



# Flooding Events Update to Council

JUNE 18, 2019

# Presentation Overview

- ▶ **Flooding in 2018**
  - ▶ Lake level flooding
  - ▶ Flash Flooding
- ▶ **Response**
  - ▶ Lake Level Technical Work Group and Report
  - ▶ Watershed Studies
  - ▶ FEMA and Ongoing Repairs
- ▶ **Moving Forward**
  - ▶ Budget
  - ▶ Flood Mitigation Projects
  - ▶ MGO and Policy Modifications

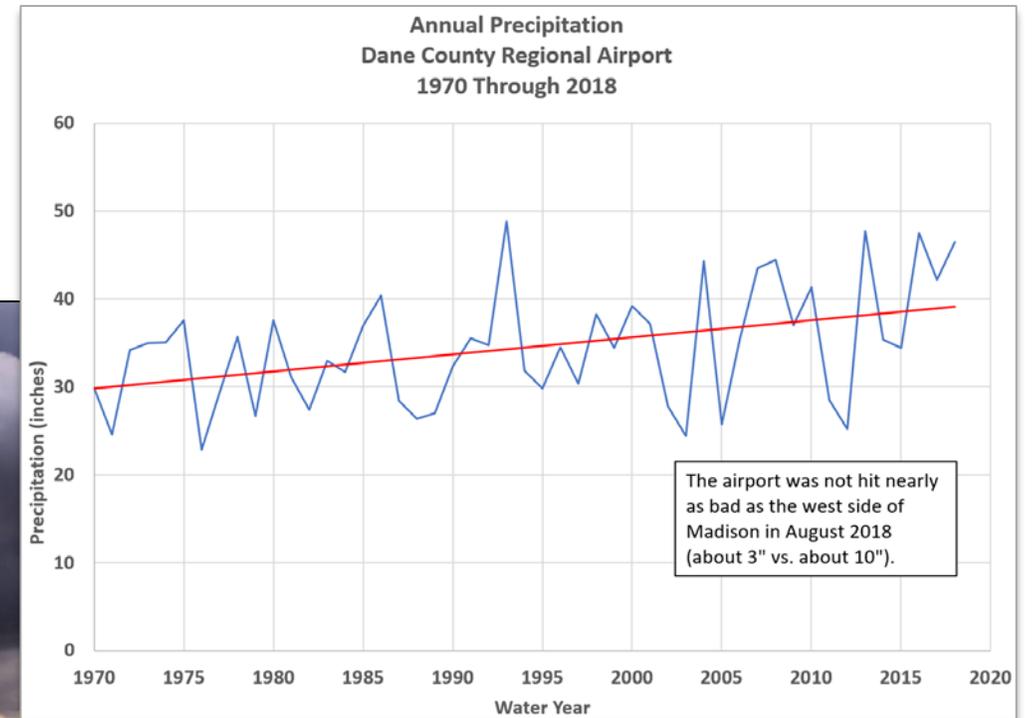


# Lake Level Flooding: Why do the Yahara Chain of Lakes Flood?

- ▶ Climate change / more intense storms
- ▶ Urbanization / More impervious area
- ▶ Draining enclosed depressions
- ▶ Deposits in the Yahara River

# Lake Level Flooding: Why do the Yahara Chain of Lakes Flood?

- Climate change / more intense storms



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# Lake Level Flooding: Why do the Yahara Chain of Lakes Flood?

- ▶ Draining enclosed depressions



# Lake Level Flooding: Why do the Yahara Chain of Lakes Flood?

- ▶ Deposits in the Yahara River

# Lake Level Flooding: Lake Level Management

Dane County Manages the Yahara Chain of Lakes under 1979 orders from the Wisconsin DNR

BEFORE THE  
DEPARTMENT OF NATURAL RESOURCES

13.19

In the Matter of Reestablishment of )  
Water Levels for Lakes Monona and )  
Waubesa, Dane County )

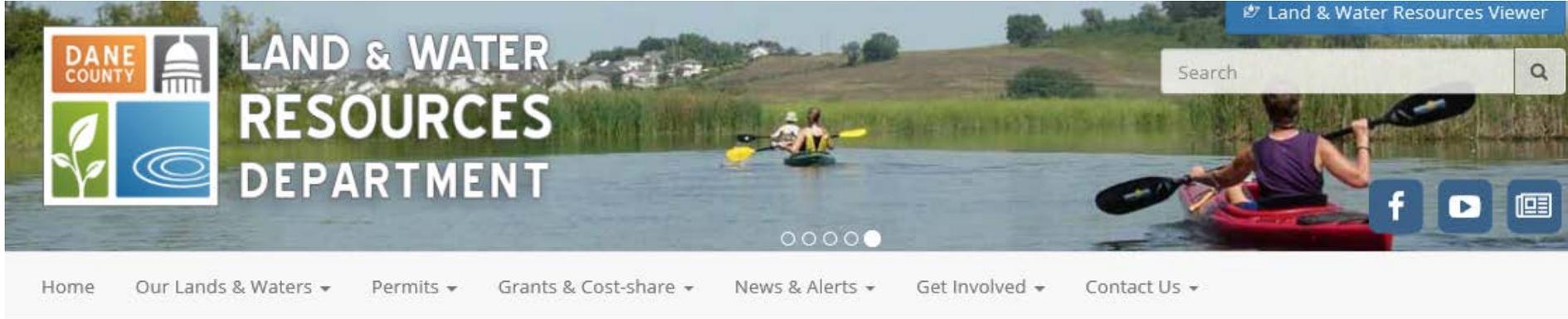
3-SD-77-819

## FINDINGS OF FACT, CONCLUSIONS OF LAW AND ORDER

The Department of Natural Resources proposes to reestablish water levels pursuant to Section 31.02, Statutes, for Lakes Monona and Waubesa in Dane County, Wisconsin.

## FINDINGS OF FACT

1. The City of Madison and Dane County, Wisconsin 53701, requested the Department to reestablish water levels pursuant to Section 31.02, Statutes, for Lake Mendota in the City of Madison, Dane County. The Department has proposed in Docket No. 3-SD-77-808 to reestablish the water levels for Lake Mendota. Because the water levels of Lakes Monona and Waubesa are highly dependent on the operation of the Tenney Park Dam, which controls the water level of Lake Mendota, the Department has proposed to reestablish the water levels for these lakes.



# Lake Levels & Information

The Land & Water Resources Department is responsible for maintaining lake levels for the four major lakes in Dane County: Lake Mendota, Lake Monona, Lake Waubesa and Lake Kegonsa. Minimum and maximum lake levels were set by the Wisconsin Department of Natural Resources in 1979 and are listed below in the information tabs for each lake. For information on the 2018 flooding, please visit our [Flood Facts & Initiatives webpage](#).

## Notices

**June 13, 2019**  
All lakes are above summer maximum water levels. The dams at Babcock County Park and LaFollette County Park are completely open in full flow condition and their associated locks are open for navigation.

## Lake Levels\*

Lake	Date	Lake Level	Summer Min	Summer Max	100-year
<a href="#">Mendota</a>	6/18/2019	850.25	849.60	850.10	852.8
<a href="#">Monona</a>	6/18/2019	845.93	844.70	845.20	847.7
<a href="#">Waubesa</a>	6/18/2019	845.61	844.50	845.00	847.0
<a href="#">Kegonsa</a>	6/18/2019	844.33	843.00	843.50	845.2



[Chart Lake Levels](#) [Tabular Data](#)

# Lake Level Flooding: Lake Level Management

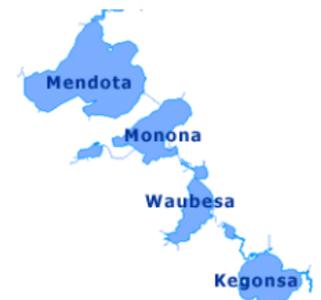
## Lake levels as of June 18th

- ▶ Mendota - 850.25(summer max 850.10) +1.8in above summer max
- ▶ Monona – 845.93 (summer max 845.20) +8.7in above summer max
- ▶ Weekly updated provided at [www.cityofmadison.com/flooding](http://www.cityofmadison.com/flooding)
- ▶ Levels are decreasing slowly continue to vary with additional rain and runoff events

### Lake Levels\*

Lake	Date	Lake Level	Summer Min	Summer Max	100-year
<a href="#">Mendota</a>	6/18/2019	850.25	849.60	850.10	852.8
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[Chart Lake Levels](#) [Tabular Data](#)



Updated lake level information available at <https://lwr.dane.countyofdane.com/lake-levels>

# Lake Level Flooding: INFOS

INFOS

# INFOS

## Integrated Nowcast/Forecast Operation System for Yahara Lakes

Home | About INFOS

### OBSERVATIONS

Surface Water

Weather

Rainfall

Groundwater

Beaches

Water Levels

### MODELS

**Nowcast**

Hydrologic

Hydraulic

Hydrodynamic

**Forecast**

Water Level &  
Discharge

### WATER QUALITY

Algae

Sediment

Nutrients

### WEBCAMS

Wingra Dam

Monona Outlet

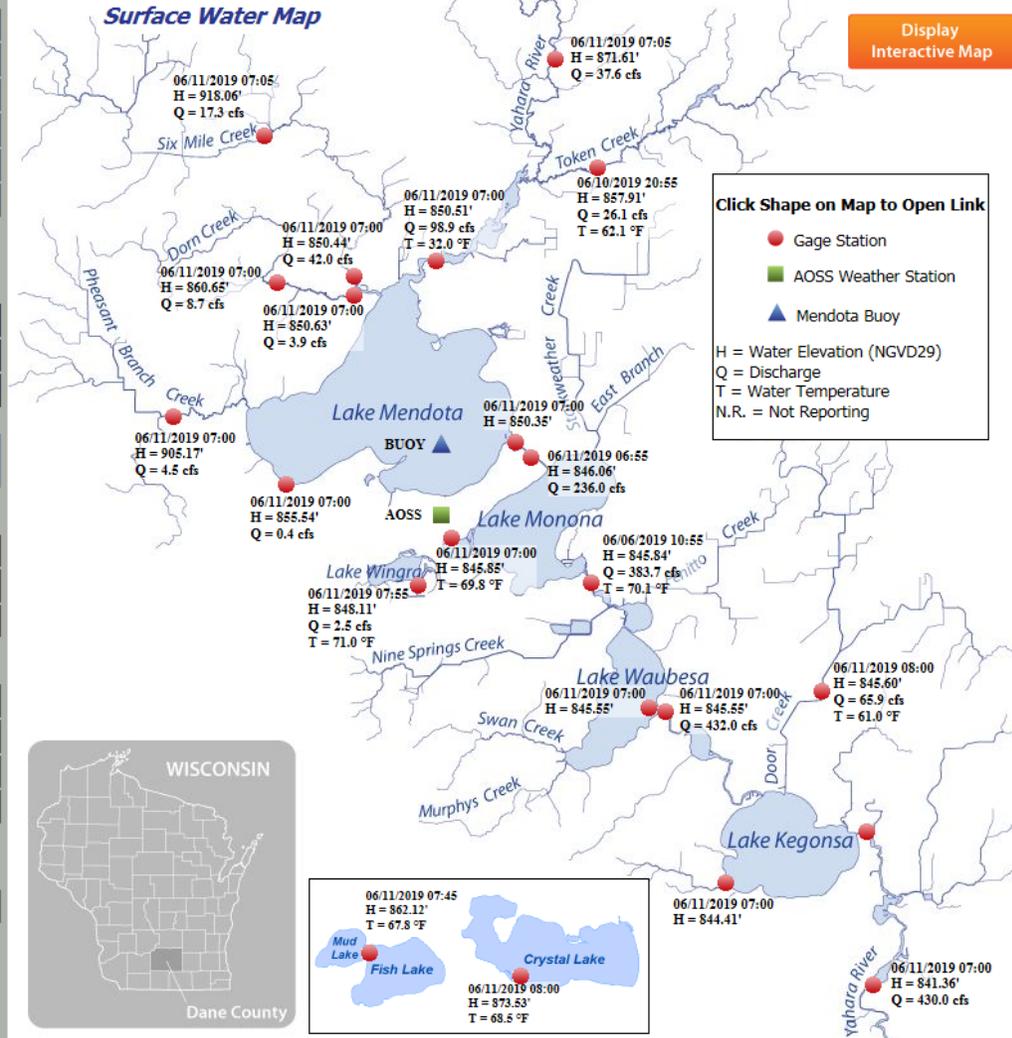
Babcock Dam

Lafollette Dam

### MORE INFORMATION

Links

### Surface Water Map



### Current Conditions

Air Temperature  
18.7°C (65.6°F)

Humidity  
46.5%

Wind Direction



WSW

240.8°

Wind Speed

5.7 m/s (12.7 mph)

Pressure

982.0 hPa

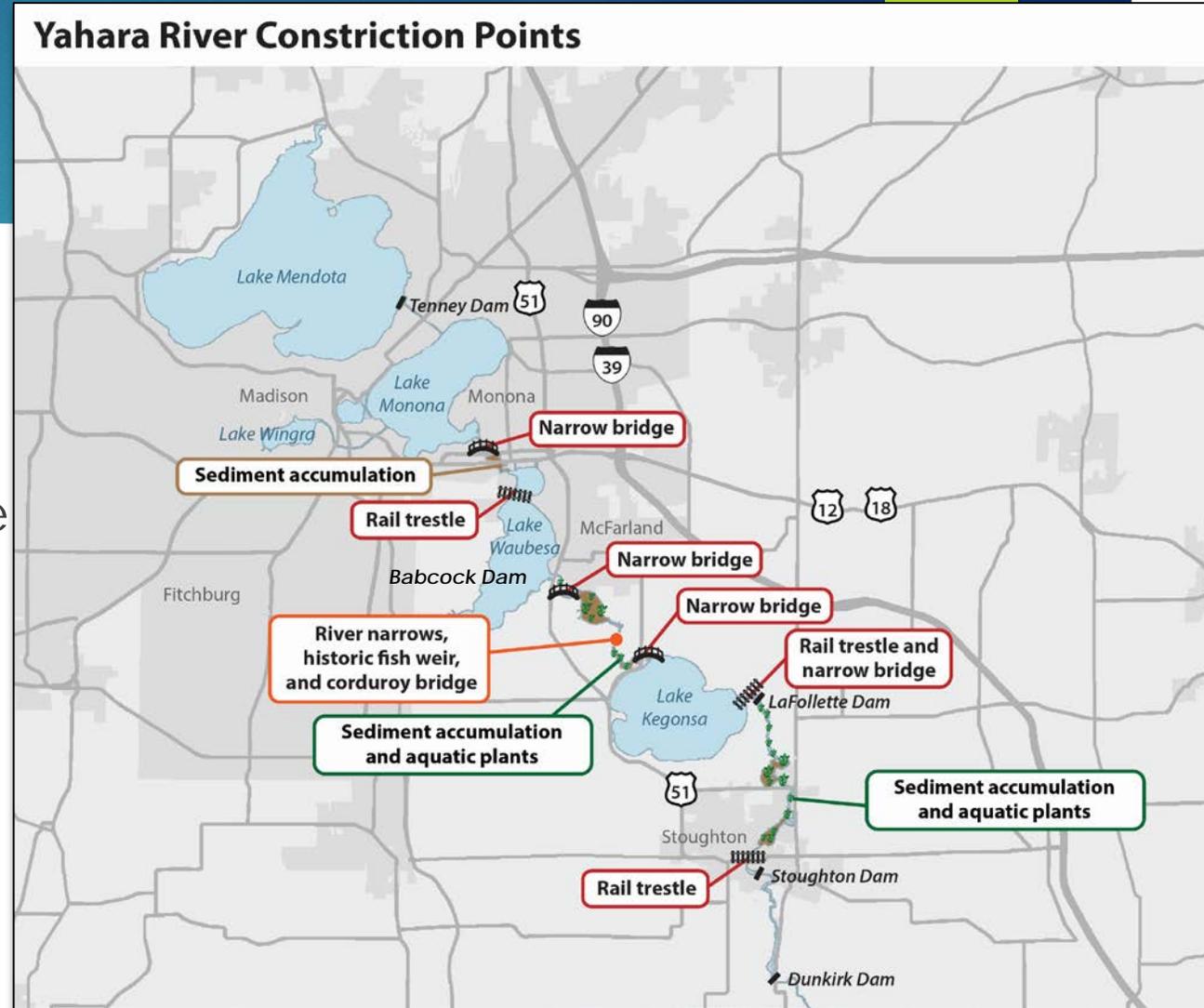
All Data Updated  
06/11/2019

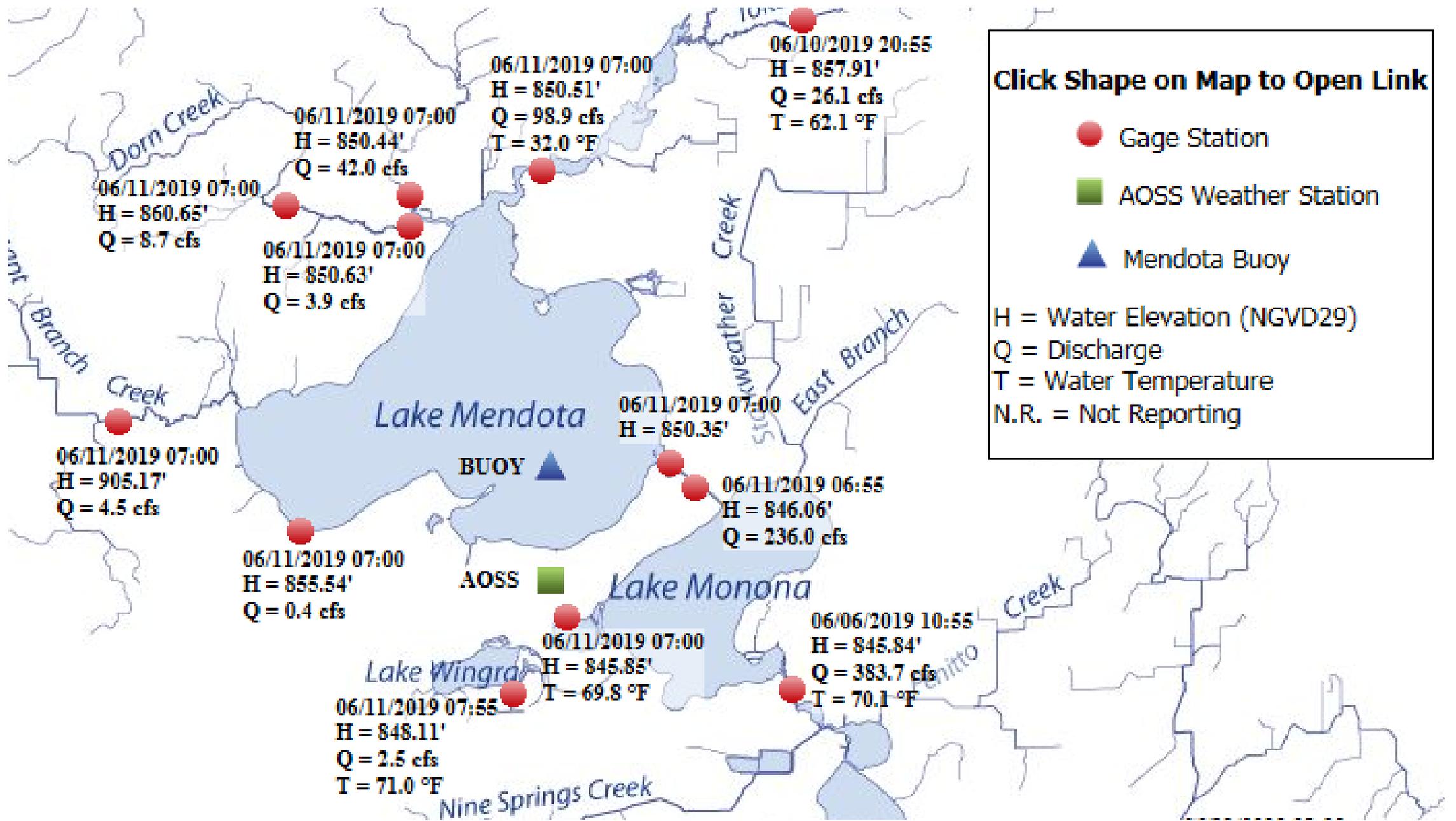
### Partnership



# Lake Level Flooding: Mechanics of the Yahara System

- ▶ Constriction Points
  - ▶ Rail trestles
  - ▶ Bridges
  - ▶ Historic fish weir / Corduroy Bridge
  - ▶ Sediment and aquatic plants
- ▶ Dams
  - ▶ Tenney Dam
  - ▶ Babcock Dam
  - ▶ Lafollette Dam
  - ▶ Stoughton Dam

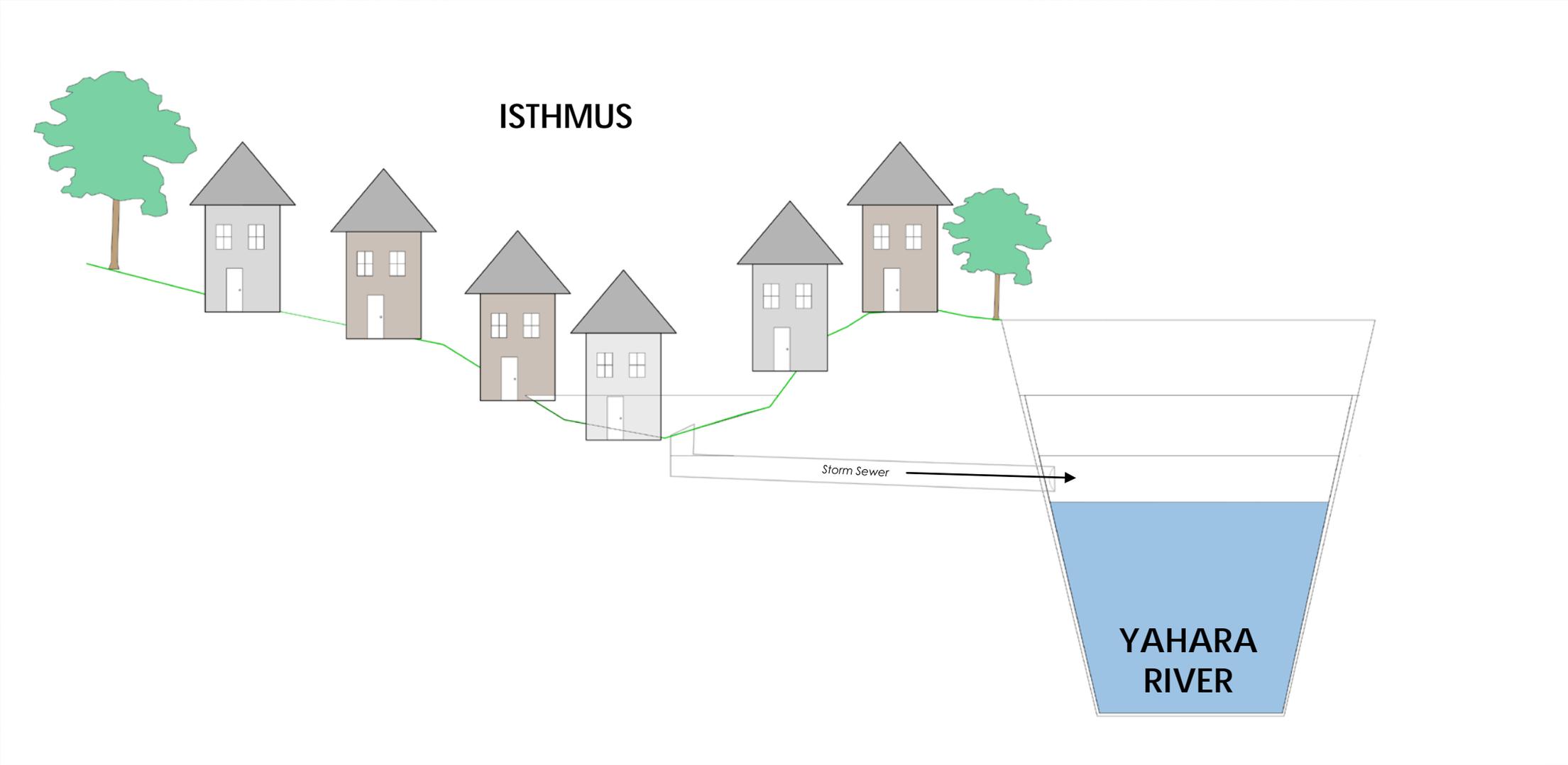




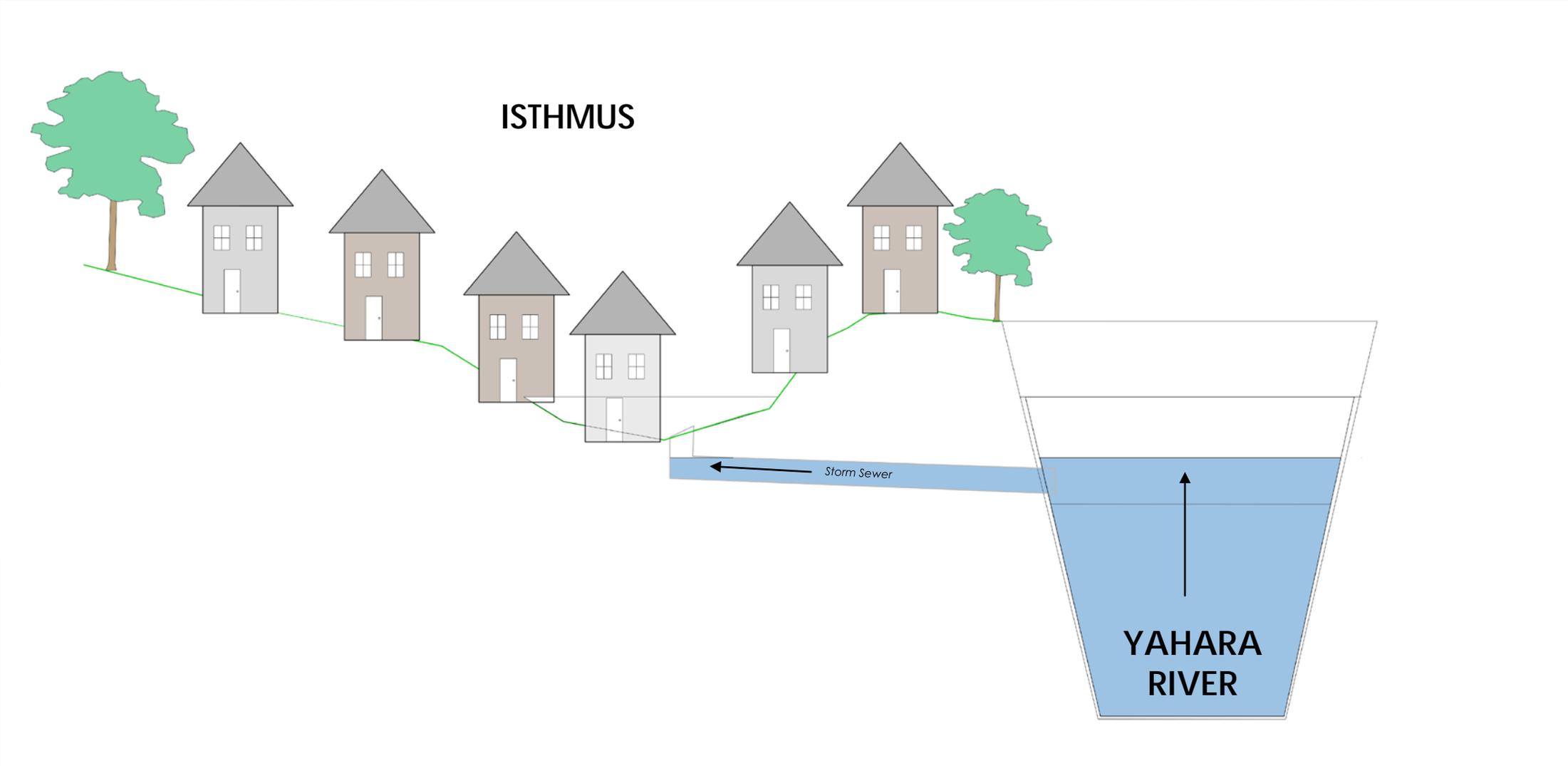
Backwater of the  
Yahara River on  
Main Street



# Isthmus Sewer Animation Example

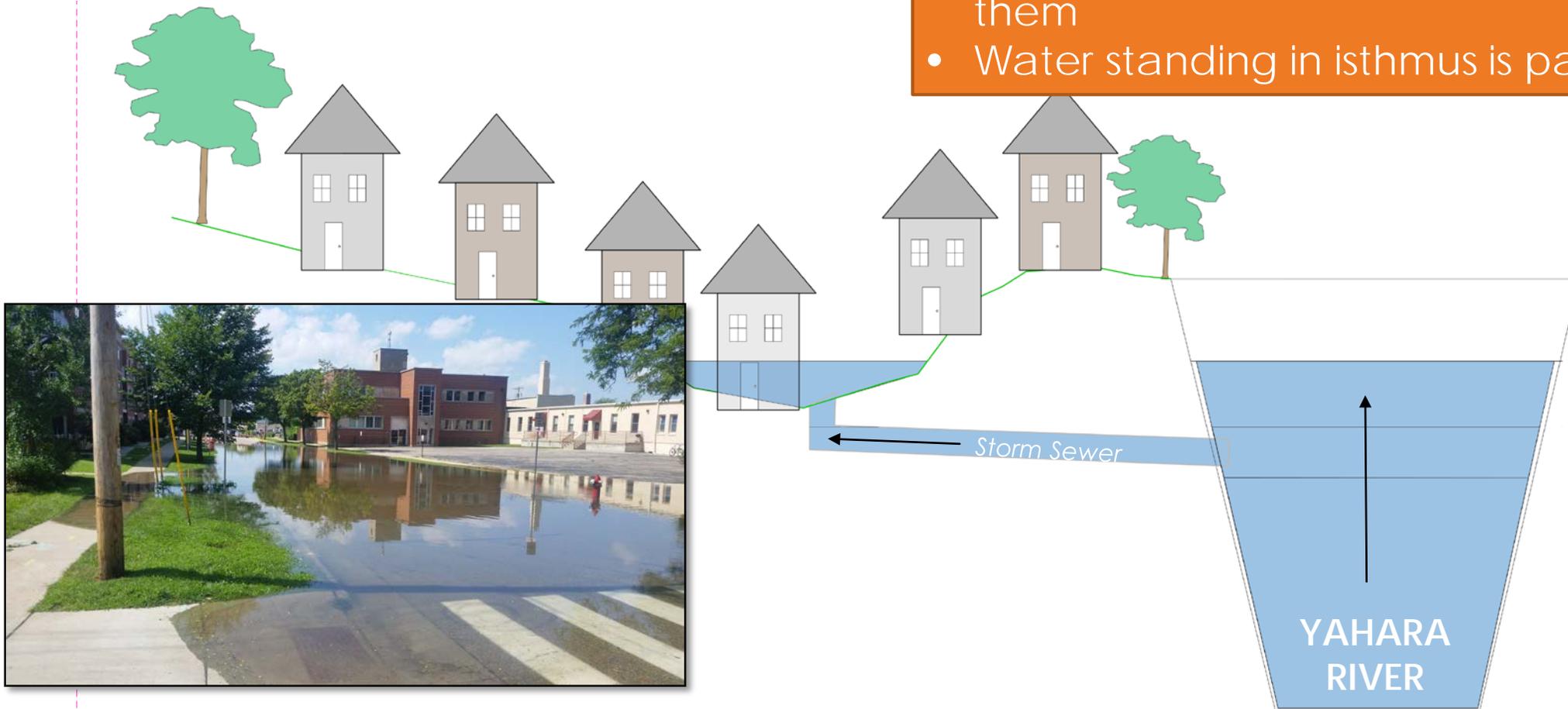


# Isthmus Sewer Animation Example

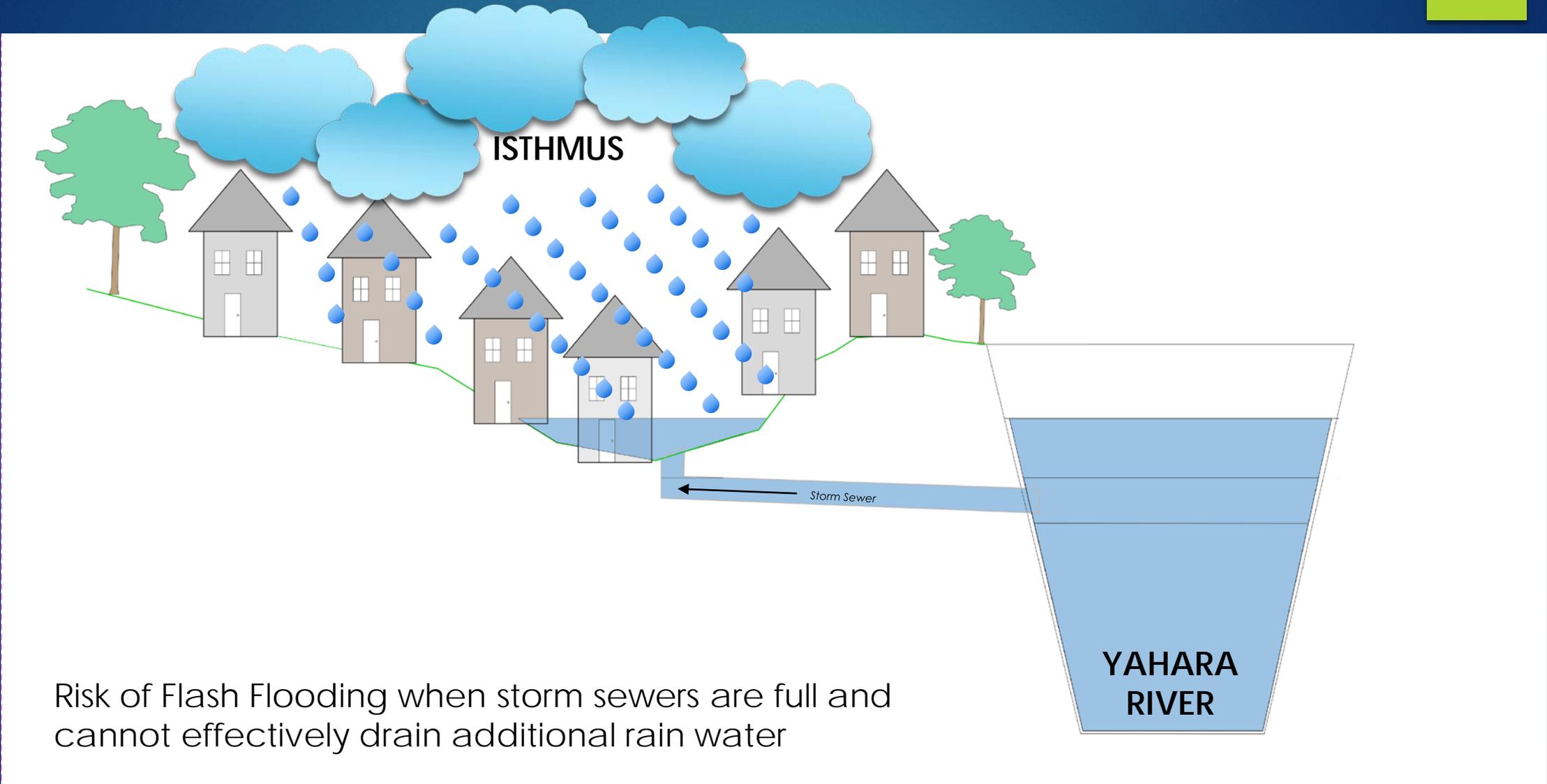


# Elevated Lake Levels

- Storm sewers drain Isthmus during rain events
- Large amounts of water released from Mendota → higher water levels in Yahara River
- Sewers act in reverse, water travels “up” them
- Water standing in isthmus is part of the lake

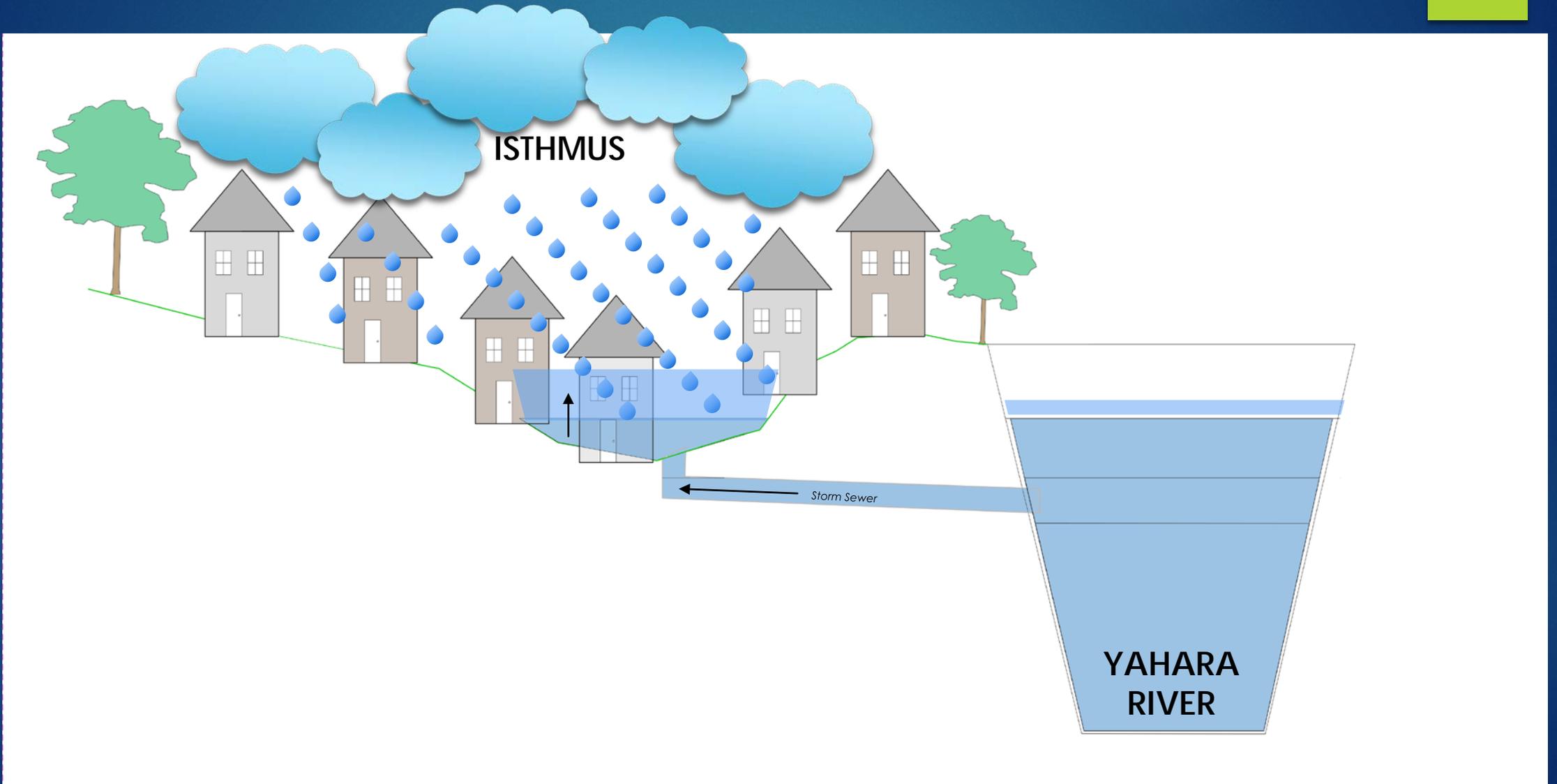


# Isthmus Sewer Animation Example-Flash Flooding



Risk of Flash Flooding when storm sewers are full and cannot effectively drain additional rain water

# Isthmus Sewer Animation Example-Flash Flooding



# Lake Levels

## Select Date Range

### Date Range

Custom date range ▼

### Start Date

01/1/2018



### End Date

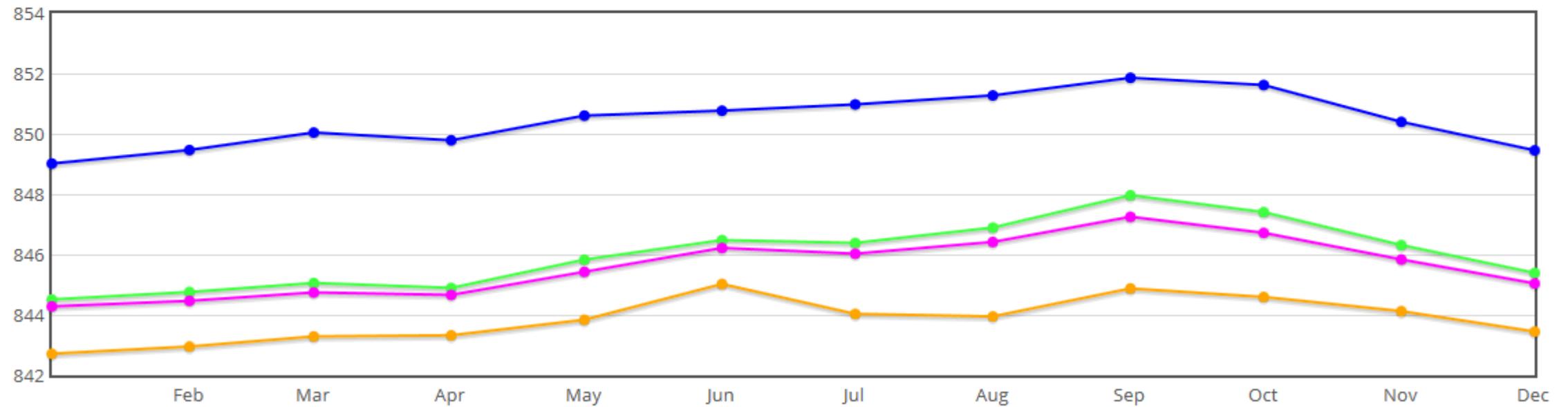
12/31/2018



## Select Lake(s)

- Mendota ●
- Monona ●
- Waubesa ●
- Kegonsa ●

Lake	Date	Lake Level	Summer Min	Summer Max	100-ye
<a href="#">Mendota</a>	6/11/2019	850.36	849.60	850.10	852.8
<a href="#">Monona</a>	6/11/2019	845.86	844.70	845.20	847.7
<a href="#">Waubesa</a>	6/11/2019	845.55	844.50	845.00	847.0
<a href="#">Kegonsa</a>	6/11/2019	844.41	843.00	843.50	845.2



# Yahara Lake Level Task Force Winter 2018/2019

- ▶ Short and Long Term Recommendations
  - ▶ Public Engagement
  - ▶ Dredging
  - ▶ Dam Management
  - ▶ Pumping
  - ▶ Aquatic Plant Harvesting
  - ▶ Lake Levels
  - ▶ Lake Level Management Guide
  - ▶ Stormwater and Infiltration



Tenney Locks

# Yahara Lake Level Task Force Winter 2018/2019

- ▶ Dredging Yahara River between Lakes Monona and Waubesa and between Monona and Mendota
- ▶ Explore Pumping from Lake Waubesa



# Lake Level Flooding vs Flash Flooding

## ▶ Lake Level flooding

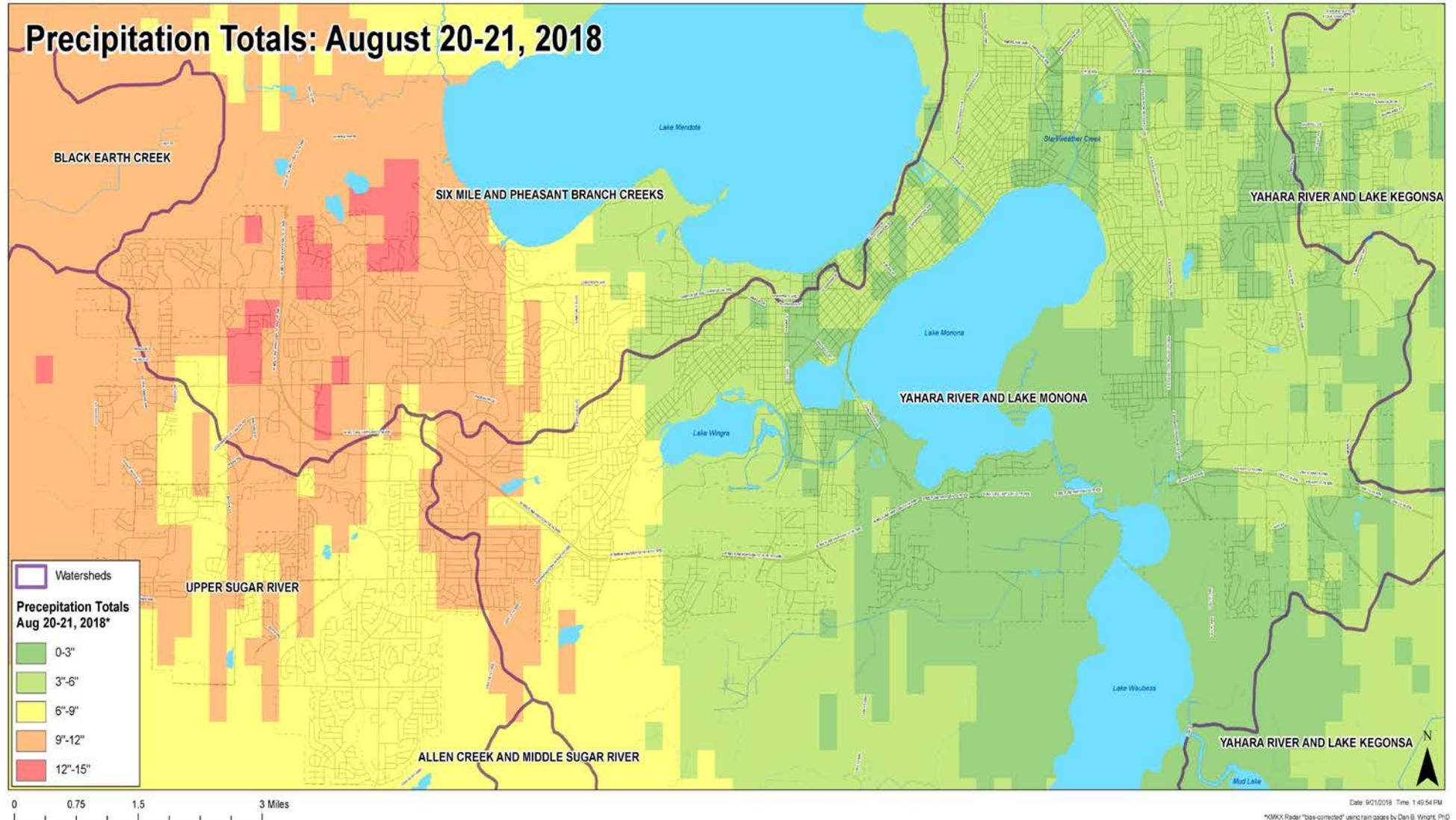
- ▶ Slow onset
- ▶ Backwater in storm sewer system
- ▶ Standing water in areas is the level of the lake or river

## ▶ Flash Flooding

- ▶ Very fast
- ▶ Infrastructure not designed to handle historic rain events
- ▶ Damaged to infrastructure

# The August 20<sup>th</sup> Storm – Flash Flood

Flash Flooding (approx. radar returns) provided by Professor Dan Wright, UW Madison



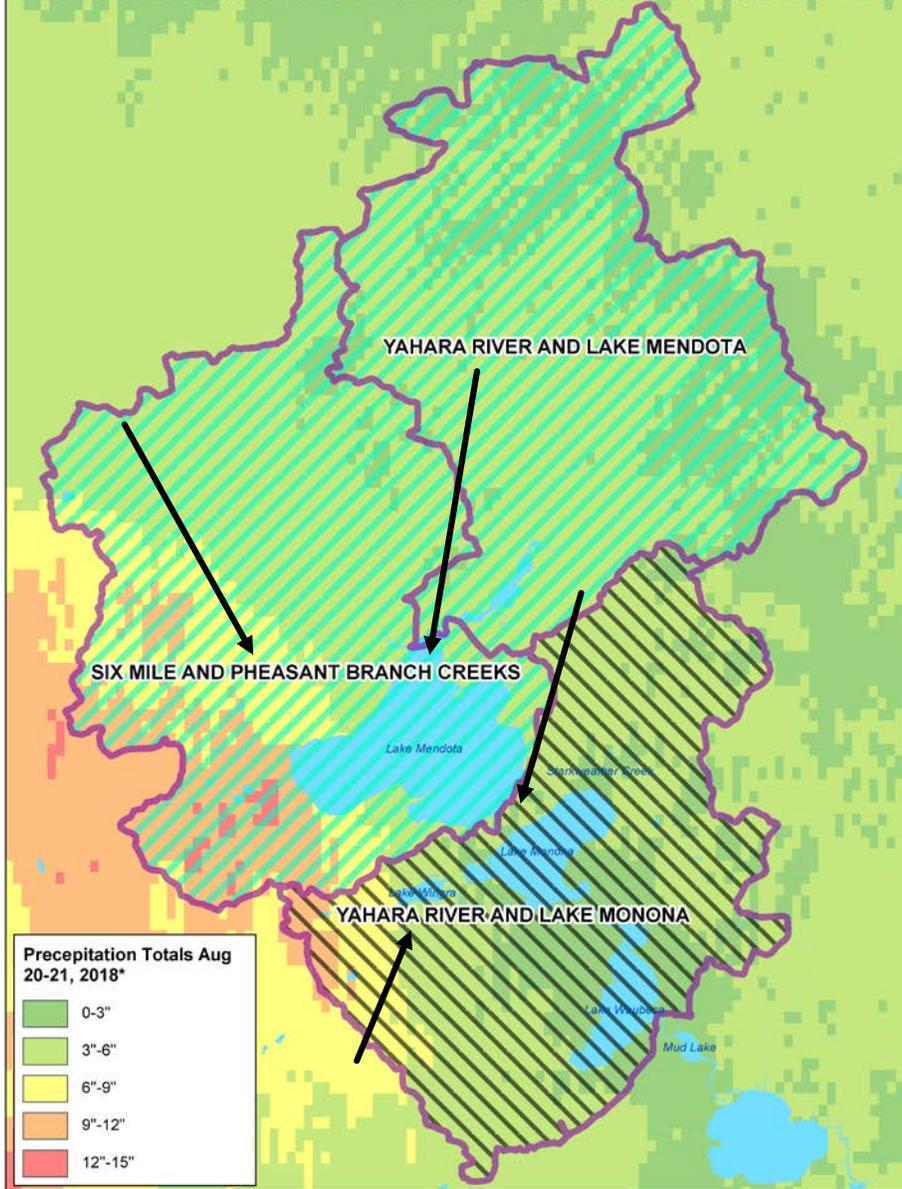
# The August 20<sup>th</sup> Storm some areas >12inches



**PDS-based precipitation frequency estimates with 90% confidence intervals (in inches)<sup>1</sup>**

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.381 (0.327-0.447)	0.437 (0.373-0.511)	0.531 (0.453-0.623)	0.613 (0.520-0.722)	0.732 (0.605-0.889)	0.829 (0.670-1.02)	0.929 (0.728-1.16)	1.04 (0.782-1.32)	1.11 (0.84-1.44)	1.30 (0.922-1.71)
10-min	0.559 (0.478-0.654)	0.639 (0.547-0.749)	0.777 (0.663-0.912)	0.898 (0.761-1.06)	1.07 (0.886-1.30)	1.21 (0.981-1.49)	1.36 (1.07-1.70)	1.52 (1.14-1.93)	1.73 (1.26-2.25)	1.90 (1.35-2.50)
15-min	0.681 (0.583-0.798)	0.780 (0.667-0.913)	0.948 (0.808-1.11)	1.10 (0.928-1.29)	1.31 (1.08-1.59)	1.48 (1.20-1.81)	1.66 (1.30-2.07)	1.85 (1.40-2.36)	2.11 (1.54-2.75)	2.32 (1.65-3.05)
30-min	0.939 (0.804-1.10)	1.08 (0.921-1.26)	1.31 (1.12-1.54)	1.52 (1.29-1.79)	1.82 (1.50-2.20)	2.06 (1.66-2.52)	2.30 (1.81-2.88)	2.57 (1.94-3.27)	2.93 (2.13-3.81)	3.21 (2.28-4.22)
60-min	1.19 (1.02-1.40)	1.38 (1.18-1.62)	1.71 (1.46-2.01)	1.99 (1.69-2.35)	2.40 (1.99-2.92)	2.74 (2.21-3.36)	3.09 (2.42-3.85)	3.45 (2.60-4.40)	3.96 (2.88-5.15)	4.36 (3.09-5.72)
2-hr	1.45 (1.25-1.69)	1.69 (1.46-1.97)	2.11 (1.81-2.45)	2.47 (2.11-2.88)	2.99 (2.49-3.61)	3.42 (2.78-4.17)	3.87 (3.05-4.80)	4.34 (3.30-5.49)	4.99 (3.66-6.46)	5.51 (3.94-7.18)
3-hr	1.60 (1.39-1.86)	1.88 (1.62-2.17)	2.35 (2.03-2.73)	2.77 (2.37-3.22)	3.38 (2.83-4.07)	3.88 (3.17-4.72)	4.41 (3.49-5.46)	4.97 (3.79-6.28)	5.75 (4.24-7.42)	6.37 (4.57-8.28)
6-hr	1.89 (1.65-2.17)	2.20 (1.91-2.53)	2.75 (2.38-3.16)	3.24 (2.79-3.74)	3.98 (3.36-4.78)	4.60 (3.79-5.56)	5.26 (4.20-6.48)	5.97 (4.60-7.51)	6.98 (5.18-8.96)	7.79 (5.62-10.1)
12-hr	2.20 (1.93-2.51)	2.52 (2.21-2.87)	3.10 (2.71-3.54)	3.64 (3.16-4.18)	4.47 (3.82-5.36)	5.19 (4.32-6.25)	5.96 (4.81-7.31)	6.81 (5.28-8.52)	8.02 (6.01-10.3)	9.02 (6.55-11.6)
24-hr	2.51 (2.21-2.84)	2.87 (2.53-3.25)	3.53 (3.10-4.00)	4.14 (3.62-4.71)	5.08 (4.36-6.03)	5.88 (4.93-7.03)	6.76 (5.48-8.23)	7.71 (6.02-9.58)	9.08 (6.84-11.5)	10.2 (7.46-13.0)

## Lake Mendota and Lake Monona Watersheds



# Flash Flooding Also Influences High Lake Level Flooding

- Runoff begins to move through watershed towards lakes
  - City has a few days to prepare

# Max Flood Extents After 8/20/18 Rainfall and Potential Flash Flood Areas

- Observed Flooding Extents from High Lake Levels
- Estimated Flash Flood Areas (851')
- Areas Draining to Yahara River**
  - East Washington Sewer Shed
  - Johnson St Sewer Shed

City was proactive and prepared for potential flash flooding

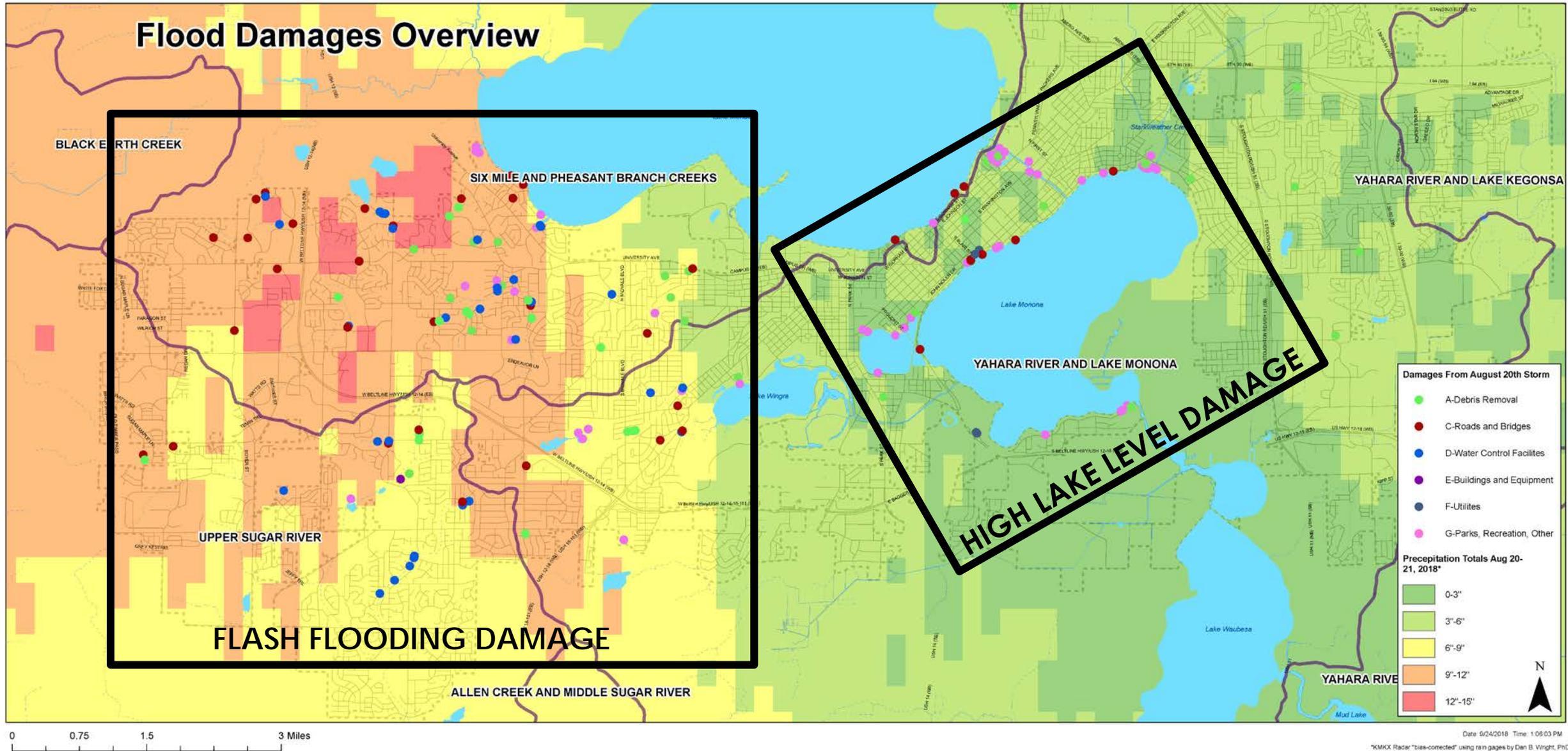
The information on this map was derived from digital databases and other City of Madison data. The City of Madison provides this site as a public service. The City of Madison makes no claims, representations or warranties, express or implied, concerning the validity, reliability or accuracy of the data and expressly disclaims

8/28 storm just missed Madison

0 0.25 0.5 1 Miles

Date: 9/26/2018 Time: 12:13:40 PM  
M:\Maps\Extreme Flood\August2018\Maps

# Damages from 2 Events: Flash Flooding + Flooding from High Lake Levels



# Response: Lake Level Technical Work Group and Report

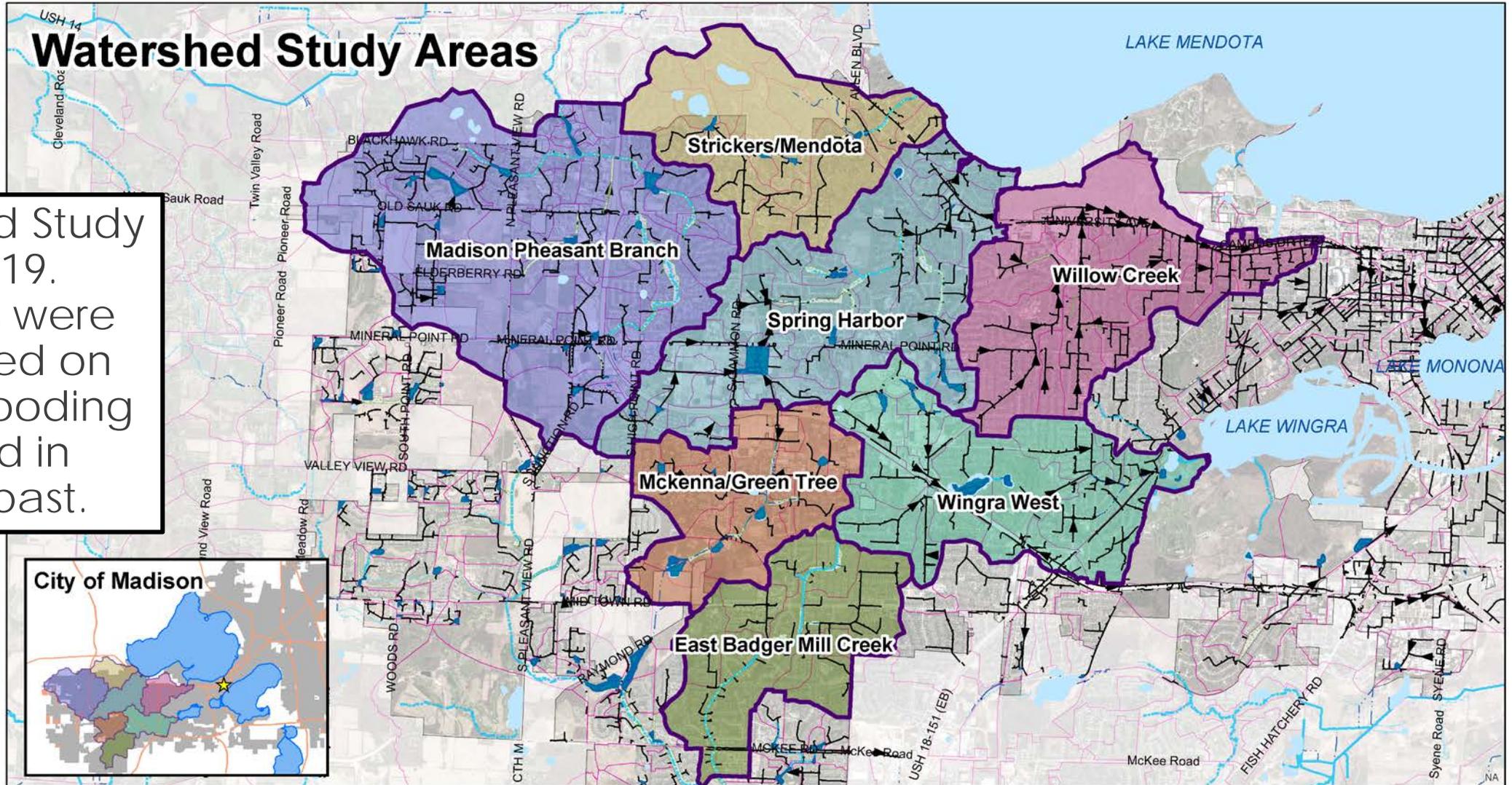
- ▶ Evaluate lake level conditions
- ▶ Model scenarios
- ▶ Climate change
- ▶ Recommendations



# Response: Watershed Studies

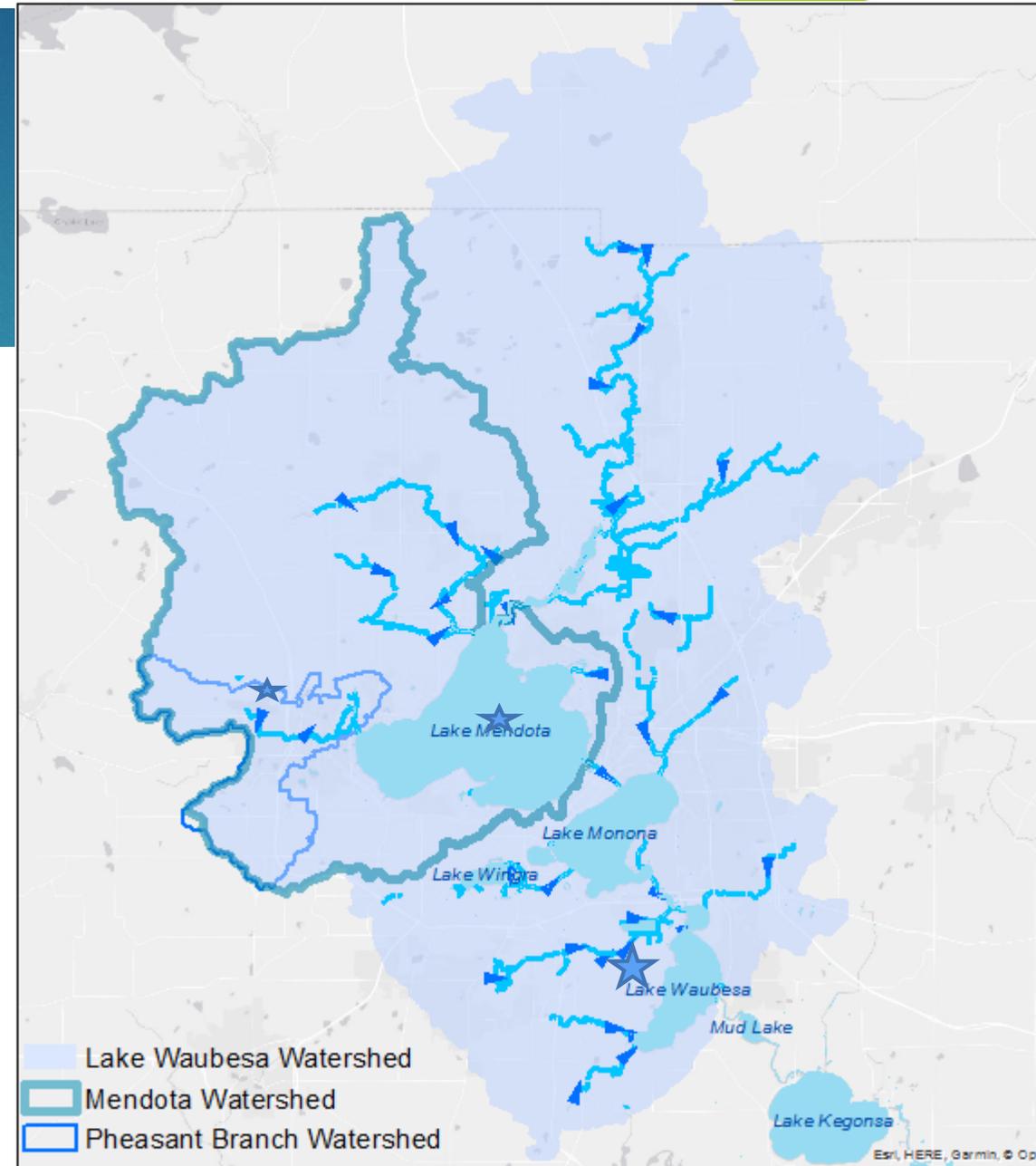
## Watershed Study Areas

8 Watershed Study areas for 2019. Study areas were picked based on extensive flooding experienced in the recent past.



# Why a Watershed Study?

- ▶ The best way to approach City-wide flood issues systematically and equitably is on a watershed scale (so we don't just move a problem)
- ▶ Budget and prioritize studies for entire City in next 5-8 years



# Moving Forward: Continued studies

- ▶ Pheasant Branch
- ▶ Spring Harbor
- ▶ Strickers /Mendota
- ▶ West Wingra Watershed
- ▶ USGS monitoring equipment



<https://www.wiscontext.org/yahara-watershed>

# Moving Forward: Continued studies

- ▶ Pheasant Branch
- ▶ Spring Harbor
- ▶ Strickers /Mendota
- ▶ West Wingra
- ▶ USGS monitoring equipment
- ▶ **Capital City Bike Path Drainage Study (with Dane Co & Fitchburg)**
- ▶ **Dunn's Marsh Study**
- ▶ **Greentree / McKenna Study**
- ▶ **East Badger Mill Creek Watershed Study**

# Moving Forward: Continued studies

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- ▶ Greentree / McKenna Study
- ▶ East Badger Mill Creek Watershed Study
- ▶ **Willow Creek Study –feasibility report University Ave Recon; RFP July**

# Watershed Study Process

Model Existing Conditions & Predict Future Flood Risk

Analyze Solutions on Watershed Scale, Rank & Budget

**Create  
Drainage  
Model**

**Identify  
Flooding  
Impacts**

**Develop  
Engineering  
Solutions**

**Prioritize  
& Budget**



# Response: FEMA & Ongoing Repairs

August 20<sup>th</sup> event

▶ Public infrastructure: \$4M

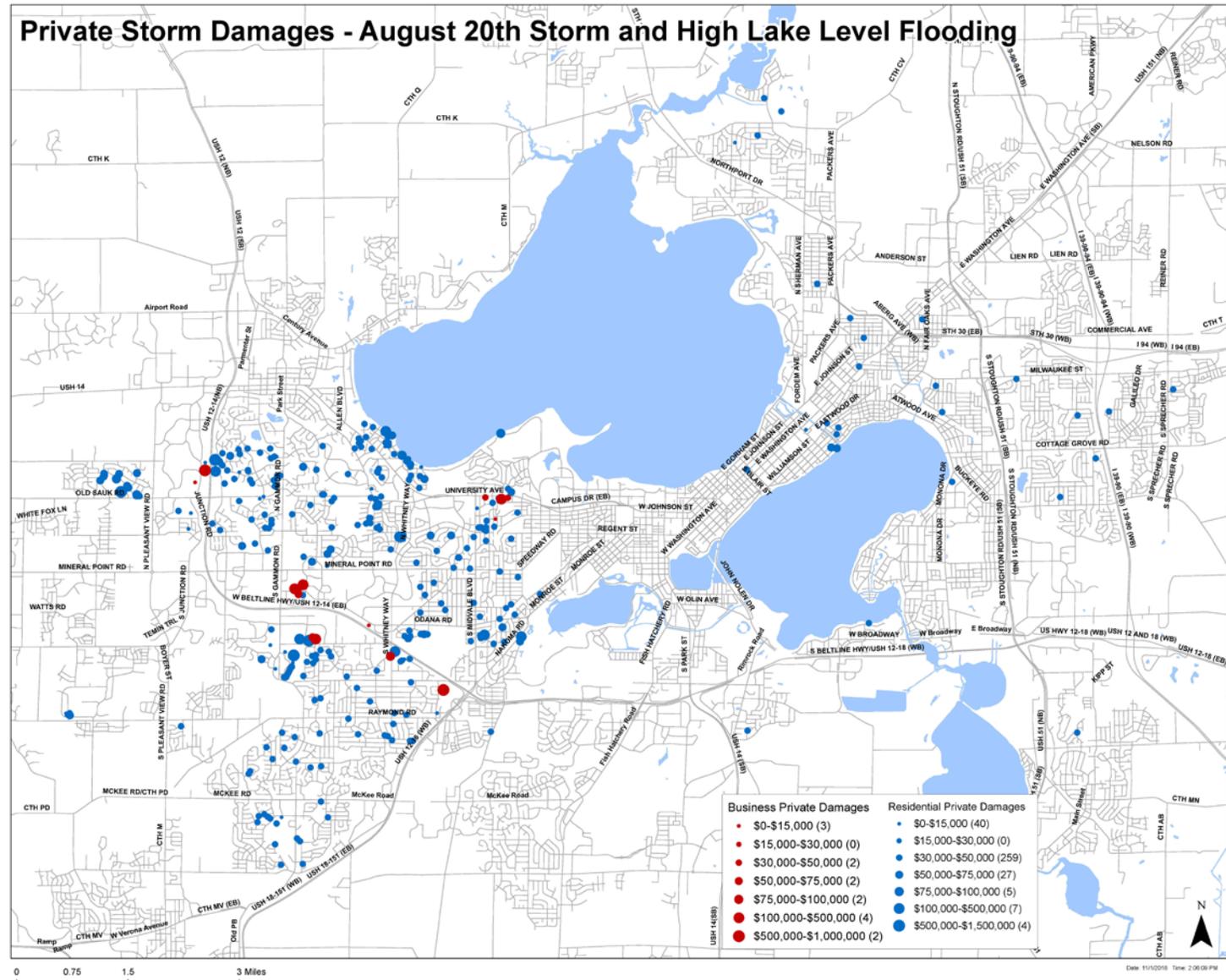
▶ Private property

▶ Reported \$17.5M

▶ Estimated \$30 million

- ▶ Most damage on the West and Near West Side
- ▶ Mostly residential damage
- ▶ Some commercial damages
- ▶ Big losses!

Private Storm Damages - August 20th Storm and High Lake Level Flooding



# Response: FEMA and Ongoing Repairs

- ▶ Deadline for reimbursement applications
  - ▶ Completed repairs – May 31, 2019
  - ▶ Repairs that are still needed - June 2020 (extensions may be granted)
  - ▶ Cost Share 75% Federal, 12.5% State, 12.5% Local
  - ▶ **STILL A LOT LEFT TO DO!**

# Moving Forward: Budget

- ▶ Total Dollar for flood mitigation is **\$7.87M** for 2019
- ▶ Current 2020 budget request
  - ▶ ~**\$4M** split between Capital and Operating Budgets
  - ▶ Watershed Studies
  - ▶ Flood mitigation projects

# Moving Forward: Budget

- ▶ **Note of caution:** not all flood mitigation solutions will be popular and they will not be cheap!

Large projects or initiatives will take time and likely require additional funding

# Moving Forward: Flood Mitigation Projects It's been BUSY!

## ▶ FEMA

- ▶ Reimbursements pending
- ▶ Repairs ongoing; additional contract work required

## ▶ Hawks Landing Flood Mitigation

- ▶ Southern flood mitigation – OUT FOR BID
- ▶ Northern flood mitigation – Bid fall 2019

## ▶ Midtown Pond expansion - purchase fall 2019/Spring 2020; Relocation order started

## ▶ Bram Street property purchase – PSA approved

## ▶ Mckenna Blvd Flood Mitigation – Bid June 2019

## ▶ SW Bike Path Culvert expansion @ Waite Circle – Bid Summer 2019

# Moving Forward: MGO modifications

- ▶ Minimum elevations for first floor openings
  - ▶ Isthmus mandate no opening < elevation 852.0
- ▶ New development route the 100-year event
  - ▶ No flooding of private property to be allowed (flood contained to ROW).
- ▶ New development route 500-year to be routed
  - ▶ Can utilize private property but cannot flood structures on private property
- ▶ First floor elevations are set and enforced on critical lots
- ▶ Detention required on prior developments that had 10-year detention "grandfathered"
- ▶ In flood prone areas detention or green roofs required with redevelopment
  - ▶ Green Roofs detain and reduce runoff through evapotranspiration

# Moving Forward: Flood Control Relief Remediation Plan

- ▶ Historical Design Standards
- ▶ Fixing vs Moving the Problem
- ▶ Policy Considerations
- ▶ Short, Mid and Long Term Action
- ▶ Proposed Mitigation Approaches
- ▶ Final Approval coming soon
- ▶ Legistar File [#53384](#)

## FIXING VS MOVING THE PROBLEM

The August 20<sup>th</sup> event impacted the far west side of the City particularly hard and highlighted some serious systematic problems that require a larger perspective to resolve in a responsible manner.

For example:

The Greentree Greenway system on the far southwest side of Madison had approximately five (5) road overtoppings associated with the Aug 20<sup>th</sup> storm event. As we proceed to reduce the frequency of these road overtopping locations we need to be very careful that improving one road crossing does not simply make the next downstream crossing worse in terms of overtopping.

## POLICY DESIGN

Engineering recently completed a Racial Equity Social Justice (RESJ) analysis to help determine an improved method to work on flood mitigation programs. Recommendations of the RESJ process include:

- 1) enhanced engagement
- 2) education for property owners, builders and developers
- 3) targeting flood prone areas for land acquisition
- 4) investigating the possibility of a reduced rate loan program for use where the problem does not involve public water but rather would be responded to under the private drainage problem policy and could require the response of only the property owner with no City involvement other than guidance
- 5) enhanced data collection
- 6) placing elevation restrictions on new and developing properties
- 7) for new development ensuring that the roadway system functions as a safe overflow for the 100-year storm event and that the design of major greenway systems accommodate the 500 year event

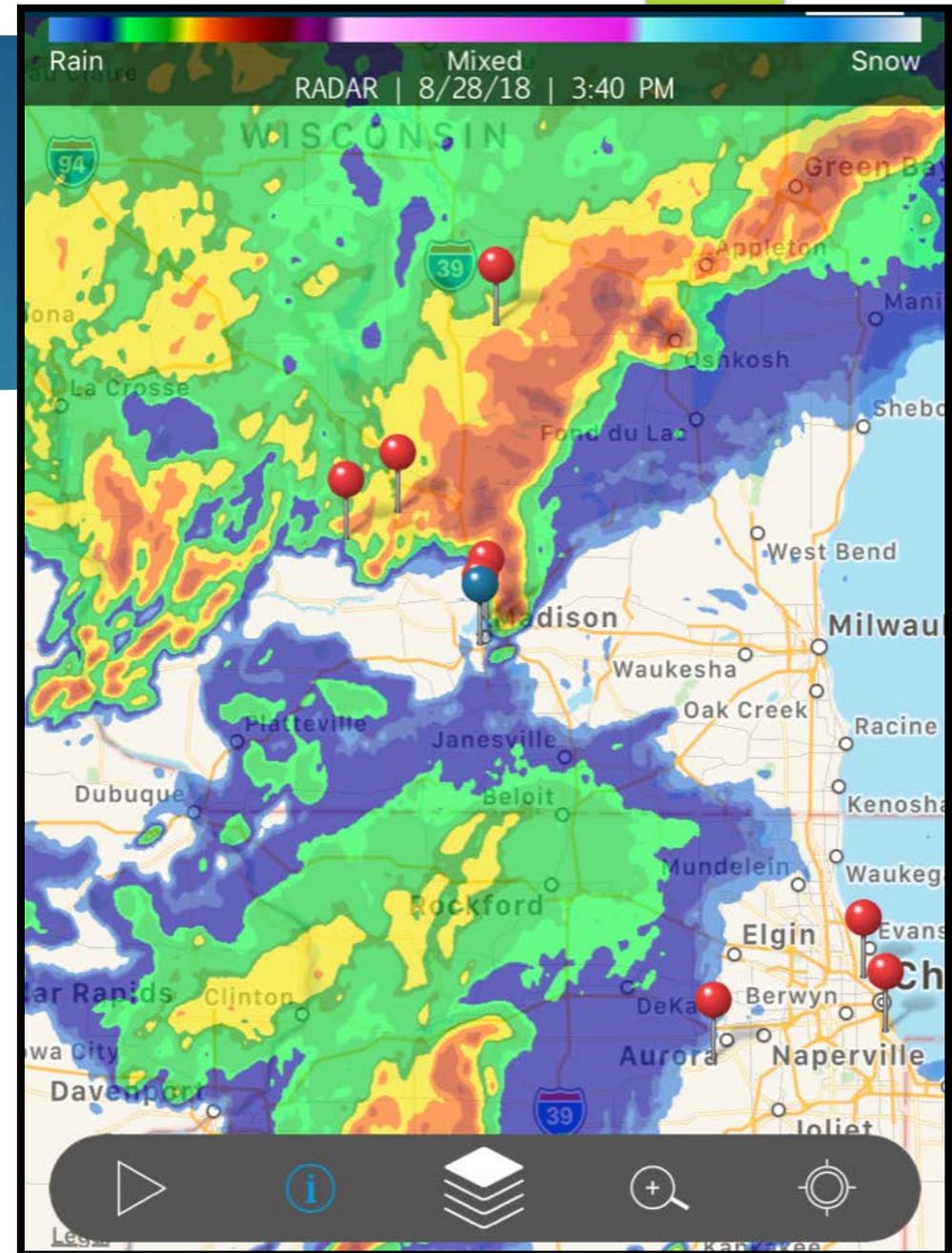
Many of these practices are already being followed (2, 5, 6, & 7). It is our intent to utilize these recommendations along with the below process to proceed to prioritize projects.

# Moving Forward: Policy for Resolving Private Drainage Problems on Private Property

- ▶ Revision of existing policy
- ▶ Categorize drainage issues
- ▶ Explain City's response
- ▶ Explain Funding
- ▶ Legistar File [#53385](#)

# We were lucky!!

- ▶ The 8/28/2018 Storm **just** missed Madison
- ▶ Need to continue initiatives to create a more resilient system.



# QUESTIONS ?

Additional information available at  
[www.cityofmadison.com/flooding](http://www.cityofmadison.com/flooding)