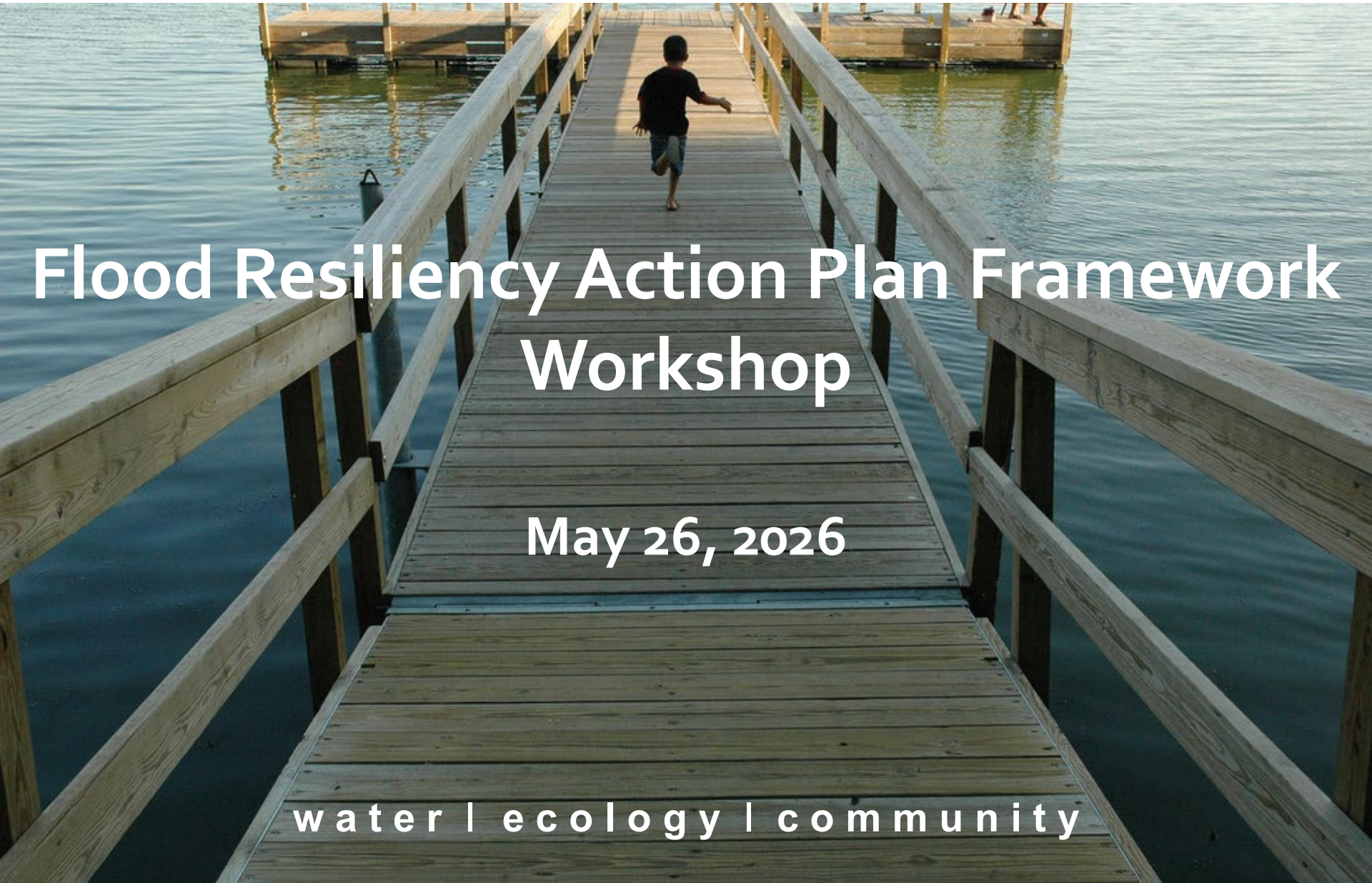
Emmons & Olivier Resources, Inc.

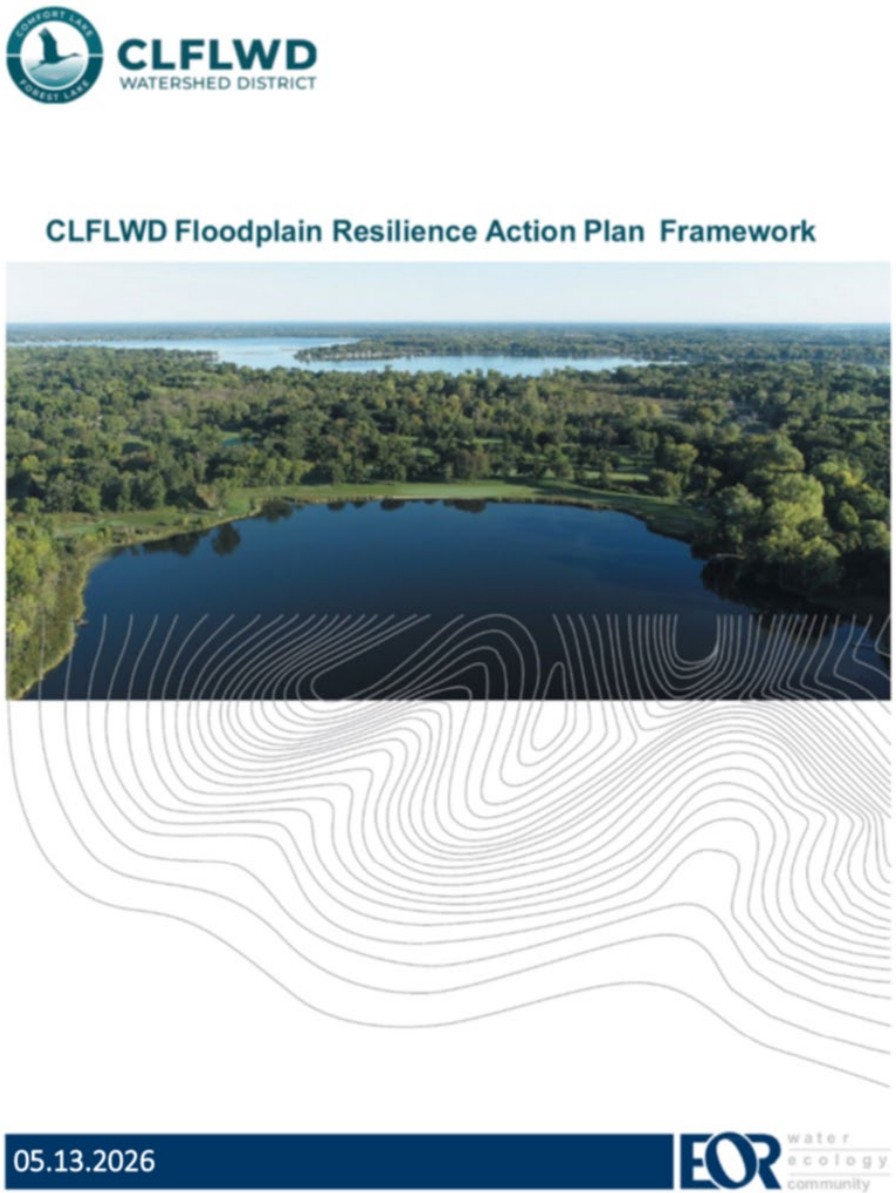


Flood Resiliency Action Plan Framework Workshop

May 26, 2026

water | ecology | community

Project Outline



Part 1- Project Overview

- Project Background
- Project Motivation
- Project Roadmap
- Project Outlook

Part 2 Framework Results

- Modeling Results
- Potential Projects
- Main Anticipated Benefits
- City of Forest Lake Comments
- Next Steps

Project Background

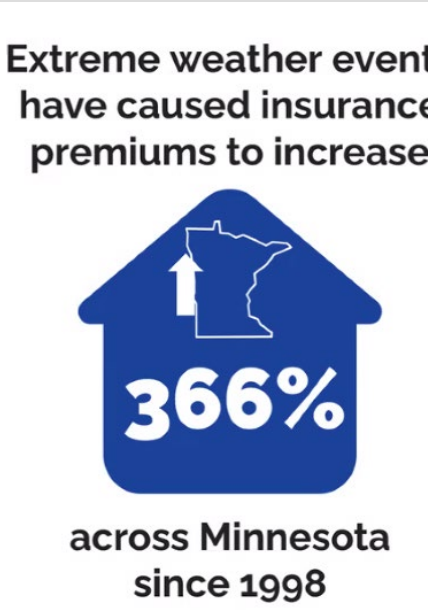
What this project does do?

- Provide a framework for flood planning
- Provide some options for storage projects to meet District goals
- Give the District the most accurate information for priorities for vulnerable infrastructure
- Brings awareness to vulnerable infrastructure under extreme storms
- Provides options for storage projects opportunities with multiple benefits

What this project doesn't do?

- Prescribe jurisdictional floodplain
- Impact permitting
- Lock in projects on developable land
- Impose a floodplain standard
- Update FEMA floodplain maps where floodplain insurance is required

Project Motivation



- Flooding poses a risk to water resources and infrastructure
- Flood Resiliency planning is becoming standard across the state
- Watershed Districts are uniquely suited for long-term flood planning because there are no municipal boundaries
  - Fits the CLFLWD Mission
  - Watershed Management Priority Section 2.3.2
  - Existing goal 99 acre-ft of storage
- Resiliency planning saves money in the long-term
  - Reactive approach is 8-15X more expensive than a proactive approach

Project Roadmap and Timeline

- **1961-2013 - NOAA Technical Paper 40:**
  - 5.9-in, 24 hour 100-yr Rainfall depth (1% AEP)
  - Published in 1961, this relied on limited station data
- **2013 - NOAA Published Atlas 14 (A-14):**
  - 6.95-in., 24-hr, 100yr rainfall depth (1% AEP)
  - Developed 2005 - 2013 - included 50 more years of data
- **2014-2016: Adoption of Atlas 14**
  - MnDOT required A-14 for hydraulic design in June 2014
  - FEMA and MN Watershed adopted A-14 as the standard
  - Watershed Districts (including CLFLWD) begin requiring A-14 for development permitting
- **2016-2019: Non-stationary rainfall and Resiliency Discussions began**
  - Agencies noticed a trend in the data showing increasing extreme events: 11 of 16 Historic mega-rain events from1970-2021 occurred between 2000-2021 (2.5x more common during the 21st century)
- **2022 - 2026:** Atlas 15 expected to be published in September 2026

Project Roadmap and Timeline

- **June 9-10, 2002 northern Minnesota**

  48 hour rainfall totals topped 12 inches in a some areas of Roseau and Lake of the Woods counties.

- **June 22-23, 2002 northern Minnesota**

  This event was so large, two different parts of northern Minnesota met the mega-rainfall definition used here.

- **September 14-15, 2004 southern Minnesota**

  More than ten inches of rain fell in a 36 hour period in Faribault and Freeborn Counties.

- **September 24-25, 2005 southern Minnesota**

  Thunderstorms raged along I-90, with 8-9 inches of rain in Fairmont and Winnebago. This event became the latest (on the calendar) mega-rain on record, but held that title for just 11 days (see next).

- **October 4-5, 2005 east-central Minnesota**

  This exceptional event produced six-inch-or-greater totals over Pine City, North Branch, and Cambridge, as well as over parts of the Twin Cities, becoming the new (and current) title-holder for the latest mega rain on record in Minnesota.

- **August 18-20, 2007 southeastern Minnesota**

  Although the 1867 storm detailed above likely produced higher totals, the 15.10 inches measured one mile south of Hokah stands as the official record for 24-hour rainfall at a Minnesota National Weather Service Cooperative station. The three day total for this station was 16.27 inches.

- **September 22-23, 2010 southern Minnesota**

  The National Weather Service site in Amboy measured 9.48 inches on September 23, with 10.68 inches for the event.

- **June 19-20, 2012 northeast Minnesota**

  The two day total at Duluth was 7.24 inches. The St. Louis River at Scanlon set a new record crest at 16.62 feet, rising 10 feet in 24 hours.

- **July 11-12, 2016, east-central Minnesota**

  Extreme rainfall affected a swath from the Brainerd Lakes area, eastward into Pine County (and also well into Wisconsin). Cloverton in Pine county recorded 9.34 inches.

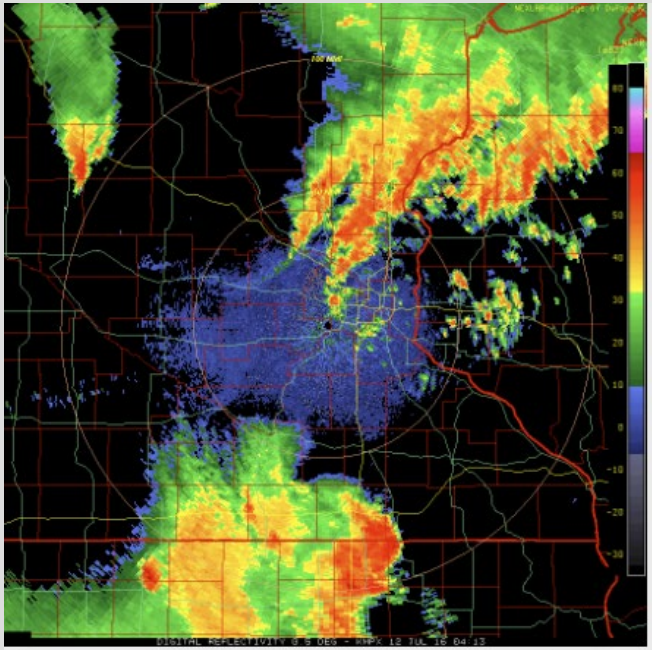
- **August 10-11, 2016, central Minnesota, southeastern Minnesota**

  Two distinct areas received over 6 inches of rainfall: one near Willmar, and another in Wabasha County. The highest total of 9.74 inches was recorded just east of Willmar.

- **July 25-26, 2020, southern Minnesota**

  Repeat thunderstorms pounded southern Minnesota, producing up to 8.65 inches near Mankato, with potentially more from near Fairfax to Winthrop, and at least 6 inches from St. Peter to Morristown.

Historic mega-rain events in Minnesota | Minnesota DNR

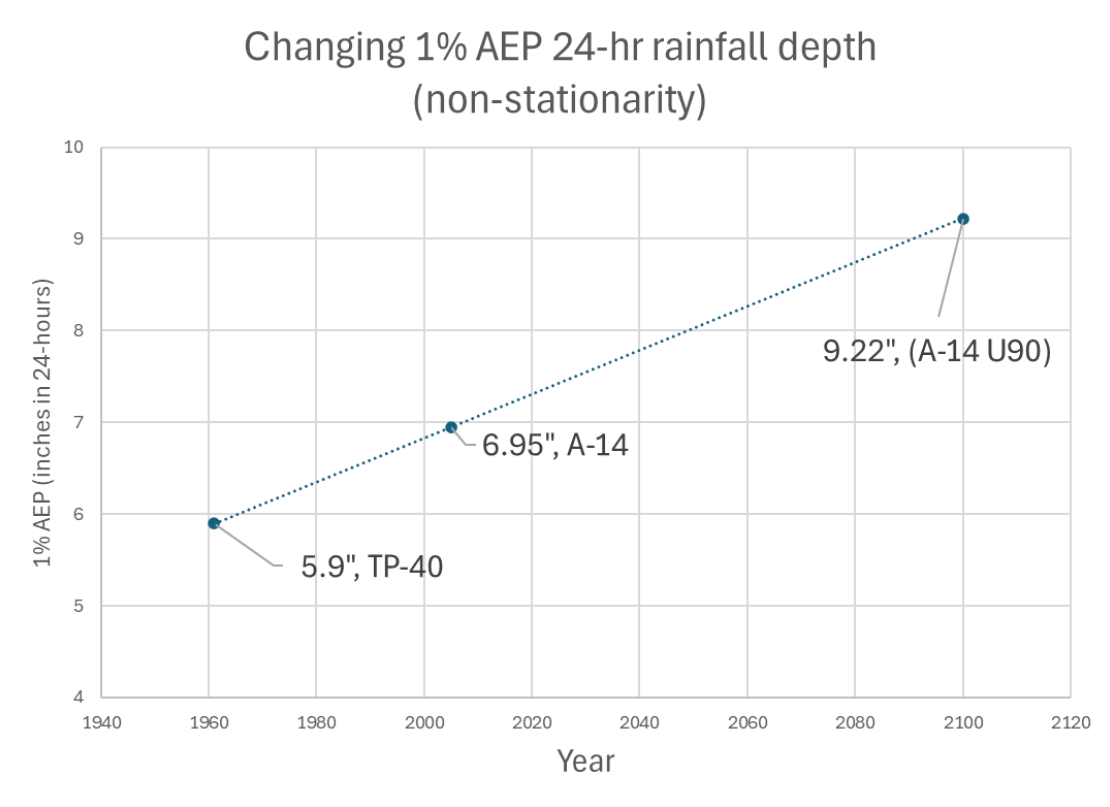


6-hour radar loop showing only part a widespread extreme rainfall event that affected eastern Minnesota and northwestern Wisconsin on July 11-12, 2016. This storm event covered thousands of square miles with excessive rainfall totals and qualifies easily as a "Mega-rain."

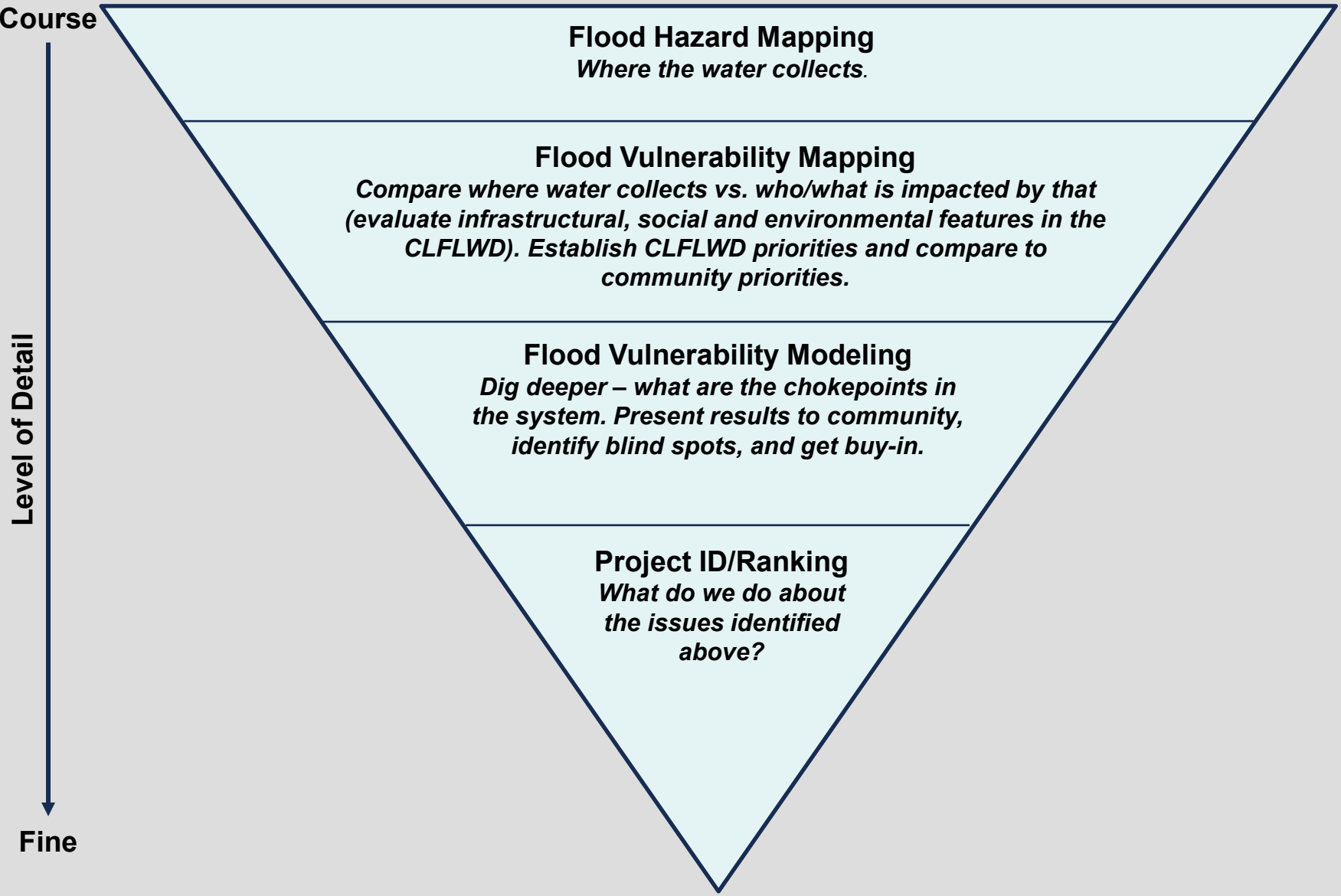
Radar source: College of DuPage

Project Roadmap and Timeline

- **Resiliency Studies using Atlas 14 Upper-90th**
  - As agencies noticed that the 1% AEP is non-stationary, they started using estimates for future precipitation depths
  - Atlas 14 looked at 1900-2010 data, while Atlas 15 will look at 2010-2023 data and include future (2100) projections



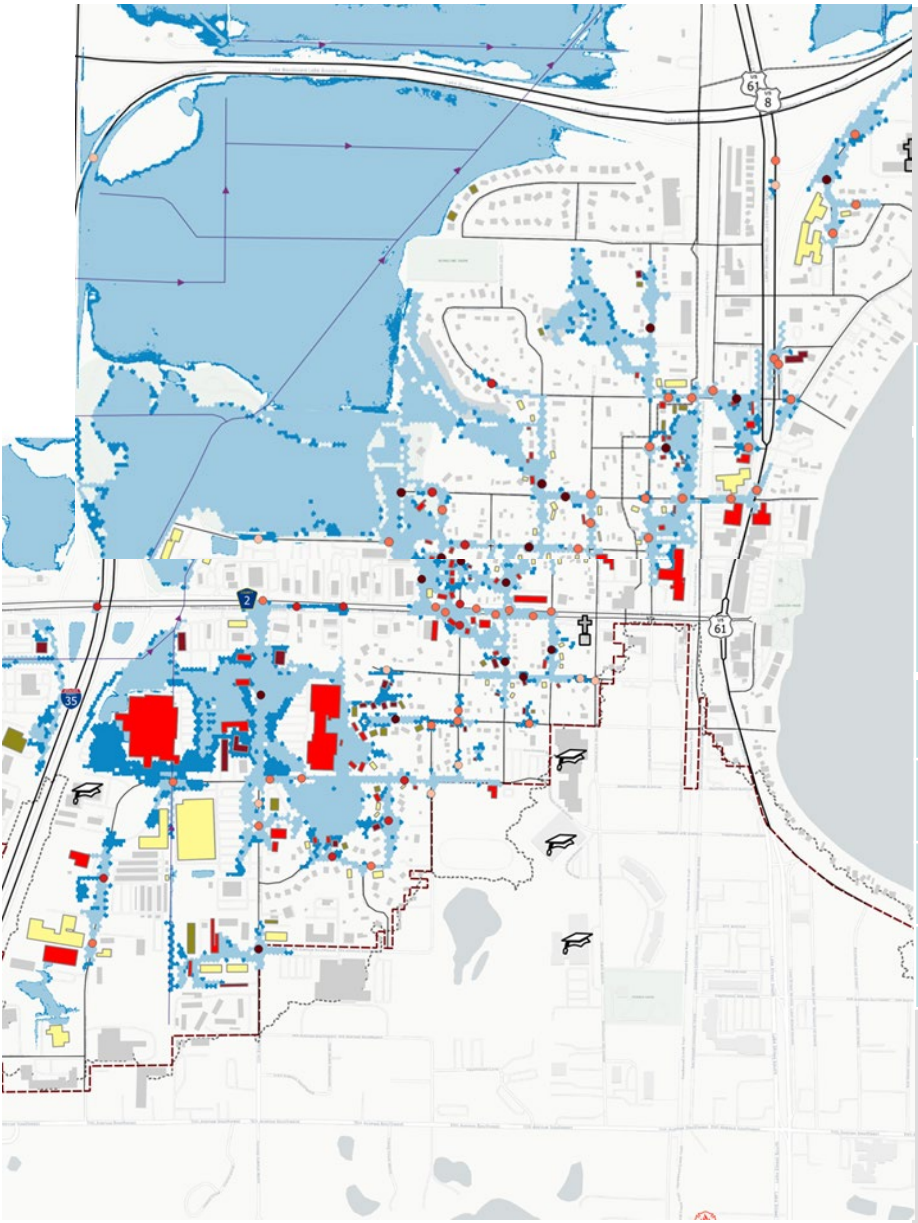
Project Roadmap



Project Outlook

- This is a framework for future planning to be proactive not reactive
- Have a grant in hand to further investigate the projects concepts outlined in the framework
- This framework has a long shelf life and should be finalized to make progress on District goals
- Future use of the framework – short, medium, and long-term solutions including projects and policies

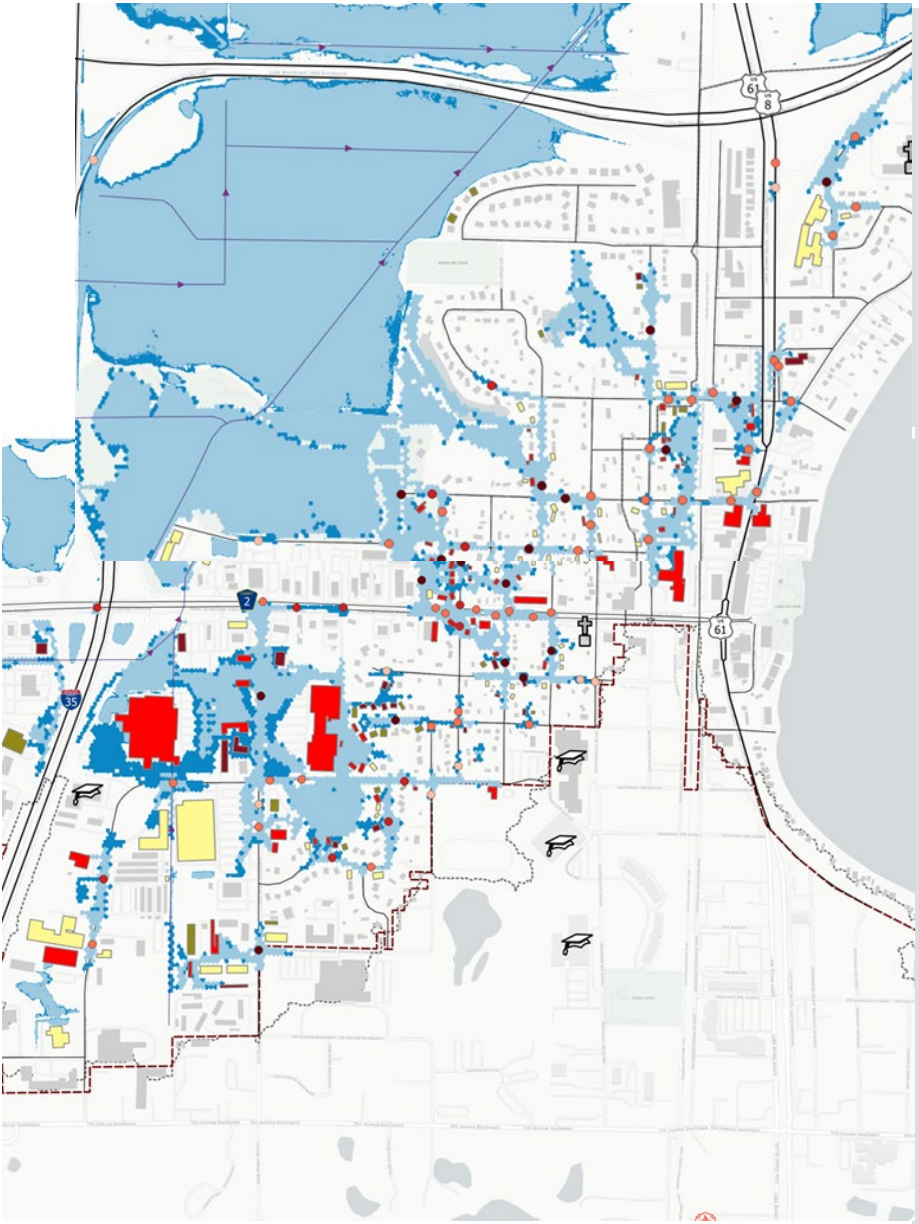
Results – Infrastructure/Roads



- No critical infrastructure (stations, fire, police, water towers, schools)

Rainfall Event	Number Roadways Flooded		
	Forest Lake Urban + SR Corridor + Little Comfort South area	Shields Lake Drainage Area	Total
Present 10-year	18	5	23
Future 10-year	24 (+6)	8 (+3)	32 (+9)
Present 100-year	39	13	52
Future 100-year	48 (+9)	16 (+3)	64 (+12)

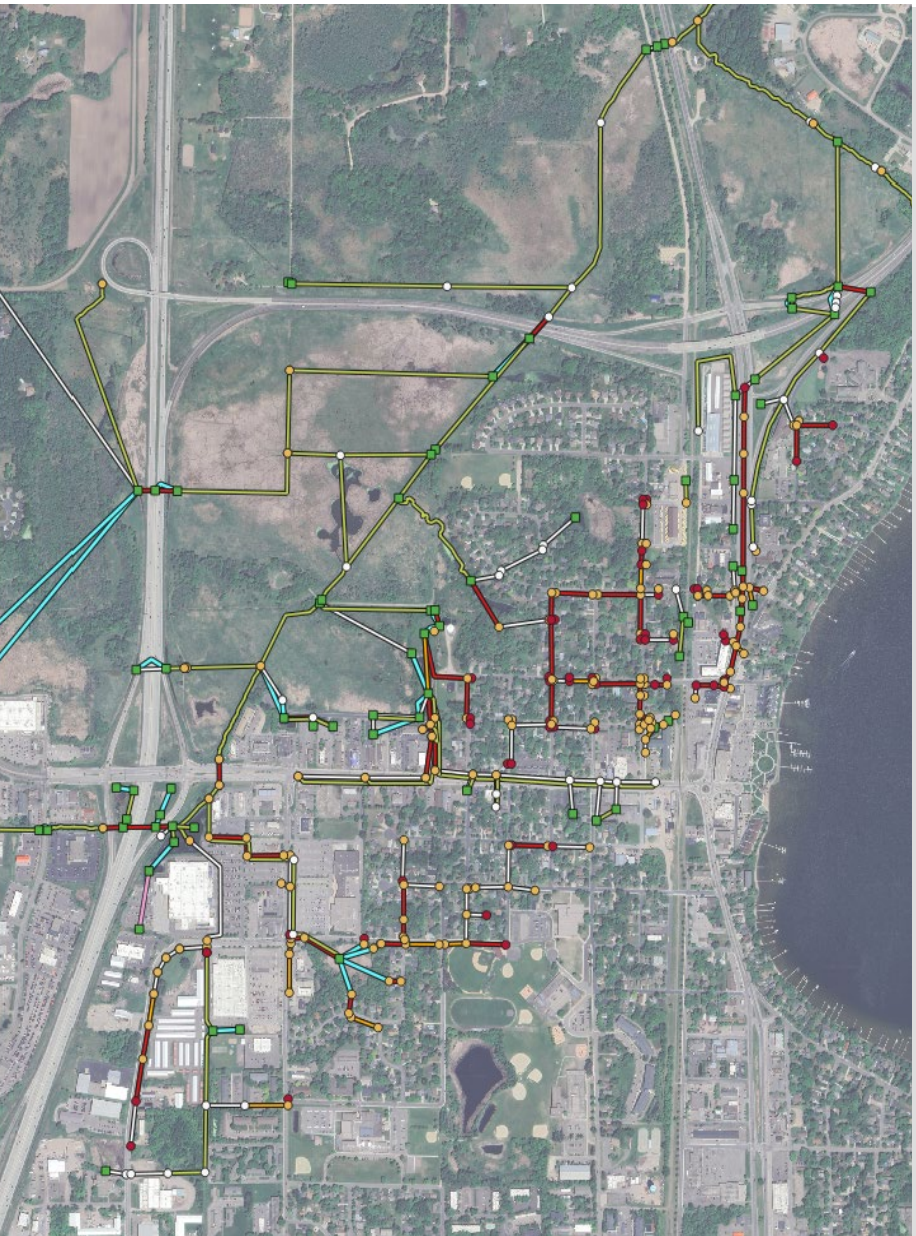
Results – Buildings & Streams



100-year Rainfall Event	Number Structures Flooded		
	Forest Lake Urban + SR Corridor + Little Comfort South	Shields Lake Drainage Area	Total
Likely Flooding (Present Precip.)	75	2	77
Likely Flooding (Future Precip.)	104 (+29)	5 (+3)	109 (+32)
At Risk Flooding Buffer < 15' (Present Precip.)	155	9	164
At Risk Flooding Buffer < 15' (Future Precip.)	194 (+39)	35 (+26)	229 (+65)

- Sunrise River + Some Urban Ditches + Some Lateral Channels (Peak-flow velocities > 15%)

Results – Network Limitations

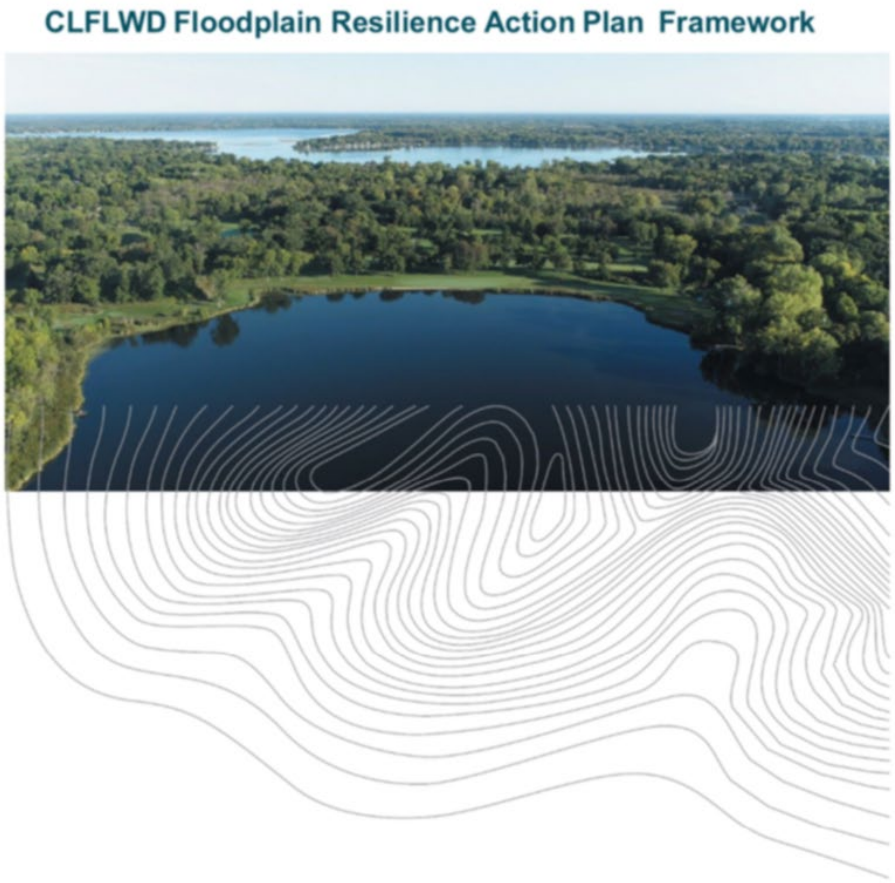


Rainfall	1-2 ft. Diameter Pipes		> 2ft. Diameter Pipes	
	1 hour	2 hours	1 hour	2 hours
Pres. 10-yr.	**28**	20	**17**	15
Future 10-yr.	**39**	23	**22**	18

Rainfall	Surcharged CB/Manholes		
	10 mins	30 mins	1 hours
Present 10-year	**41**	9	3
Future 10-year	**50**	16	3

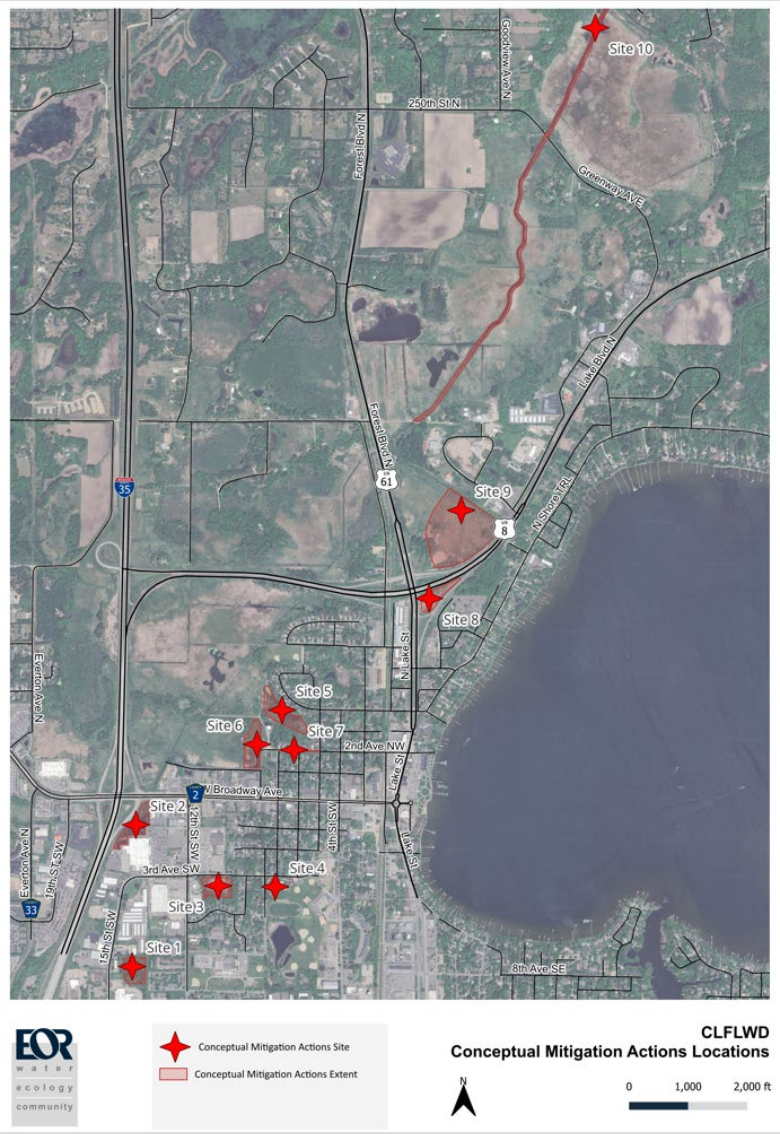
- Current standard = 10-yr. event
- Template for upgrade priorities
- Pipe/junctions' limitations = Local Flooding

Overall Conclusions



- Stormwater network undersized for current standards
- No critical infrastructure affected by flooding
- There is a significant increase in the number of buildings and roadways flooded under future rainfall scenarios
- An increase in Sunrise River flow and velocity (>15%) is estimated under future conditions if no action is taken
- Proposed actions will significantly mitigate anticipated flood impacts
- Role identification, coordination & buy-in from cities, counties, MNDOT, and landowners are key

Potential Mitigation Actions and Opportunities



Potential Mitigation Actions

- Storage expansion opportunities identified throughout Forest Lake and Wyoming
- Prioritized city stormwater infrastructure maintenance/upgrades
- Public outreach campaign and small-scale residential project incentives
- City of Forest Lake provided detailed commentary on proposed mitigation actions and potential mitigation sites

City of Forest Lake Comments

- Refrain from adjusting regulations so as not to hinder development or city projects
- Preserve developable land (i.e., no projects that could potentially impact areas that are buildable)
- Any flood storage projects constructed on city-owned land should be eligible for stormwater credits for city roadway projects and/or developers
- Supportive of CLFLWD projects downstream of City boundaries and on MnDOT right-of-way
- City requested responses to four specific questions/comments regarding regulations and potential project timelines/funding sources/stormwater credits

Framework Next Steps

With an agreed upon framework, we can begin:

- Working with the city to implement their needs into the areas and sites we identified as potential mitigation areas;
  - Incorporate stacked benefits (flood mitigation, water quality, and volume control)
  - Identify additional nature-based, resilient solution in the Sunrise River corridor (i.e. Hwy 61)
- Implementing additional short-term mitigation actions identified in the framework
  - Explore Green Infrastructure retrofits opportunities in urban areas
  - Work with cities to adopt updated stormwater management rules
  - Work with the City of Forest Lake to prioritize stormwater infrastructure maintenance (e.g. pipes, ditches)
  - In coordination with cities develop flood reduction community outreach plans and incentives.
- Planning and Implementing long-term mitigation actions
  - Continue to monitor Atlas 15 updates and resiliency guidance for incorporation during future design and planning
  - Work with the City of Forest Lake to identify and repair/replace key under capacity stormwater pipes to achieve 10-year standard of service.

Highway 61 Wetland is a good example

Sunrise River/Highway 61 Wetland Restoration Project
26 ac-ft of floodplain storage toward 99 ac-ft goal
22 acres habitat restoration
90 lbs/yr TP removal

Next assessment phase:

- Help target WHERE to add the needed 99 acre-feet and implement other mitigation strategies with stacked benefits
- As of now we've achieved 40 ac-ft out of the 99 ac-ft goal by implementing projects with multiple benefits
  - Primarily water quality improvements
  - Also created flood storage, wildlife habitat, groundwater conservation, etc.

Conclusion

- Flooding poses a risk to water resources and infrastructure
- Provide a framework for flood planning
- Resiliency planning saves money in the long-term
  - Reactive approach is 8-15x more expensive than a proactive approach
- Provides options for storage projects opportunities with multiple benefits
- Future use of the framework – short, medium, and long-term solutions including projects and policies
- Have a grant in hand to further investigate the projects concepts outlined in the framework