North Central Texas Council of Governments

Building Water Resilient Communities in North Texas

NCTCOG Webinar
August 15, 2023

Prepared in cooperation with the Texas Commission on Environmental Quality and U.S. Environmental Protection Agency

Alyssa Knox, NCTCOG
aknox@nctcog.org

North Central Texas Council of Governments Environment & Development

www.nctcog.org/WaterResources

Procedures for Webinar

- The webinar is being recorded and will be posted to NCTCOG's website under the green banner called "Webinars" here:
- https://www.nctcog.org/envir/natural-resources/water-resources
- If you submitted a RSVP for this webinar, you will receive an email with the presentation slides, and eventually, a link to the recording. If you did not RSVP and would like these webinar materials, please email aknox@nctcog.org.
- Please keep your microphone on mute until the Question-and-Answer period at the end of each presentation.
- Thank you!

Webinar Agenda

- Welcome and Introduction of Speakers
  - **"Regional Flood Planning and the Assessment of Future Conditions"-** Glenn Clingenpeel
  - **"Green Stormwater Infrastructure for Urban Flood Resilience: Opportunity Analysis in Dallas, Texas"-** Dr. Kathy Jack and Dr. Fouad Jaber
  - **"How Regional Water Planning Groups Plan for Drought Resilience in an Uncertain Future"-** Kevin Smith
- Time for Q & A after each presentation

Speaker Introduction

Glenn Clingenpeel

- Executive Manager of Technical Services & Basin Planning for the Trinity River Authority

- Chair of the Trinity River Regional Flood Planning Group

NCTCOG Building Water Resilient Communities in North Texas

August 15, 2023

Trinity River Authority of Texas
Enriching the Trinity basin as a resource for Texans

Agenda

1. Origin and Overview of State Flood Planning

2. Region 3 Flood Planning Group

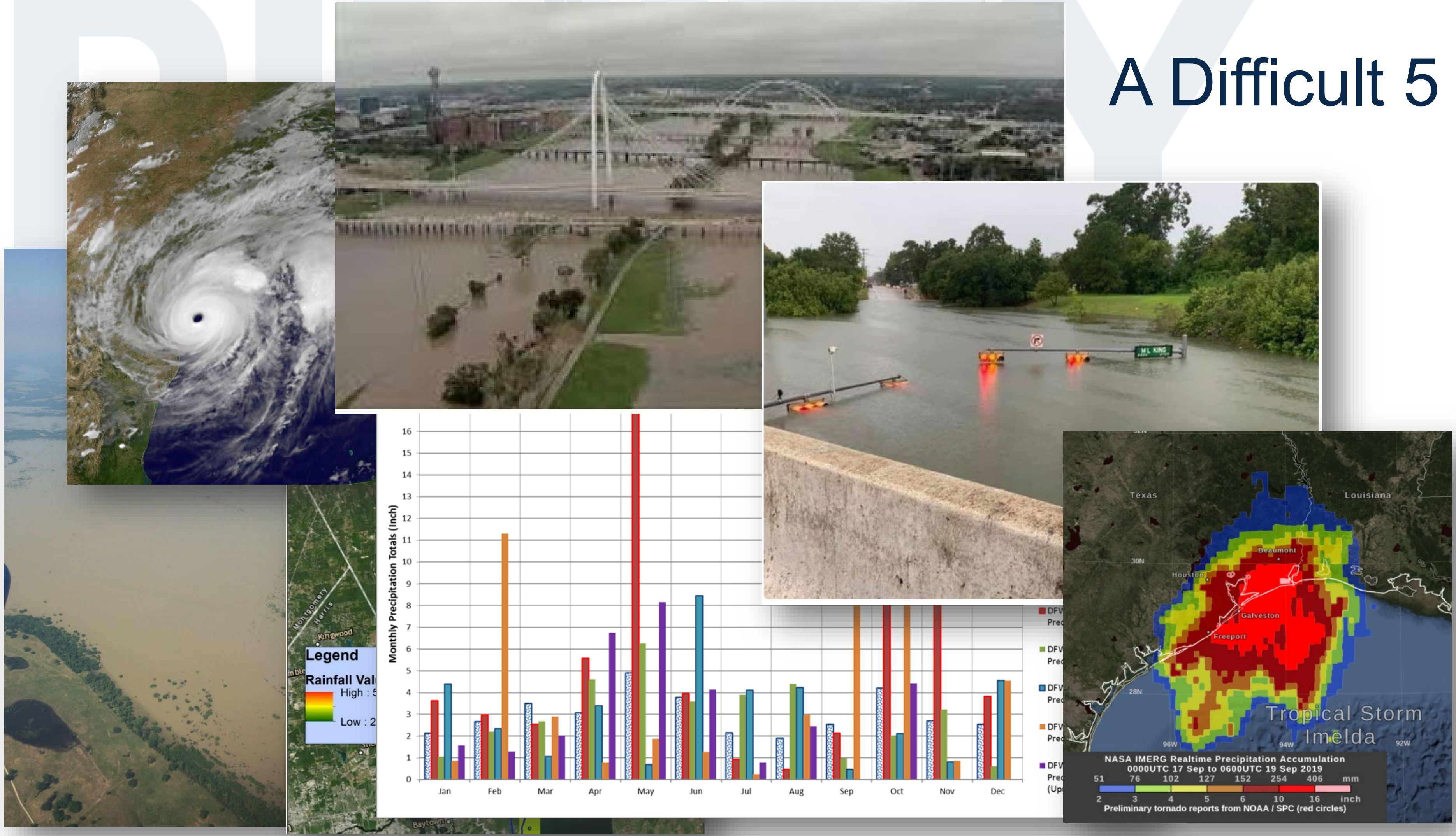
3. Region 3 Flood Plan

4. Amended Flood Plan

REGION 3 TRINITY
REGIONAL FLOOD PLANNING GROUP

Texas Drought 2011 - 2014

A Difficult 5 Years



2015 -2016

2017

2018

2019

State Legislature Reacts

- In 2019 Texas Legislature passed SB 8 to established the first-ever State Flood Plan
- SB 8 charged the TWDB with developing, implementing and overseeing the process
- Regional flood planning is similar to the regional water planning process

REGION 3 TRINITY
REGIONAL FLOOD PLANNING GROUP

First-ever Regional Flood Plan for Texas’ Trinity River Basin Underway

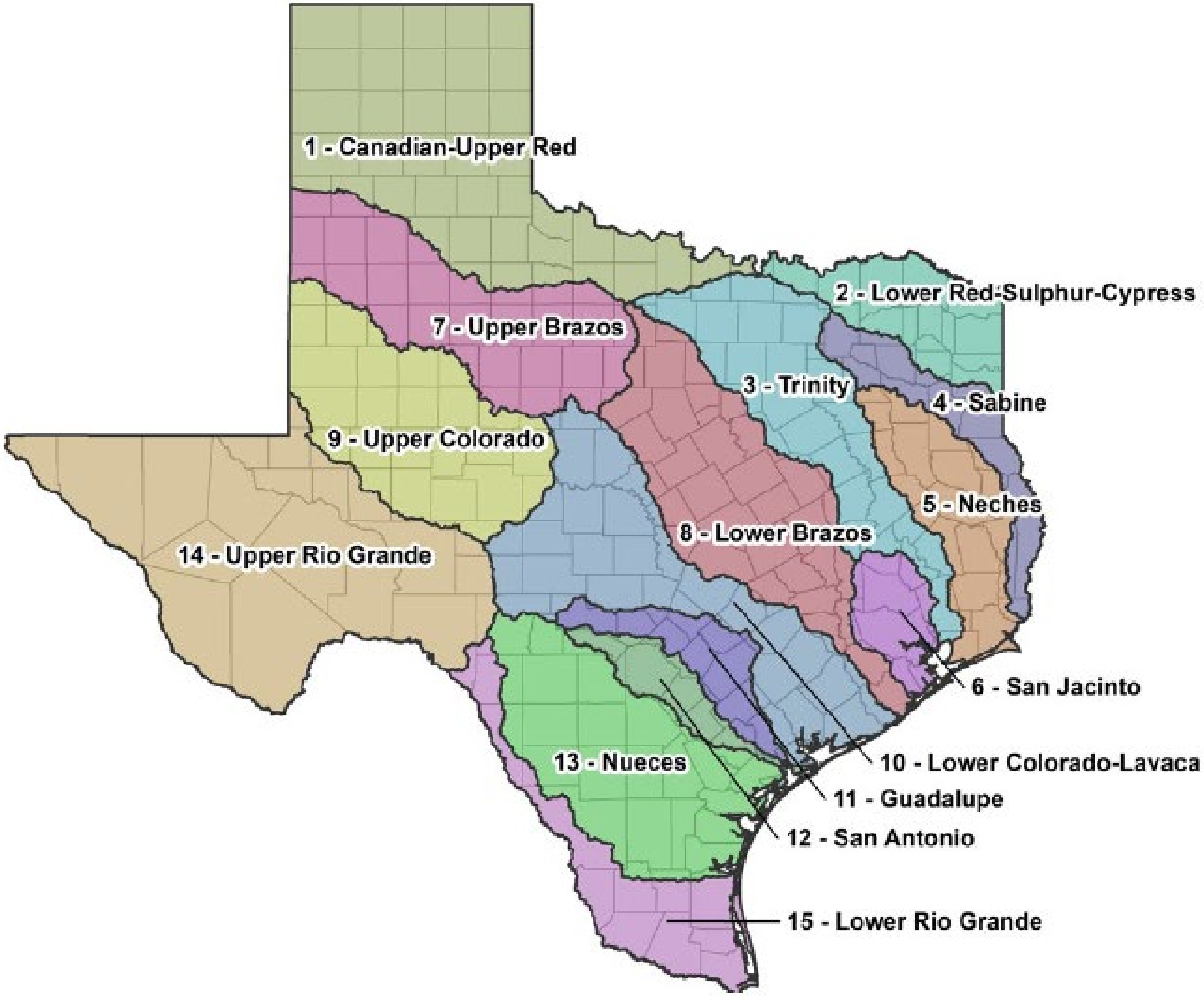
- Bottom up approach

- The Trinity RFPG is among 15 regional flood planning groups designated in April 2020

- This group’s plan will then become part of Texas’ first-ever State Flood Plan

Flood Planning

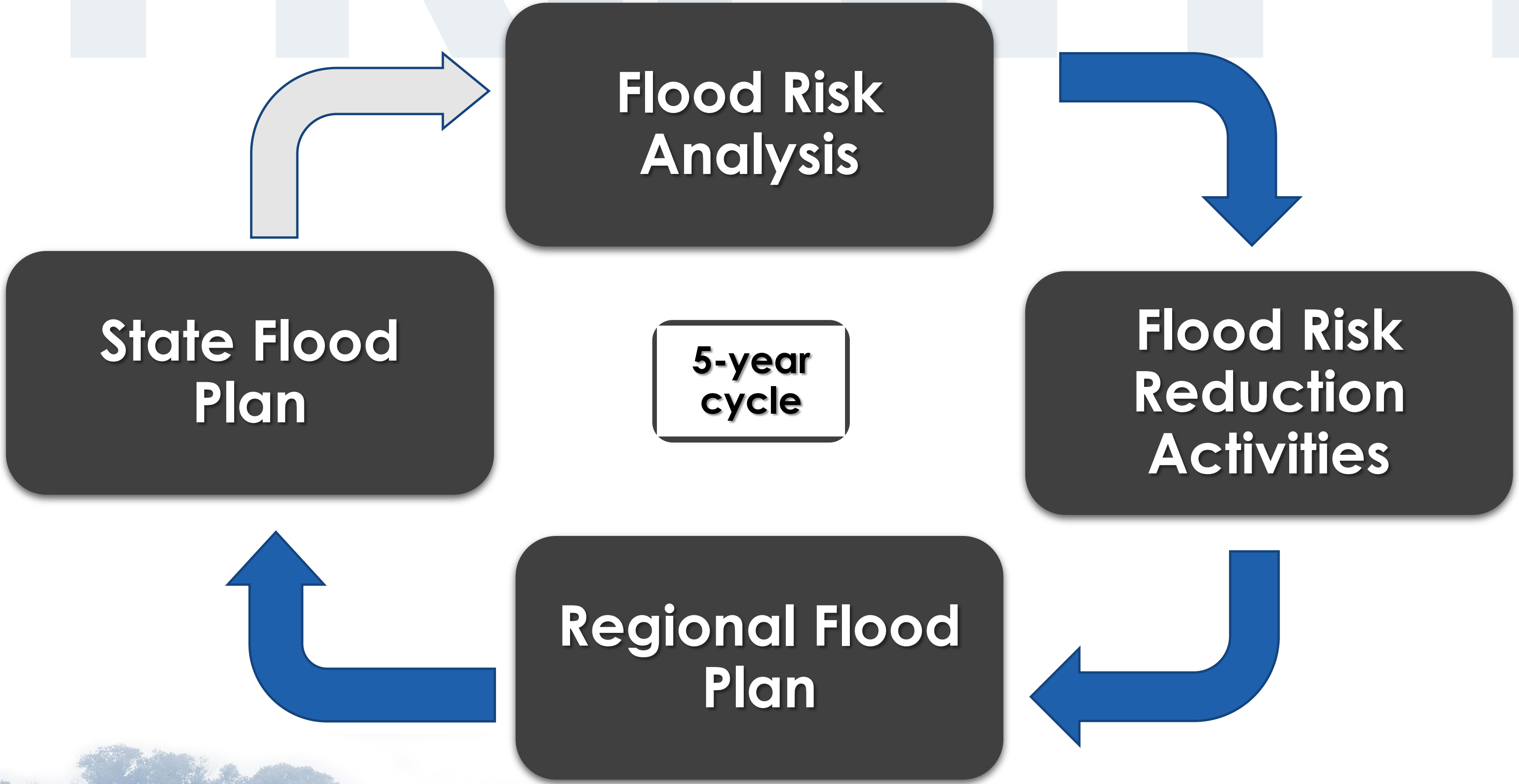
- 15 Flood Planning Regions
- Trinity Basin is one region – Region 3



Flood Planning Process - Summary

- Determine Current and Future Flood Risks
- Determine Measurable Goals
- Evaluate and Propose Risk Reduction Actions
- Compile into a regional report that will be combined into a single, state-wide document

Regional Flood Plan Cycle



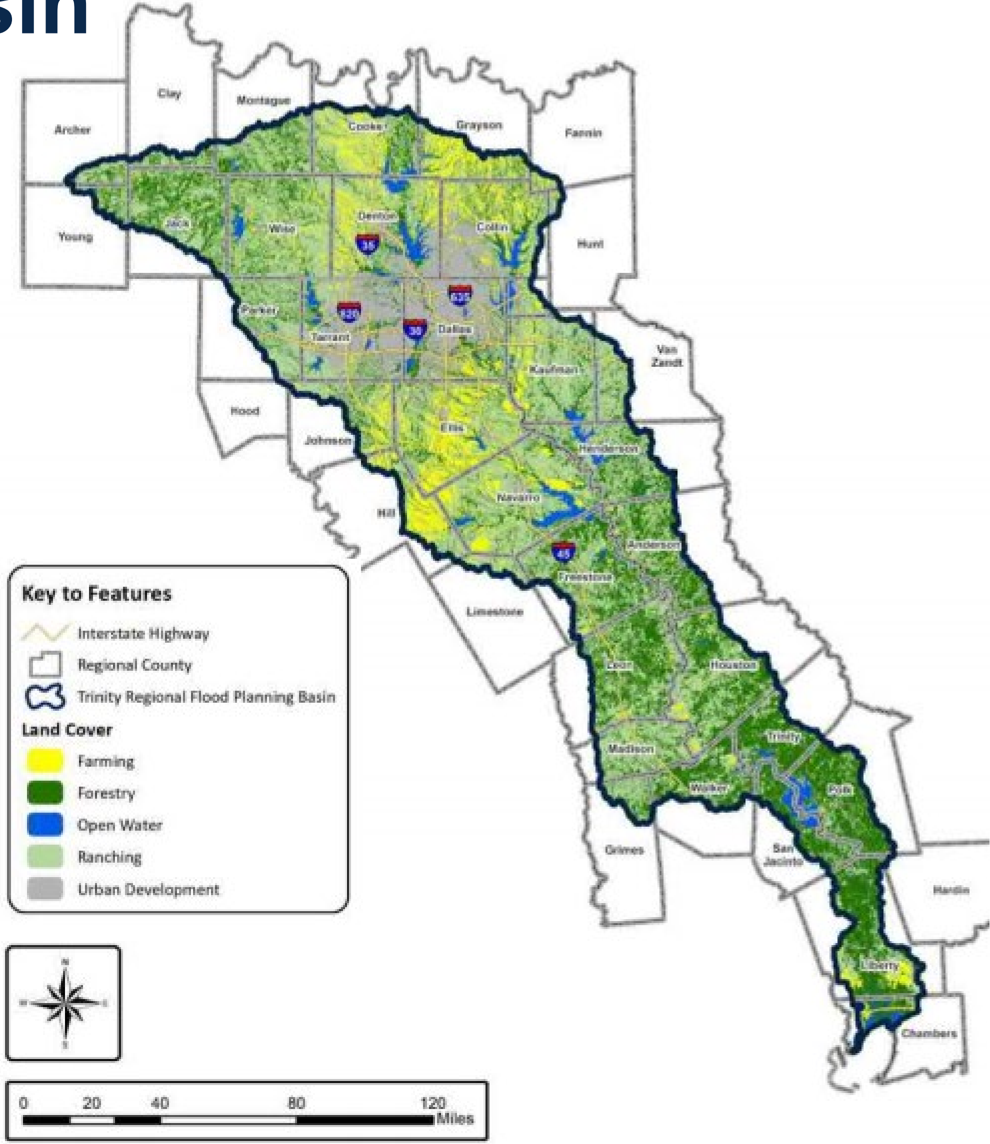
The initial RFPs shall be delivered on or before January 10, 2023

The initial SFP shall be delivered on or before September 1, 2024

REGION 3 TRINITY
REGIONAL FLOOD PLANNING GROUP

Region Three, the Trinity River Basin

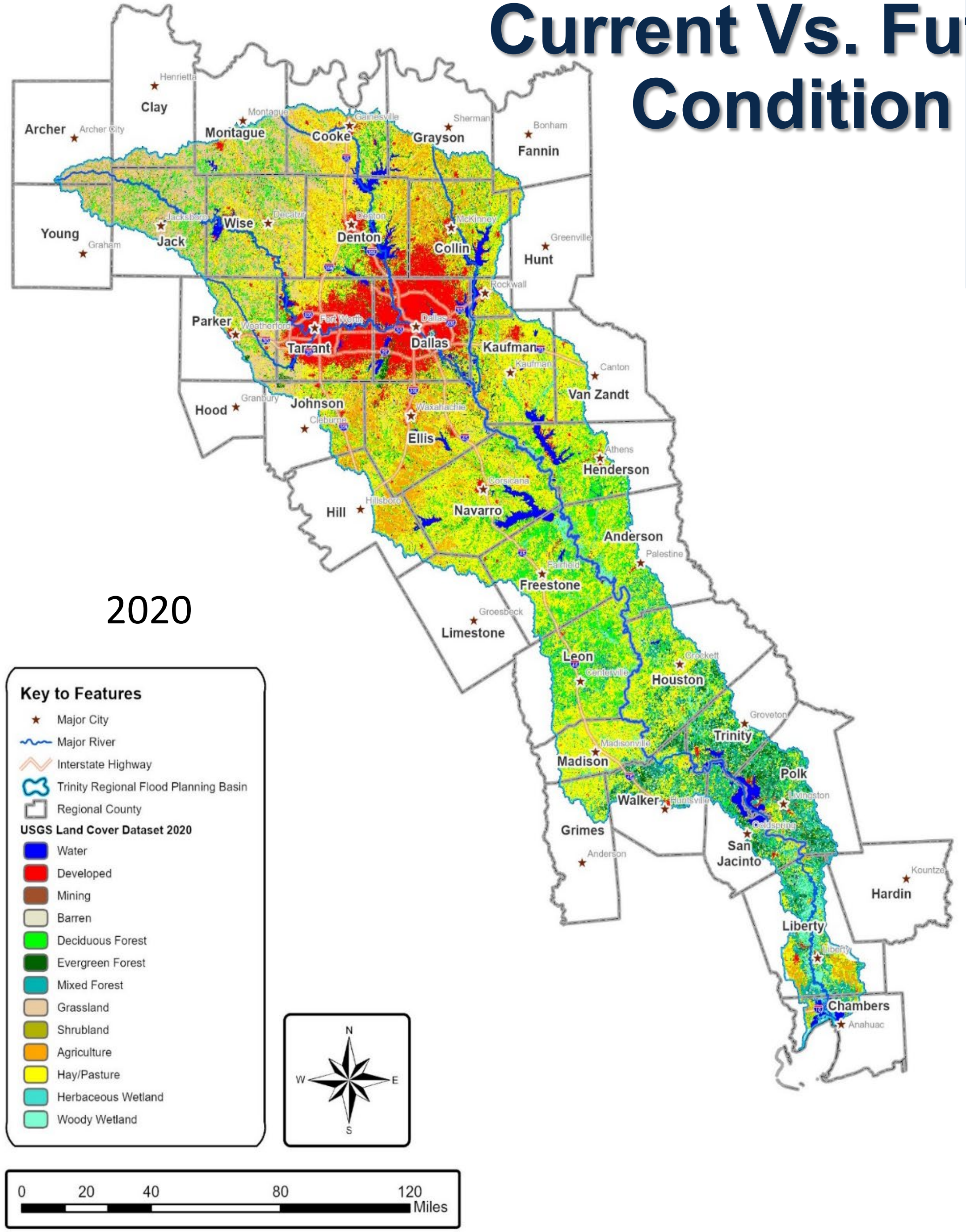
- App. 18,000 mi2
- Dallas-Fort Worth-Arlington SMA, population app. 7.8 million people
  - Service/Tech industry heavy economy
- Middle and lower basin important agricultural areas
  - Row crops in Blackland prairies
  - Ranchland in middle Trinity
  - Rice in lower Trinity



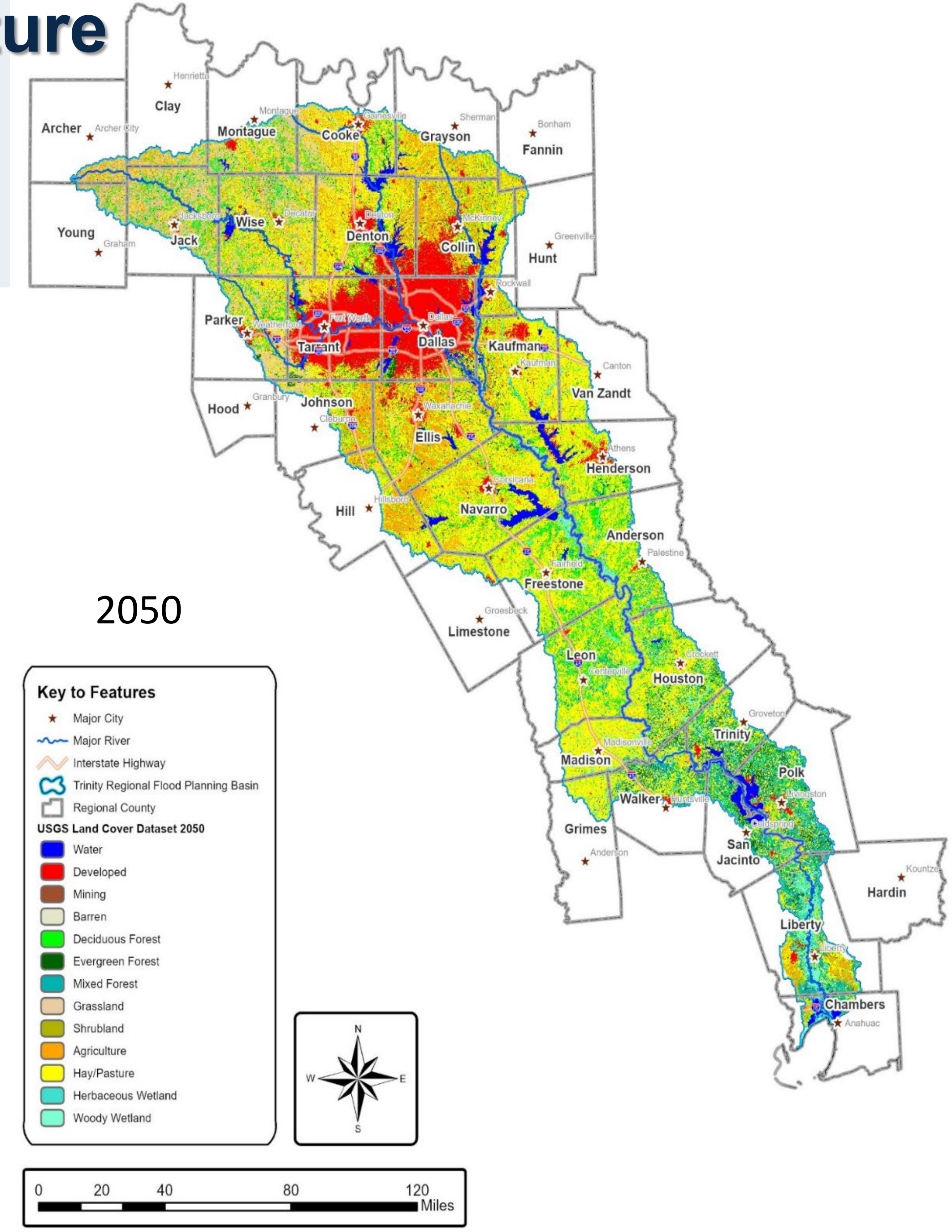
REGION 3 TRINITY
REGIONAL FLOOD PLANNING GROUP

Current Vs. Future Condition

2020

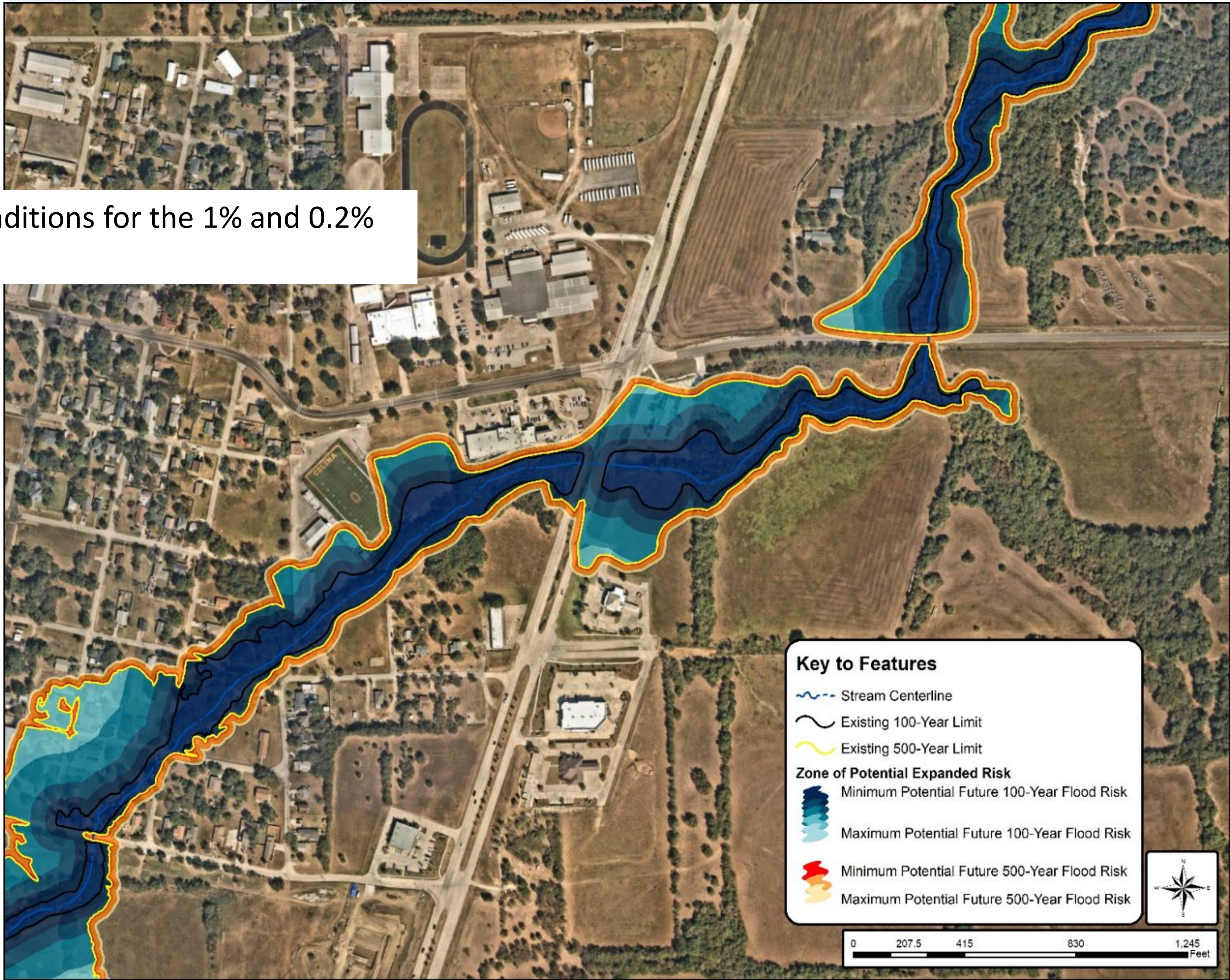


2050



Future Flood Risk Analysis

Used a range of possible future conditions for the 1% and 0.2% annual flooding.



<u>1%</u>

Minimum: Current 1%
Maximum: Current 0.2%

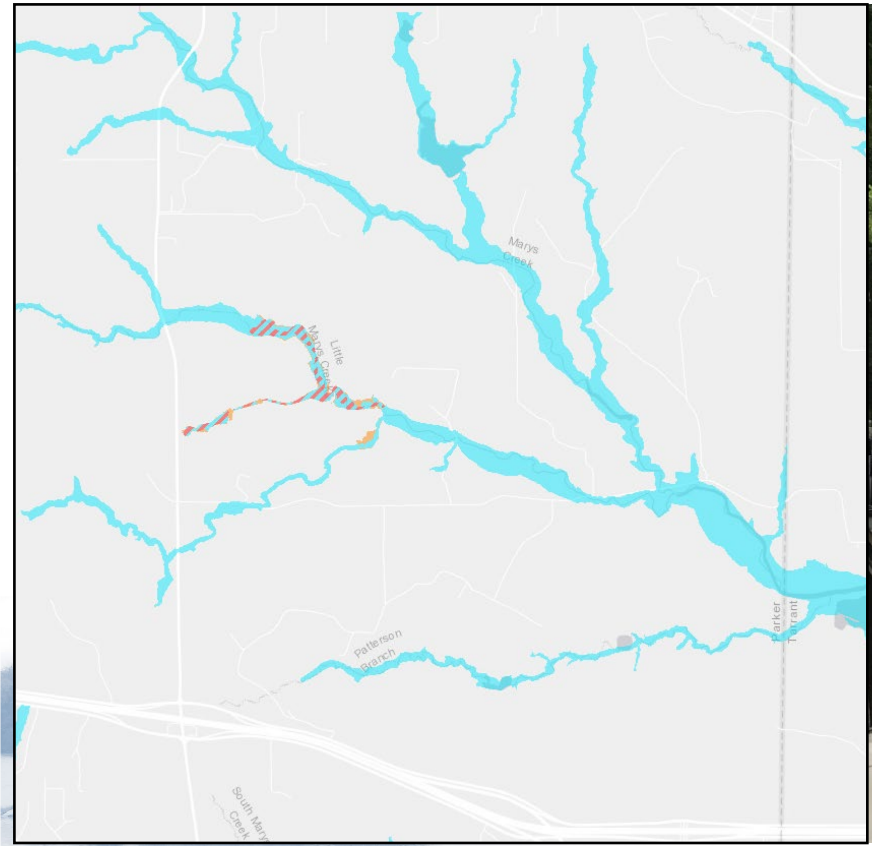
<u>0.2%</u>

Minimum: Current 0.2%
Maximum: Current plus 40 ft.

Recommendation of Flood Management Evaluations, Strategies and Projects

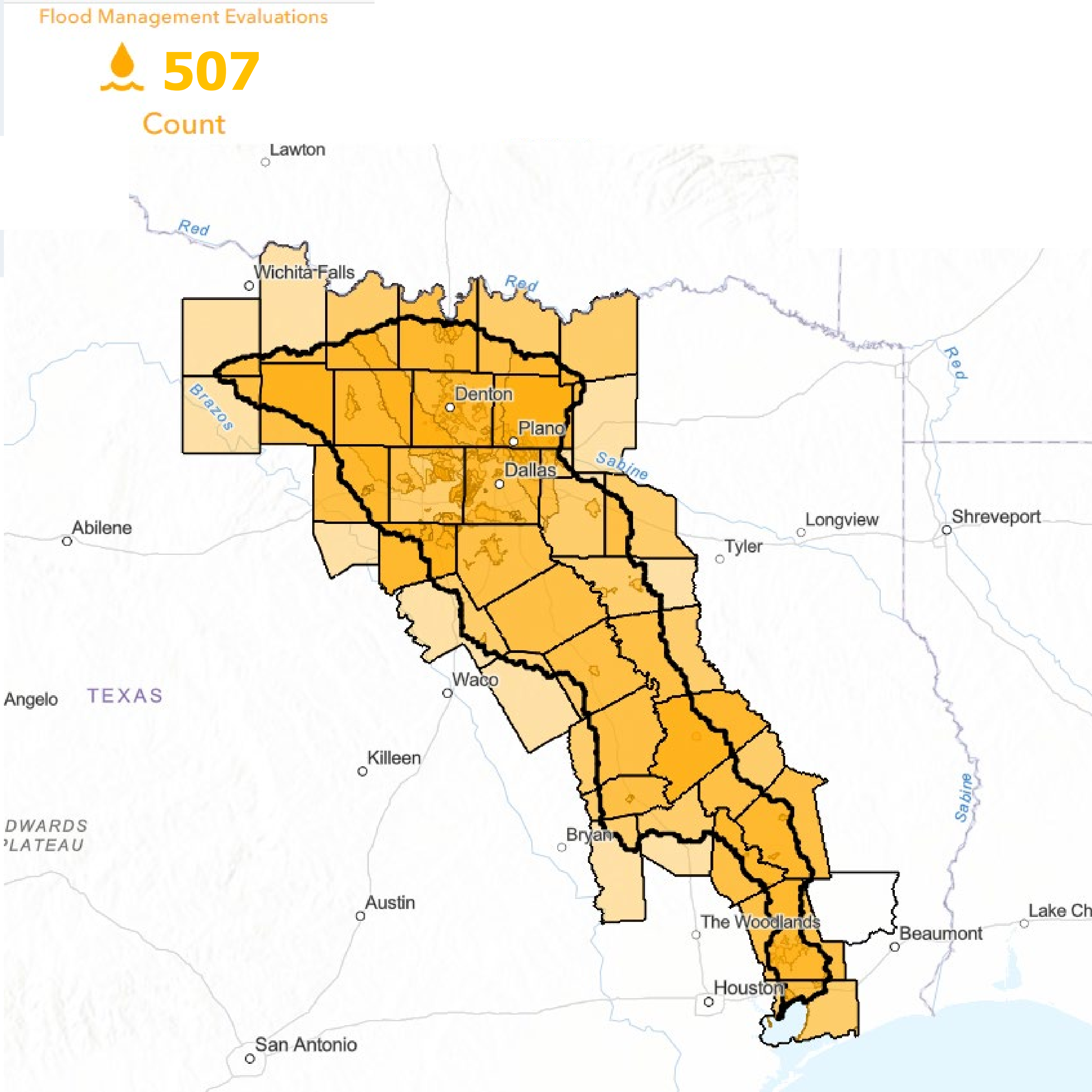
700 “actions” recommended

> $1.6 billion



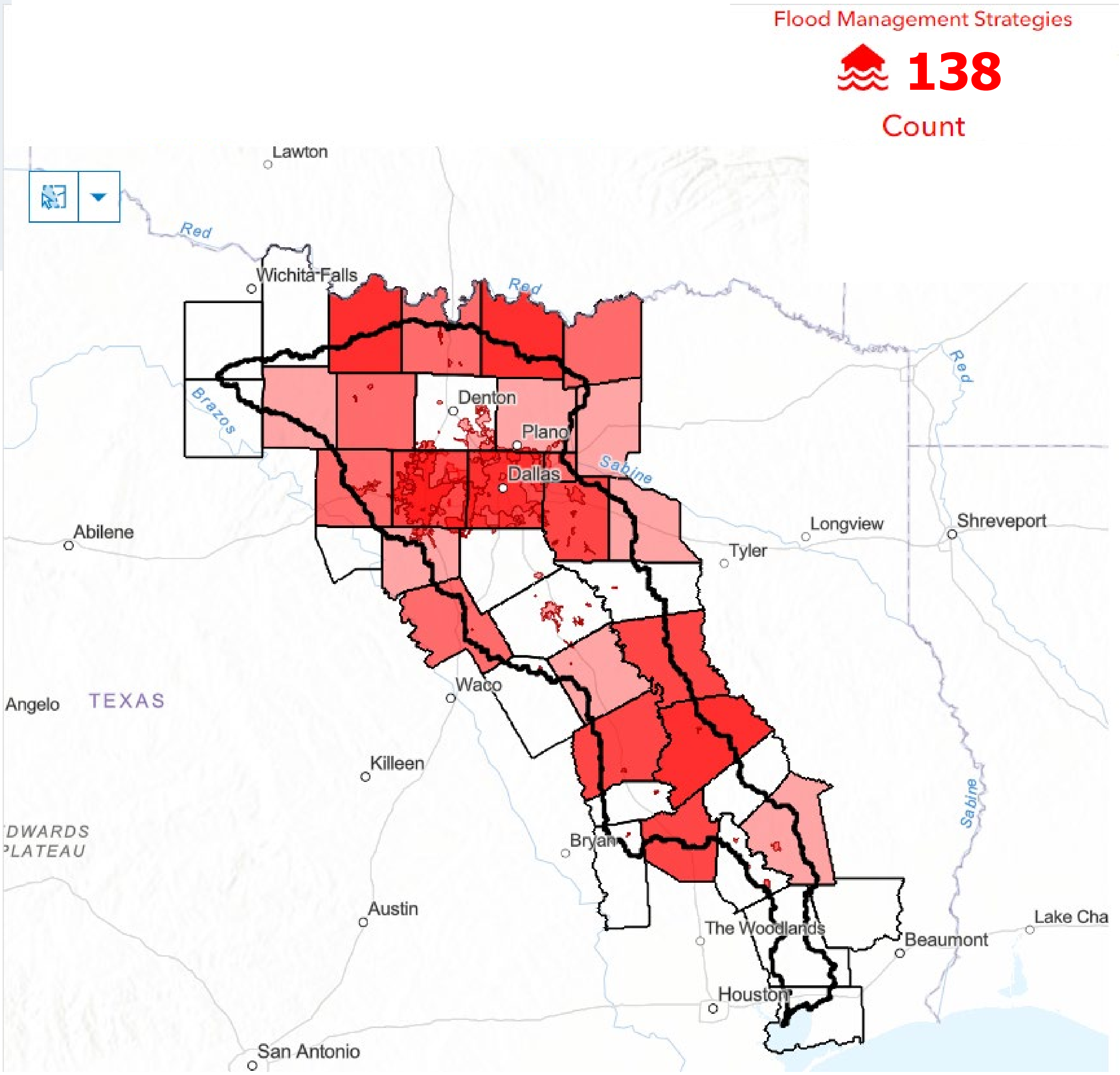
Recommended Flood Management Evaluations

521 FME's evaluated



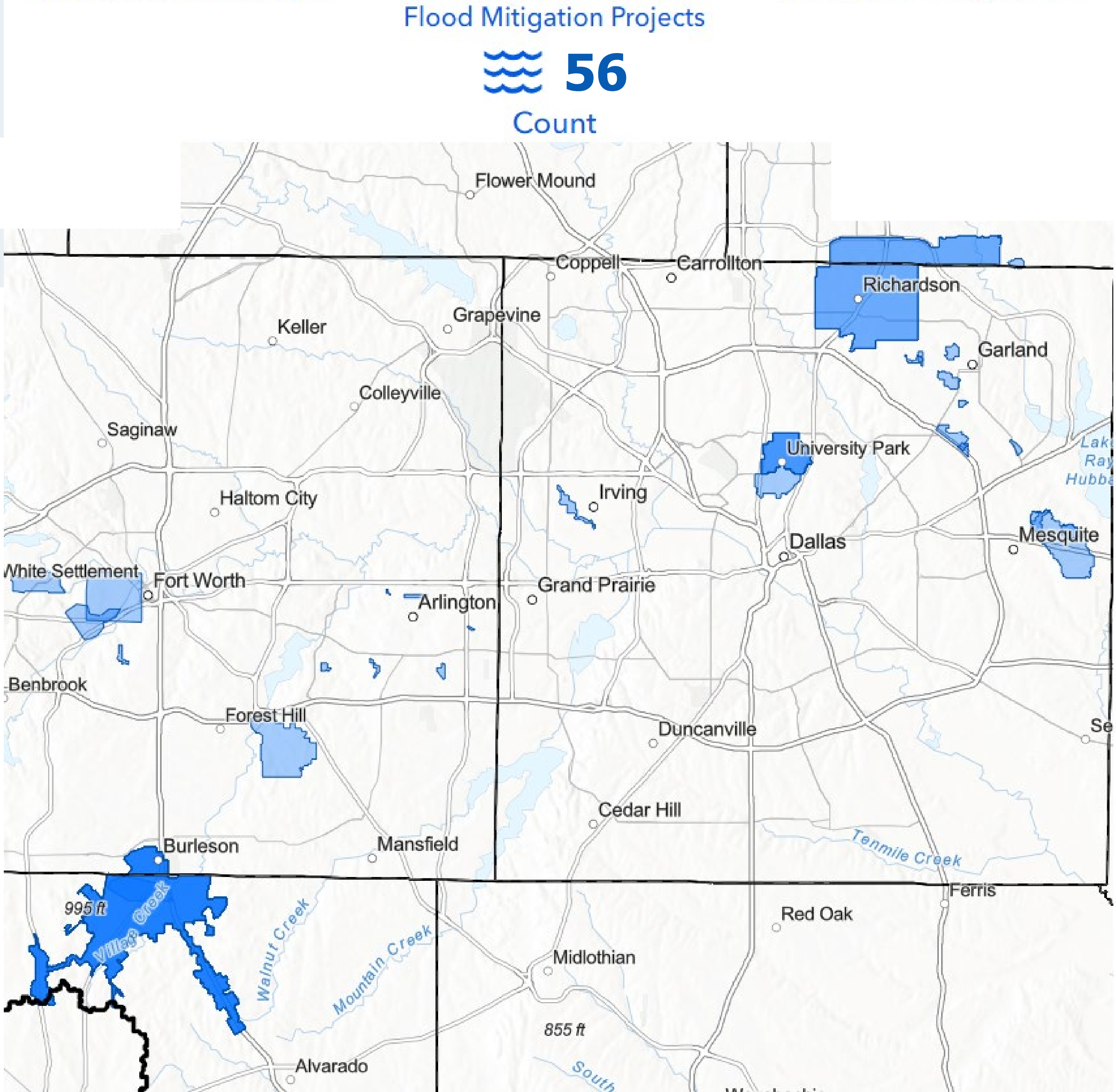
Recommended Flood Management Strategies

145 FMS's evaluated



Recommended Flood Management Projects

73 FMP’s evaluated



Questions?

Full plan available at: https://trinityrfpg.org/

Speaker Introduction

Dr. Kathy Jack

- Texas Climate Program Director with the Nature Conservancy

Dr. Fouad Jaber

- Professor and Extension Specialist with Texas A&M AgriLife

Green Stormwater Infrastructure for Urban Flood Resilience

Opportunity Analysis for Dallas, Texas

Nature.org/DallasGSI
Executive Summary

Kathy Jack, Ph.D. ,
The Nature Conservancy

Fouad Jaber, Ph.D., P.E,
Texas A&M AgriLife Extension

The Nature Conservancy

Texas A&M AgriLife Extension

Analysis and report produced by The Nature Conservancy (TNC) and Texas A&M AgriLife Extension, in collaboration with the City of Dallas and The Trust for Public Land (TPL). This analysis was made possible with the support of Lyda Hill Philanthropies.

The Nature Conservancy

Kathy Jack, Ph.D.

Texas A&M AgriLife Extension

Fouad Jaber, Ph.D., P.E.
Bardia Heidari Ph.D., E.I.T.
Victoria Prideaux

Dallas Environmental Quality & Sustainability

Susan Alvarez, P.E., CFM

dallas water utilities city of dallas

Sarah Standifer
Kim Dewailly, P.E., CFM
Stephen Parker, P.E., CFM
David Phan, P.E., CFM

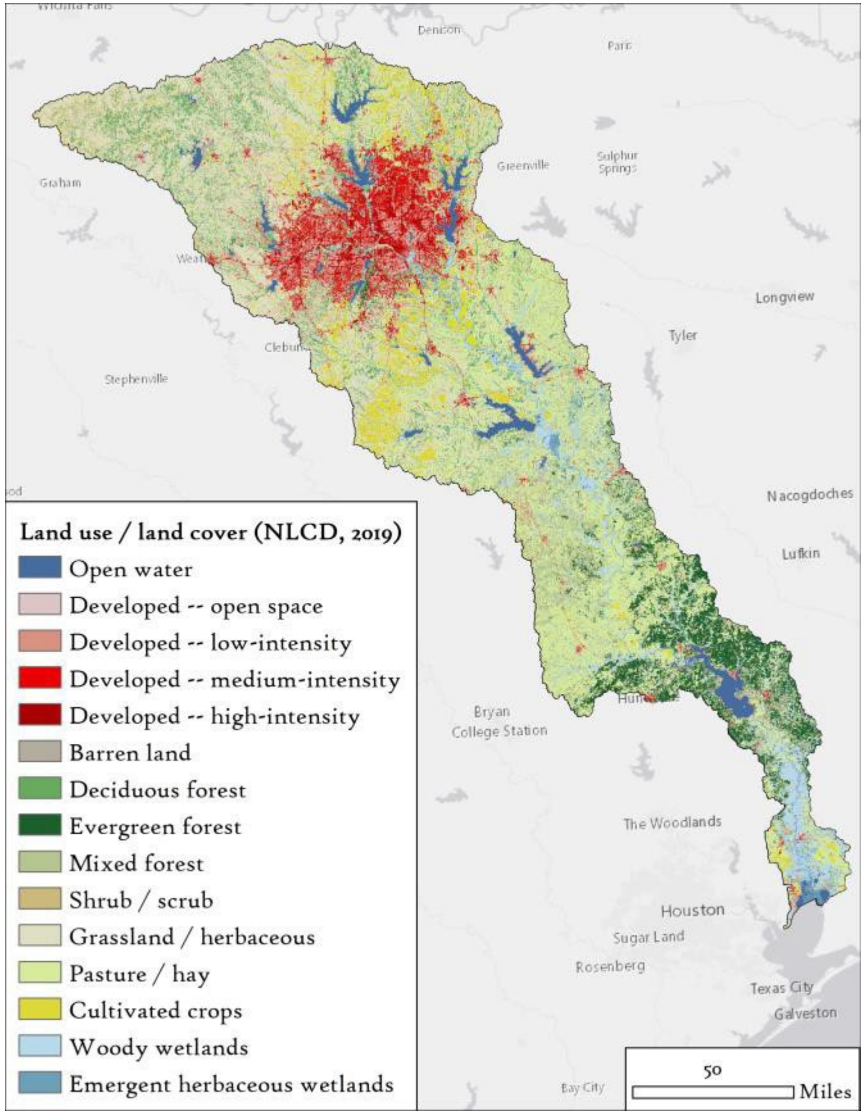
The Trust for Public Land

Mitch Hannon
Nick Viau
Robert Kent
Molly Plummer

Challenge: Impervious Cover

Texas Has Nation's Largest Annual State Population Growth.[1]

Dallas-Fort Worth is the fastest growing metropolitan area in the United States[2]. With rapid and widespread conversion of natural land cover to impervious surfaces.



[1,2]U.S. Census Bureau, 2020

Challenge: Climate Change

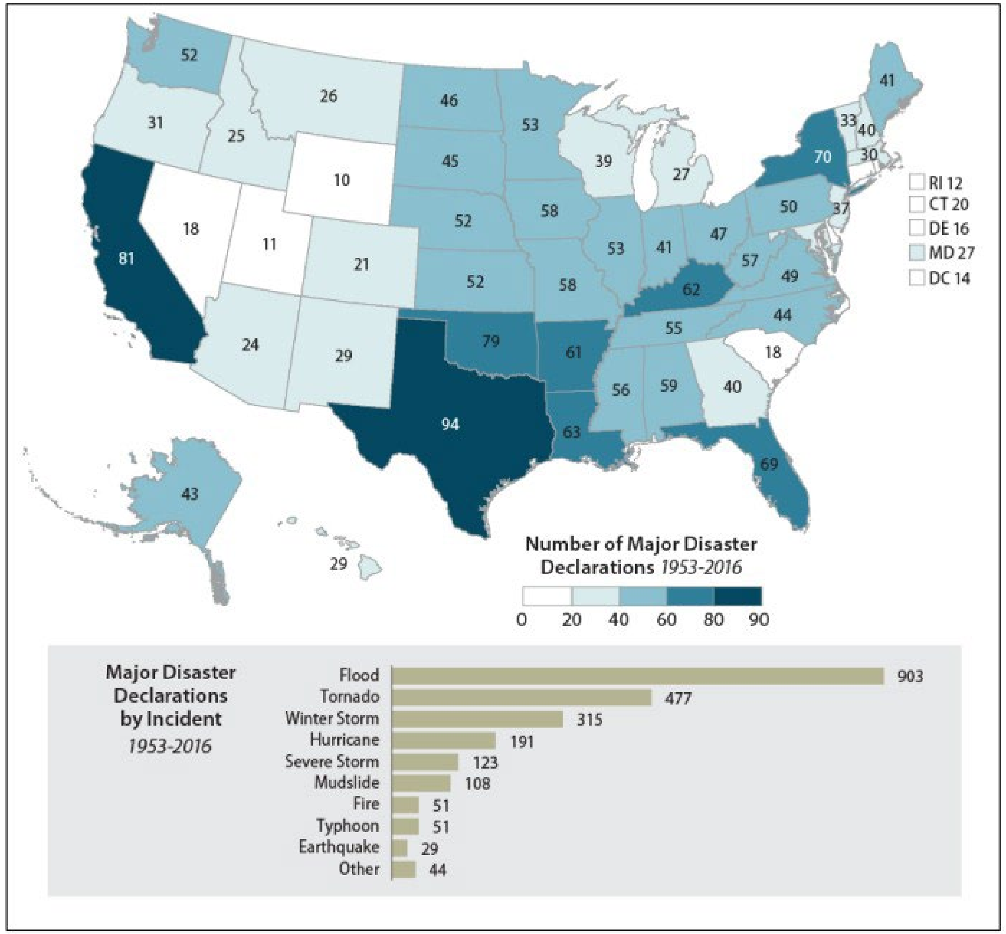
Texas leads the country in federally declared natural disasters.[1]

"Texas has seen its number of natural disasters increase by 244% over the past four decades."[2]

By 2036, flooding in our cities is estimated to become up to 50% more frequent.[3]

Figure 6. Major Disaster Declarations by State and Type

1953-2016



Source: CRS analysis based on data from U.S. Department of Homeland Security, Federal Emergency Management Agency, *Disaster Declarations*, available at https://www.fema.gov/disasters.

[1] Congressional Research Services, 2017;

[2] Insurancenews.net. January 9, 2020.

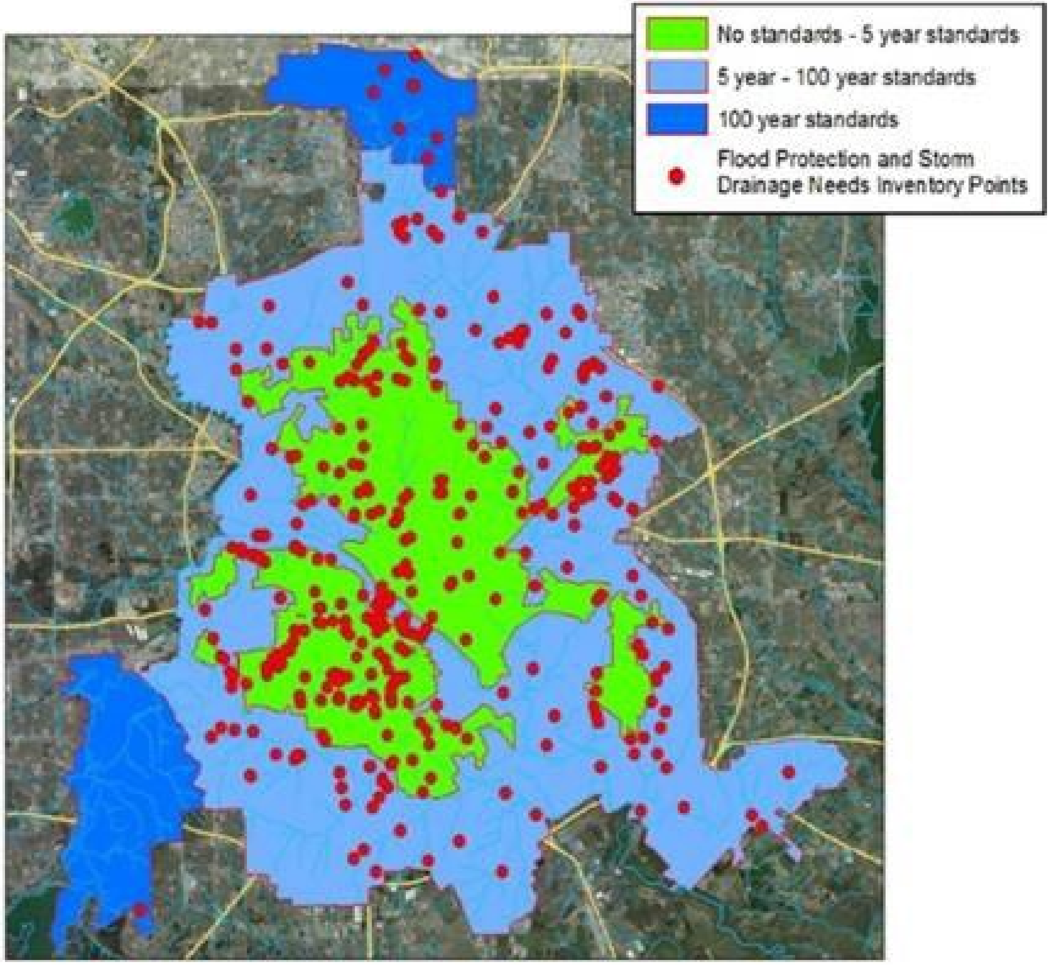
[3] Texas A&M University. Office of the Texas State Climatologist. Assessment of Historic and Future Trends of Extreme Weather in Texas, 1900-2036

Challenge: Outgrowing Drainage

Most of the drainage needs in the City are associated with areas developed prior to current Drainage Standards

Total City-wide Estimated Needs:
$2.1 B

2017 Drainage Bond Proposition:
$48.75 M



City of Dallas Drainage Standards & Needs Inventory

City of Dallas

Dallas flooding. © Steven Luu.

Opportunity: Nature-Based Solutions

Cities across the world are increasingly utilizing green stormwater infrastructure (GSI) practices, engineered plant and soil systems that recreate natural hydrological processes, to enhance stormwater management in urbanized watersheds.

In addition to improving water quality, GSI can provide an important and cost-effective tool to enhance urban flood management.

The Nature Conservancy

Texas A&M AgriLife Extension

Dallas Environmental Quality & Sustainability

City of Dallas

The Trust for Public Land

City of Dallas- GSI

Since 2007, The City has worked to better integrate GSI, into City planning and design manuals, and to support regional efforts.

- iSWM- voluntary
- USEPA report on GSI Barriers and Opportunities.
- Impervious surface drainage fees
- Complete Streets; Green Streets
- *Resilient Dallas*
- iSWM in Paving, Street and Drainage Design Manuals

Sidewalk bioretention areas in Deep Ellum. © Katy Evans/ City of Dallas

City of Dallas

City of Dallas

CECAP GSI Goals

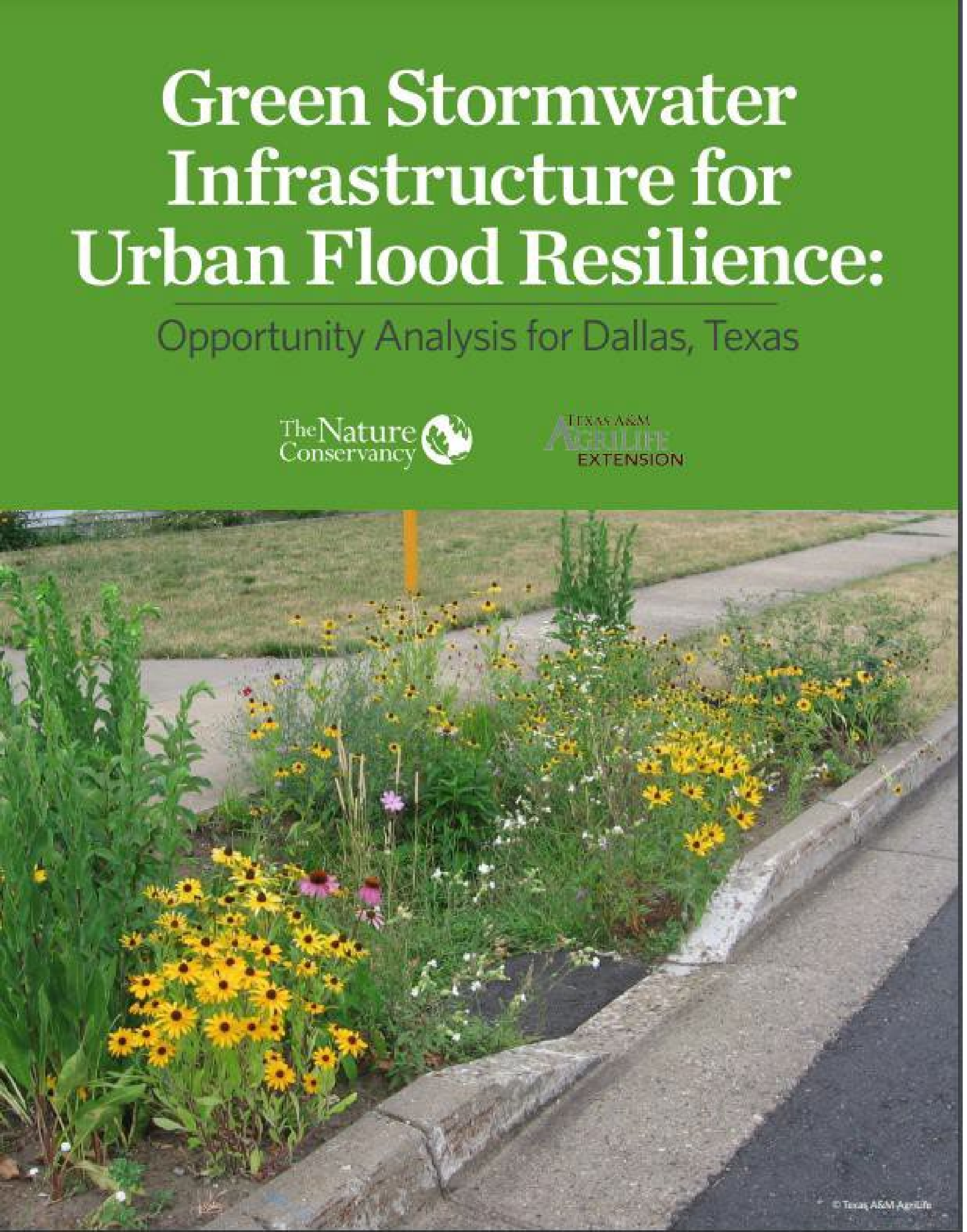
Incorporate green infrastructure to mitigate adverse impacts of development. (WR10)

Establish urban greening factor that quantifies stormwater benefits. (EG1)

Increase and improve access to Green Space to reduce impacts of urban heat islands, localized flooding, and improve public health. (EG1)

Assess opportunities for Blue-Green Infrastructure in the Public realm to reduce flood risk. (EG2)

Implement green infrastructure programs that treat the ROW as both a mobility and green infrastructure asset. (T15)

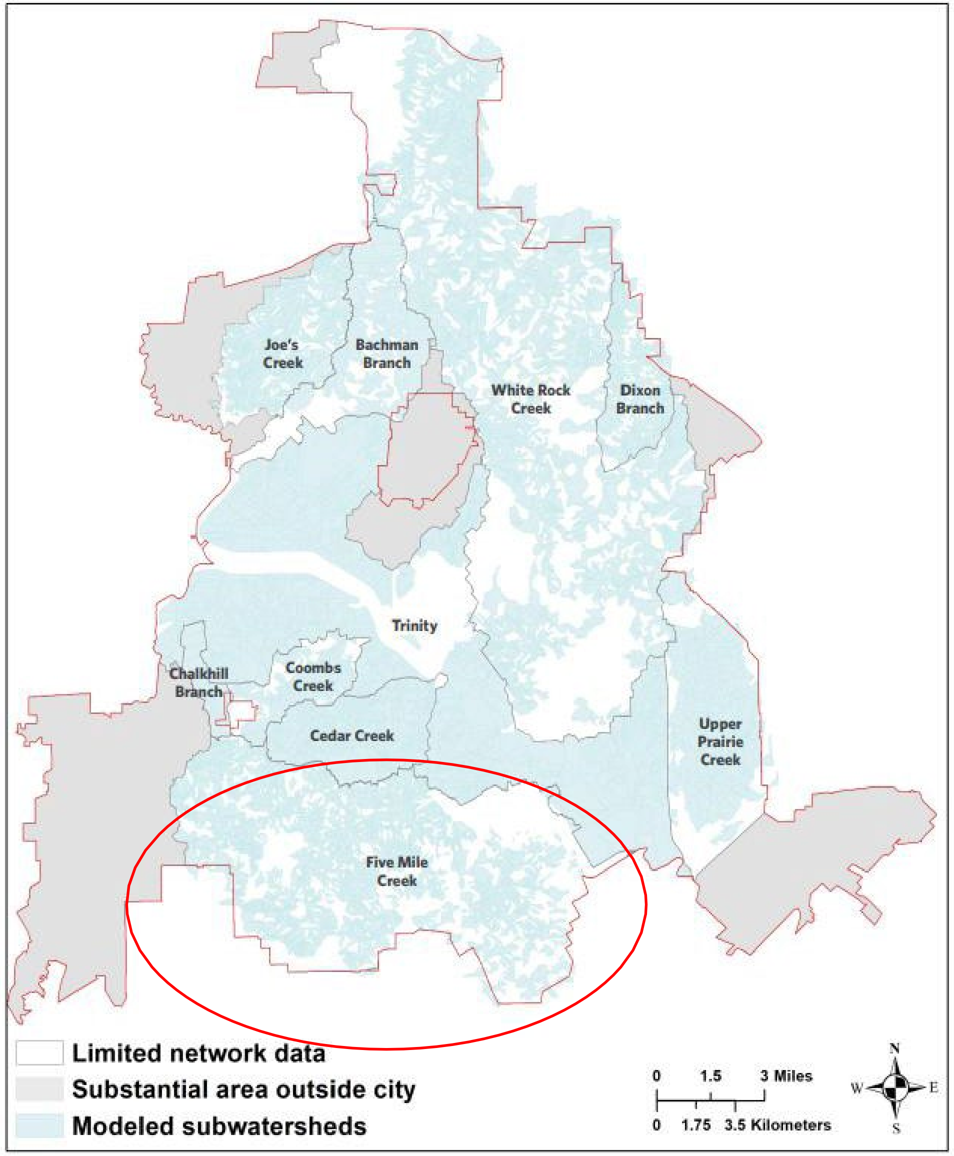


Where can green stormwater infrastructure (GSI) most effectively enhance urban flood management within Dallas, Texas, when considering capacity, cost, and future impacts of climate change?

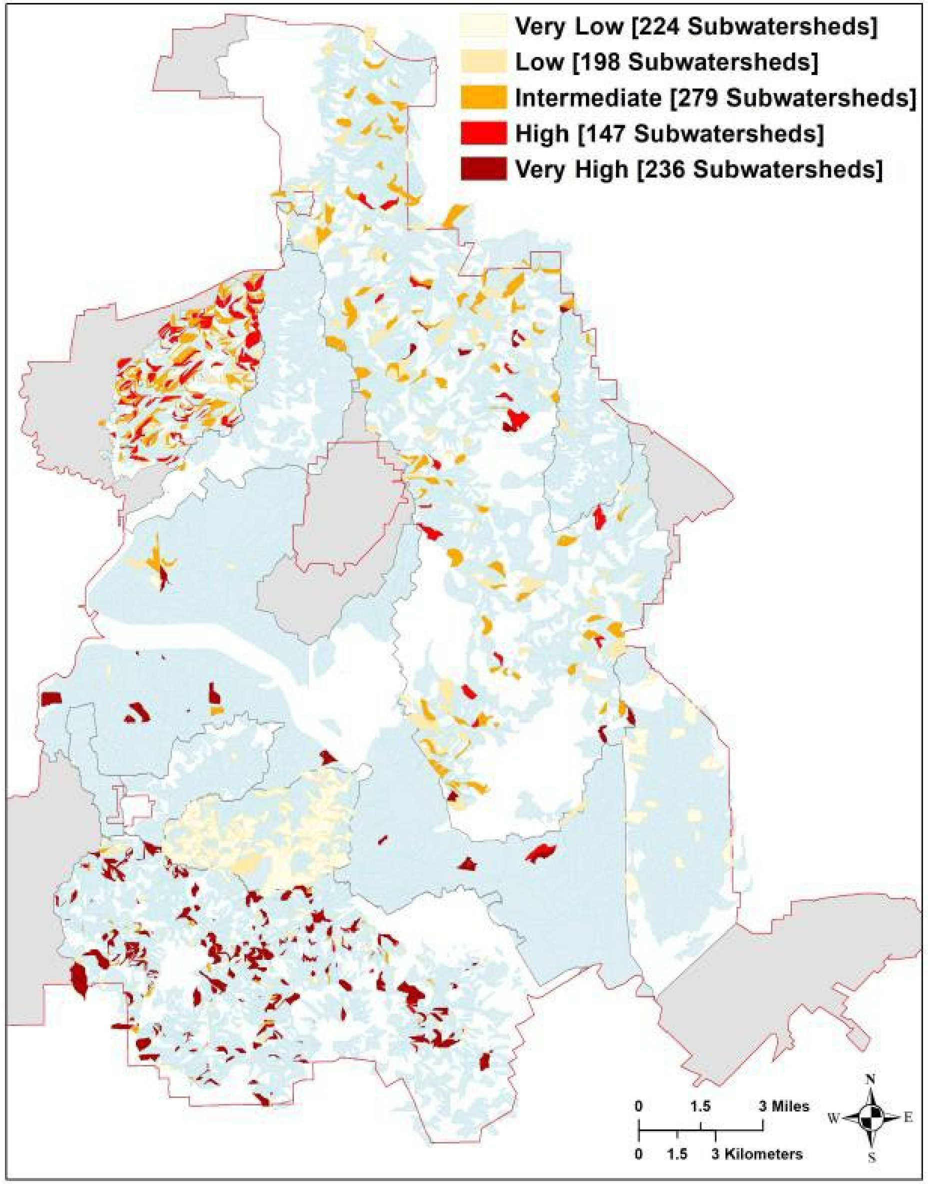
This study utilized hydrologic modeling (USEPA SWMM v. 5.1) and spatial analysis to help answer this question.

Nature.org/DallasGSI

Part I : Identify Priority Sub-watersheds

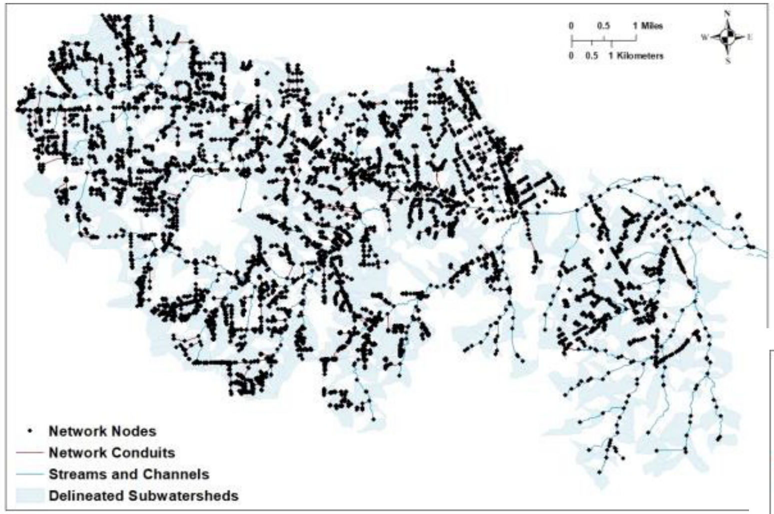


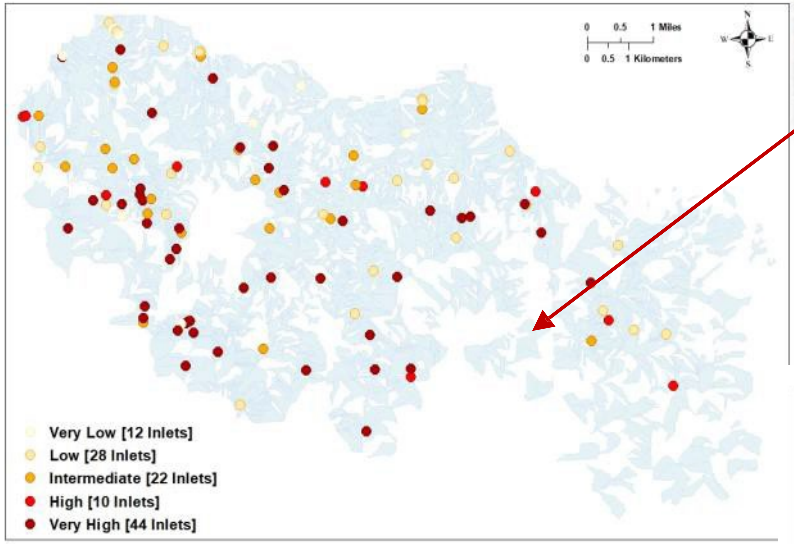
The study was limited to areas with complete stormwater drainage system, and included a total of 118,418 acres, or 53% of watershed area within the City.

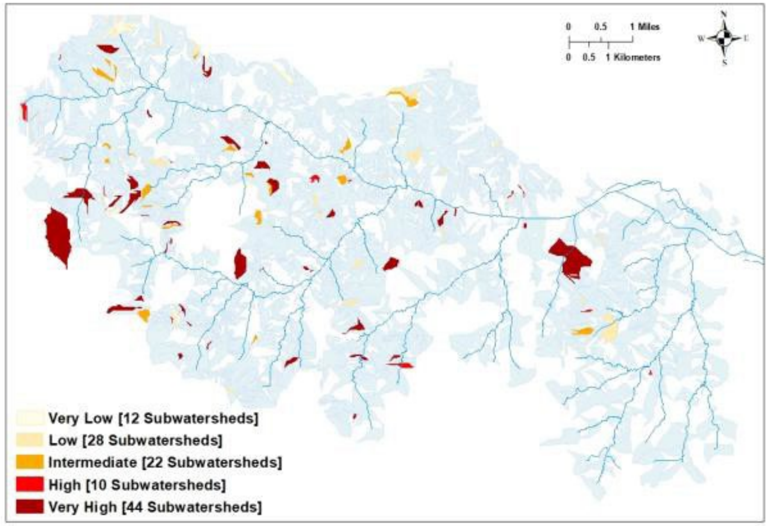


Challenged Subwatersheds, Classified by Severity of Inlet Overflows, as Modeled for 100-yr (1%)Storm

USEPA SWMM v. 5.1

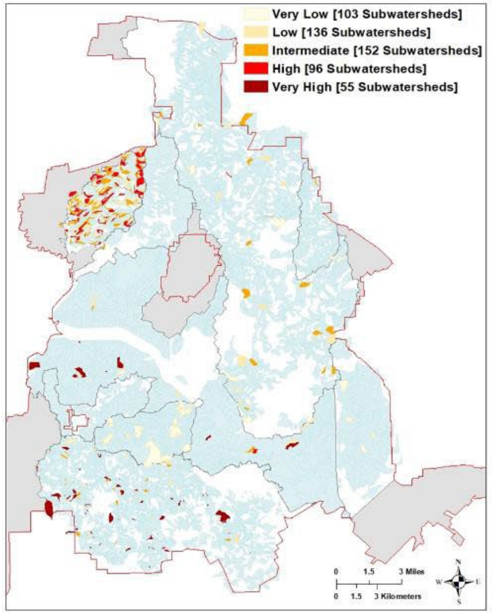


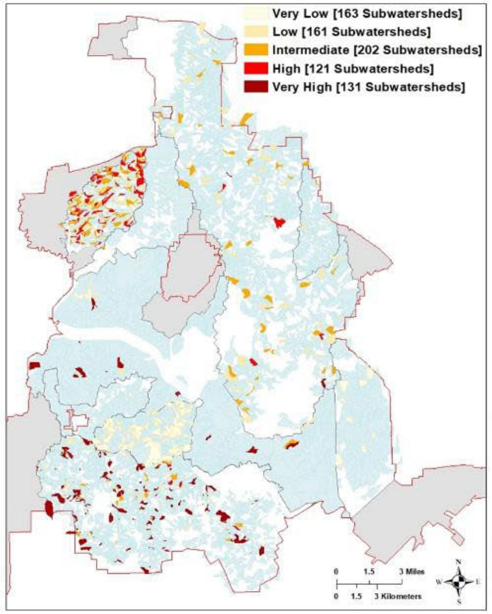


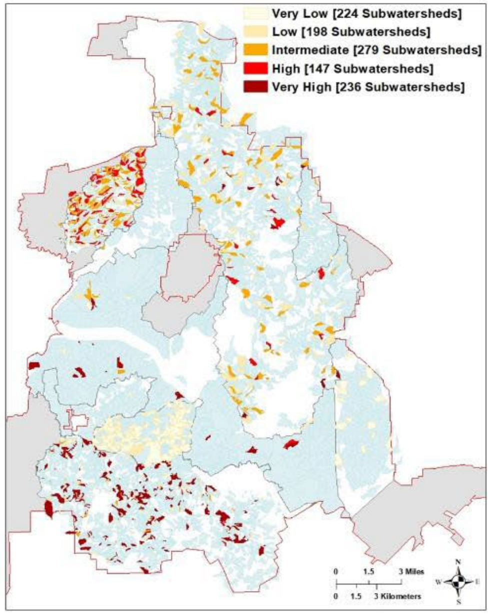


FJ

Current

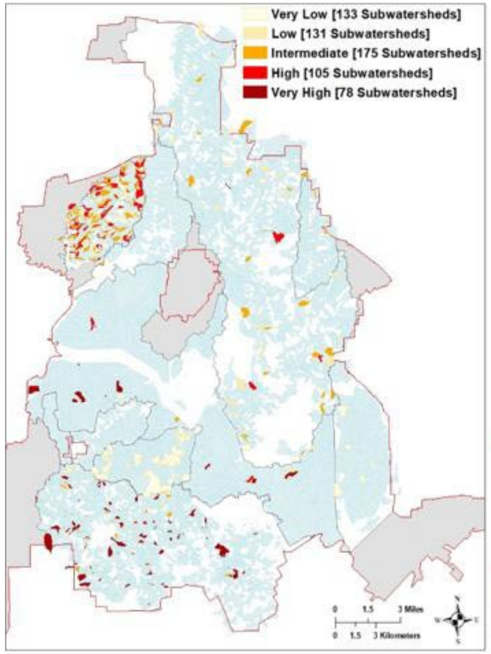


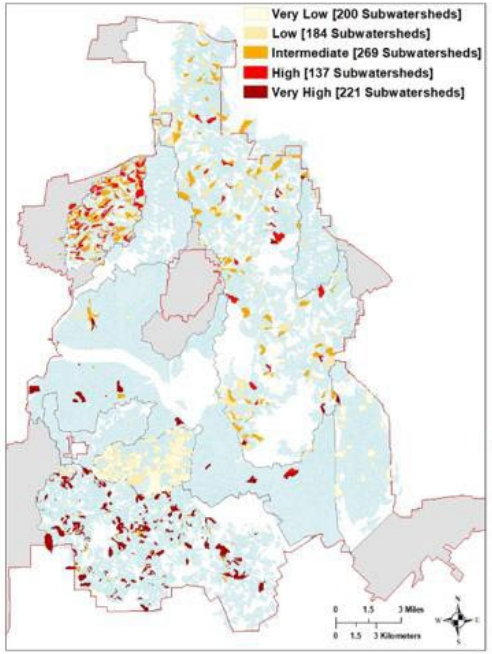


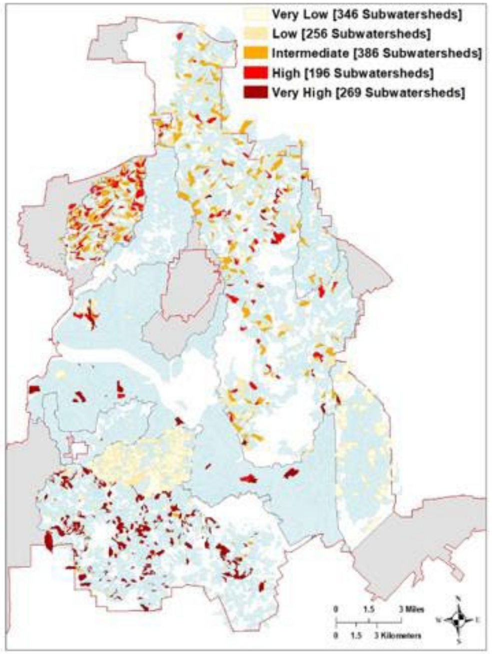


2-year (50%) 10-year (10%) 100-year (1%)

Forecasted 2045







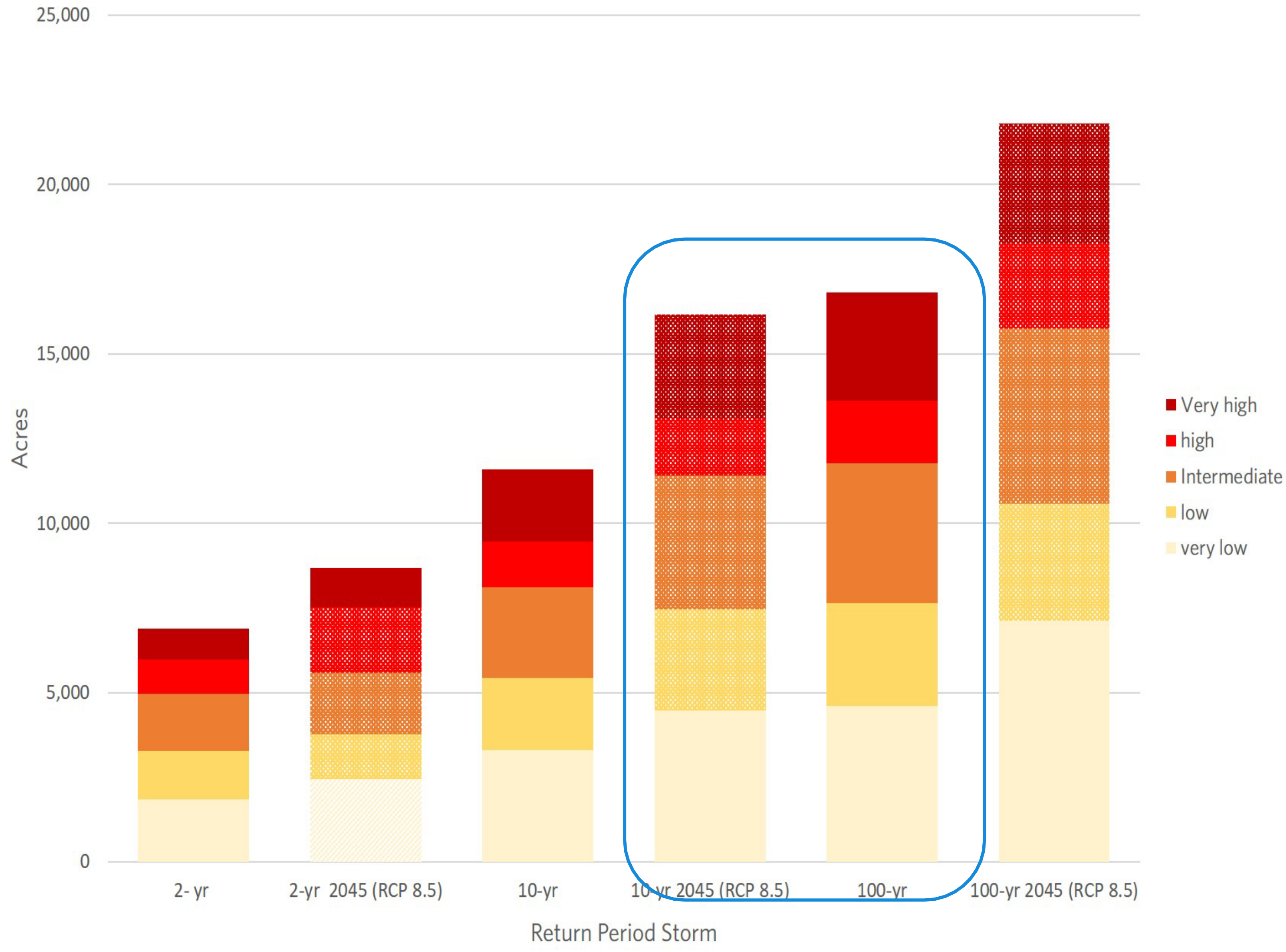
Part I: Key Findings

Identified areas of concern.

More precipitation will lead to more and more severe, system hotspots.

Climate change will result in an average increase in the number of system hotspots (+26%).

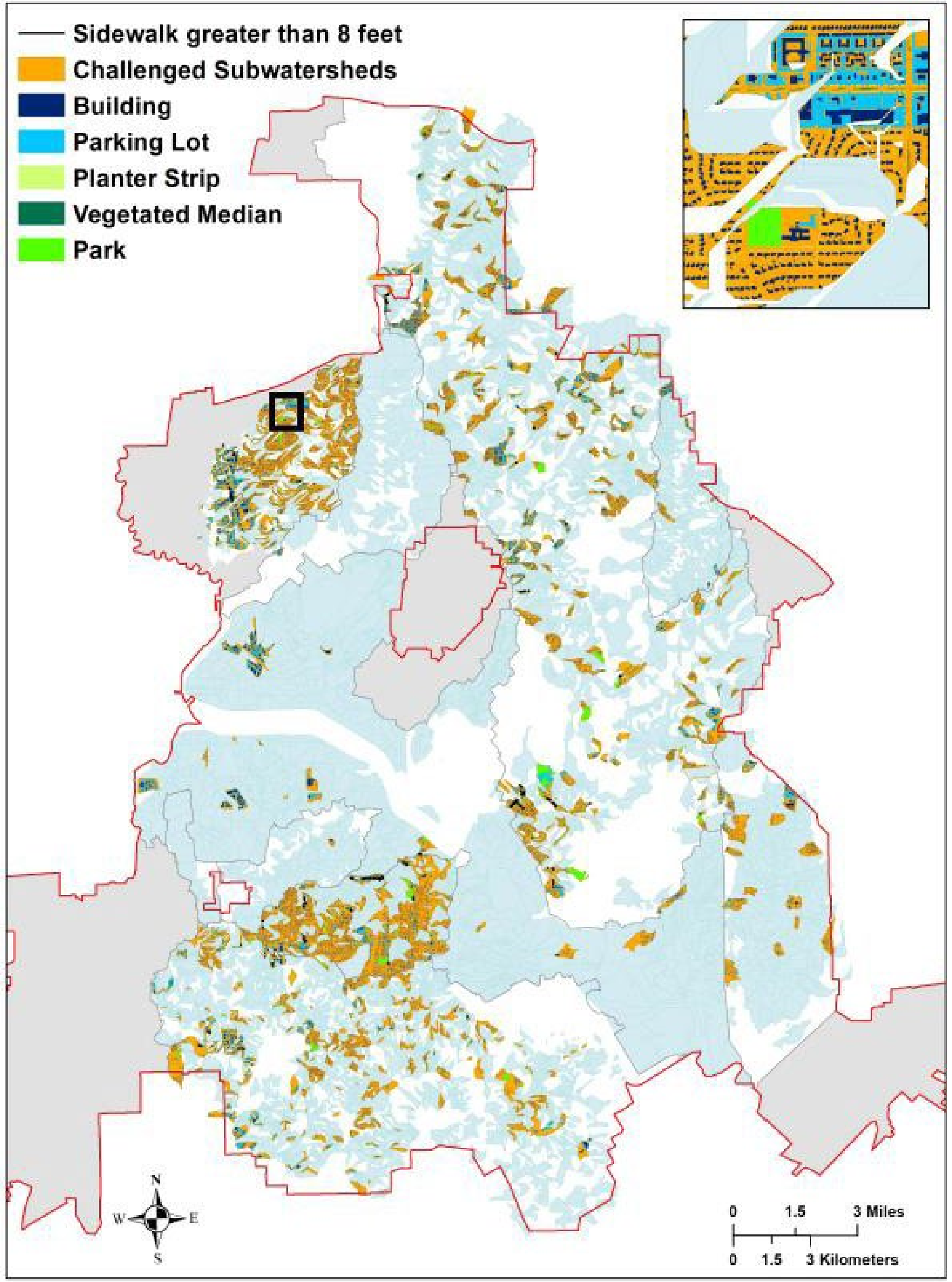
Precipitation amounts and hotspots for the 10-year storm forecasted for 2045 resemble those for today's 100-year storm.



Challenged Subwatershed Area (acres), Classified by Severity of Inlet Overflows, as Modeled for Return Period Storms, Current and Forecasted Conditions

KJ

Part II: Estimate Potential Green Stormwater Infrastructure Opportunity

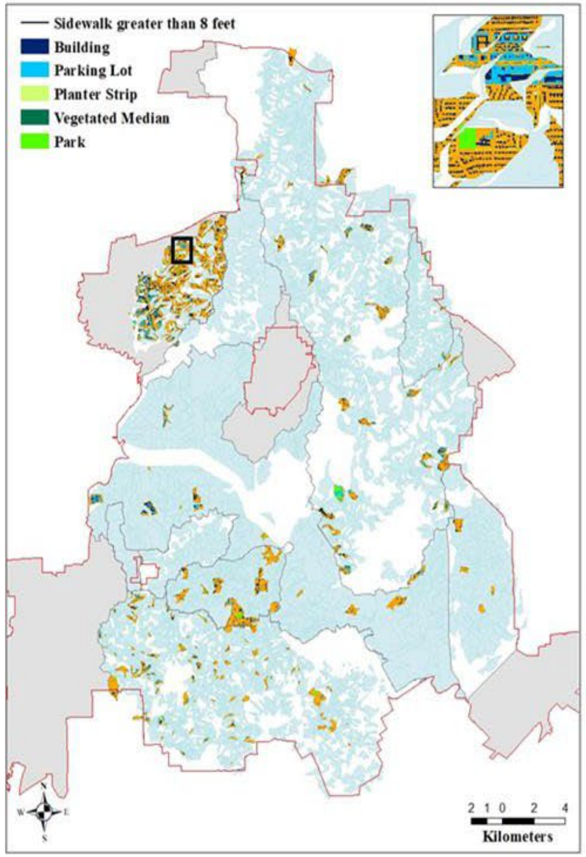


Bioretention areas

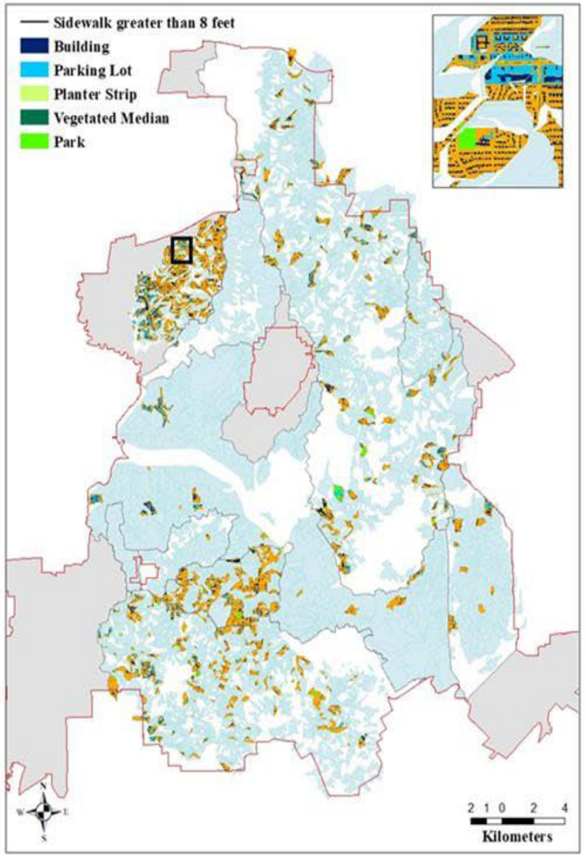
Raingarden

Rainwater Harvesting

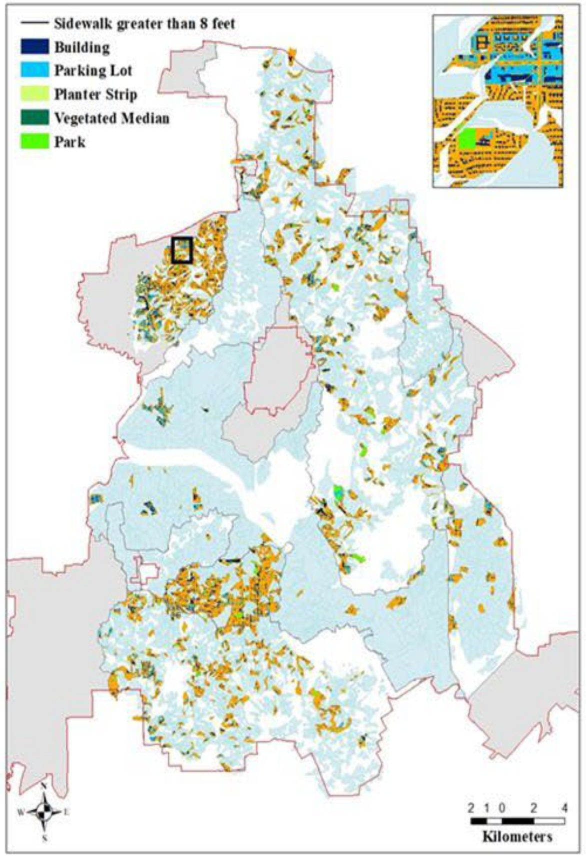
2-year (50%)



10-year (10%)



100-year (1%)



Identified substantial opportunities to deploy GSI.

Bioretention areas—particularly in parking lots—have the most widely available siting opportunities and represent the "biggest bang for the buck."

Estimated Maximum Stormwater Volume Capture Capacity for GSI in challenged sub-watersheds, Based on Standard System Designs and Spatial Criteria

2-year (50 %)	GSI TOTAL	111.2 MG
	Bioretention	78.4 MG
	Raingarden	16.4 MG
	Rainwater Harvesting	16.4 MG

10-year (10 %)	GSI TOTAL	191.6 MG
	Bioretention	135.6 MG
	Raingarden	28.1 MG
	Rainwater Harvesting	27.9 MG

100-year (1 %)	GSI TOTAL	284.7 MG
	Bioretention	200.9 MG
	Raingarden	42 MG
	Rainwater Harvesting	41.8 MG

FJ

Estimated Stormwater Management Capacity, Potential Reduction of Modeled Overflows, and Costs per Gallon Captured by GSI, per Storm Event

WATERSHED	2-Year (50%)				10-Year (%10)				100-Year (1%)			
	CAPTURE CAPACITY/EVENT (MG)	OVERFLOW REDUCTION (%)	AVERAGE COST ($/GAL)[c]	AVERAGE COST WITH MAINTENANCE ($/GAL)	CAPTURE CAPACITY/EVENT (MG)	OVERFLOW REDUCTION (%)	AVERAGE COST ($/GAL)[c]	AVERAGE COST WITH MAINTENANCE ($/GAL)	CAPTURE CAPACITY/EVENT (MG)	OVERFLOW REDUCTION (%)	AVERAGE COST ($/GAL)[c]	AVERAGE COST WITH MAINTENANCE ($/GAL)
Bachman	No overflow				No overflow				No overflow			
Cedar Creek[b]	11.9	49%	2.3	2.9	27.9	0.4	2.3	2.9	47.1	23%	2.2	2.8
Chalk Hill	No overflow				No overflow				No overflow			
Coombs Creek	No overflow				0.2	33.9%	2.3	2.9	0.2	21.4%	2.3	2.9
Dixon[a]	0.3	58.9%	1.7	2.0	1.1	37.0%	2.0	2.4	1.1	19.5%	2.0	2.4
Five Mile[ab]	15.5	35.9%	1.9	2.2	38.7	29.1%	1.9	2.2	55.5	19.4%	1.9	2.2
Joe's Creek[ab]	51.4	29.1%	1.9	2.3	56.6	19.6%	1.9	2.3	61.7	12.4%	1.9	2.2
Trinity	10.9	25.8%	1.7	1.9	15.0	19.4%	1.7	2.0	18.6	12.8%	1.7	1.9
Upper Prairie	1.7	20.9%	2.1	3.1	5.0	16.2%	2.1	2.6	10.9	10.6%	2.1	2.6
White Rock[b]	19.5	28.7%	2.0	2.4	47.3	28.7%	1.9	2.3	89.6	20.6%	1.9	2.3
City of Dallas TOTAL	**111.2**	**30.6%**	**1.9**	**2.4**	**191.6**	**24.7%**	**2.0**	**2.4**	**284.7**	**16.9%**	**2.0**	**2.4**

Gray (Pipe) Infrastructure	414.4	24.6%	10.6
Green & Gray Infrastructure	699.1	41.5%	7.1

GSI reduced modeled overflows for all storms (17-31% reduction).

GSI is 77% less costly than upgrading gray infrastructure alone, to meet modelled overflows.

Combination of green and gray provides the maximum cost-effective benefits.

KJ

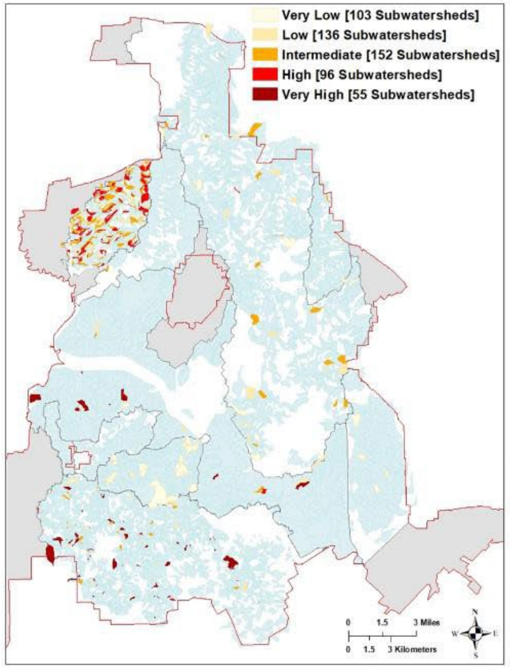
Part III: Pre- and Post-GSI Analysis

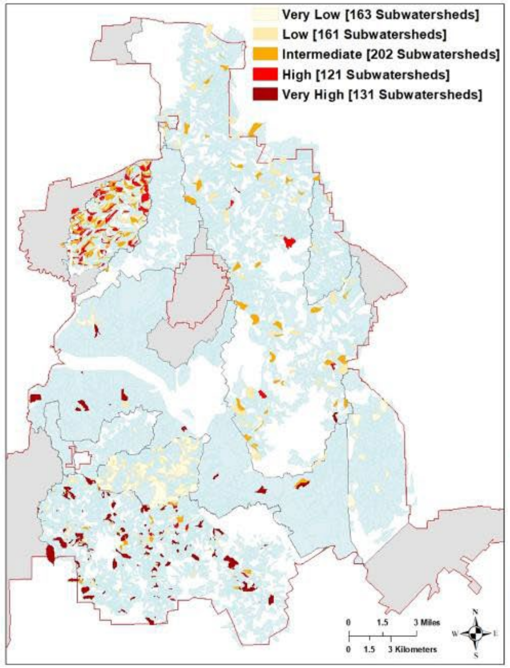
Reduction in hotspots.

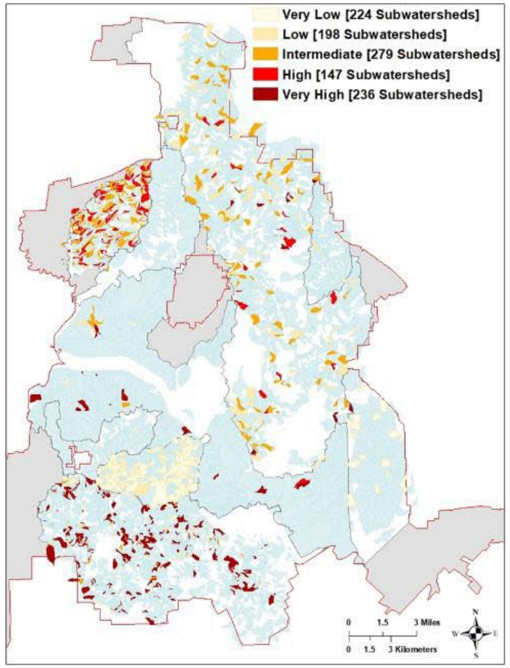
Less severe flooding.

Substantial peak flow reduction and delay resulting from GSI

Pre





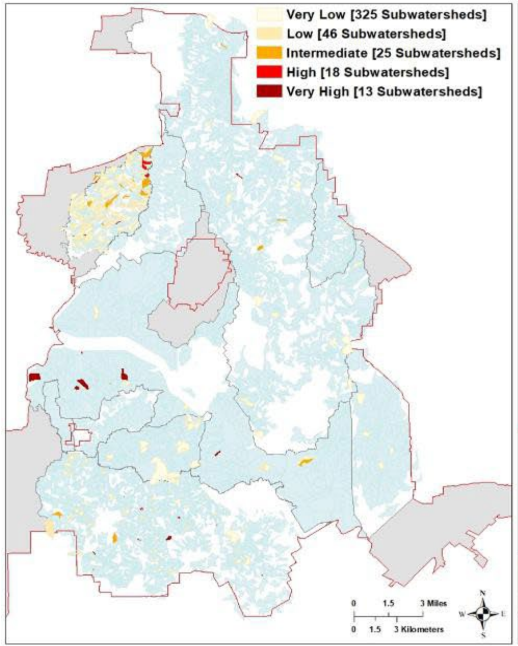


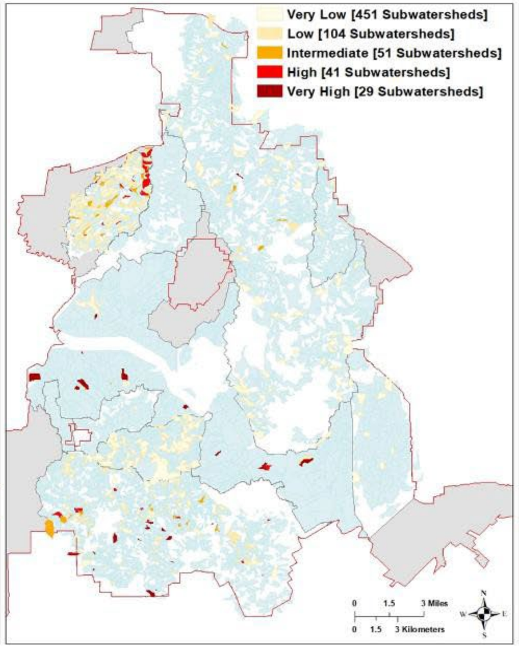
2-year (50%)

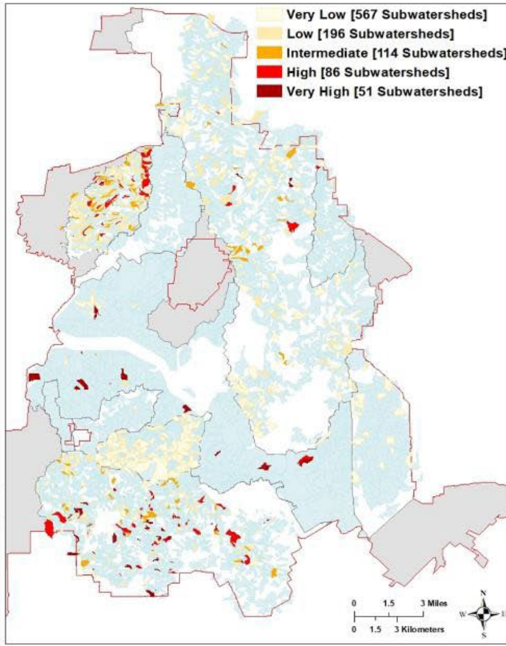
10-year (10%)

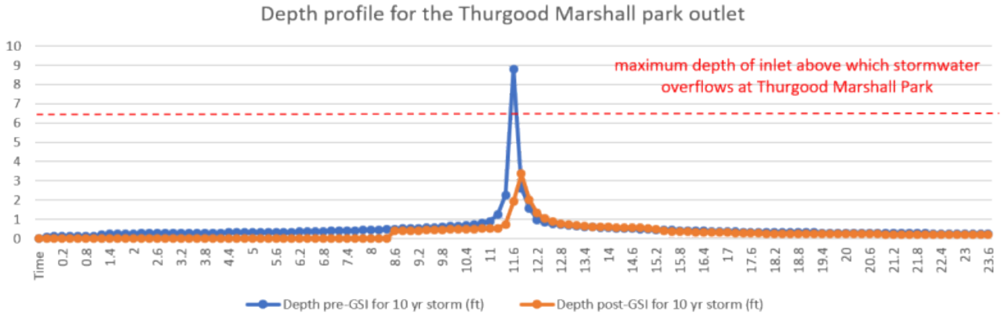
100-year (1%)

Post









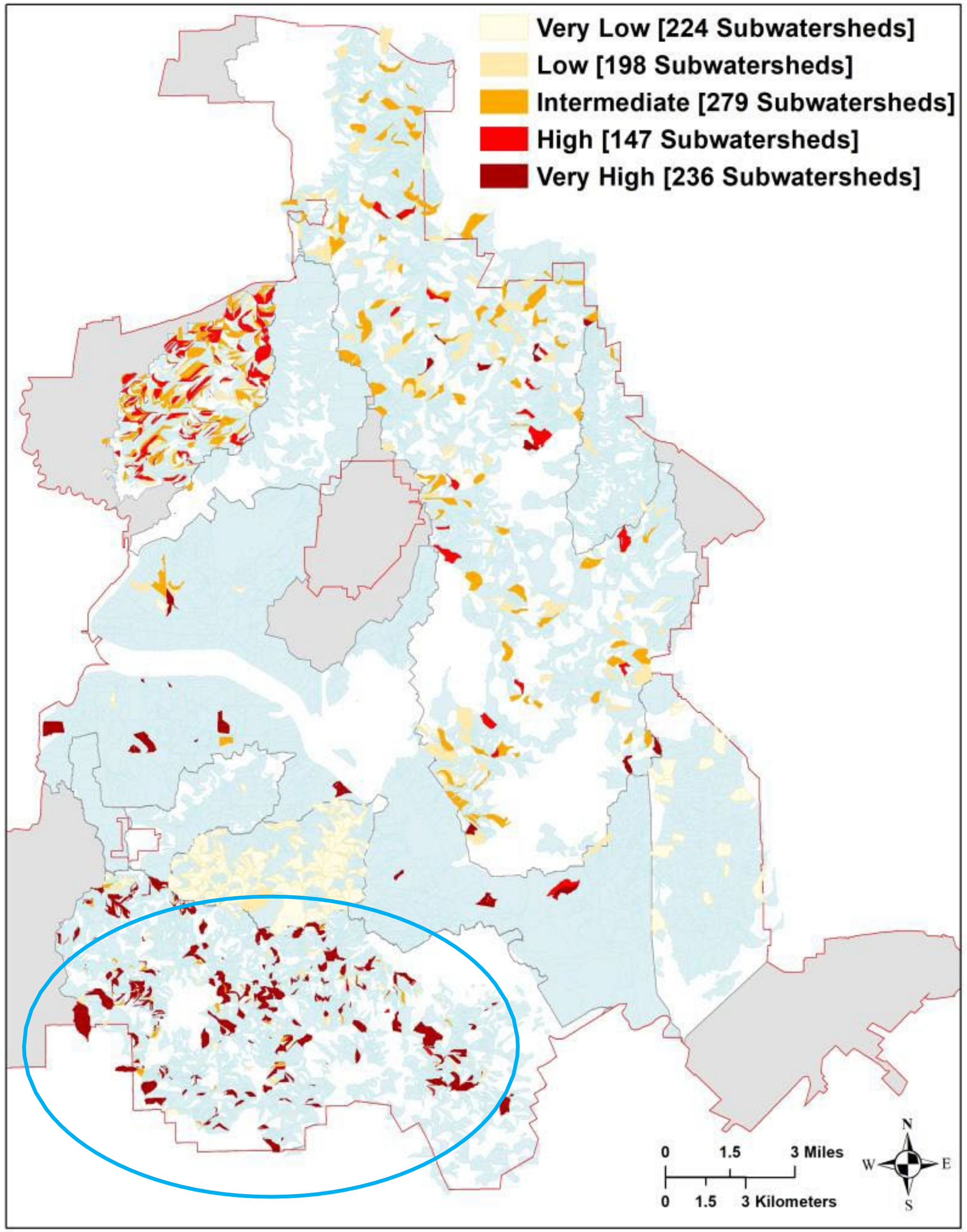
FJ

Application & Next Steps

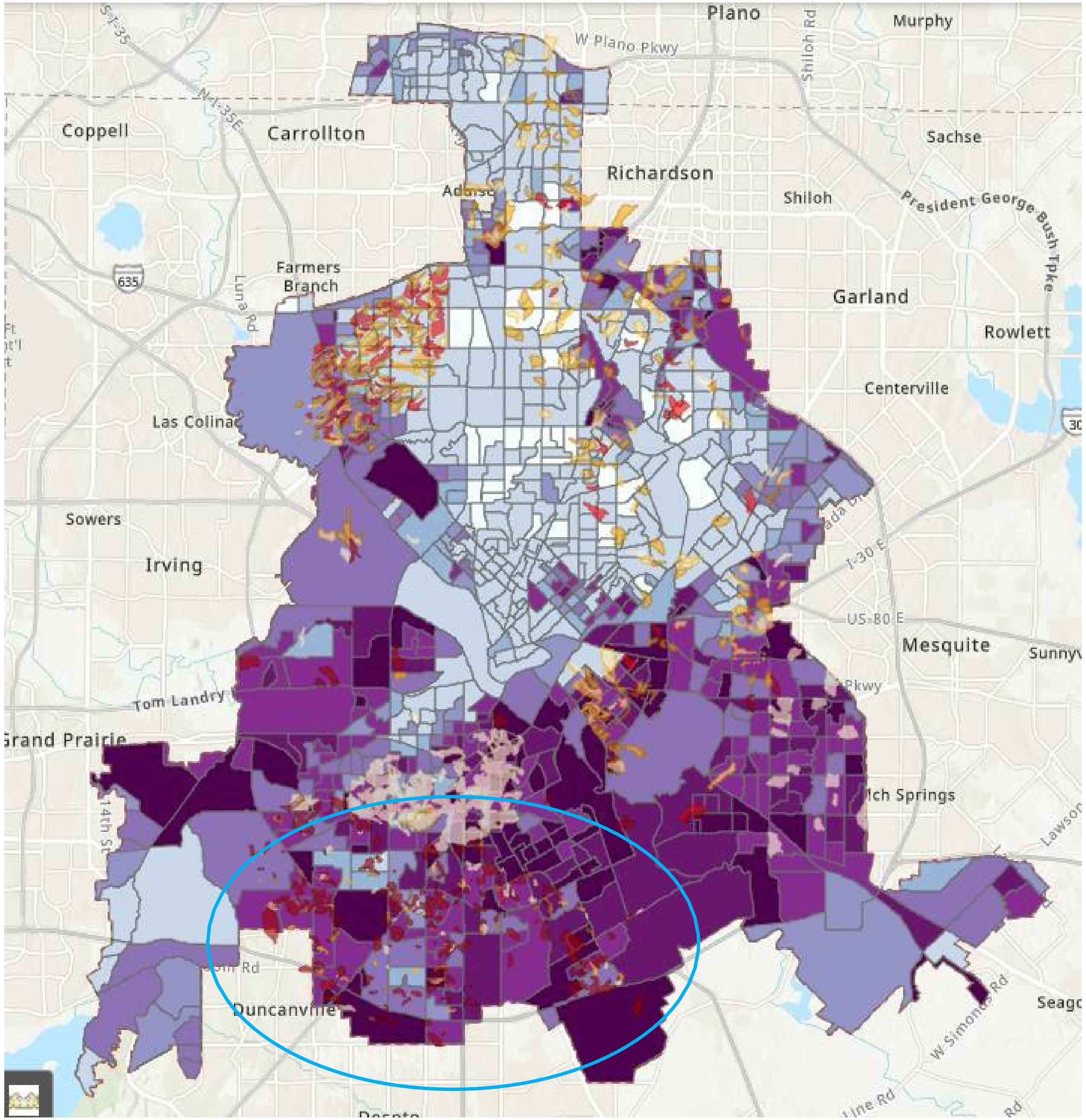
- GIS layers have been integrated into TPL's Smart Growth decision-support tool for consideration with additional data and planning objectives, including equity and land-use.

- Data layers shared with additional City departments and stakeholders to evaluate planning and policy opportunities, including updates to the parking ordinance and *Forward Dallas* land use plan.

- As the next step from our study, TNC & Texas A&M AgriLife Extension developed a Webapp tool to help view priority watersheds identified in the hydrologic study together with additional data relevant to planning decisions, including parcel, neighborhood, and demographic data .



100-yr (1%) storm Pre GSI



With USEPA Social Vulnerability Index

Publication

[*A planning framework to mitigate localized urban stormwater inlet flooding using distributed Green Stormwater Infrastructure at an urban scale: Case study of Dallas, Texas*]() ; Heidari et al. Journal of Hydrology, Volume 621, June 2023, 129538

Journal of Hydrology 621 (2023) 129538

Contents lists available at ScienceDirect

Journal of Hydrology

journal homepage: www.elsevier.com/locate/jhydrol

Research papers

A planning framework to mitigate localized urban stormwater inlet flooding using distributed Green Stormwater Infrastructure at an urban scale: Case study of Dallas, Texas

Bardia Heidari [a,b,*], Victoria Prideaux [c], Katherine Jack [d], Fouad H. Jaber [e]

[a] Department of Biological and Agricultural Engineering, Texas A&M University, 17360 Coit Rd, Dallas, TX, USA
[b] Texas Water Resources Institute, Texas A&M AgriLife Research, 17360 Coit Rd, Dallas, TX 75252, USA
[c] Geospatial Analyst I, Texas A&M AgriLife Research, 17360 Coit Rd, Dallas, TX 75252, USA
[d] Dallas Healthy Cities Program, The Nature Conservancy, 3001 Knox St, Dallas, TX 75205, USA
[e] Professor and Extension Specialist, Biological and Agricultural Engineering Dept., Texas A&M AgriLife Extension, 17360 Coit Road, Dallas, TX 75252, USA

ARTICLE INFO

This manuscript was handled by Nandita Basu, Editor-in-Chief, with the assistance of Claire J. Oswald, Associate Editor

Keywords:
Green stormwater infrastructure
Localized inlet pluvial flooding
Opportunity subwatersheds
Stormwater investment prioritization
Resilient urban watershed planning

ABSTRACT

Mitigation of localized pluvial flooding is one of the major resiliency goals in urban environments, and Green Stormwater Infrastructure (GSI) has the potential to deliver such an outcome. However, there is a lack of systematic approaches to prioritize investment in different candidate areas. This study provides a framework to identify vulnerable stormwater drainage inlets and their contributing areas, prioritize them, identify dominant factors in their selection, assess the potential of GSI in mitigating their overflows, and compare the impact and its cost to gray infrastructure upgrade alternatives. Using SWMM 5.1.013, decision trees, and a volumetric-based assessment of GSI overflow capture, we applied the framework to the City of Dallas, Texas, for three design storms with three GSI practices— bioretention cells, raingardens, and rainwater harvesting tanks. Results showed that there was a significant increase in the number of overflowing stormwater drainage inlets, referred to as hotspots, and their contributing subwatersheds, referred to as opportunity areas, with more intense storms especially in problematic watersheds. Also, prioritization results provided a series of maps to rank the opportunity areas based on overflow severity, recurrence of the overflows, and GSI availability. Moreover, classification results showed that inlet features, especially the inlet depth, were the dominant factors in the identification of the non-problematic inlets. Finally, the GSI impact assessment showed substantial overflow mitigation even at the "very high" severity levels when GSI is comprehensively deployed across opportunity areas. Despite gray infrastructure upgrades yielding higher reduction levels, their cost per cubic meter was higher than GSI. Therefore, a combination of GSI and gray results in maximum overflow reduction at a lower cost compared to common practices.

1. Introduction

Non-tropical and severe floods accounted for 20% of the damage and 45 % of the frequency of natural disasters in the U.S. between 1980 and 2011 (Smith and Katz, 2013). The severity and frequency of the damages have been progressively exacerbated due to climate change impacts on precipitation and extreme weather (Martinich and Crimmins, 2019). In the last decade, the United States has had 18 non-hurricane inland flood disasters costing roughly $4.6 billion per event, whereas the previous three decades have a combined total of 14 flood disasters (NCEI, 2020).

Pluvial and localized urban flooding is one of the common flooding categories in urban settings (Rosenzweig et al., 2018; See, 2019). This category of flood risk accounts for about one-third of flood risk exposure in the United Kingdom (Houston et al., 2011). Specifically, drainage inlet flooding, which happens when the capacity of the stormwater inlet does not meet the volume and intensity of runoff or when runoff cannot effectively be routed to the inlet, is one of the forms of such flooding (Bulti and Abebe, 2020; Palla et al., 2018).

One increasingly popular solution to mitigate the increased flooding hazard within an urban setting is to reintroduce natural infiltration

* Corresponding author.
E-mail addresses: b.heidariharatmeh@ag.tamu.edu (B. Heidari), victoria.prideaux@ag.tamu.edu (V. Prideaux), Kathy.jack@tnc.org (K. Jack), Fouad.Jaber@ag.tamu.edu (F.H. Jaber).

https://doi.org/10.1016/j.jhydrol.2023.129538
Received 26 June 2022; Received in revised form 8 March 2023; Accepted 14 April 2023
Available online 18 April 2023
0022-1694/

GSI & Urban Flood Resilience

Climate change will continue to exacerbate urban flooding challenges in cities.

GSI is an important and cost-effective tool for managing urban flooding, particularly when <u>comprehensively deployed</u> in the fabric of a City.

GSI can support multiple community health and resilience goals:

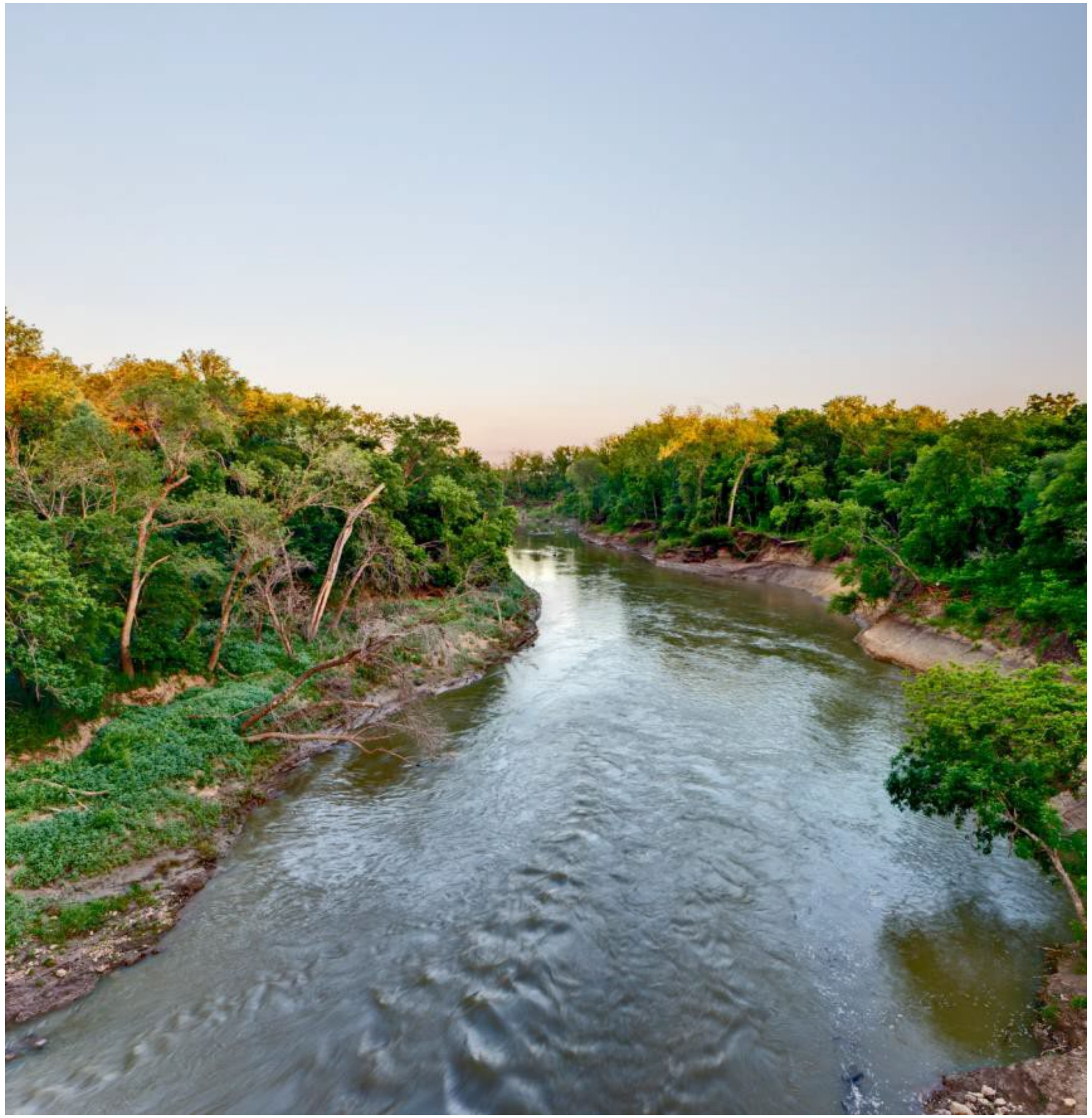
urban flood management
water quality
urban heat island impacts
ecological function of city landscapes.

Start with most challenged areas and parking lots!

Consider additional BMPs like Stormwater Parks.

NBS & Flood Resilience

- Incorporating GI/LID into Hazard Mitigation Planning, Denton County, Texas A&M AgriLife
- Upper Trinity Transportation Stormwater Infrastructure Project, NCTCOG
- Green Asset Management, Silver Jackets, City of Denton, Texas A&M AgrLife
- Trinity Floodplain Planning and Prioritization, Silver Jackets, TNC
- TWDB *NBS for Flood Resilience in Texas Guidance Manual*



Trinity Floodplain © Sean Fitzgerald

Thank You.

Kathy Jack, Ph.D. ,
The Nature Conservancy
kathy.jack@tnc.org

https://www.facebook.com/natureconservancytexas
https://twitter.com/nature_tx
https://www.instagram.com/nature_tx/

Fouad Jaber, Ph.D., P.E,
Texas A&M AgriLife Extension
Fouad.Jaber@ag.tamu.edu

Questions?

Speaker Introduction

Kevin Smith

- Planner with the Texas Water Development Board

How Regional Water Planning Groups Plan for Drought Resilience in an Uncertain Future

Kevin Smith
Water Supply Planning
Office of Planning
Texas Water Development Board

August 15, 2023

Sources of Uncertainty in Water Planning

- **Population and Municipal Water Demand**
    - Population growth and distribution
        - Economic and social factors
    - Per capita use
        - Individual preferences, culture and habits, weather, local conservation ordinances, adoption of water-efficient appliances
- **Water Supply**
    - Precipitation, temperature, evaporation, soil moisture conditions
- **Strategy Implementation**
    - Technical and political factors, permitting, financing, implementation timeline
- **Future Drought Conditions**
    - Warmer temperatures, increased evaporation, increasingly variable precipitation

Uncertainty in Water Planning

- **Population and Municipal Water Demand**
  - TWDB bases water demand projections utilized in regional water planning from reported data of historic annual water use estimates.
  - Data limitations introduce uncertainty in water use estimations, but demand projections are reexamined each five-year cycle, allowing regional water plans to be adaptive, adjust for corrections, and incorporate most recent and best available information.

- **Water Supply**
  - Quantifying surface water availability for regional water planning relies largely on deriving a single firm yield or safe yield value that is generated based on the historical record that includes the drought of record (DOR).

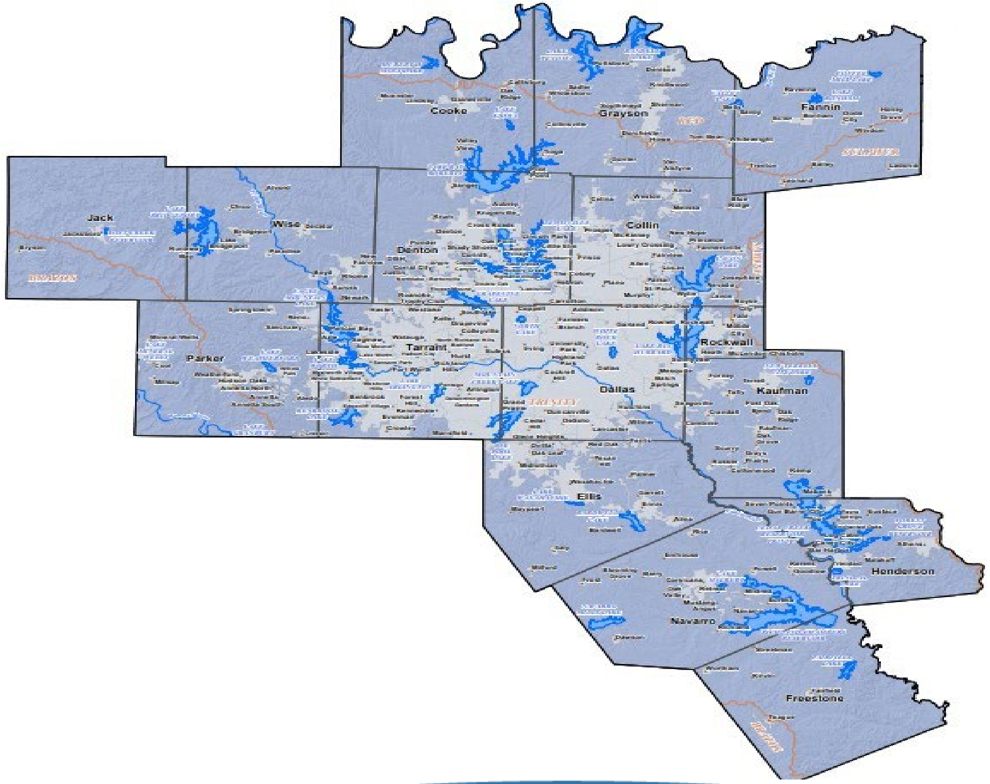
Uncertainty in Water Planning

- **Strategy Implementation**
  - To account for the possibility of strategies being downsized, modified, or abandoned, some RWPGs recommend a combination of strategies that, if implemented, would provide more water supplies than are required to only meet needs.
  - Some RWPGs also include 'alternative' strategies that can be easily substituted for a recommended strategy that becomes infeasible.
- **Future Drought Conditions**
  - Projections of future rainfall, temperature, and streamflow can be utilized to quantify the uncertainty associated with future available water resources and drought conditions. The TWDB is consulting with the State Climatologist to receive information and projections that could be used to identify regions of the state more likely to experience severe drought.

Water Planning Staff Efforts Related to Uncertainty

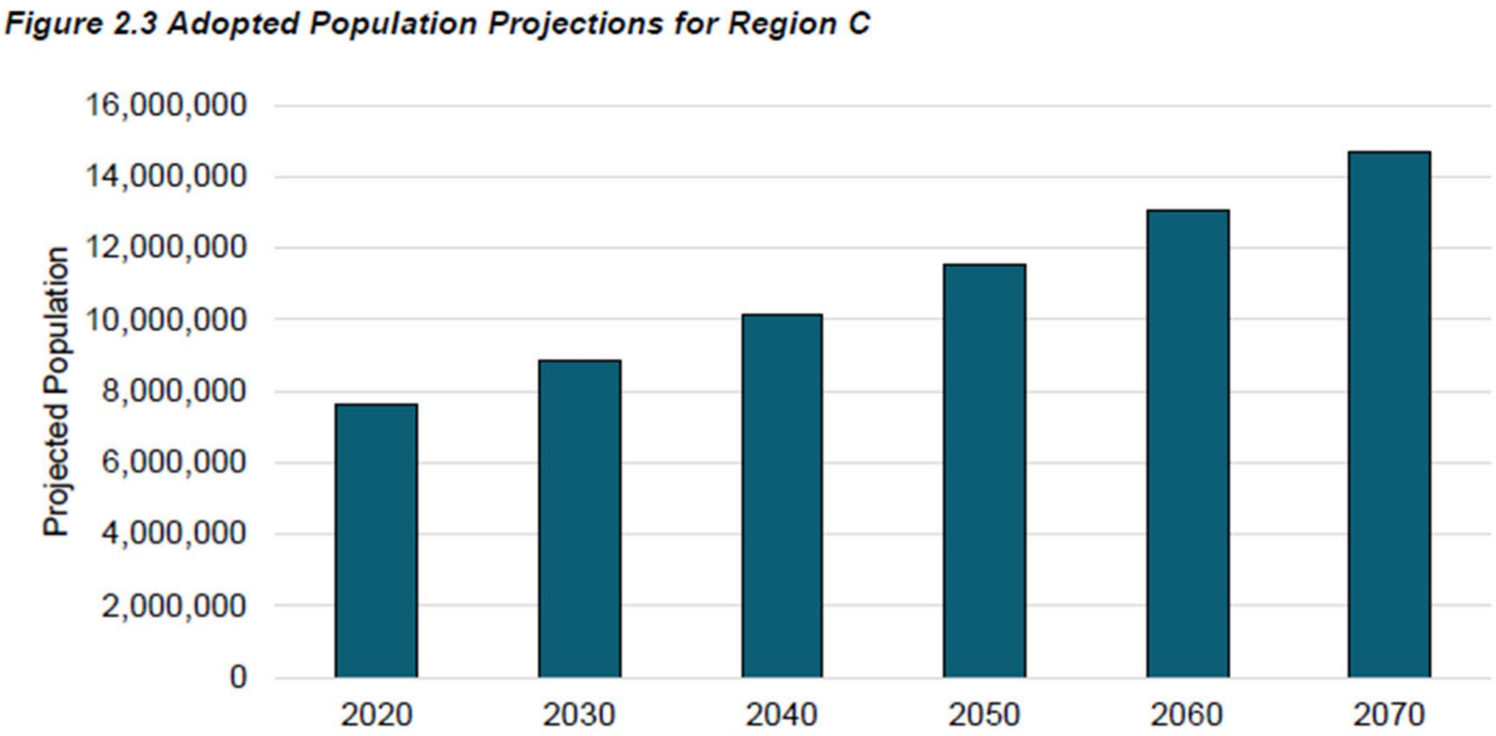
- TWDB was directed by a 2022 Sunset Commission recommendation to consult with the Office of the State Climatologist at Texas A&M University in the preparation of regional and state water plans to receive information and projections to identify regions of the state that are likely to experience severe drought or excessive rainfall.
- Prior to the 2022 Sunset recommendation, TWDB had already been working with the State Climatologist, John Nielsen-Gammon, on climate-related science and uncertainty.
- TWDB continues to work with the State Climatologist to explore ways
  - to be responsive to the Sunset directive, and
  - to better highlight and, where possible, quantify water planning uncertainties in the state water plan
- How certain results of TWDB's consultation with the State Climatologist may eventually be considered in the state and regional planning processes will be determined with stakeholder input, as appropriate.

Region C Regional Water Planning Group



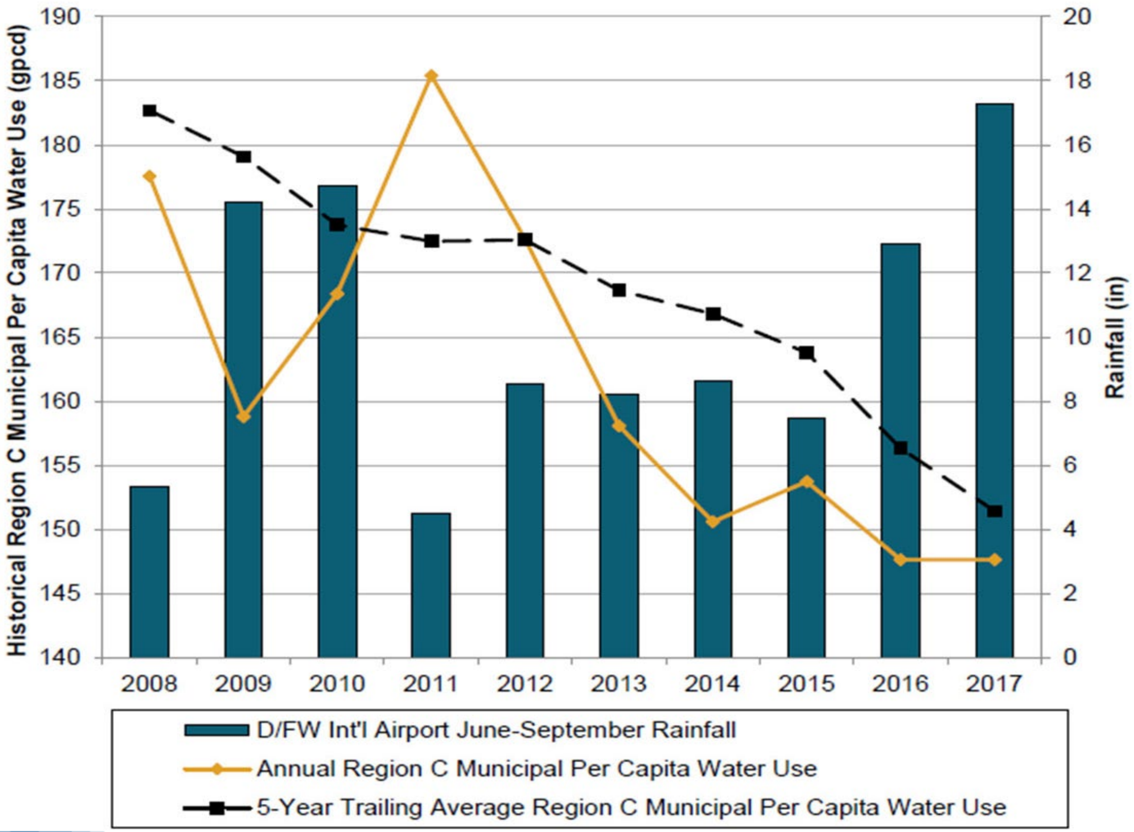
Collin	Dallas
Denton	Ellis
Erath	Hood
Hunt	Johnson
Kaufman	Navarro
Palo Pinto	Parker
Rockwall	Somervell
Tarrant	Wise

Region C Population



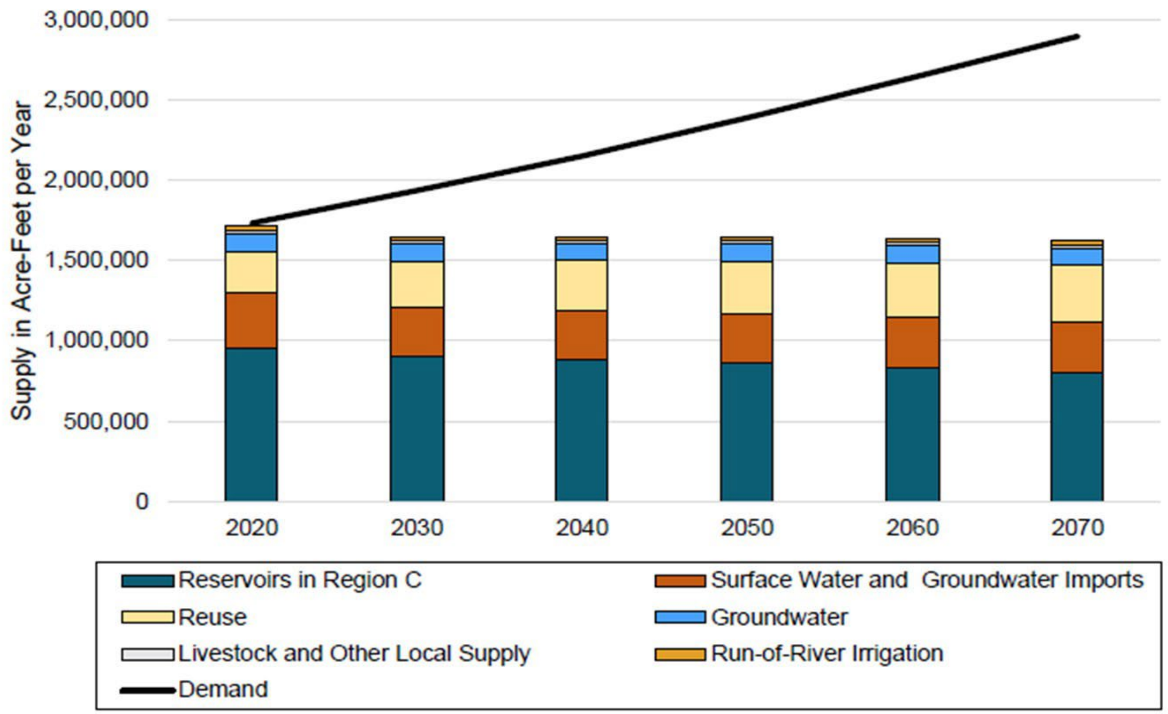
Region C Water Use

Figure 5B.1 Region C Historical Municipal Per Capita Water Use



Region C Water Supply

Figure ES.3 Comparison of Currently Available Supplies and Projected Demands



Region C Water Supply

Table ES.2 2070 Supplies for the Major and Regional Water Providers in Region C

Wholesale Water Provider	Supplies Available in 2070 from Current Sources [a]	Supplies Available in 2070 from New Strategies [a]	Total Supplies Available in 2070[a]	% of Total Supply from Conservation and Reuse	Cost of Strategies (Millions)
Dallas Water Utilities	500,097	436,063	936,160	33.1%	$5,137
Tarrant Regional Water District	471,897	539,990	1,011,887	31.4%	$6,311
North Texas Municipal Water District	400,272	635,961	1,036,233	28.9%	$10,035
City of Fort Worth	282,992	250,890	533,882	31.0%	$2,191
Trinity River Authority	155,466	156,582	312,048	36.2%	$0
Upper Trinity Regional Water District	54,586	141,328	195,914	27.1%	$2,143
Greater Texoma Utility Authority	22,679	75,549	98,228	15.1%	$240
Total for Region C[b]	**1,590,440**	**1,869,546**	**3,459,986**		**$30,334**
2070 Demand in Region C			**2,898,540**		
Management Supply Factor for Region C			**1.194**		

a. *Current sources include only those that are connected. Some supplies are used by more than one supplier. For example, TRWD supplies water to TRA and Fort Worth, DWU supplies water to UTRWD, etc.*

b. *Total for Region C is not a sum of the numbers above. It includes other providers as well. Some supplies serve multiple suppliers.*

Drought of Record (DOR) in Region C

- DOR for most supplies in Region C occurred from 1950 to 1957.
- Recent drought periods (2003-2006 and 2011-2015) caused low inflows and water level for many Region C lakes.
- Jim Chapman (Cooper Lake) in the Sulphur River Basin recently experienced a new DOR (2011-2015), yield reduced by 7 percent from last regional water plan.
- Yields of proposed projects in the Sulphur Basin are reduced.

SOURCE: 2021 Region C Plan

Planning for Drought Worse Than DOR

- HB 1565 - TWDB Sunset Bill
  - RWPGs may plan for conditions worse than drought of record.
- New RWP subsection required to address how RWPGs address uncertainty and droughts worse than DOR (if applicable), and what additional measures not included in the plan could be available during a drought worse than DOR.
- Planning groups have been addressing drought uncertainty within existing planning framework.
  - Use of safe yield and safety factors for water availability modeling
  - Additional recommended strategy supplies in excess of identified needs
  - MWP/WWP use of scenario planning in long-range plans

Drought Preparations in Region C

- Drought Contingency Plans (DCP) required for wholesale and retail public water suppliers, irrigation districts, and applicants for new or amended water rights. DCPs reviewed and updated at least every five years.
- Most major water providers (DWU, Fort Worth, NTMWD, TRWD and UTRWD) share consistent DCPs with three stages of uniform irrigation restrictions. MWPs also encourage customers to adopt similar DCPs.
- Region C obtained DCPs from sixty-three (63) entities in the region and has developed a DCP database.

Table 7.1 Statistics for Common Drought Contingency Plan Measures

Drought Response Measure	Percentage of Plans Specifying Strategy	Average Stage Initiated
No irrigation with hose-end sprinklers	96.8%	3.3
No irrigation with automatic irrigation systems	95.2%	3.3
Prohibit non-essential water uses - hosing of buildings or other structures except for fire protection	87.3%	2.6
No draining and filling of pools and spas	87.3%	2.9
Public awareness/ customer awareness measures	84.1%	1.1
Mandatory no more than twice per week irrigation limits	82.5%	1.3
Prohibit non-essential water uses - hosing of paved areas	81.0%	2.5
No operation of ornamental fountains/ ponds	79.4%	2.9
Mandatory no more than once per week irrigation limits	76.2%	2.1
No irrigation of golf course fairways	73.0%	3.2
No vehicle washing outside commercial facilities	71.4%	3.1
Encourage delay in establishing new landscaping	68.3%	1.3
No irrigation of athletic fields	66.7%	3.3
Discontinue non-essential water use by city/utility	65.1%	1.9
Use alternative supply sources	65.1%	2.7
No new permits for swimming pools, Jacuzzis, spas, ornamental ponds, or fountains	63.5%	3.1
No new landscaping or watering of new landscaping	63.5%	3.1
Water rationing/ reductions by set percentages for commercial/ industrial customers	63.5%	3.2
No irrigation of public areas	63.5%	3.4
No irrigation of landscaped areas, such as gardens, trees, and flowers	63.5%	3.5
No irrigation by hand-watering, with soaker hoses, or by drip irrigation	61.9%	3.5
Investigate alternative water sources	60.3%	1.6
Request wholesale customers implement Stage 1 or similar measures	57.1%	1.0
Discourage/ reduce frequency of draining and filling of pools and spas	57.1%	1.0
Increased enforcement; add personnel	57.1%	1.3
Prohibit non-essential water uses - flushing gutters, allowing runoff, not repairing leaks	57.1%	1.8
Request wholesale customers implement Stage 2 or similar measures	57.1%	2.0
Mandatory limit on irrigation hours	55.6%	1.4
Request wholesale customers implement Stage 3 or similar measures	55.6%	3.0
Vehicle washing only with bucket and/or handheld hose with shutoff nozzle (outside of commercial facilities)	52.4%	1.3
Mandatory maximum once weekly landscape watering schedule for private parks and golf courses	52.4%	2.0
Intensify public awareness/ customer awareness measures	52.4%	2.1
Implement rate surcharges	50.8%	2.0

Drought Preparations in Region C

- Numerous entities have DCPs which include an emergency response stage and corresponding measures for droughts exceeding the DOR. Some entities, including a number of wholesale water providers have emergency action plans which establish procedures for responding rapidly and effectively to emergency conditions.
- Developed list of emergency interconnects detailing interconnection relationships, facilities, general locations, and supply volumes and sources.
- Region C has developed model DCPs for entities not required to have a DCP and not under the DCP of a supplier.

Questions?

Kevin Smith
Regional Water Planner, TWDB
(512) 475-1561
Kevin.Smith@twdb.texas.gov

Wrap-Up

- If you submitted a RSVP for this webinar, you will receive an email with the presentation slides and a subsequent email with a link to the recording.
- All webinar slides and recordings are posted on NCTCOG's website under the green banner, "Webinars" here:
- https://www.nctcog.org/envir/natural-resources/water-resources
- If you did not RSVP and would like these webinar materials, please email aknox@nctcog.org.

Webinar Feedback

- Please provide your feedback on today's webinar in this 4-question survey. Thank you!

[Provide Webinar Feedback Here]

North Central Texas Council of Governments

Thank you for attending!

NCTCOG Webinar
August 15, 2023

Prepared in cooperation with the Texas Commission on Environmental Quality and U.S. Environmental Protection Agency

United States Environmental Protection Agency

Alyssa Knox, NCTCOG
aknox@nctcog.org

North Central Texas Council of Governments
Environment & Development

www.nctcog.org/WaterResources