A Proactive Approach To North-Central Texas Growth & Development:

Integrated Transportation and Stormwater Infrastructure (TSI)

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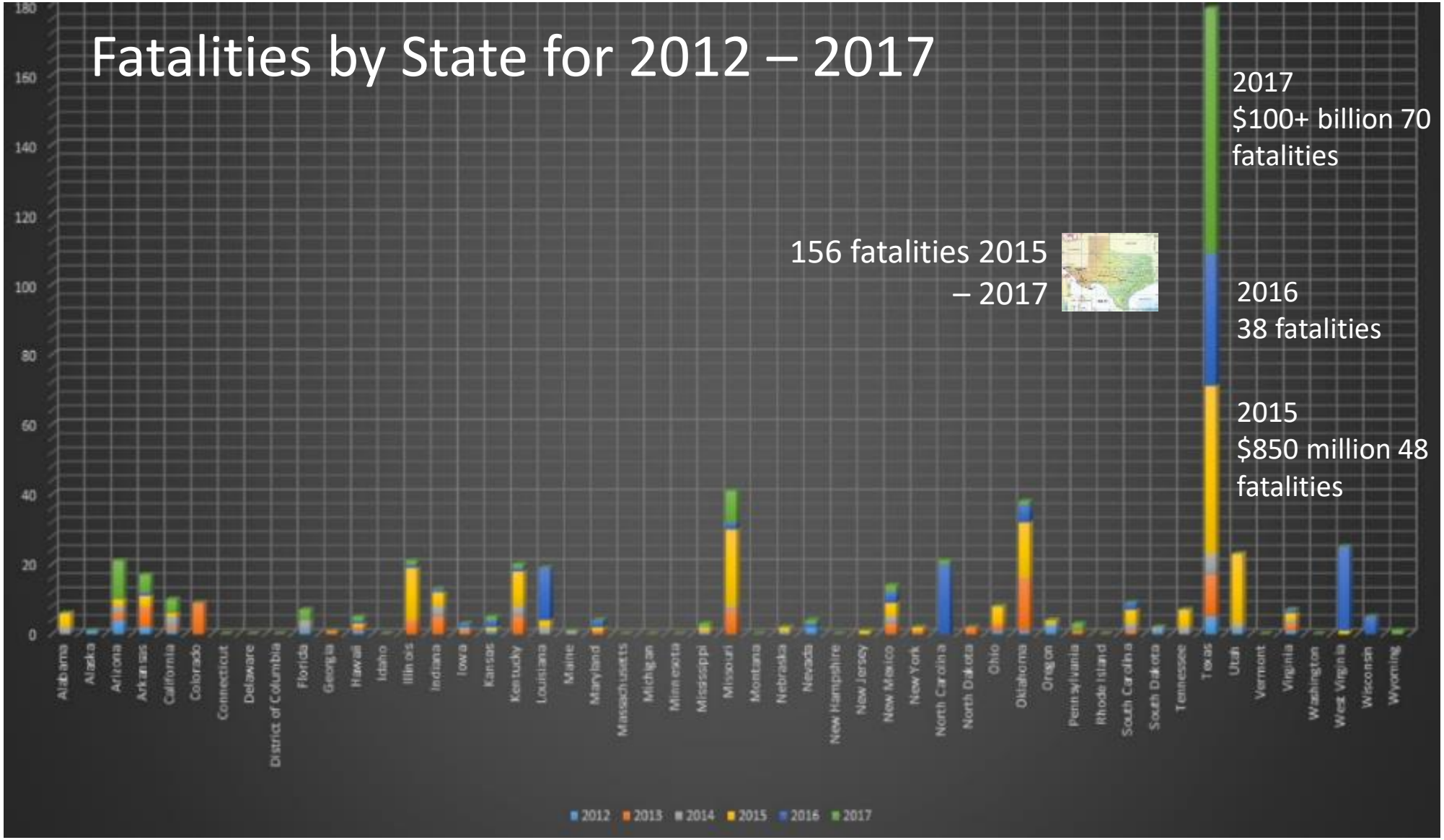
Urban Riparian Symposium – February 20, 2025

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.

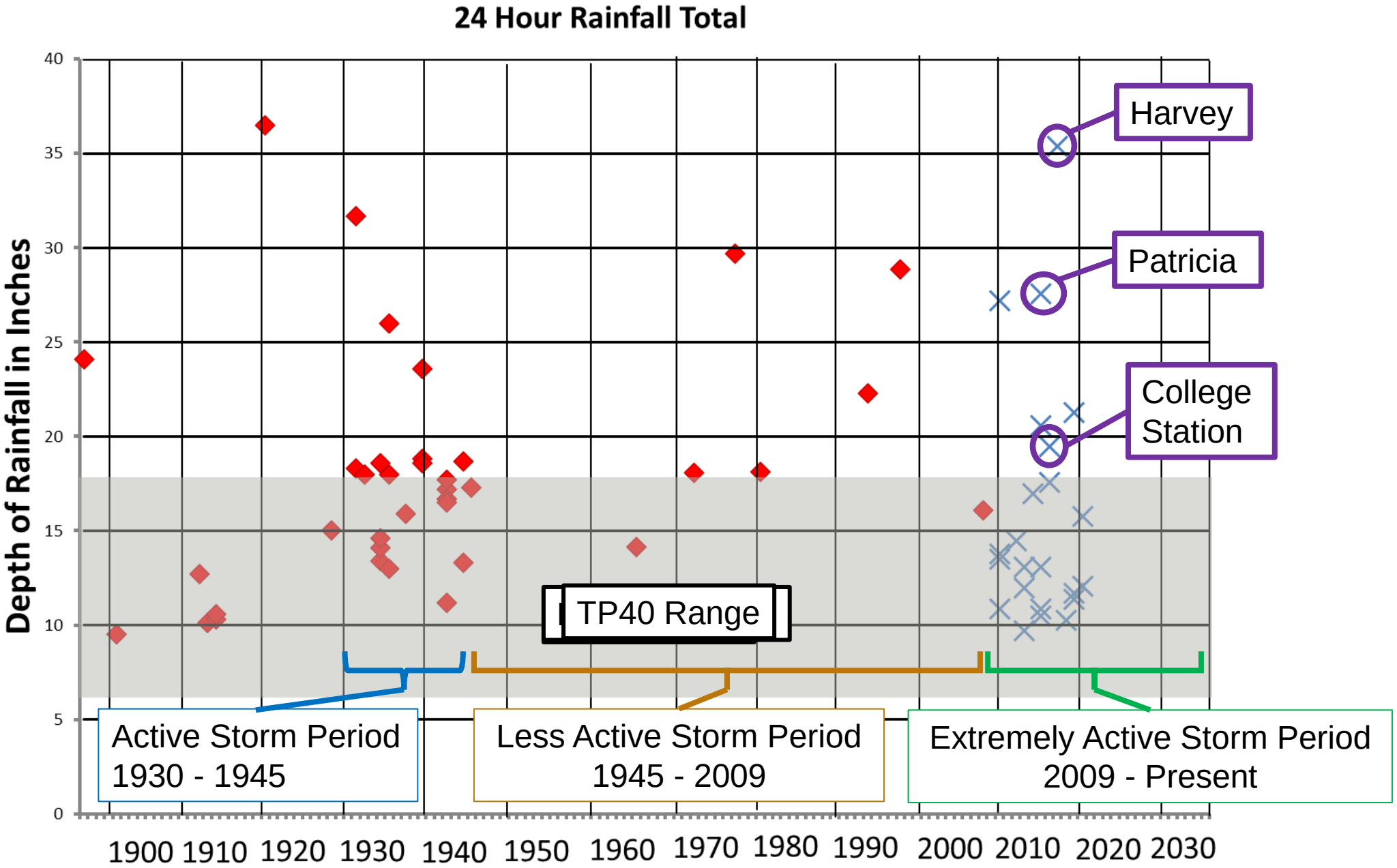
Flooding Fatalities and Damages

Texas far outpaces other states in flood-related fatalities and flood-related damages

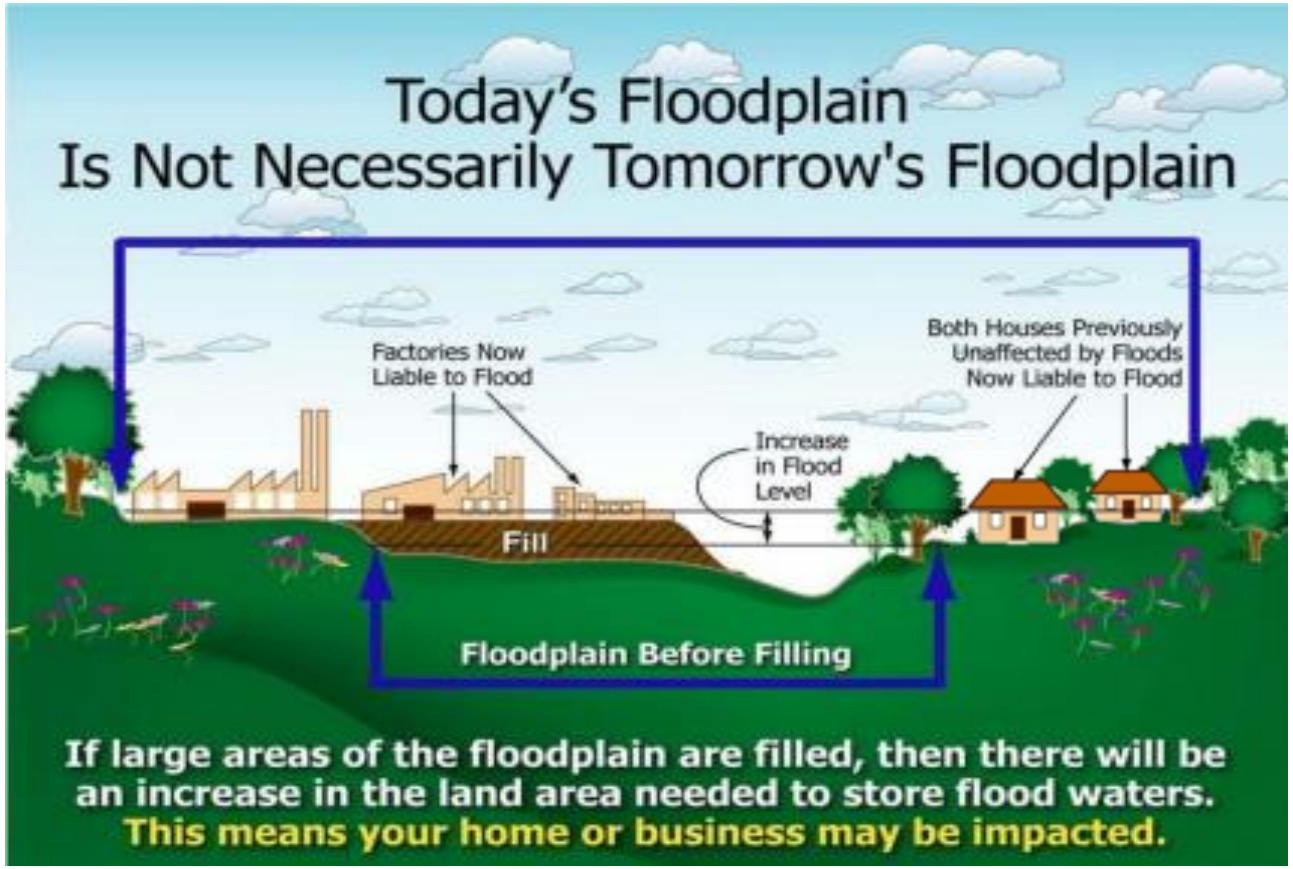


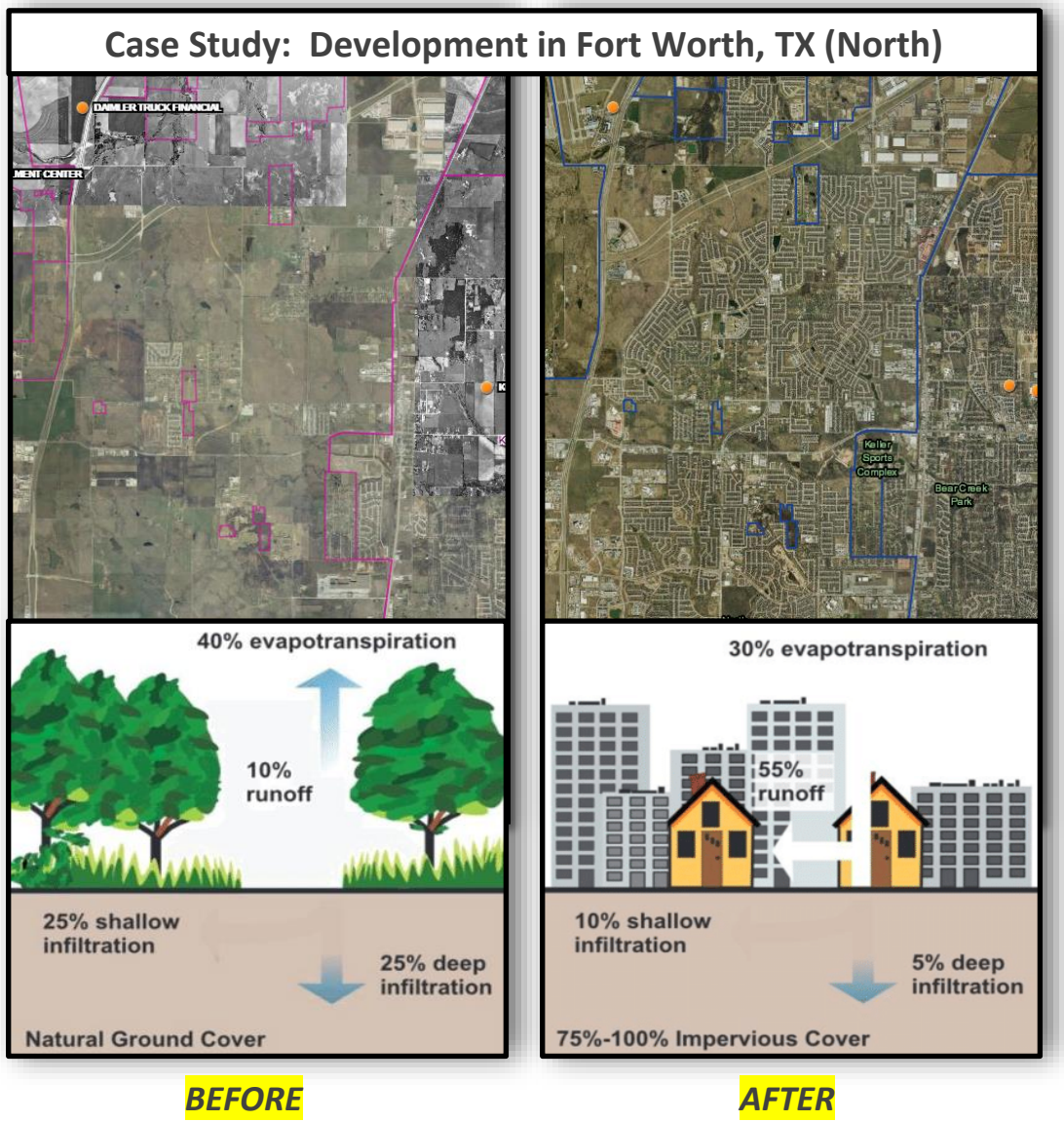
Source: Gregory Waller, Service Coordination Hydrologist, NWS – West Gulf River Forecast Center, http://www.nws.noaa.gov/om/hazstats.shtml, 11/18 TFMA

Extreme Storms… A History Lesson



Urbanization Challenges





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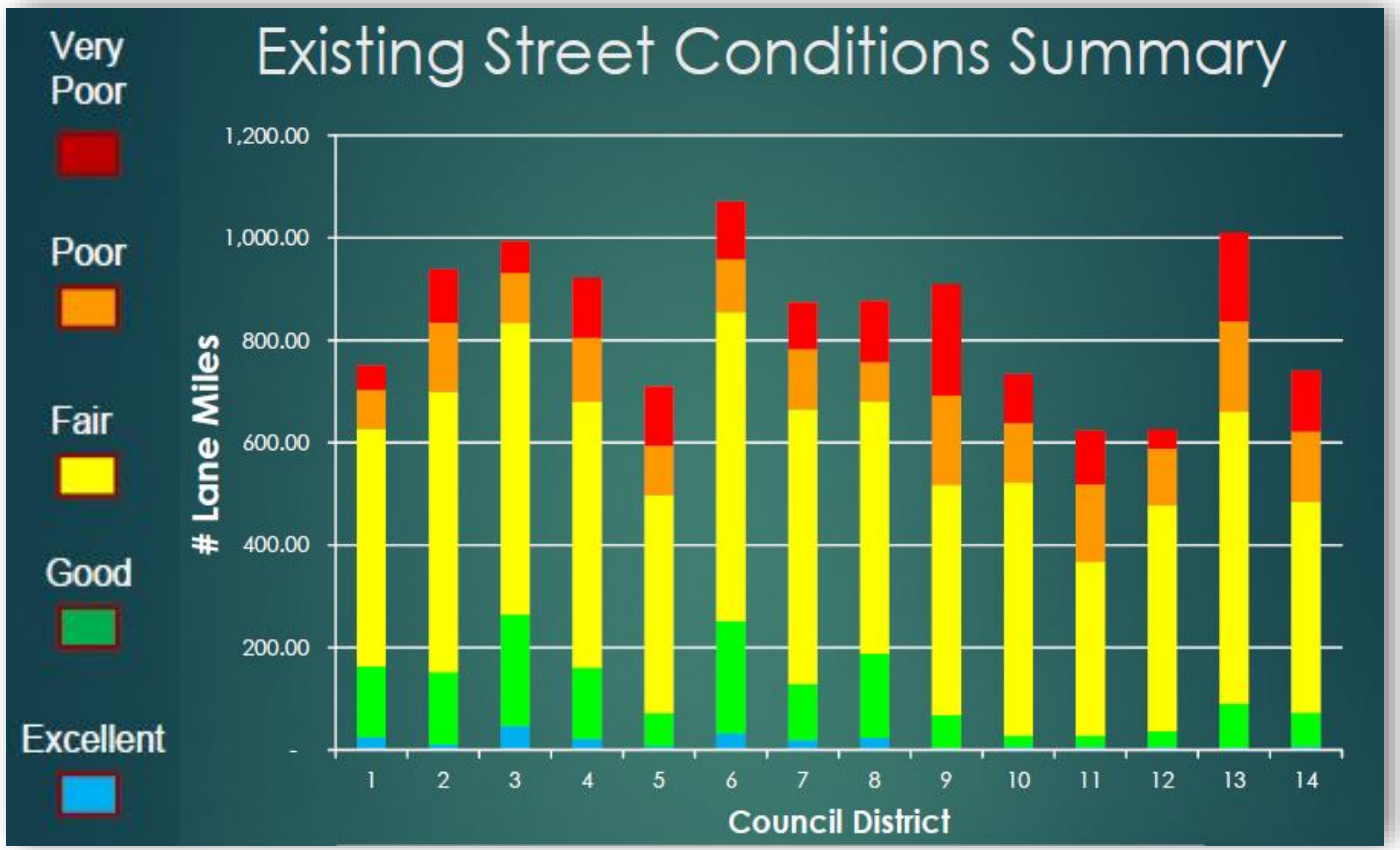
Stormwater Challenges

- No regionwide data
- Piece-meal/lacks connectivity
- NOAA Atlas 14 rainfall estimates
  - Required for infrastructure design, planning, and delineation of flood risk
  - 2022 FLOODS Act
  - 10-year updates

Transportation Challenges

- Transportation spending is high and growing
- Rate of deterioration for transportation infrastructure increasing
- Needs far outweigh resources



Source: Dallas 2017 Bond Program – http://www.dallasbond.com/

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How long and high should this bridge be?

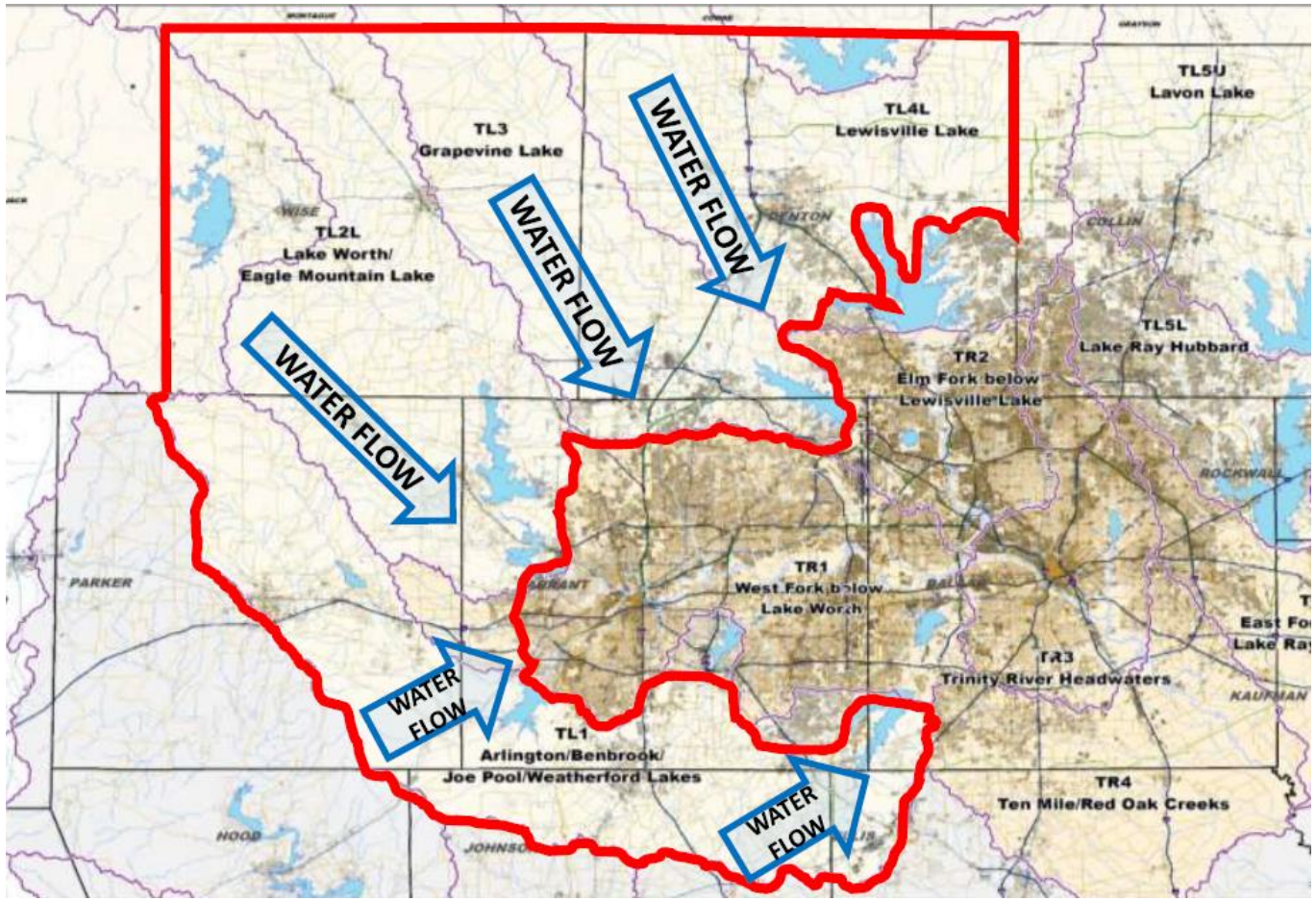
How will this business be impacted by flooding?

What is a safe elevation for this electrical substation?

How will extreme storms affect this neighborhood?

Integrated Transportation and Stormwater Infrastructure (TSI) Initiative

- Integrate stormwater management, urban development, transportation, and environmental planning
- Identify impacts and alleviate risks from flooding
- Get ahead of growth
- Reduce costs



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Project Area Details

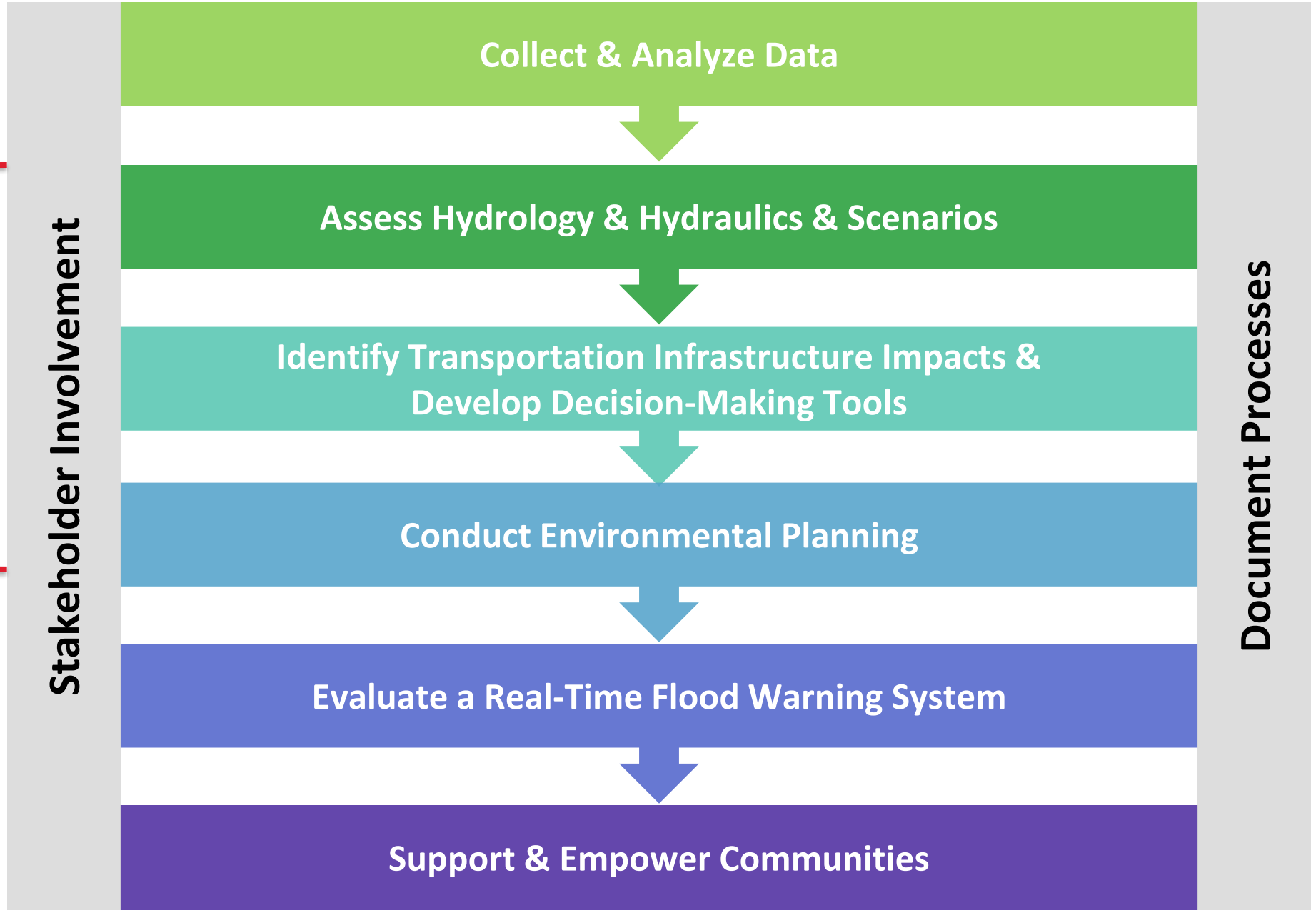
- 85 cities and portions of 8 counties
- 126% increase in population (2020 – 2045)
- 60% undeveloped (2015)
- 19% growth in impervious surface (2006 – 2016)
- > 7,000 miles of streams and > 274,000 acres of 100-year floodplain

Photo courtesy of City of Newark

Stakeholder Engagement

1. Identifying Stakeholders
2. Prioritizing Local Governments for Outreach
3. Preparing for Outreach to Local Governments
4. Following Up After Outreach to Local Governments
5. Addressing Equity
6. Reaching Rural and Agricultural Audiences
7. Reaching Business Audiences

Mapping, Modeling, and Policy Recommendations



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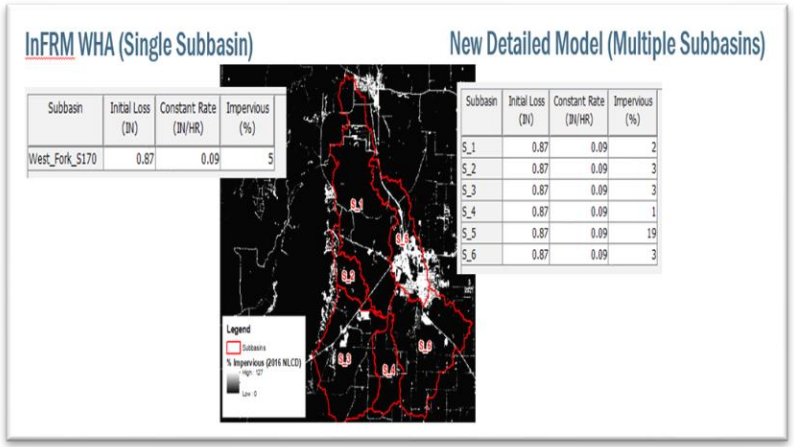
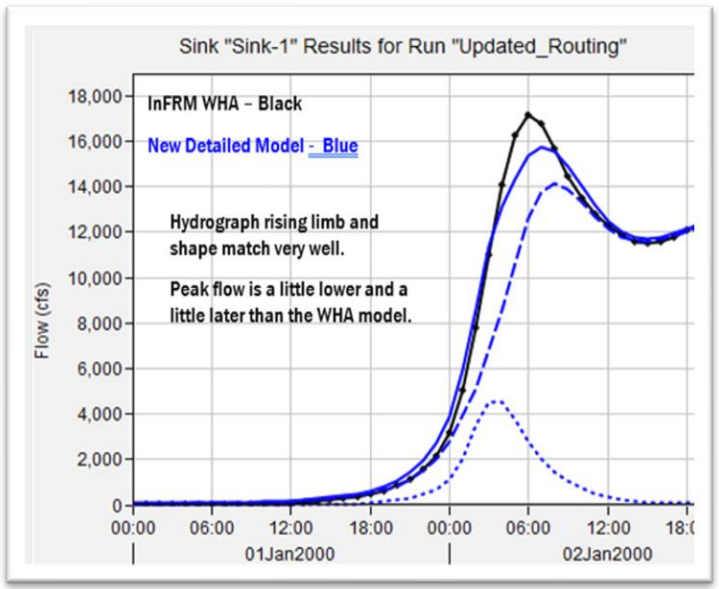
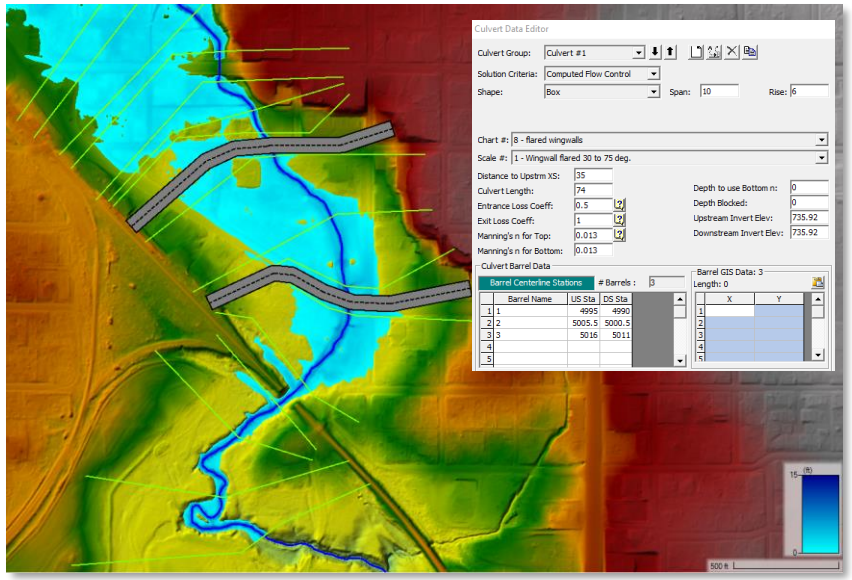
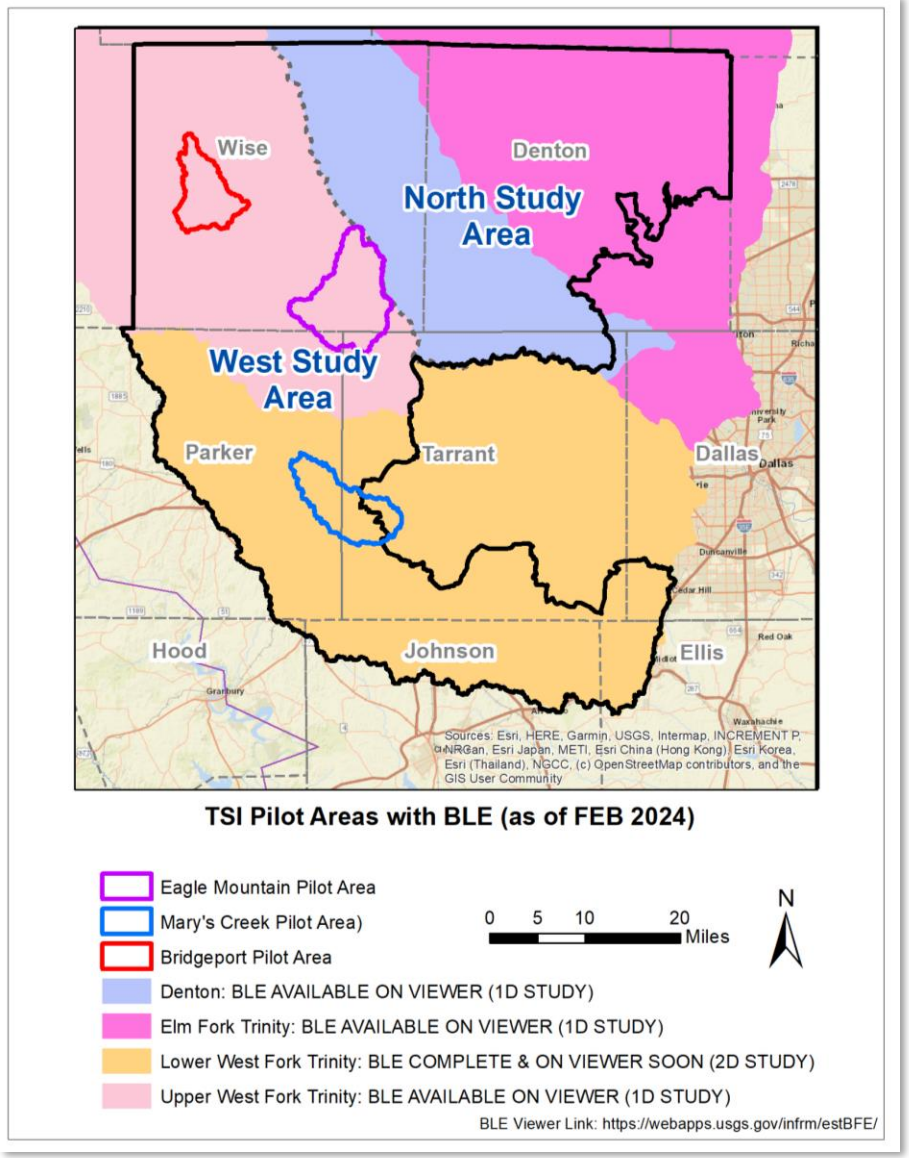
H&H Modeling Approach



- Testing and refining enhancements of InFRM Watershed Hydrology Assessment (WHA) to ensure quality & applicability
- Enhance hydraulic models to ensure accuracy and usability







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Approach to Flood Risk Reduction: Flood-prone Area ID

- Indicator method: Develop a flood susceptibility map using a GIS stacking model that includes four categories of conditioning factors: **Environmental, Socio-economical, Infrastructural, and Institutional**

Environmental

Topographical
- Elevation
- Slope
- LS factor
- Aspect
- Curvature
- TWI
- TRI

Meteorological
- Rainfall intensity
- Rainfall duration
- Rainfall frequency

Geological
- Geology (lithology)
- Soil hydrologic group

Hydromorphological
- SPI
- STI
- Stream order
- Distance from river
- Stream density
- Flow accumulation
- Flow direction
- Time of concentration
- Curve number

Land use/cover
- NDVI
- NDWI
- Imperviousness or NDBI

Socio-economical

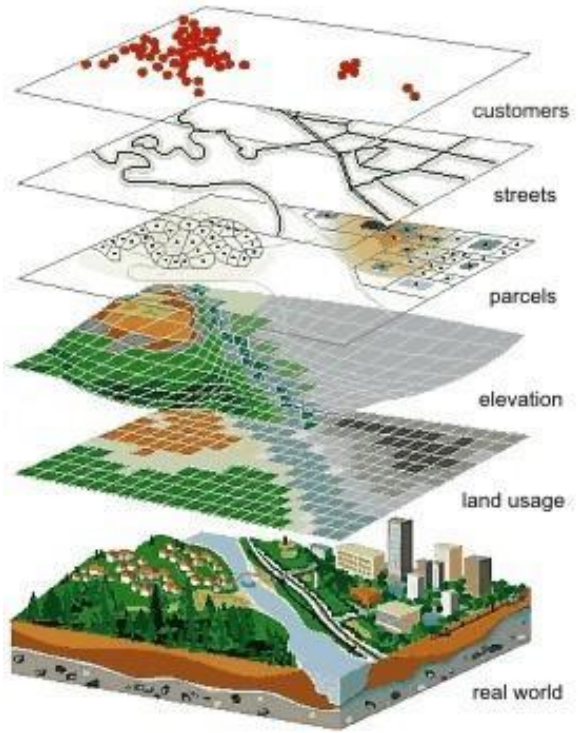
- Social vulnerability index
- Population density

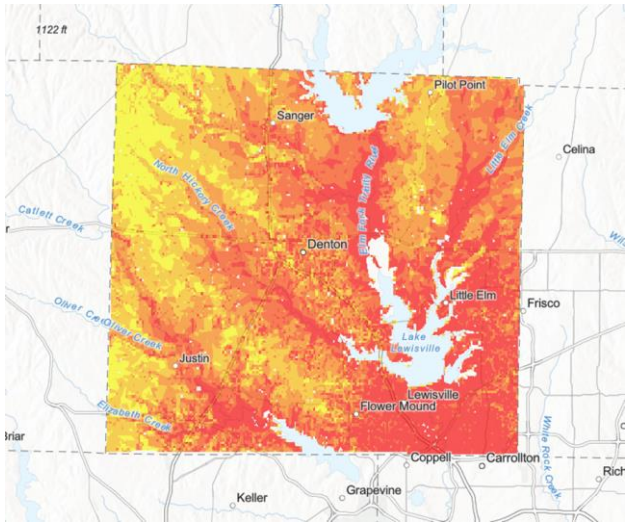
Infrastructural

- Distance from transportation network
- Distance from NRCS BMPs (ex. water harvesting catchment, pumping plant, roof runoff structure)

Institutional

- Distance from USGS streamflow monitoring gauges





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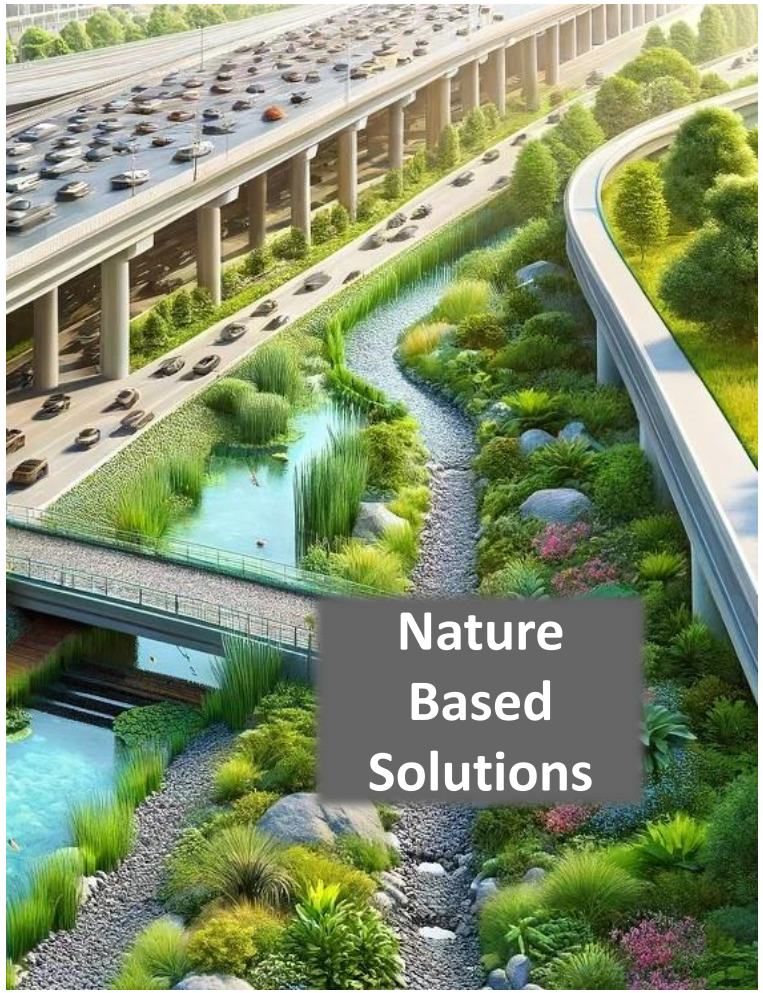
Note: Factors are summarized based on a literature review from 30 peer-reviewed journal articles over the past three years. All these factors could be considered in TSI study according to the data availability.

Result: A menu of options & integration where it makes sense



*Note that these images were made with AI to appease our robot overlords that will eventually rule over all humankind**

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**just kidding†*
† kinda kidding

Green Stormwater Infrastructure Integration

10% of the park converted to bioretention area

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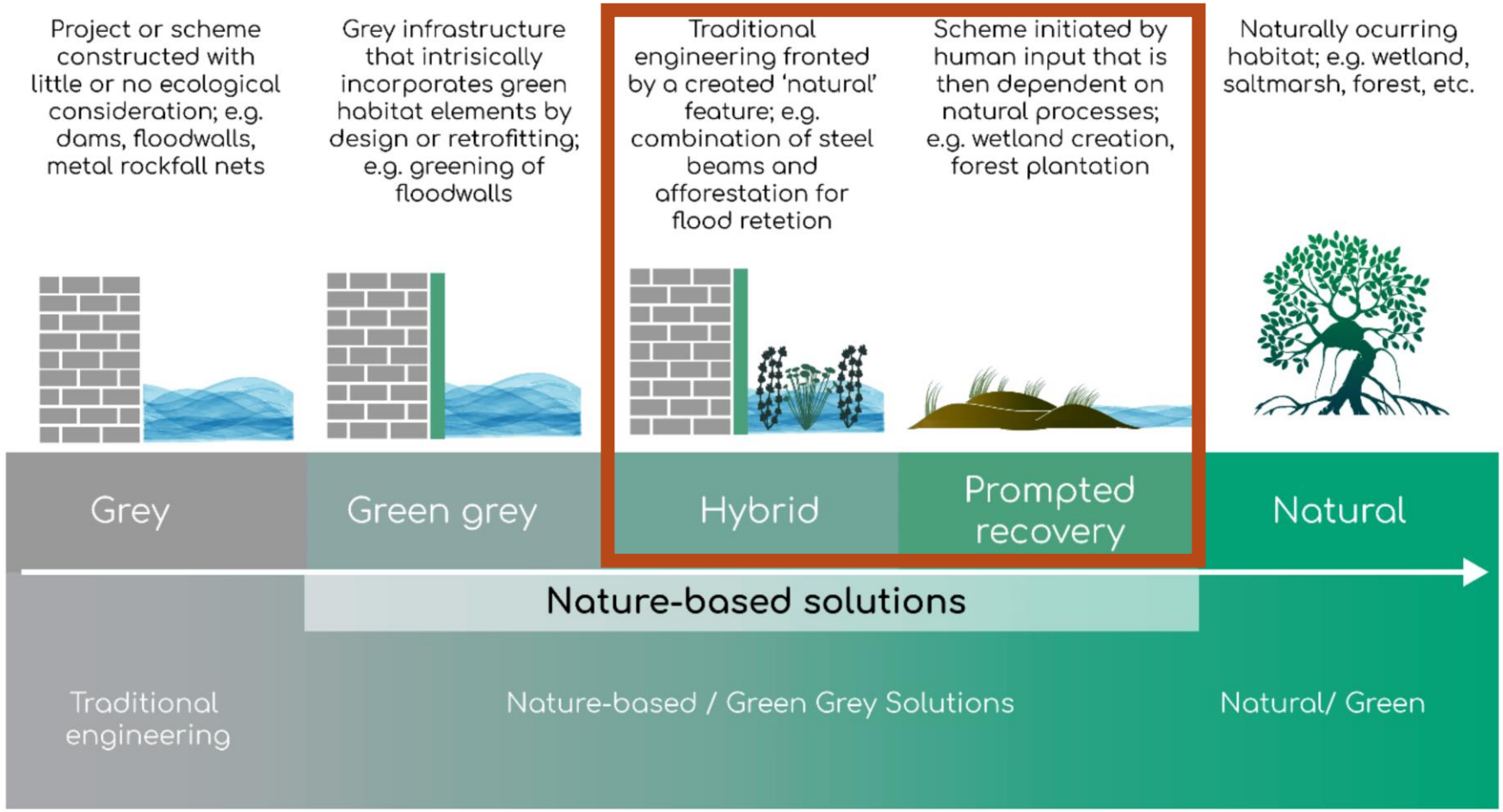
Environmental Planning – what is it?

3.2.9	Optimization study: model ideal location and sizing for ponds and other drainage/flood control structures, and consider potential alternatives to reduce downstream flows.
3.2.8	Planning tool with map of vulnerable areas to identify design criteria and opportunities for environmental stewardship as potential revenue
3.3.1	Memo documenting review of ongoing planning and infrastructure efforts related to green stormwater infrastructure and nature based solutions
3.3.9	Web-based map that identifies flood prone areas and ideal locations for implementation of GSI and NBS
3.3.6	Fact sheets on GSI and NBS applications illustrating project economics
3.3.7	Documented ROI of identified GSI and NBS applications using Economic & Environmental Benefits of Stewardship tool, to produce a menu of options for communities
3.3.3	List of GSI and NBS suitability index based on geological, social, and environmental parameters and ranking of project types and locations
3.3.5	Financial pro forma, benefit cost analysis tool for various GSI and NBS applications
3.3.2	Environmental and wetland analysis memo (mitigation banking considerations)
3.3.4	Literature review of ROI for developers and cities that have preserved floodplain areas and implemented GSI
3.5.1	Document potential options or incentives to provide for conservation and preservation of flood-prone and environmentally sensitive areas

Environmental Planning:
Know what you know you know

- What GSI/NBS projects have been implemented locally?
- Any local efforts to monetize restoration?
  - Mitigation banks
  - Other revenue generation



Source: Martin JGC, Scolobig A, Linnerooth-Bayer J, Liu W, Balsiger J. Catalyzing Innovation: Governance Enablers of Nature-Based Solutions. *Sustainability*. 2021; 13(4):1971. https://doi.org/10.3390/su13041971

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GSI/NBS - What works best where?

- Map your vulnerable areas
- Index suitable projects for those areas
- Optimize for implementation
  - Alternatives analysis

Source: Stefanakis, Alexandros et. al. (2021). Nature-Based Solutions as a Tool in the New Circular Economic Model for Climate Change Adaptation. Circular Economy and Sustainability. 1. 10.1007/s43615-021-00022-3.

Let’s talk $$$ - Support & Empower Communities

- Talk to developers/municipal staff
  - ROI on implemented GSI/NBS
  - Greenspace preservation
- Don’t overlook the Power of Stewardship
  - Social capital
  - Economic & Environmental Benefits
- Make a menu using feedback and existing tools
  - Include cost/benefit analysis
  - What’s the best ROI for my community?
- Incentivize conservation/preservation
  - Existing codes, ordinances, and policies
  - Model policies

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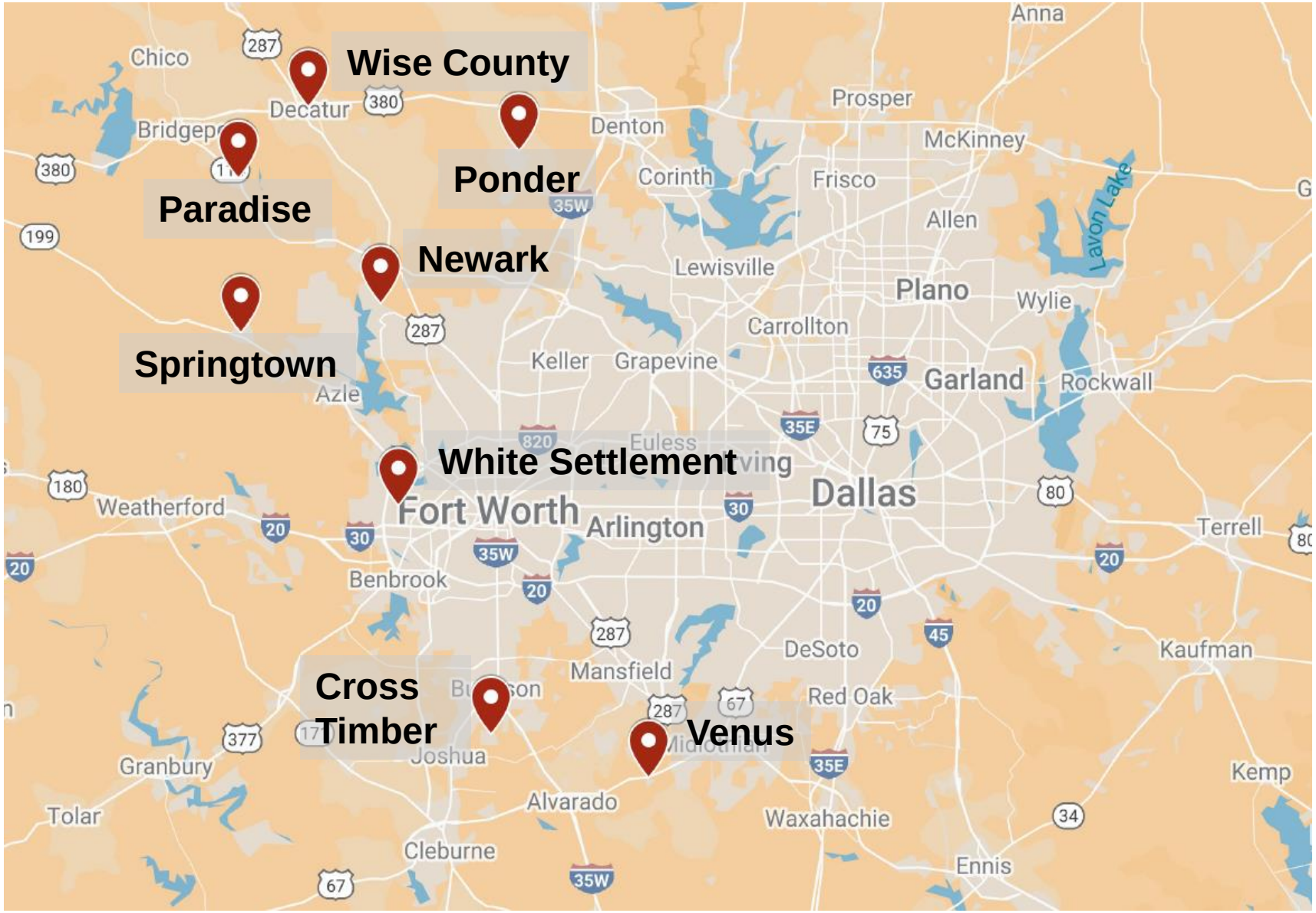
Communities Visited

- Cross Timber
- Newark
- Paradise
- Ponder
- Springtown
- Venus
- White Settlement
- Wise County



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Change the Perception

Stormwater as a valuable resource, not a nuisance to be gotten rid of or passed on to your neighbor to “deal with”

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"***There are idle spots on every farm***, *and every highway is bordered by an idle strip as long as it is; keep cow, plow, and mower out of these* ***idle spots***, *and the full native flora, plus dozens of interesting stowaways from foreign parts, could be part of the normal environment of every citizen.*"

- Aldo Leopold

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Funding Partners

- Texas Water Development Board
- Federal Highway Administration
- Texas Department of Transportation
- Federal Emergency Management Agency

Study Partners

- North Central Texas Council of Governments
- US Army Corps of Engineers
- University of Texas at Arlington
- Texas A&M AgriLife
- Tarrant Regional Water District