



# 2018 Flooding Events - Response

COE

# Presentation Overview

- ▶ The August 20th Storm
- ▶ MADISON'S WATERSHED
- ▶ BUDGET
- ▶ WHAT ARE WE DOING AS A RESULT

# The August 20th Storm

- ▶ Historic Rain: Lets call it 10" in about 8 hours (this varied a lot ...)
- ▶ Caused historic flash flooding throughout the west side of Madison and Middleton – WHY?
- ▶ The volume of runoff created by the event resulted in historically high lake levels within a few days – WHY?

# The August 20th Storm

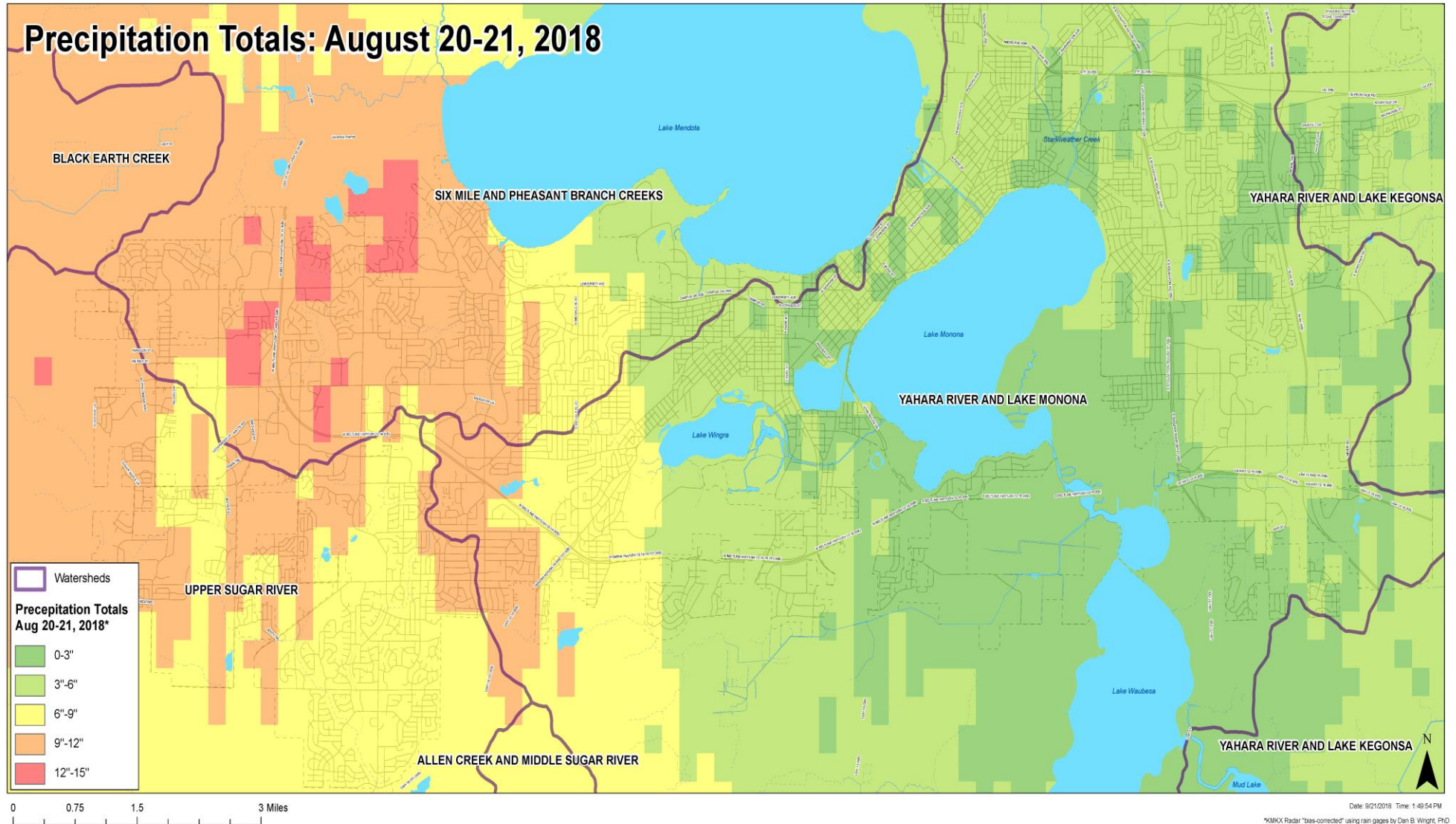
- ▶ The term "100-year storm" is used to define a rainfall event that statistically has a 1% chance of occurring in any given year" In other words, over the course of 1 million years, these events would be expected to occur 10,000 times. But, just because it rained 10 inches in one day last year doesn't mean it can't rain 10 inches in one day again this year.

# The August 20th Storm

- ▶ What event was the Aug 20th rain ?????? -
  - ▶ To define an event two terms are needed DURATION & AMOUNT when these are combined they create the Intensity/Duration/Frequency curves (IDF).
  - ▶ There are multiple “100 – year” events. In the Madison area for example:
    - ▶ 1 hour 3.09”
    - ▶ 2 hours 3.87”
    - ▶ 12 hours 5.96”
    - ▶ 24 hours 6.76”

# The August 20<sup>th</sup> Storm

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



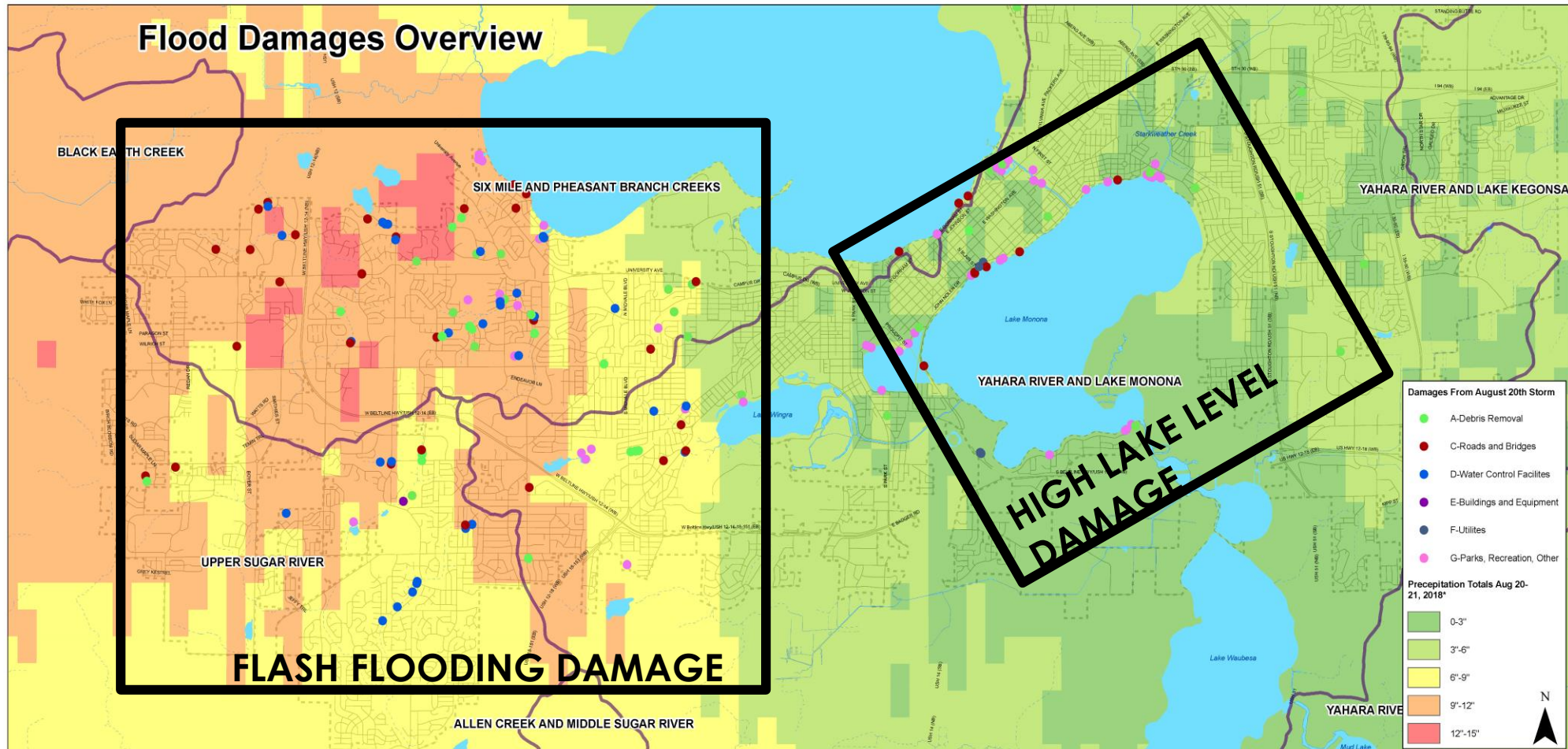
# The August 20<sup>th</sup> Storm



**PDS-based precipitation frequency estimates with 90% c...**

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	<b>0.381</b> (0.327-0.447)	<b>0.437</b> (0.373-0.511)	<b>0.531</b> (0.453-0.623)	<b>0.613</b> (0.520-0.722)	<b>0.732</b> (0.605-0.889)	<b>0.829</b> (0.670-1.02)	<b>0.929</b> (0.728-1.16)	<b>1.04</b> (0.782-1.32)	<b>1.18</b> (0.861-1.54)	<b>1.30</b> (0.922-1.71)
10-min	<b>0.559</b> (0.478-0.654)	<b>0.639</b> (0.547-0.749)	<b>0.777</b> (0.663-0.912)	<b>0.898</b> (0.761-1.06)	<b>1.07</b> (0.886-1.30)	<b>1.21</b> (0.981-1.49)	<b>1.36</b> (1.07-1.70)	<b>1.52</b> (1.14-1.93)	<b>1.73</b> (1.26-2.25)	<b>1.90</b> (1.35-2.50)
15-min	<b>0.681</b> (0.583-0.798)	<b>0.780</b> (0.667-0.913)	<b>0.948</b> (0.808-1.11)	<b>1.10</b> (0.928-1.29)	<b>1.31</b> (1.08-1.59)	<b>1.48</b> (1.20-1.81)	<b>1.66</b> (1.30-2.07)	<b>1.85</b> (1.40-2.36)	<b>2.11</b> (1.54-2.75)	<b>2.32</b> (1.65-3.05)
30-min	<b>0.939</b> (0.804-1.10)	<b>1.08</b> (0.921-1.26)	<b>1.31</b> (1.12-1.54)	<b>1.52</b> (1.29-1.79)	<b>1.82</b> (1.50-2.20)	<b>2.06</b> (1.66-2.52)	<b>2.30</b> (1.81-2.88)	<b>2.57</b> (1.94-3.27)	<b>2.93</b> (2.13-3.81)	<b>3.21</b> (2.28-4.22)
60-min	<b>1.19</b> (1.02-1.40)	<b>1.38</b> (1.18-1.62)	<b>1.71</b> (1.46-2.01)	<b>1.99</b> (1.69-2.35)	<b>2.40</b> (1.99-2.92)	<b>2.74</b> (2.21-3.36)	<b>3.09</b> (2.42-3.85)	<b>3.45</b> (2.60-4.40)	<b>3.96</b> (2.88-5.15)	<b>4.36</b> (3.09-5.72)
2-hr	<b>1.45</b> (1.25-1.69)	<b>1.69</b> (1.46-1.97)	<b>2.11</b> (1.81-2.45)	<b>2.47</b> (2.11-2.88)	<b>2.99</b> (2.49-3.61)	<b>3.42</b> (2.78-4.17)	<b>3.87</b> (3.05-4.80)	<b>4.34</b> (3.30-5.49)	<b>4.99</b> (3.66-6.46)	<b>5.51</b> (3.94-7.18)
3-hr	<b>1.60</b> (1.39-1.86)	<b>1.88</b> (1.62-2.17)	<b>2.35</b> (2.03-2.73)	<b>2.77</b> (2.37-3.22)	<b>3.38</b> (2.83-4.07)	<b>3.88</b> (3.17-4.72)	<b>4.41</b> (3.49-5.46)	<b>4.97</b> (3.79-6.28)	<b>5.75</b> (4.24-7.42)	<b>6.37</b> (4.57-8.28)
6-hr	<b>1.89</b> (1.65-2.17)	<b>2.20</b> (1.91-2.53)	<b>2.75</b> (2.38-3.16)	<b>3.24</b> (2.79-3.74)	<b>3.98</b> (3.36-4.78)	<b>4.60</b> (3.79-5.56)	<b>5.26</b> (4.20-6.48)	<b>5.97</b> (4.60-7.51)	<b>6.98</b> (5.18-8.96)	<b>7.79</b> (5.62-10.1)
12-hr	<b>2.20</b> (1.93-2.51)	<b>2.52</b> (2.21-2.87)	<b>3.10</b> (2.71-3.54)	<b>3.64</b> (3.16-4.18)	<b>4.47</b> (3.82-5.36)	<b>5.19</b> (4.32-6.25)	<b>5.96</b> (4.81-7.31)	<b>6.81</b> (5.28-8.52)	<b>8.02</b> (6.01-10.3)	<b>9.02</b> (6.55-11.6)
24-hr	<b>2.51</b> (2.21-2.84)	<b>2.87</b> (2.53-3.25)	<b>3.53</b> (3.10-4.00)	<b>4.14</b> (3.62-4.71)	<b>5.08</b> (4.36-6.03)	<b>5.88</b> (4.93-7.03)	<b>6.76</b> (5.48-8.23)	<b>7.71</b> (6.02-9.58)	<b>9.08</b> (6.84-11.5)	<b>10.2</b> (7.46-13.0)

# TWO EVENTS – FLASH FLOOD, LAKE LEVEL FLOODING



0 0.75 1.5 3 Miles

Date: 9/24/2018 Time: 1:08:03 PM

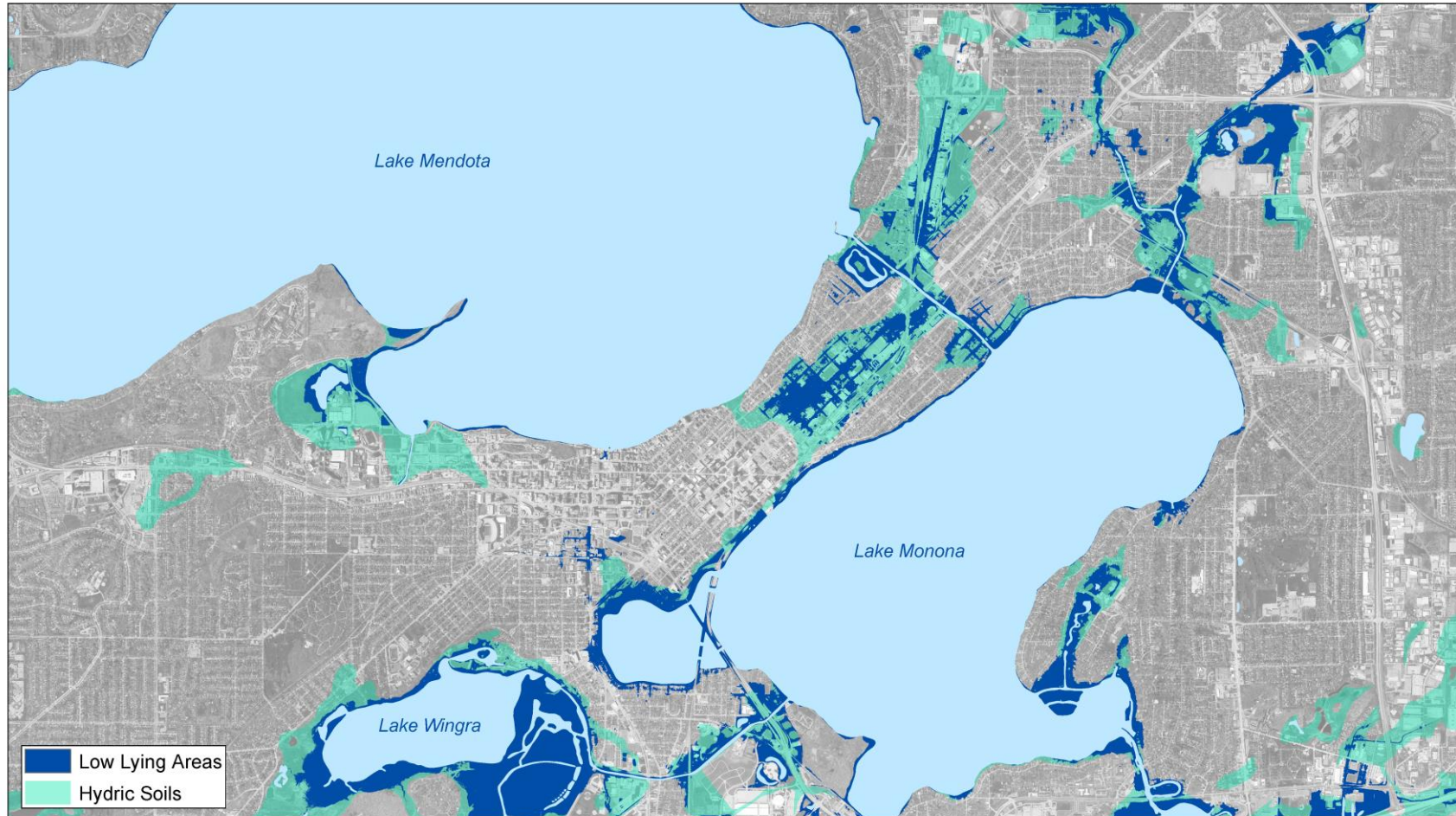
\*KMXR Radar "bias-corrected" using rain gages by Dan B. Wright, PhD



# Why does Madison flood?



# Downtown Flooding

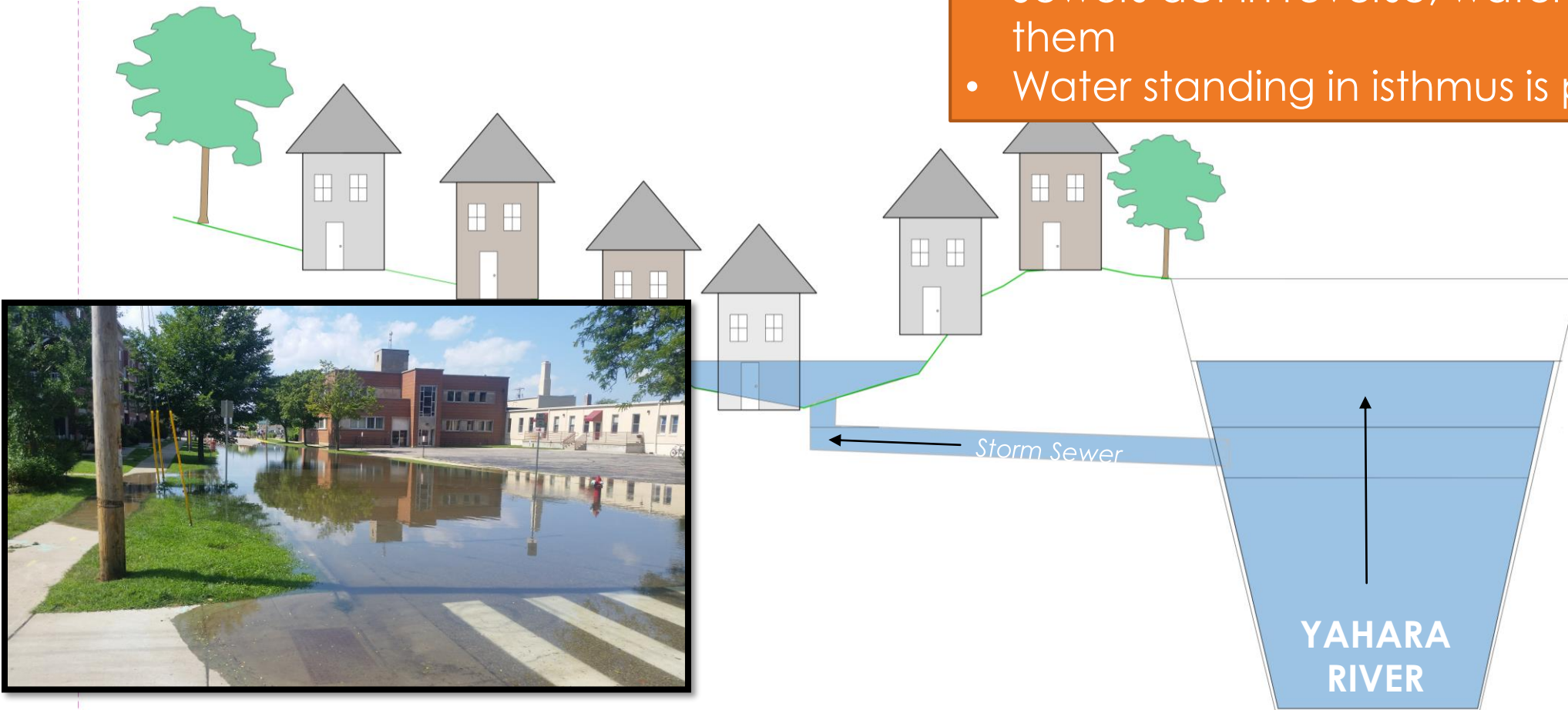


**City of Madison - Current Hydric Soils + Low Lying Areas**



# 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





ROAD  
CLOSED

STOP

STOP

NOW LEASING  
800-579-5019

266-4466  
ID # 1927

Livingston St

Livingston St

SIDEWALK  
CLOSED

BFS

KRAUSE ANDERSON  
Building Strong Relationships  
with the Community

STRONG





# BUDGET

- ▶ The total dollar amount dedicated to flood efforts is \$6.97M.
- ▶ The budget amendment requested \$5.77M, but \$1.2M was shifted from the Coagulant project on Starkweather as that will not happen at the earliest till 2020 and new funds can be requested.
- ▶ Additionally, we have \$900k in the original 2019 citywide flood mitigation project.
- ▶ Resulting in a Total Dollar for flood mitigation is \$7.87M for 2019

# Projects planned – acquisition and construction

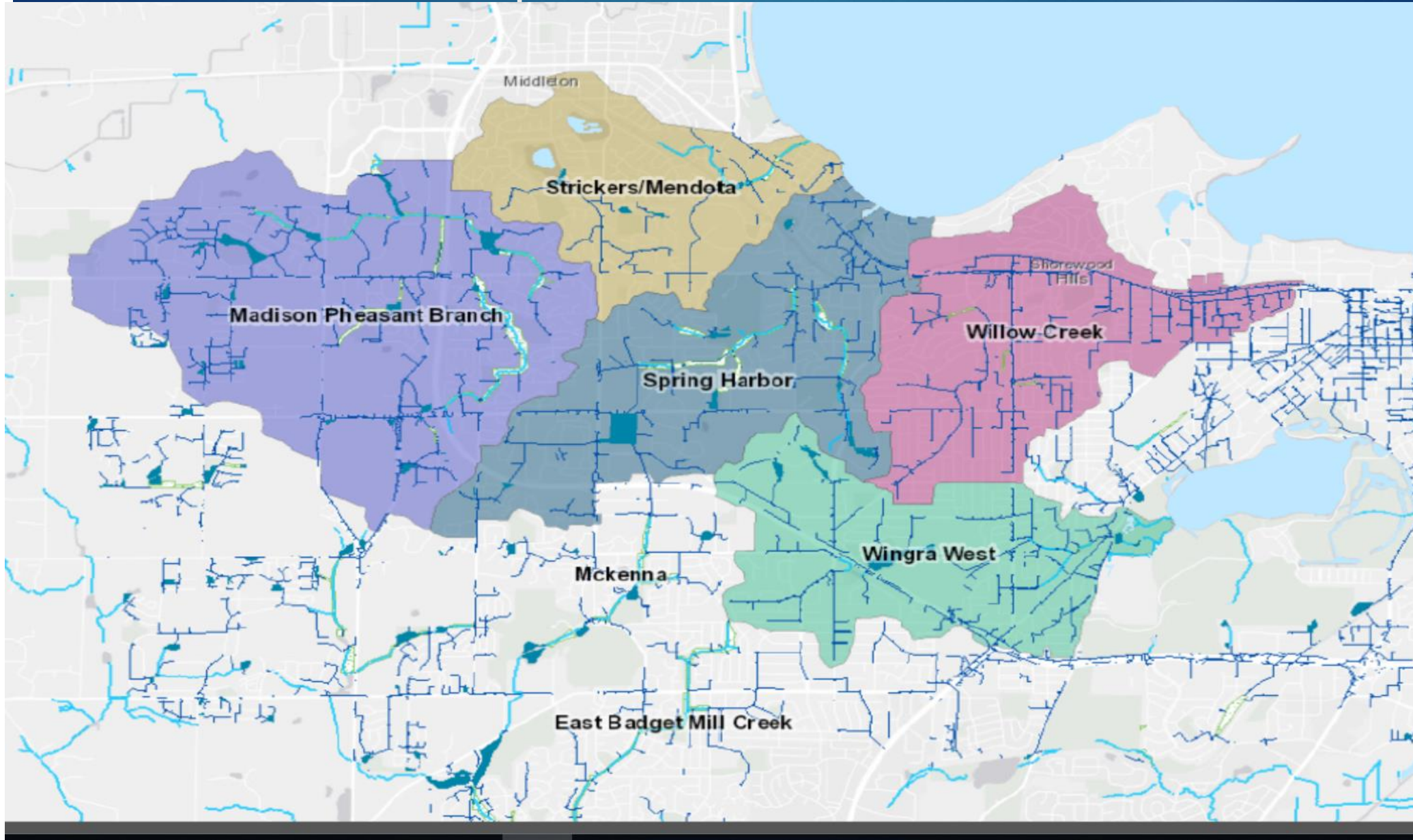
- ▶ Hawks Landing Northern Pond land purchase
- ▶ Midtown Pond expansion land purchase
- ▶ Bram Street property purchase
  
- ▶ FEMA repairs (continued repair of last years emergency repairs (if approved our share is 12.5% = \$525K)
- ▶ Mckenna Blvd and channel reconstruction
- ▶ SW Bike Path Culvert expansion @ Waite Circle



# Projects planned – Studies

- ▶ Dunn's Marsh Watershed Plan
- ▶ Greentree (Upper Badger Mill Creek Watershed) – in house
- ▶ Pheasant Branch Watershed Plan – in house
- ▶ Capital City Bike Path Drainage Study (with Dane Co & Fitchburg)
- ▶ Spring Harbor Watershed Plan - consultant
- ▶ Strickers Pond Watershed Plan - consultant
- ▶ West Lake Wingra Watershed Plan - consultant
- ▶ University Avenue/Willow Creek Watershed Update - consultant
- ▶ MOU with USGS to help us create, install and operate a gauging and monitoring network (flow and rain gauges).

# Watersheds Map



# SO WHAT ARE WE DOING?

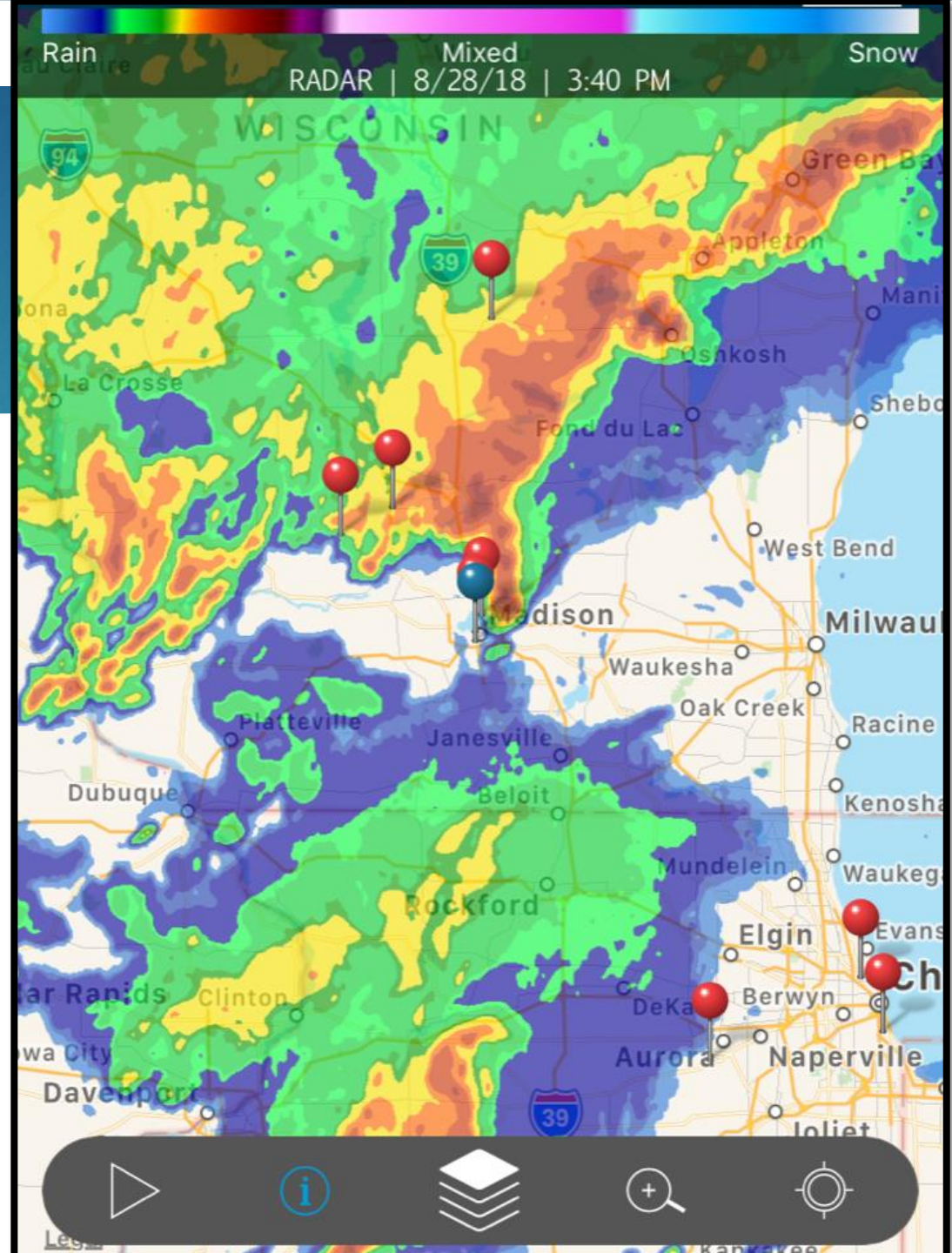
- ▶ So what is Madison doing????
  - ▶ Changes lake level management
  - ▶ Design changes in developing areas to better address flash flood events
  - ▶ Changes to areas affected by lake level flooding – more restrictive heights
  - ▶ Finding solutions to existing problems

# Moving Forward – Lake Level Mngt.

- ▶ Dane Co has put together a technical group to look at options to allow the lakes to be better controlled. This is a technical hydraulics and hydrology look at the system for only flood control.
- ▶ Immediate need – Look at ways to move the water out of Monona, Waubesa and Kegonsa faster.
  - ▶ We already have a problem - we need to get a better way to control existing issues.
- ▶ Long term – Changes to how much water the lakes get during a storm (volume controls/infiltration)
  - ▶ Once we fix #1 we have to find a way not to recreate the problem so in a generation we are not back here with a new group of people at the table and the same exact problems

We had better get better at this:

- ▶ 8/28 Storm just missed Madison – had this hit our watershed all bets would have been off the table.



# Moving Forward – design changes new development.

- ▶ So what is Madison doing????
  - ▶ Ordinance changes to require
    - ▶ The use of a Madison specific IDF curve
    - ▶ require that the developers engineer and City Engineering review how the 100-year event reaches the detention pond.
    - ▶ During the 100-year event no flooding of private property to be allowed (flood contained to ROW).
    - ▶ 500 year to be routed – this event can utilize private property but cannot flood structures on private property
    - ▶ First floor elevations are set and enforced on critical lots

# Moving Forward – downtown elevation criteria.

- ▶ So what is Madison doing????
  - ▶ Prior to this event we had set the lowest entry elevation of any new/redeveloped property in the downtown area prone to backwater lake flooding to 850.75.
  - ▶ This was approximately 0.5 higher than any flood event that had been anecdotally reported to City Engineering.
  - ▶ Good news it worked
  - ▶ Bad news not by much and we were lucky
  - ▶ There continues to be strong redevelopment in the flood prone area.
  - ▶ New elevation is 852.00

# Moving Forward – finding solutions to existing problems

- ▶ So what is Madison doing????
  - ▶ This is obviously the hardest as we have:
    - ▶ Existing pipes
    - ▶ Existing street grades
    - ▶ Existing private structures with potential vulnerabilities.
    - ▶ Easy solutions to just make pipes bigger may be off the table



# Fixing Vs Moving the Problem

## 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

- ▶ What solutions will we look at?

- 1) **Can an improvement in pipe or inlet capacity be made that will rectified the problem?** Is it possible to make this improvement without causing additional damaging flood problems downstream? Will this solution protect the impacted properties in events up to and including the 100 Year Storm? If it is too costly to safely pass the 100 Year Storm, what storm event will this improvement protect the impacted properties to and what is the difference in cost? If not...
- 2) **Is there a problem with the system overflow such** that when the street is overtopped or the pipe system reaches capacity, the excess flow leaves publicly owned lands and damages private property? If so can a physical change be made in the street/channel such that the overland flow can be rerouted to resolve this problem? Will this solution protect the impacted properties in events up to and including the 100 Year Storm? If it is too costly to safely pass the 100 Year Storm, what storm event will this improvement protect the impacted properties to and what is the difference in cost? If not...
- 3) **Is there a means to increase storage/detention upstream** of the problem area that can be implemented to decrease flows in the impacted area? Is there a means to increase storage downstream to temper the increased flows from upstream improvements? Can this project be completed without causing new/additional flooding problems in the areas where the storage is to occur? Will this solution protect the impacted properties in events up to and including the 100 Year Storm? If it is too costly to safely pass the 100 Year Storm, what storm event will this improvement protect the impacted properties to and what is the difference in cost? If not...
- 4) **Is there a solution on private property that would not significantly adversely impact the property owner that could be made at low cost?** Will this solution protect the impacted properties in events up to and including the 100 Year Storm? If it is too costly to safely pass the 100 Year Storm, what storm event will this improvement protect the impacted properties to and what is the difference in cost? If not...
- 5) **Is there a major change that can be made to private property that would resolve the problem** but would negatively impact the homeowner? Examples of this could include but are not limited to: Closing off exposed windows/doors, reconstruction of full exposures from wood frame to concrete walls, construction of berms, retaining walls and flood walls on private property. Will this solution protect the impacted properties in events up to and including the 100 Year Storm? If it is too costly to safely pass the 100 Year Storm, what storm event will this improvement protect the impacted properties to and what is the difference in cost?

# Big Topic issues we are considering:

- ▶ DO WE USE NEW CUSTOM IDF CURVES THAT GIVE PRIORITY TO THE LAST 15 YEARS OF RAINFALL RECORD VS USING THE FULL RECORD AS WAS DONE WITH ATLAS 14?
- ▶ ENCLOSED DEPRESSIONS DESIGNED INTO NEW DEVELOPMENTS OR PRIVATE DEVELOPMENTS MUST STORE 100 YEAR EVENTS BACK TO BACK?
- ▶ DO WE ENFORCE COMPLIANCE WITH ELEVATION MANDATES? PROBLEMS WITH UDC?
- ▶ DOWNTOWN DO WE DRIVE TOWARD VOLUME CONTROL VIA GREENROOFS?
- ▶ DO WE CREATE STORAGE REQUIREMENTS BY WATERSHED?
- ▶ DO WE WORK ON PRIVATE PUBLIC PARTNERSHIPS TO RESOLVE SOME OF THESE ISSUES?
- ▶ DO WE BUY UP HOMES WE CANNOT PROTECT TO A 100 YEAR (WHICHEVER ONE WE CHOOSE ) STANDARD?

QUESTIONS ?