

LAKE WINNEBAGO REGULATION MEETING

USACE Detroit District
16 October 2019



US Army Corps
of Engineers



AGENDA



- **Regulation Team Introduction**
- **Basin Overview**
- **FRNSA Update**
- **Major Stakeholders**
- **Current Weather Conditions**
- **Operations Overview**
- **2018-2019 Water Level Explanation**
- **2019-2020 Water Level Strategy Development**
- **Open Discussion/Questions**



DETROIT DISTRICT AREA OF RESPONSIBILITY





FOX RIVER NAVIGATION SYSTEM AUTHORITY UPDATE

By Jeremy Cords, CEO



FOX-WOLF RIVER BASIN

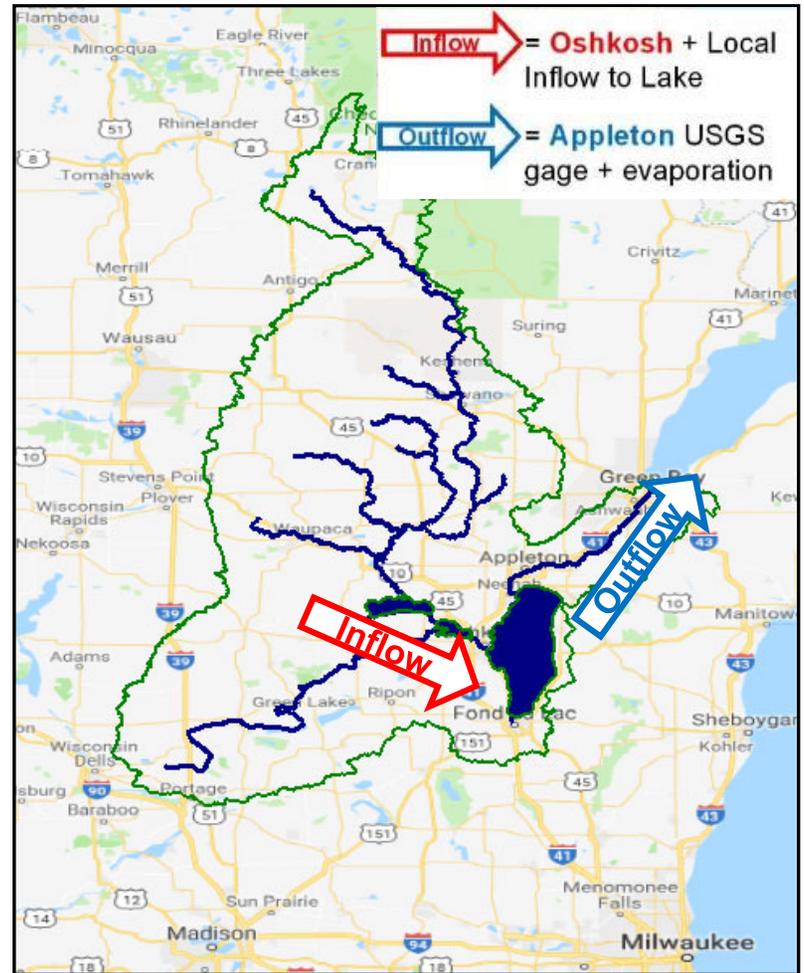


Fox-Wolf River Basin

Drainage Area = 6,430 mi²

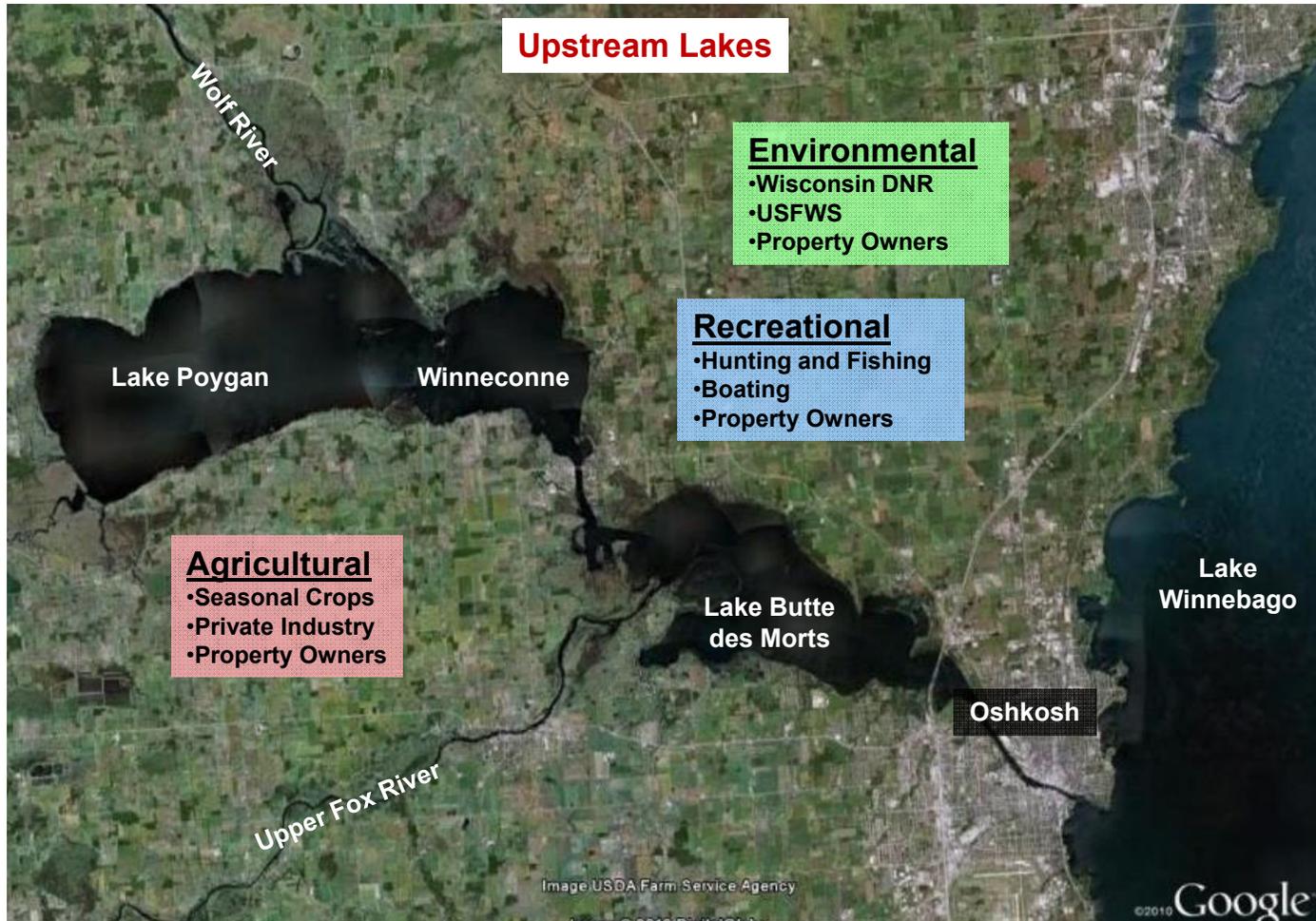
Lake Winnebago
Surface Area = 206 mi²
Length = 28 mi
Width = 10 mi
Maximum Depth = 21 ft

7 day travel time from upper reaches of basin to Lake Winnebago



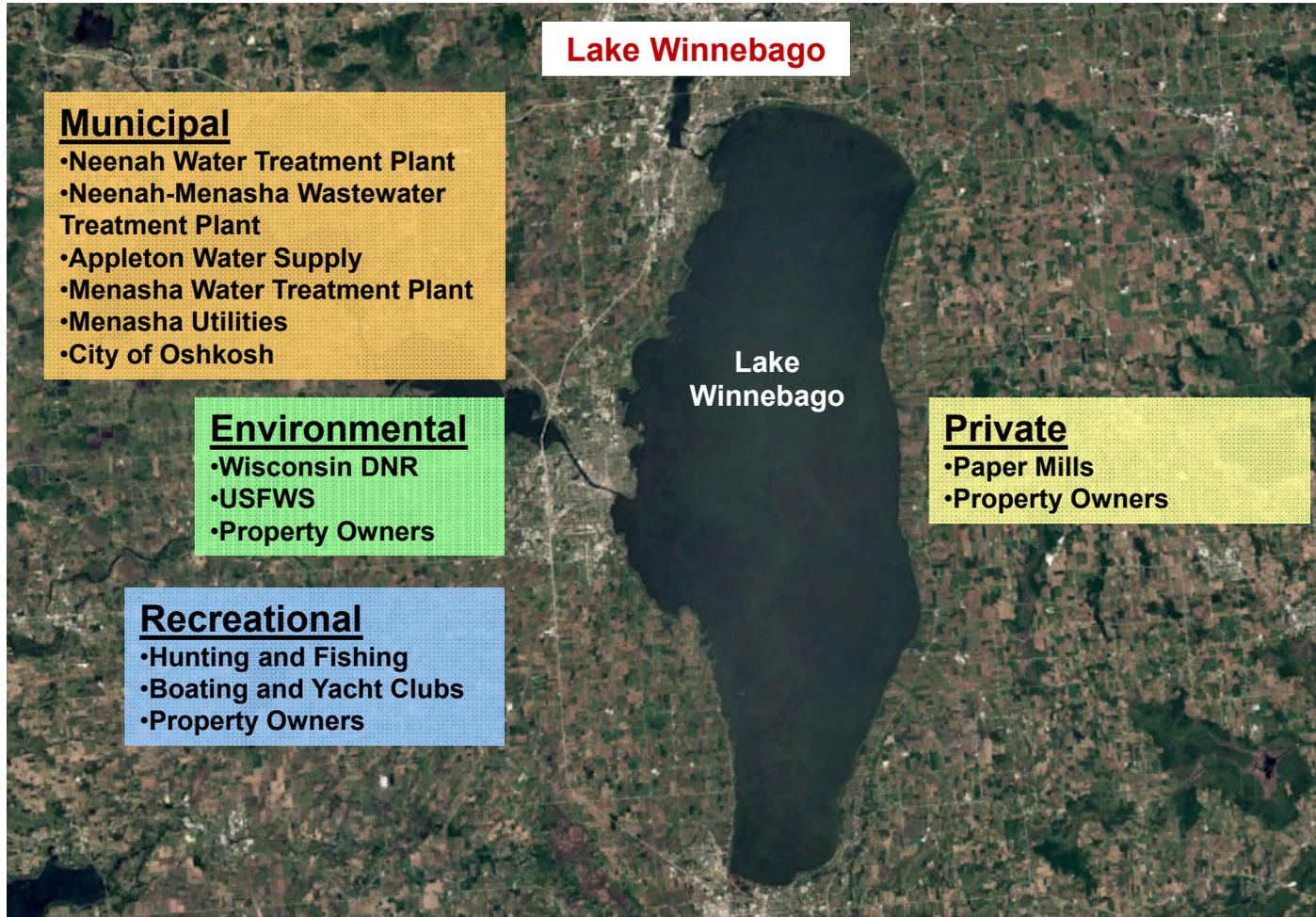


STAKEHOLDER GROUPS



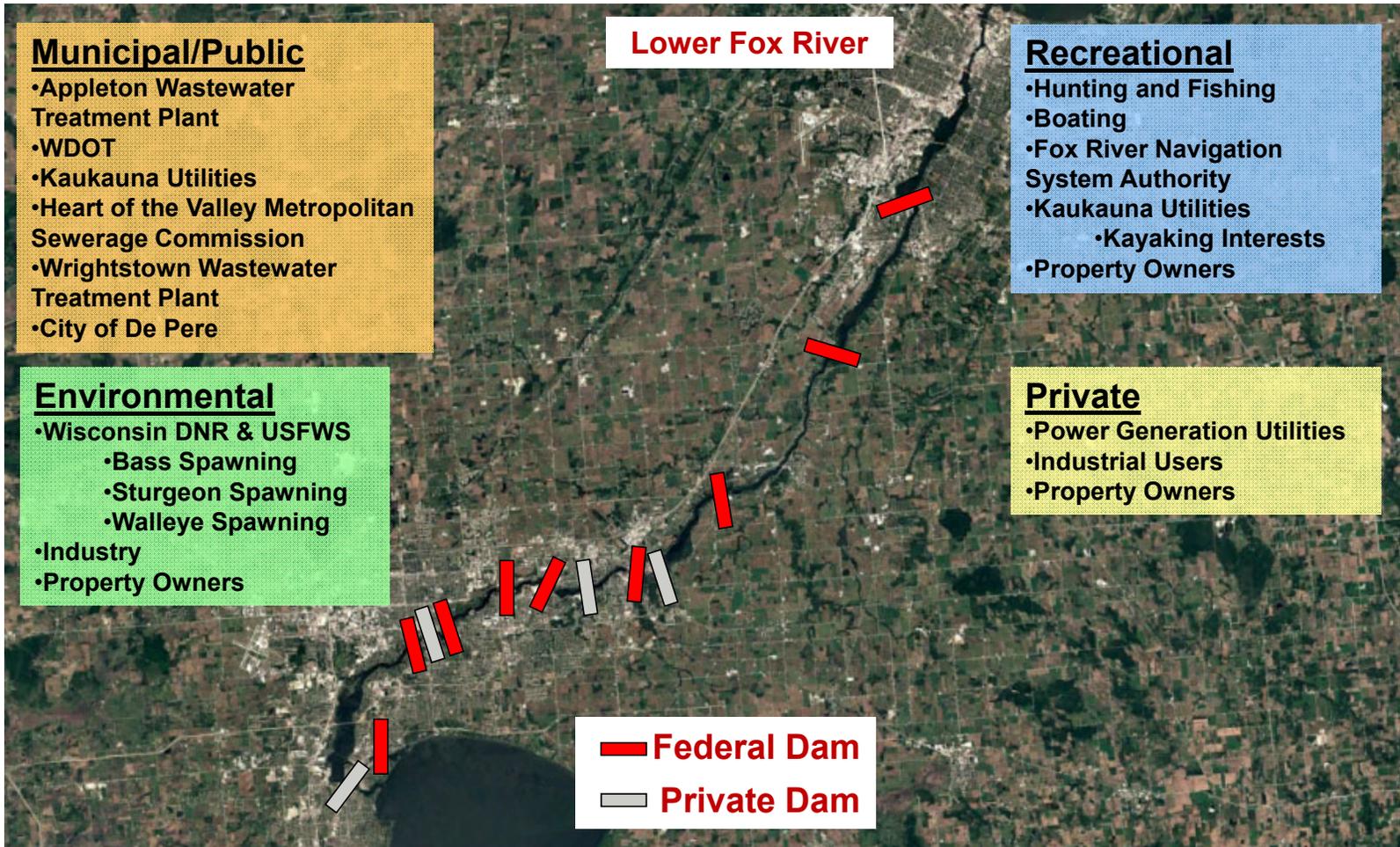


STAKEHOLDER GROUPS (CONT.)





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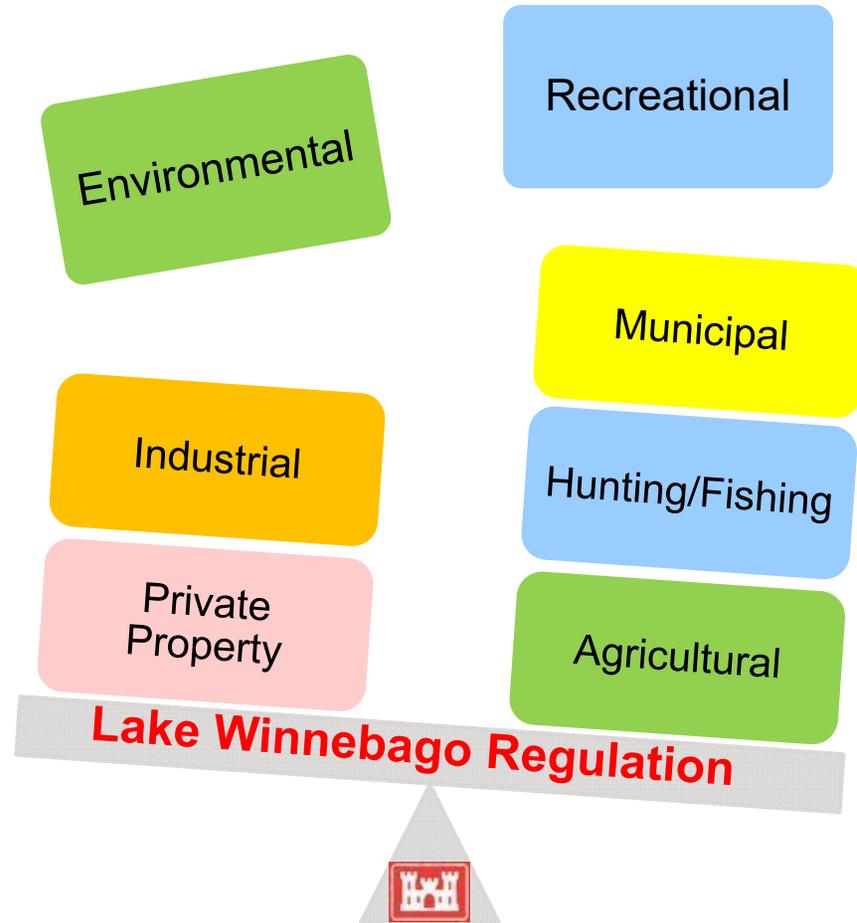


COMPETING INTERESTS



A wide variety of stakeholders produces compounding and competing needs

- Upper Pools
- Lake Winnebago
- Lower Fox River





CURRENT WEATHER AND BASIN CONDITIONS



Current Lake Level	3.11 feet
Inflows at Oshkosh	13,225 cfs, 3 day average
Outflows at Appleton	14,700 cfs
5 Day Rainfall Forecast	0.6 inches, mostly Monday
Winds	Strong NW winds
Soil Moisture	Very high, nearly 6 inches above normal
Forecasted Water Level Trend	Steady decline after winds settle



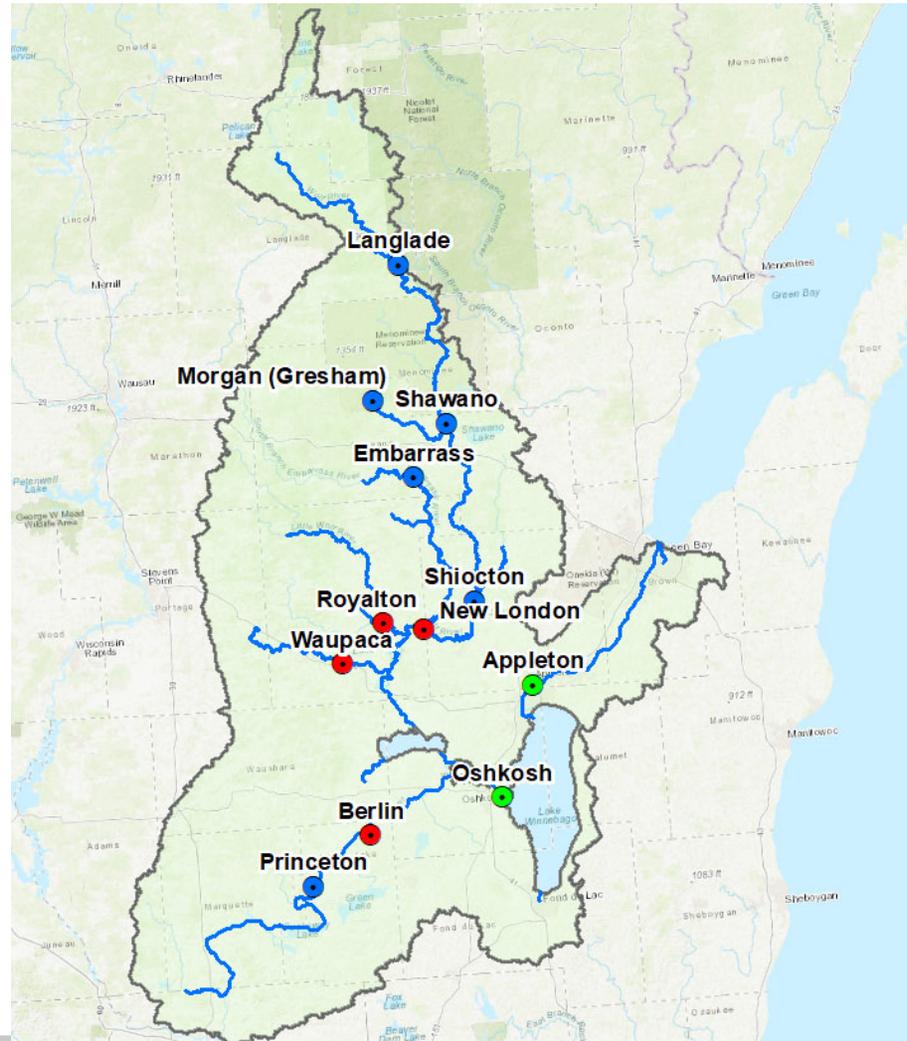
RIVER GAGE LOCATIONS



USACE uses several stream gages throughout the basin in regulation decisions.

Gages are operated by USACE and partner agencies USGS and NWS

- Water Level
- Water Level and Precipitation (USACE)
- Water Level and Velocity





RIVER AND LAKE GAGE LOCATIONS

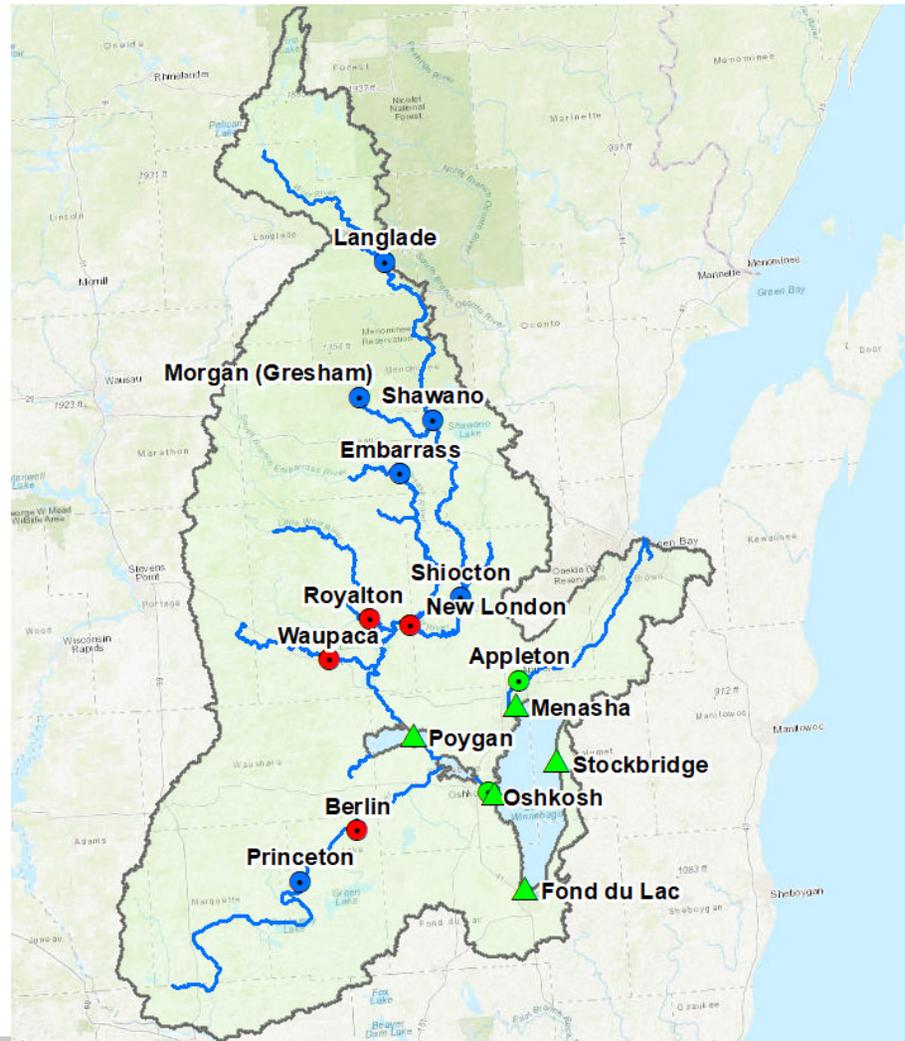


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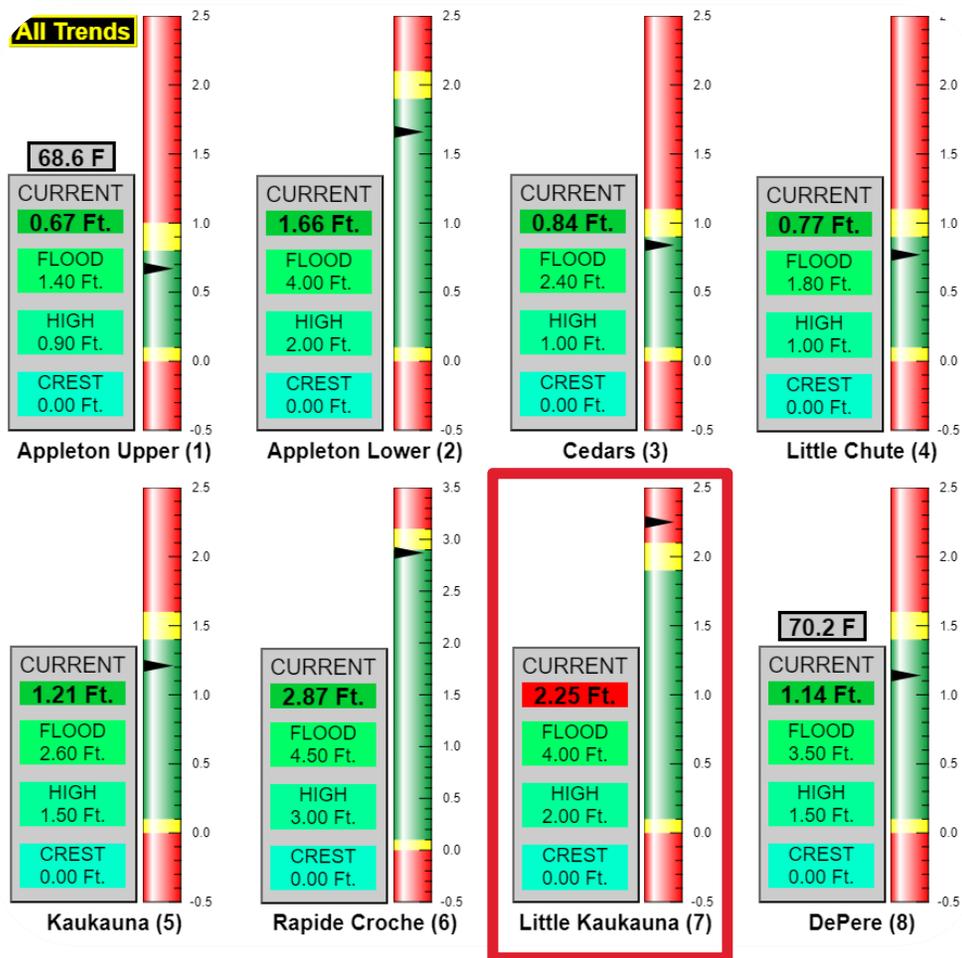
4 Lake gages provide an average lake level

- Water Level
- Water Level and Precipitation (USACE)
- Water Level and Velocity
- ▲ Lake Level Gages





LOWER FOX RIVER DAMS

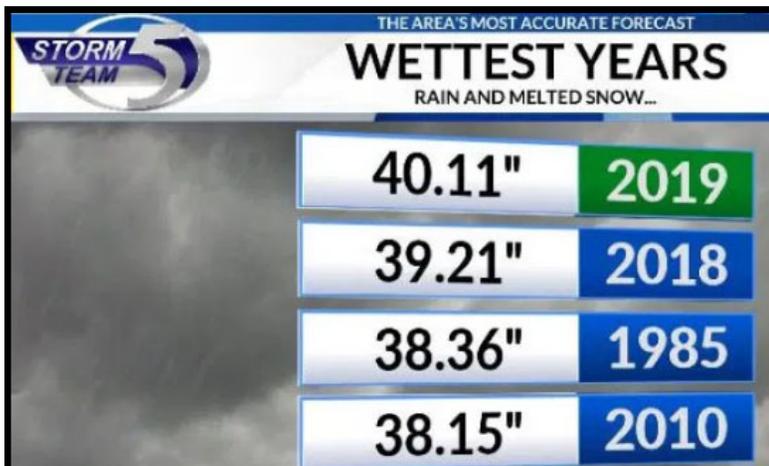


There are 8 federal dams on the lower Fox River, managed for ***flood risk, hydro power, municipal and industrial uses, and recreation.***

Each pool has an authorized limit. The crest of the dam or zero on the vertical scale provides for **6ft** of water depth in the navigation channel.



FLOODING IN EARLY OCTOBER



NWS Green Bay ✓
@NWSGreenBay



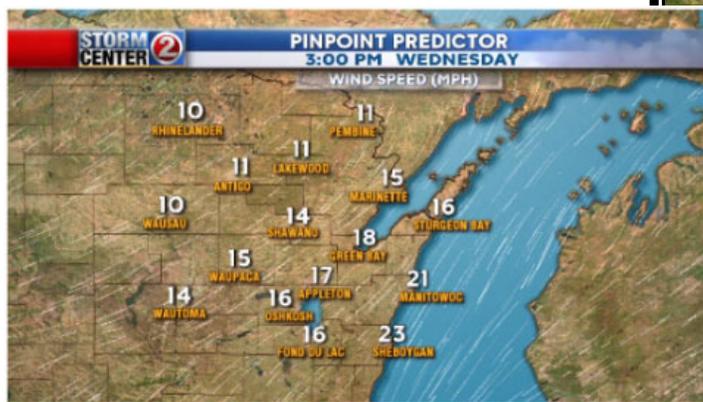
It is official !!! 2019 is now the wettest year on record in Green Bay! As of 3pm, we are up to 39.23" of precipitation. This breaks the old record 39.21" set last year. ☁️ #wiwx #record

♥️ 16 3:17 PM - Oct 1, 2019

💬 22 people are talking about this



Roadways, parks, and the Football field flooded in Fond du Lac Overnight on Oct 1st and continued through the day on Oct 2nd



Strong northeast winds combined with high water levels on Lake Michigan can cause serious flooding concerns for the greater Green Bay area.

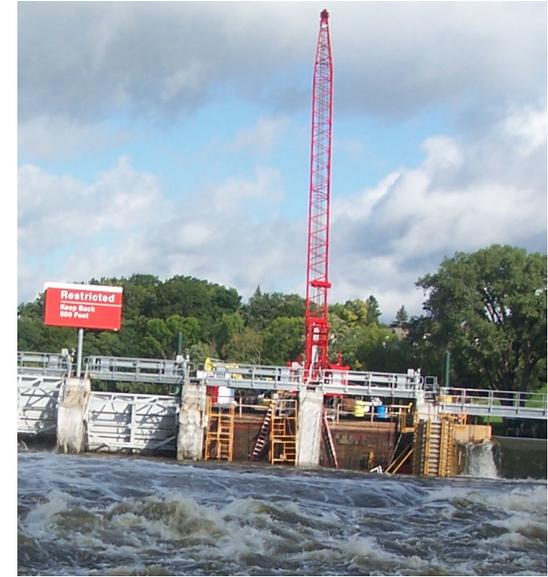
The impacts of additional flow and high water levels will factor into future regulation decisions.



CURRENT AND UPCOMING INFRASTRUCTURE REPAIR PROJECTS



New Piers and Gates at the Kaukauna Dam



Upcoming Projects – New walkways at De Pere, Appleton Upper, and Appleton Lower Dams. New gates at both Appleton Dams. And new gate seals at the Little Kaukauna Dam.

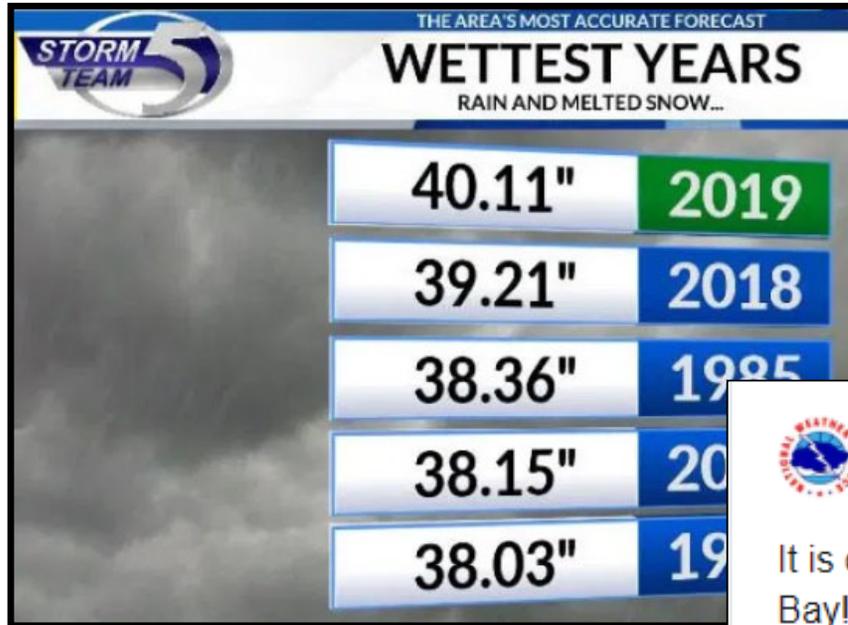


2018-2019 WATER LEVEL EXPLANATION





RECENT HEADLINES FROM GREEN BAY



NWS Green Bay 
@NWSGreenBay

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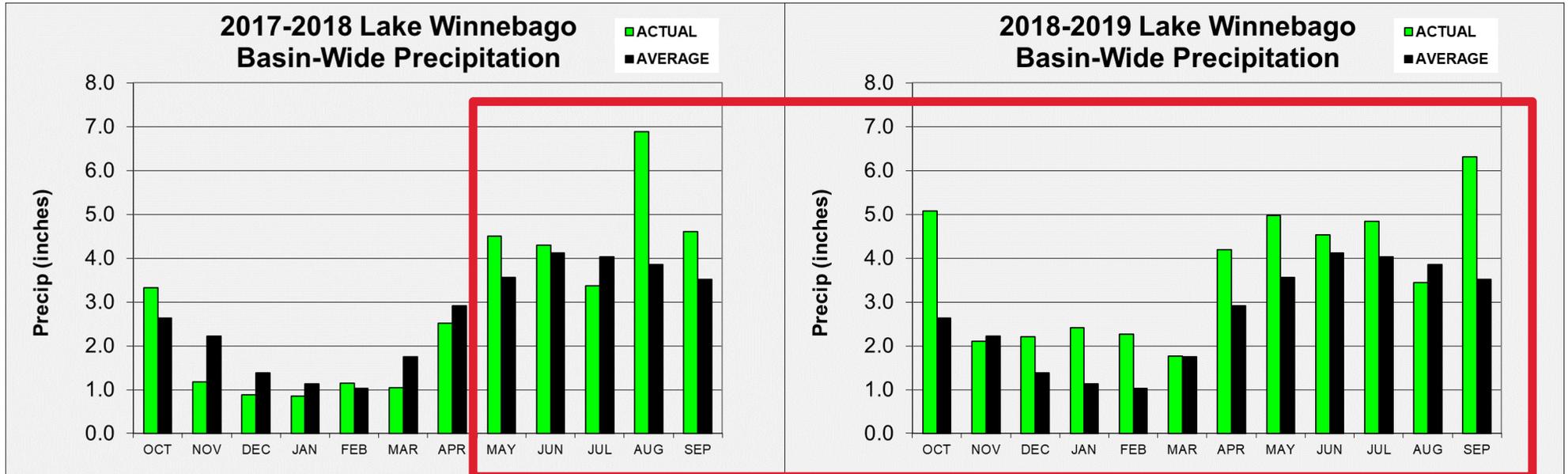


LAKE WINNEBAGO BASIN - A WET PATTERN



A continuation of the second half of 2018 has resulted in near record precipitation for 2019.

Record set in Green Bay on October 2nd with 3 months remaining.





WISCONSIN STATE-WIDE PRECIPITATION



Download: [XML](#)

View Period (Months): All 1 2 3 4 5 6 7 8 9 10 11 **12** 18 24 36 48 60

Record Driest	Bottom 1/10	Bottom 1/3	Normal	Top 1/3	Top 1/10	Record Wettest
PERIOD	VALUE	1901-2000 MEAN	ANOMALY	RANK (1895-2019)	WETTEST/DRIEST SINCE	RECORD
Oct 2018–Sep 2019 12-Month	43.58" (1,106.93mm)	31.32" (795.53mm)	12.26" (311.40mm)	124th Driest	Driest since: 2018	1948
				1st Wettest	Wettest to Date	2019
Record Driest	Bottom 1/10	Bottom 1/3	Normal	Top 1/3	Top 1/10	Record Wettest
PERIOD	VALUE	1901-2000 MEAN	ANOMALY	RANK (1895-2019)	WETTEST/DRIEST SINCE	RECORD
Oct 2017–Sep 2019 24-Month	80.86" (2,053.84mm)	62.67" (1,591.82mm)	18.19" (462.02mm)	122nd Driest	Driest since: 2018	1931
				2nd Wettest	Wettest since: 2017	2017
Record Driest	Bottom 1/10	Bottom 1/3	Normal	Top 1/3	Top 1/10	Record Wettest
PERIOD	VALUE	1901-2000 MEAN	ANOMALY	RANK (1895-2019)	WETTEST/DRIEST SINCE	RECORD
Oct 2016–Sep 2019 36-Month	118.92" (3,020.57mm)	93.98" (2,387.09mm)	24.94" (633.48mm)	122nd Driest	Driest since: 2018	1989
				1st Wettest	Wettest to Date	2019

NOAA National Centers for Environmental information, Climate at a Glance: Statewide Time Series, published October 2019, retrieved on October 16, 2019 from <https://www.ncdc.noaa.gov/cag/>



Wisconsin

Precipitation Rankings, September 2019

Download: [XML](#)

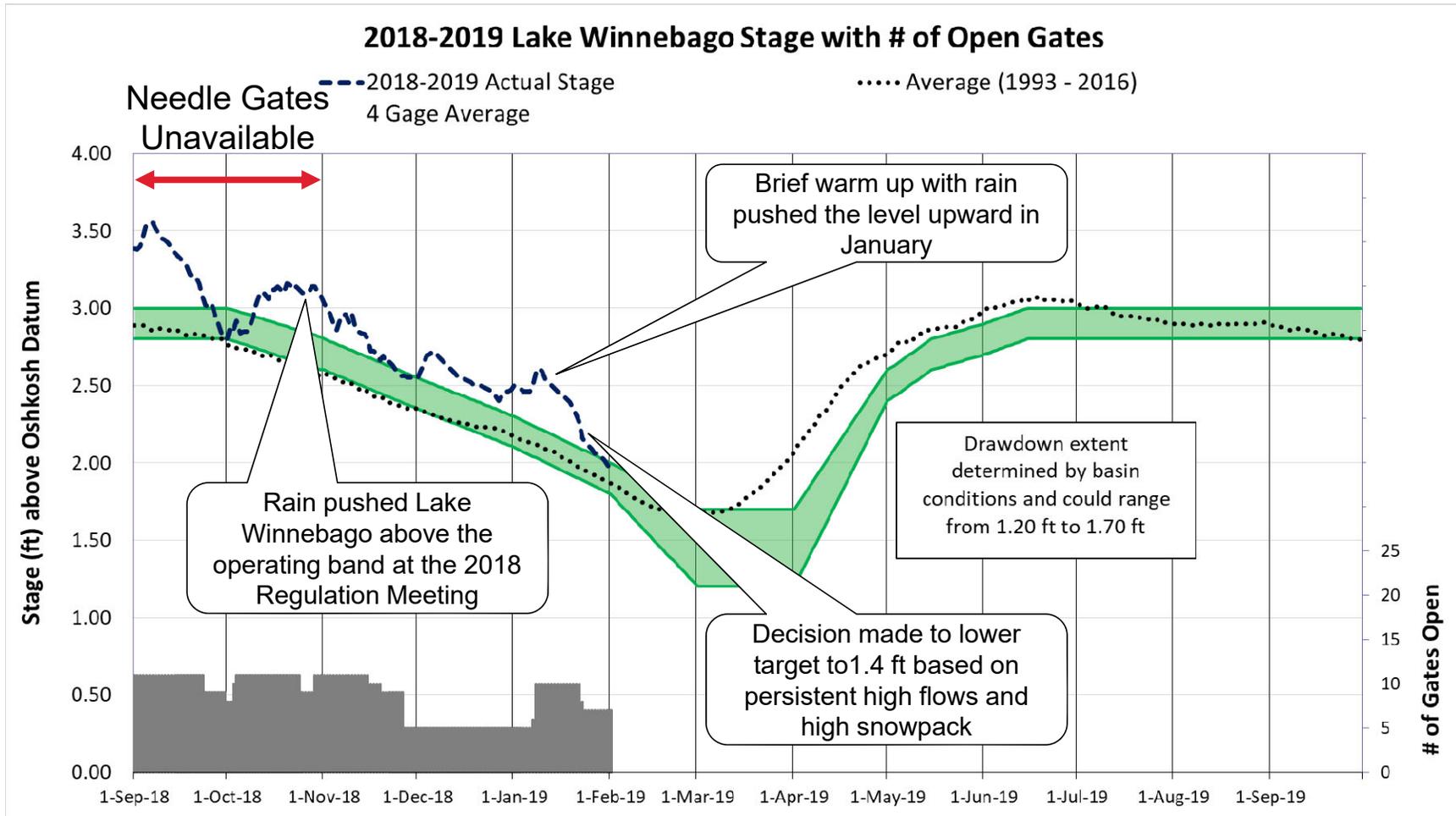
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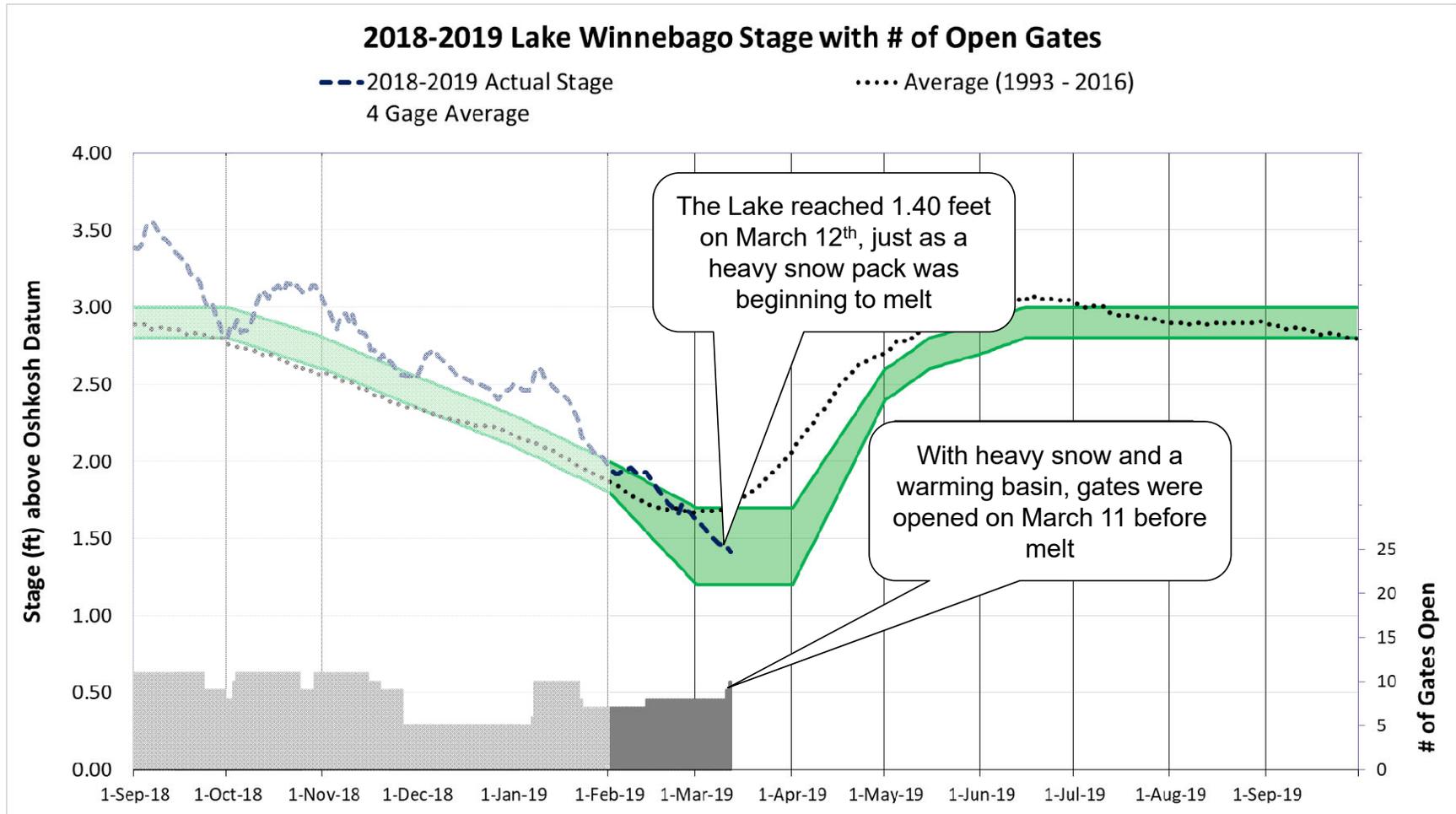


REGULATION DECISIONS - FALL DRAWDOWN





THE TURNING POINT – MARCH 12

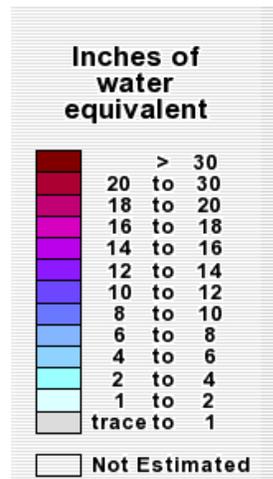
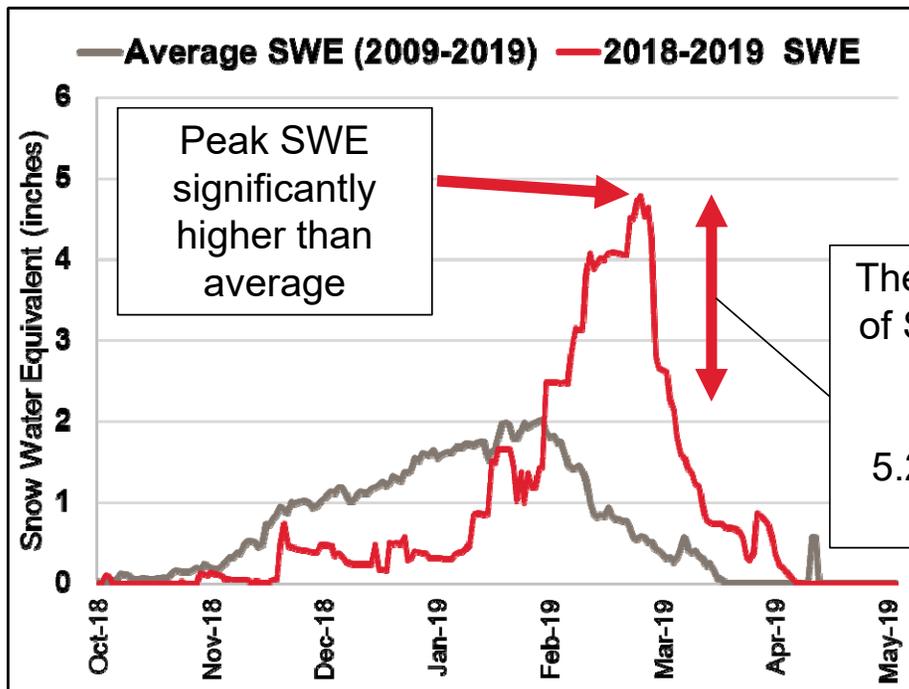




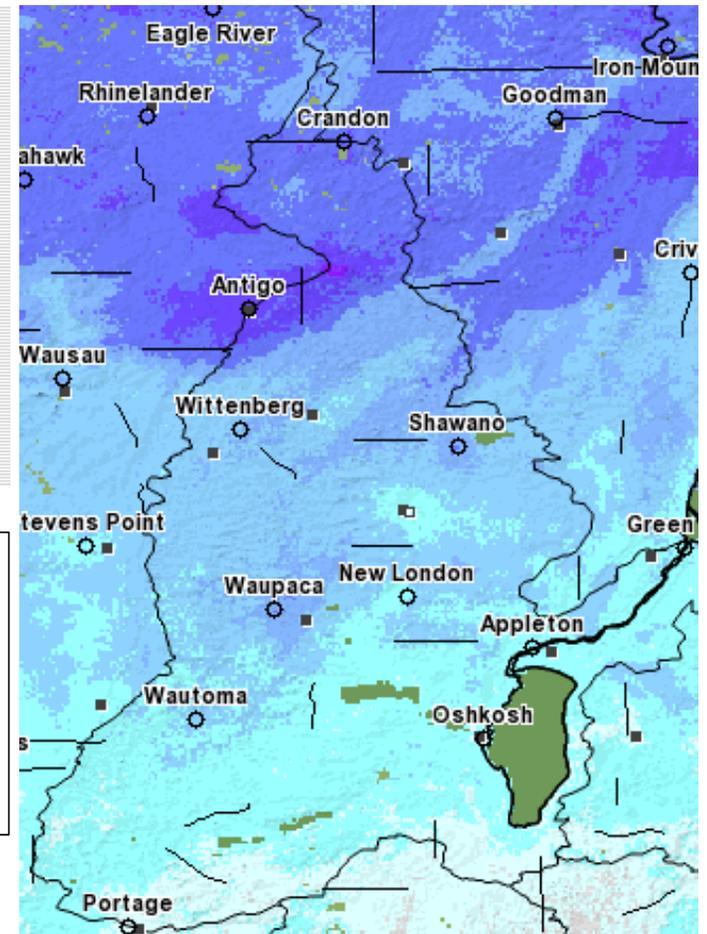
SNOWFALL IN THE BASIN

We track and use Snow Water Equivalent (SWE) in making regulation decisions.

2019 had a significantly above average SWE

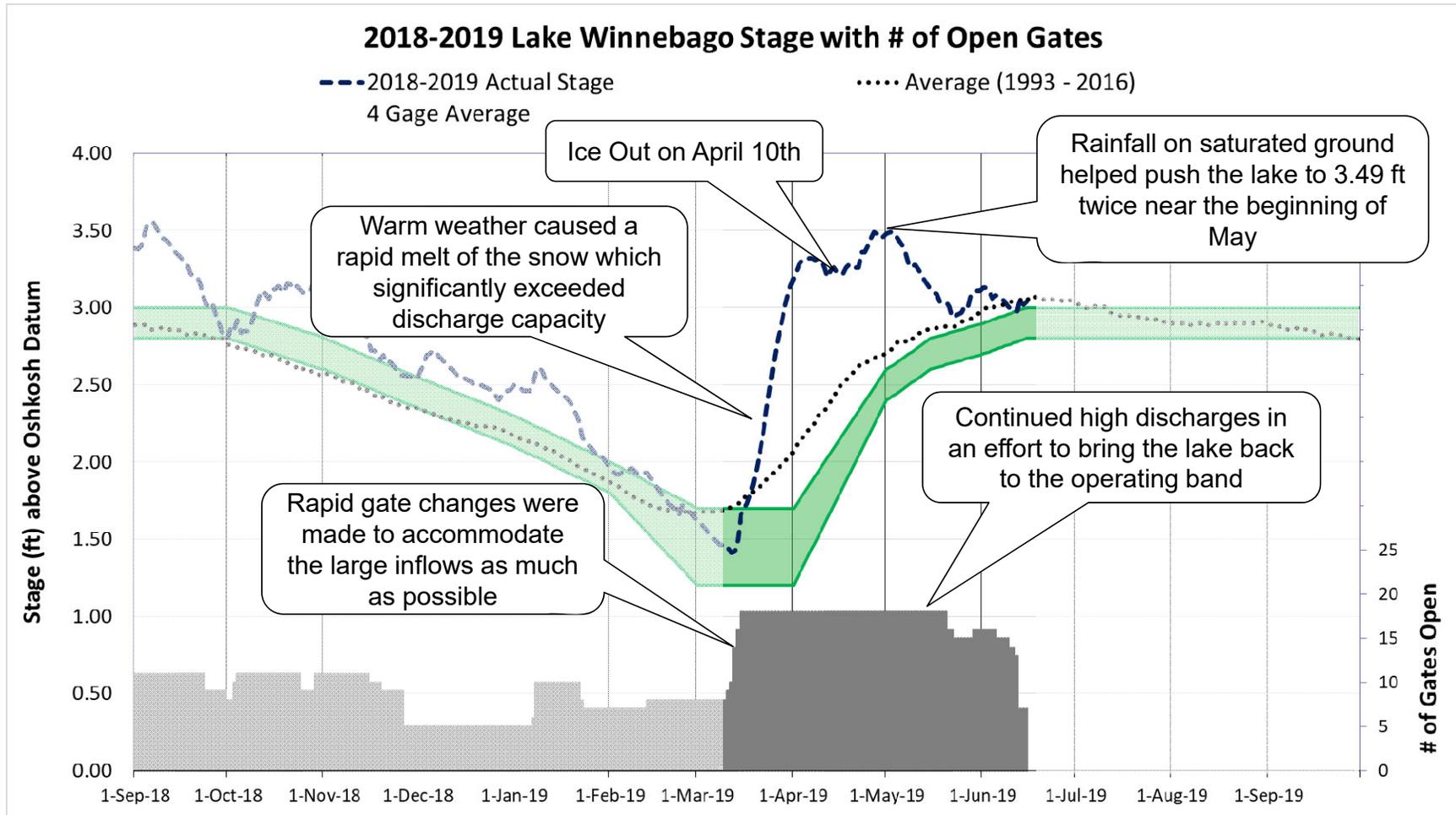


March 12th, 2019





SPRING RISE

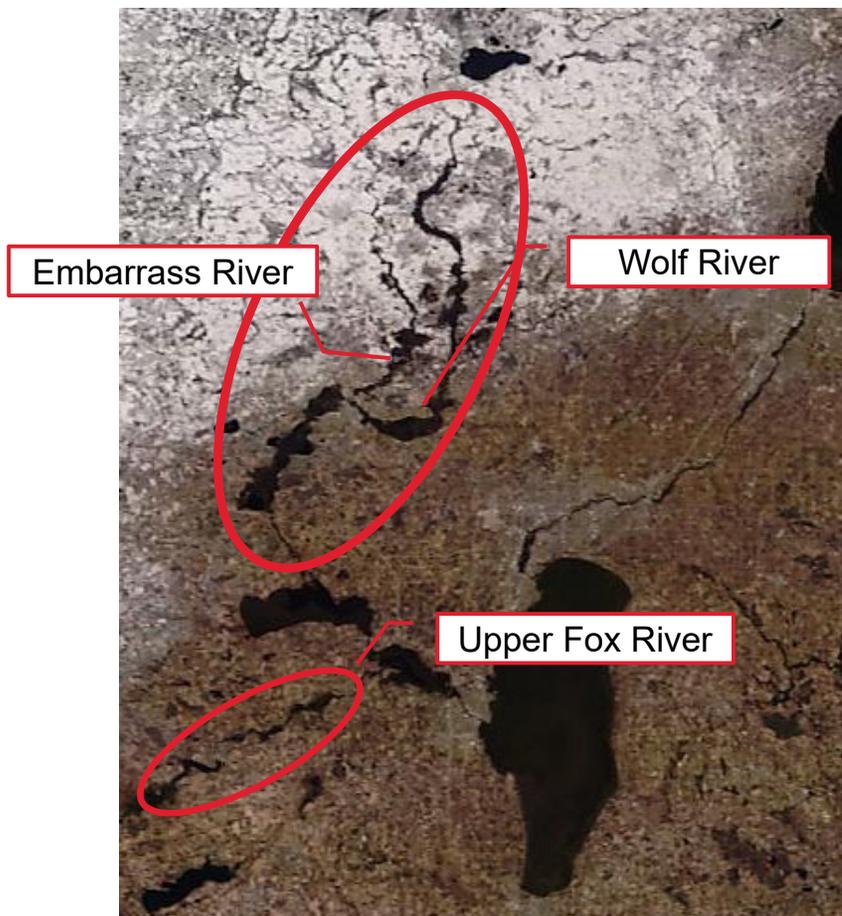




LARGE SCALE AREAL FLOODING



High Inflow - April 15, 2019

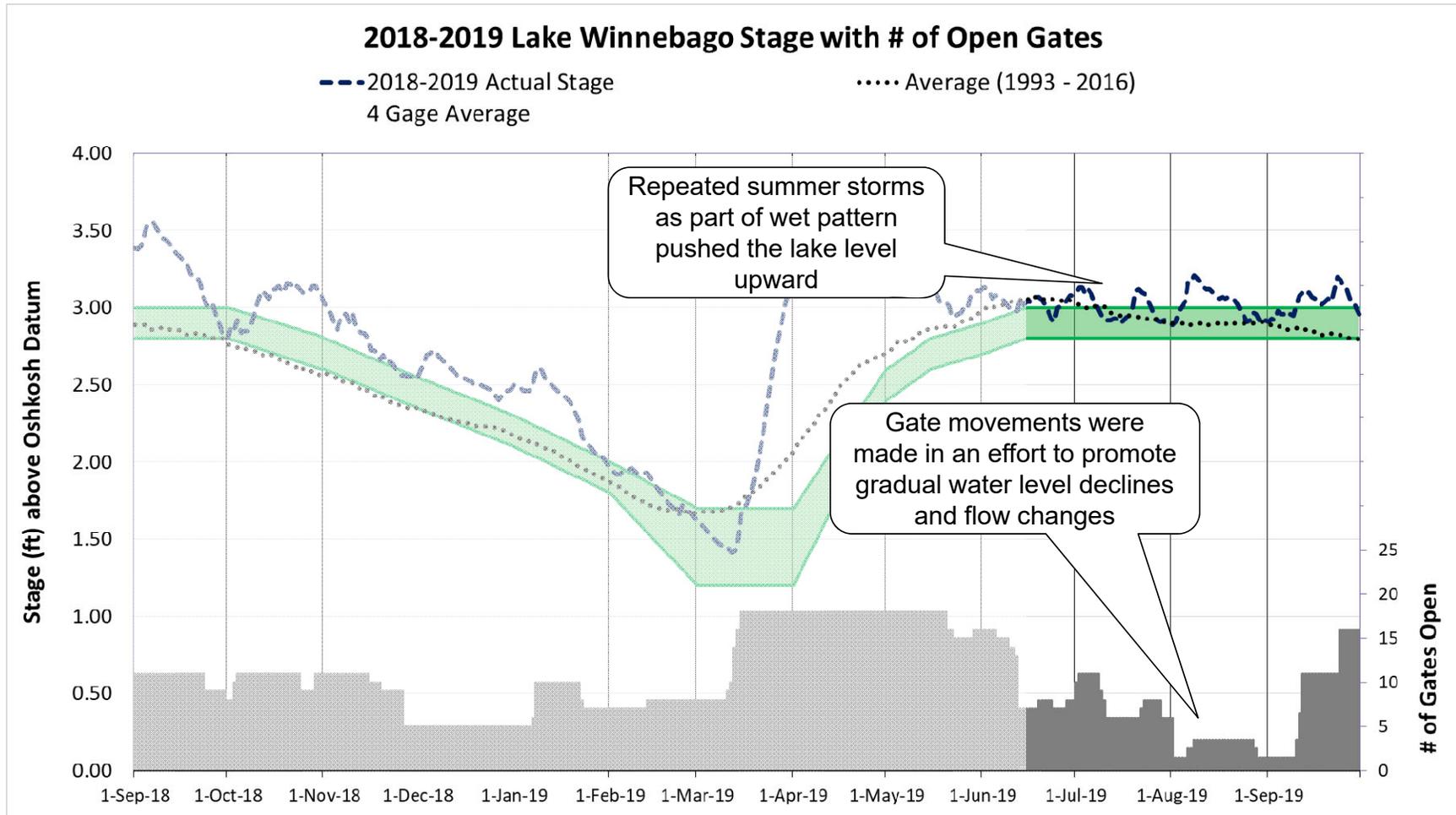


Low Inflow - Aug 8, 2017





SUMMER OPERATIONS





MONTHLY RAINFALL TOTALS



USACE Rain Gage Averaged Rain 2019

May	4.9"
June	4.75"
July	3.5"
August	5.5"
September	9.3"

27.95" total for the 2019 season

14.26" during the same period 2018

13.39" during the same period 2017

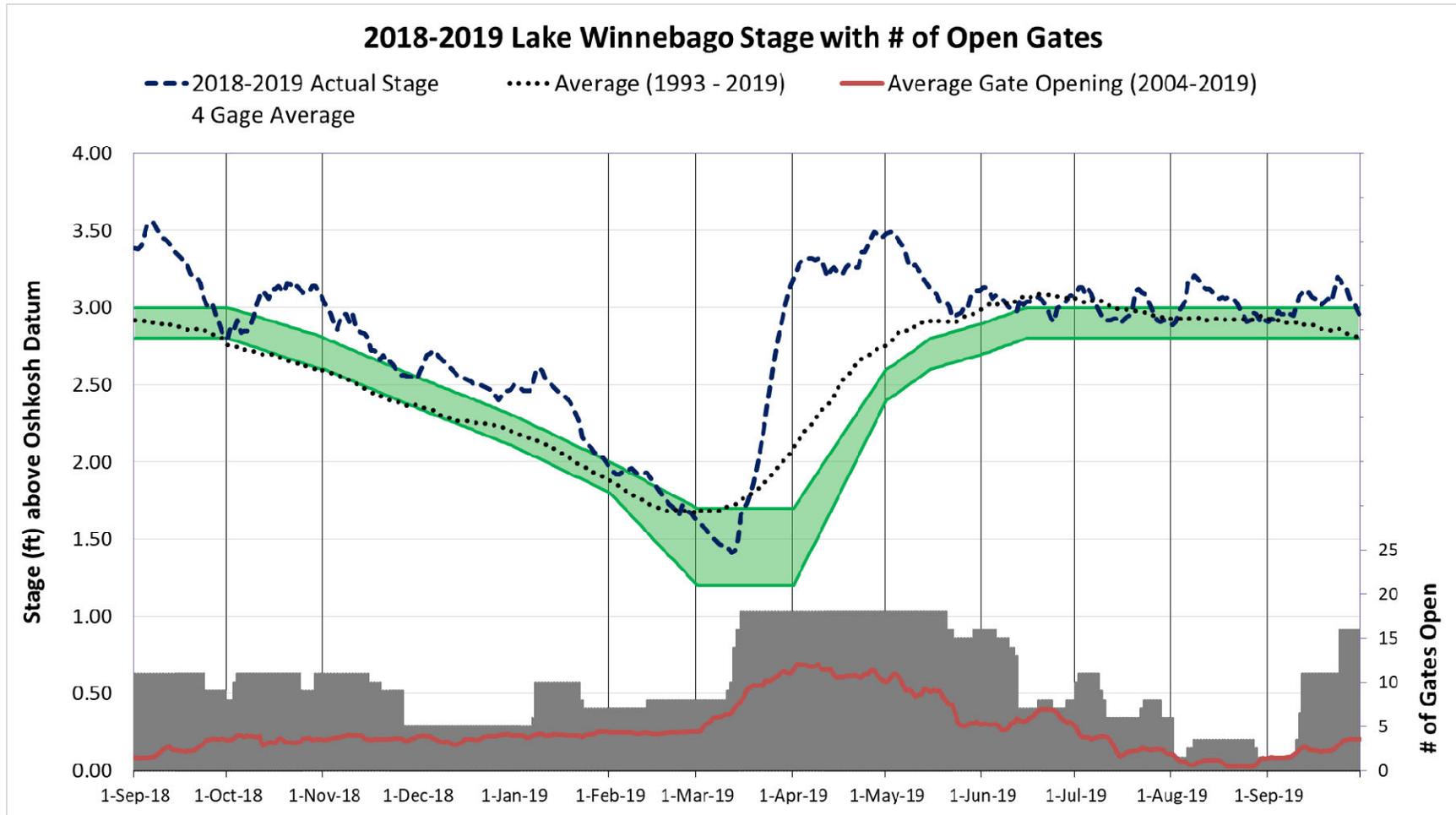
10.75" normal totals for the same period

Source National Weather Service, Green Bay





2018-2019 FULL YEAR IN REVIEW



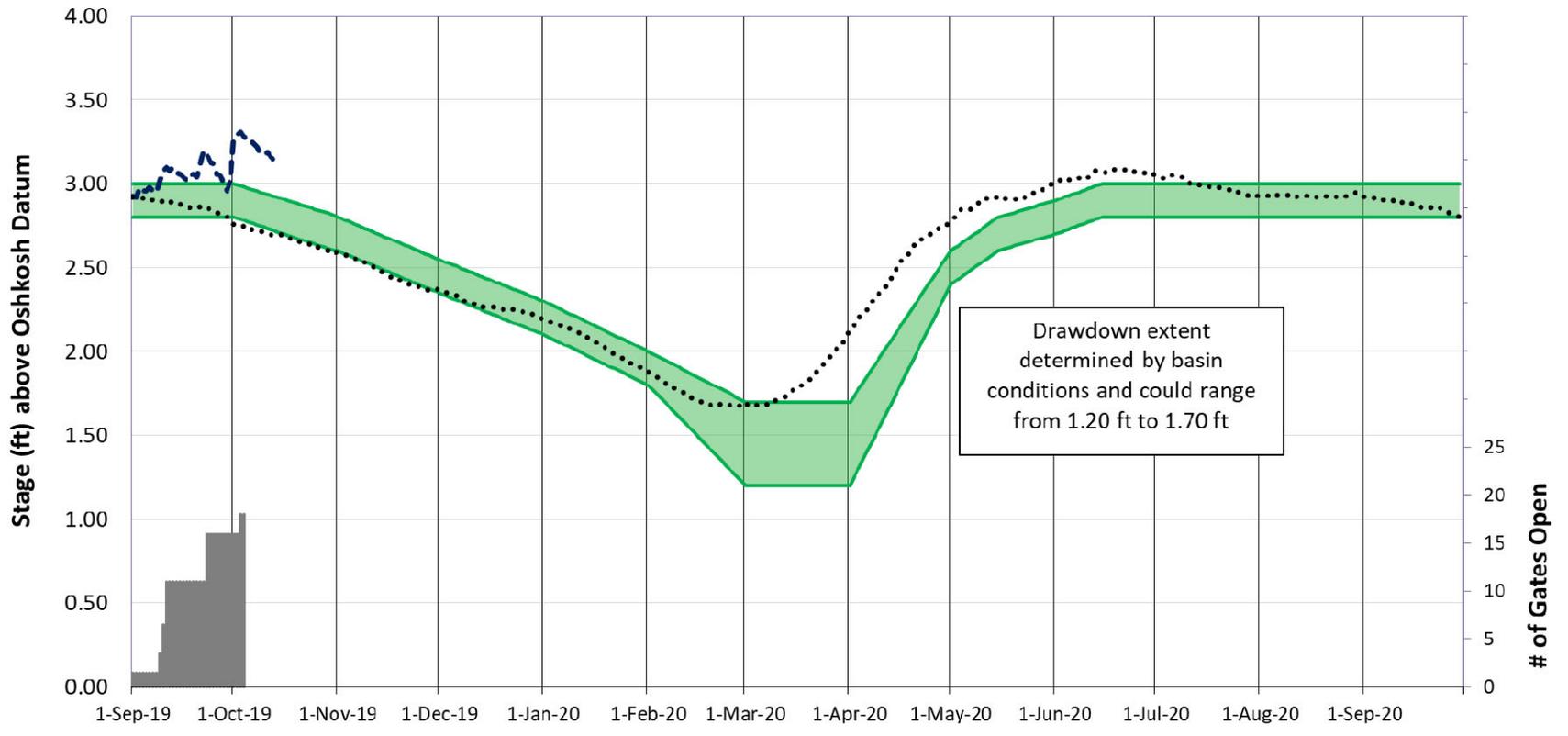


2019-2020 YEAR TO DATE



2019 - 2020 Lake Winnebago Stage with # of Open Gates

--- 2019-2020 Actual Stage
..... Average (1993 - 2019)
4 Gage Average





WEBSITE REDESIGN



<http://www.lre.usace.army.mil/Missions/Great-Lakes-Information/Lake-Winnebago/>

The screenshot shows the top navigation bar with links: About, Business With Us, Missions, Media, Library, Locations, Careers, Contact. A search bar is on the right. Below the navigation is a breadcrumb trail: Missions / Great Lakes Information.

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

Lake Superior Regulation

Collapse All Expand All

- Latest updates on Lake Superior outflow and compensating works gate settings

Lake Winnebago

Collapse All Expand All

- Information about Lake Winnebago including important notices, levels and flows, basin precipitation, basin water temperature, and other resources.

Coastal Program

Collapse All Expand All

- Information about the Detroit District's coastal program, including coastal engineering services, the Regional Sediment Management program, the Section 111 program, and a multitude of coastal issues.

Flood Monitoring



WEBSITE REDESIGN



<http://www.lre.usace.army.mil/Missions/Great-Lakes-Information/Lake-Winnebago/>

Water Level Forecasts
Lake Superior Regulation
Lake Winnebago
Coastal Program
Flood Monitoring
Contact Information
Related Links

Lake Winnebago

[Collapse All](#) [Expand All](#)

[Information about Lake Winnebago including important notices, levels and flows, basin precipitation, basin water temperature, and other resources.](#)

Lake Winnebago

Important Notices

The IGLD 1985 relationships in the Lake Winnebago system are currently being updated. Please contact the Chief of Construction & Survey at (920) 388-3720 for more information

- [NEW Lake Winnebago 2019 Strategy Meeting](#)
- [Lake Winnebago Regulation Strategy 2018-2019](#)
- [Click here for the Lake Winnebago Current Conditions Update](#) (Includes Lower Fox River information regarding high flows)
- [Click here for the 2018 Lake Winnebago Regulation Presentation](#)
- [Click here for the Revised Lake Winnebago Facts Book](#)

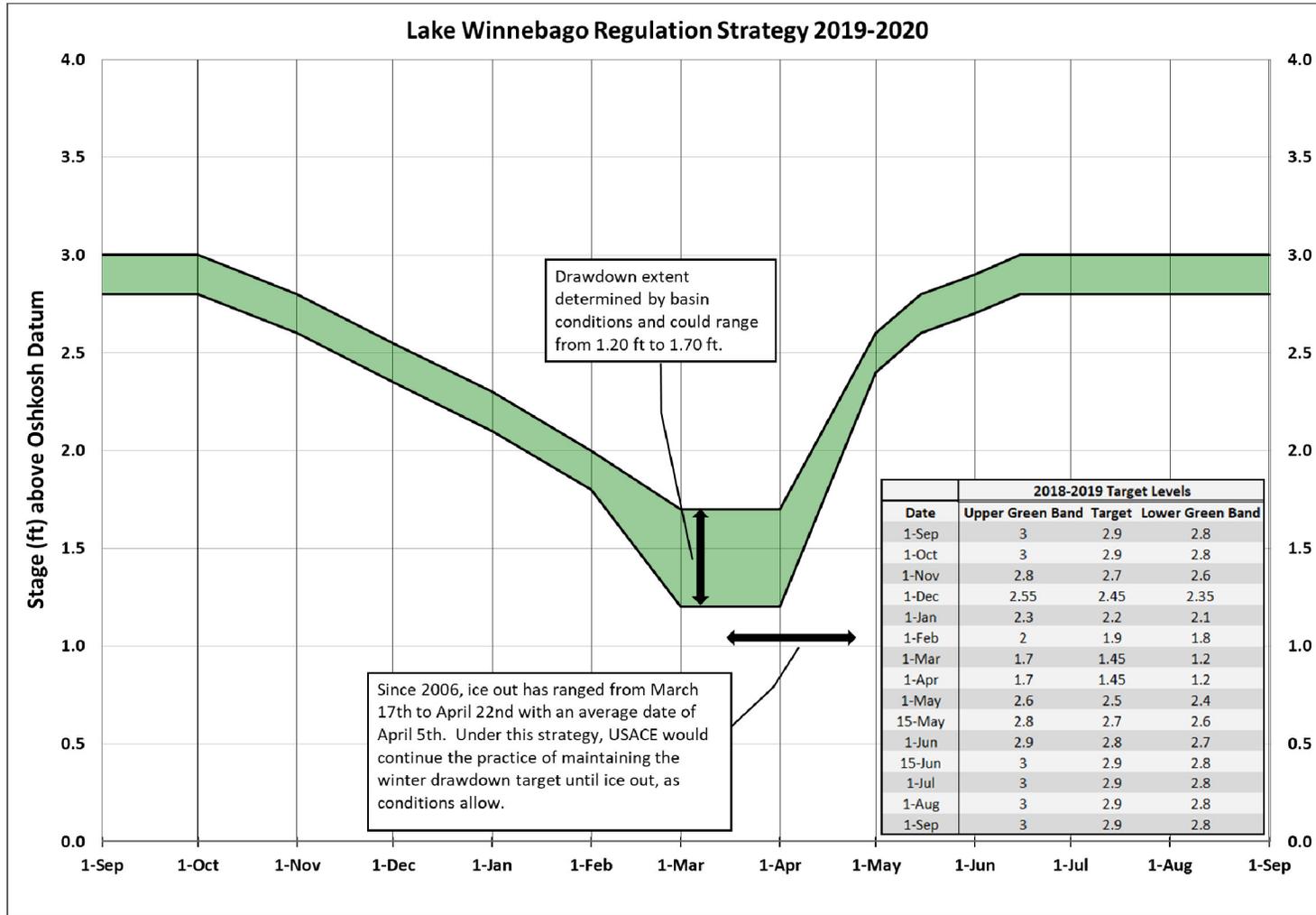
Lake Winnebago Levels and Flows

Levels and Flows	
Today's Hourly Data	Yesterday's Hourly Data
This Month's Daily Data	Last Months Daily Data

Historical Data	
Water Levels for the Last 3 Months Graph or Table	River Stages for the Last 3 Days



PROPOSED 2019-2020 WATER LEVEL STRATEGY





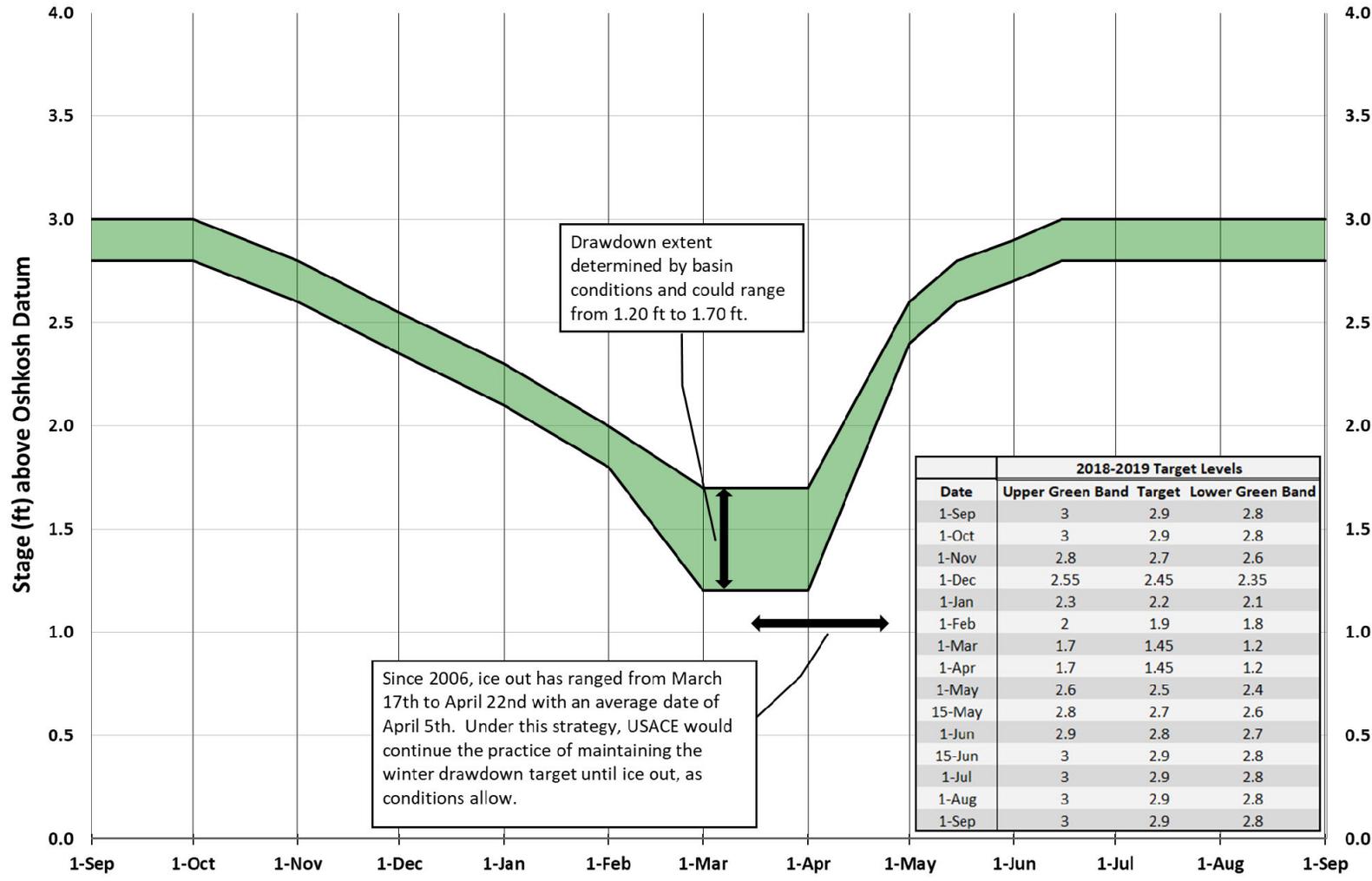
QUESTIONS?



EXTRA SLIDES



Lake Winnebago Regulation Strategy 2019-2020





DAYS ABOVE 3.30 FT



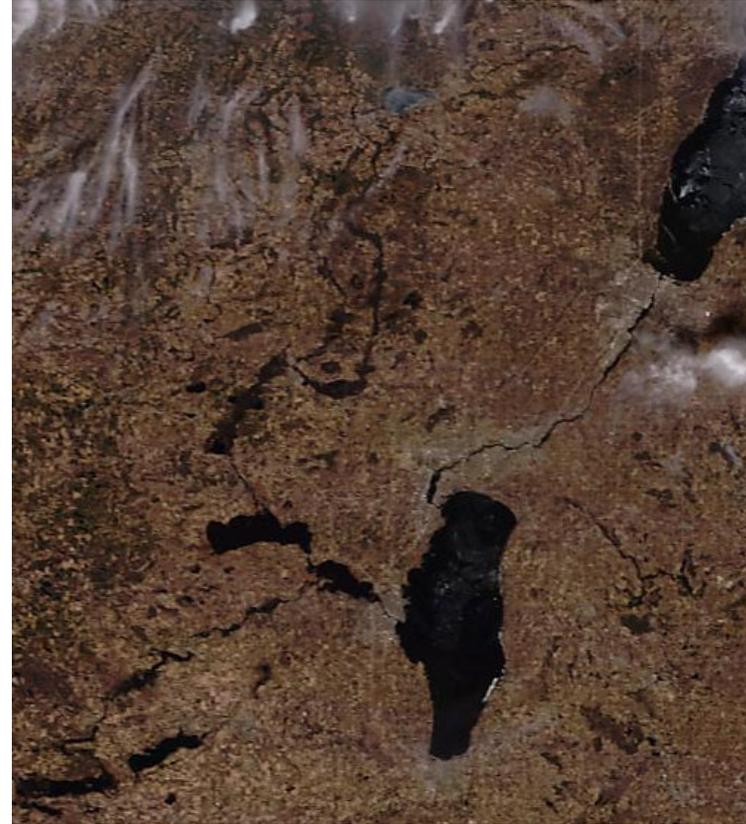
Historic Lake Winnebago levels above 3.30 ft					
Linde Plan			Prior to Linde Plan		
Date	# of days	Peak Level	Date	# of days	Peak Level
Jun/Jul 1993	33	3.81	Apr/May 1973	41	3.65
Jun/Jul 2004	22	3.71	Apr/May/Jun 1960	40	4.32
April/May 2019	22	3.49	Mar/Apr/May 1929	40	4.17
Aug/Sept 2018	20	3.55	Apr/May 1922	34	4.75
May 2018	19	3.62	Apr 1979	25	3.89
Jun 2008	16	3.78	Jun/Jul 1969	25	3.83
Jul 2010	16	3.48	Mar/Apr 1973	22	3.92
Apr/May 1993	14	3.4	Sep/Oct 1938	17	3.67
May 2012	10	3.42	Jun 1945	13	3.56



**Ice Cover
January 4, 2019**



**Ice Out
April 10, 2019**



Ice Cover Last Year: Dec 19, 2017



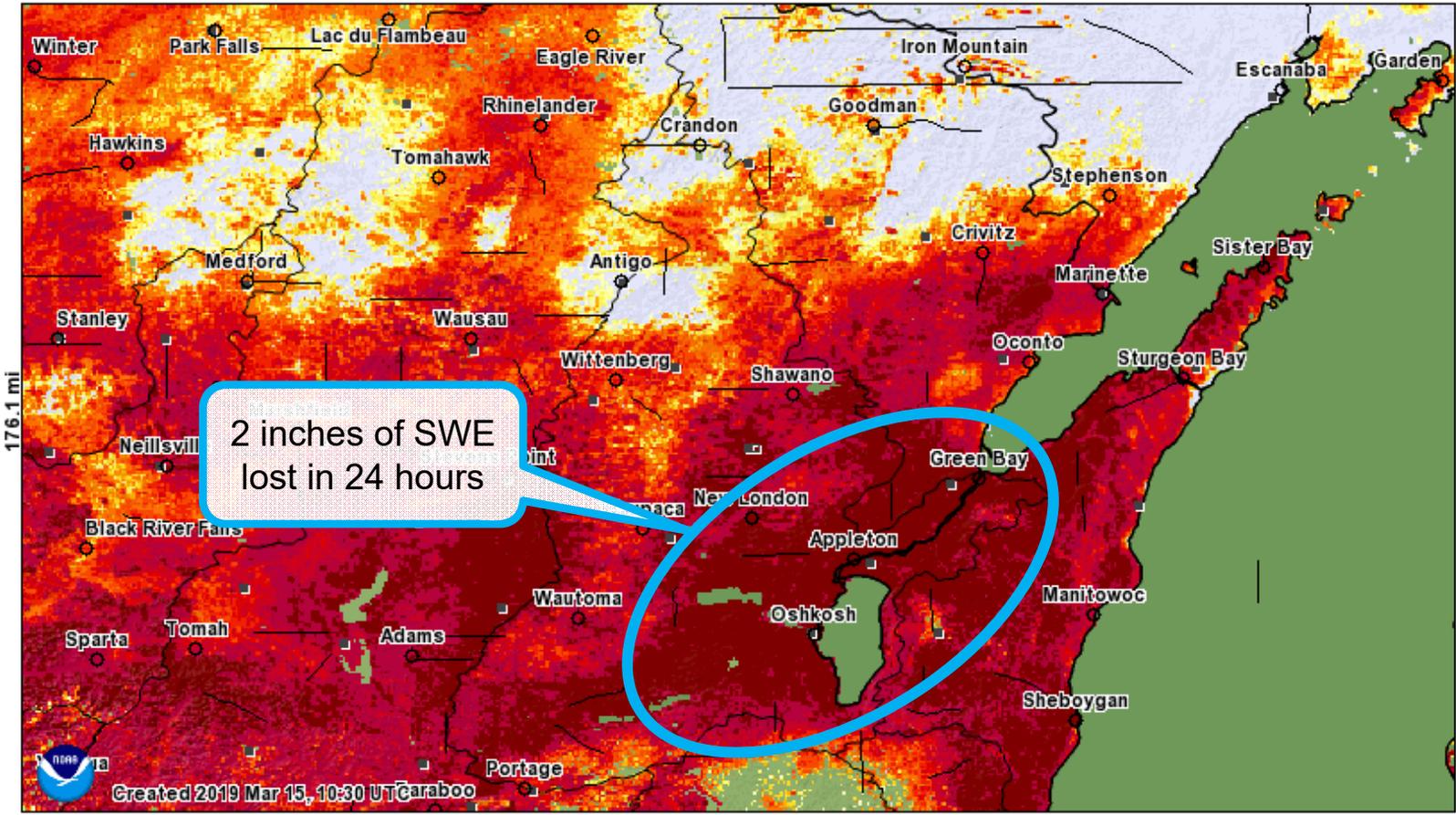


MELT RATE FOR MARCH 14

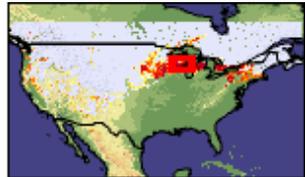


Total Modeled Snow Melt during 24h preceding 2019 March 15, 5:00 UTC

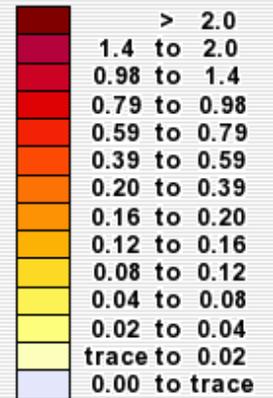
218.1 mi



2 inches of SWE lost in 24 hours



Inches of water equivalent



Not Estimated

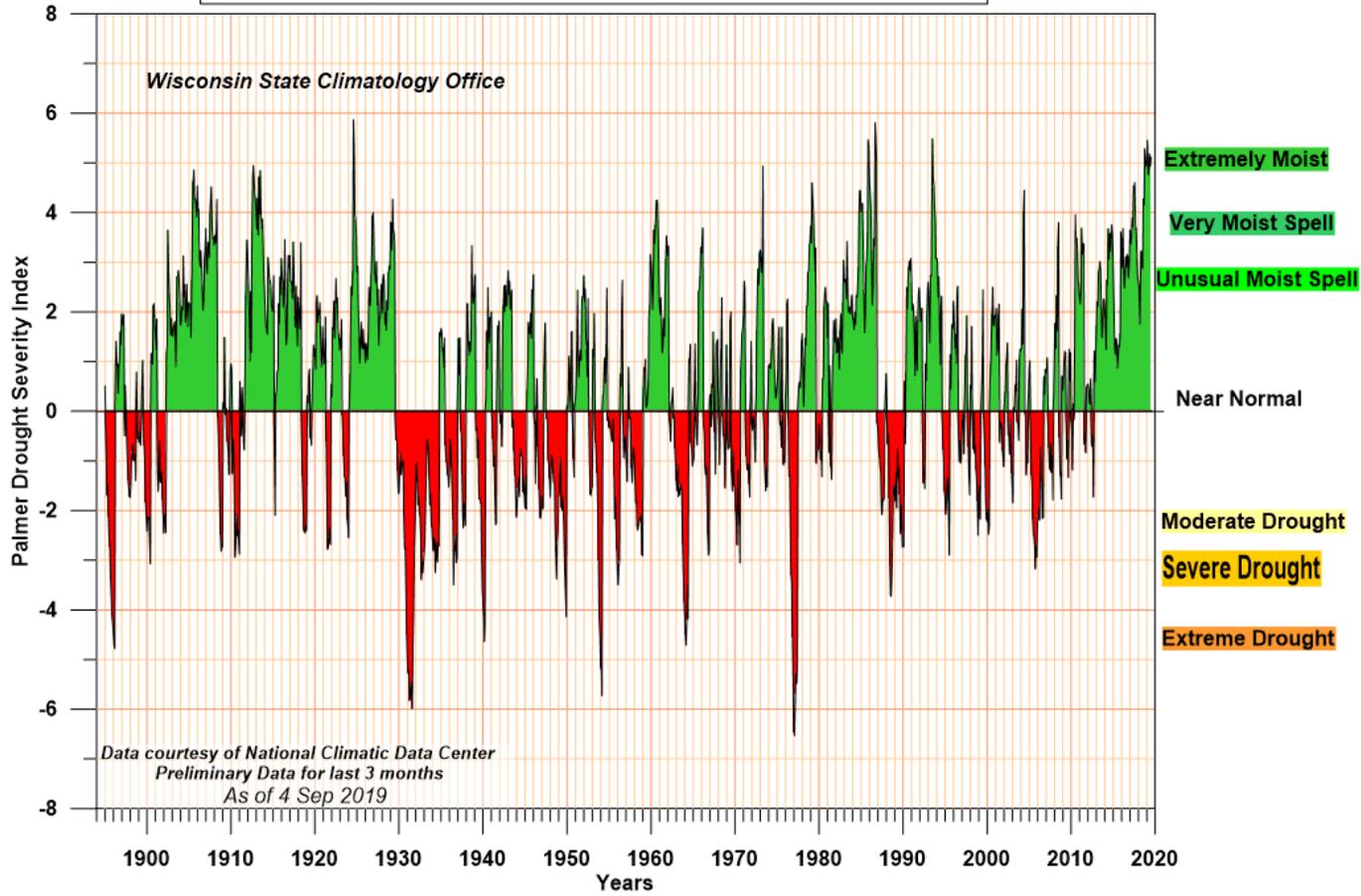
Elevation in feet



Created 2019 Mar 15, 10:30 UT Caraboo



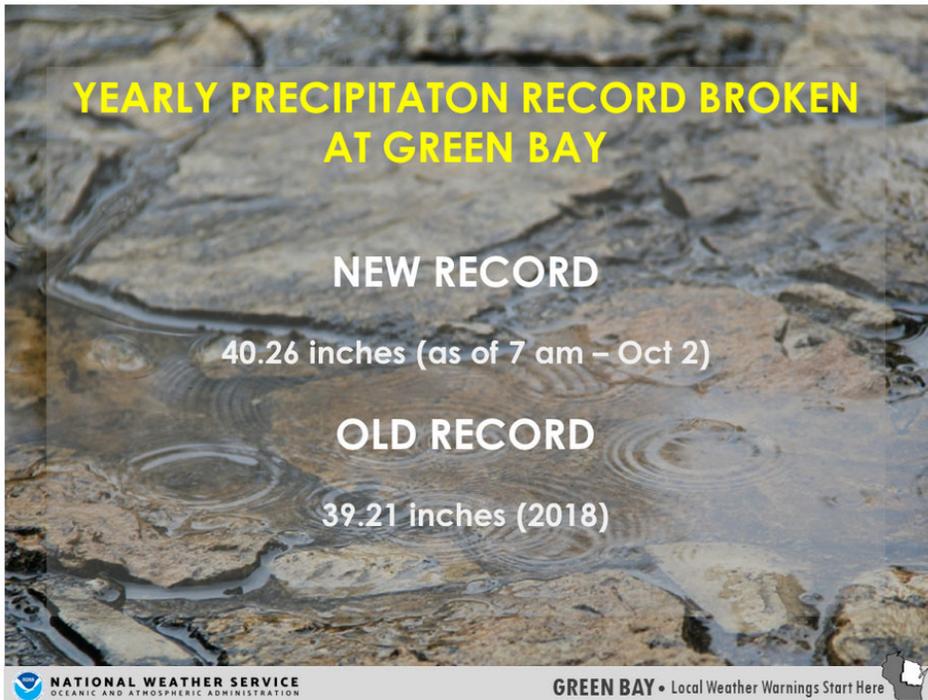
**East Central Wisconsin (Div 4706) Palmer Drought Severity Index
Jan 1895-Aug 2019**





RECORDS AND MORE

The NWS in Green Bay reported that the annual precipitation record was set with 3 months to go in 2019. This follows a record setting 2018.

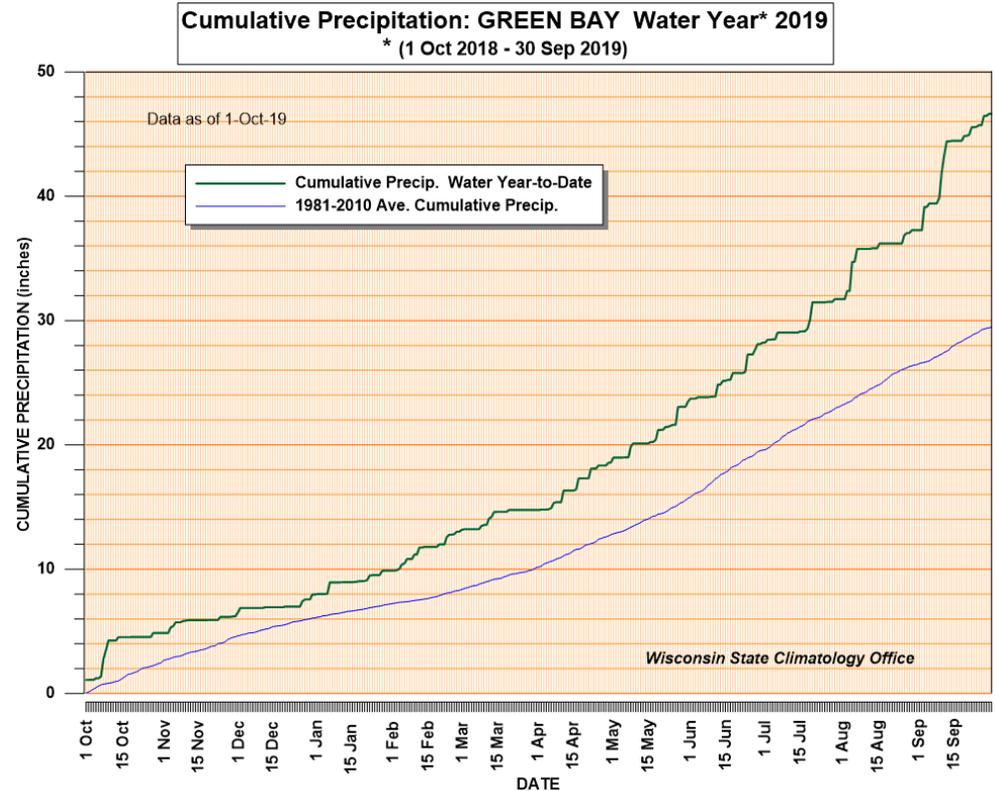


Published on: 10/02/2019 at 7:24AM

As of 7 am the precipitation total stands at 40.26 inches at Green Bay, breaking the old record of 39.21 inches set all the way back in 2018 with three months to go in 2019! Green Bay has established yearly precipitation records in consecutive years for the first time since 1887 and 1888 (the first two years of official Green Bay weather records). More rain is in the forecast tonight into Thursday and then again late Friday night into Saturday evening.

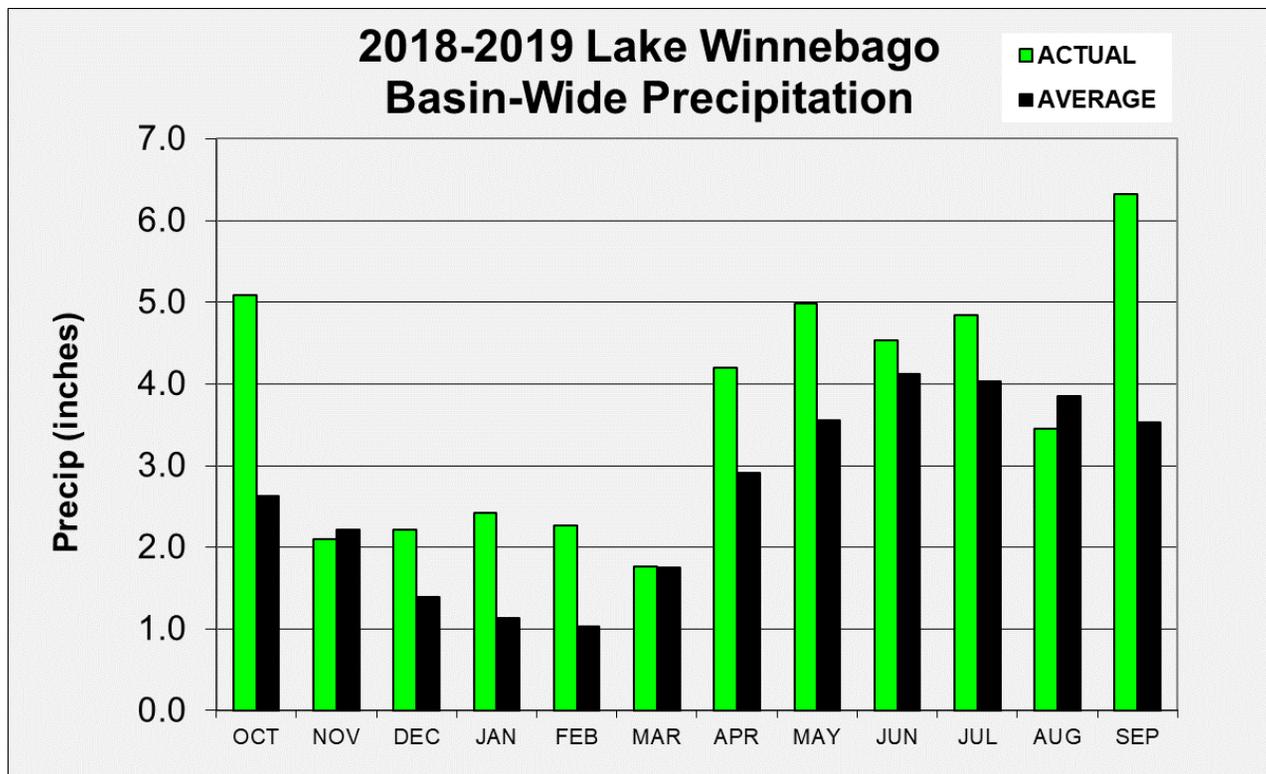


The blue line is average total rainfall and the green is this year. For the 2018-2019 season, **Green Bay** received more than **150% of it's normal rainfall.**





MONTHLY PRECIPITATION TRACKING



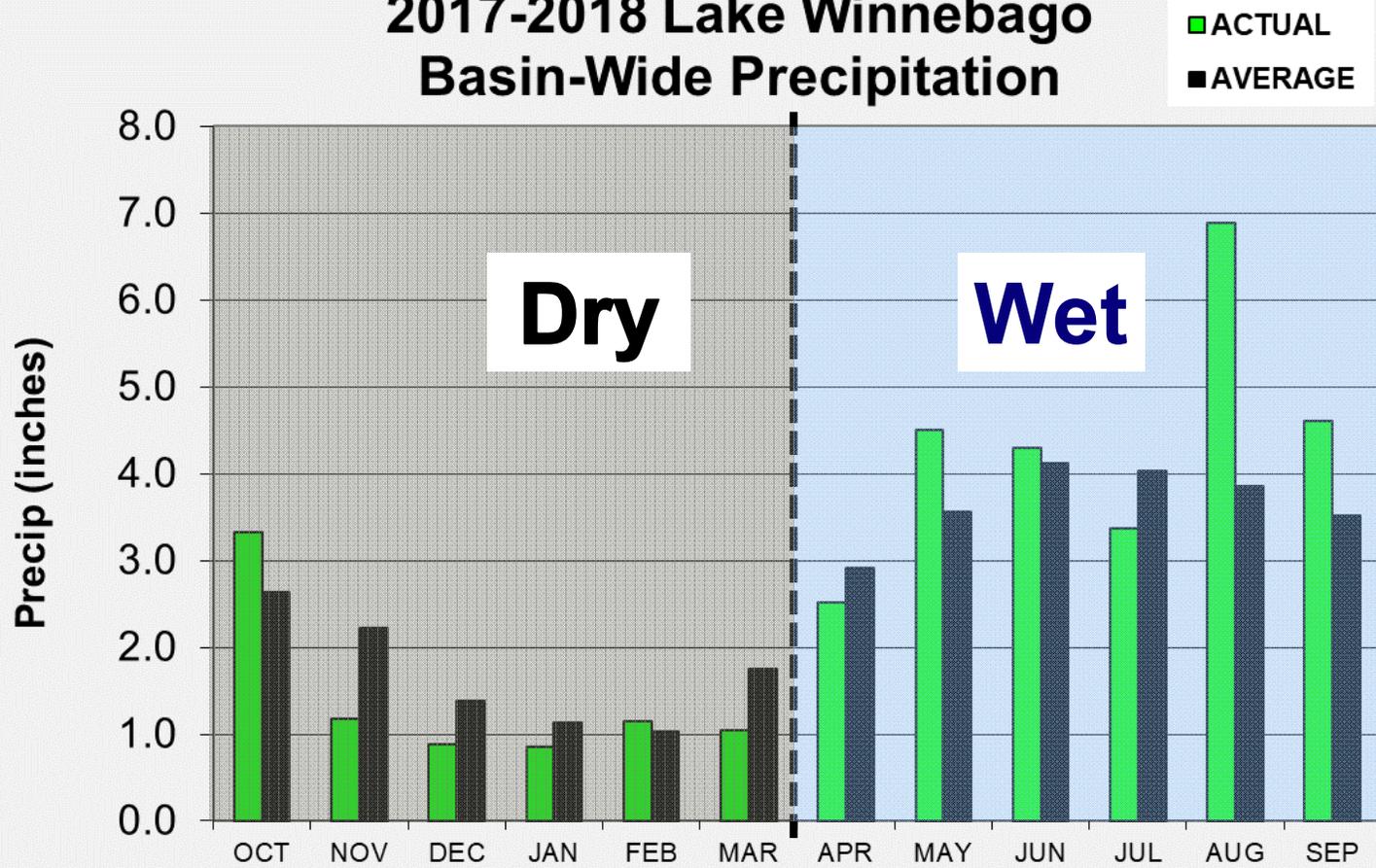
Last year's wet pattern continued this year

The basin never received less than 90% of average in a given month and **finished at 137% of average for the year.**

Above average precipitation from December through March was stored in a large snowpack

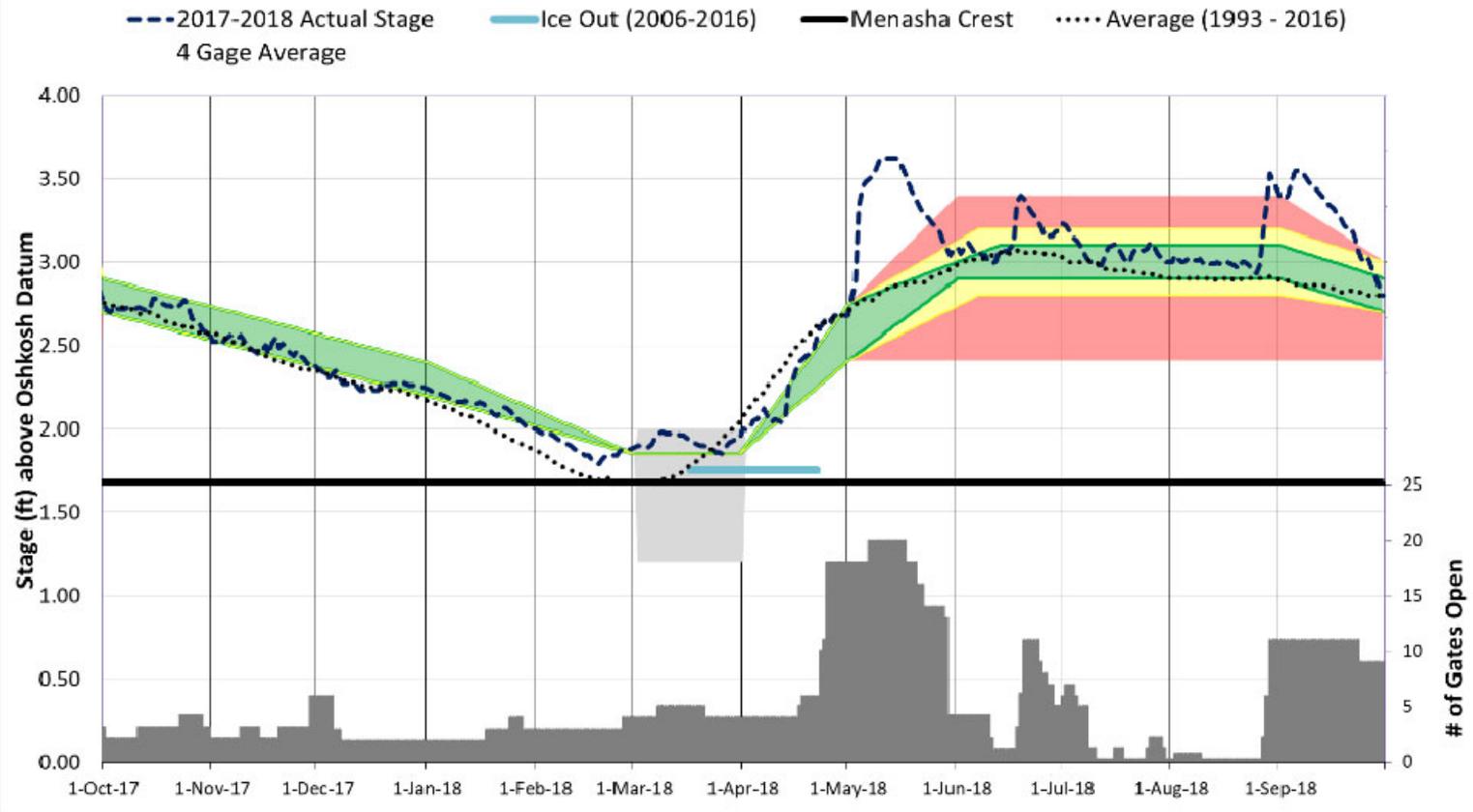


2017-2018 Lake Winnebago Basin-Wide Precipitation



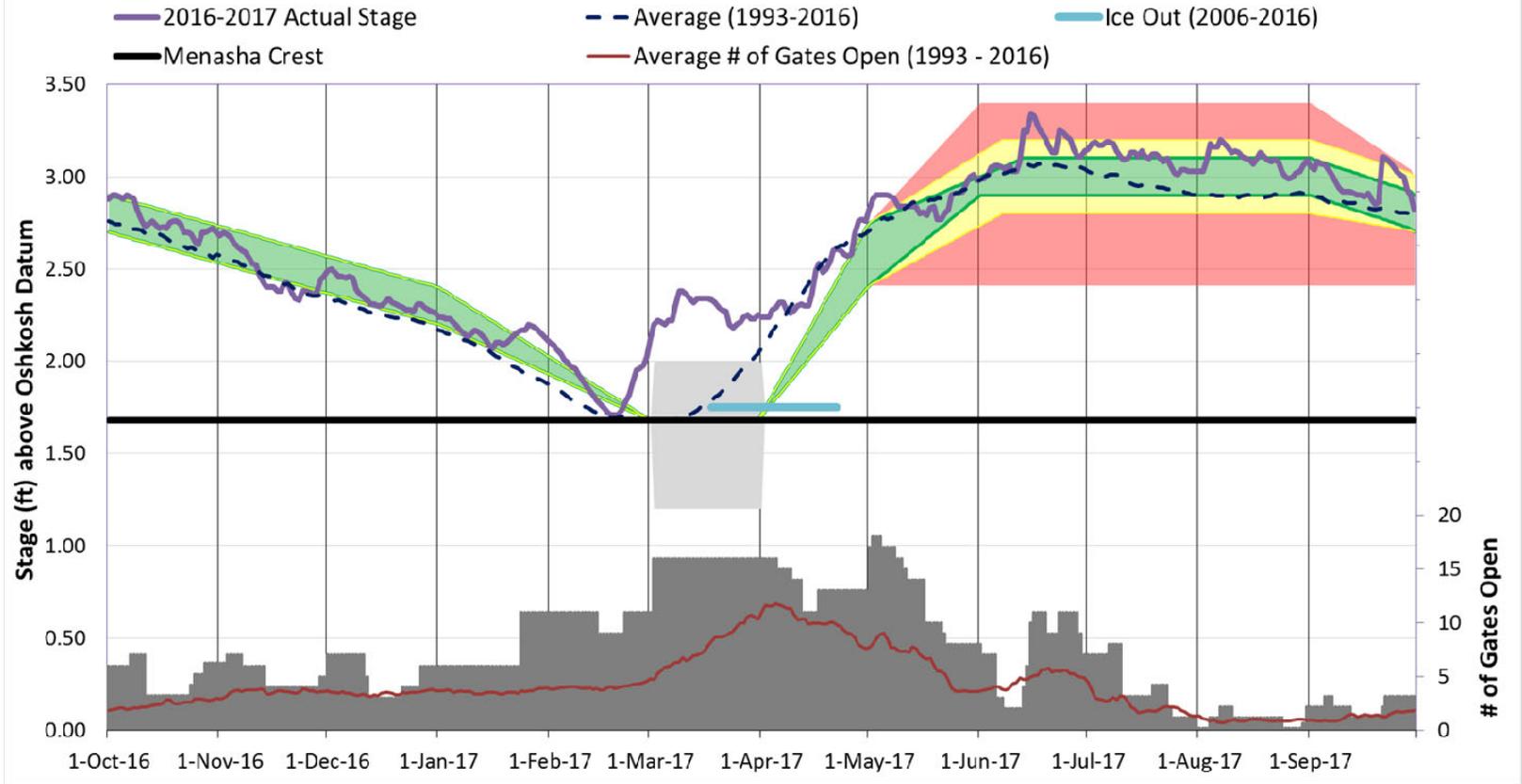


2017-2018 Stage with # of Open Gates

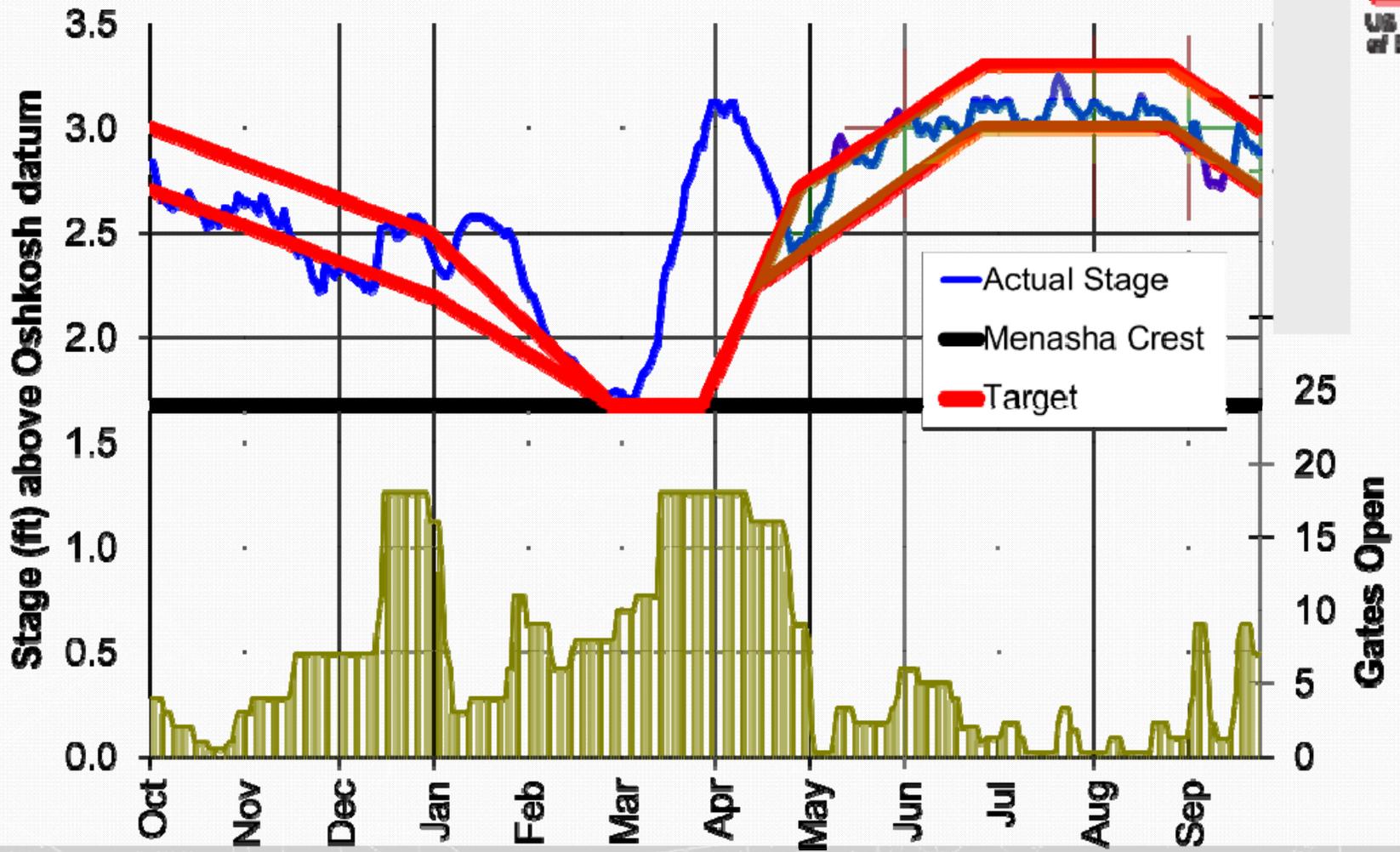




2016-2017 Stage with # of Open Gates

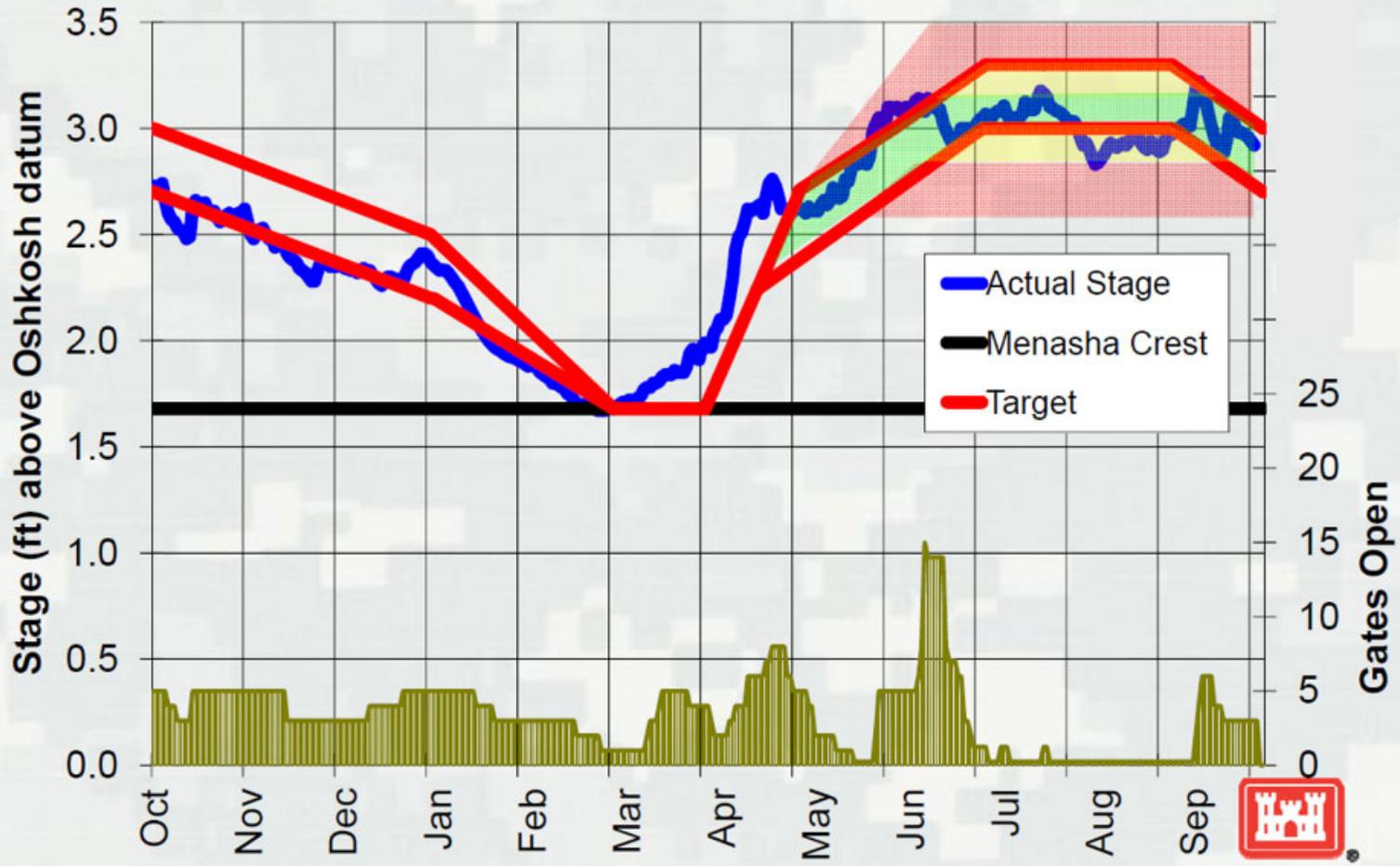


2015-2016 Stage with # of Open Gates



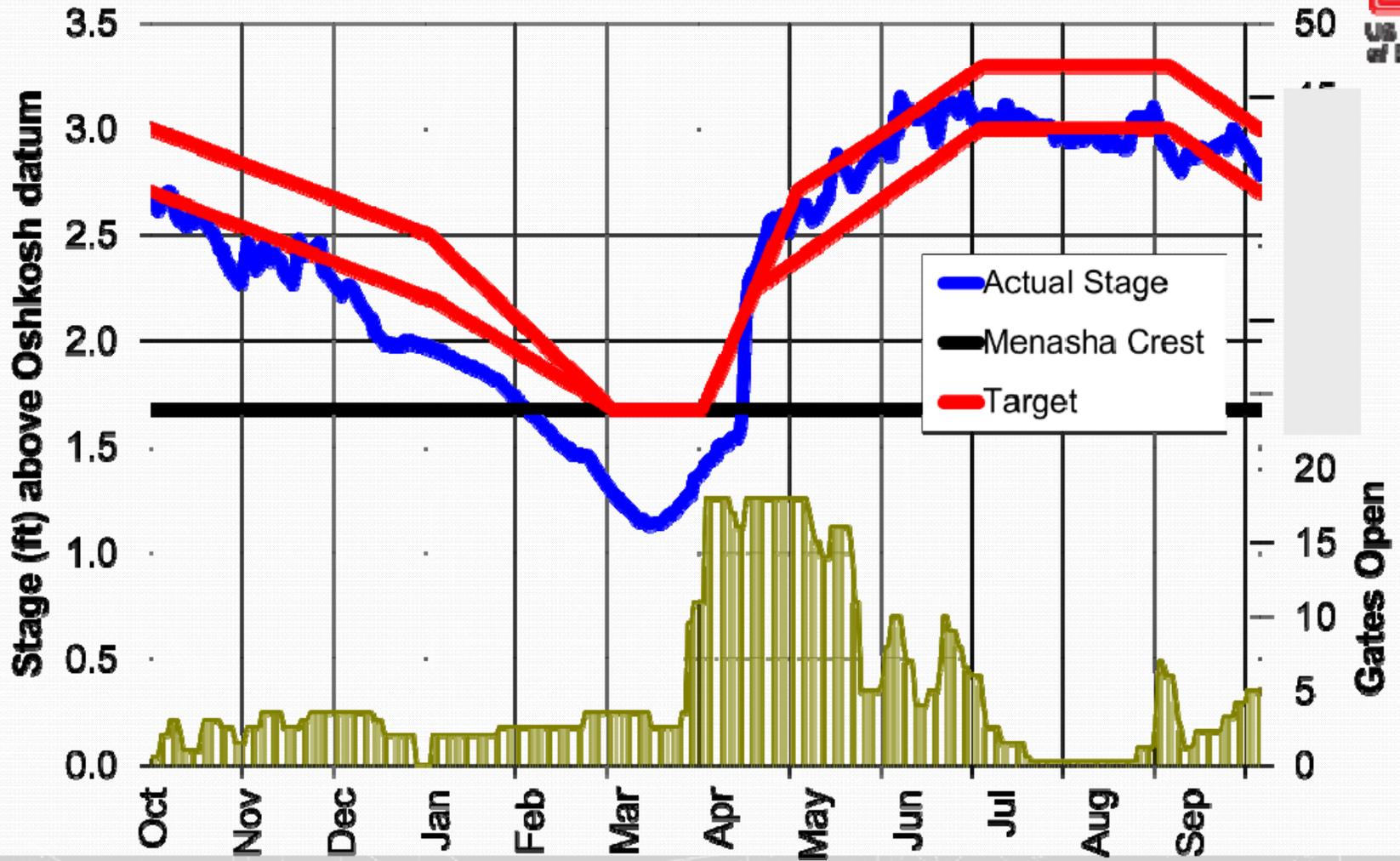


2014-2015 Stage with # of Open Gates

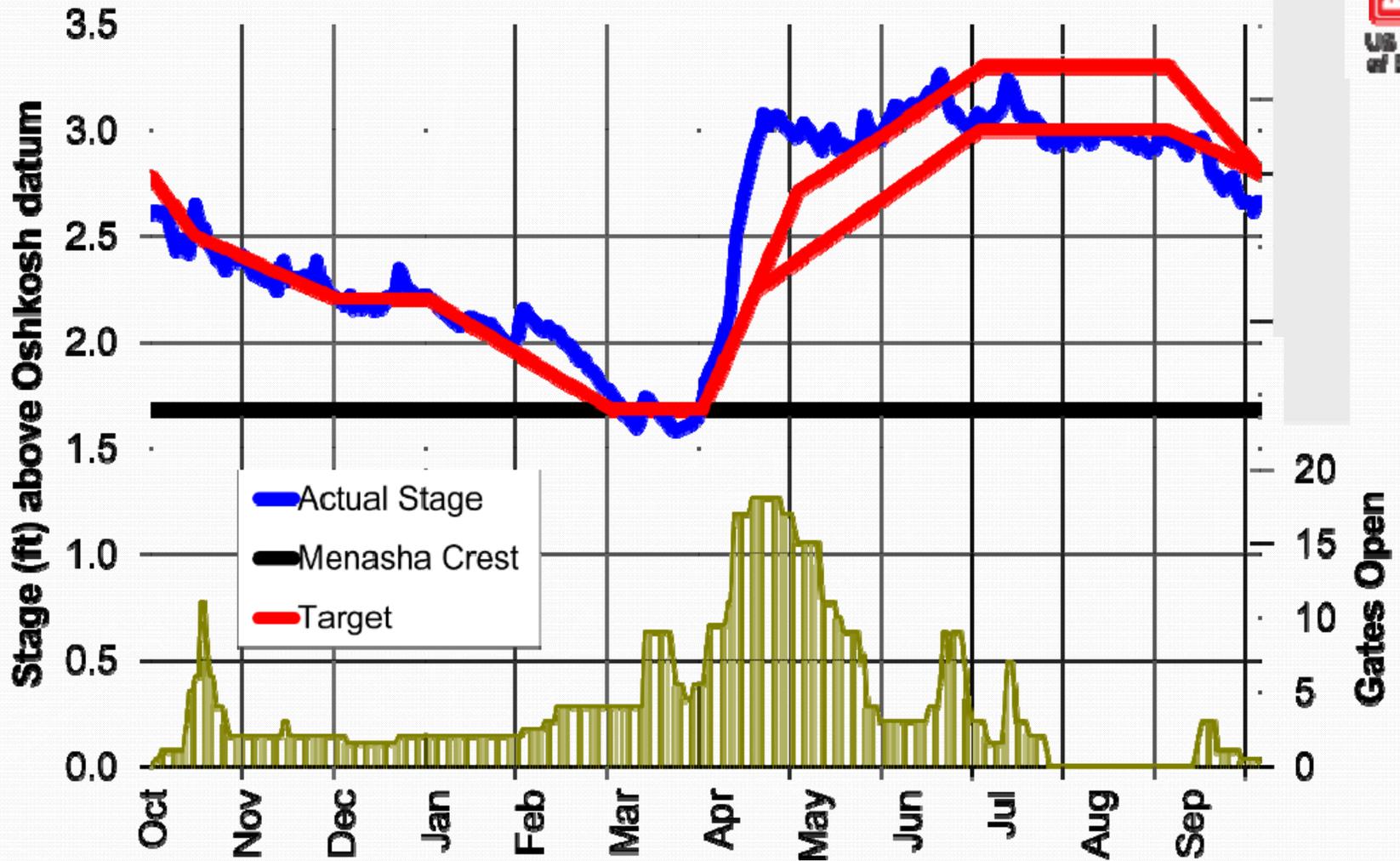


BUILDING STRONG®

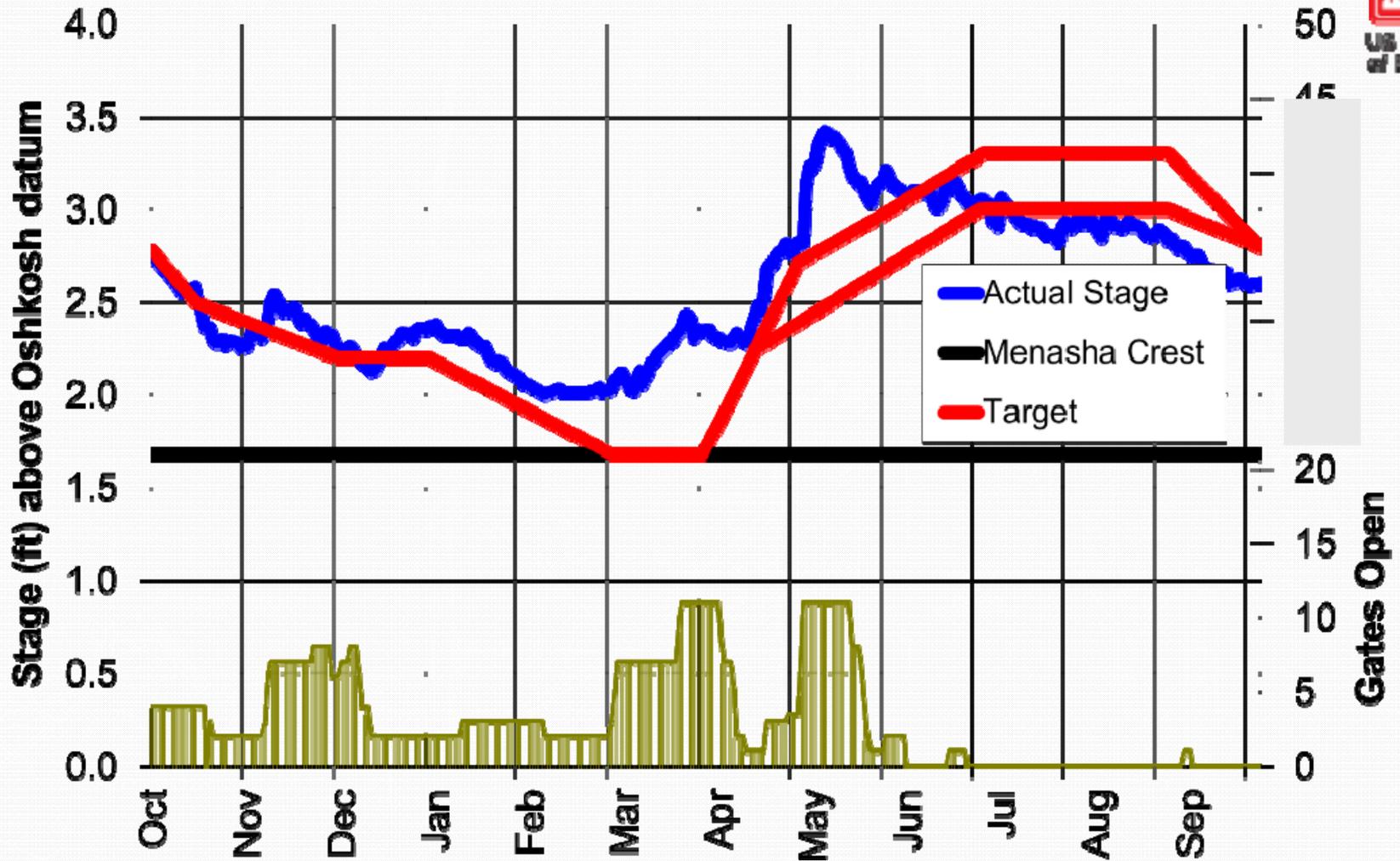
2013-2014 Stage with # of Open Gates



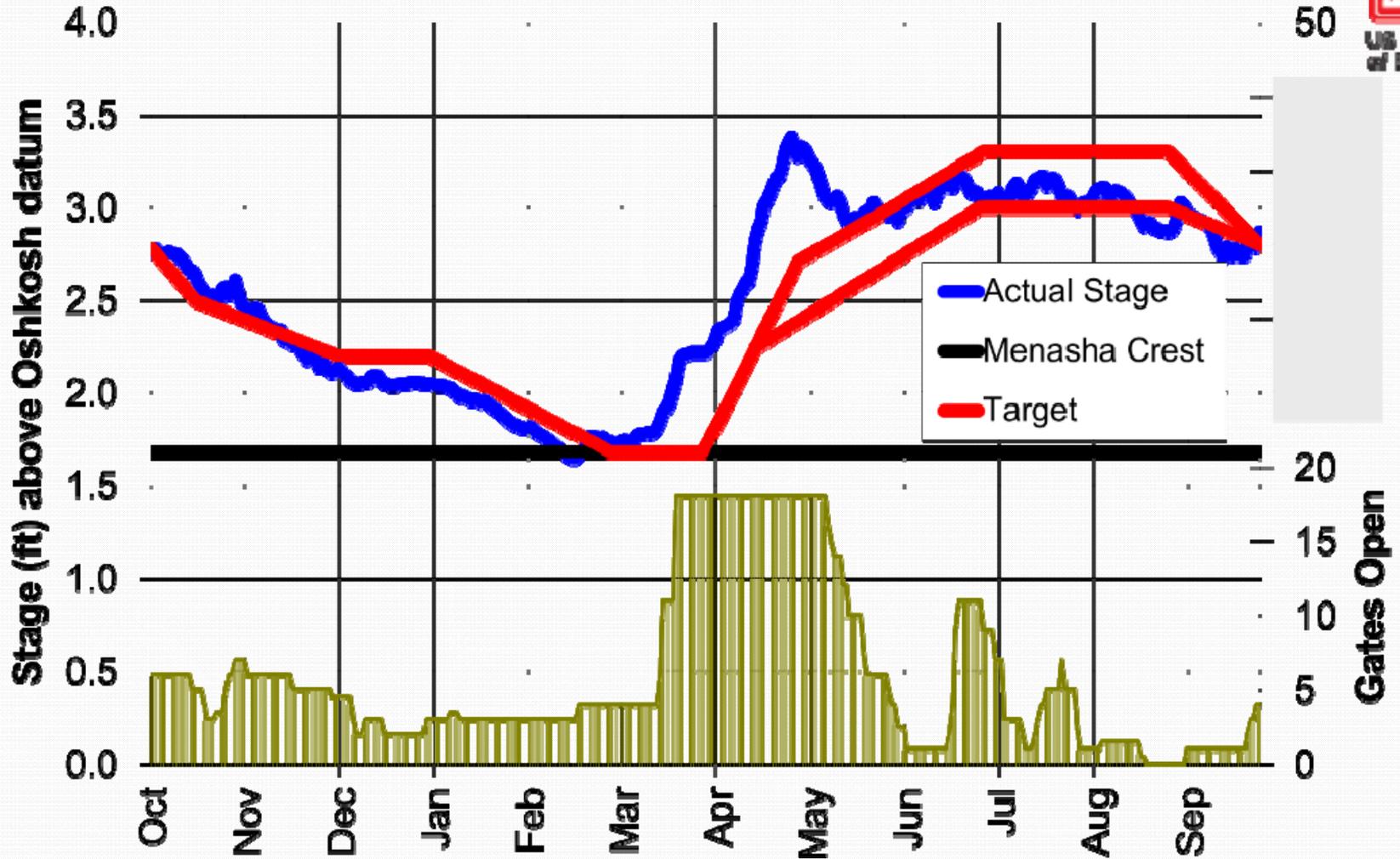
2012-2013 Stage with # of Open Gates



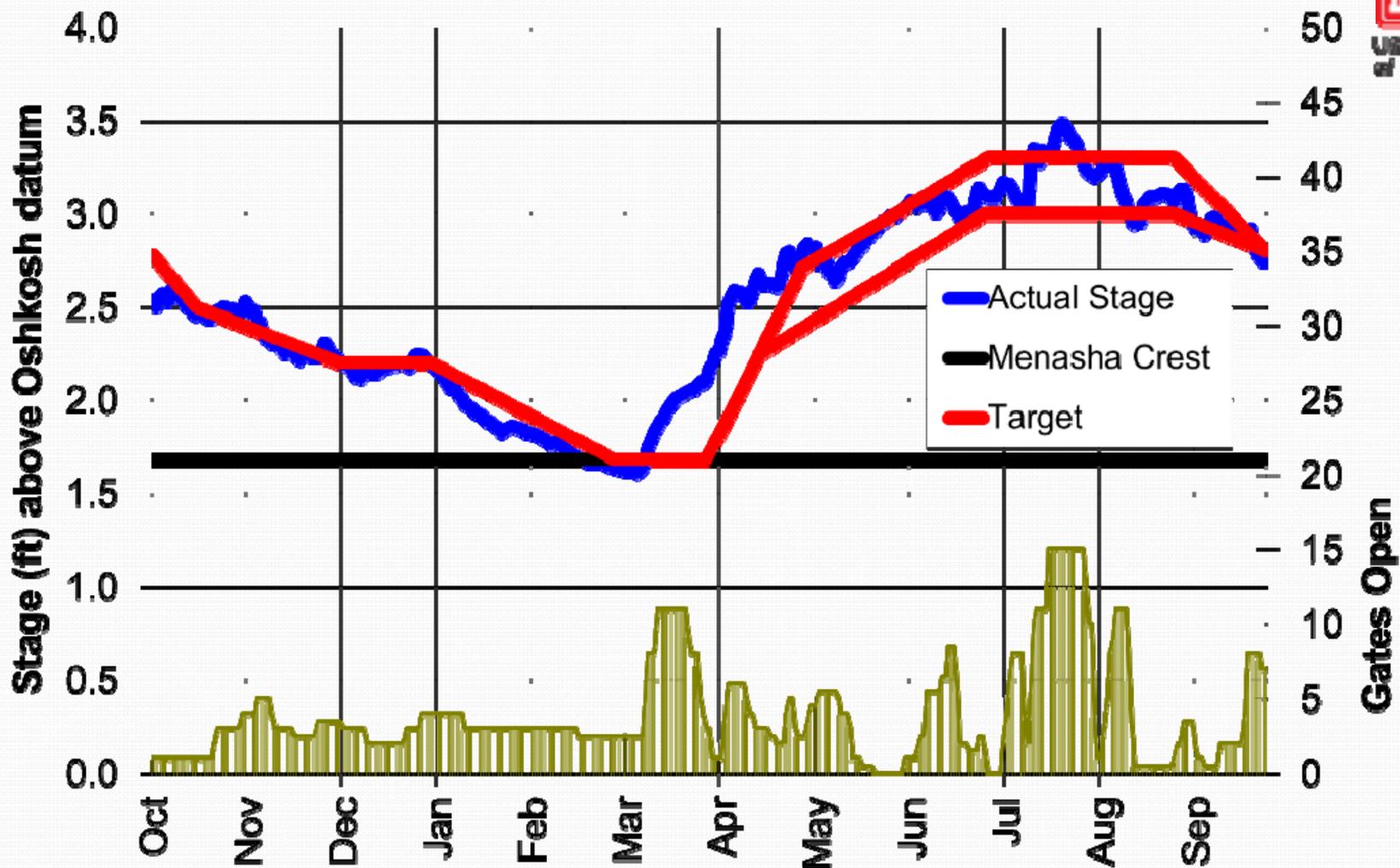
2011-2012 Stage with # of Open Gates



2010-2011 Stage with # of Open Gates



2009-2010 Stage with # of Open Gates



- **District Mission: Flood Risk Management, Hydro Power and Navigation**

- The Locks and Dams were constructed in the 1850's for **navigation** purposes.
- In 1872, USACE was authorized to operate the structures to maintain navigation.
- The **Marshall Order** was established in 1886 to “maintain the level of Lake Winnebago at or below” flood stage, and above the crest of the dam which retains that pool. The term "flood" is to be considered to refer to all stages of water above an ordinary high-water stage.
- The 3-foot 6-inch upper limit specified is 21-1/4 inches above the spillway crest of Menasha Dam. This was determined by the mean annual high-water stage for the 28 year period from 1859 to 1886. Today we operate to keep the level within the limits set by the **Marshall Order**.
- The **Linde Plan** is also used as guidance for habitat protection on management practices within the bounds of the Marshall Order.



HISTORY AND AUTHORITY



- Our mission is **Flood Risk Management**.
- We are mandated to regulate Lake Winnebago within the limits established by the Marshall Order.
- We operate within the Marshall Order limits according to the Linde Plan.
- In 1870 Congress passed legislation to allow for the purchase of the Fox-Wisconsin Waterway from **The Green Bay and Mississippi Canal Company**, who retained the water rights to develop waterpower along the river. The price was set by an arbitrator after deducting the value of waterpower, the value of the Waterway was set at \$145,000. The transfer was completed October 28, 1872.



SNOWFALL IN THE BASIN - SWE



March 12th, 2019

