North Central Texas
Council of Governments

Technical Advisory Group Meeting

January 24, 2025

Funded by the Texas General Land Office, Community Development Block Grant, Disaster Recovery Program.

Also Funded by the Texas Water Development Board and Texas Department of Transportation.

Agenda

I. Duke-TRWD Conservation Priority Mapping Project

II. Progress to Date

III. Flood Control Prioritization Mapping – Stacking Model

IV. Expansion of Corridor Development Certificate Process

V. North Study Area H&H Modeling Update

VI. Denton County Greenbelt Plan

VII. Outreach to Local Governments

VIII. Next Steps and Upcoming Events

Duke-TRWD Conservation Priority Mapping Project

TARRANT REGIONAL WATER DISTRICT

Katie Myers

integrating **Transportation**
& Stormwater Infrastructure

Duke MEM Project: Prioritizing Land Conservation for Water Supply

TSI TAG

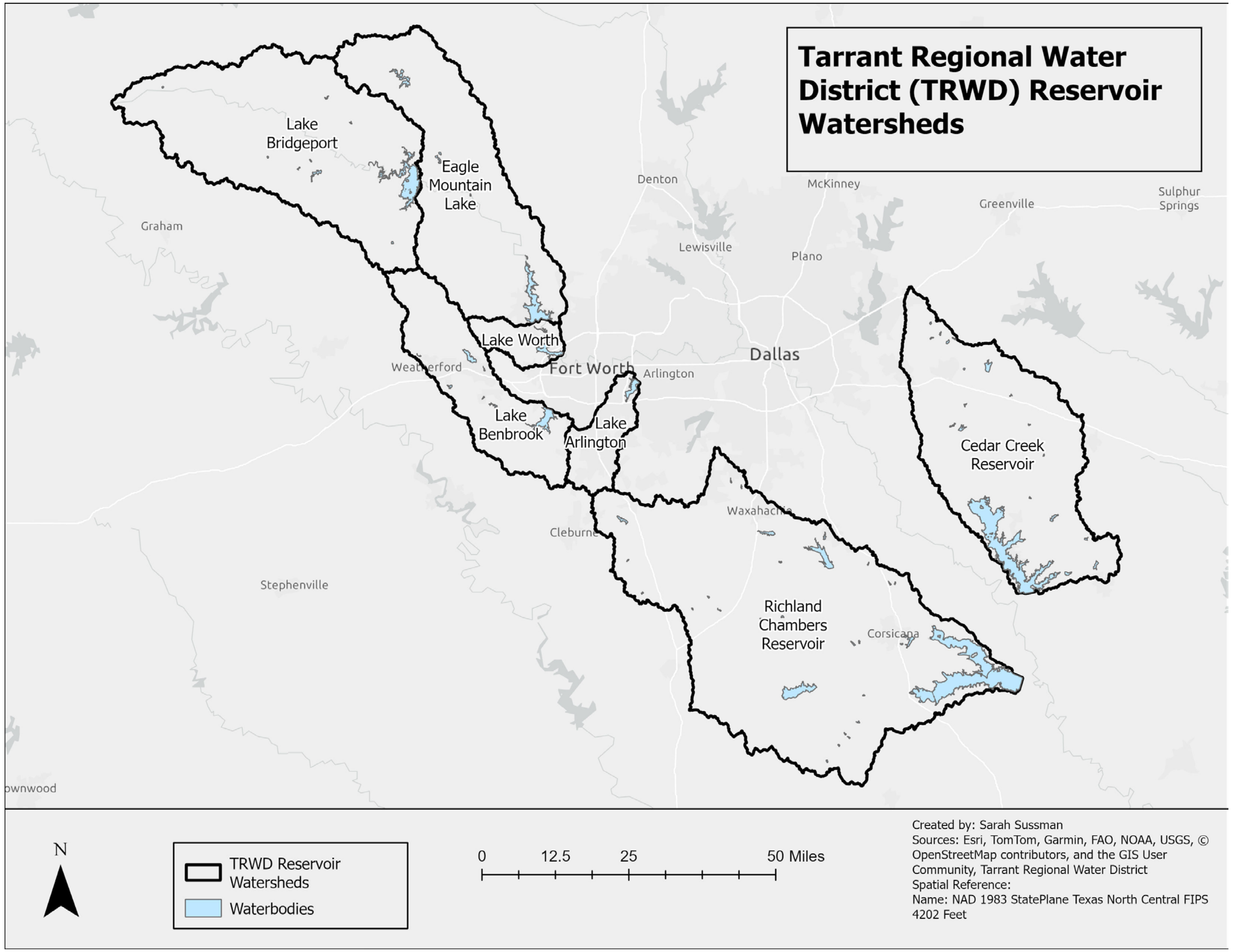
Katie Myers, Rural Programs Supervisor, TRWD

Sarah Sussman and Samantha White, Duke University MEM Candidates May 2025

Advised by Jim Heffernan, PhD

Background

- TRWD owns 4 reservoirs and stores water in 3 additional reservoirs
- In a growing metro, the longevity and quality of these water supplies is paramount to meeting future needs
- Additionally, the urbanizing NW fringe of the metro will result in higher runoff flows through the Fort Worth Floodway system
- Conserved landscapes act as natural infrastructure with regulating services including infiltration and erosion control


Tarrant Regional Water District (TRWD) Reservoir Watersheds

Created by: Sarah Sussman
Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community, Tarrant Regional Water District
Spatial Reference:
Name: NAD 1983 StatePlane Texas North Central FIPS 4202 Feet

Project Overview

Primary Goals

- Identify priority areas for potential conservation within TRWD-affiliated watersheds that provide maximum water supply impact
  - Resulting product will be useful in partner conversations with land trusts and land-holding entities
  - Identification of maximum impact areas bolsters future internal programmatic/budget conversations for this work

Secondary Goals

- Provide a valuable real-world work experience for the next generation of environmental professionals
- Bring attention to the region as an area where there's a lot of great work to be done

Data and Methods

Conservation Value =

Environmental Factors + Social Factors + Proximity to Protected Areas

Land Cover
Slope
Soil k Factor
Riparian Areas

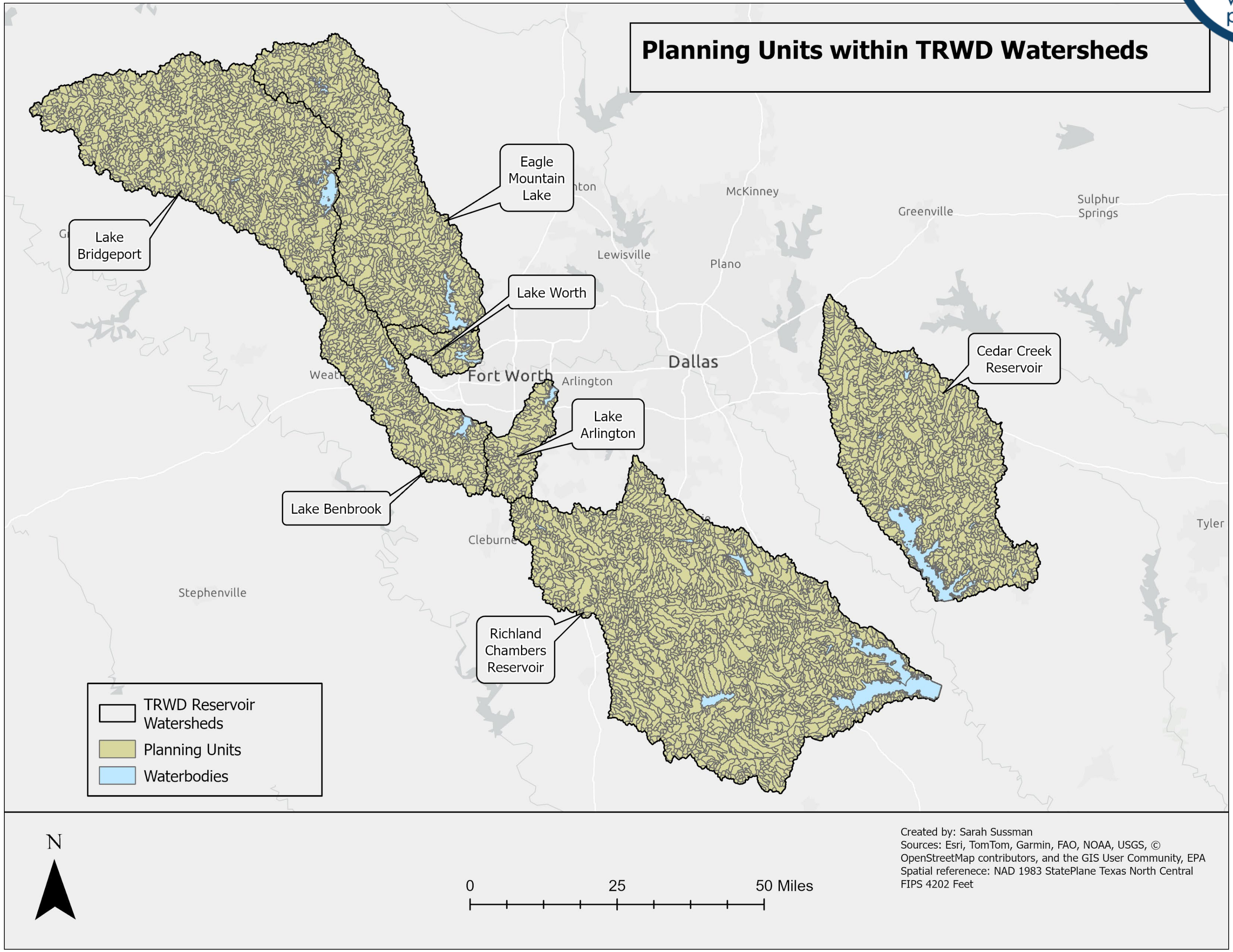
Development Pressure
Household Income
Property Ownership

Proximity to Existing Protected Areas

- Primary tool of analysis was ArcGIS Pro
- Data sourced from TRWD, USGS, and US Census
- Framework allows for adjusted weightings in the future and for each analysis to stand alone
- All factors normalized 0-1 for uniformity when stacking

Planning Units

- Students developed planning units using watersheds tool and hydroDEM
- HUC 12 (readily available) was too large to give us the outputs we wanted; parcels were far too granular

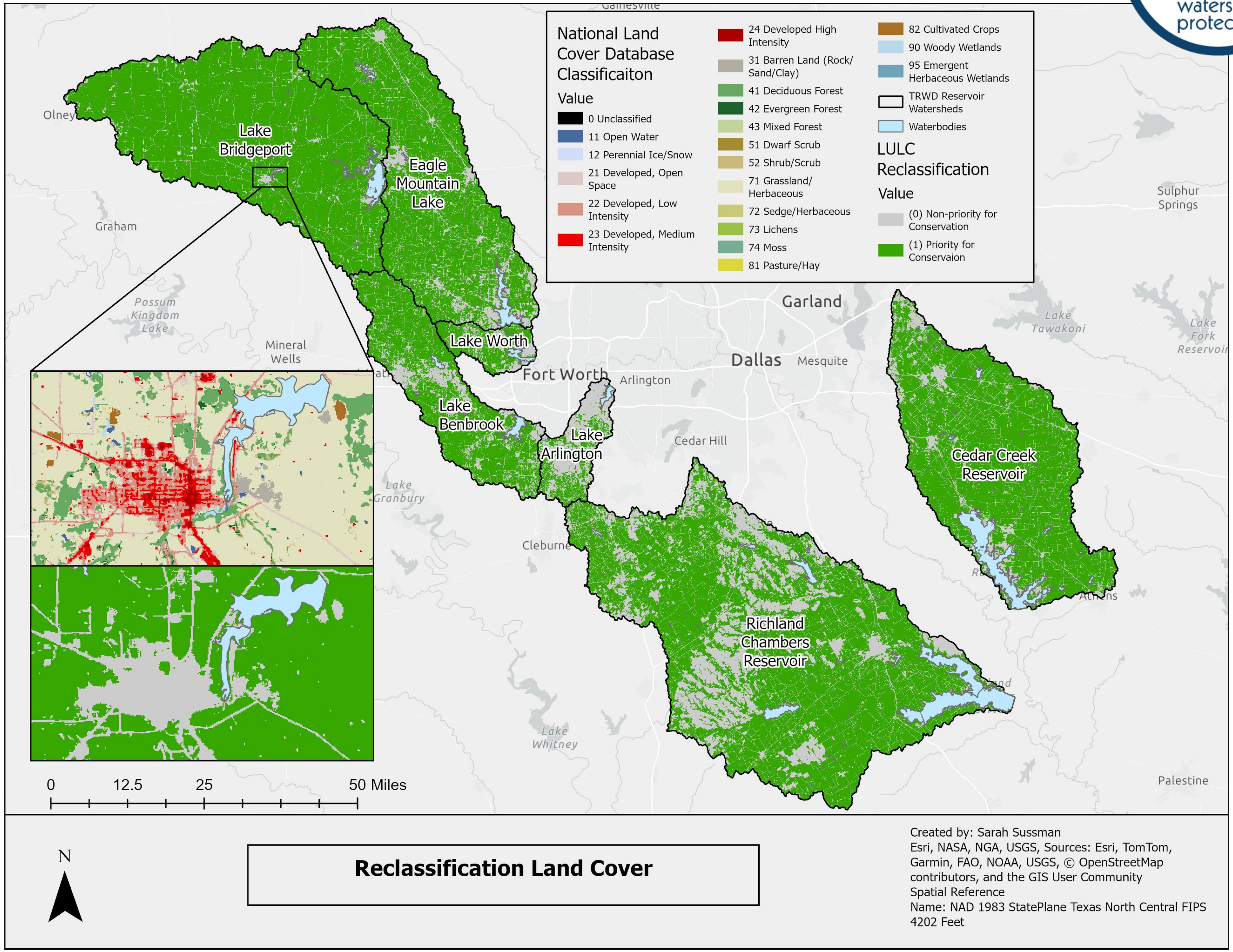


Planning Units within TRWD Watersheds

Created by: Sarah Sussman
Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community, EPA
Spatial referenece: NAD 1983 StatePlane Texas North Central FIPS 4202 Feet

Environmental: Land Cover

Land Use/Land Cover	Reclassification (0,1)
Unclassified (0)	0
Open Water (11)	0
Perennial Ice/snow (12)	0
Developed (21-24)	0
Barren Land (31)	0
Forest types (41-43)	1
Scrub types (51-52)	1
Grassland (71)	1
Sedge/Herbaceous (72)	1
Lichens (73), Moss (74)	1
Pasture/Hay (81)	1
Cultivated Crops (82)	0
Woody Wetlands (90)	1
Emergent Herbaceous Wetlands (95)	1

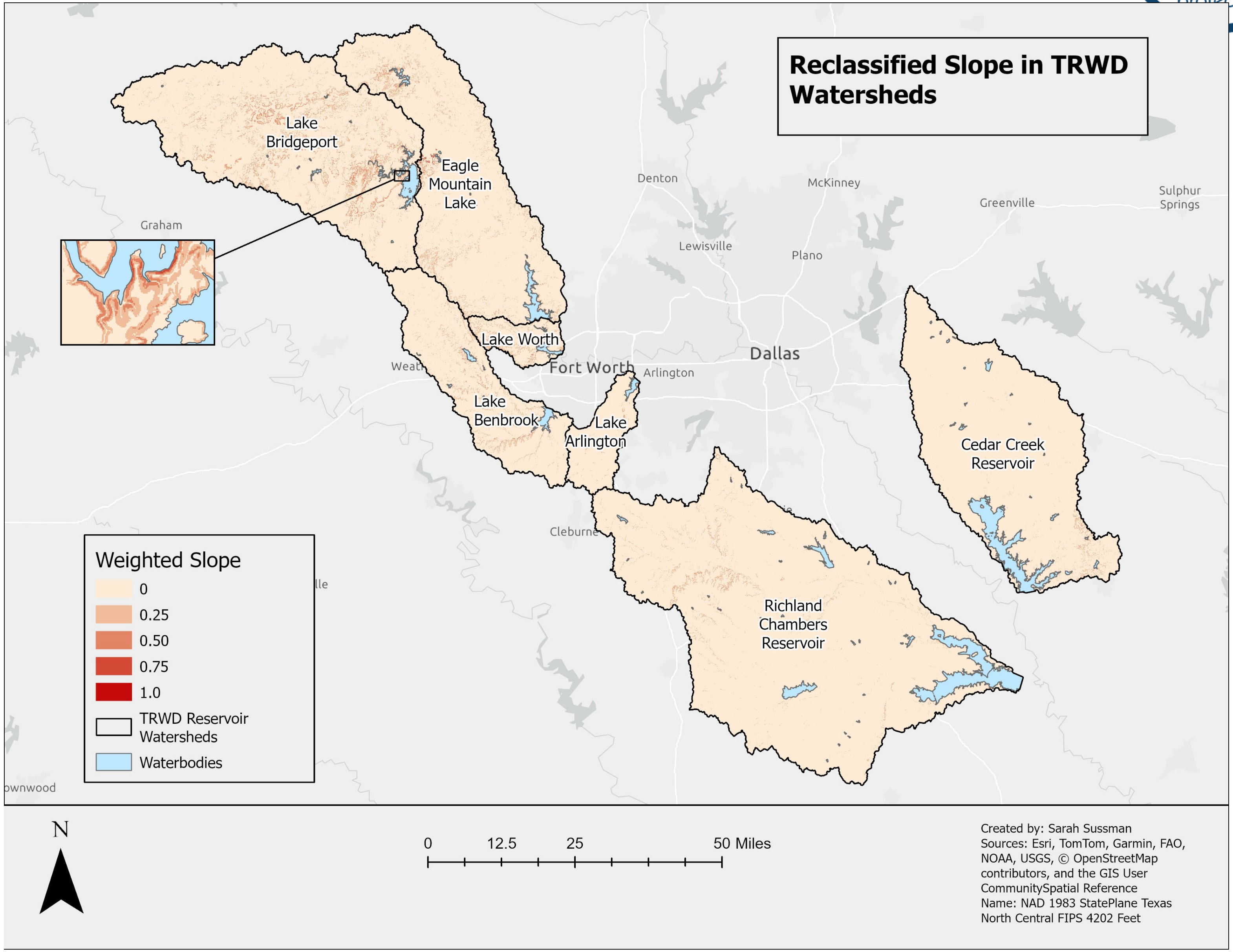


Reclassification Land Cover

Created by: Sarah Sussman
Esri, NASA, NGA, USGS, Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community
Spatial Reference
Name: NAD 1983 StatePlane Texas North Central FIPS 4202 Feet

Environmental: Slope

Slope %	Reclassification
0 - 5	0
6 - 10	0.25
11 - 20	0.50
21 - 30	0.75
31 - 50	1



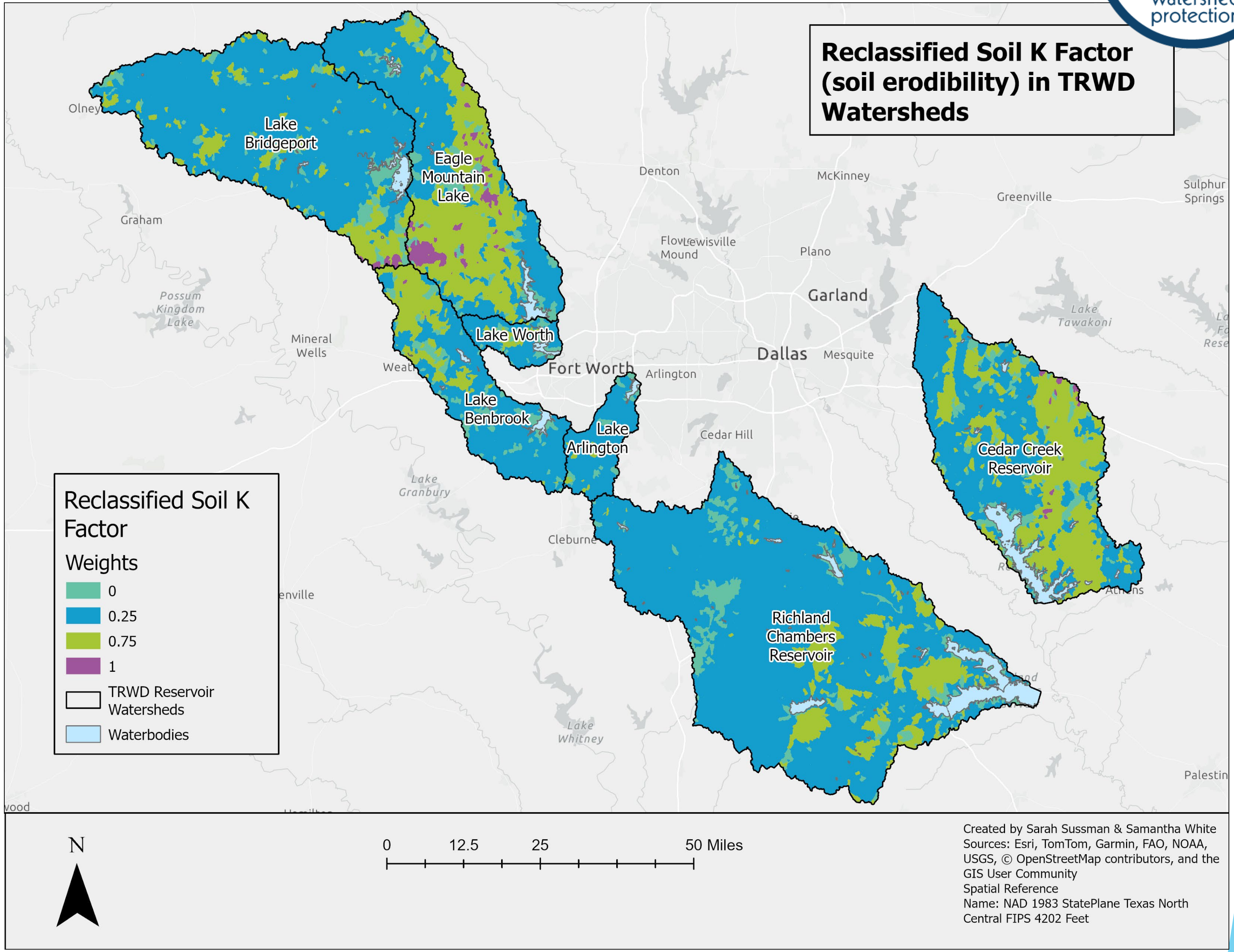
Reclassified Slope in TRWD Watersheds

Created by: Sarah Sussman
Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User CommunitySpatial Reference Name: NAD 1983 StatePlane Texas North Central FIPS 4202 Feet

Environmental: Soil Erodibility

- Based on soil K factor
- Clays and sands have the lowest K factor; loams are intermediate; silts are highest (past land use can make this less accurate)

Soil k Factor	Reclassification
0.02 – 0.19	0
0.2 – 0.35	0.25
0.36 – 0.52	0.75
0.53 - 0.69	1

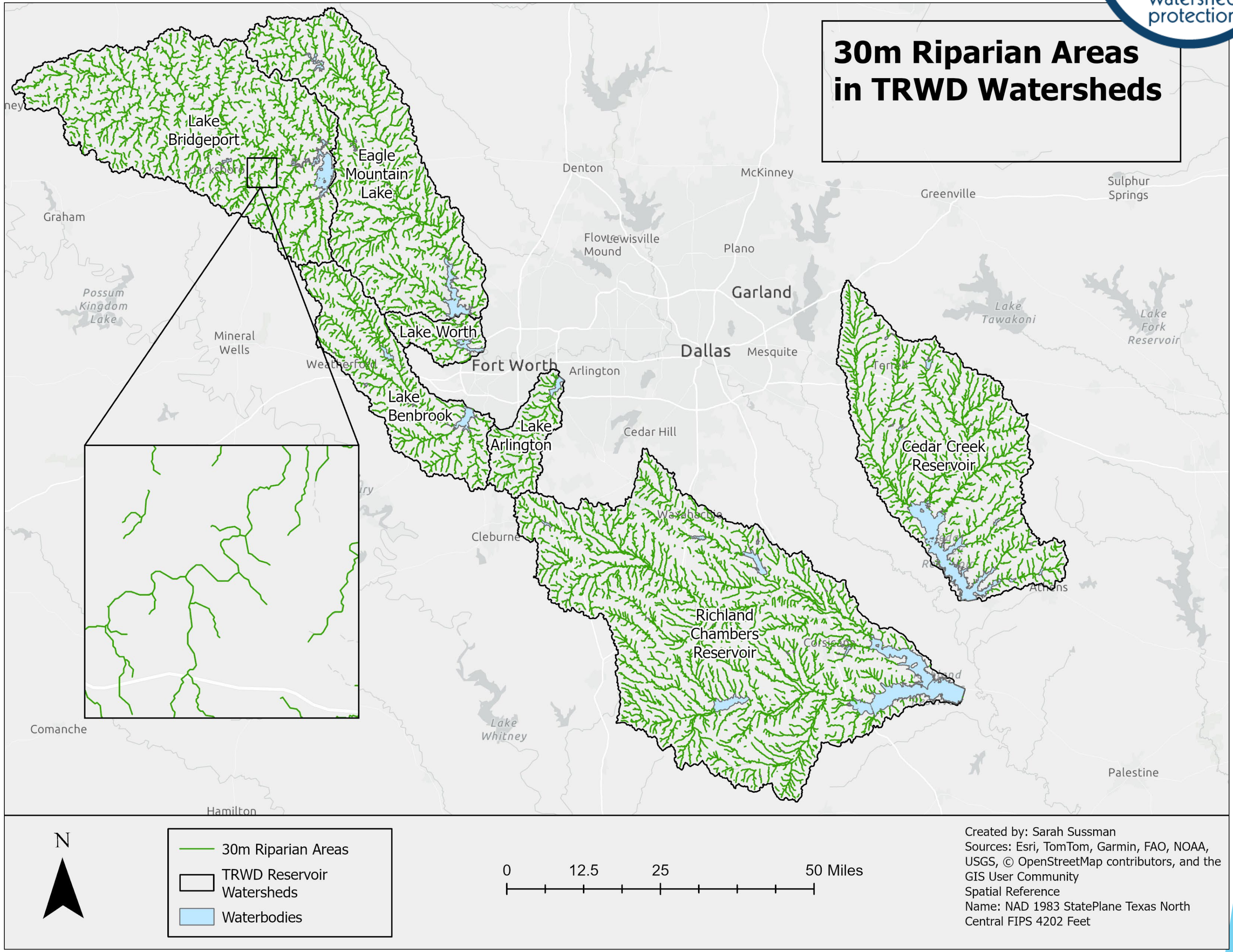


Reclassified Soil K Factor (soil erodibility) in TRWD Watersheds

Created by Sarah Sussman & Samantha White
Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community
Spatial Reference
Name: NAD 1983 StatePlane Texas North Central FIPS 4202 Feet

Environmental: Riparian Areas

Riparian Area (30m)	Reclassification
Riparian Areas? YES	1
Riparian Area? NO	0



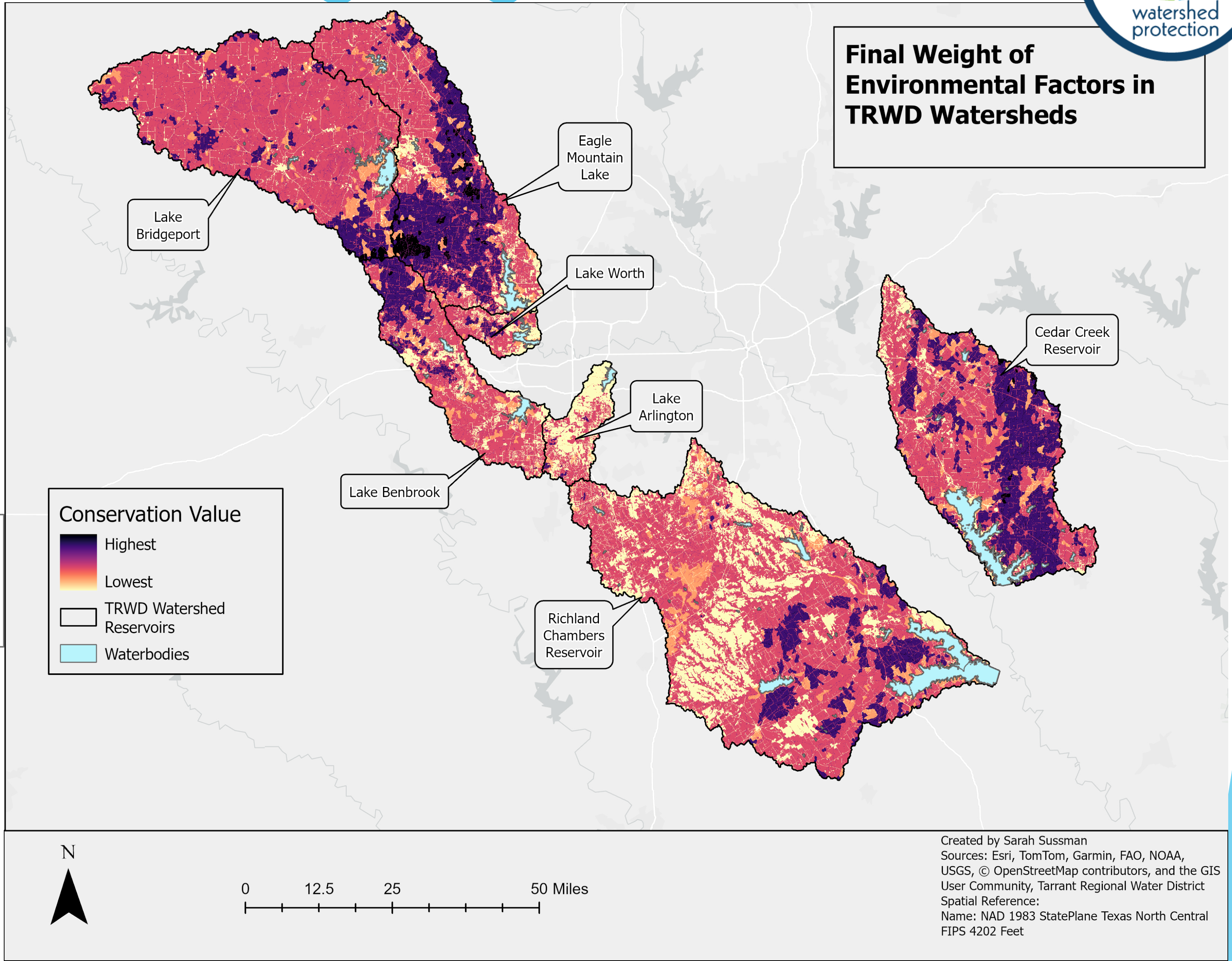
30m Riparian Areas in TRWD Watersheds

Created by: Sarah Sussman
Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community
Spatial Reference
Name: NAD 1983 StatePlane Texas North Central FIPS 4202 Feet

Environmental: Final Weighting

Factor	Additional Weight
Riparian Areas	0.15
Slope	0.10
Land Cover	0.25
Soil k factor	0.50

Final Environmental Weight = *(Riparian Areas * 0.15) + (Slope * 0.10) + (Land Cover * 0.25) + (Soil k factor * 0.50)*



Final Weight of Environmental Factors in TRWD Watersheds

Created by Sarah Sussman
Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community, Tarrant Regional Water District
Spatial Reference:
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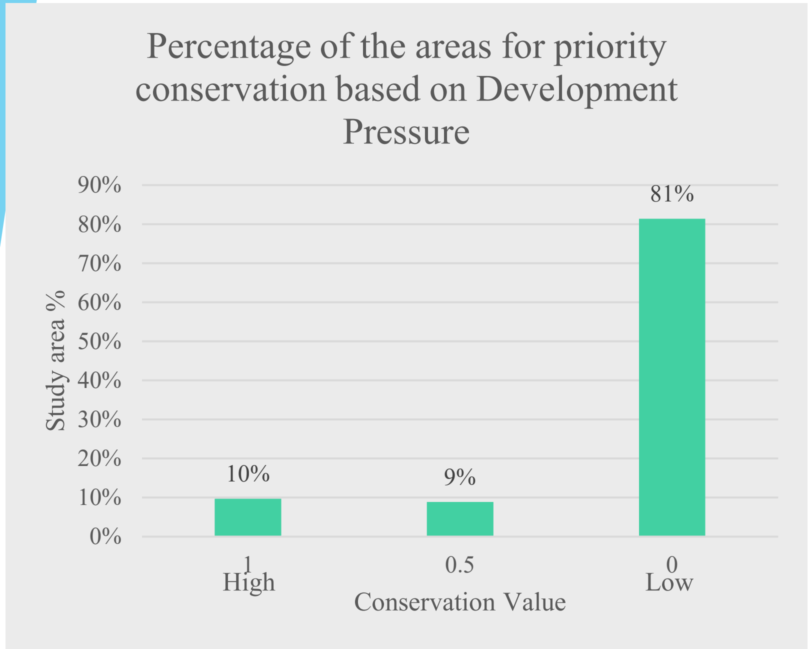
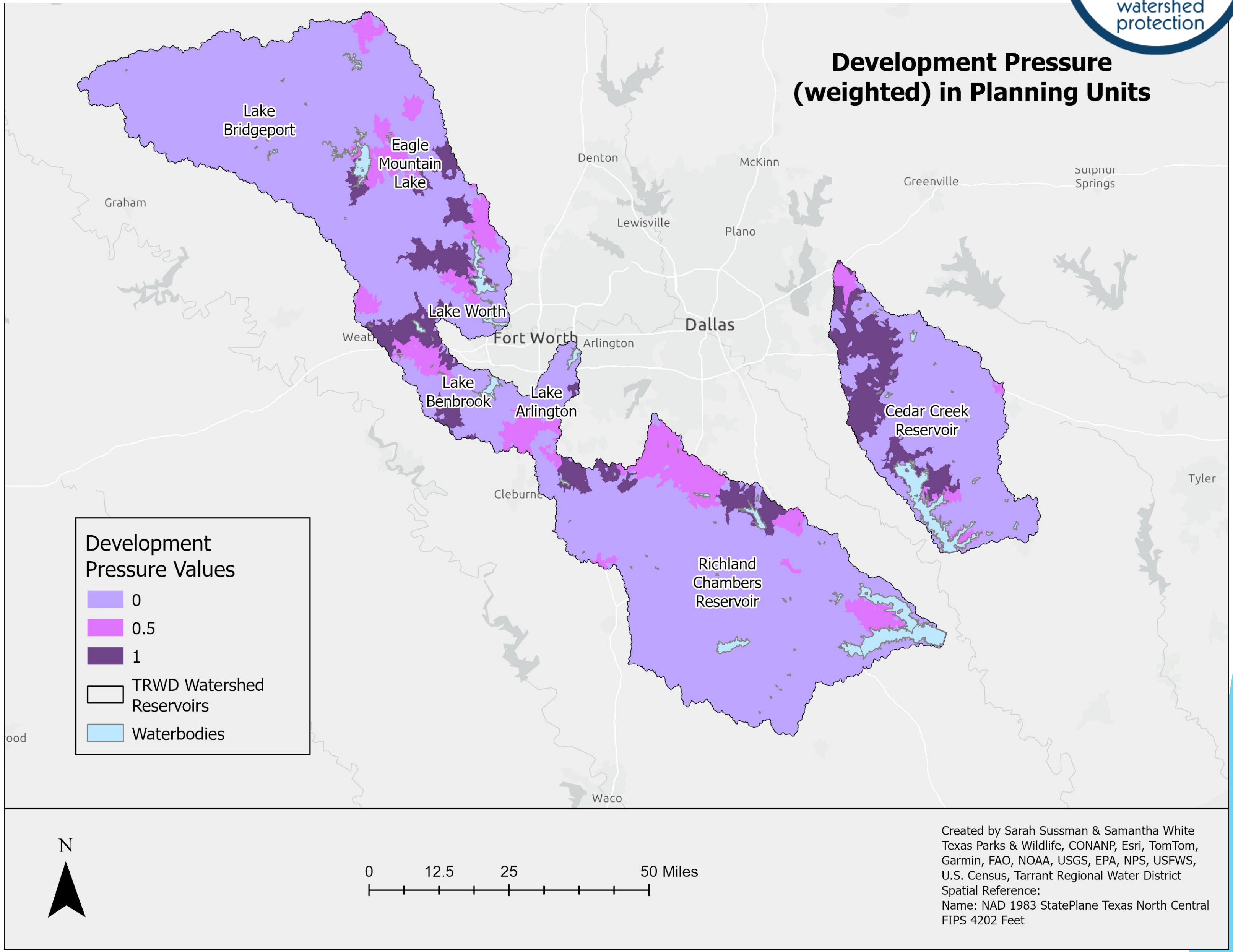
Social: Development Pressure

Cities % population growth (2020 - 2023)	Reclassification
< 2%	0
2% - 4%	0.5
> 4%	1



Percentage of the areas for priority conservation based on Development Pressure

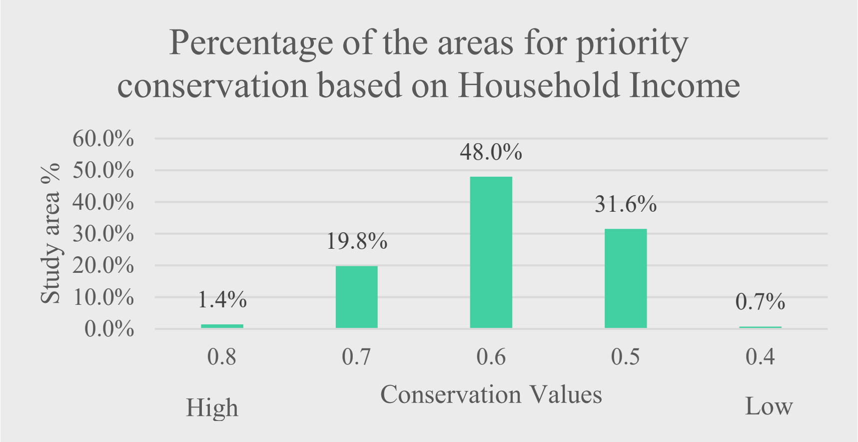


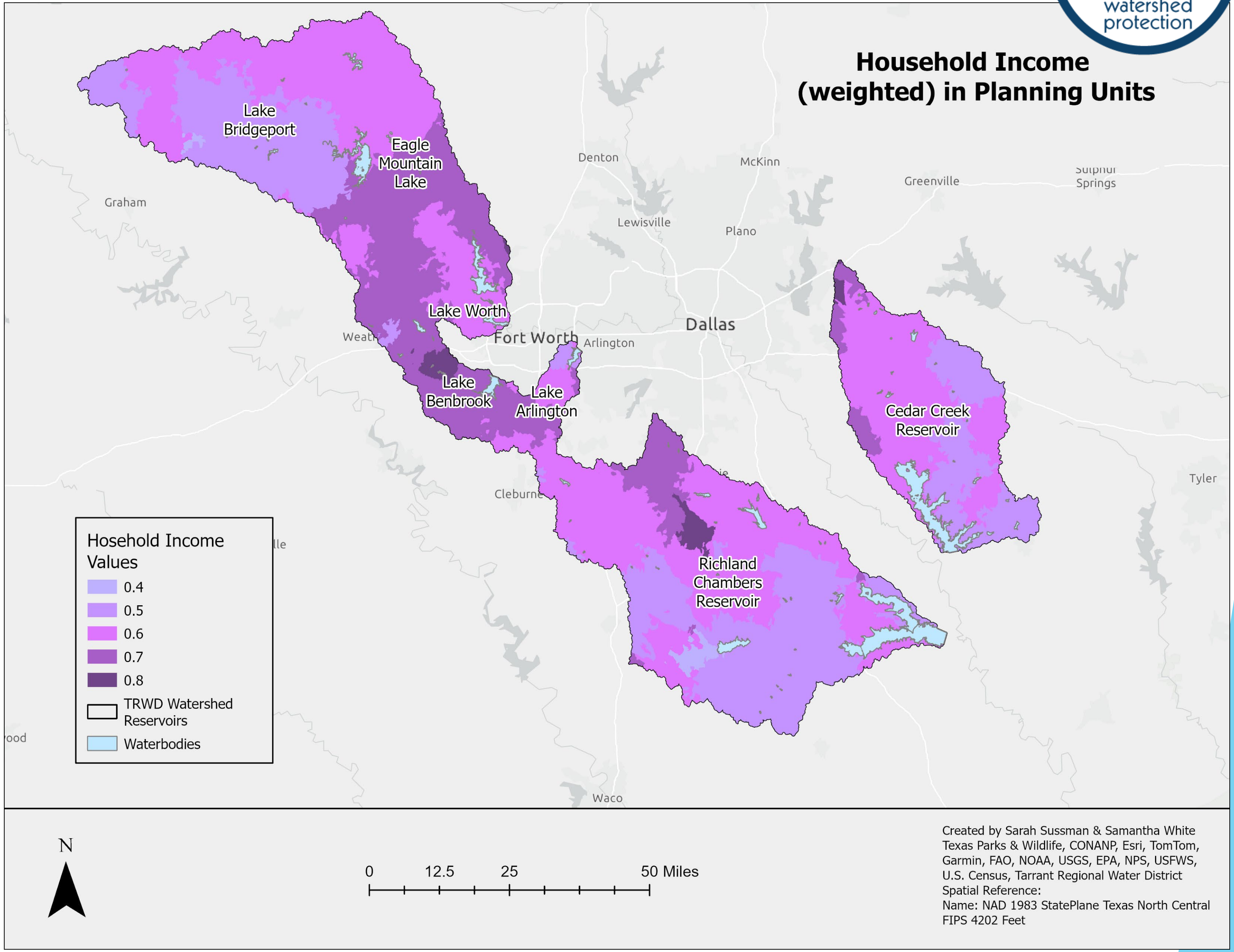
Development Pressure (weighted) in Planning Units

Created by Sarah Sussman & Samantha White
Texas Parks & Wildlife, CONANP, Esri, TomTom, Garmin, FAO, NOAA, USGS, EPA, NPS, USFWS, U.S. Census, Tarrant Regional Water District
Spatial Reference:
Name: NAD 1983 StatePlane Texas North Central FIPS 4202 Feet

Social: Household Income

Household income (Zip Code)	Reclassification
< $ 10,000	0
$10,000 - $14,999	0.1
$15,000 - $24,999	0.2
$25,000 - $34,999	0.3
$35,000 - $49,999	0.4
$50,000 - $74,999	0.6
$75,000 - $99,999	0.7
$100,000 - $149,999	0.8
$150,000 – $199,999	0.9
> $200,000 year	1


Percentage of the areas for priority conservation based on Household Income


Household Income (weighted) in Planning Units

Created by Sarah Sussman & Samantha White
Texas Parks & Wildlife, CONANP, Esri, TomTom, Garmin, FAO, NOAA, USGS, EPA, NPS, USFWS, U.S. Census, Tarrant Regional Water District
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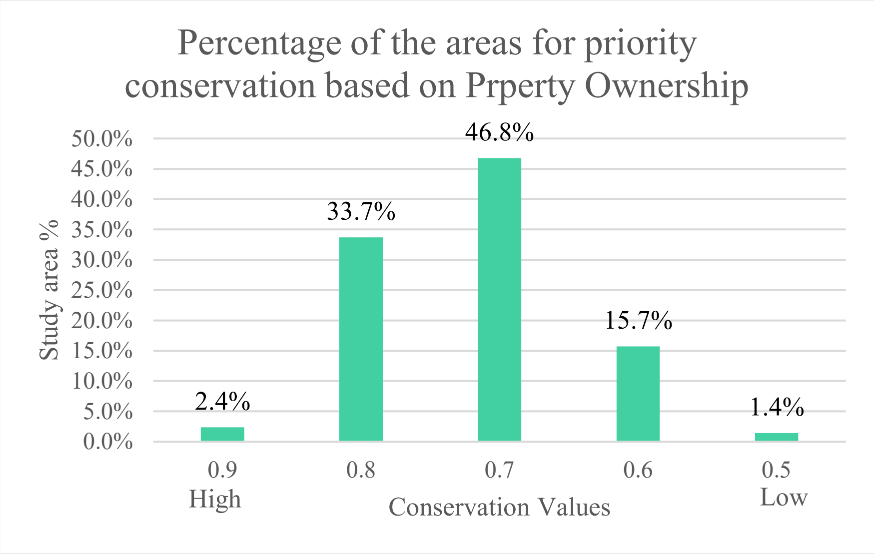
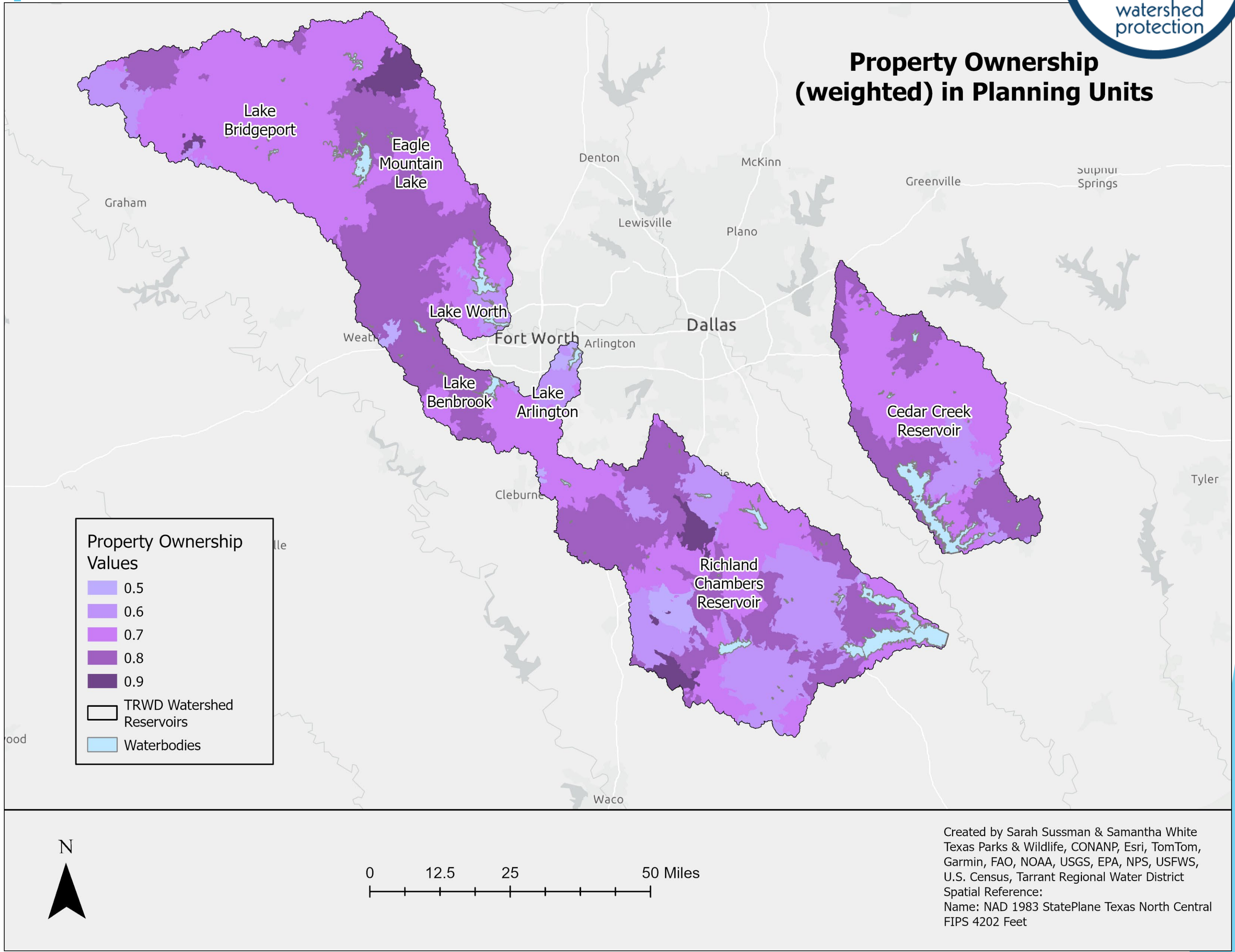
FIPS 4202 Feet

Social: Ownership

% Land Own or Rent (ZIP)	Reclassification
Own	1
Rent	0



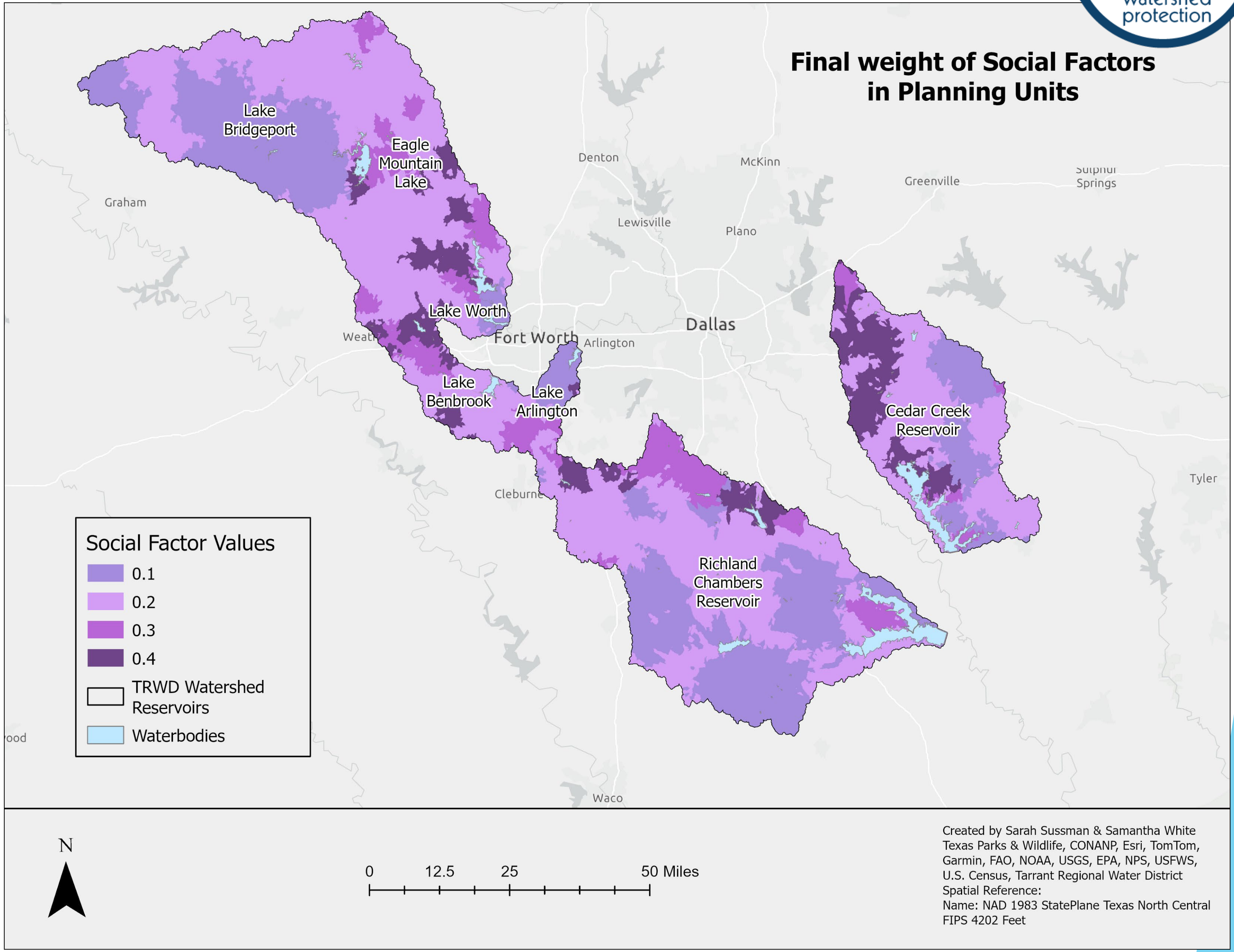

Property Ownership (weighted) in Planning Units

Created by Sarah Sussman & Samantha White
Texas Parks & Wildlife, CONANP, Esri, TomTom, Garmin, FAO, NOAA, USGS, EPA, NPS, USFWS, U.S. Census, Tarrant Regional Water District
Spatial Reference:
Name: NAD 1983 StatePlane Texas North Central FIPS 4202 Feet

Social: Final Weighting

Factor	**Additional Weight**
Development Pressure	0.68
Land Ownership	0.45
Household Income	0.24

Final Social Weight =
*(Development pressure * 0.68)* +
*(Land Ownership * 0.45)* +
*(Household Income * 0.24)*



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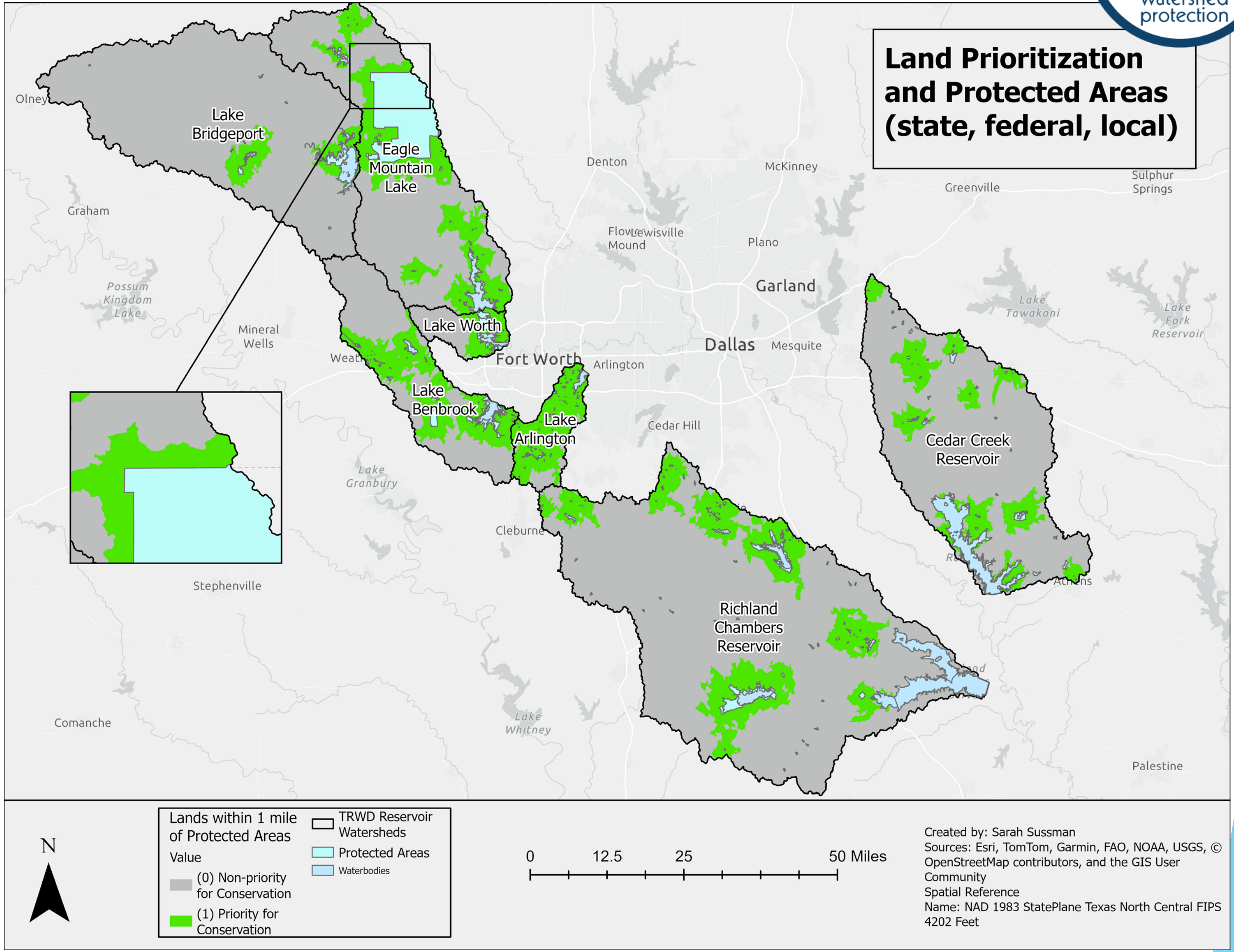
Spatial Reference:
Name: NAD 1983 StatePlane Texas North Central FIPS 4202 Feet

Proximity to Protected Areas

Protected Lands	Reclassification
Within 1 mile? YES	1
Within 1 mile? NO	0



Land Prioritization and Protected Areas (state, federal, local)

Created by: Sarah Sussman
Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community
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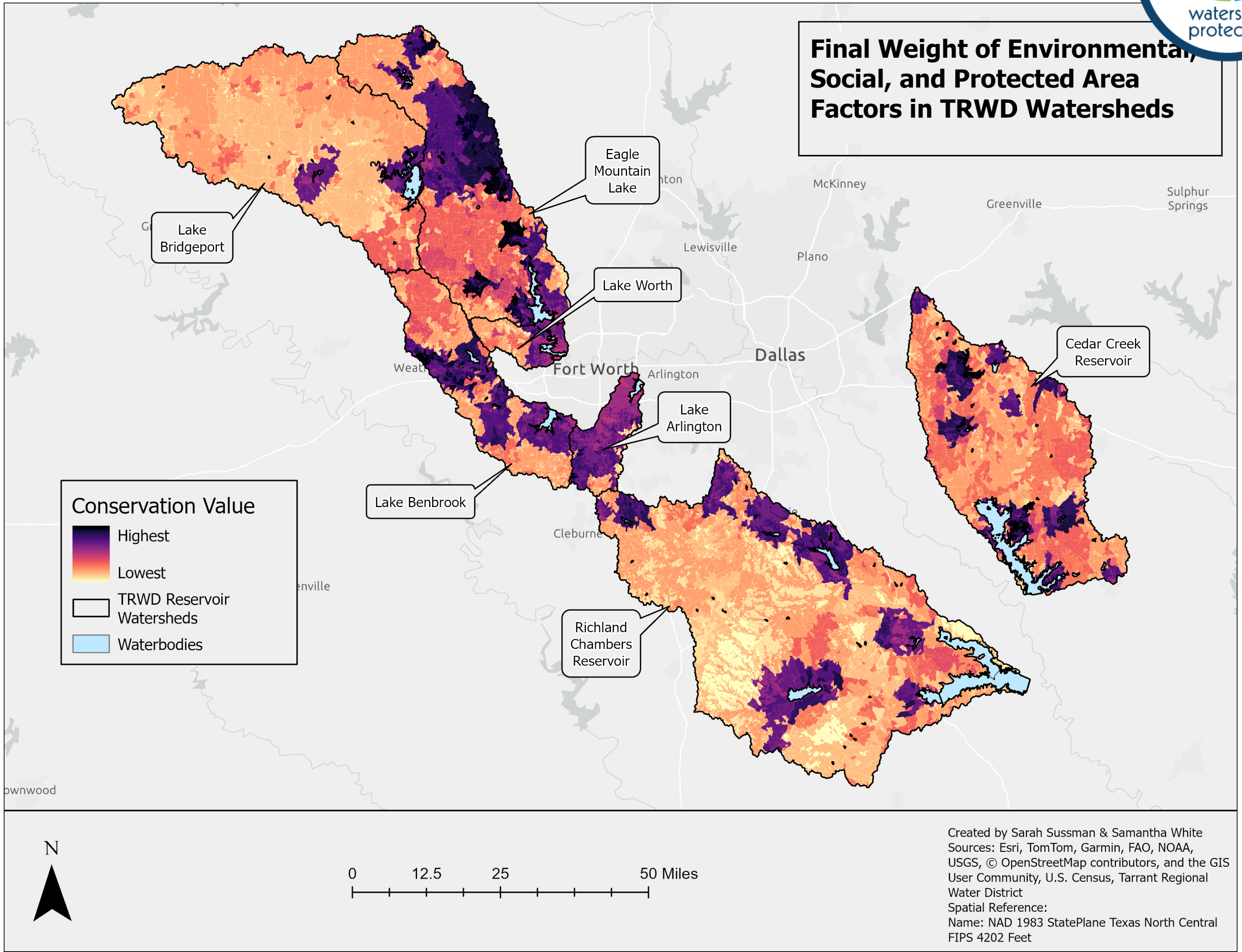
Final Stack All Factors

Final Combined Weight =
Environmental Factors +
Social Factors +
Protected Areas

- Potential skew toward Lake Arlington on strength of social factors and near universal proximity to public/protected space in suburban spaces
- Final weightings within this stack can be adjusted to favor environmental factors
- Additional information about average parcel size per planning unit could be useful for conservation partners



Final Weight of Environmental, Social, and Protected Area Factors in TRWD Watersheds

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Update on Project Progress

NCTCOG

Kate Zielke, CFM

integrating **Transportation**
& Stormwater Infrastructure

Progress to Date

Outreach Tasks

3 rounds of meetings in study area

8 Technical Advisory Group meetings

6 Steering Committee meetings

3 Workshops

16 Community site visits

Stakeholder Engagement Plan

North Central Texas
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LOCAL GOVERNMENT FAQ

What is the integrated Transportation and Stormwater Infrastructure (TSI) study?

This planning study coordinates transportation planning, stormwater management, and environmental planning to mitigate flooding risks and

KEY TERMS

Community:
A local government or political entity that adopts and enforces

Technical Tasks

Literature review

Pilot studies

H&H SOPs

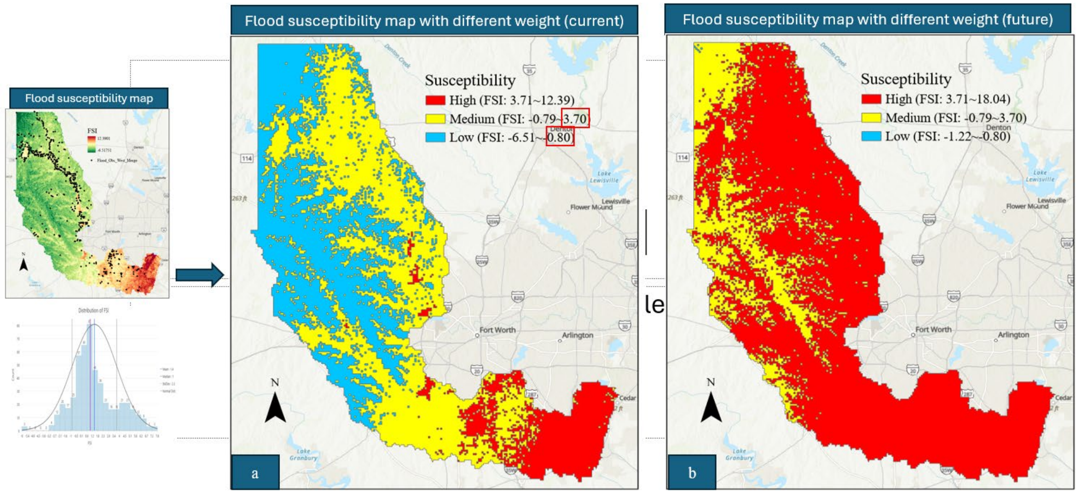
Storm shifting SOPs

H&H – West Study Area

Stacking model – West Study Area

Optimization study – West Study Area

H&H launch – North Study Area



Flood Control Prioritization Mapping – Stacking Model

TEXAS A&M AGRILIFE EXTENSION SERVICES

Yufan Zhang, Ph.D.

Fouad Jaber, Ph.D., P.E.

Texas A&M AgriLife

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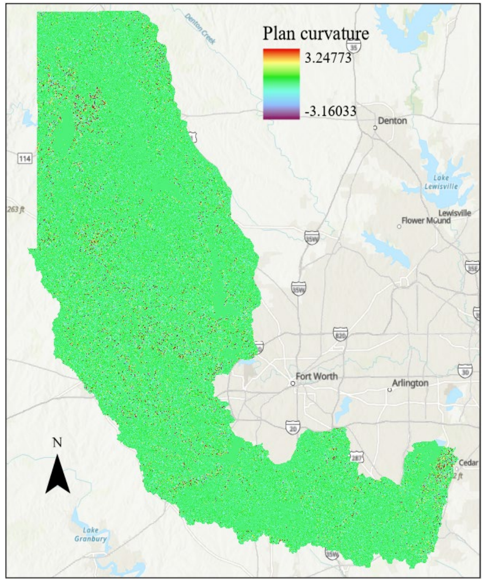
Stacking Model (GIS-Based Multi-Criteria Decision-Making Approach)

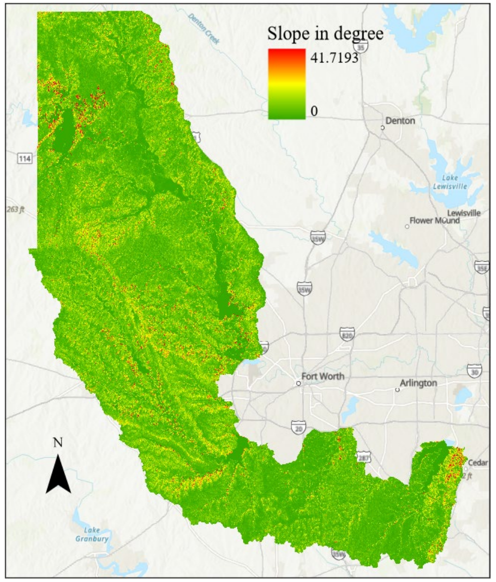
- It is used to find some areas with both high flood potential and low resilience, or either of them
- It is the first step in the planning framework to provide guidance where the control measures (detention ponds, rain gardens, constructed wetlands, etc.) should go
- It is different from hydrologic and hydraulic modeling, it is geospatial analysis
- It can also help to identify the transportation infrastructure (e.g. roadways) under the high flood potential in the existing and future condition

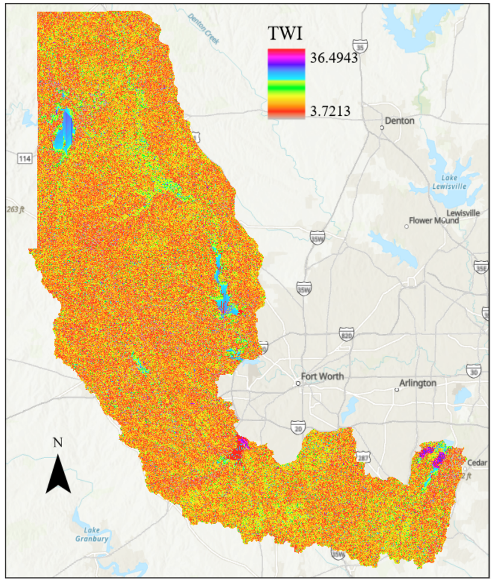
Flood Conditioning Factor

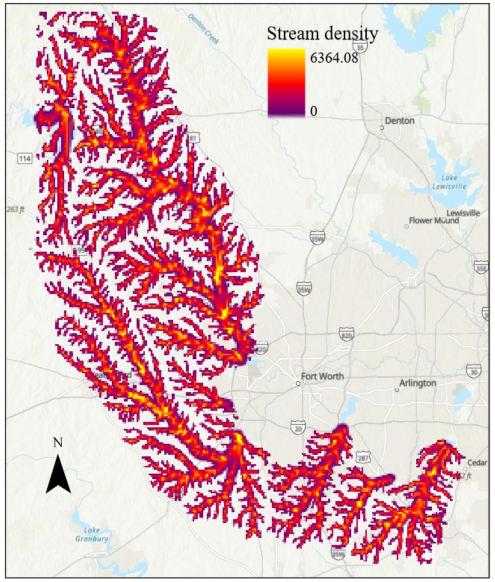
Factors	Category	Data sources	Year	Processing	Relation to flooding
Elevation	Topographical	USGS TNM	2021	Direct download	Negative
Slope		DEM-derived	-	Slope	Negative
Plan curvature		DEM-derived	-	Curvature	Negative
TWI		DEM-derived	-	Flow direction, flow accumulation	Positive
Extreme rainfall depth	Meteorological	NOAA Atlas 14	-	Direct download	Positive
CN	Landscape	USGS NLCD, SSURGO, USDA Forest Service	2023, 2023, 2021	Union	Positive
NDVI		USGS Earth Explorer	2023	Direct download	Negative
Stream density	Hydrological	DEM-derived	-	Stream order, Kernel density	Positive
Road density	Infrastructural	NCTCOG, TxDOT	2023	Kernel density	Positive
Road traffic density		NCTCOG, TxDOT	2023	Kernel density	Positive
Dam density		NID	2024	Kernel density	Negative
Bridge vulnerability		TxDOT	2024	Kernel density	Positive
Bridge traffic density		TxDOT	2024	Kernel density	Positive
SVI	Socio-economic	CDC/ATSDR	2022	Direct download	Positive

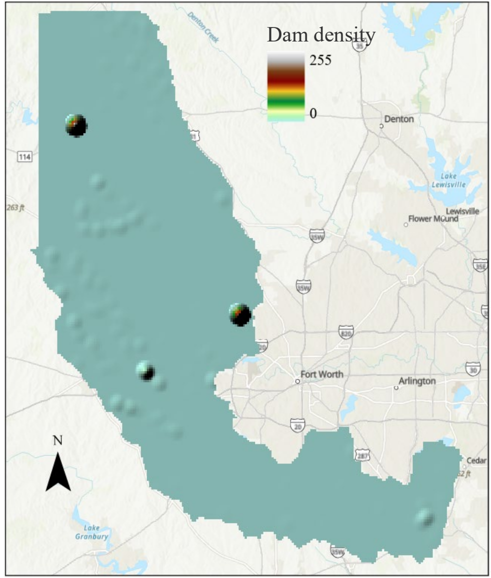
Maps for each individual factor

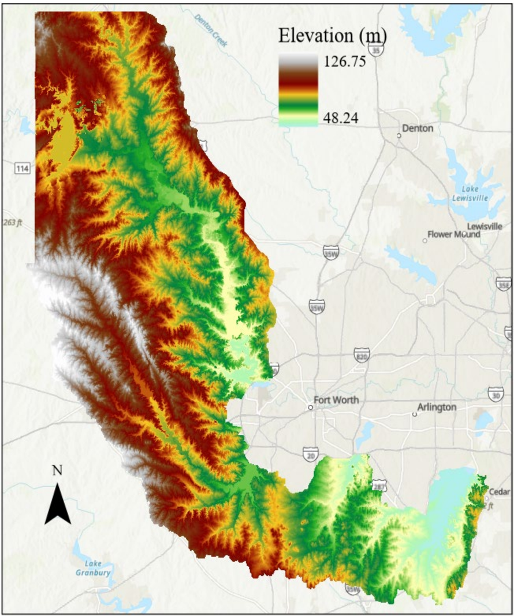


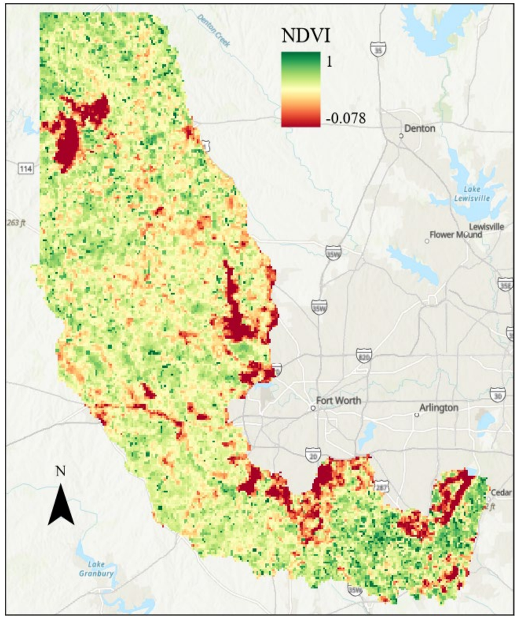


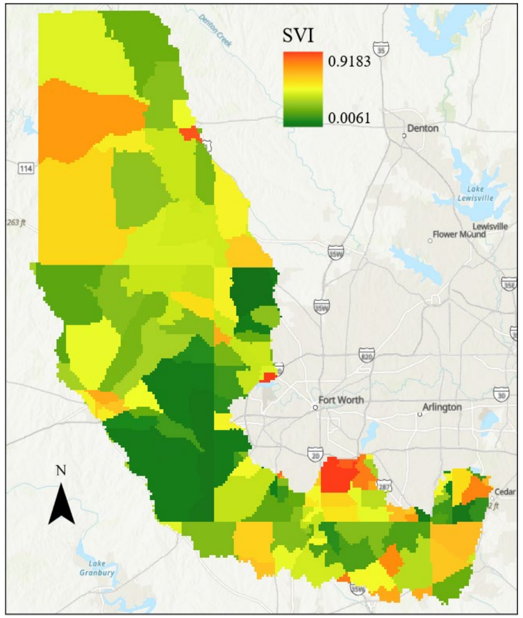


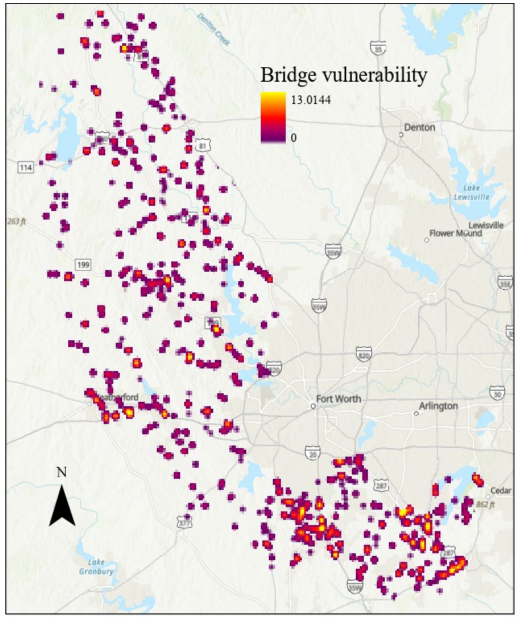


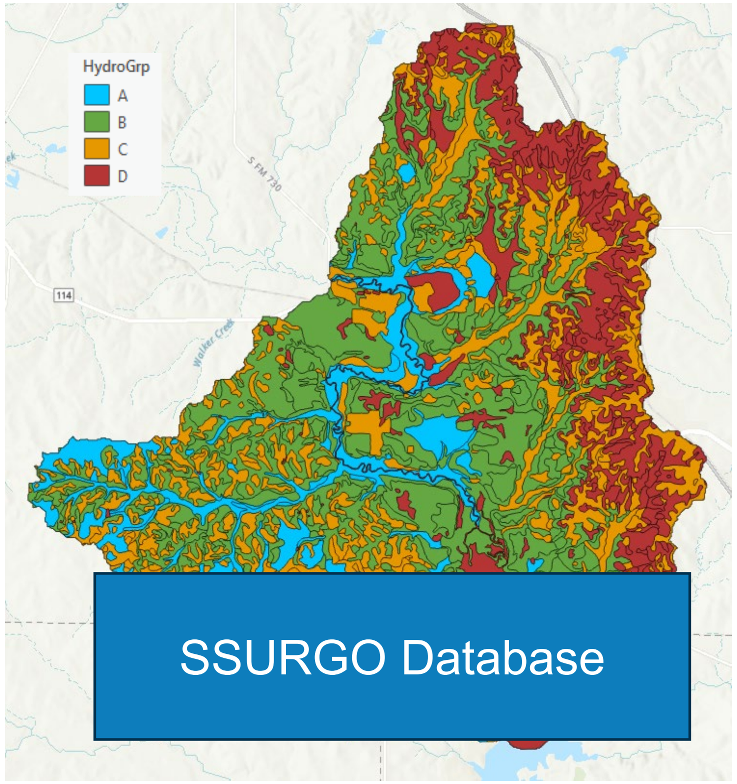




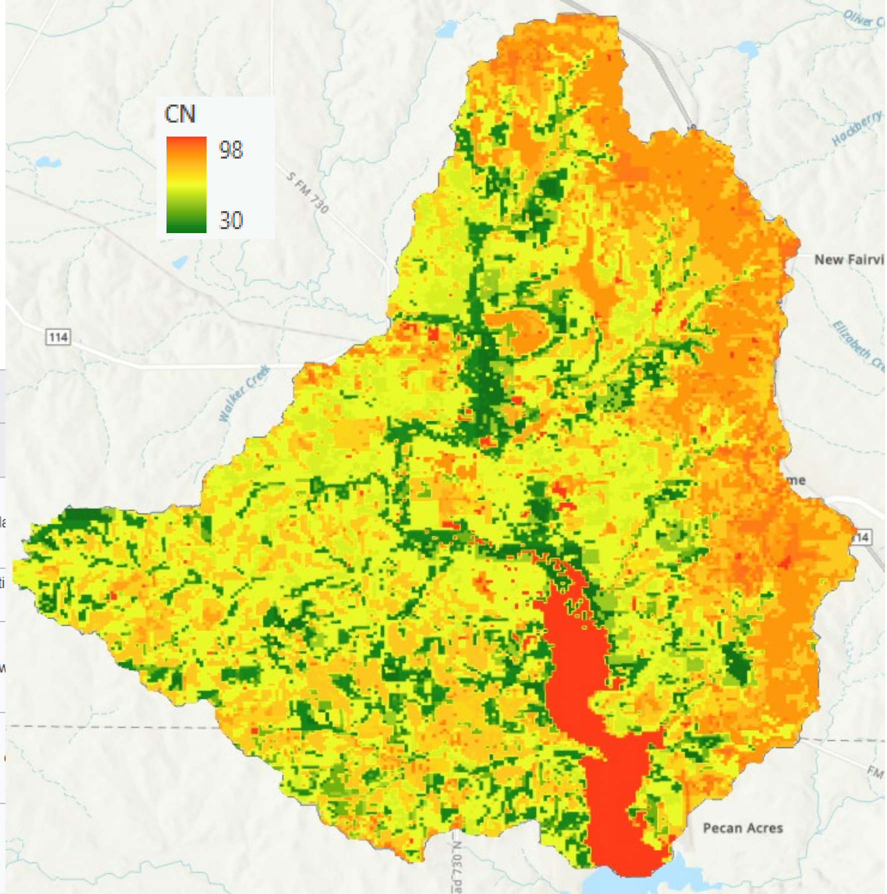


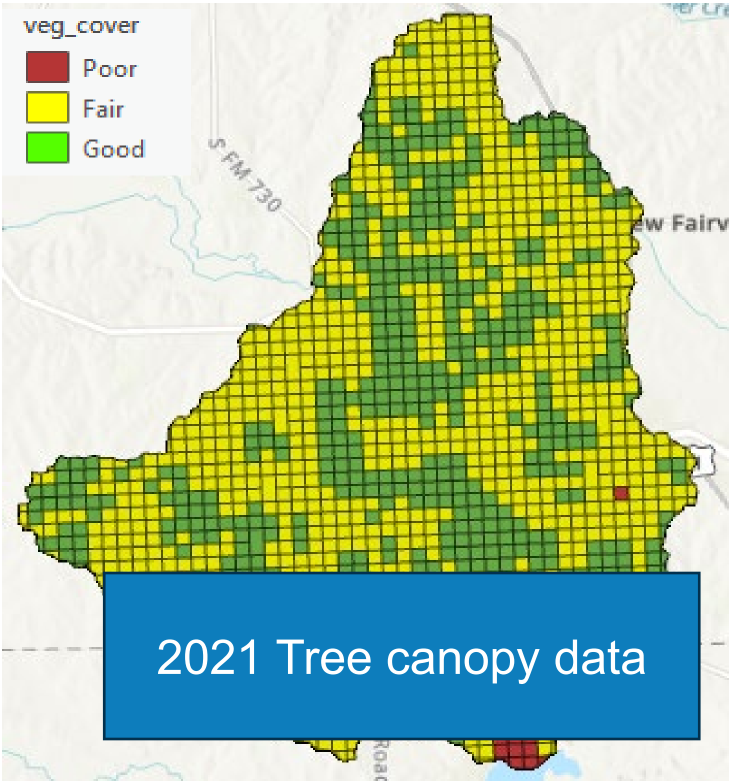




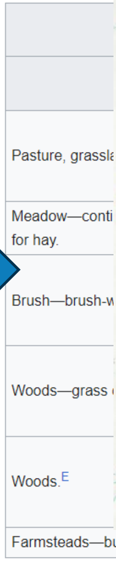


SSURGO Database

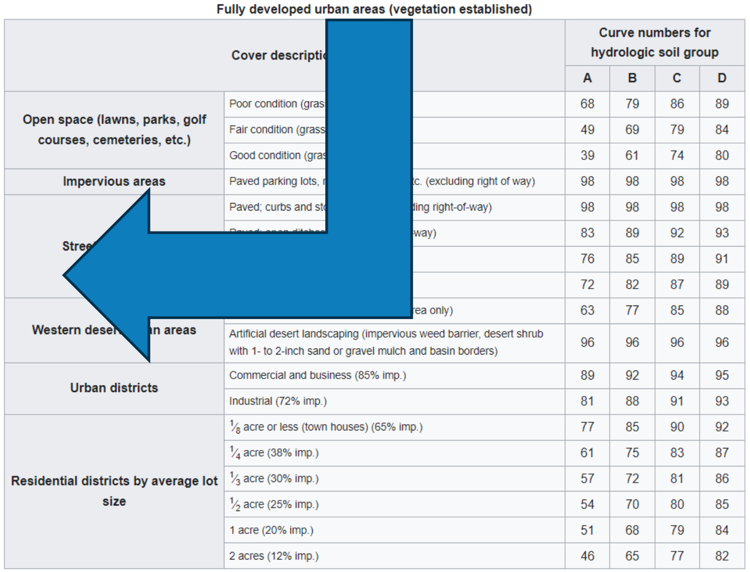




2021 Tree canopy data



Pasture, grassla					
Meadow—conti for hay.					
Brush—brush-w					
Woods—grass					
Woods.E					
Farmsteads—buildings, lanes, driveways, and surrounding lots.	—	59	74	82	86



Fully developed urban areas (vegetation established)

Cover descripti		Curve numbers for hydrologic soil group			
		A	B	C	D
Open space (lawns, parks, golf courses, cemeteries, etc.)	Poor condition (gras	68	79	86	89
	Fair condition (grass	49	69	79	84
	Good condition (gras	39	61	74	80
Impervious areas	Paved parking lots, tc. (excluding right of way)	98	98	98	98
Stre	Paved; curbs and st ding right-of-way)	98	98	98	98
	way)	83	89	92	93
		76	85	89	91
		72	82	87	89
Western dese n areas	rea only)	63	77	85	88
	Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)	96	96	96	96
Urban districts	Commercial and business (85% imp.)	89	92	94	95
	Industrial (72% imp.)	81	88	91	93
Residential districts by average lot size	$^1\!/_8$ acre or less (town houses) (65% imp.)	77	85	90	92
	$^1\!/_4$ acre (38% imp.)	61	75	83	87
	$^1\!/_3$ acre (30% imp.)	57	72	81	86
	$^1\!/_2$ acre (25% imp.)	54	70	80	85
	1 acre (20% imp.)	51	68	79	84
	2 acres (12% imp.)	46	65	77	82

- **Curve number**

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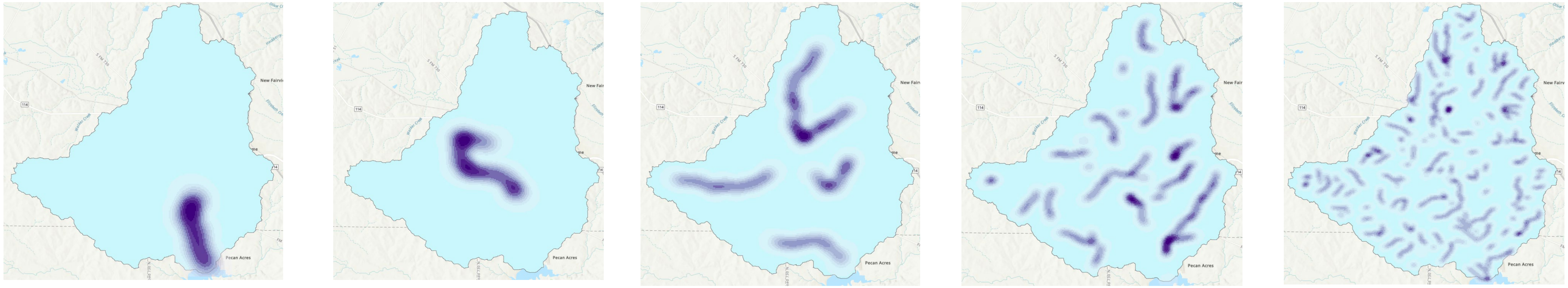
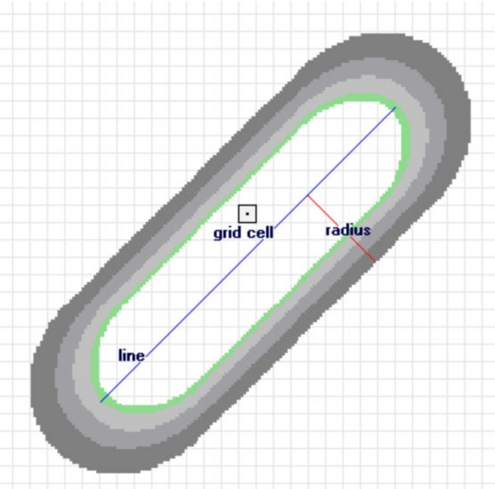
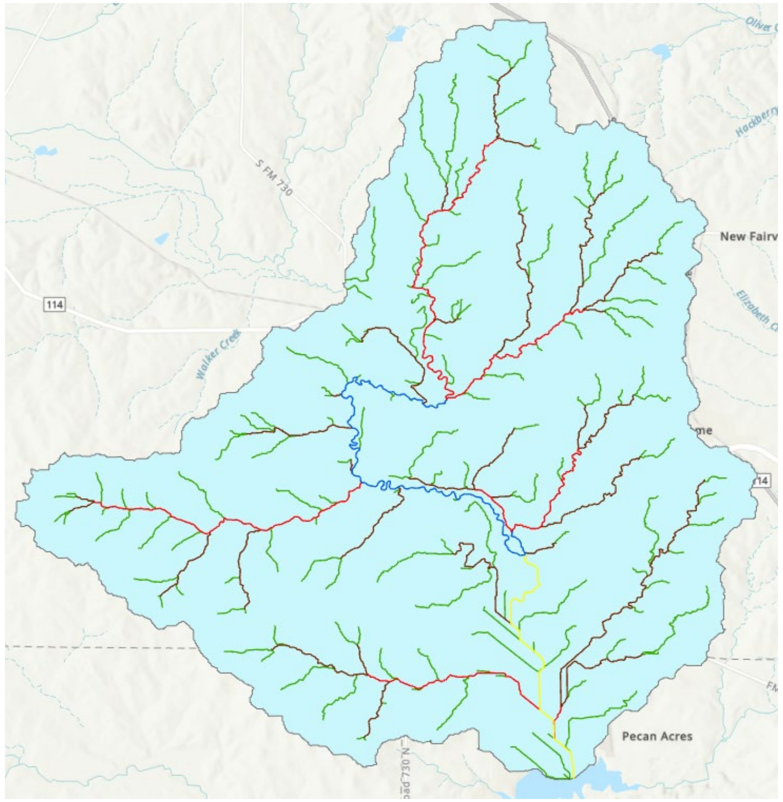
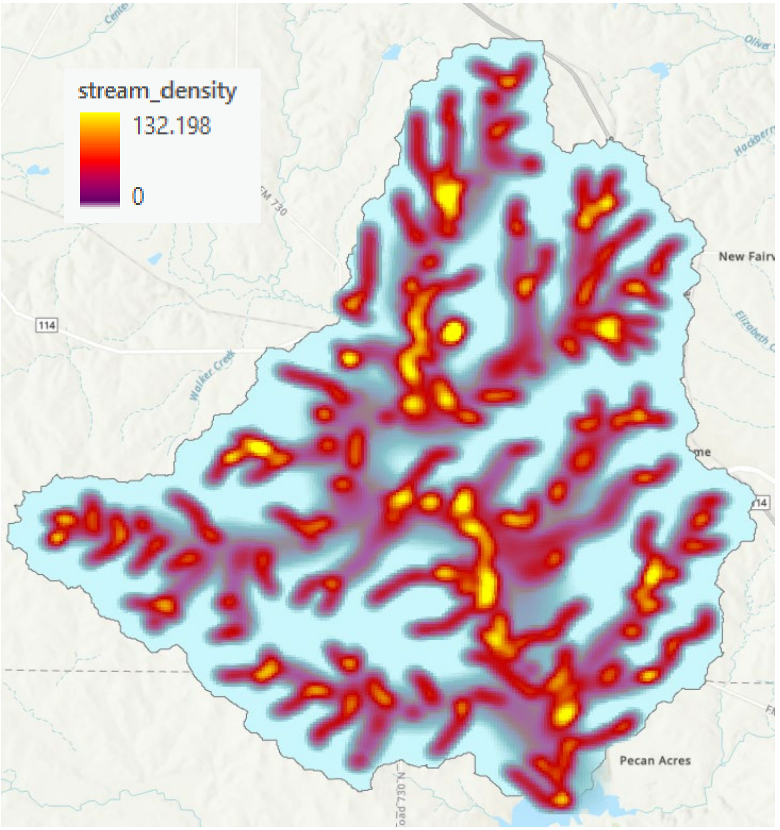


➢ Stream density (distance from streams)

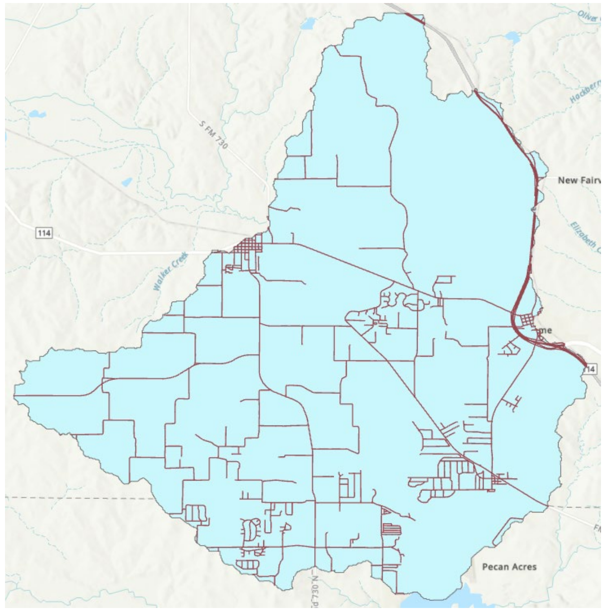
Kernel analysis
*search radius: assigned varying search radius to reflect their impact ranges (from headwater to the ultimate convergence)







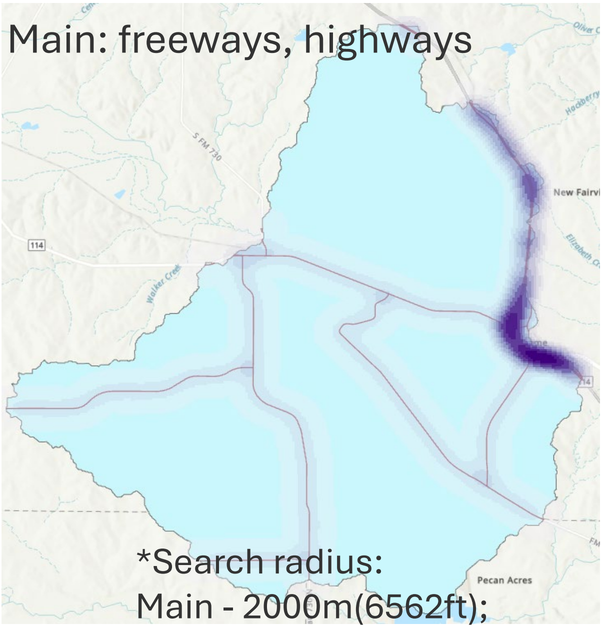
- **Road density (distance from roads)**



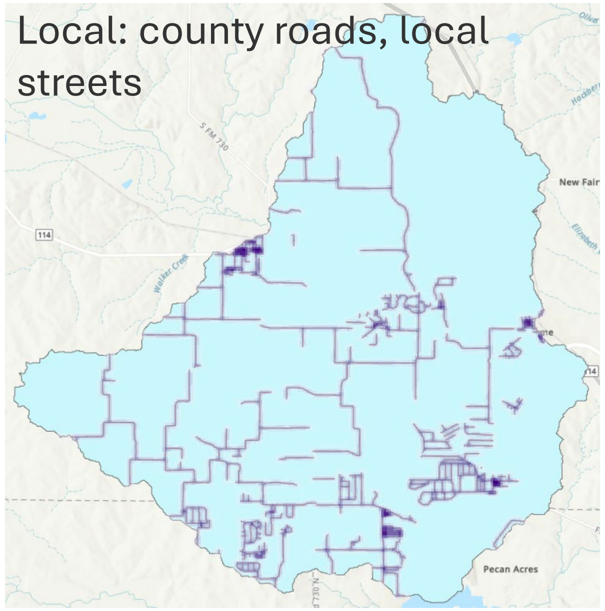
- **Road traffic density**

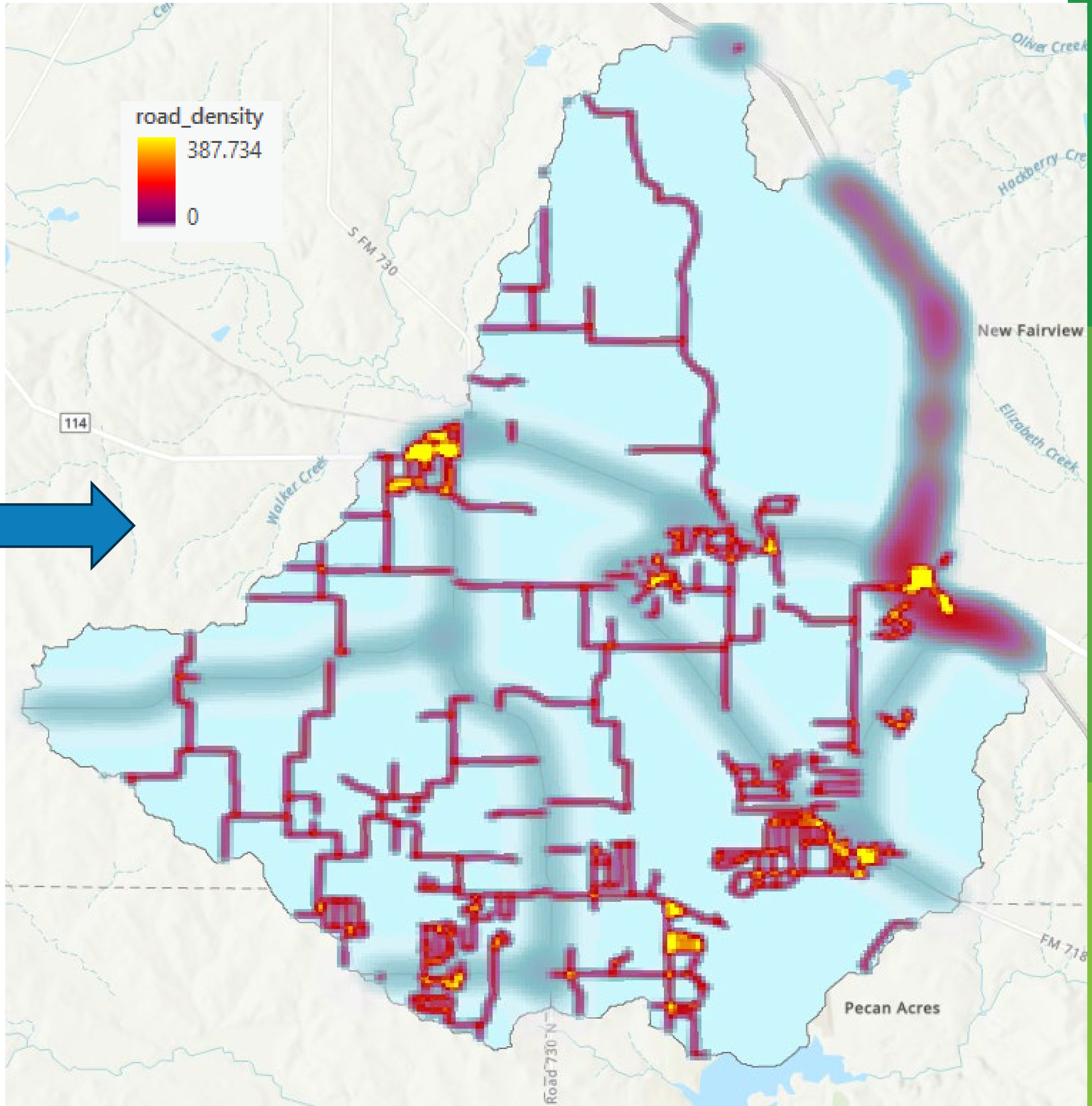
*Search radius:
Main - 500m(1640ft);
Local - 250m(820ft)
*Population density: Daily Vehicle Miles Traveled (DVMT)

- **Bridge traffic density**


Main: freeways, highways

*Search radius:
Main - 2000m(6562ft);
Local - 1000m(3280ft)


Local: county roads, local streets



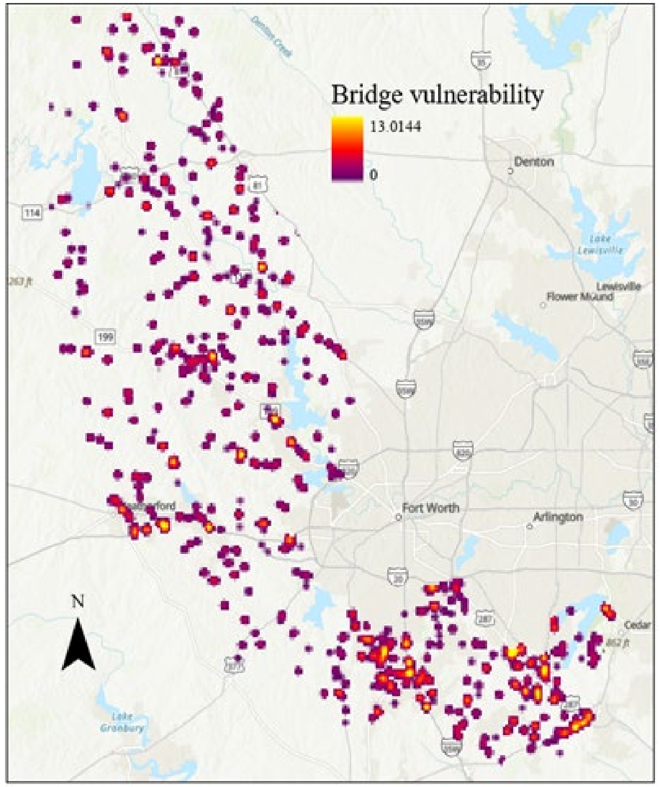
Bridge vulnerability

Vulnerability = historical significance (HIST_SIG) * (10 - waterway adequacy (APPRSL_RTN_4))

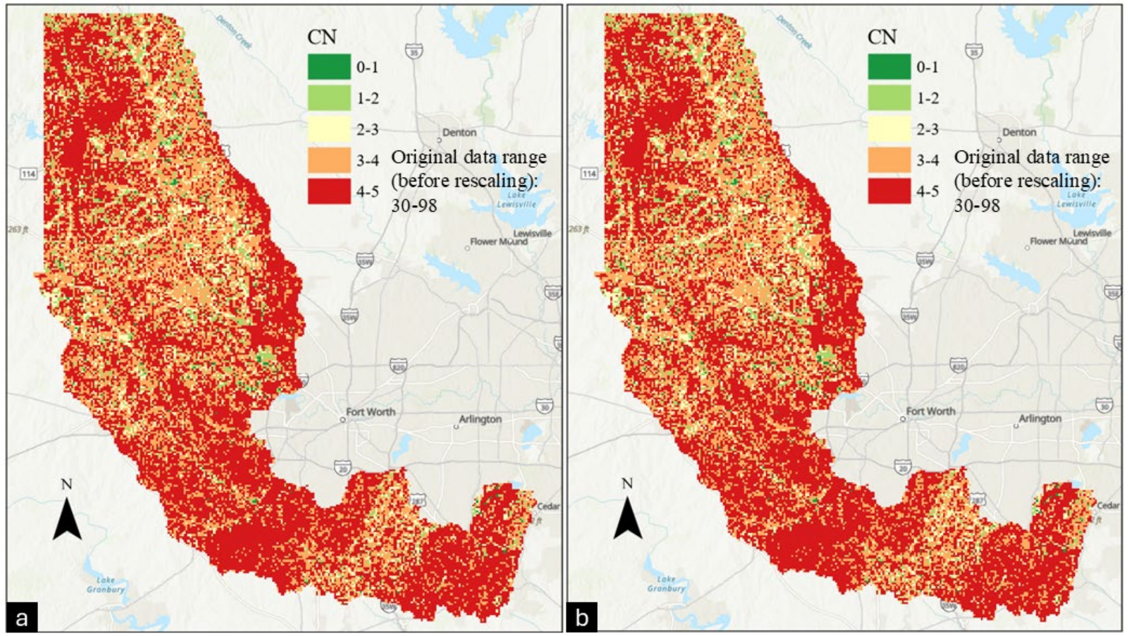
- Historical significance considers the cultural, structural, or functional importance of the bridge, emphasizing the potential societal and economic impacts of its failure.
- The appraisal rating for waterway adequacy evaluates the bridge's capacity to handle water flow, accounting for the chance of overtopping the bridge deck or its approaches during extreme rainfall or flood conditions.

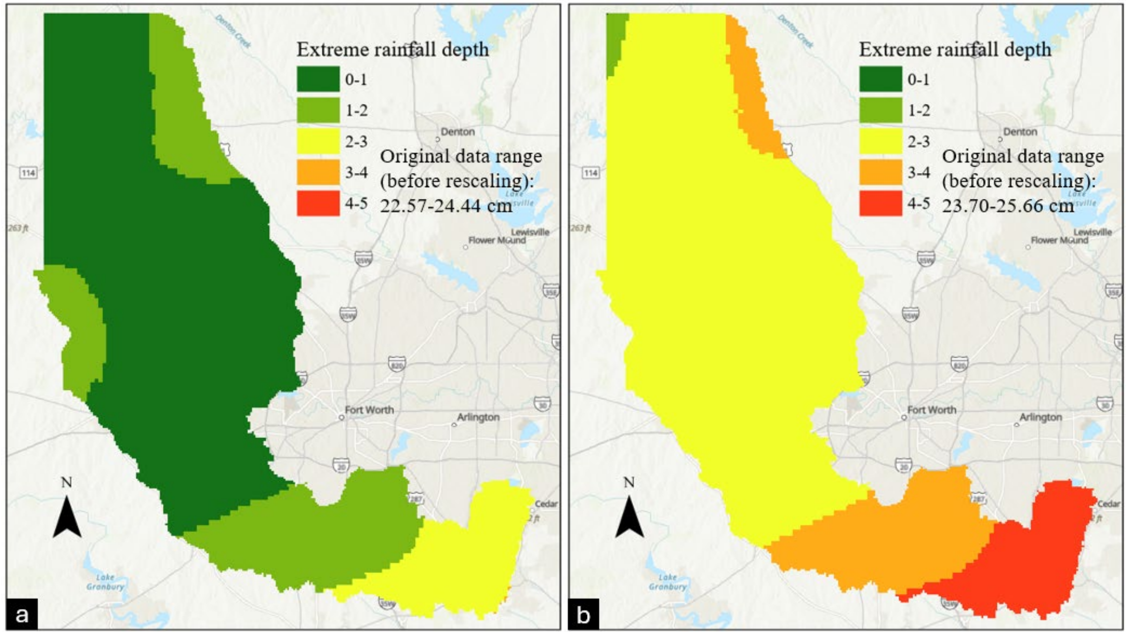
Appraisal rating for waterway adequacy

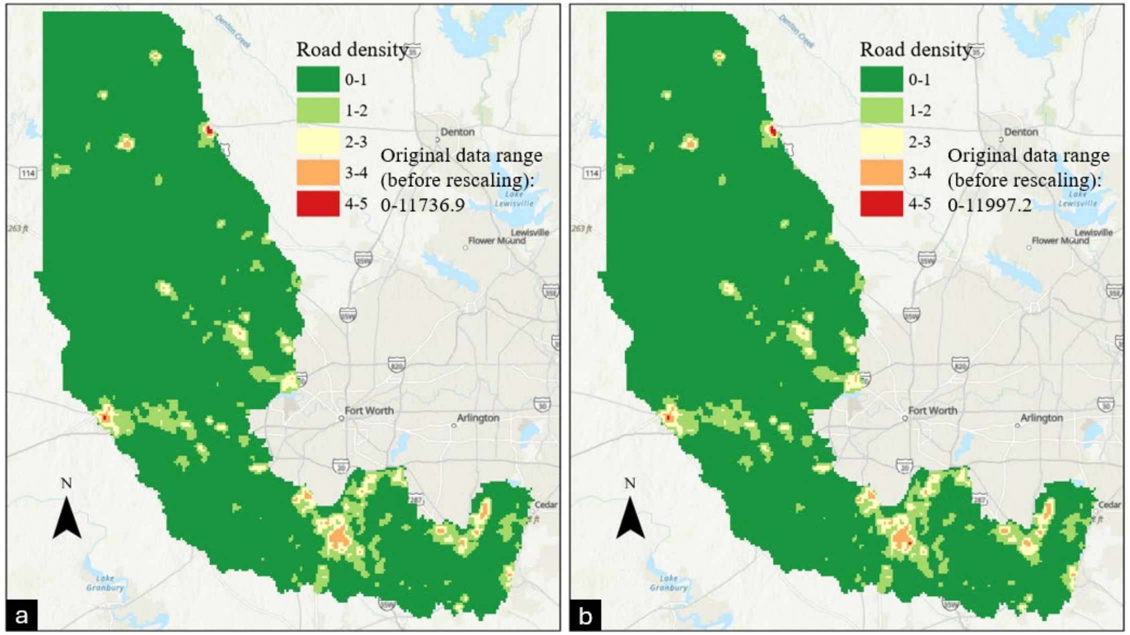
Code	Description
9	Superior to present desirable criteria
8	Equal to present desirable criteria
7	Better than present minimum criteria
6	Equal to present minimum criteria
5	Somewhat better than minimum adequacy to tolerate being left in place as is
4	Meets minimum tolerable limits to be left in place as is
3	Basically intolerable requiring high priority of corrective action
2	Basically intolerable requiring high priority of replacement
1	This value of rating code not used
0	Bridge closed



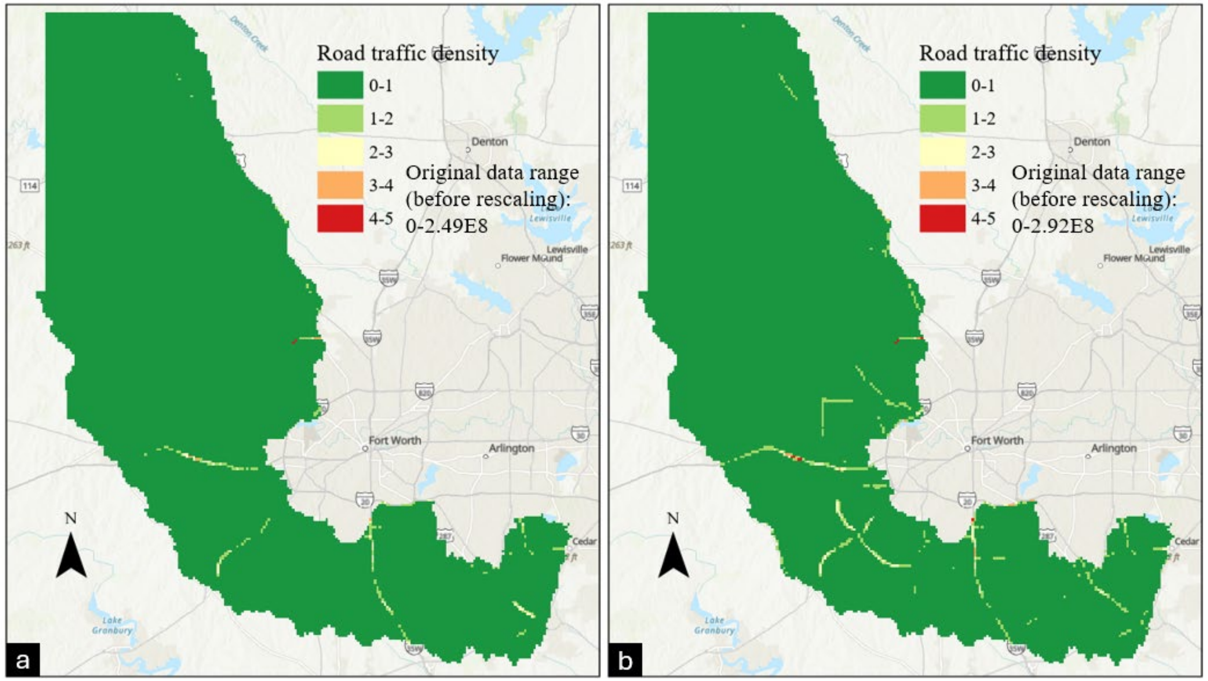
Future scenario (Year 2045)

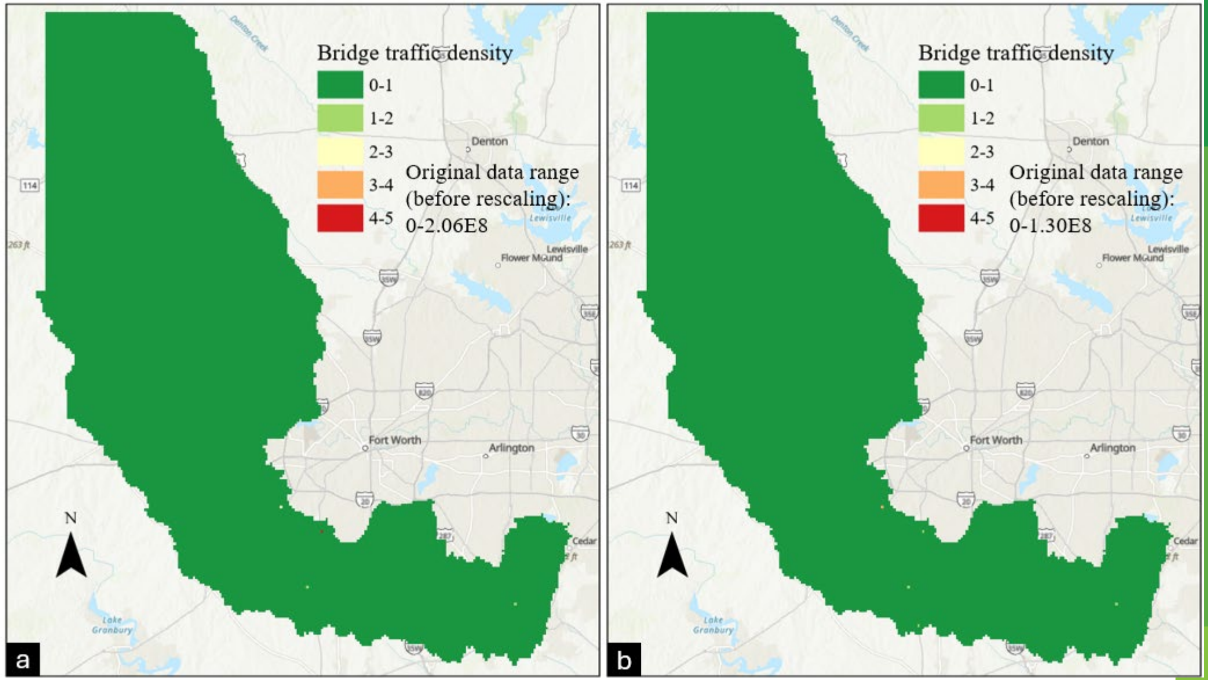






Future scenario (Year 2045)





Stacking model (GIS-Based Multi-Criteria Decision-Making Approach)

Flood susceptibility mapping

Environmental

Topographical
Elevation, Slope, Plan Curvature, topographic wetness index (TWI),

Meteorological
Extreme rainfall depth

Landscape
Curve number, NDVI

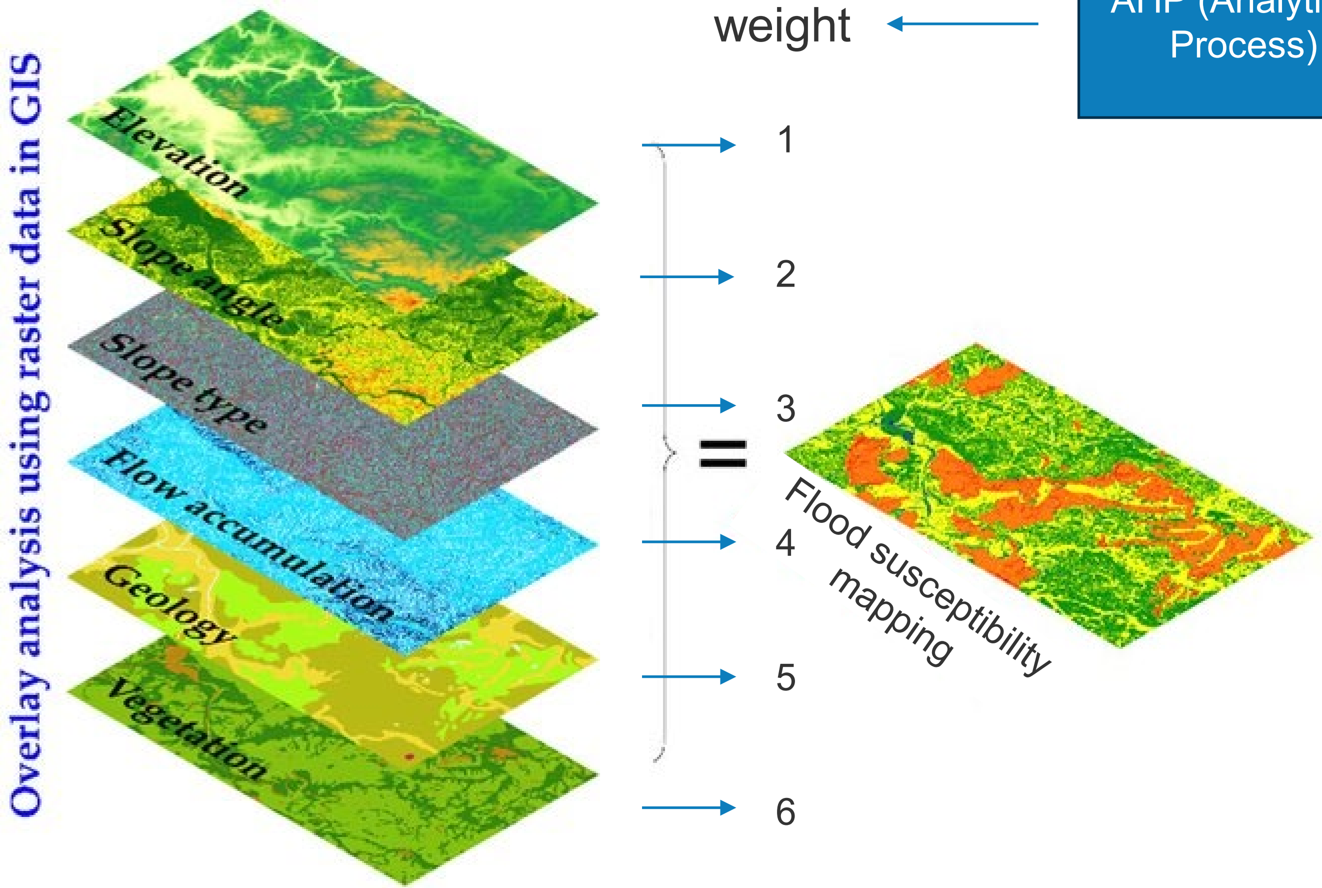
Hydrological
Stream density

Infrastructural

Road density, Dam density

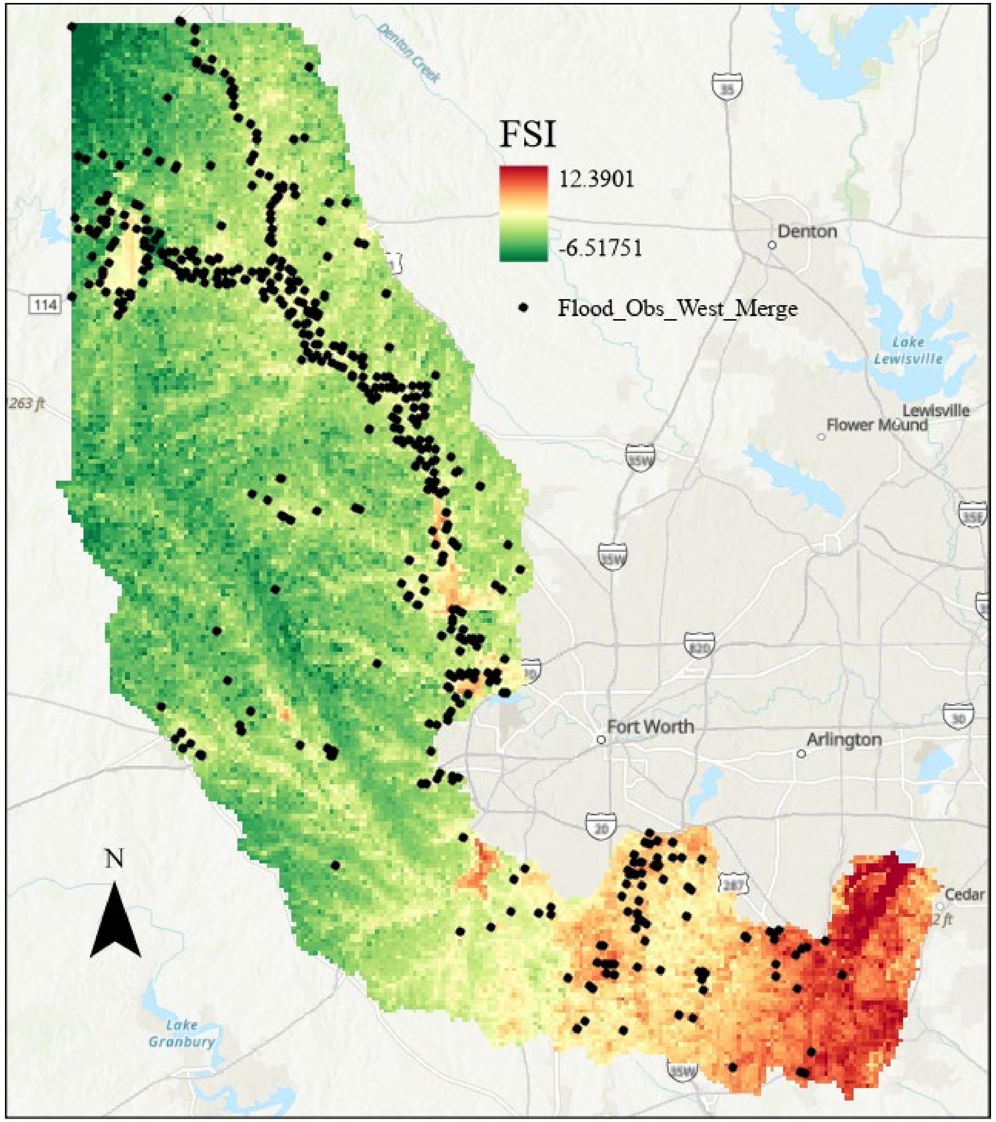
🟥 Negative related

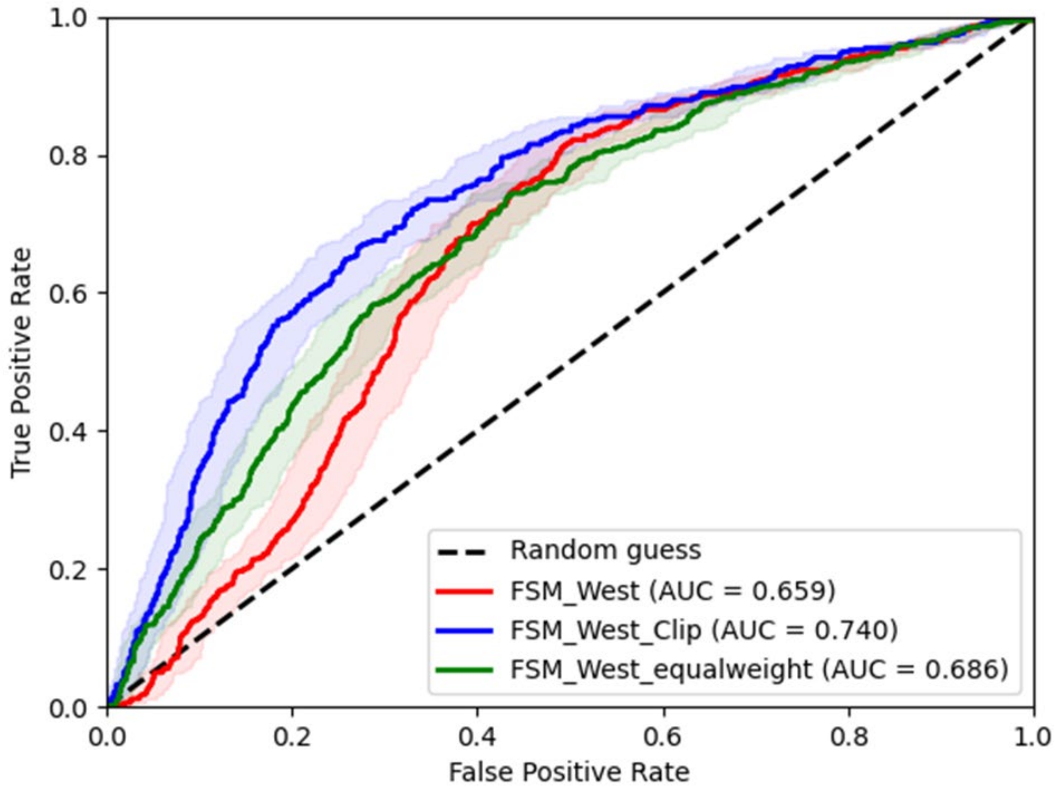
🟩 Positive related



weight ← AHP (Analytic Hierarchy Process) method

Model Validation





a

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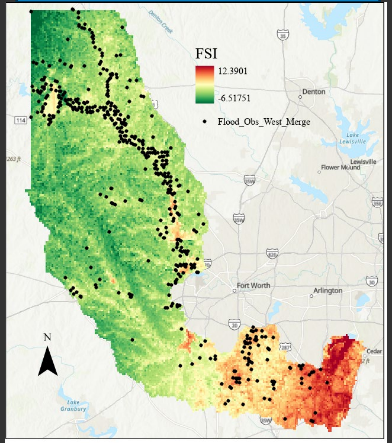
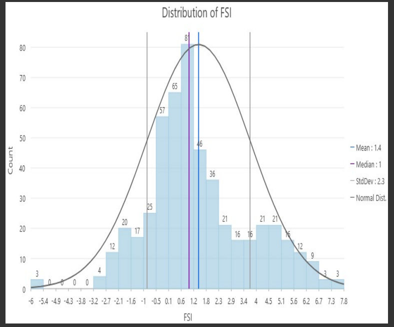
Occurred

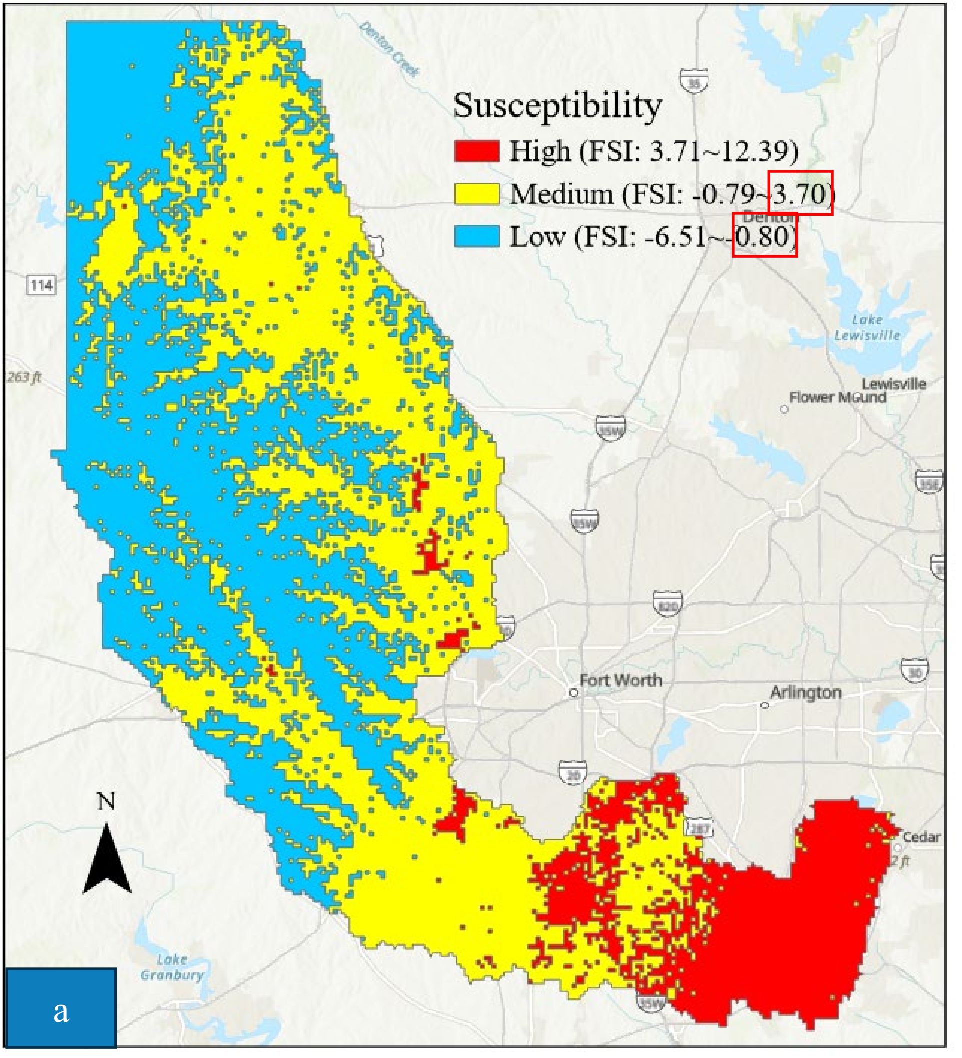
- **Area Under the Curve (AUC):**
  - **AUC = 1.0** → Perfect classifier.
  - **AUC > 0.9** → Excellent model.
  - **AUC between 0.7 and 0.9** → Good model.
  - **AUC between 0.5 and 0.7** → Poor model.
  - **AUC = 0.5** → Random guessing.

Flood susceptibility map

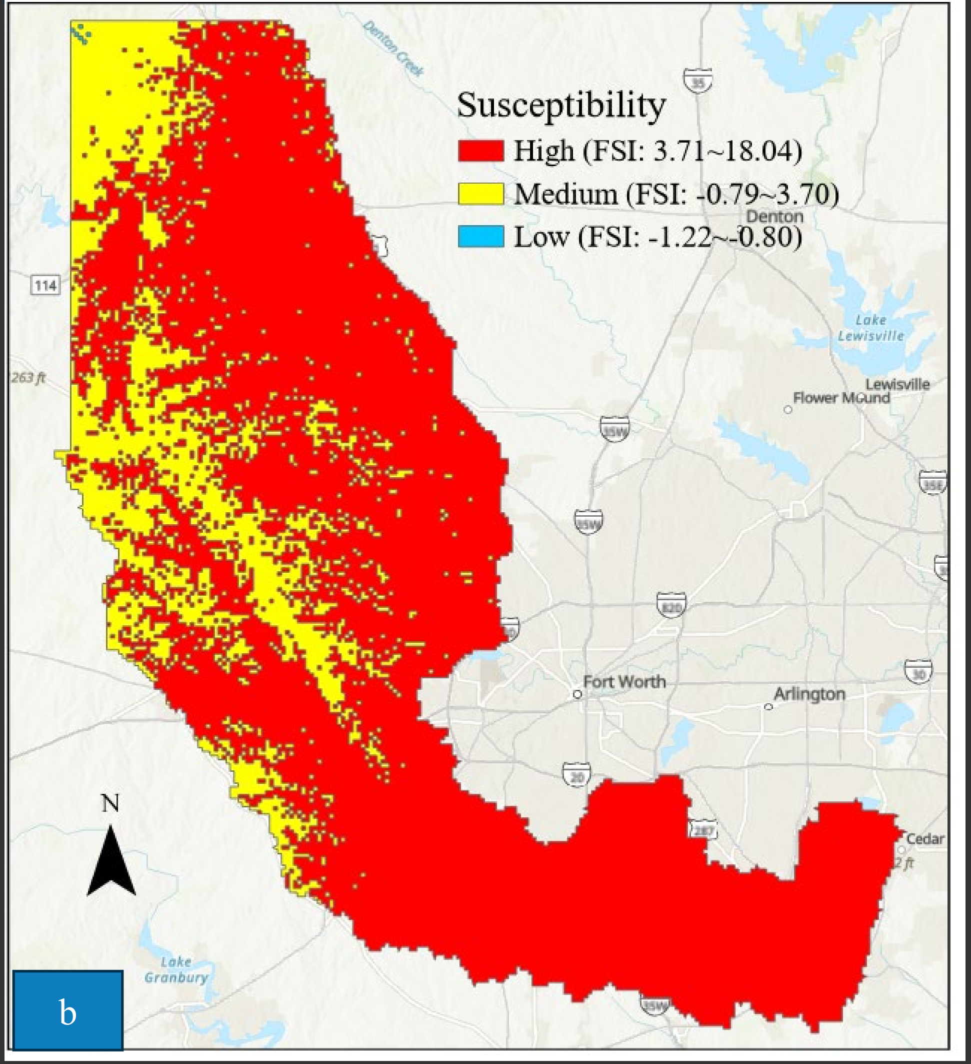




Flood susceptibility map with different weight (current)



Flood susceptibility map with different weight (future)



Stacking Model (GIS-Based Multi-Criteria Decision-Making Approach)

Flood vulnerability mapping, flood control prioritization mapping

Infrastructural

Road traffic density, Bridge traffic density , Bridge vulnerability

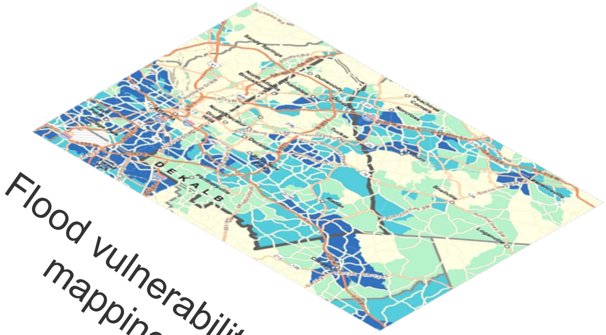
Socio-economical

Social vulnerability index

Negative related

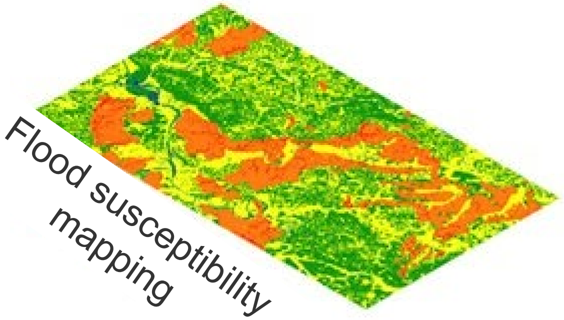
Positive related

Same approach as flood susceptibility mapping (overlay, AHP)



Flood vulnerability mapping

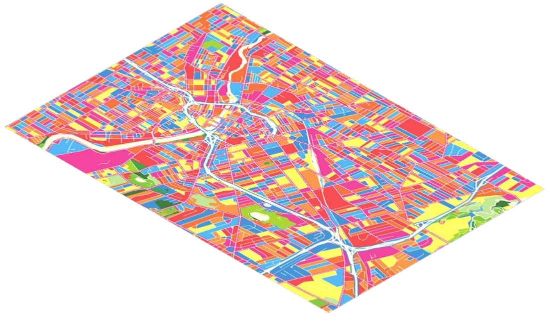
\+



Flood susceptibility mapping

🟥 High FSI & high FVI
🟥 High FSI & moderate FVI
🟧 High FSI & low FVI
🟨 Moderate FSI & high FVI
🟩 Moderate FSI & moderate FVI
🟩 Moderate FSI & low FVI
🟦 Low FSI & high FVI
🟦 Low FSI & moderate FVI
🟦 Low FSI & low FVI

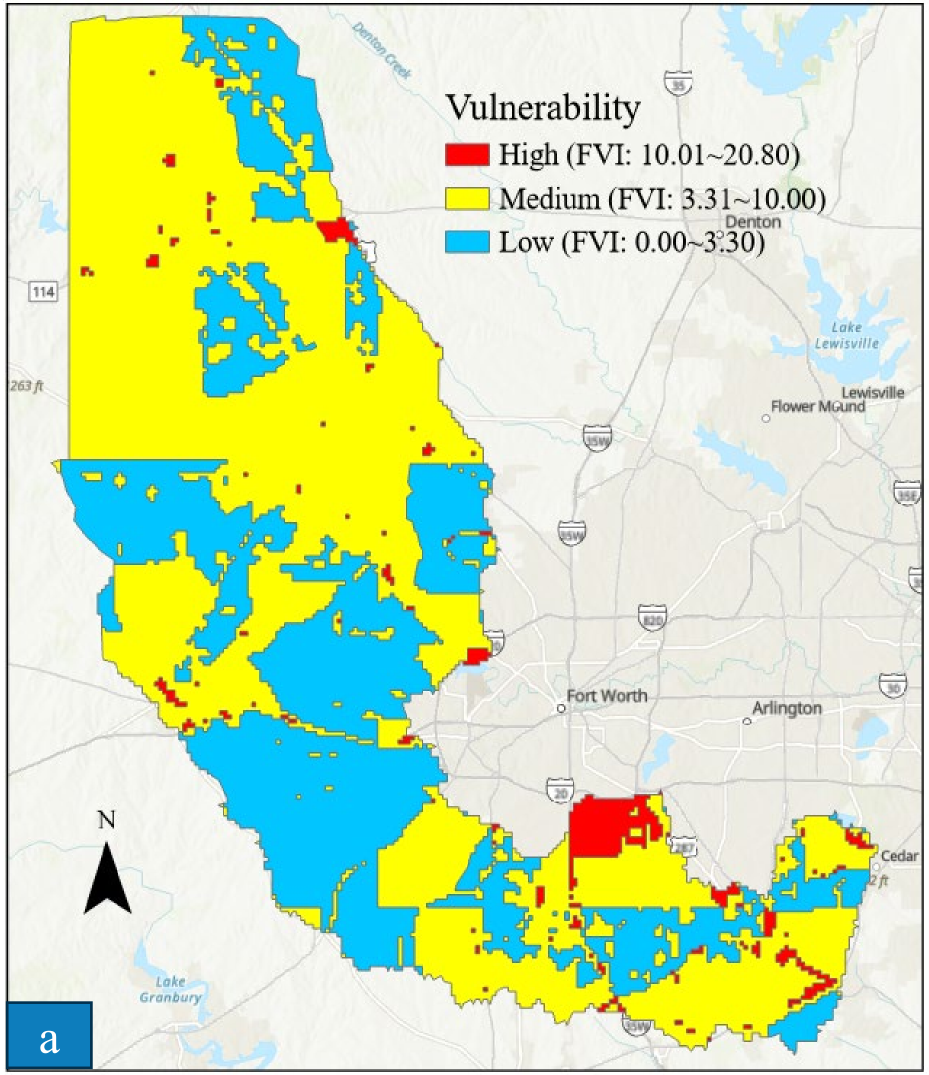
FSI: flood susceptibility index
FVI: flood vulnerability index



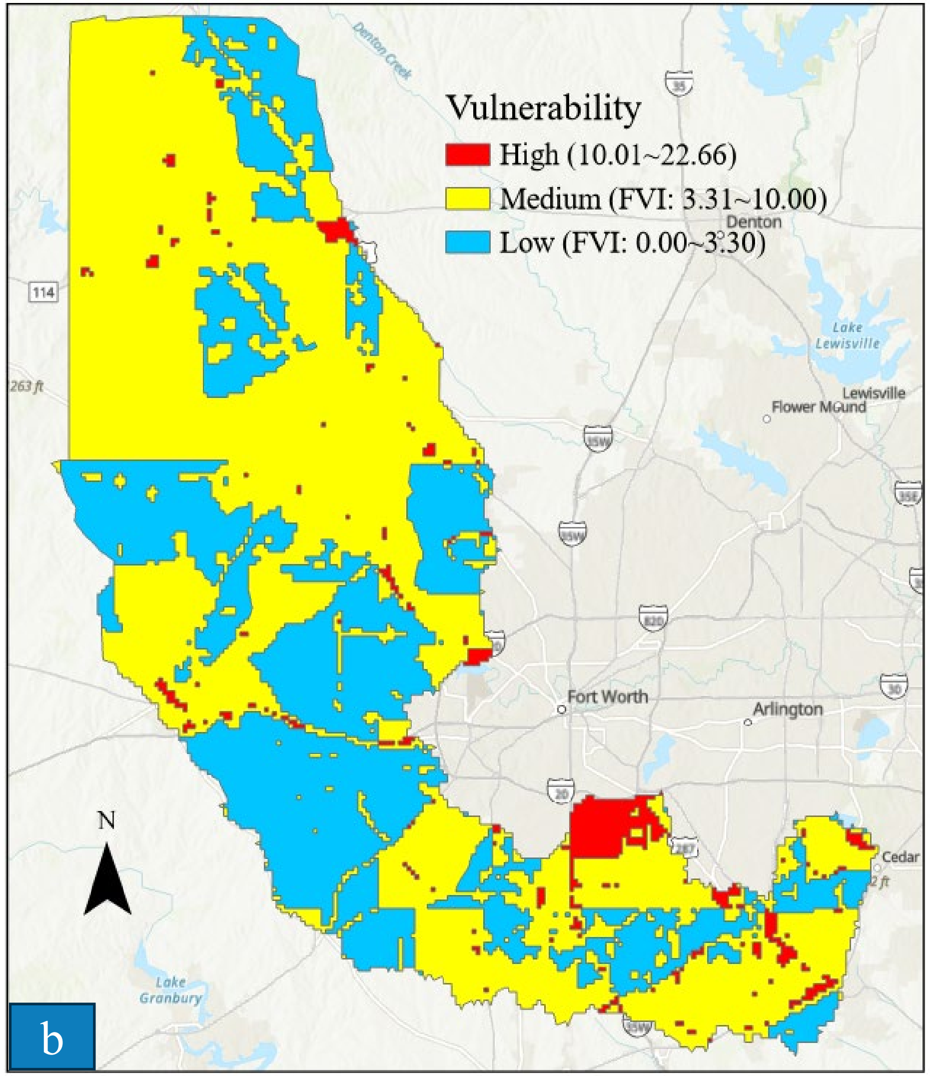
Flood control prioritization mapping

integrating **Transportation & Stormwater Infrastructure**

Flood vulnerability map (current)

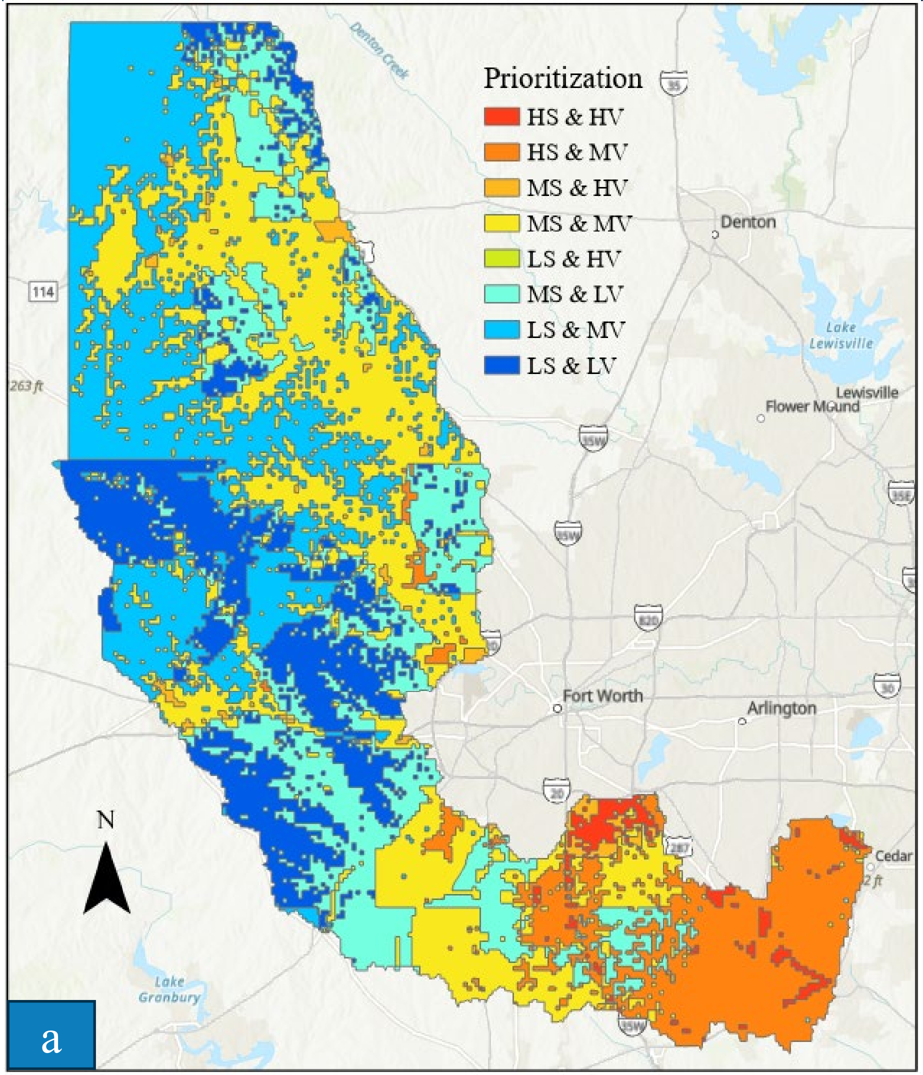


Flood vulnerability map (future)

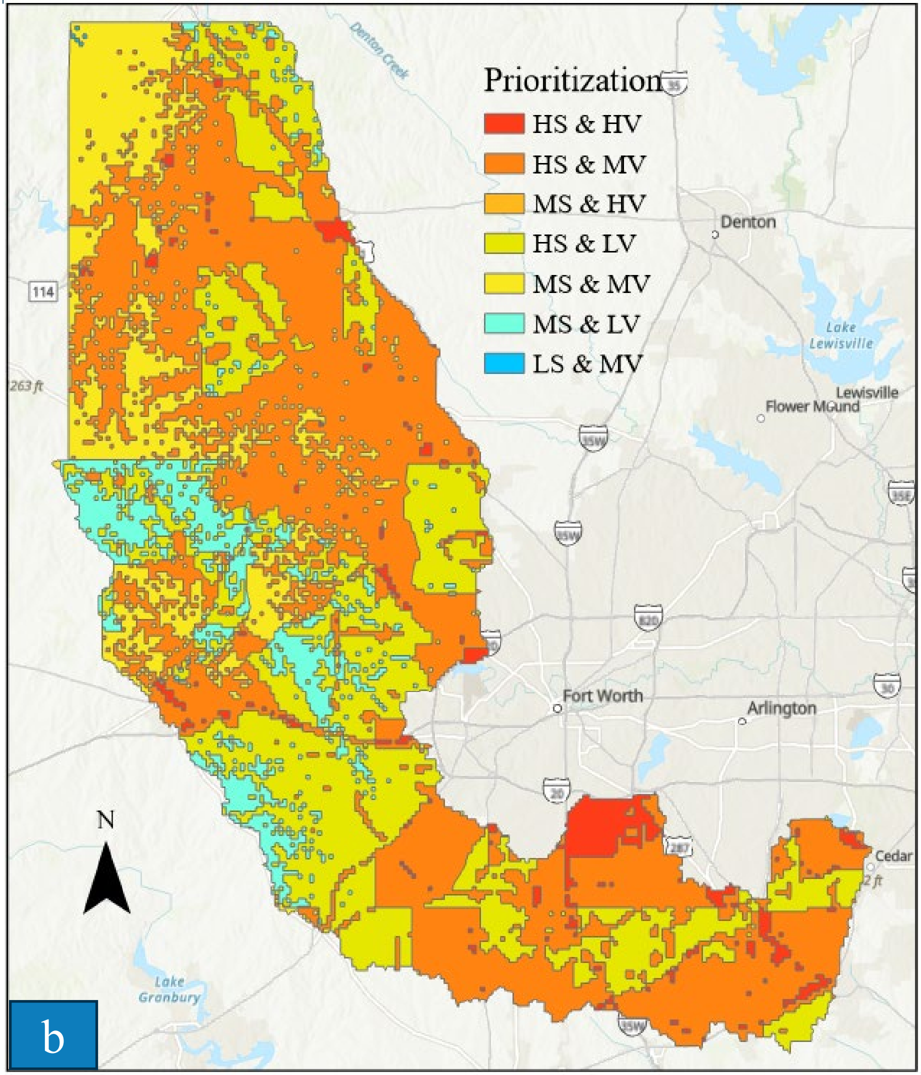


integrating **Transportation**
& Stormwater Infrastructure

Flood control prioritization map (current)



Flood control prioritization map (future)



Map Links to ArcGIS Online

- Flood susceptibility map (current condition, west):
  https://tamu.maps.arcgis.com/home/item.html?id=4eaee3a528434f4ba647912b28b70992
- Flood susceptibility map (future condition, west):
  https://tamu.maps.arcgis.com/home/item.html?id=e8951c8b04054abeb2d86b042863033c
- Flood vulnerability map (current condition, west):
  https://tamu.maps.arcgis.com/home/item.html?id=370d094b72624c2d963cb082157ed87b
- Flood vulnerability map (future condition, west):
  https://tamu.maps.arcgis.com/home/item.html?id=ae151e80f38c45aeaf20d3e5fee2d121
- Flood control prioritization map (current condition, west):
  https://tamu.maps.arcgis.com/home/item.html?id=e618155602a44655b7e165bff0e7f5bb
- Flood control prioritization map (future condition, west):
  https://tamu.maps.arcgis.com/home/item.html?id=c5537dbd02bf4586b374964df070eb93

Thank you for listening!

Questions?

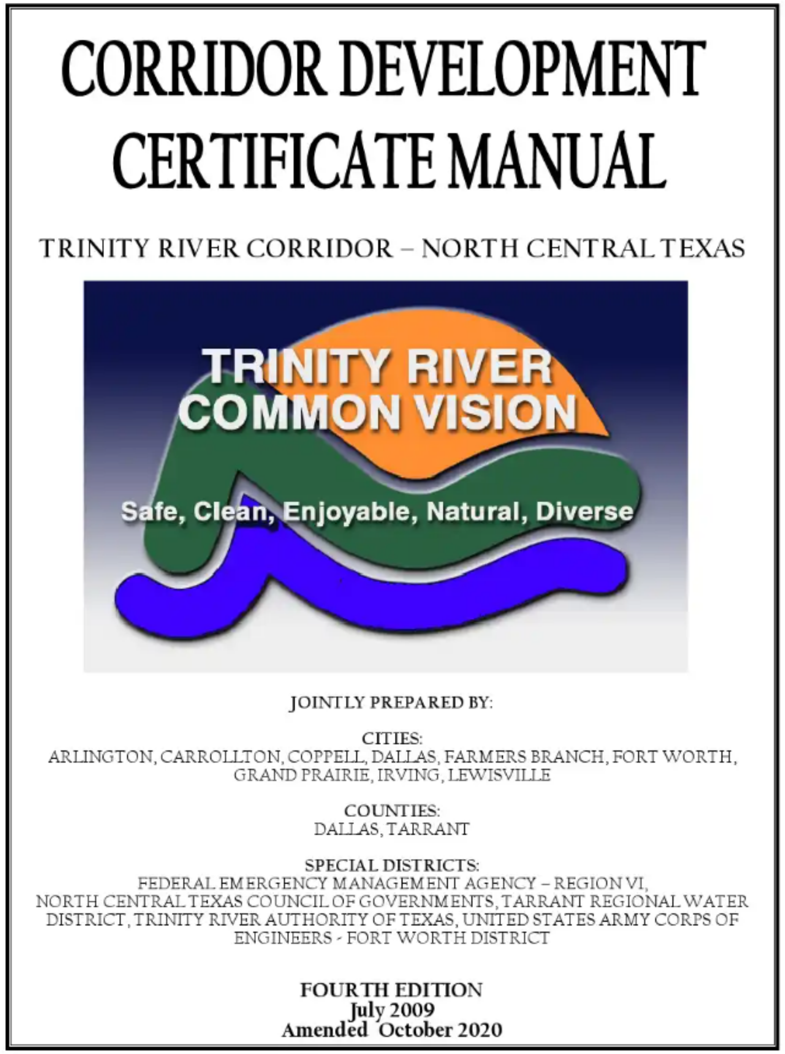
Expansion of Corridor Development Certificate Process

US ARMY CORPS OF ENGINEERS

Vincent A. Geracci, PE, CFM

integrating **Transportation**
& Stormwater Infrastructure

Trinity River Corridor Development Certificate



CORRIDOR DEVELOPMENT CERTIFICATE MANUAL

TRINITY RIVER CORRIDOR – NORTH CENTRAL TEXAS

TRINITY RIVER COMMON VISION

Safe, Clean, Enjoyable, Natural, Diverse

JOINTLY PREPARED BY:

CITIES:
ARLINGTON, CARROLLTON, COPPELL, DALLAS, FARMERS BRANCH, FORT WORTH, GRAND PRAIRIE, IRVING, LEWISVILLE

COUNTIES:
DALLAS, TARRANT

SPECIAL DISTRICTS:
FEDERAL EMERGENCY MANAGEMENT AGENCY – REGION VI, NORTH CENTRAL TEXAS COUNCIL OF GOVERNMENTS, TARRANT REGIONAL WATER DISTRICT, TRINITY RIVER AUTHORITY OF TEXAS, UNITED STATES ARMY CORPS OF ENGINEERS - FORT WORTH DISTRICT

FOURTH EDITION
July 2009
Amended October 2020

USACE 1988 Regional Environmental Impact Statement Trinity River and Tributaries:

- the cumulative impact of allowing individual development projects in the Trinity River floodplain could be both **measurable** and **significant**
- The permitting approach adopted by USACE had the potential to significantly reduce flood hazards

USACE 1990 Upper Trinity River Study:

With only National Flood Insurance Program (NFIP) criteria, Standard Project Flood would:

- Flood 42,460 acres in the Upper Trinity River Basin
- Cause $11.1 billion in damages

With CDC criteria, Standard Project Flood would:

- Flood 22,720 acres in the Upper Trinity River Basin
- Cause $4.25 billion in damages

Trinity River Corridor Development Certificate

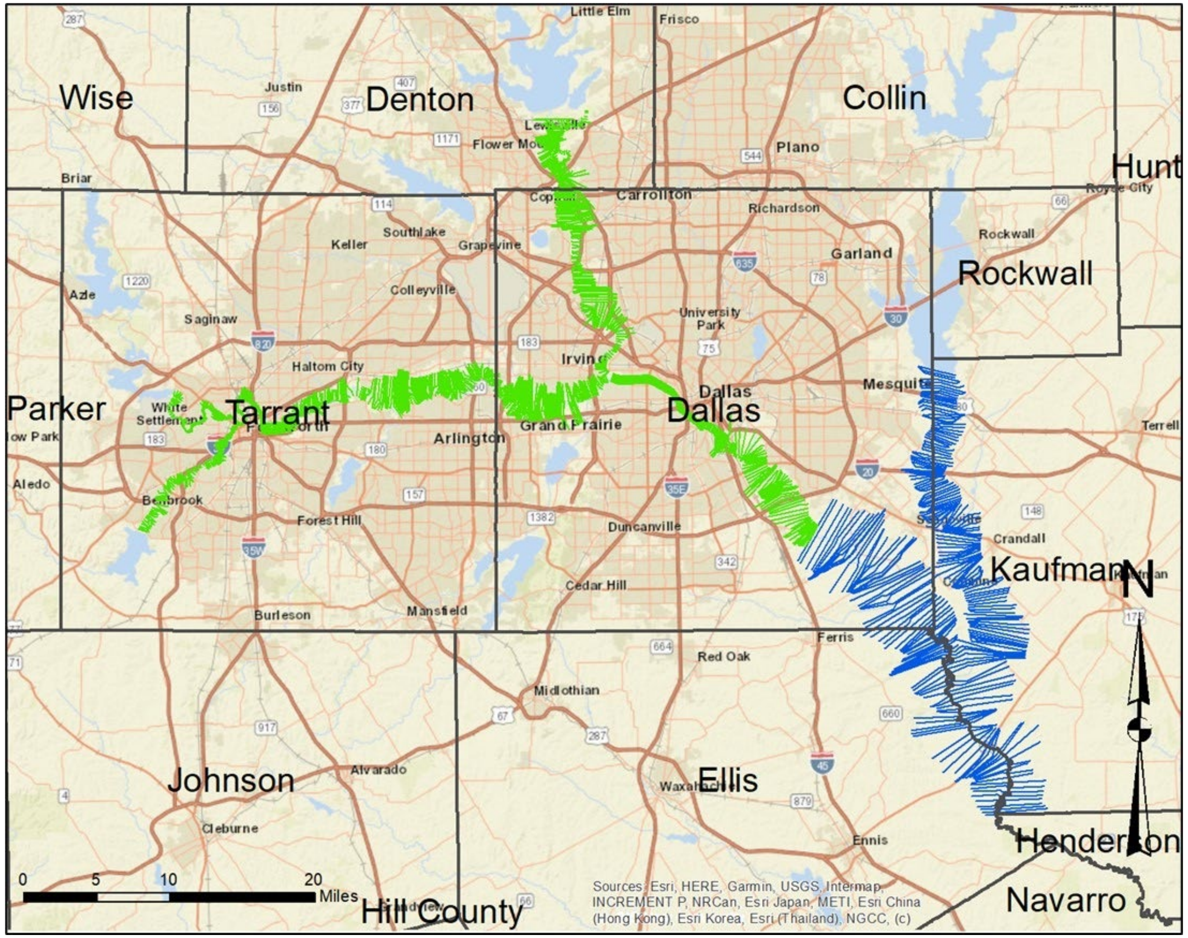
Important Note:

The Corridor Development Certificate Process (CDC) **affirms local government authority** for local floodplain management and establishes a set of Common Regional Criteria and procedures for development within the Trinity River Corridor.

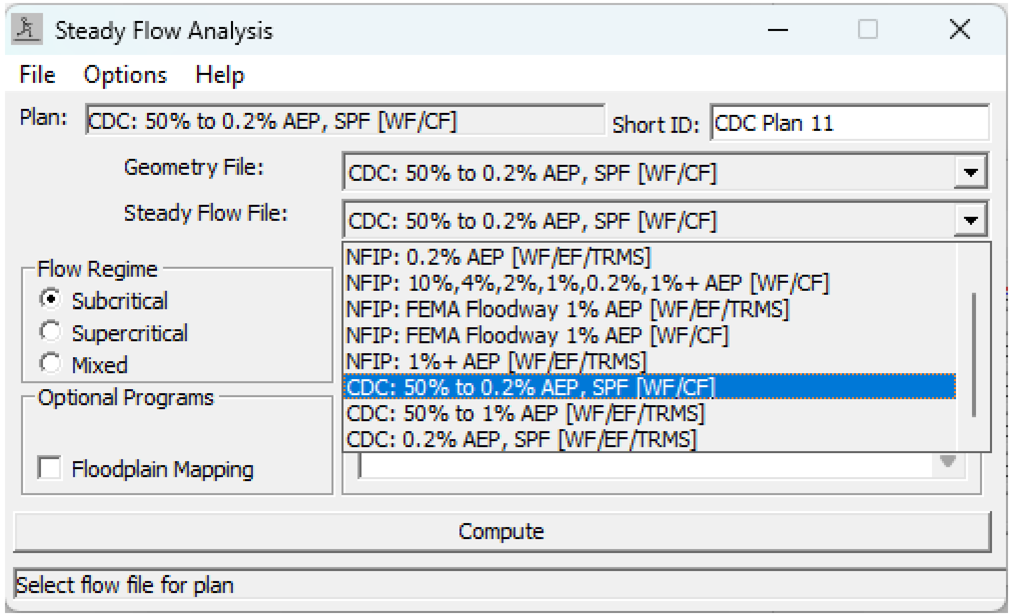
Criteria:

- “No rise in the 100-year or SPF elevation for the proposed condition will be allowed.”
- “The maximum allowable loss in storage capacity for the 100-year and SPF, 0% and 5% respectively.”
- “Alterations in the floodplain may not create or increase an erosive water velocity on or off-site.”

Current Regulatory Zone



Trinity River Corridor Development Certificate



Plan: CDC: 50% to 0.2% AEP, SPF [WF/CF]

Short ID: CDC Plan 11

Geometry File: CDC: 50% to 0.2% AEP, SPF [WF/CF]

Steady Flow File: CDC: 50% to 0.2% AEP, SPF [WF/CF]

- NFIP: 0.2% AEP [WF/EF/TRMS]
- NFIP: 10%,4%,2%,1%,0.2%,1%+ AEP [WF/CF]
- NFIP: FEMA Floodway 1% AEP [WF/EF/TRMS]
- NFIP: FEMA Floodway 1% AEP [WF/CF]
- NFIP: 1%+ AEP [WF/EF/TRMS]
- CDC: 50% to 0.2% AEP, SPF [WF/CF]
- CDC: 50% to 1% AEP [WF/EF/TRMS]
- CDC: 0.2% AEP, SPF [WF/EF/TRMS]

Flow Regime
● Subcritical
○ Supercritical
○ Mixed

Optional Programs
☐ Floodplain Mapping

Select flow file for plan

Benefits:

- Common Regional Criteria
- State-of-the-art floodplain mapping
- Hydrologic modeling based on year 2055 Upper Trinity River watershed development
- A hydraulic model incorporating CDC permitted floodplain development
- U.S. Army Corps of Engineers technical review
- Regional review and comment
- Guarantee of local control of floodplain development decisions

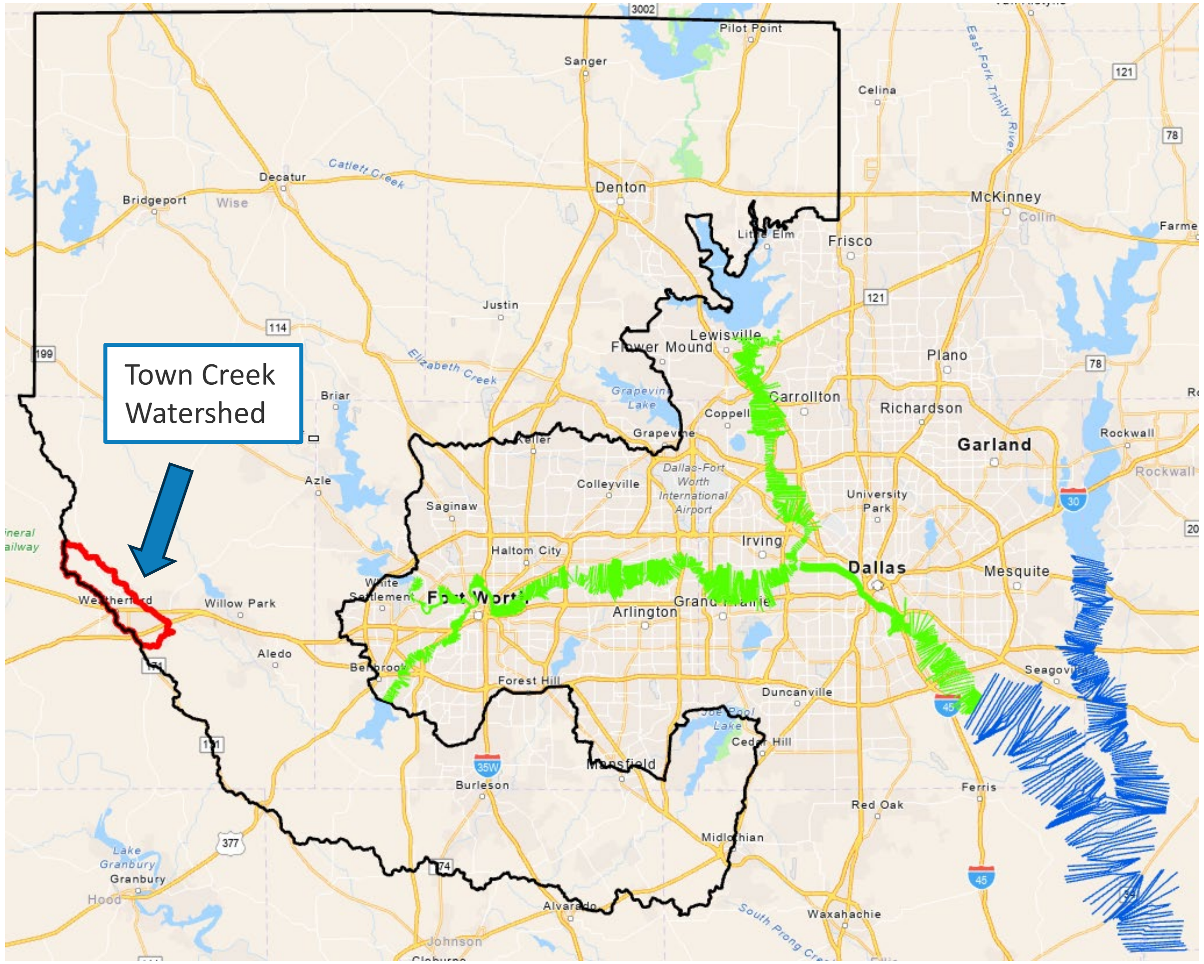
Expansion of the Corridor Development Certificate Process

Pilot Study:

- Communities within the TSI project were presented the opportunity to participate in the Pilot Study
- **City of Weatherford** selected due to high population, not a current CDC participant, and availability of H&H modeling to use as a basis
- **Town Creek** watershed Flood Risk Identification (FRI) study provided to USACE

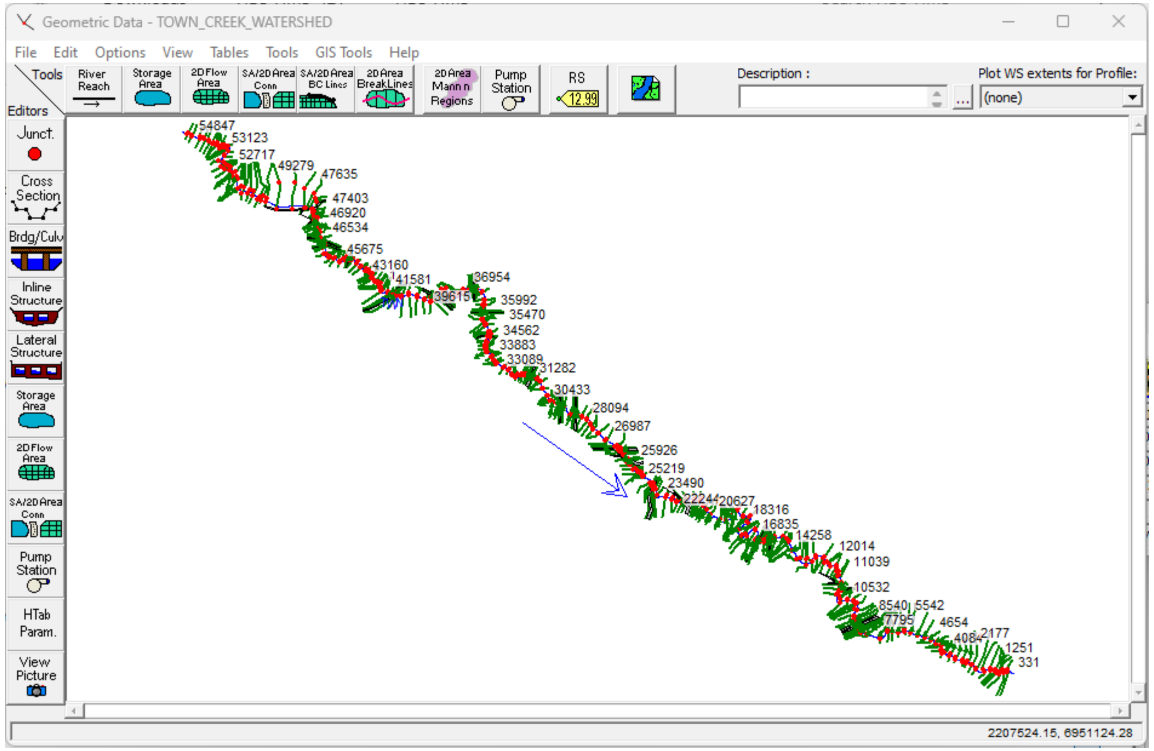
Goals and Deliverables:

- Use Town Creek FRI study as a basis to develop pilot study CDC H&H models as funding allows
- Create scope, replicable guidance, and document lessons learned for inclusion in final TSI report
- Provide template USACE Floodplain Management Services (FPMS) funding application

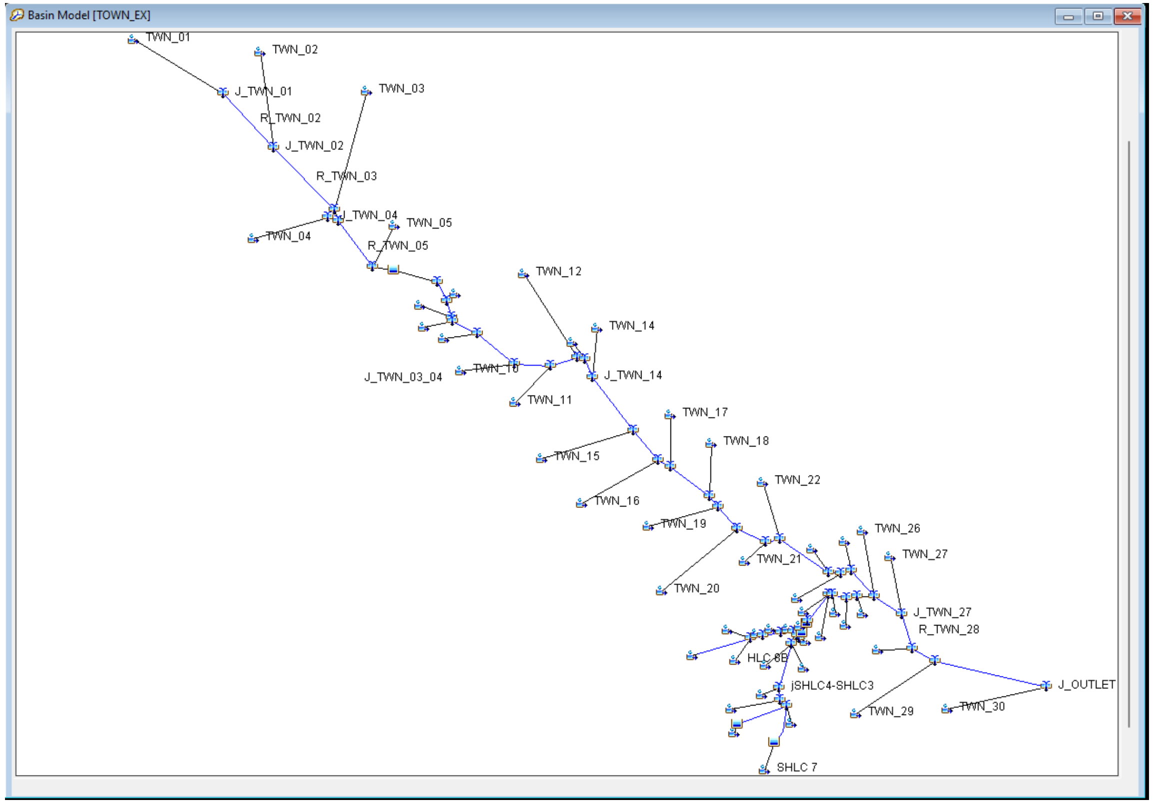

Town Creek Watershed

Expansion of the Corridor Development Certificate Process

HEC-RAS v5.0.3:

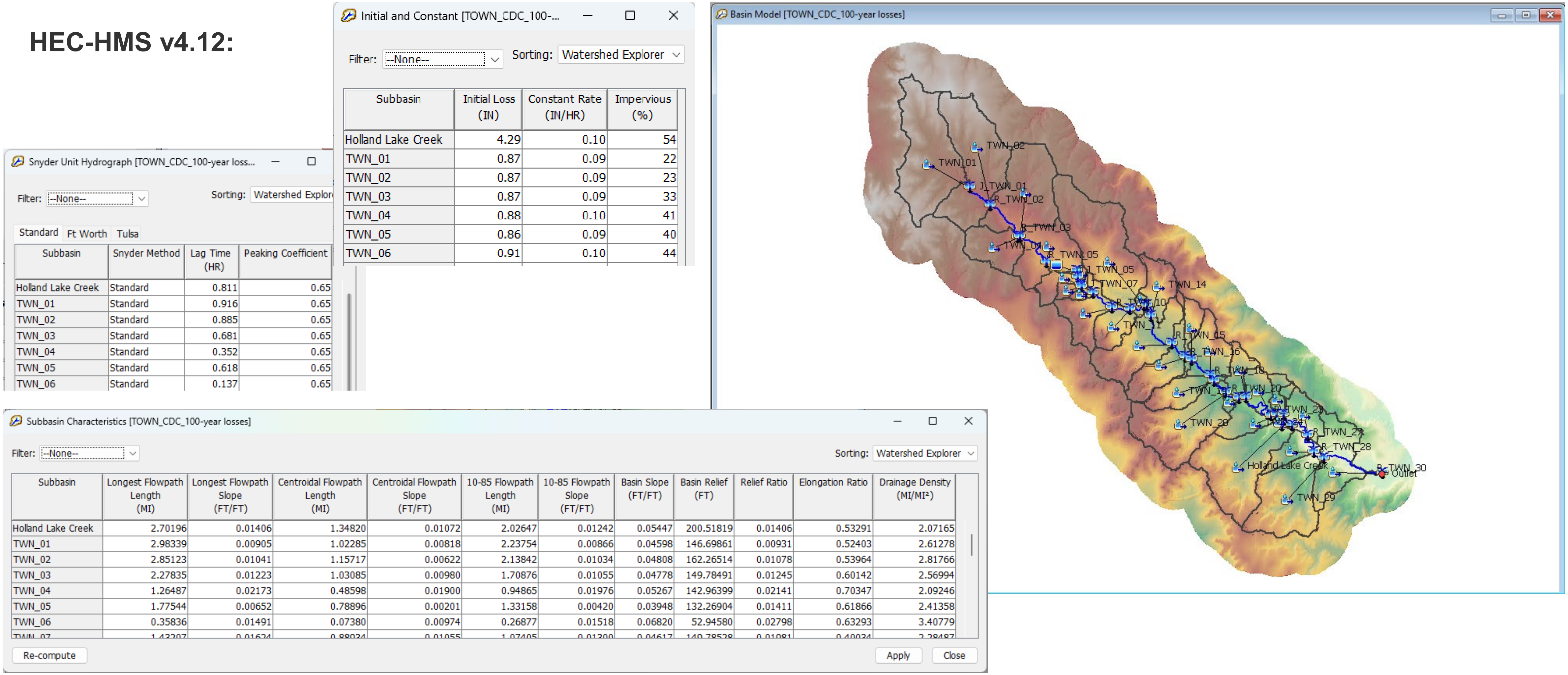


HEC-HMS v4.2:



Expansion of the Corridor Development Certificate Process

HEC-HMS v4.12:



Initial and Constant [TOWN_CDC_100-...

Filter: --None-- Sorting: Watershed Explorer

Subbasin	Initial Loss (IN)	Constant Rate (IN/HR)	Impervious (%)
Holland Lake Creek	4.29	0.10	54
TWN_01	0.87	0.09	22
TWN_02	0.87	0.09	23
TWN_03	0.87	0.09	33
TWN_04	0.88	0.10	41
TWN_05	0.86	0.09	40
TWN_06	0.91	0.10	44

Snyder Unit Hydrograph [TOWN_CDC_100-year loss...

Filter: --None-- Sorting: Watershed Explor

Subbasin	Snyder Method	Lag Time (HR)	Peaking Coefficient
Holland Lake Creek	Standard	0.811	0.65
TWN_01	Standard	0.916	0.65
TWN_02	Standard	0.885	0.65
TWN_03	Standard	0.681	0.65
TWN_04	Standard	0.352	0.65
TWN_05	Standard	0.618	0.65
TWN_06	Standard	0.137	0.65

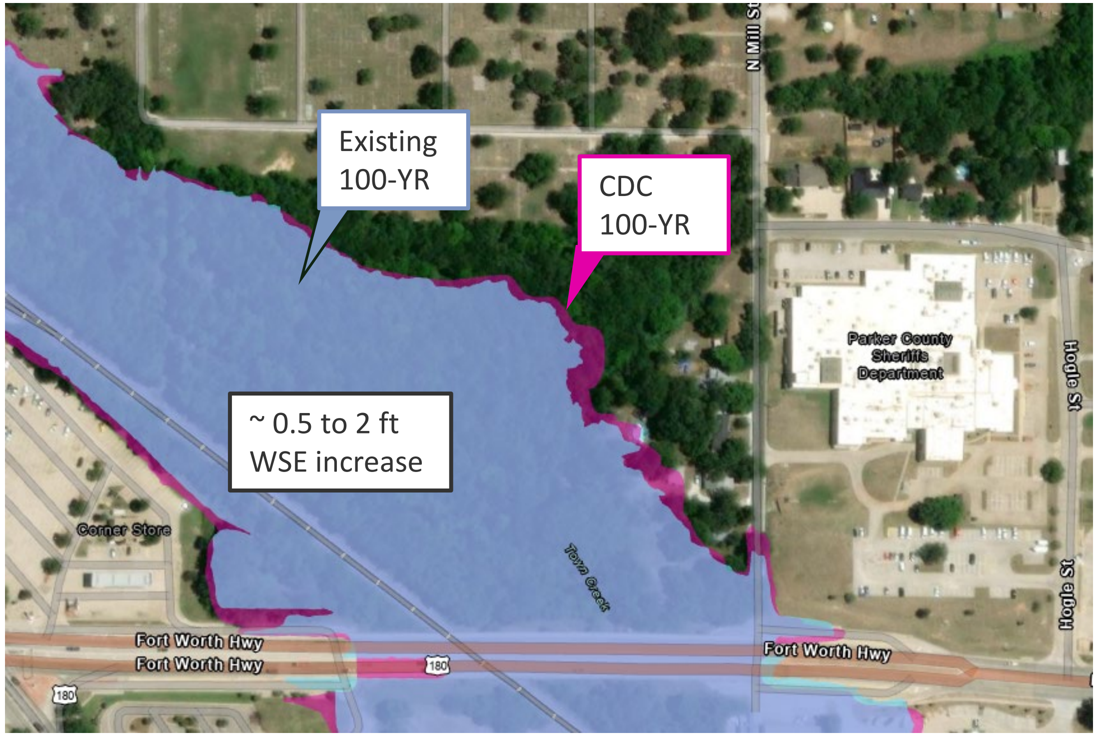
Subbasin Characteristics [TOWN_CDC_100-year losses]

Filter: --None-- Sorting: Watershed Explorer

Subbasin	Longest Flowpath Length (MI)	Longest Flowpath Slope (FT/FT)	Centroidal Flowpath Length (MI)	Centroidal Flowpath Slope (FT/FT)	10-85 Flowpath Length (MI)	10-85 Flowpath Slope (FT/FT)	Basin Slope (FT/FT)	Basin Relief (FT)	Relief Ratio	Elongation Ratio	Drainage Density (MI/MI²)
Holland Lake Creek	2.70196	0.01406	1.34820	0.01072	2.02647	0.01242	0.05447	200.51819	0.01406	0.53291	2.07165
TWN_01	2.98339	0.00905	1.02285	0.00818	2.23754	0.00866	0.04598	146.69861	0.00931	0.52403	2.61278
TWN_02	2.85123	0.01041	1.15717	0.00622	2.13842	0.01034	0.04808	162.26514	0.01078	0.53964	2.81766
TWN_03	2.27835	0.01223	1.03085	0.00980	1.70876	0.01055	0.04778	149.78491	0.01245	0.60142	2.56994
TWN_04	1.26487	0.02173	0.48598	0.01900	0.94865	0.01976	0.05267	142.96399	0.02141	0.70347	2.09246
TWN_05	1.77544	0.00652	0.78896	0.00201	1.33158	0.00420	0.03948	132.26904	0.01411	0.61866	2.41358
TWN_06	0.35836	0.01491	0.07380	0.00974	0.26877	0.01518	0.06820	52.94580	0.02798	0.63293	3.40779

Expansion of the Corridor Development Certificate Process

HEC-RAS v6.6:



Next Steps:

- Develop SPF hydrology, consolidated NFIP-CDC model for Town Creek, and inundation mapping as funding allows
- Create scope, replicable guidance, and document lessons learned for inclusion in final TSI report
    - To include steps taken for pilot study modeling and alternative processes for communities that do not have effective model products as a basis
- Provide template USACE Floodplain Management Services (FPMS) funding application

North Study Area H&H Modeling Update

HALFF

Sam Sarkar, PE

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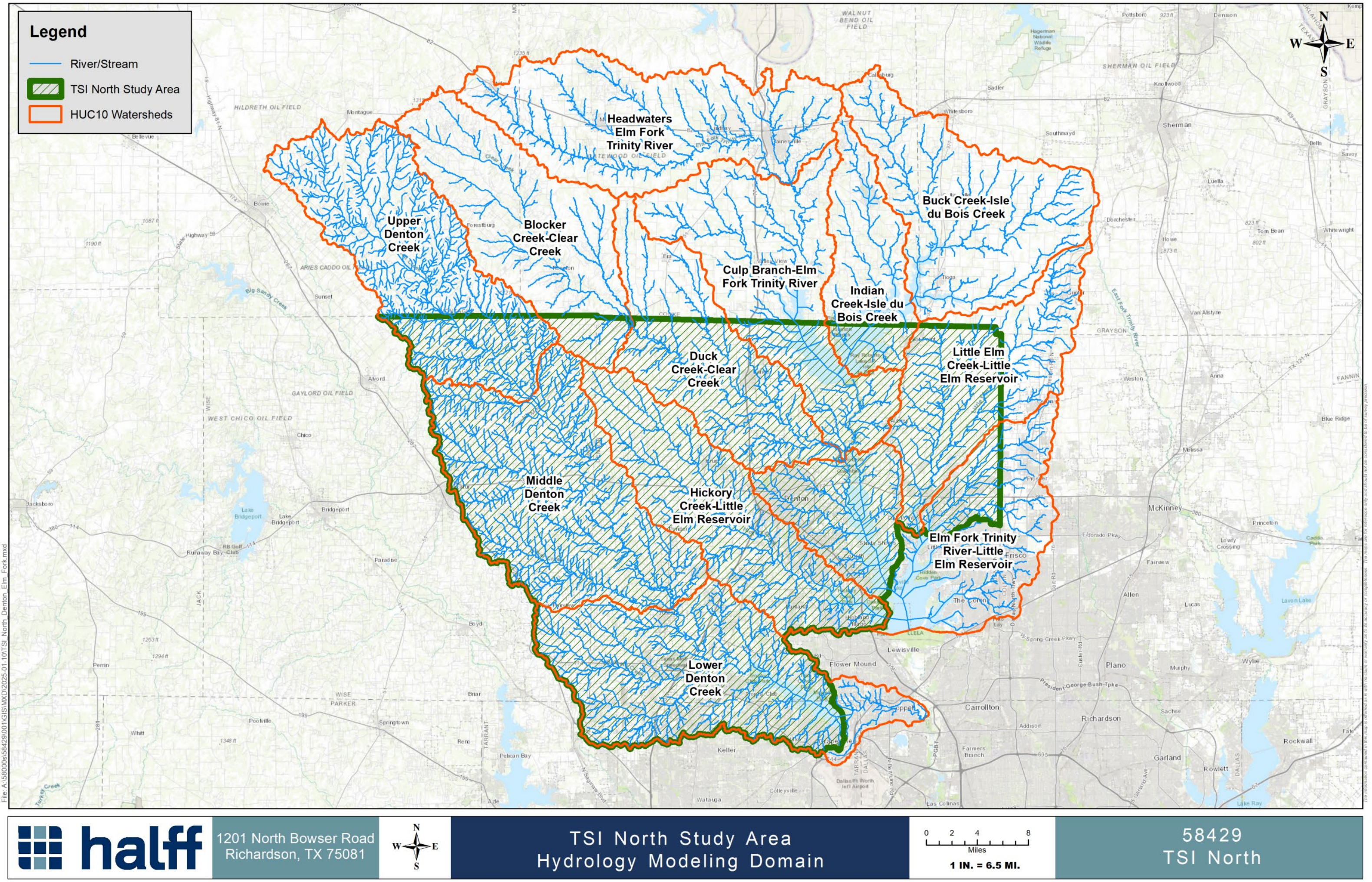
& Stormwater Infrastructure

Hydrology Modeling

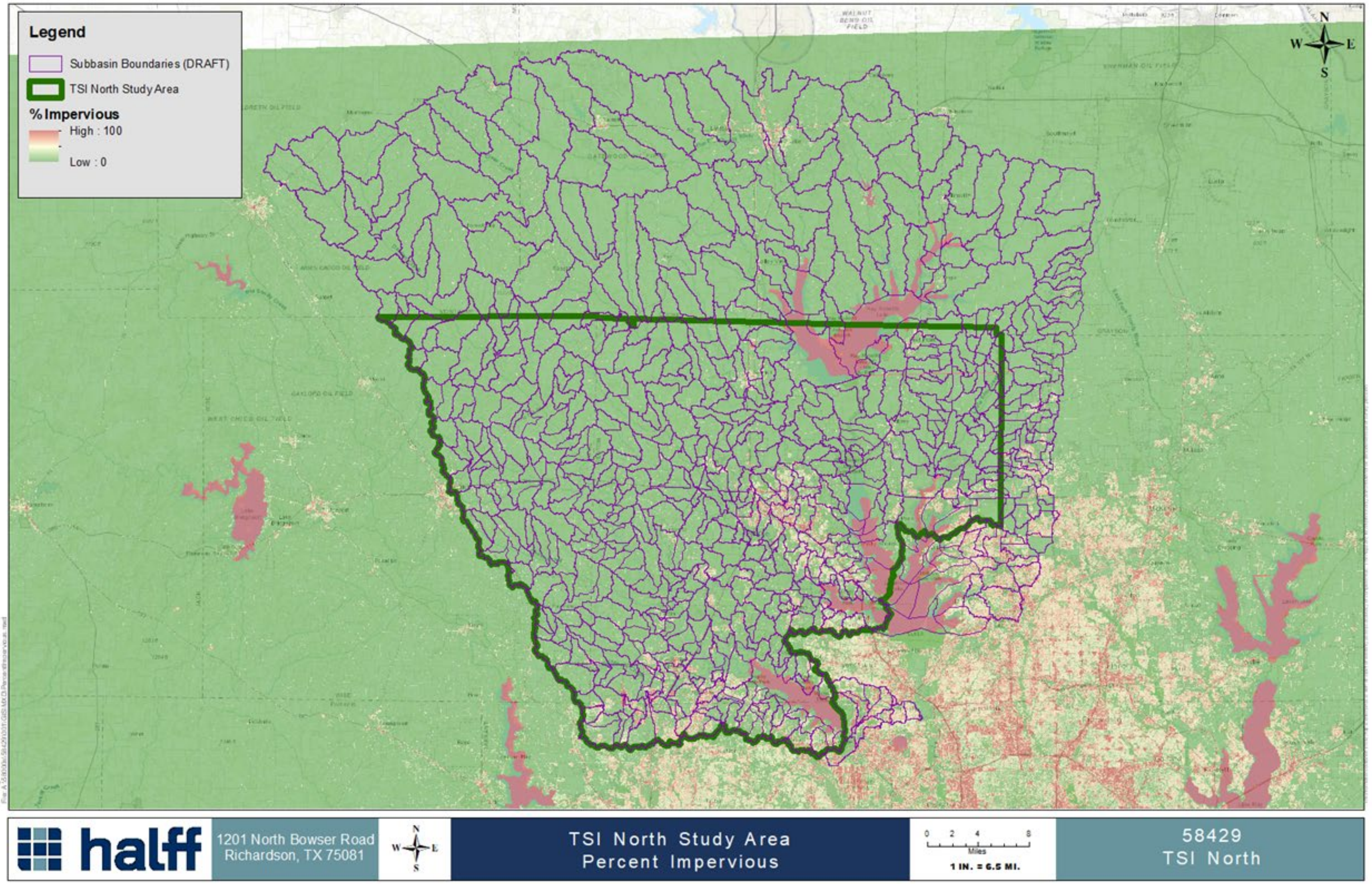
- ✓ Hydrology SOP
- ✓ Subbasins Delineation
- ✓ HEC-HMS Model Development
- ✓ Runoff Parameters
  - ✓ Losses
  - ✓ Baseflow
  - ✓ Lag Times



Runoff Model

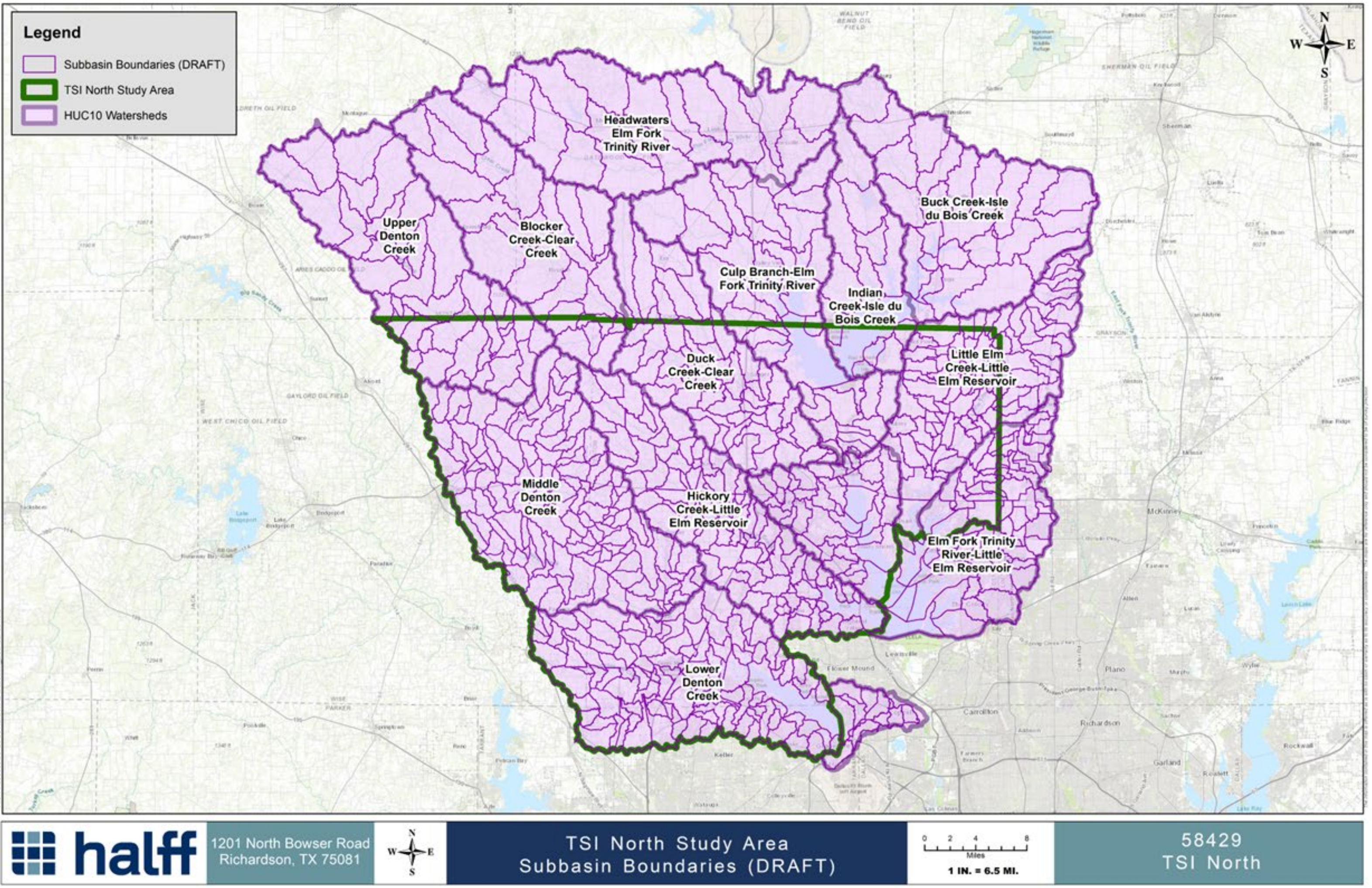
- ✓ Loss
  - ✓ Initial and Constant
  - ✓ Percent Impervious
- ✓ Transform
  - ✓ Snyder UH
- ✓ Baseflow
  - ✓ Recession

- ✓ NLCD 2016
- ✓ Trinity InFRM WHA



Routing

- ✓ Modified Puls
  - ✓ Trinity InFRM WHA
  - ✓ BLE Models



Next Steps

- Complete routing
- Incorporate precipitation
- Run HMS and calibrate against Trinity InFRM WHA
- Identify pilot study area to implement TSI process
  - ✓Existing Conditions H&H
  - ✓Future Conditions H&H
  - ✓Hazard Assessment
  - ✓Alternatives Analysis

Denton County Greenbelt Plan

UPPER TRINITY REGIONAL WATER DISTRICT

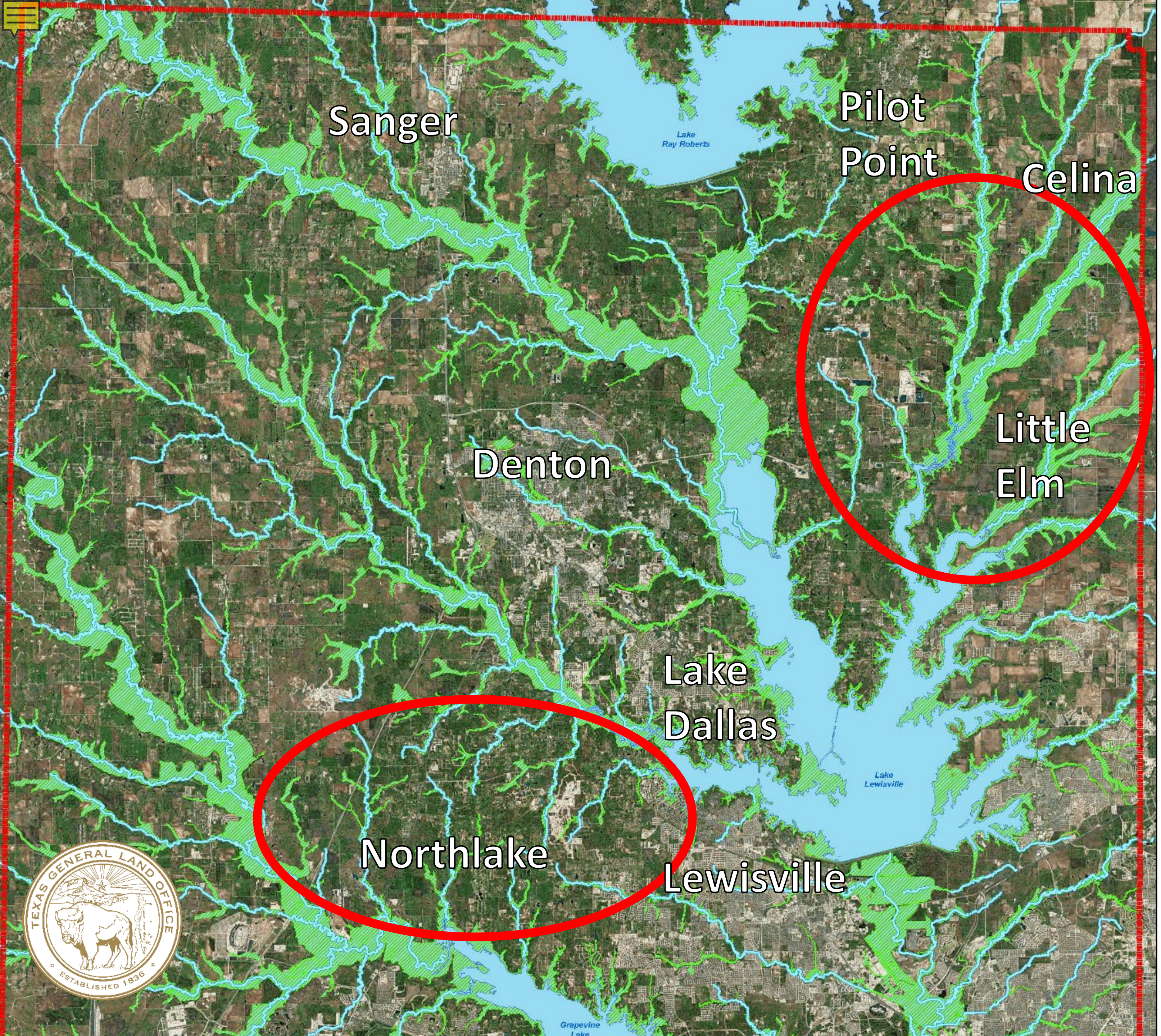
Blake Alldredge

integrating **Transportation**
& Stormwater Infrastructure

Denton County Greenbelt Plan

Blake Alldredge
Upper Trinity Conservation Trust / UTRWD

UPPER TRINITY
CONSERVATION TRUST



Our Waterways

- Thousands of miles of streams and creeks
- Three major water supply reservoirs
- Hundreds of miles of hike/bike trails

Why is Watershed Management Important?

- Protects Drinking Water Sources
- Protects Human Health / Aquatic Life
- Recreational / Economic Benefits

Upper Trinity Conservation Trust

UTCT

PROUD MEMBER | TEXAS LAND TRUST COUNCIL

Land Trust Alliance
Together, conserving the places you love

TEXAS GENERAL LAND OFFICE
ESTABLISHED 1836

- Established in 2010
- 501 (C)(3) Non-Profit Land Trust
- Landowner Outreach and Education
- Preserve Greenbelts and other Key Watershed Features
- Focuses on Lakes Lewisville, Ray Roberts, Grapevine & Lake Ralph Hall

Benefits of Greenbelts

Little Elm Creek, NE Denton County

- Serves as a buffer to protect water quality.
- Lessen flooding impacts.
- Preserve wildlife and aquatic habitat.

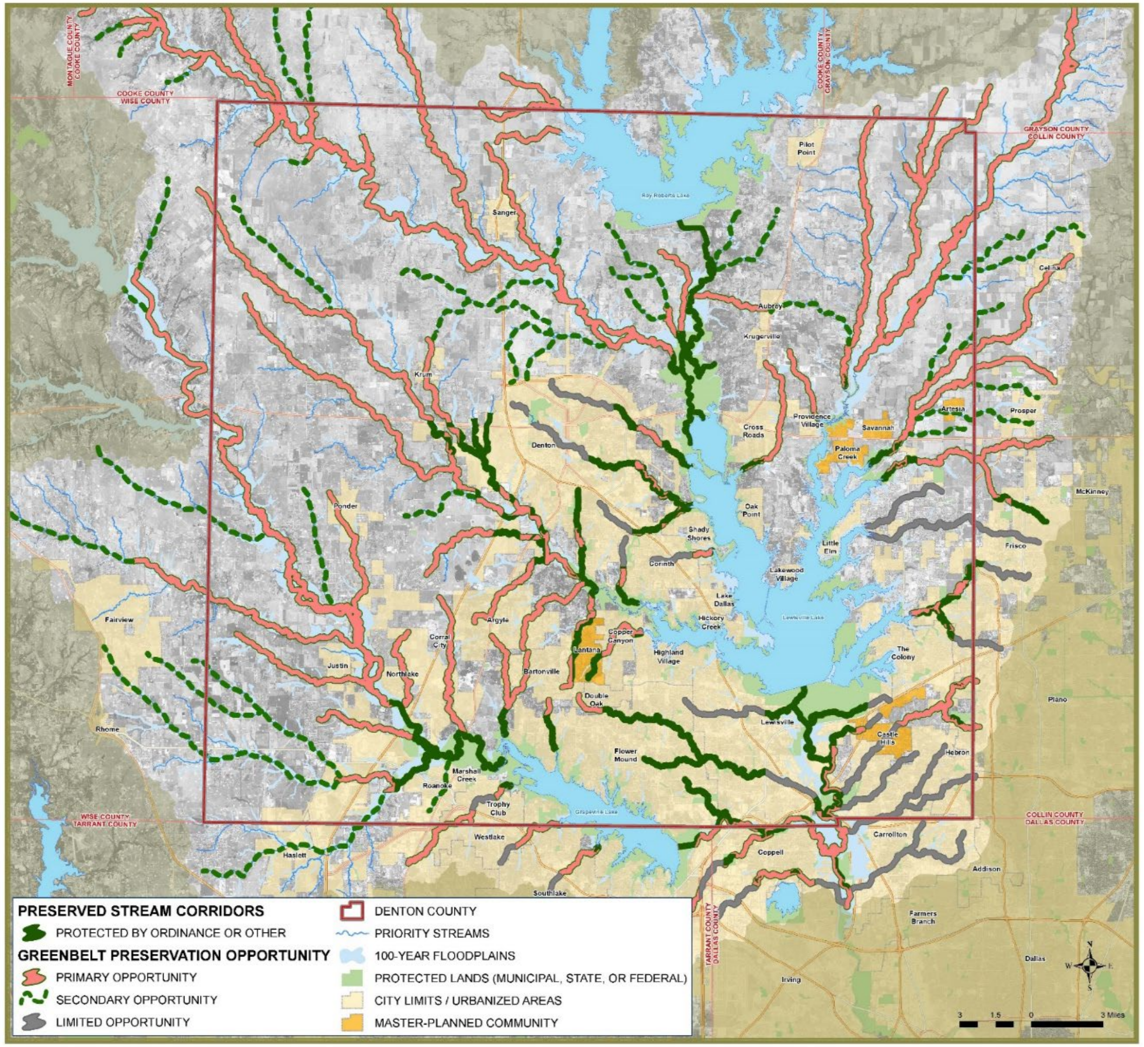
Riparian Vegetation is Key

- Stabilizes streambank soil
- Dissipates floodwater energy
- Filters water

TEXAS GENERAL LAND OFFICE
ESTABLISHED 1836

UTCT

Denton County Greenbelt Plan



- Adopted by Denton County, UTRWD & UTCT in 2017.
- Guides preservation of greenbelts and related areas to protect water quality.
- Identifies high-priority areas.
- Advocates a common vision.
- Provides a toolbox of implementation strategies - - on a voluntary basis.

Aligns with Transportation & Stormwater Infrastructure Initiative

TSi

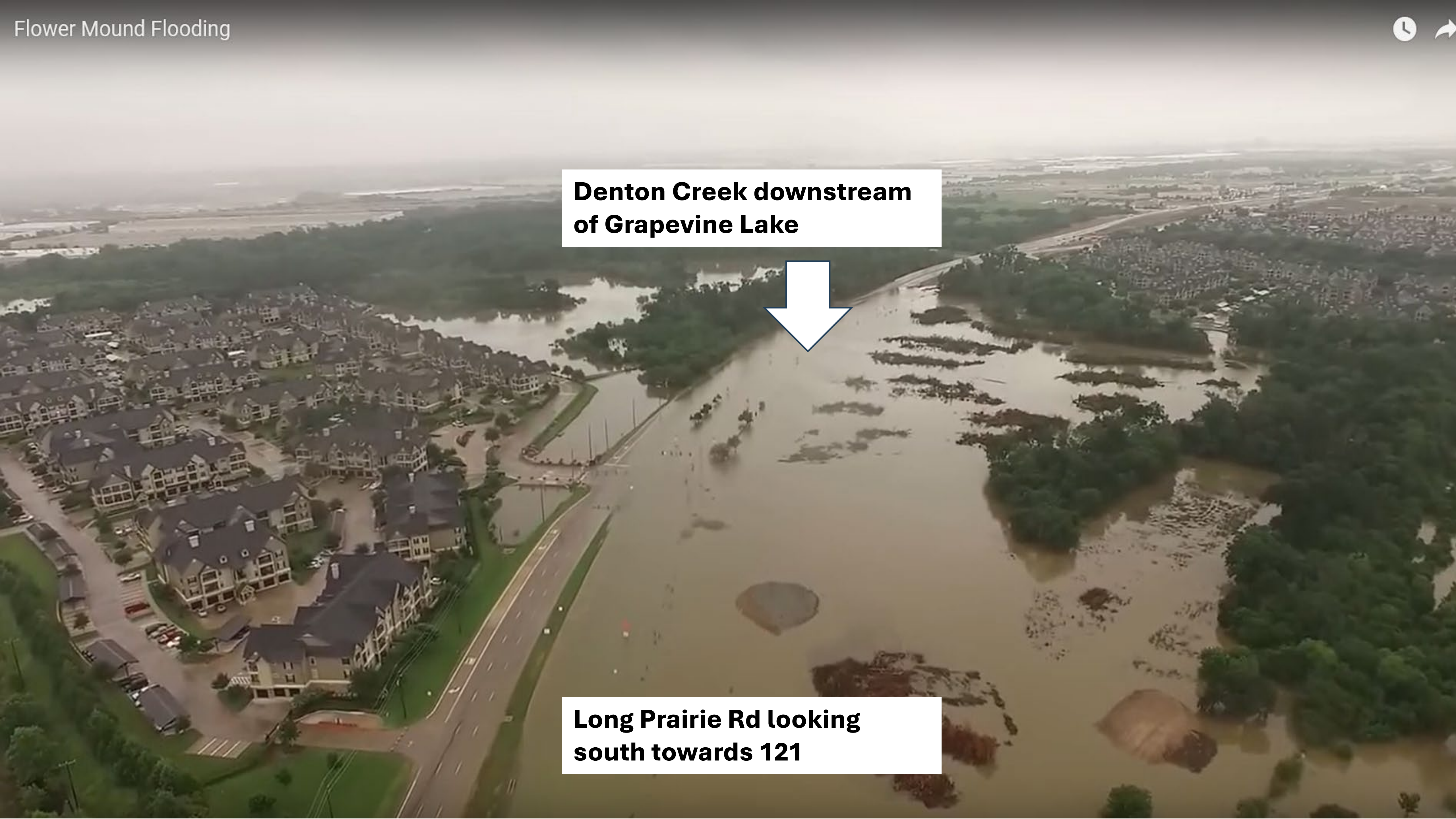
integrating **Transportation**
& Stormwater Infrastructure

Practices for Flood Reduction

- Development Standards & Ordinances
- Conservation Easements
- Alternative Development Ideas
- Green Stormwater Infrastructure
- Mowing Regimes

TEXAS GENERAL LAND OFFICE
ESTABLISHED 1836

UTCT



Denton Creek downstream of Grapevine Lake

Long Prairie Rd looking south towards 121

Social Benefits of Preserving Greenbelts

Greenbelt within Lantana community

✓Recreation/Exercise → Lower Chronic Disease

✓ Connection to Nature → Greater Well-Being → Lower Stress & Anxiety → Improved Mental Health

Better Physical, Mental and Emotional Health

"Healthy Trees, Healthy Lives" (*Texas A&M Forest Service*)

Economic Benefits of Preserving Greenbelts

Lewisville Lake in 2016:

✓ 2.7 million visits
✓ $65 million in visitor spending within 30 miles
✓Supports 601 jobs
*USACE Lewisville Lake 2020 Master Plan

Water Treatment Costs?
Flood Damage?

Benefits of Conserved Lands

- Every **$1** invested in conservation yields up to **$9** return on investment.
    - Water Quality
    - Water Quantity
    - Flood Protection
    - Agricultural Productivity

**Valuing Economic Benefits of Texas Conservation Lands (Texas Land Trust Council)*

Benefits of Conserved Lands

- Saves **$69 million** per year in projected water treatment costs.
- Capture **$316 million** in usable water.
- Every **$1** spent on flood risk reduction can decrease disaster costs by **$4.**

UTCT

Green Stormwater Infrastructure

North Central Texas Council of Governments iSWM Program – iswm.nctcog.org

Capture and filter excess stormwater in urban areas

TEXAS GENERAL LAND OFFICE
ESTABLISHED 1836

2012

TEXAS GENERAL LAND OFFICE
ESTABLISHED 1836

2013

2015

Entities Adopted the Greenbelt Plan

City of Aubrey

City of Corinth

City of Denton

Town of Double Oak

Town of Flower Mound

Town of Hickory Creek

City of Justin

Lake Cities MUA

Lantana

City of Lewisville

City of Pilot Point

City of Sanger

...interested?

Stay Connected!

Upper Trinity
Conservation Trust

@UTCTrust

www.utct.org

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Outreach to Local Governments

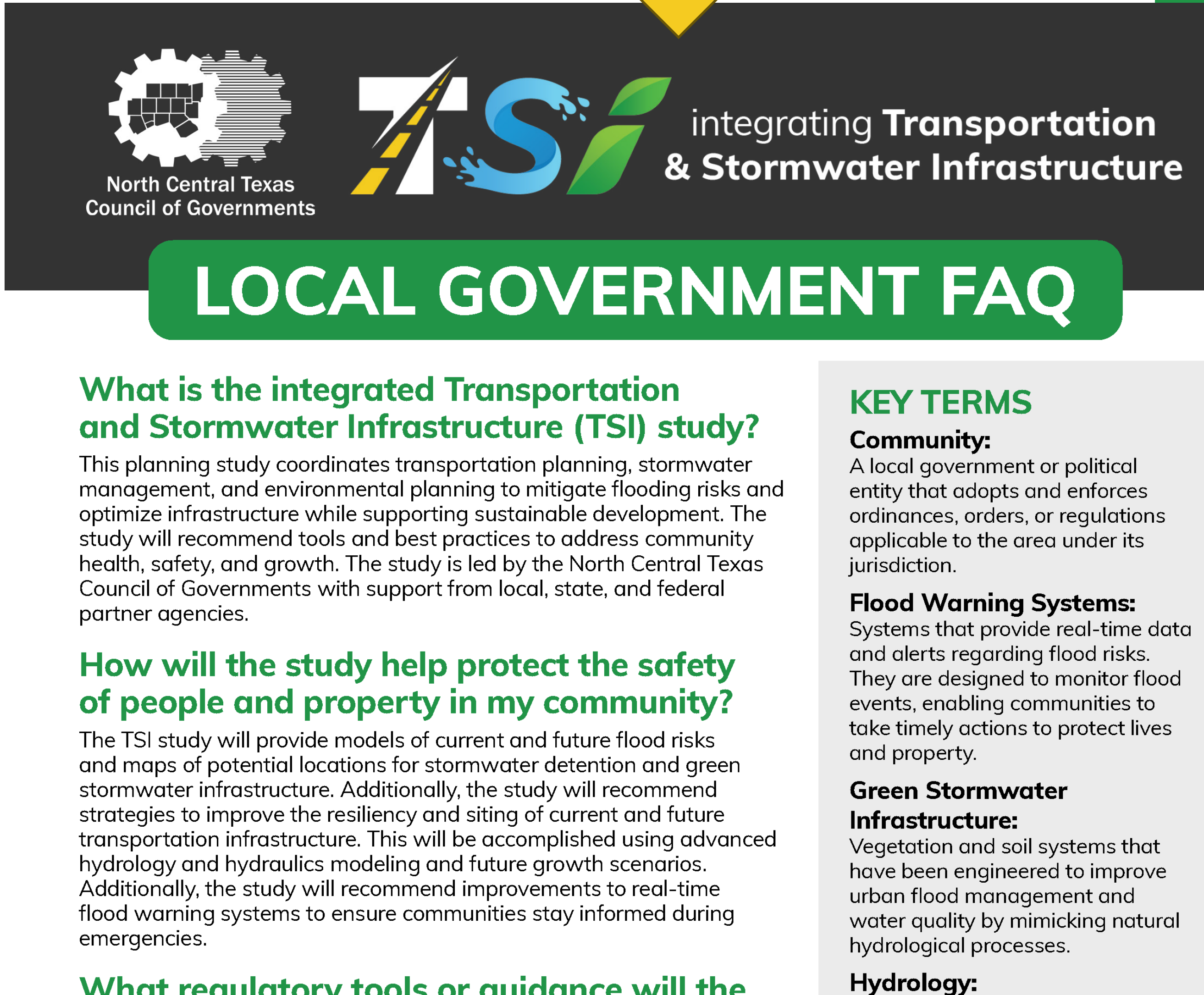
NCTCOG

integrating **Transportation**
& Stormwater Infrastructure

Local Government FAQ

www.nctcog.org/tsi

- What is the integrated Transportation and Stormwater Infrastructure (TSI) study?
- How will the study help protect the safety of people and property in my community?
- What regulatory tools or guidance will the TSI study produce?
- What recommendations from the study will benefit my community?
- How can my community fund the TSI study's recommendations?
- How can my community participate in the study?
- Why should my community participate in the TSI study?



North Central Texas Council of Governments

integrating **Transportation & Stormwater Infrastructure**

LOCAL GOVERNMENT FAQ

What is the integrated Transportation and Stormwater Infrastructure (TSI) study?

This planning study coordinates transportation planning, stormwater management, and environmental planning to mitigate flooding risks and optimize infrastructure while supporting sustainable development. The study will recommend tools and best practices to address community health, safety, and growth. The study is led by the North Central Texas Council of Governments with support from local, state, and federal partner agencies.

How will the study help protect the safety of people and property in my community?

The TSI study will provide models of current and future flood risks and maps of potential locations for stormwater detention and green stormwater infrastructure. Additionally, the study will recommend strategies to improve the resiliency and siting of current and future transportation infrastructure. This will be accomplished using advanced hydrology and hydraulics modeling and future growth scenarios. Additionally, the study will recommend improvements to real-time flood warning systems to ensure communities stay informed during emergencies.

What regulatory tools or guidance will the

KEY TERMS

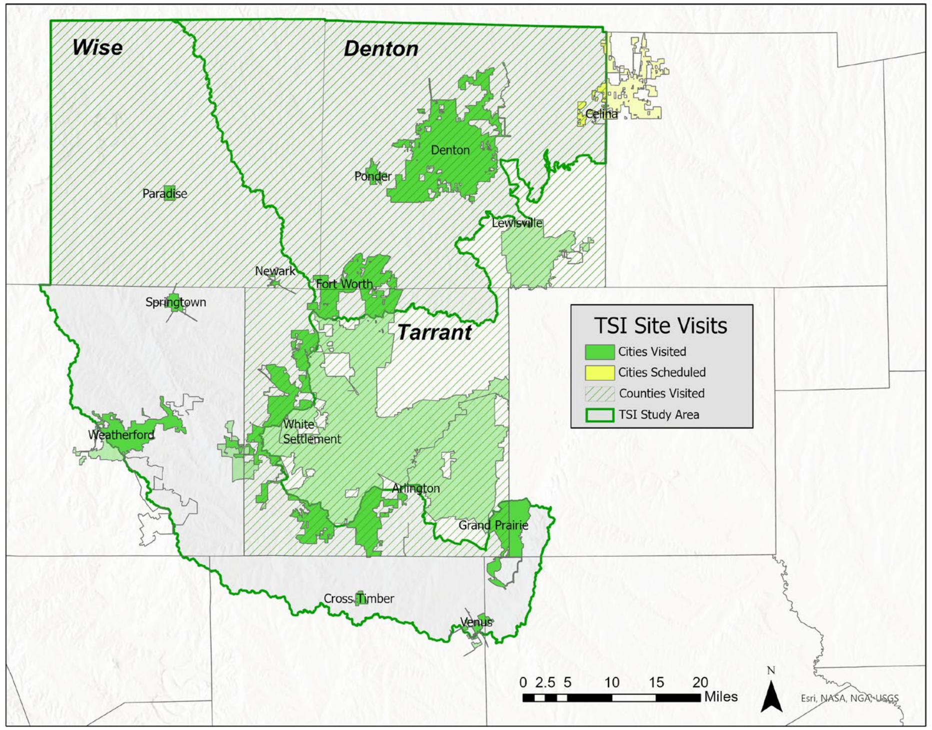
Community:
A local government or political entity that adopts and enforces ordinances, orders, or regulations applicable to the area under its jurisdiction.

Flood Warning Systems:
Systems that provide real-time data and alerts regarding flood risks. They are designed to monitor flood events, enabling communities to take timely actions to protect lives and property.

Green Stormwater Infrastructure:
Vegetation and soil systems that have been engineered to improve urban flood management and water quality by mimicking natural hydrological processes.

Hydrology:

Community Site Visits



To schedule a site visit, please email tsi@nctcog.org or kzielke@nctcog.org

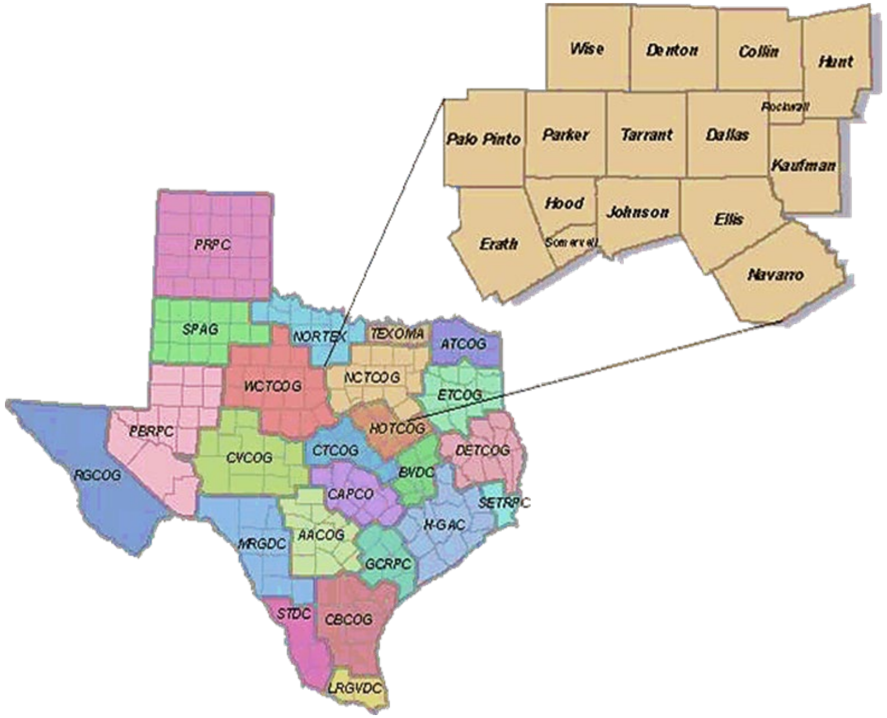
- Buyouts leading to open space preservation
- Regular meetings with developer groups
- Concern about maintenance for green stormwater infrastructure
- Processes that streamline plan or plat submissions
- Change incentivized by FEMA Community Rating System
- Stormwater utility fees and bonds to fund repairs and upgrades

A sample of strategies and concerns identified at site visits

integrating **Transportation**
& Stormwater Infrastructure

County Watershed Workshop

- Date TBD – looking at days in June
- Hybrid – NCTCOG offices and Microsoft Teams
- Seeking additional speaker/s related to floodplain management, stormwater, and transportation
- Discussion of state code
- Discussion of implementation from 2017 Menu of Regionally Recommended Standards in Watershed Management For New Development Within County Regulated Areas



Upstream/Downstream Workshop

- Target timeline Fall 2025
- Opportunity for neighboring communities to discuss growth and future collaboration
- To participate, please email tsi@nctcog.org or kzielke@nctcog.org

Next Steps and Upcoming Events

NCTCOG

Kate Zielke, CFM

Next Steps

West

Finalization of storm shifting SOPs

Hydraulic work

Finalization of optimization study

Policy inventory and research

Community site visits

North

Continued hydrologic work

GIS stacking model

Alternatives analysis SOP

Policy inventory and research

Community site visits

Upcoming Events

- RISE Coalition Meeting – May 14, 9:30-11:30 a.m., https://www.addevent.com/event/hY24288000
- Trinity River COMMON VISION Flood Management Task Force meeting – May 16, 9:30-11:30 a.m., https://www.addevent.com/event/Ut25508952
- Regional Stormwater Management Coordinating Council, May 21, 9:30-11:30 a.m., https://www.addevent.com/event/Aa25070471
- iSWM Manual Updates – to be involved in the updates, please contact Katie Hunter, khunter@nctcog.org

Speaker Contacts

Tarrant Regional Water District

Katie Myers | Rural Programs Supervisor, Watershed Protection

817.720.4419 | katie.myers@trwd.com

Aaron Hoff | Watershed Programs Manager

817-720-4453 | aaron.hoff@trwd.com

Texas A&M AgriLife Extension Service

Dr. Fouad Jaber, Ph.D., P.E. | Professor and Extension Specialist

972.952.9672 | fouad.jaber@ag.tamu.edu

Dr. Yufan Zhang, Ph.D., E.I.T. | Post-doc Extension Associate

217.721.0624 | yufan.zhang@ag.tamu.edu

US Army Corps of Engineers

Vincent A. Geracci, PE, CFM. | Hydraulic Engineer

817.886.1549 | Vincent.A.Geracci@usace.army.mil

Halff

Sam Sarkar, PE | Senior Project Manager

214.346.6368 | ssarkar@halff.com

Upper Trinity Regional Water District

Blake E. Alldredge

972.219.1228 | balldredge@utrwd.com

North Central Texas Council of Governments

Kate Zielke, CFM | Program Supervisor

817.695.9227 | kzielke@nctcog.org