario
2019					
Ft.	603.15	597.76	577.60	574.61	249.05
M.	183.84	177.37	175.95	175.14	75.91
2018					
Ft.	602.23	580.64	576.53	573.79	246.78
M.	183.56	176.96	175.70	174.89	75.22
Ft.	602.89	581.79	577.17	574.28	248.72
M.	185.76	177.15	175.97	173.04	75.81
Yr. '1986	1986	1986	1986	1986	2017
Ft.	599.90	576.64	572.24	568.06	243.41
M.	182.85	175.76	174.45	173.45	74.19
Yr. '1926	1926	1964	1954	1954	1955
Ft.	601.87	579.23	574.74	572.01	246.26
M.	185.45	176.55	175.18	174.35	75.06

* provisional
** Average, Maximum and Minimum for period 1918-2018

ELEVATIONS REFERENCED TO THE CHART DATUM OF EACH RESPECTIVE LAKE

MONTHLY FORECAST

Done at the beginning of each month
Forecasts out 6 months



US Army Corps of Engineers



ARMY CORPS OF ENGINEERS WEEKLY GREAT LAKES WATER LEVEL UPDATE

Jul 12, 2019

WEATHER CONDITIONS

This last week, temperatures throughout the Great Lakes Basin climbed towards above average values for this time of year, with temperatures expected to continue to rise through the weekend. Some minor rainfall was experienced last week, but in general dry weather returned to the region. Expect drier than average conditions to continue through the weekend, with some potential for scattered precipitation. So far in July, precipitation has been below average throughout the Great Lakes Basin, with the exception of Lake Erie, which is just a bit above average. Temperatures are predicted to stay warm over the weekend, with a dip in temperature on Saturday in the Lake Superior Basin.

LAKE LEVEL CONDITIONS

Water levels remain high across the Great Lakes. The forecasted water level for July 12th indicates a decrease from last month of 1 inch on Lake Superior, and an increase of 3 and 4 inches on Lakes Michigan-Huron and St. Clair, respectively. There was no change on Lake Erie and Lake Ontario is expected to be 4 inches below its level a month ago. The forecasted level for July 12th either meets or exceeds the record high July monthly mean for all of the Great Lakes except Lake Michigan-Huron, which is 1 inch below. Lakes Superior and Michigan-Huron are projected to remain fairly steady by August 12th, while Lakes St. Clair, Erie and Ontario are expected to decline 3, 5, and 10 inches, respectively, over the next month. See our [Daily Levels](#) web page for more water level information.

FORECASTED MONTHLY OUTFLOWS/CHANNEL CONDITIONS

Outflows from Lake Superior through the St. Mary's River, and Lake Michigan-Huron's outflow into the St. Clair River, are projected to be above average in July. Lake St. Clair's outflow through the Detroit River is also forecasted to be above average. Similarly, Lake Erie's outflow through the Niagara River and the Lake Ontario's outflow through the St. Lawrence River are predicted to be above average for July.

ALERTS

Water levels shown are still-water surface elevations over the entire lake surface. Water levels at specific locations may differ substantially due to meteorological influences. Official records are based on monthly average water levels and not daily water levels. Users of the Great Lakes, connecting channels and St. Lawrence River should keep informed of current conditions before undertaking any activities that could be affected by changing water levels. Mariners should utilize navigation charts and refer to current water level readings. High water levels and potentially record high water levels are expected to persist for at least the next six months, so flood prone areas are expected to remain vulnerable.

	SUPERIOR	MICH-HURON	ST. CLAIR	ERIE	ONTARIO
Forecasted Water Level for Jul 12, 2019 (feet)	603.12	581.92	577.59	574.61	248.75
Chart Datum (feet)	601.10	577.50	572.30	569.20	243.30
Difference from chart datum (inches)	+24	+53	+63	+65	+65
Difference from average water level for Jun 12, 2019 (inches*)	-1	+3	+4	0	-4
Difference from average water level for Jul 12, 2018 (inches*)	+7	+15	+13	+12	+29
Difference from long-term monthly average of Jul (inches)	+13	+31	+33	+32	+32
Difference from highest monthly average of record for Jul (inches)	0	-1	+5	+4	+5
Year of highest recorded monthly mean	1950	1986	1986	1986	2017
Difference from lowest monthly average of record for Jul (inches)	+34	+63	+61	+67	+66
Year of lowest recorded monthly mean	1926	1964	1934	1934	1934
Projected net change in levels by Aug 12, 2019 (inches)	0	0	-3	-5	-10

ALL DATA SHOWN IN THIS SUMMARY ARE REFERENCED TO IGLD 1985
 *VALUES FOR SPECIFIC DAY ARE BASED ON 3-DAY DAILY AVERAGE AROUND SPECIFIED DATE
 LONG TERM AVERAGE PERIOD OF RECORD, 1918-2018

FORECASTED INFORMATION PROVIDED
 Department of the Army
 Detroit District, Corps of Engineers
[Detroit District Home](#)
 1-888-694-8313 ext. 1

RECORDED DATA (1918 – present)
 provided by
[NOAA Center for Operational Oceanic
 Products and Services](#)

FOR MORE INFORMATION VISIT
[Detroit District Great Lakes Homepage](#)
[International Joint Commission](#)
[Great Lakes Information Network](#)

WEEKLY FORECAST

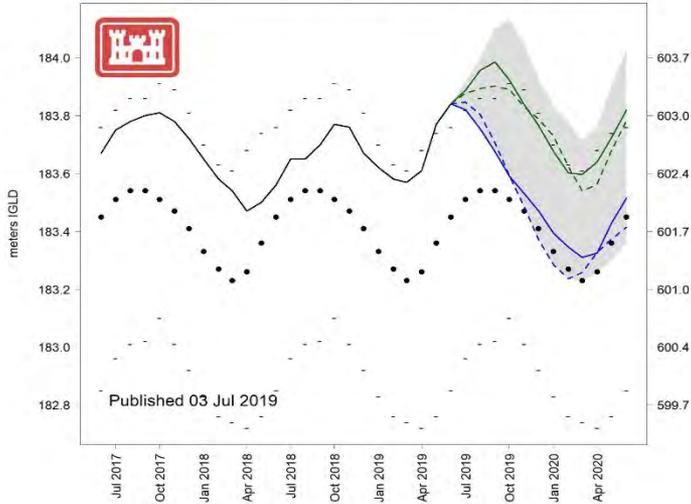
Done by Friday morning each week
 Forecasts out 1 month from that day



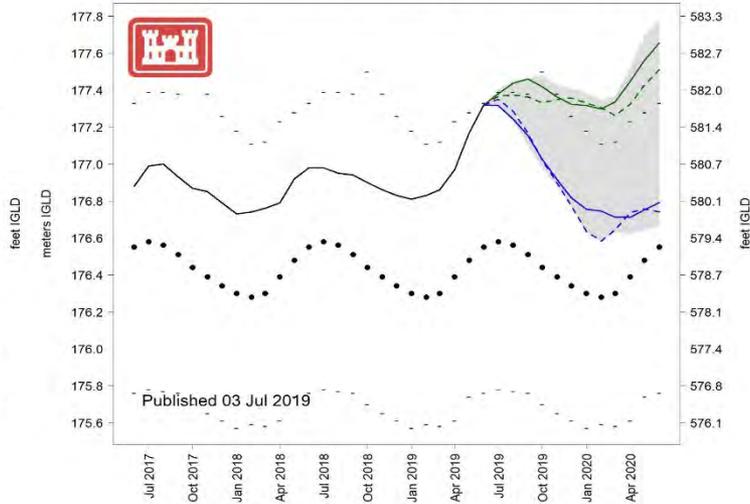
US Army Corps
 of Engineers.



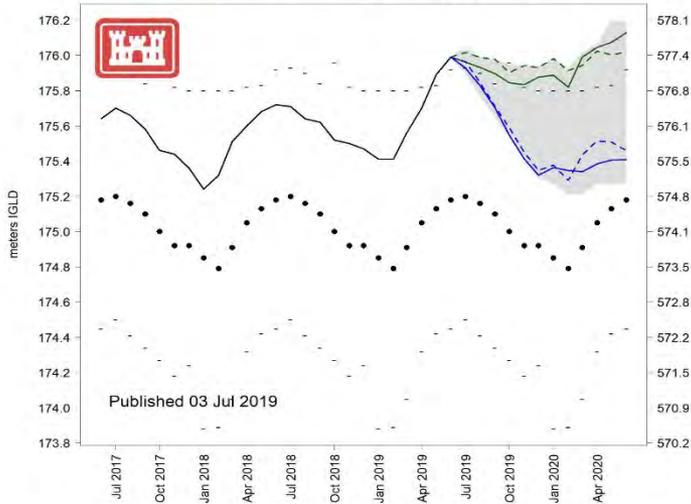
Lake Superior Monthly Mean Water Levels



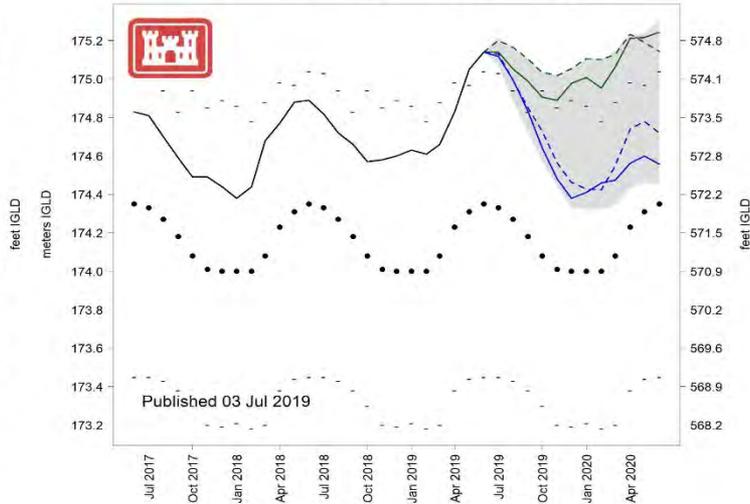
Lake Michigan-Huron Monthly Mean Water Levels



Lake St. Clair Monthly Mean Water Levels



Lake Erie Monthly Mean Water Levels



WATER LEVEL OUTLOOK

What if.....

Scenario driven based on historical supplies

- Observed Monthly Mean
- Range of Possible Outcomes
- Long Term Average
- Long Term Max/Min
- 1972-73
- - 1992-93
- 1998-99
- - 1976-77



GREAT LAKES WATER LEVELS

1. Where are they now?
(and how did they get here?)
2. How do we forecast them?
3. Where will they be?



US Army Corps
of Engineers.



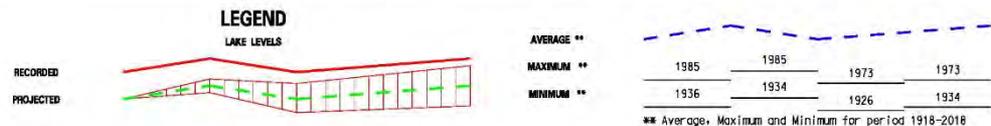
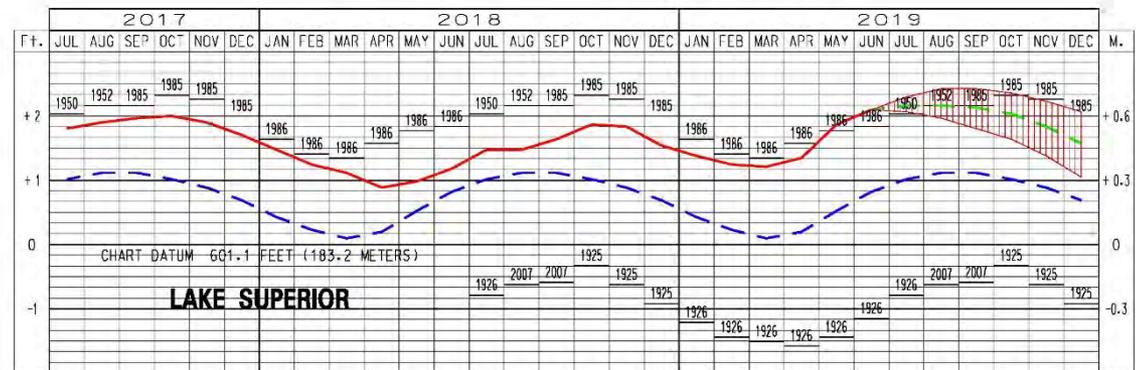
6-MONTH WATER LEVEL FORECAST

New record high set in
May and June

Projected levels(dashed green line):

- New record high expected in July. At old record in August and September
- 11 to 14 inches above long term average levels
- Above last year through October

LAKE SUPERIOR WATER LEVELS – JULY 2019



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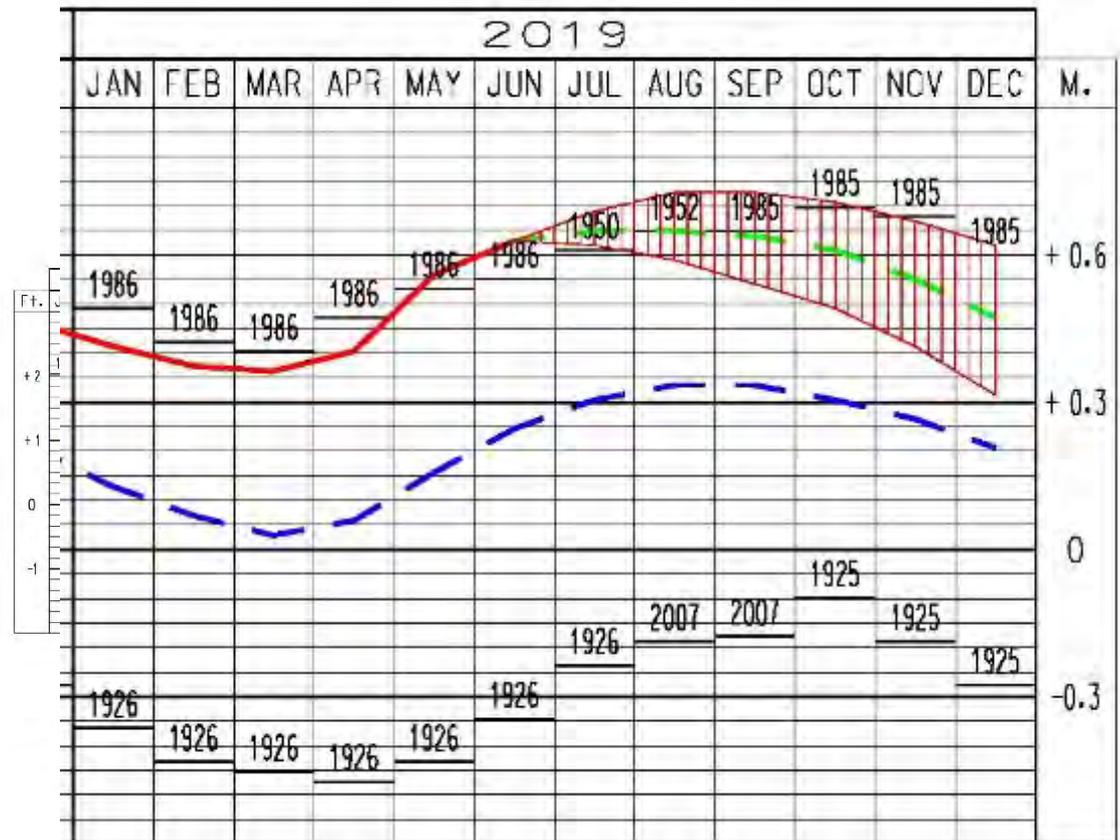


6-MONTH WATER LEVEL FORECAST

**New record high set in
May and June**

Projected levels (dashed green line):

- New record high expected in July. At old record in August and September
- 11 to 14 inches above long term average levels
- Above last year through October



US Army Corps
of Engineers.



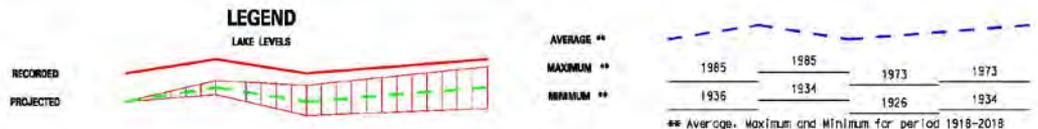
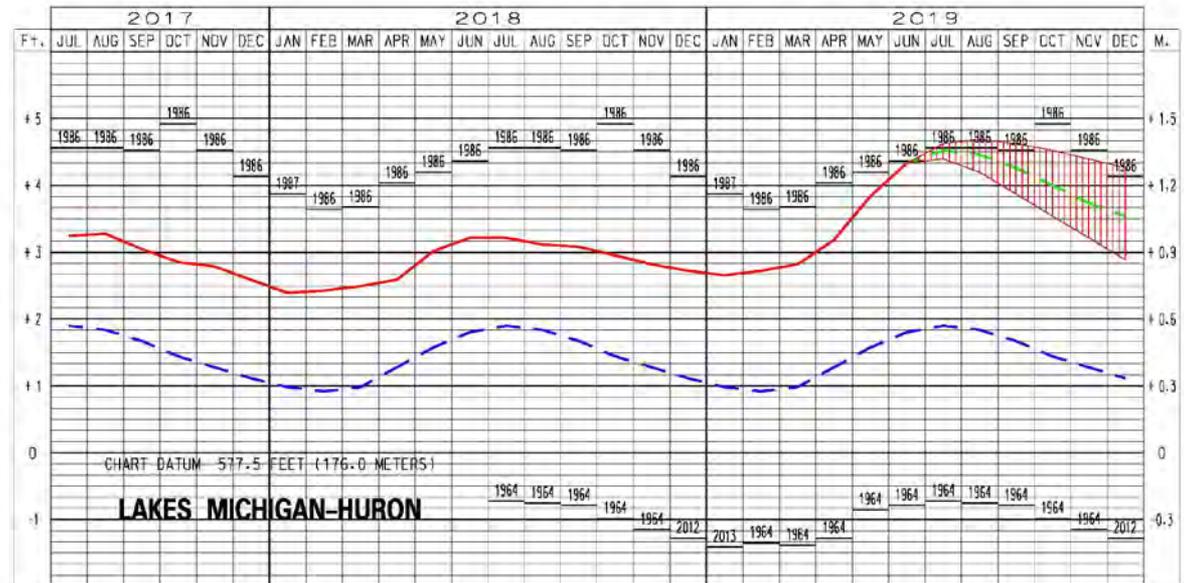
6-MONTH WATER LEVEL FORECAST

Within 1 inch of record high in June

Projected levels(dashed green line):

- Tie record highs in July
- 29 to 31 inches above long term average levels
- 10 to 16 inches above last year's levels

LAKES MICHIGAN-HURON WATER LEVELS - JULY 2019



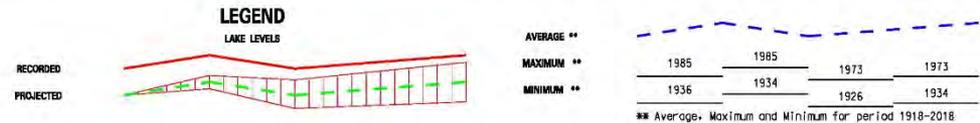
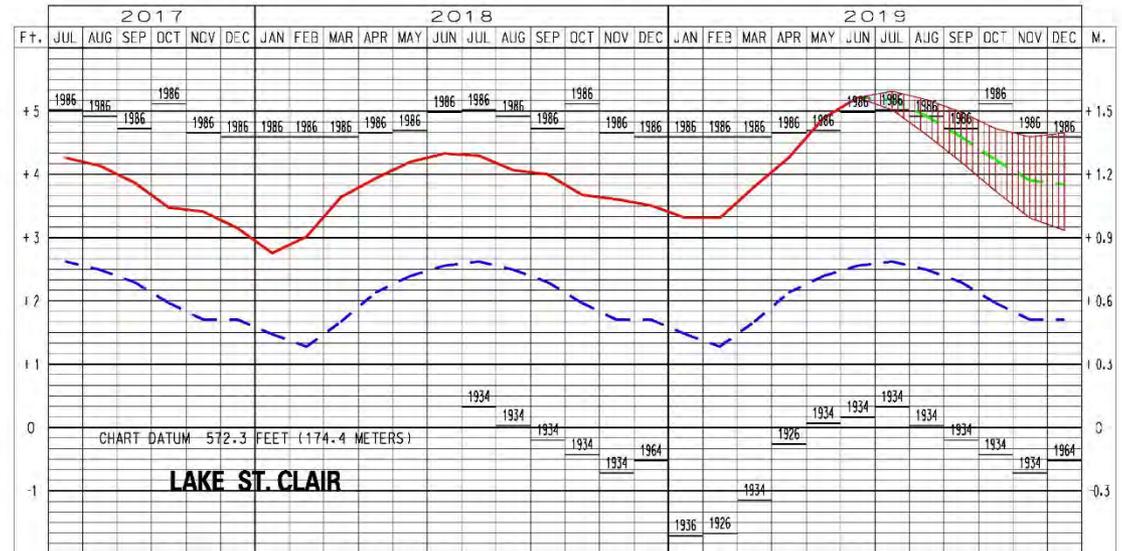
6-MONTH WATER LEVEL FORECAST

New record high set in May and June

Projected levels(dashed green line):

- Sets new record in July, ties record high in August
- 26 to 31 inches above long term average levels
- 4 to 11 inches above last year's levels

LAKE ST. CLAIR WATER LEVELS – JULY 2019



US Army Corps
of Engineers.

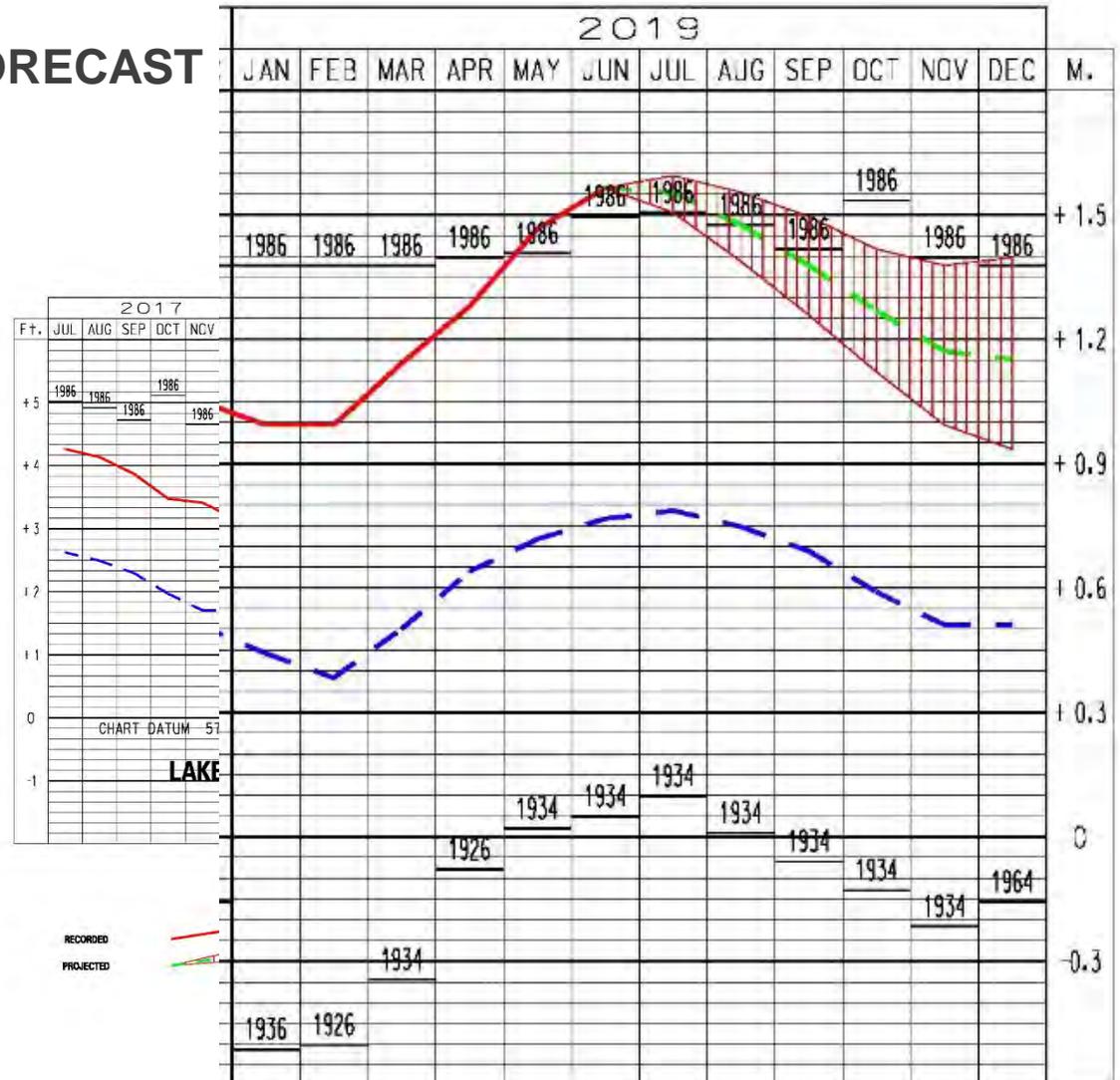


6-MONTH WATER LEVEL FORECAST

New record high set in May and June

Projected levels(dashed green line):

- Sets new record in July, ties record high in August
- 26 to 31 inches above long term average levels
- 4 to 11 inches above last year's levels



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of Engineers.



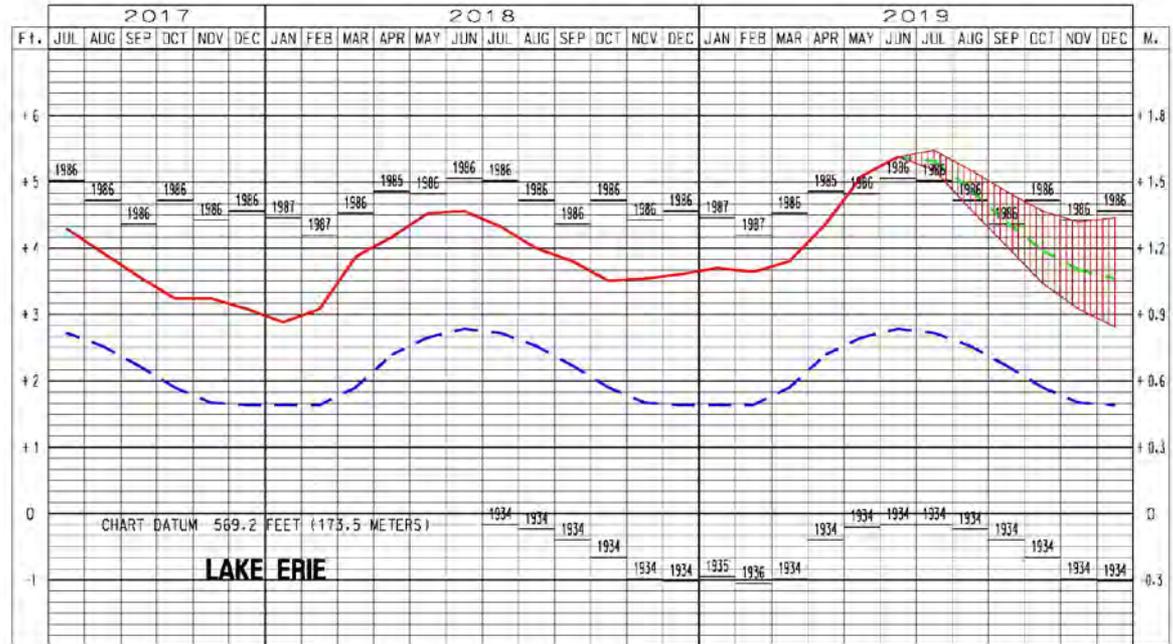
6-MONTH WATER LEVEL FORECAST

New record high set in May and June

Projected levels(dashed green line):

- New record high expected in July and August
- 23 to 31 inches above long term average levels
- 2 to 12 inches above last year's levels through November

LAKE ERIE WATER LEVELS - JULY 2019



LEGEND

LAKE LEVELS

RECORDED: Solid red line

PROJECTED: Dashed green line

AVERAGE **: Dashed blue line

MAXIMUM **: 1985, 1985, 1973, 1973

MINIMUM **: 1936, 1934, 1926, 1934

** Average, Maximum and Minimum for period 1918-2018



US Army Corps of Engineers.

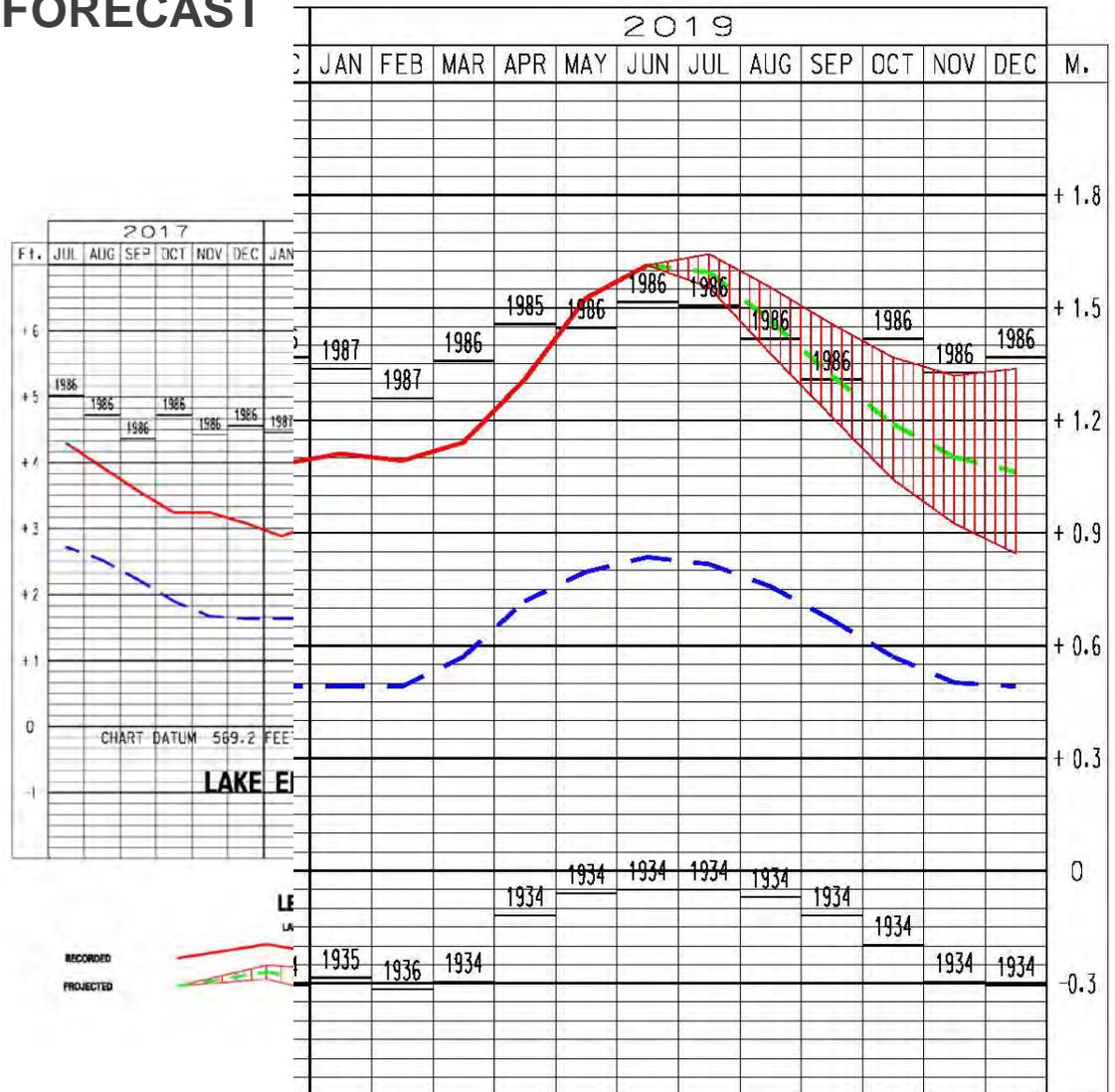


6-MONTH WATER LEVEL FORECAST

New record high set in May and June

Projected levels(dashed green line):

- New record high expected in July and August
- 23 to 31 inches above long term average levels
- 2 to 12 inches above last year's levels through November



US Army Corps of Engineers



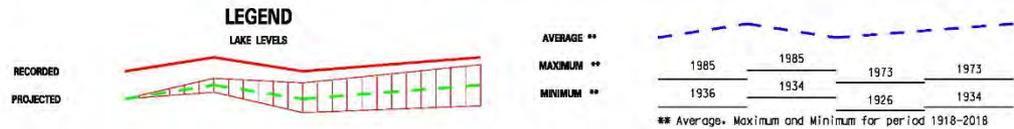
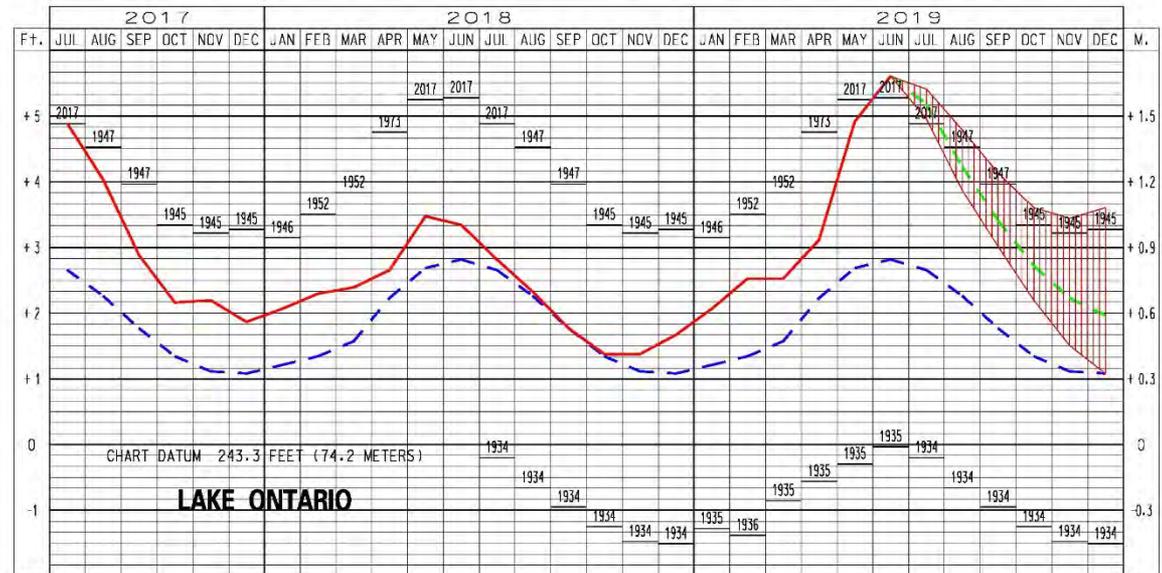
6-MONTH WATER LEVEL FORECAST

New record high set in June

Projected levels(dashed green line):

- New record high expected in July
- 11 to 30 inches above long term average levels
- 4 to 28 inches above last year's levels

LAKE ONTARIO WATER LEVELS - JULY 2019

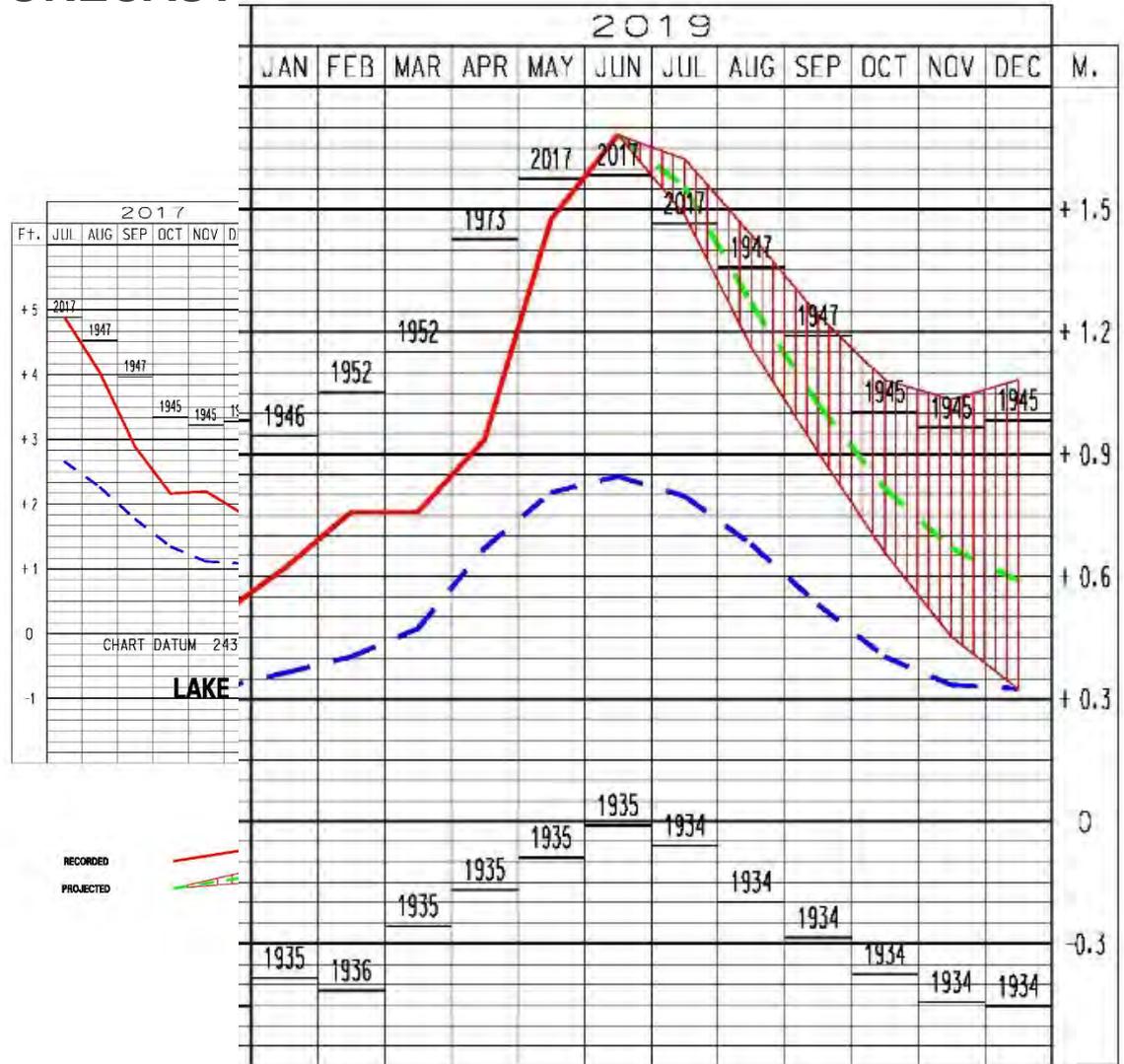


6-MONTH WATER LEVEL FORECAST

New record high set in June

Projected levels(dashed green line):

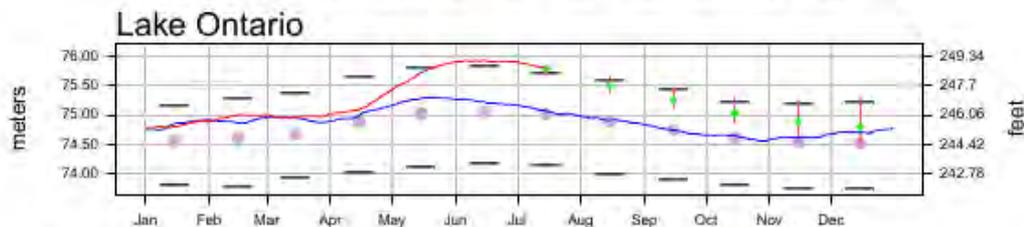
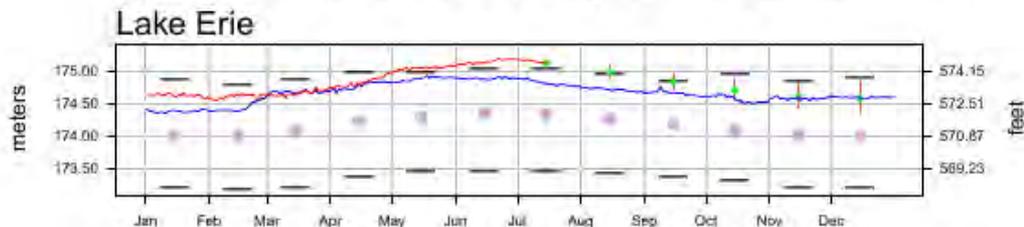
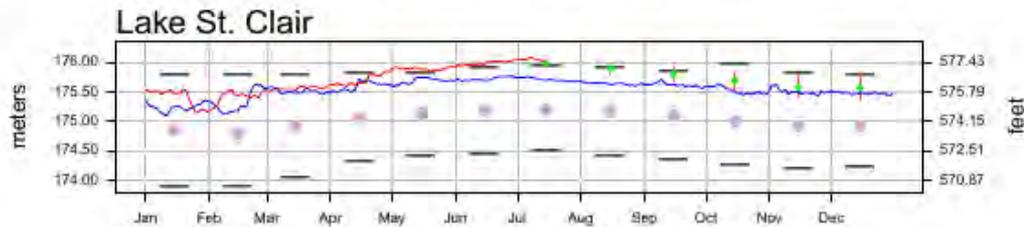
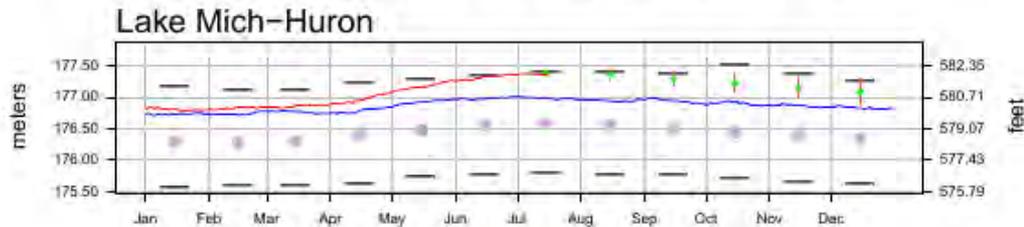
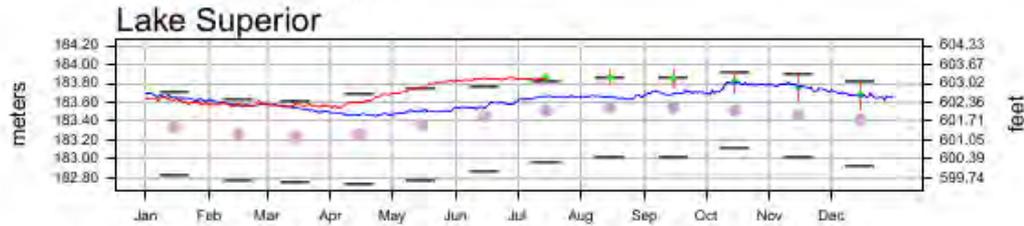
- New record high expected in July
- 11 to 30 inches above long term average levels
- 4 to 28 inches above last year's levels





Daily Great Lakes Water Levels

- 2019
- 2018
- ↓ Coordinated Forecast
- LTA Monthly Mean
- Record High/Low Monthly Mean



Lakewide average levels are based on a network of water level gages located around the lakes.
 LTA and record levels are computed from a period of record of 1918 to 2018.
 Elevations are referenced to the International Great Lakes Datum (1985).

Updated 2019-07-17



US Army Corps of Engineers.



GET ALL THE LATEST WATER LEVEL INFORMATION ON OUR WEBPAGE

<https://www.lre.usace.army.mil/Missions/Great-Lakes-Information/Great-Lakes-Information.aspx>

The screenshot displays the website's navigation bar with the US Army Corps of Engineers logo and menu items: About, Business With Us, Missions, Media, Library, Locations, Careers, and Contact. A search bar for "Detroit District" is also present.

Quick Links

- Great Lakes Information +
- Great Lakes Basin Conditions
- Great Lakes Outflows
- Great Lakes Precipitation
- Great Lakes Update Articles
- Water Level Data
- Water Level Forecasts
- Lake Superior Regulation
- Lake Winnebago
- Coastal Program
- Flood Monitoring
- Contact Information
- Related Links

Great Lakes Information

Collapse All Expand All

- Great Lakes water level data and forecasts, basin conditions, outflows, and other information relating to Great Lakes water levels

Great Lakes Information

Click on a box below to view water level data, water level forecasts, basin conditions, outflows, or update articles.

Water Level Data

Click this box to view historical monthly mean lakewide average water levels, daily Great Lakes Water Levels Reports, water levels on the Detroit, St. Clair, and St. Marys Rivers, and links to NOAA water level gage data.

Water Level Forecasts

Click this box to view all Great Lakes forecast products, including the Weekly Water Level Update, the Connecting Channels Forecast, the Monthly Bulletin of Great Lakes Water Levels, and the Great Lakes Water Level Outlook.

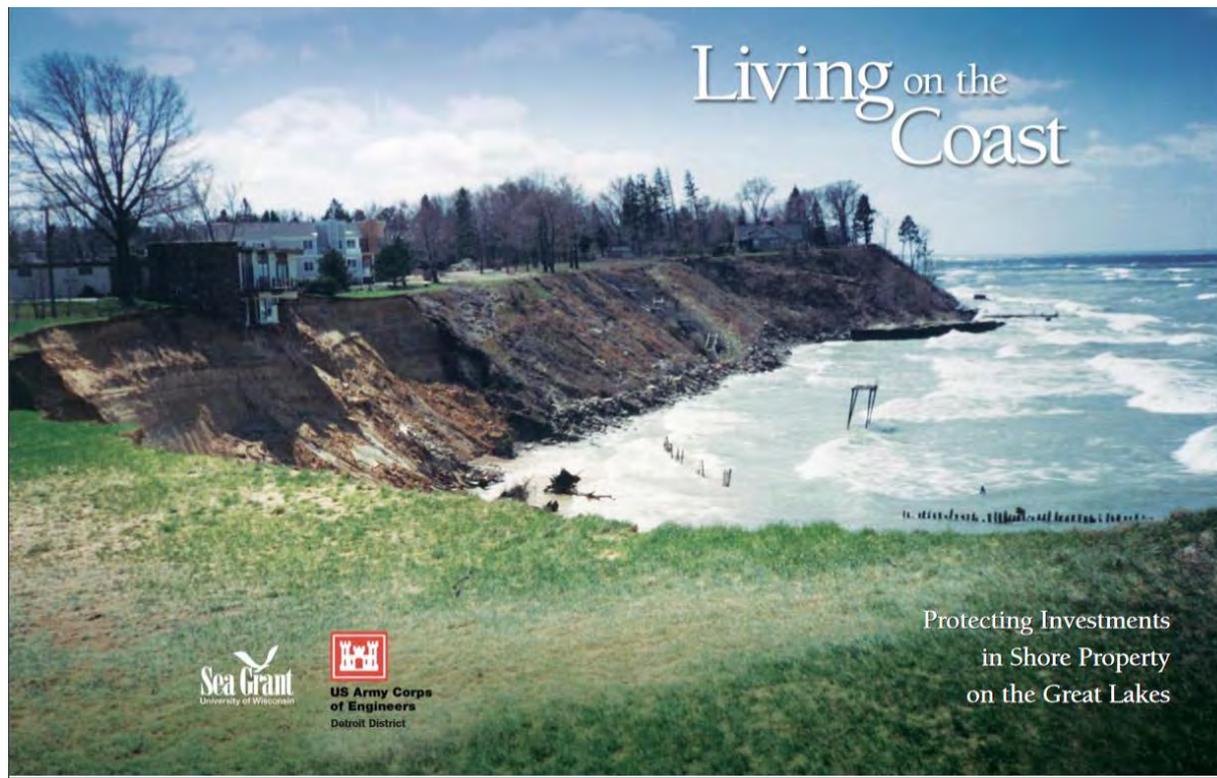


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LIVING ON THE COAST

<https://www.lre.usace.army.mil/Portals/69/docs/GreatLakesInfo/docs/CoastalProgram/Living%20on%20the%20Coast%20Booklet.pdf?ver=2016-06-06-105107-683>



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EMERGENCY RESPONSE

33 U.S.C. 701n (commonly referred to as Public Law (PL) 84-99):

USACE can support local natural disasters **supplementing** local resources just prior to or during an event.

Technical Assistance: Technical expertise in review of and recommendations in support of state and local efforts, and helping to determine feasible solutions.

Direct Assistance: Sandbags, plastic sheeting, HESCO barriers, for protection of **public infrastructure**

Currently providing Technical Assistance to the City of Detroit, Wayne County, Macomb County, and St. Clair County.



US Army Corps
of Engineers.



QUESTIONS?



Credit: DetroitIsIt.com

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