integrating **Transportation & Stormwater Infrastructure**

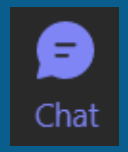
North Central Texas Council of Governments

Water Rights and Green Stormwater Infrastructure Webinar

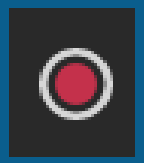
June 25, 2024

A few reminders…

Please mute your line



Please insert questions in the chat to be addressed at the end of the webinar or as time allows



This webinar will be recorded

Please take a few moments to complete the Pre-Webinar Survey

Agenda

- Welcome & Purpose
  Erin Blackman, NCTCOG
- Water Rights & How State Water is Regulated
  Kathy Alexander, Texas Commission on Environmental Quality
- Water Rights & Stormwater Infrastructure
  Brenton Dunn, Tarrant Regional Water District
- Water Rights/Environmental Due Diligence
  Chris Hamilton, Westwood
- Green Stormwater Infrastructure in North Texas
  Fouad Jaber, Texas A&M AgriLife Extension
- Q&A/Closing
  Erin Blackman, NCTCOG

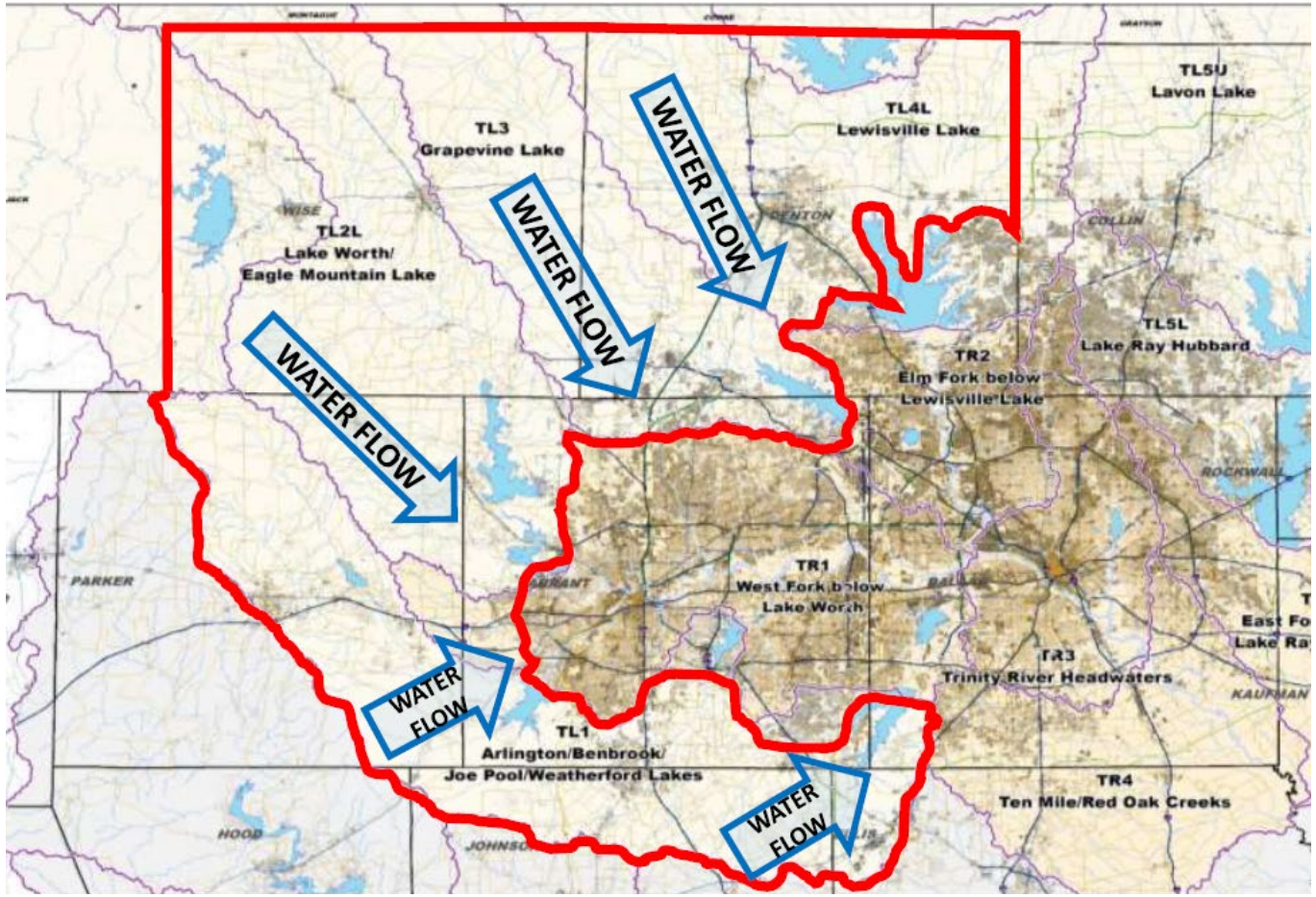
Welcome & Purpose

Erin Blackman, North Central Texas Council of Governments

integrating **Transportation & Stormwater Infrastructure**

Integrating 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



Green Stormwater Infrastructure (GSI) and Nature-Based Solutions (NBS) Can Mitigate Increased Runoff

TSI will produce:

- Menu of potential GSI and NBS mitigation strategies
- Ideal locations for GSI and NBS
- Return-on-investment analysis

What do we need to know about water rights, and will it impact the implementation of GSI/NBS strategies?

integrating **Transportation & Stormwater Infrastructure**

NCTCOG TSI Project Contacts

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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

integrating **Transportation & Stormwater Infrastructure**

More information: www.nctcog.org/tsi

Water Rights & How State Water is Regulated

Dr. Kathy Alexander, Texas Commission on Environmental Quality

Surface Water Rights Permitting
June 25, 2024

Kathy Alexander, PhD
Senior Policy and Technical Analyst
Water Availability Division

Surface Water is the Property of the State

State Water - The water of the ordinary flow, underflow, and tides of every flowing river, natural stream, and lake, and of every bay or arm of the Gulf of Mexico, and the storm water, floodwater, and rainwater of every river, natural stream, canyon, ravine, depression, and watershed in the state is the property of the state.

State Water is Water in a Watercourse

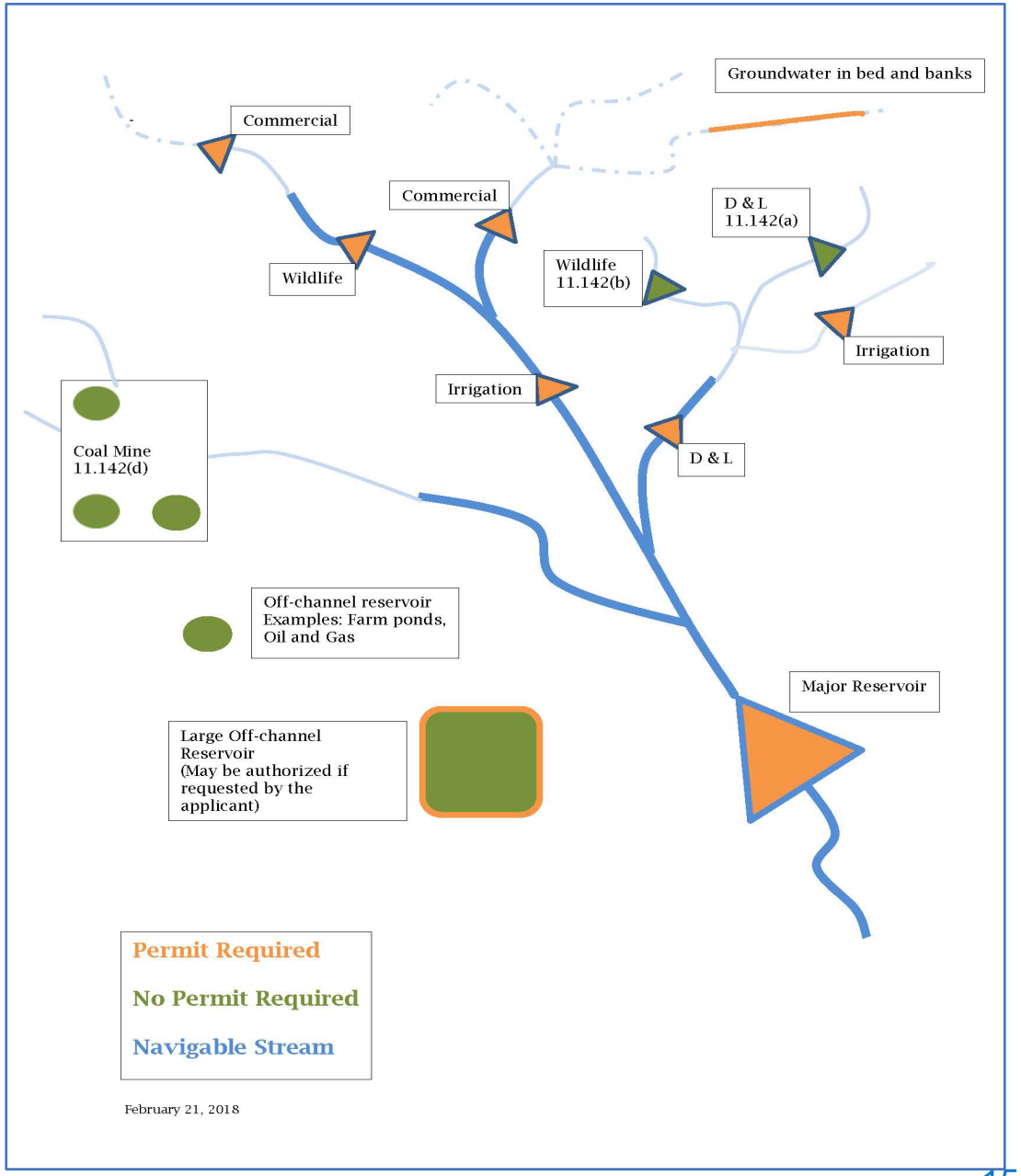
Watercourse--A definite channel of a stream in which water flows within a defined bed and banks, originating from a definite source or sources. The water may flow continuously or intermittently, and if the latter with some degree of regularity, depending on the characteristics of the sources

Priority Doctrine - First in Time is First in Right

Exemptions from Permitting (TWC Section 11.142)

Most Common exemptions:

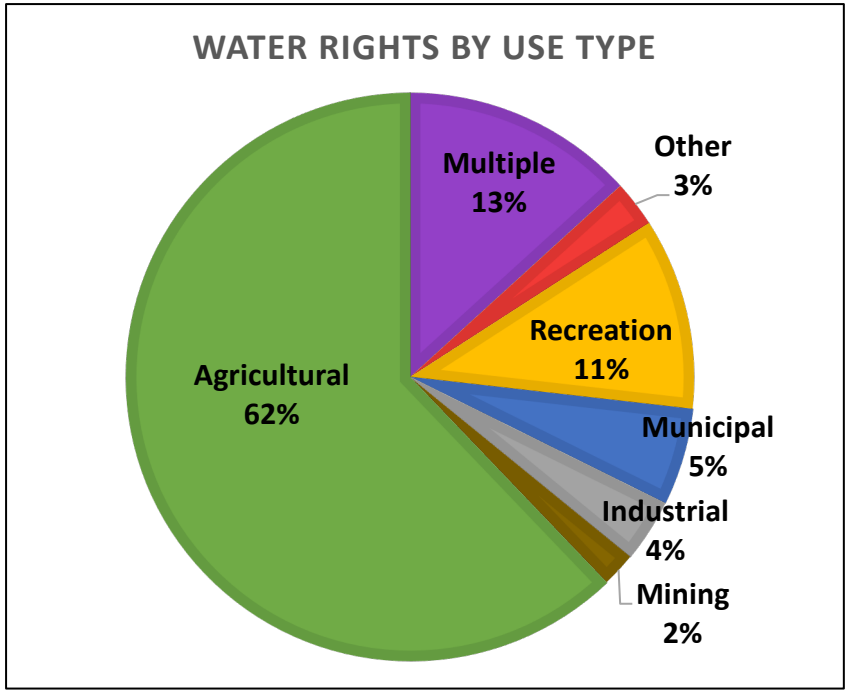
- A person may construct a dam/reservoir on their property with a storage capacity of no more than 200 acre-feet of water for domestic and livestock or wildlife management use.
- The reservoir cannot be located on a navigable stream
- “Reasonable” diversions for domestic use



When is a Water Right Required?

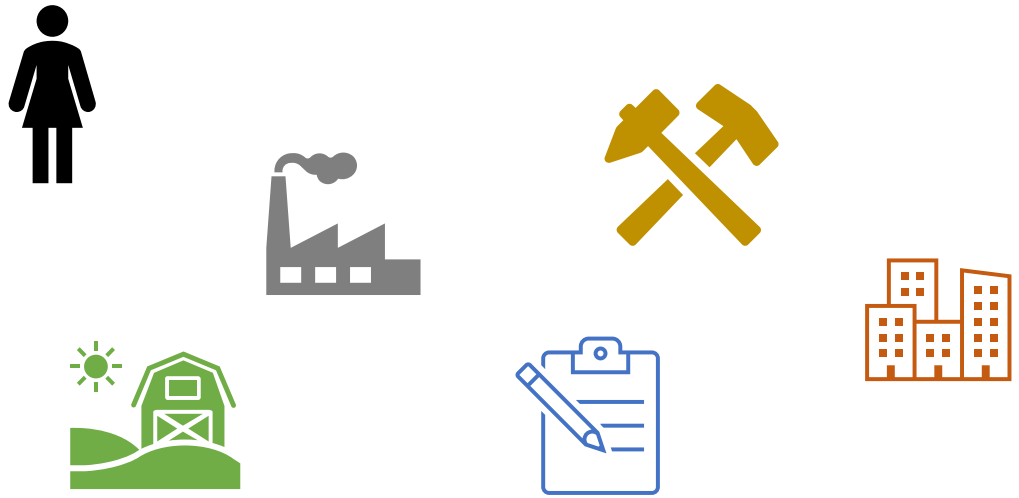
- Texas Water Code Section 11.121
- No person may appropriate any state water or begin construction of any work designed for the storage, taking, or diversion of water without first obtaining a permit.

Beneficial Uses



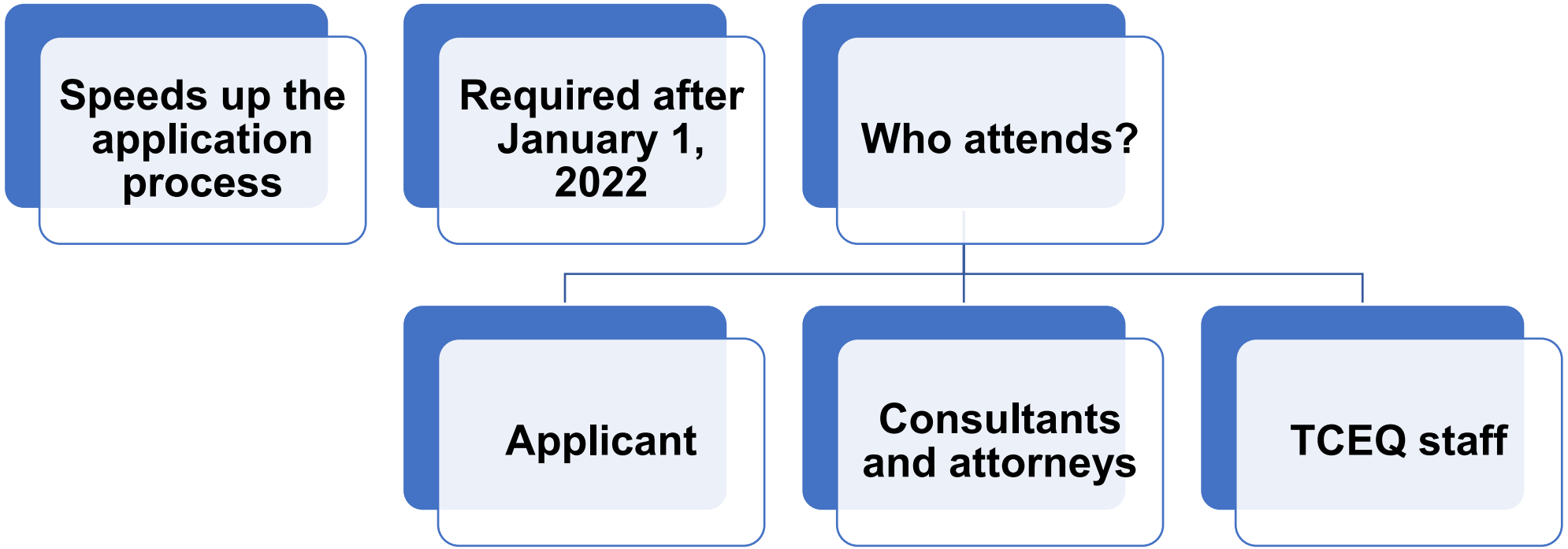
Water Right Owners

- Water rights can be owned by:
  - individuals,
  - businesses,
  - municipalities,
  - industries,
  - mining operations,
  - farmers and ranchers, and
  - river authorities.



- A water right can have multiple owners and water right owners can sell their water rights or portions of their water right to other users.

Pre-Application Meetings



Call 512-239-4600 or email WRPT@tceq.Texas.gov to schedule a pre-application meeting.

Online Resources and Data

- Application Forms
- Online Water Use Reporting
- Pending Applications Webpage
- Texas Water Rights Viewer

Contact Information & Website

Water Availability Division

Water Rights Permitting & Availability Section

512-239-4600

https://www.tceq.texas.gov/permitting/water_rights/wawr_permits.html

Kathy.alexander@tceq.texas.gov

512-239-0778

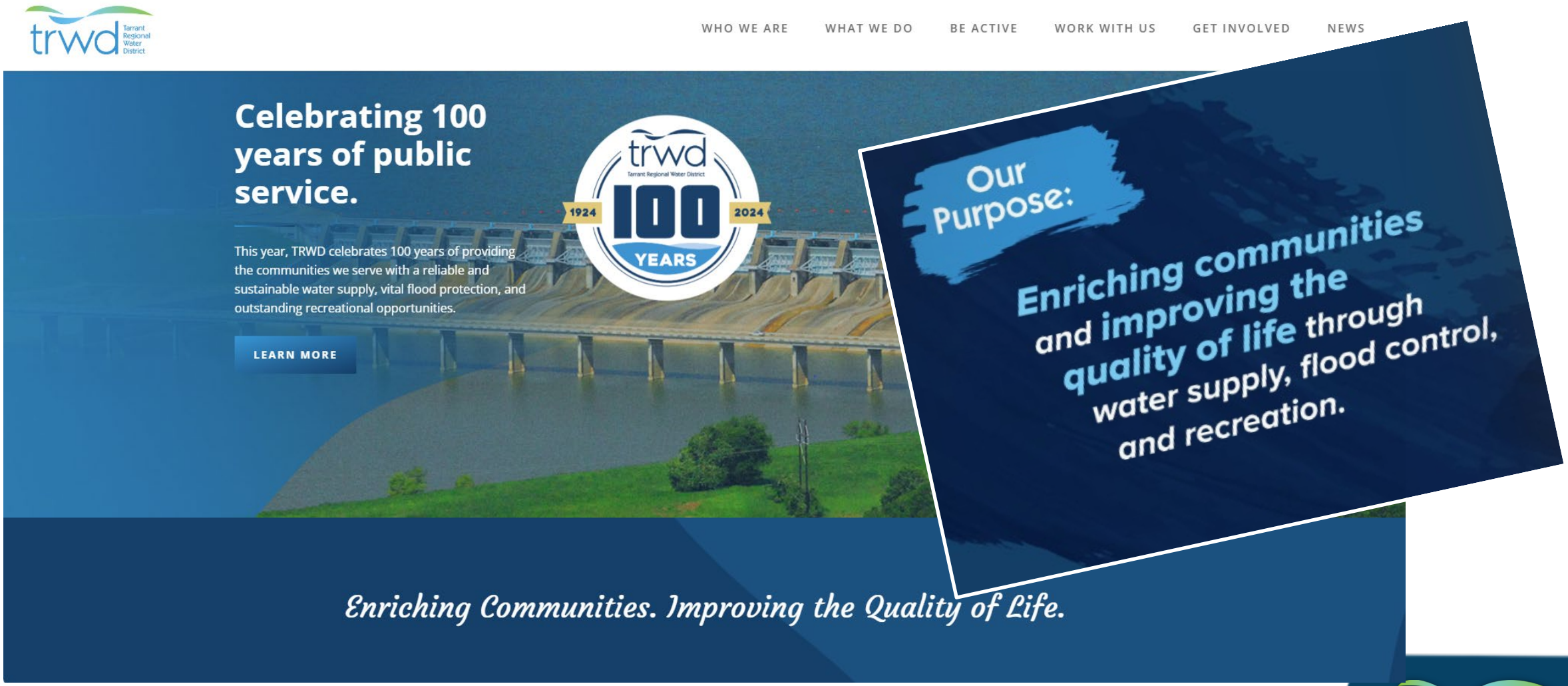
Experience as a Major Water Rights Holder in the TSI Study Area

Brenton Dunn, Tarrant Regional Water District

Water Rights and StormWater Infrastructure

Tarrant Regional Water District
R. Brenton Dunn, PE

www.trwd.com


trwd
Tarrant Regional Water District
WHO WE ARE
WHAT WE DO
BE ACTIVE
WORK WITH US
GET INVOLVED
NEWS
Celebrating 100 years of public service.
This year, TRWD celebrates 100 years of providing the communities we serve with a reliable and sustainable water supply, vital flood protection, and outstanding recreational opportunities.
LEARN MORE
1924
100
YEARS
2024
Our Purpose:
Enriching communities and improving the quality of life through water supply, flood control, and recreation.
Enriching Communities. Improving the Quality of Life.

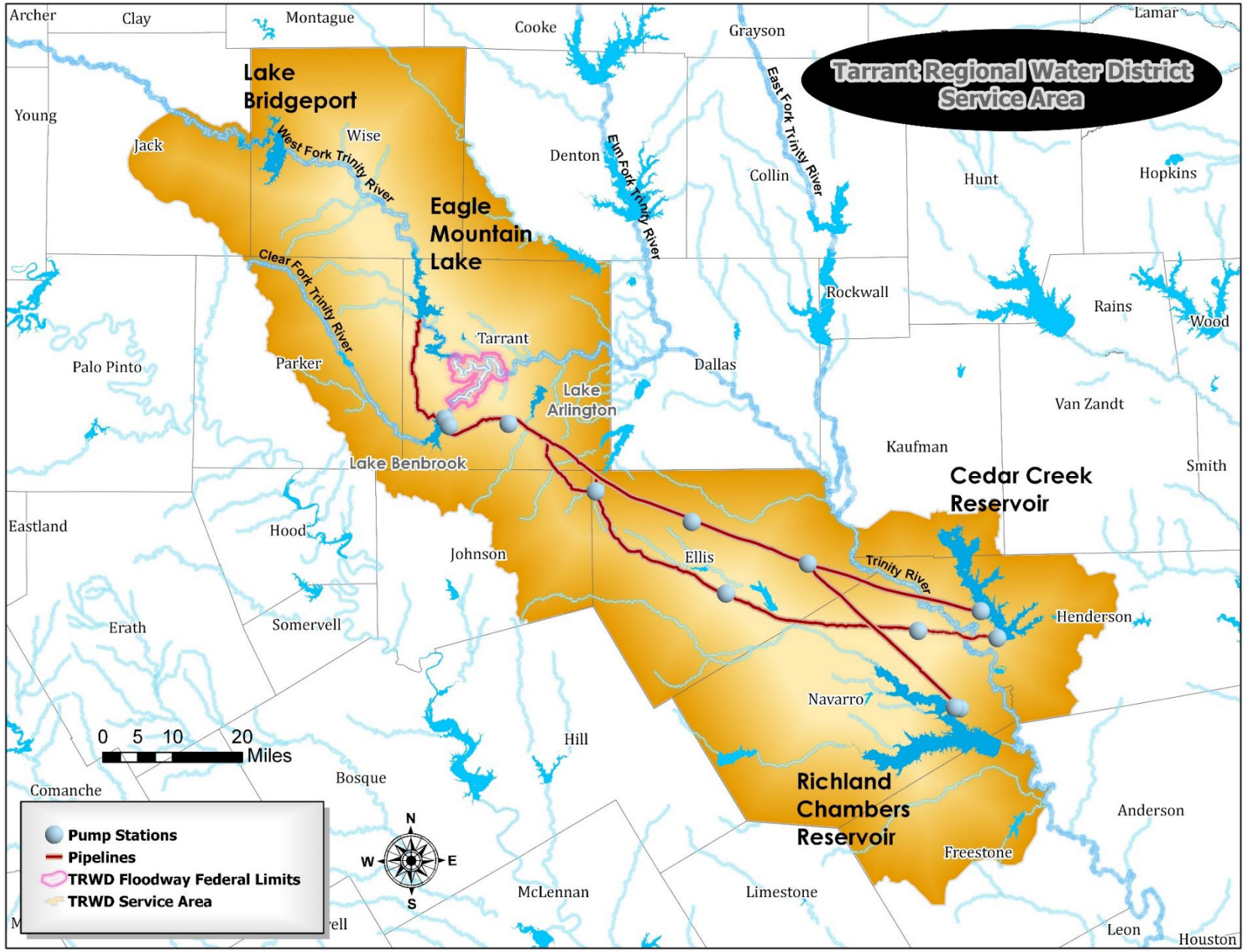
system description

Tarrant Regional Water District provides raw water to 2.4 million people, implements vital flood control measures & creates recreational opportunities for the residents of 11 North Texas Counties.

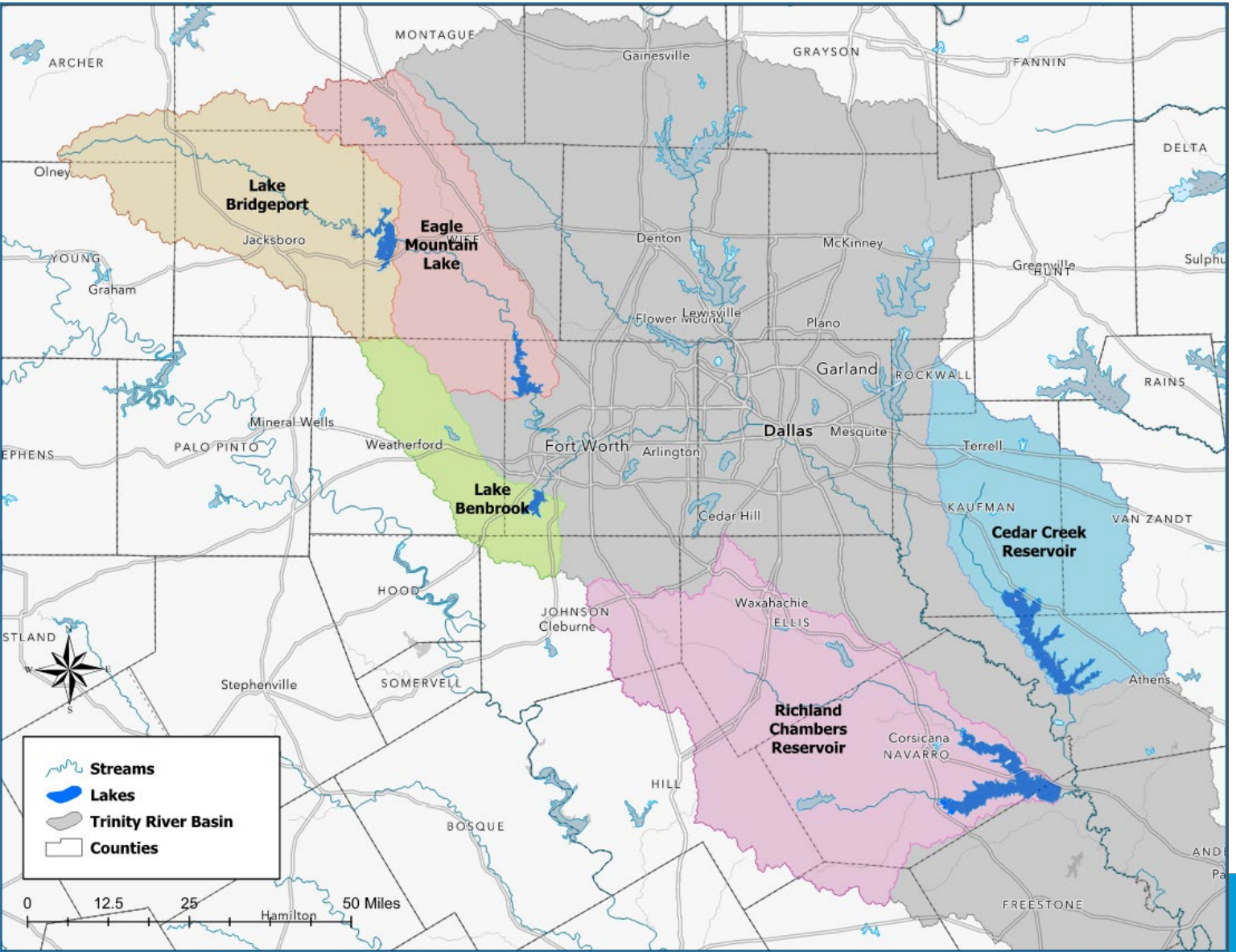
TRWD System:

- 4 major reservoirs and 3 additional supply reservoirs
- 267 miles of water pipelines
- 2,000 acre operational wetland
- 27 miles of floodway levees – Fort Worth
- 72 miles of Trinity River Trails – Fort Worth

System Map


Tarrant Regional Water District Service Area
Lake Bridgeport
Eagle Mountain Lake
Lake Arlington
Lake Benbrook
Cedar Creek Reservoir
Richland Chambers Reservoir
West Fork Trinity River
Clear Fork Trinity River
Elm Fork Trinity River
East Fork Trinity River
Trinity River
Archer
Clay
Montague
Cooke
Grayson
Lamar
Young
Jack
Wise
Denton
Collin
Hunt
Hopkins
Rockwall
Rains
Wood
Tarrant
Parker
Palo Pinto
Dallas
Van Zandt
Kaufman
Smith
Eastland
Hood
Johnson
Ellis
Henderson
Erath
Somervell
Navarro
Hill
Bosque
Comanche
Anderson
Freestone
McLennan
Limestone
Leon
Houston
0 5 10 20 Miles
N
W
E
S
Pump Stations
Pipelines
TRWD Floodway Federal Limits
TRWD Service Area

Watersheds Map




www.youtube.com/watch?v=zX5KBhFGltk
PROTECTING
THE TRINITY

Environmental Sustainability

Education and Outreach Programs

TRWD offers wide-ranging educational programs to support and inspire our communities to conserve and protect our water supply. Our adult education programs focus on building knowledge and skills to maximize water efficiency in our homes and promote the health of rivers and lakes in our community. Our youth programs encourage young persons to value water, understand its journey to reach our faucets, and take action to reduce water use and protect water quality. As a leader in sustainability, it is our social responsibility to educate the public and collaborate with community partners to conserve and protect the water resources that sustain us.

GET EDUCATED

Environmental Sustainability

Protecting Habitat

The district has built Eagle Mountain Park, Airfield Falls Trailhead & Conservation Park, the George W. Shannon Wetlands, and our beautiful campus Rainscapes. These projects provide important habitats for pollinators, birds, and other wildlife as well as beautiful natural spaces for North Texans to enjoy.

Environmental Sustainability

Conserving Water

Conserving our water supply is extremely important. TRWD is responsible for providing water for 2.4 million residents and that number is expected to almost double over the next 50 years. Water conservation efforts are a water supply strategy for the district and currently help save an average of 50 million gallons per day. Education efforts with our customers and regional partners are helping to change behaviors and create a sustainable future for North Texas. Learn more about our water conservation programs.

SAVE TARRANT WATER

WATER IS AWESOME

Environmental Sustainability

Monitoring

Keeping tabs on water quality is important, and we do so through an established program that allows us to track the health of our reservoirs over time. We've been monitoring our system for almost 30 years. The Trinity River and seven North Texas lakes are sampled continuously at multiple sites for various parameters, providing valuable information that can help lower treatment costs for our customers and keep our lakes and rivers thriving for wildlife and recreational uses.

LAKE SAMPLING | TRINITY RIVER MONITORING PROGRAM

Learn more about how we're protecting the health of our reservoirs

Environmental Sustainability

Modeling

To study TRWD lakes, the district utilizes the WASP model developed by the EPA. Models like this one are used to better understand our complex water systems and help manage them into the future.

Currently, the district is working to develop two additional models for the Trinity River that will simulate river flow and erosion impacts on the river as well as other parameters.

Environmental Sustainability

Stormwater Guidance

Rain must go somewhere, and it can present challenges with the toxins and litter it pulls into a water supply system. TRWD works with the City of Fort Worth to implement a Stormwater Management Plan (MS4 SWMP) that helps reduce the amount of pollutants flowing into the Trinity River system.

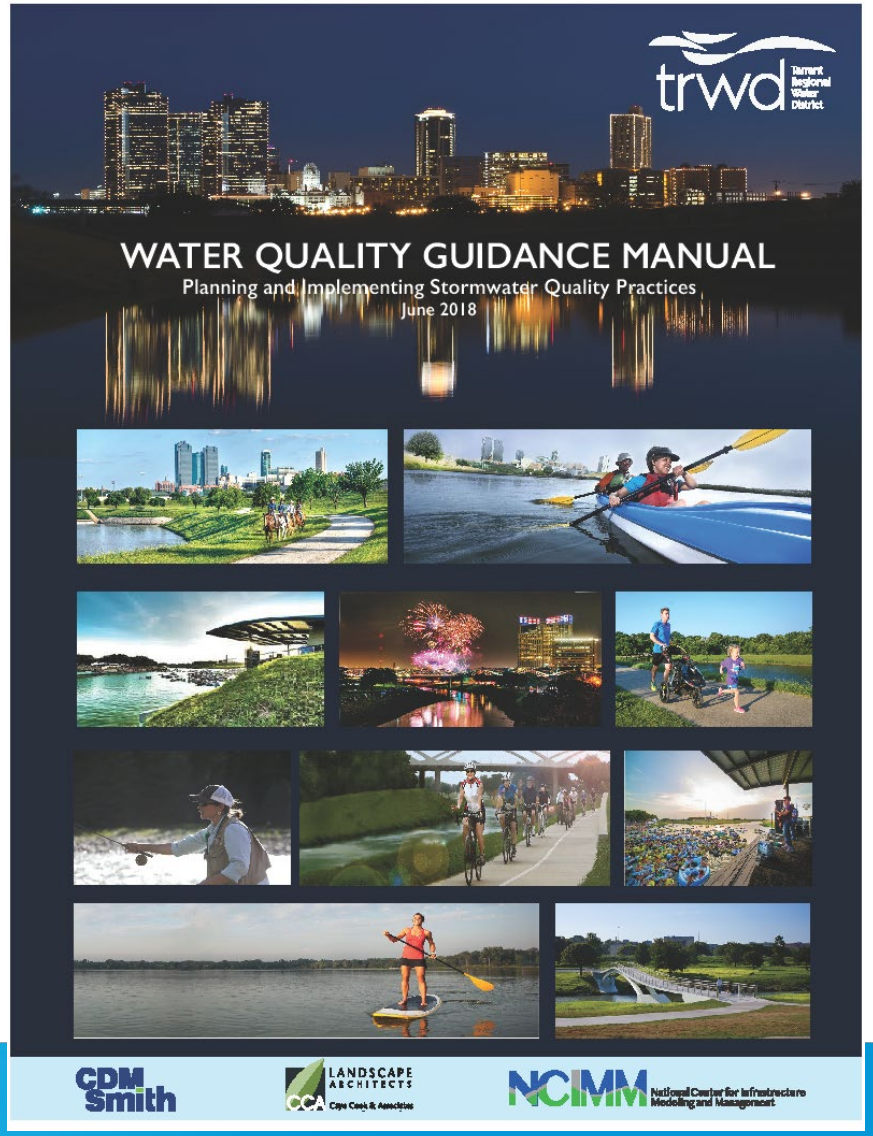
The District has developed a Water Quality Guidance Manual that outlines construction standards for all projects that occur in the floodway. The purpose of this document is to minimize soil runoff during construction as well as establish post-construction standards that will reduce erosion potential.

STORYMAP: BEST MANAGEMENT PRACTICES ALONG THE TRINITY RIVER

WATER QUALITY RESOURCES

Water Quality Guidance Manual

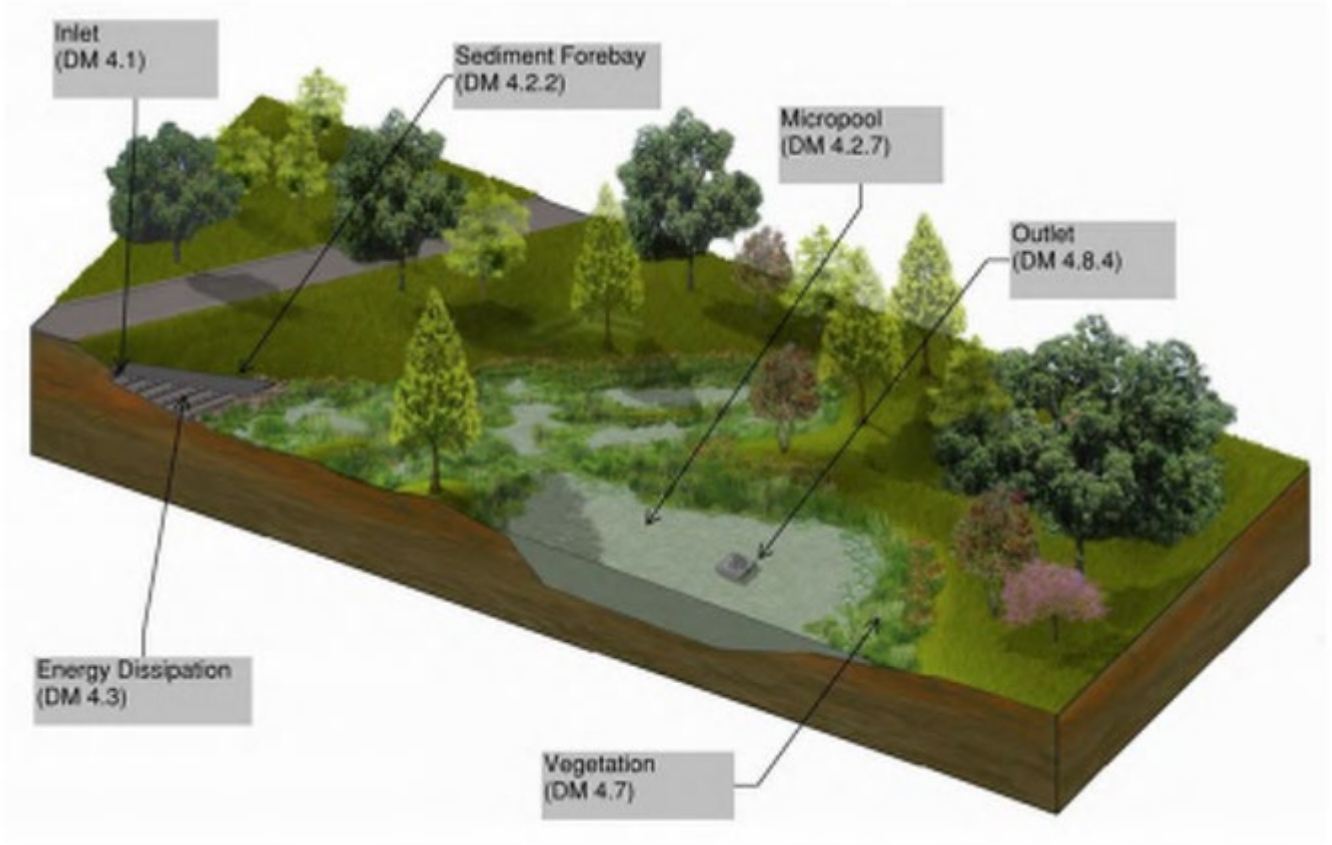
Focusing on Storm Water & Green BMPs

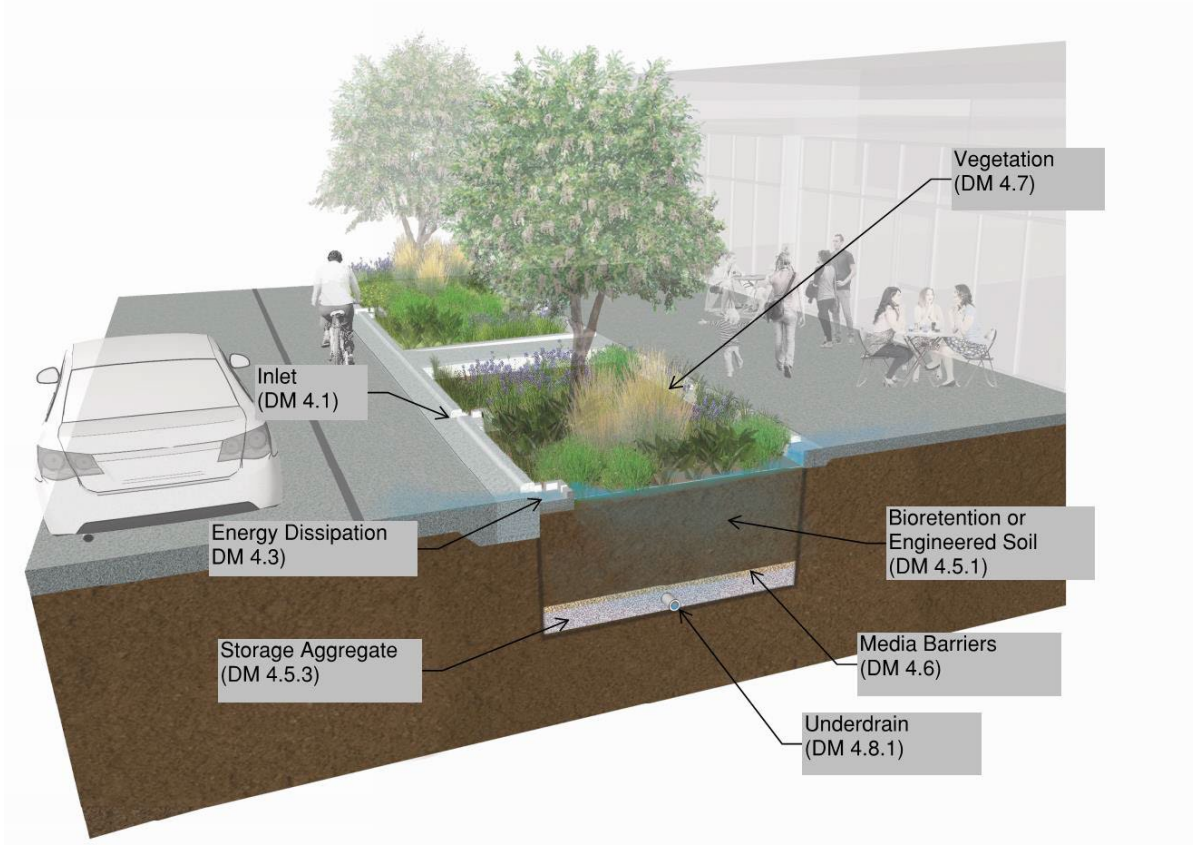


Consultants:
CDM Smith
Caye Cook & Associates
NCIMN (National Center for Infrastructure Modeling and Management)

Treating at the Source

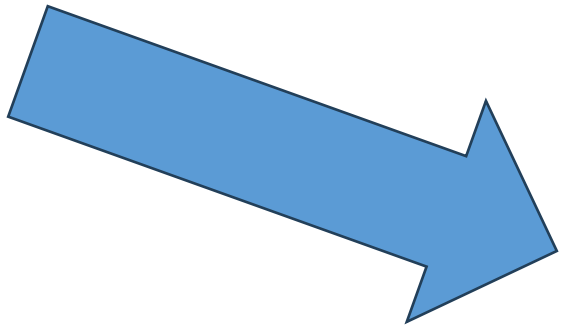
Green BMPs


Inlet
(DM 4.1)
Sediment Forebay
(DM 4.2.2)
Micropool
(DM 4.2.7)
Outlet
(DM 4.8.4)
Energy Dissipation
(DM 4.3)
Vegetation
(DM 4.7)


Vegetation
(DM 4.7)
Inlet
(DM 4.1)
Energy Dissipation
DM 4.3)
Bioretention or
Engineered Soil
(DM 4.5.1)
Storage Aggregate
(DM 4.5.3)
Media Barriers
(DM 4.6)
Underdrain
(DM 4.8.1)

State Water Right -TCEQ

Start Here!



www.tceq.texas.gov/permitting/water_rights

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

NOTICE OF AN APPLICATION FOR A WATER USE PERMIT

APPLICATION NO [redacted]

[redacted] requests a Water Use Permit to divert and use not to [redacted] acre-feet of water per year for municipal, industrial, and agricultural purposes for use in the service area in the Trinity River Basin [redacted] also requests authorization to use the bed and banks of the Clear Fork Trinity River, and the West Fork Trinity River to convey water from Lake Benbrook to [redacted] customers. More information on the application and how to participate in the permitting process is given below.

APPLICATION. [redacted] Applicant, has applied to the Texas Commission on Environmental Quality (TCEQ) for Water Use Permit pursuant to Texas Water Code (TWC) §§ 11.042 and 11.121, and TCEQ Rules Title 30 Texas Administrative Code (TAC) §§ 295.1, *et seq.* Notice is being published and mailed to the water right holders in the Trinity River Basin pursuant to Title 30 TAC § 295.151.

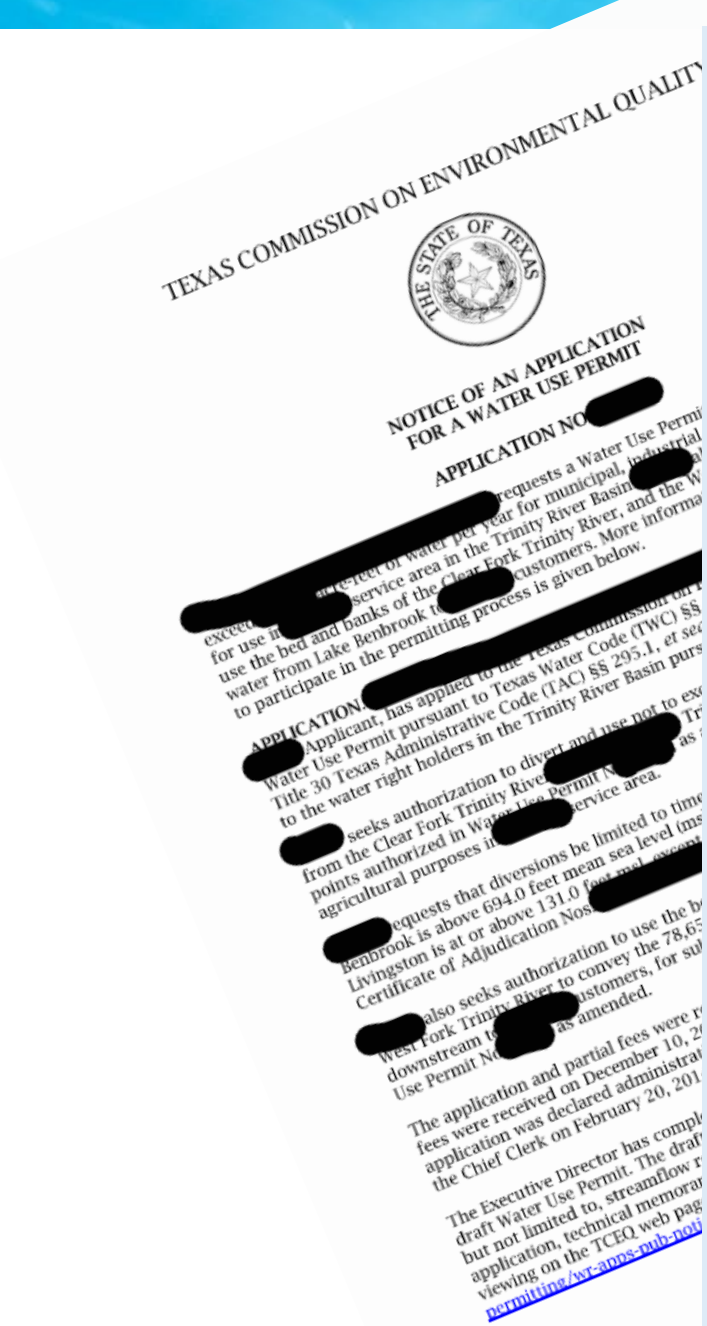
[redacted] seeks authorization to divert and use not to exceed [redacted] acre-feet of water per year from the Clear Fork Trinity River [redacted] Trinity River Basin, at diversion rates and points authorized in Water Use Permit No. [redacted] as amended, for municipal, industrial, and agricultural purposes in the [redacted] service area.

[redacted] requests that diversions be limited to times when the water surface elevation of Lake Benbrook is above 694.0 feet mean sea level (msl) and when the water surface elevation of Lake Livingston is at or above 131.0 feet msl, except upon written consent of the owners of Certificate of Adjudication Nos. [redacted]

[redacted] also seeks authorization to use the bed and banks of the Clear Fork Trinity River and the West Fork Trinity River to convey the 78,653 acre-feet of water per year from Lake Benbrook downstream to [redacted] customers, for subsequent diversion and use as authorized by Water Use Permit No. [redacted] as amended.

The application and partial fees were received on January 13, 2012. Additional information and fees were received on December 10, 2012, August 19, September 4 and November 7, 2013. The application was declared administratively complete and accepted for filing with the Office of the Chief Clerk on February 20, 2014.

The Executive Director has completed the technical review of the application and prepared a draft Water Use Permit. The draft permit, if granted, would contain special conditions including, but not limited to, streamflow restrictions and maintenance of an accounting plan. The application, technical memoranda, and Executive Director's draft permit are available for viewing on the TCEQ web page at: www.tceq.texas.gov/permitting/water_rights/wr-permitting/wr-apps-pub-notice. Alternatively, you may request a copy of the documents by


TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

THE STATE OF TEXAS

NOTICE OF AN APPLICATION FOR A WATER USE PERMIT

APPLICATION NO

TRWD would consider all factors, including:

- Location
- Amount
- TCEQ Exemptions
- TCEQ Water Availability Model

And then may engage the landowner as necessary

Thank You

Water Rights/Environmental Due Diligence

Chris Hamilton, Westwood

Environmental & Water Rights Due Diligence

Presented by: Chris A. Hamilton

Westwood

Topics To Be Covered

- What is Environmental Due Diligence?
- Why should you Complete Environmental Due Diligence?
- Example Environmental Checklists
- Environmental Due Diligence Topics
- Water Rights Permitting Due Diligence

Westwood

What is Environmental Due Diligence?

"Environmental due diligence is a systematic procedure that evaluates a property or land for possible environmental risks…"

Source: https://corporatefinanceinstitute.com/resources/commercial-real-estate/environmental-due-diligence/

Different Levels of Environmental Due Diligence and Examples

<u>Desktop/Remote Sensing</u>

Public websites, GIS maps, literature review

<u>Field Inspections</u>

Wetland delineation, wildlife surveys, drone surveys

<u>Sampling and Testing</u>

Groundwater samples, soil testing, lab analysis

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Why is Environmental Due Diligence Important?

Federal Nexus Typically Requires It (FEMA/404/401/NPDES)

Other Federal and State rules

Municipalities Require Compliance with Environmental Rules

Reduce Risk

Save Time and Prevent project delays

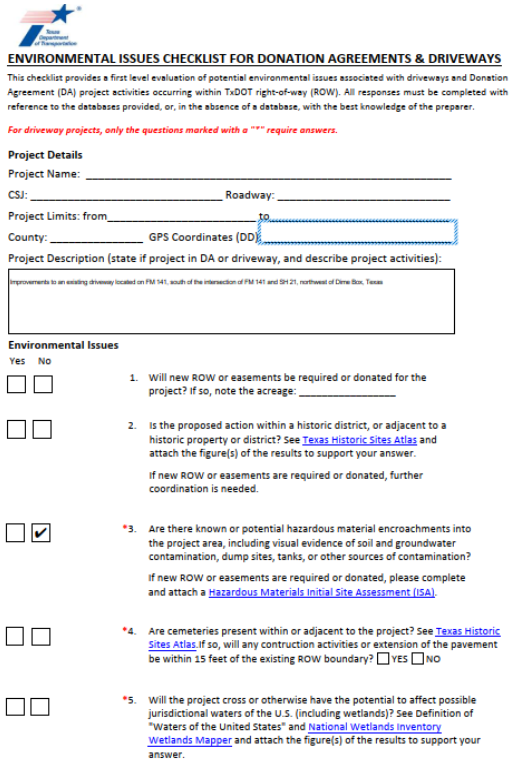
Same Money on Possible Remediation or Mitigation

Westwood

Example Environmental Due Diligence Checklists

Who completes the checklists and at what stage of the project (the sooner the better)?

Environmental Quality Assurance Steps:
☐ Determine if the location is in a FEMA floodplain area
☐ Obtain floodplain permit, if required
☐ Determine if construction will impact designated Waters of the US
☐ Obtain Waters of the US permit, if required
☐ Determine if construction is near any potentially environmentally sensitive areas or receptors (wetlands, creeks, etc.)
☐ Determine if there are Cultural Resources (archeological sites) present
☐ Determine if there will be an impact to designate Threatened and Endangered Species
☐ Review general site drainage conditions



ENVIRONMENTAL ISSUES CHECKLIST FOR DONATION AGREEMENTS & DRIVEWAYS

This checklist provides a first level evaluation of potential environmental issues associated with driveways and Donation Agreement (DA) project activities occurring within TxDOT right-of-way (ROW). All responses must be completed with reference to the databases provided, or, in the absence of a database, with the best knowledge of the preparer.

For driveway projects, only the questions marked with a "" require answers.*

Project Details

Project Name: _____

CSJ: _____ Roadway: _____

Project Limits: from_____ to_____

County: _____ GPS Coordinates (DD)

Project Description (state if project in DA or driveway, and describe project activities):

Improvements to an existing driveway located on FM 141, south of the intersection of FM 141 and SH 21, northwest of Dime Box, Texas

Environmental Issues

Yes No

☐ ☐ 1. Will new ROW or easements be required or donated for the project? If so, note the acreage: _____

☐ ☐ 2. Is the proposed action within a historic district, or adjacent to a historic property or district? See Texas Historic Sites Atlas and attach the figure(s) of the results to support your answer.

If new ROW or easements are required or donated, further coordination is needed.

☐ ☑ *3. Are there known or potential hazardous material encroachments into the project area, including visual evidence of soil and groundwater contamination, dump sites, tanks, or other sources of contamination?

If new ROW or easements are required or donated, please complete and attach a Hazardous Materials Initial Site Assessment (ISA).

☐ ☐ *4. Are cemeteries present within or adjacent to the project? See Texas Historic Sites Atlas. If so, will any contruction activities or extension of the pavement be within 15 feet of the existing ROW boundary? ☐ YES ☐ NO

☐ ☐ *5. Will the project cross or otherwise have the potential to affect possible jurisdictional waters of the U.S. (including wetlands)? See Definition of "Waters of the United States" and National Wetlands Inventory Wetlands Mapper and attach the figure(s) of the results to support your answer.

Environmental Due Diligence Best Practices

- Plan accordingly
- Involve an environmental professional at the start of the project
- Conduct environmental due diligence at the feasibility phase
- Consider the ramifications of permitting during planning
- Set expectations for possible increased mitigation and permitting
- Avoid impacts that can be avoided
- Minimize impacts that cannot be avoided

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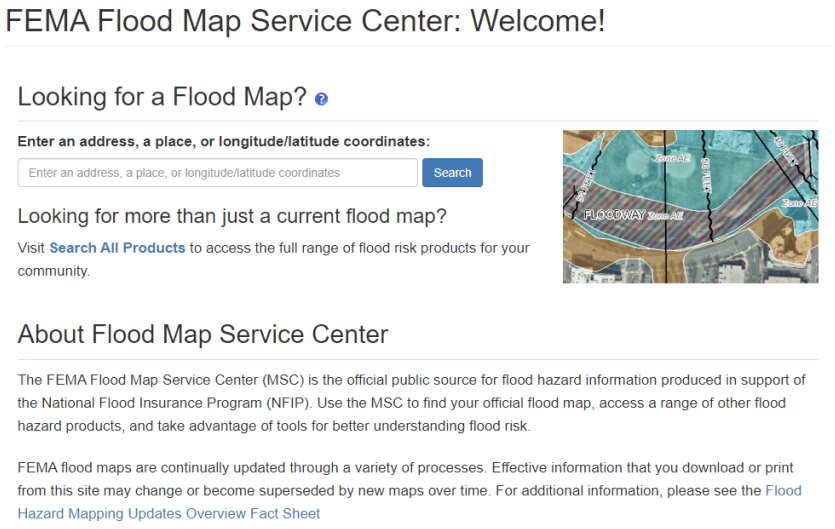
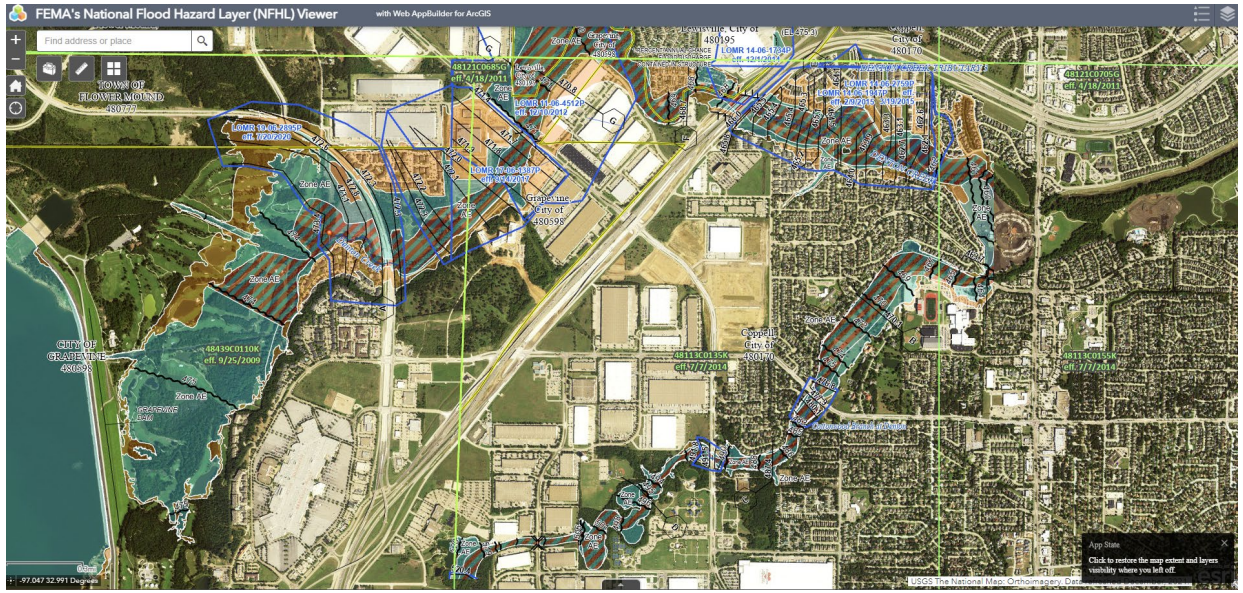
FEMA Floodplain

The Federal Emergency Management Administration (FEMA) defines a floodplain as any land area susceptible to being inundated by floodwaters from any source.





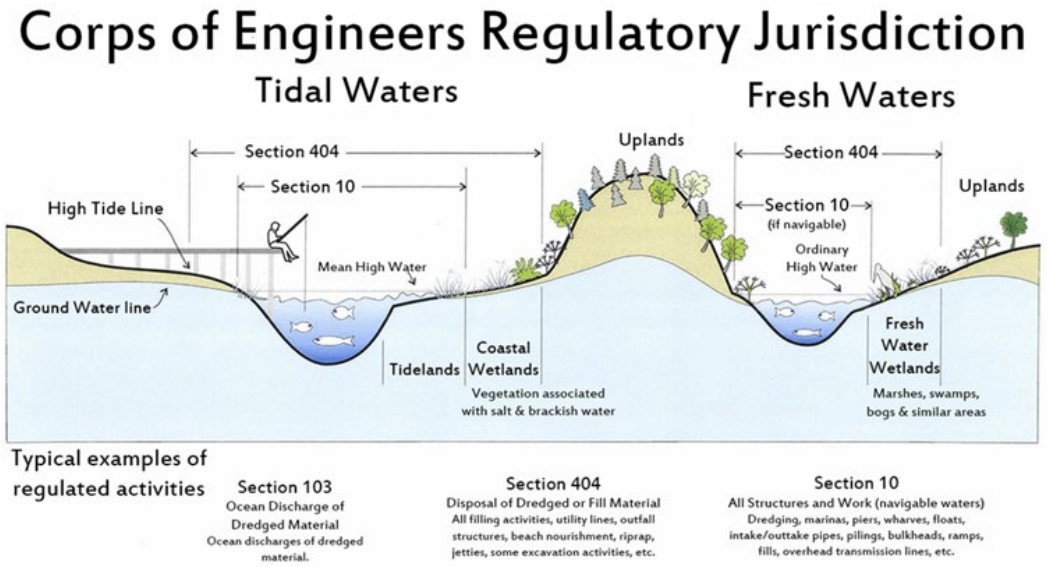
FEMA Flood Map Service Center - https://msc.fema.gov/portal/home

FEMA National Flood Hazard Layer Viewer - https://hazards-fema.maps.arcgis.com/apps/webappviewer/index.html

Westwood

Wetlands and other Waters of the U.S.

- Waters of the U.S.
  - Navigable and interstate waters
  - Territorial seas
  - Lakes, streams, rivers, mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds
  - Tributaries
  - Some adjacent wetlands



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Background: Definitions

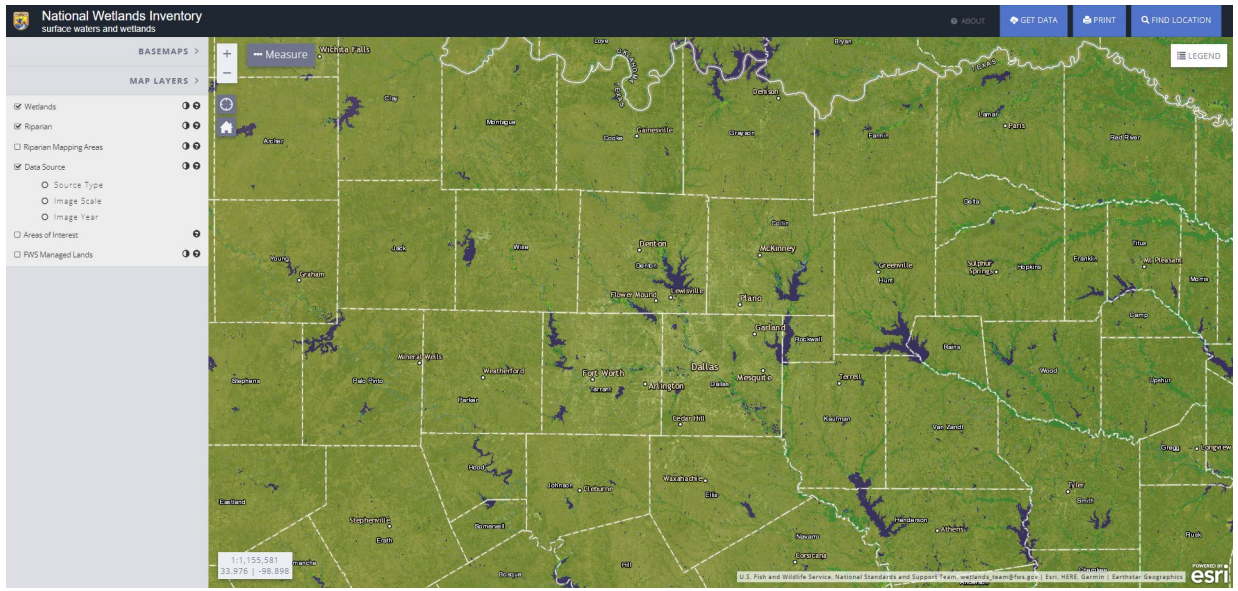
- Wetlands
  - Areas that are inundated or saturated by surface- or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions.
  - Includes swamps, marshes, bogs, and similar areas.
  - Wetlands have to meet three criteria: (1) hydrophytic vegetation, (2) hydric soils, and (3) hydrology.

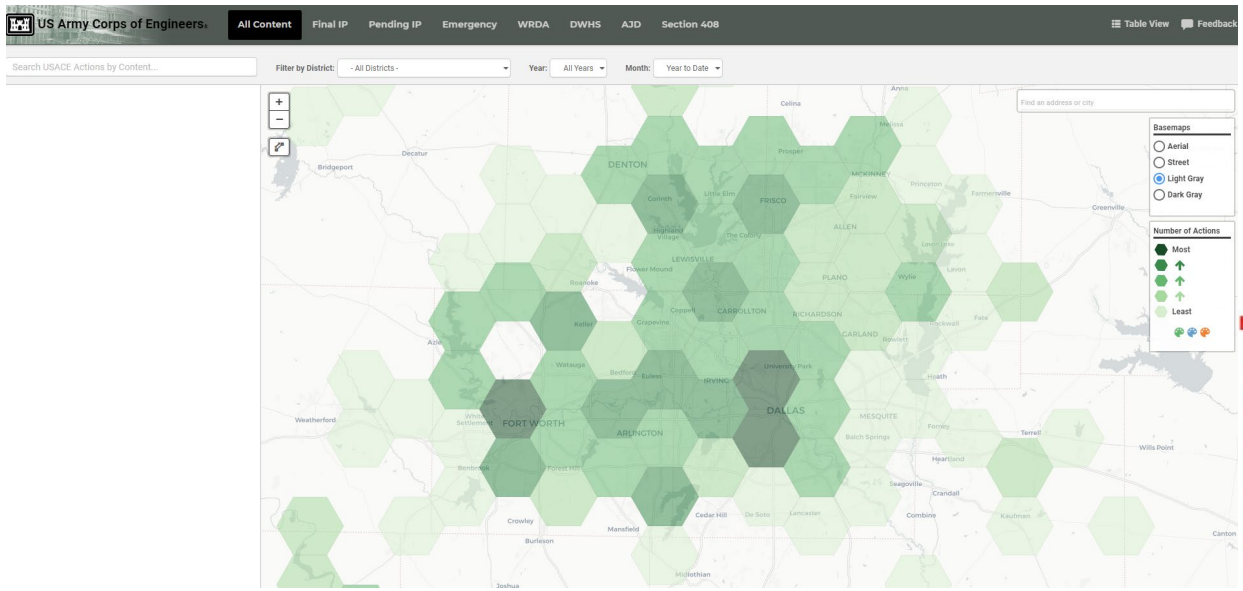
Westwood

National Wetlands Inventory & USACE Project Viewer

There is no map showing jurisdictional waters! Fieldwork required!

Only USACE/EPA can make an official determination of jurisdictional waters!





National Wetlands Inventory - https://fwsprimary.wim.usgs.gov/wetlands/apps/wetlands-mapper/

USACE Project Viewer - https://permits.ops.usace.army.mil/orm-public

Westwood

Environmentally Sensitive Areas

Typically designated by the local municipality (e.g., Denton or Austin)

It could also include endangered species/habitat or special wetlands

Westwood

Cultural Resources

Cultural Resources

Corps of Engineers Nationwide Permit General Condition #21/Section 106

Permittees that discover any previously unknown historic, cultural or archeological remains and artifacts while accomplishing the activity authorized by an NWP, they must immediately notify the district engineer of what they have found, and to the maximum extent practicable, avoid construction activities that may affect the remains and artifacts until the required coordination has been completed.

Section 106 of the National Historic Preservation Act of 1966 (NHPA) requires federal (including states and cities) agencies to consider the effects on historic properties.

Generally, properties eligible for listing in the National Register of Historic Places are at least 50 years old ≈1974

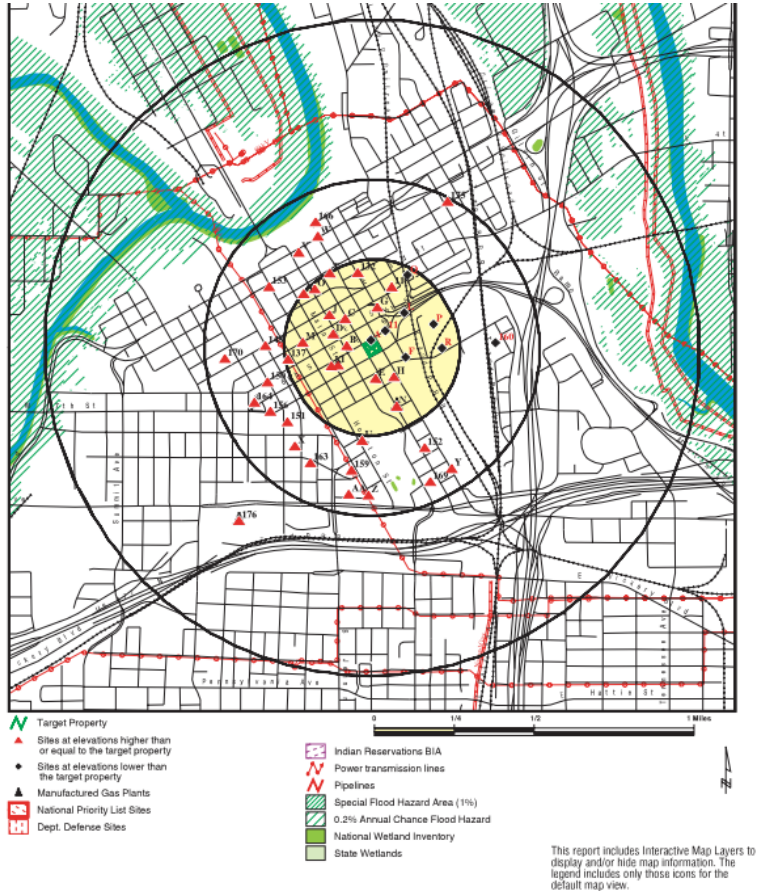
Texas Historical Commission – Texas Historic Sites Atlas - https://atlas.thc.state.tx.us/Map

Westwood

Hazardous Materials/Soil and Groundwater Contamination

Westwood

Phase I Environmental Site Assessments



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Phase I Environmental Site Assessments

- The EPA All Appropriate Inquiries, or AAI, is the process of evaluating a property's environmental conditions and assessing potential liability for any contamination.
- Every Phase I environmental site assessment conducted must be conducted in compliance with the AAI Final Rule at 40 CFR Part 312.
- The AAI Final Rule provides that ASTM International Standard E1527-21 (“Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process”) is consistent with the requirements of the final rule and can be used to satisfy the statutory requirements for conducting AAI.

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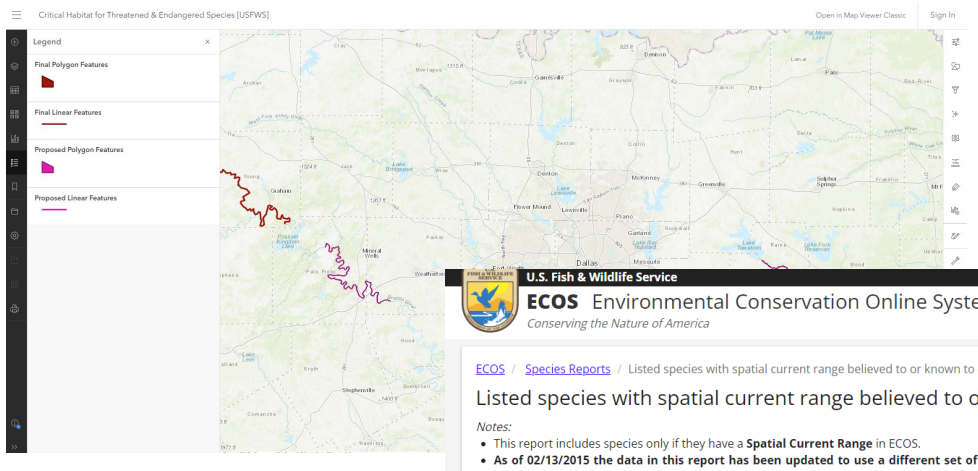
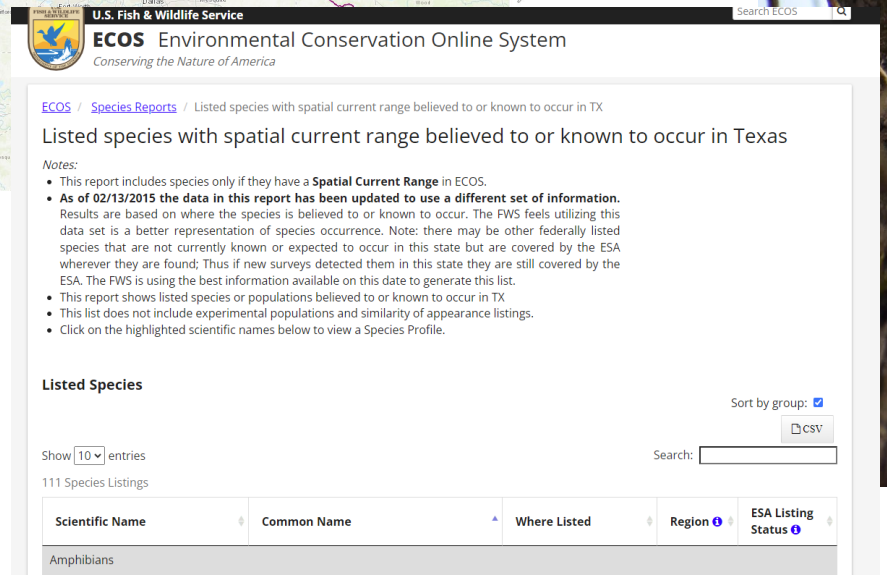
Oil and Gas

TXRRC Website mapper -https://gis.rrc.texas.gov/GISViewer/

Endangered Species & Critical Habitat





USFWS Critical Habitat for Threatened and Endangered Species - https://fws.maps.arcgis.com/home/webmap/viewer.html

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Threatened and Endangered Species

Corps of Engineers Nationwide Permit General Condition #18/ESA

No activity is authorized under any NWP which is likely to directly or indirectly jeopardize the continued existence of a threatened or endangered species or a species proposed for such designation, as identified under the Federal Endangered Species Act (ESA), or which will directly or indirectly destroy or adversely modify designated critical habitat or critical habitat proposed for such designation.

The Endangered Species Act (ESA) provides a program for the conservation of threatened and endangered plants and animals and the habitats in which they are found. The law requires federal agencies, in consultation with the U.S. Fish and Wildlife Service and/or the NOAA Fisheries Service, to ensure that actions they authorize, fund, or carry out are not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of designated critical habitat of such species.

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Water Rights Due Diligence

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TYPES OF WATER (DEFINITIONS)

- Natural Surface Waters
  - Ordinary flow, underflow and tides of every flowing natural watercourse in the state, including flood water or storm water within natural rivers lakes and streams (watercourses have definite bed and banks)
- Diffuse Surface Waters
  - Water that is not part of a running stream or a defined water course
- Groundwater
  - Water beneath the surface of the land that fills the pore spaces of rock and soil materials and supplies wells and springs with water.
- Finished or Treated Water
  - Water from a City hydrant or other tap
- Reuse Water
  - Some advantages – heavily regulated – sourcing is not easy

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Water Rights

In Texas, a stream is navigable if it is either “navigable in fact” or “navigable by statute.” Conversely, a non-navigable stream is a stream that is neither navigable in fact nor navigable by statute.

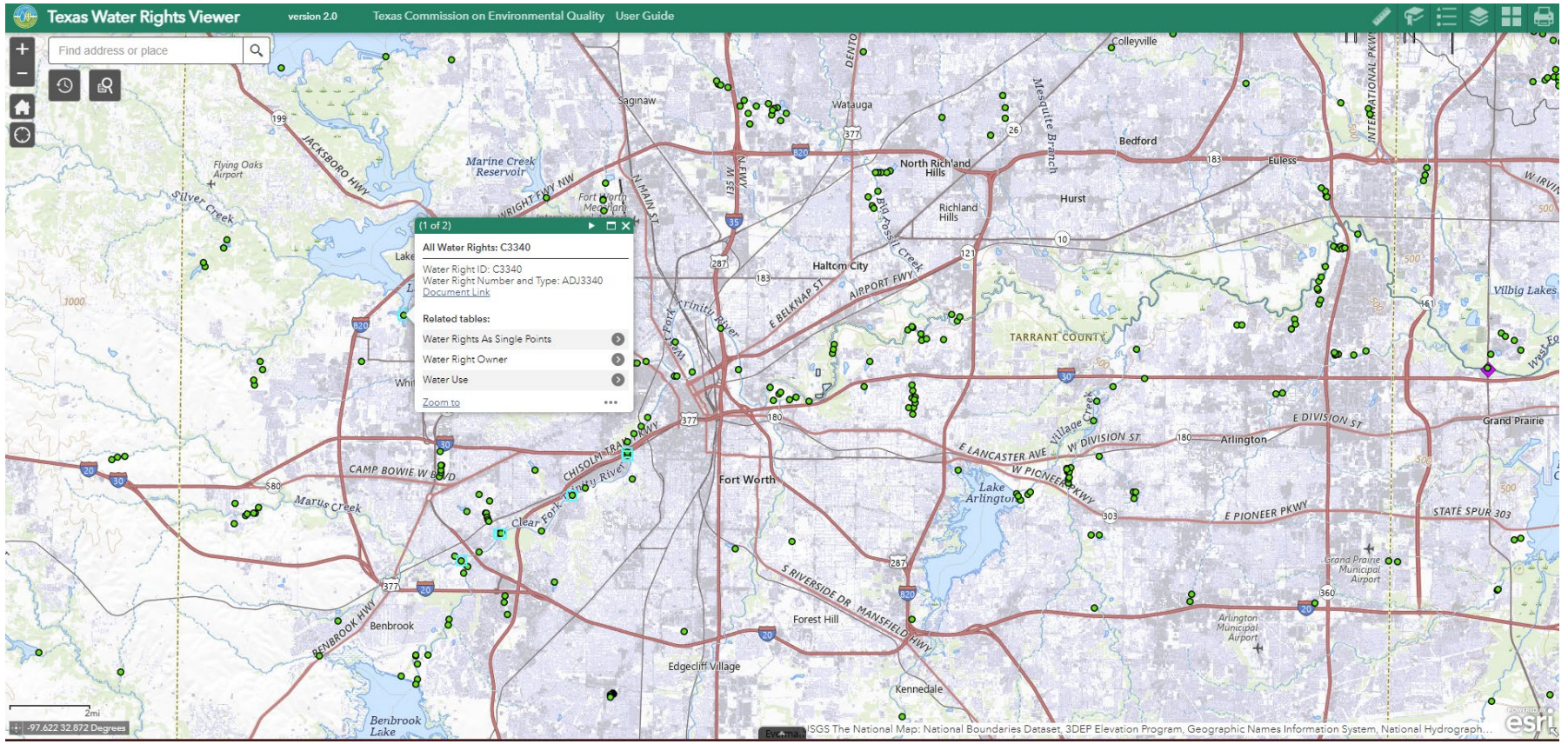
Navigable in Fact

A number of criteria have been suggested for whether a stream is navigable in fact. Some relate to passage by boats, others to the ability to float logs, and still others to its usefulness in commerce. Various courts, both state and federal, have recognized different tests. Texas courts have acknowledged a wide range of uses in support of navigability in fact.

Navigable by Statute

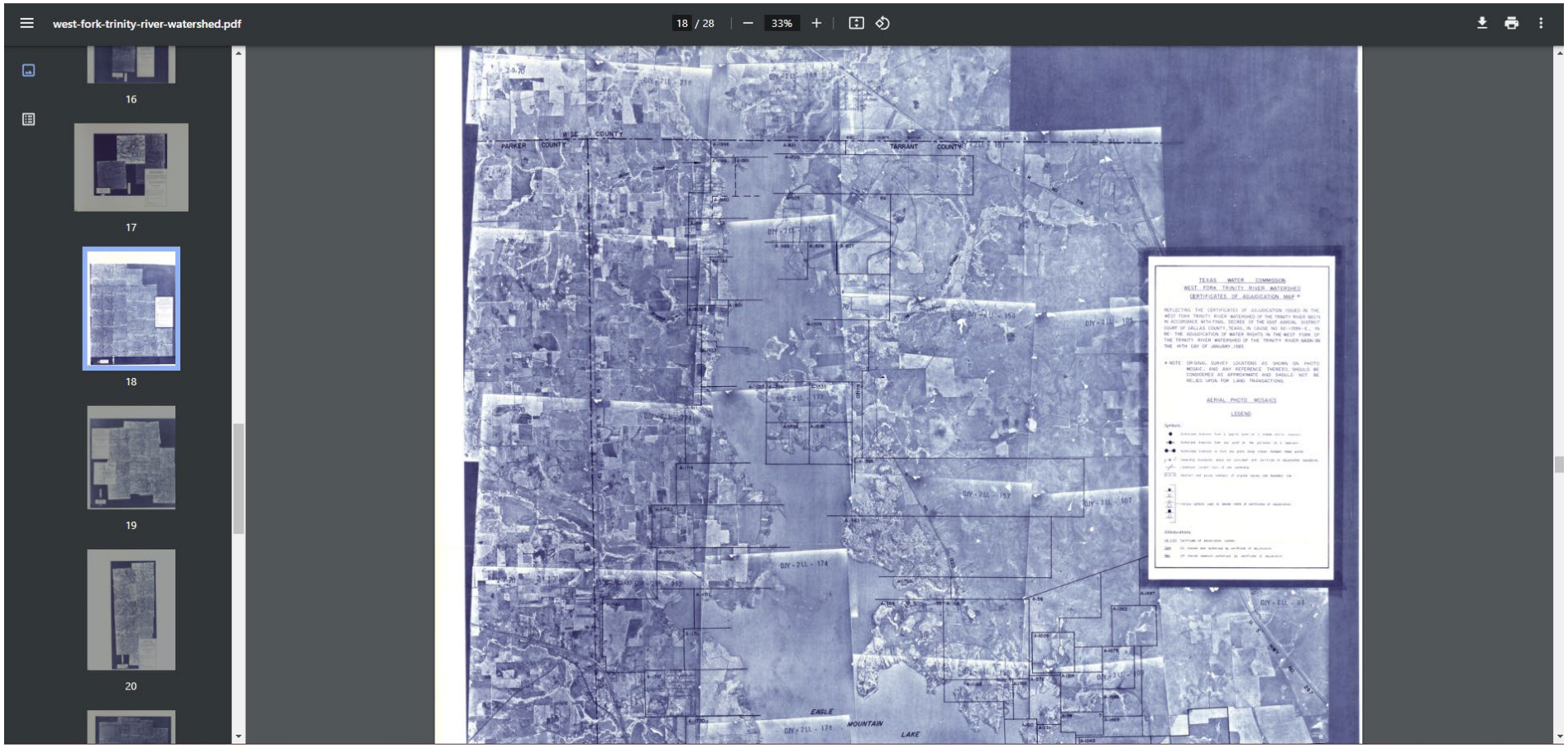
Under a law dating from 1837, a stream is navigable so far as it retains an average width of 30 feet from its mouth up. The width measured is the distance between the fast (or firmly fixed) land banks. A stream satisfying the 30-foot rule is sometimes referred to as “statutorily navigable” or “navigable by statute.” Under a court decision, the public has rights along a stream navigable by statute just as if the stream were navigable in fact.

Water Rights – Existing Water Rights



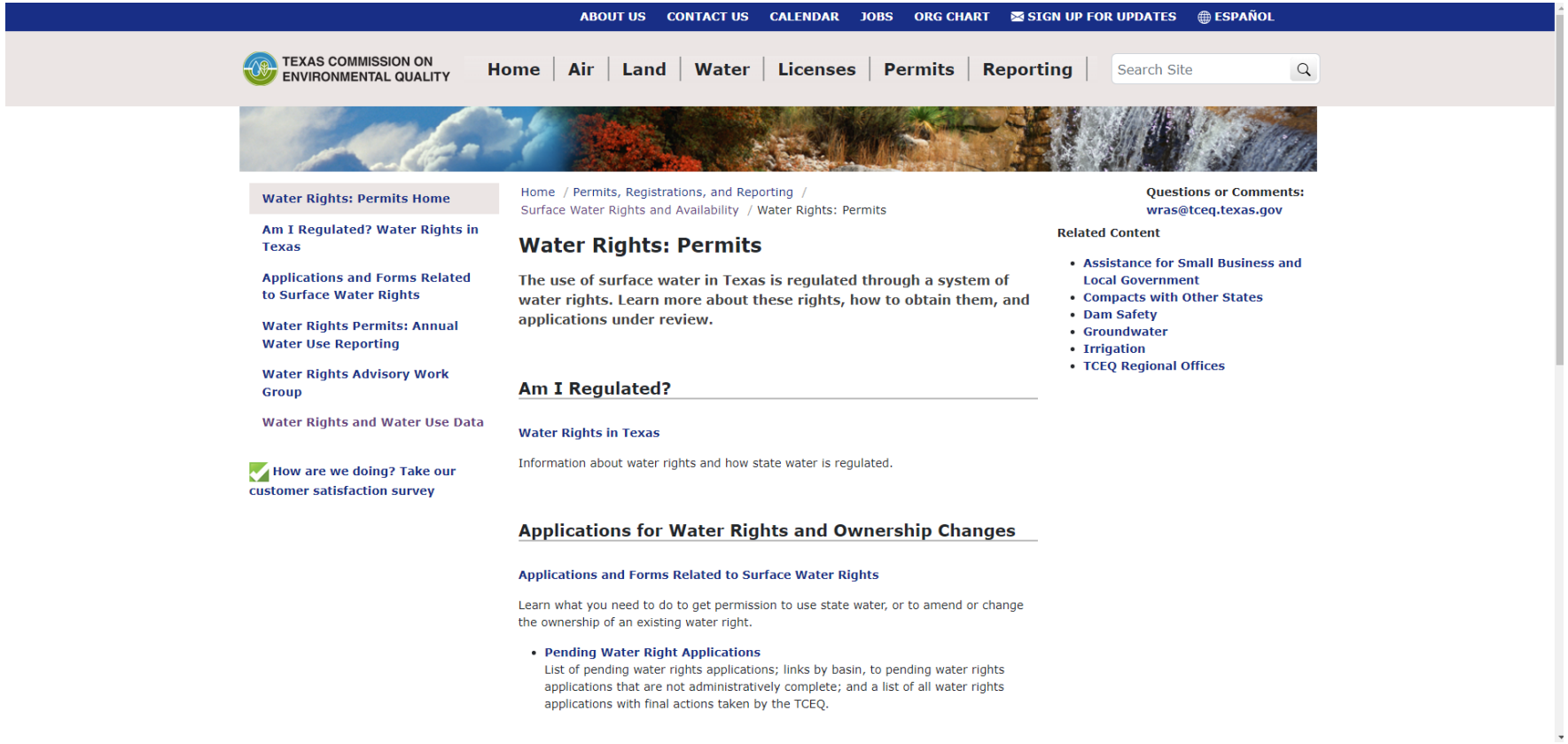
TCEQ water rights viewer - https://www.tceq.texas.gov/gis/water-rights-viewer

Water Rights – Adjudication Maps



TCEQ Water Rights Adjudication Maps - https://www.tceq.texas.gov/permitting/water_rights/wr_technical-resources/water-rights-adjudication-maps

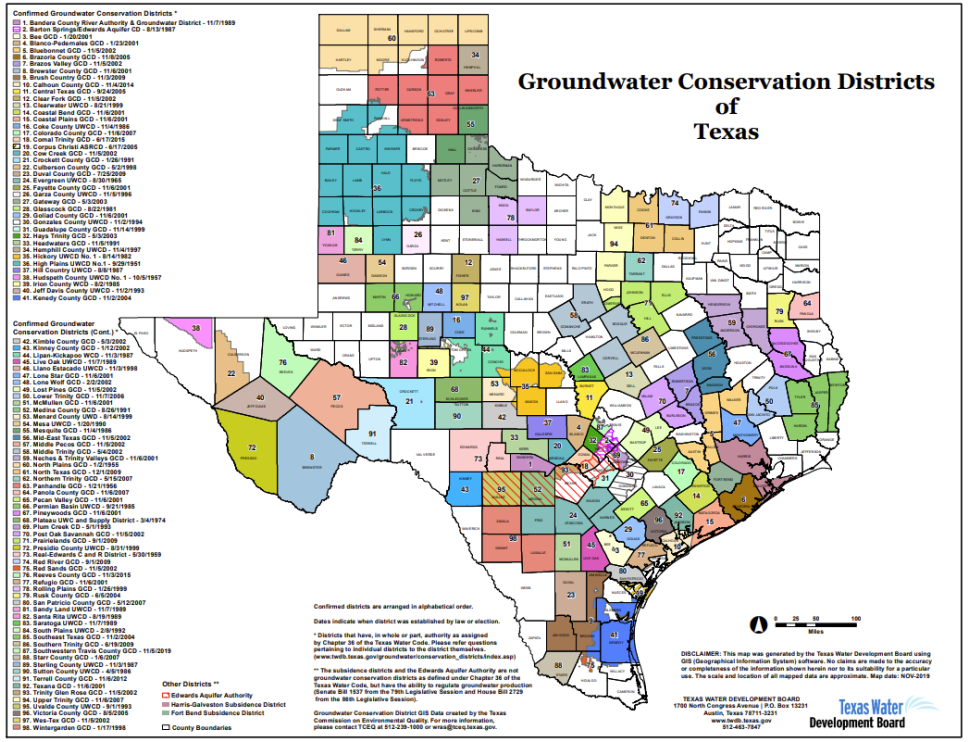
Water Rights – Permit Documents



TCEQ Water Rights - https://www.tceq.texas.gov/permitting/water_rights/wr-permitting

Water Rights – Groundwater

- Where is your make water coming from?
- What is the quality of the water?
- What is the reliability of the water in drought conditions?
- Compliance with GCD Permits and water well restrictions?



Water Rights & Dam safety

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DAM SAFETY CONSIDERATIONS

- Building & owning a dam is an ultrahazardous/inherently dangerous activity.
- Strict (absolute) liability is the legal standard for damages.
- Floods are an act of God, but floods can be made worse by impounding water.
- For practical purposes - there is no level of care that can be exercised to reduce or remove liability.
- Source: American State Dam Safety Organization (ASDSO)

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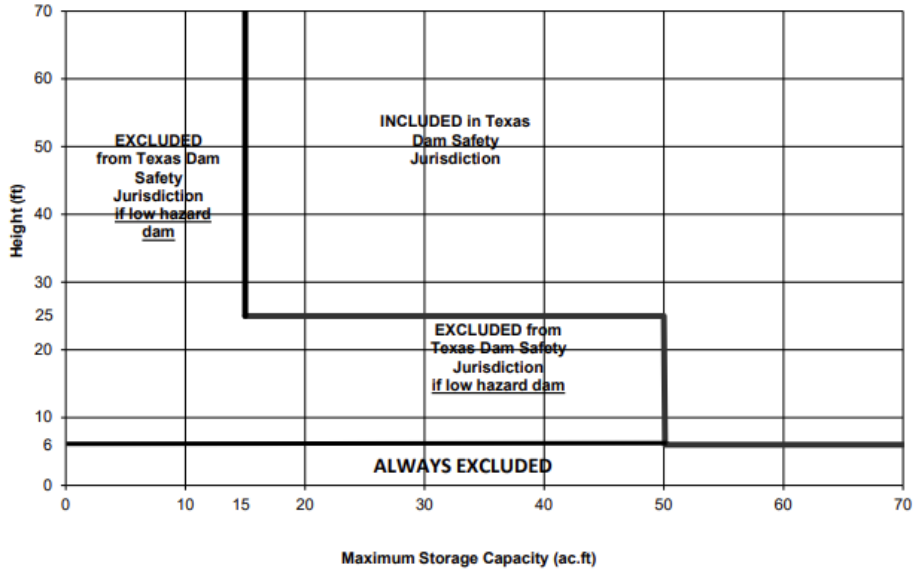
DAM SAFETY CONSIDERATIONS

- Standard of care set by TCEQ
  - Size (height & volume)
  - Hazard condition (what is downstream – how many lives at risk)
- When developing, think about potential future hazards



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ENVIRONMENTAL SERVICE LEAD, LAND DEVELOPMENT

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FORT WORTH, TX 76177

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Green Stormwater Infrastructure in North Texas

Dr. Fouad Jaber, Texas A&M AgriLife Extension

Integrated Green Stormwater Infrastructure for Water Quality and Flooding Management

Fouad H. Jaber, PhD, PE
Professor and Extension Specialist
Biological and Agricultural Engineering
Texas A&M AgriLife Extension
Dallas Research and Extension Center

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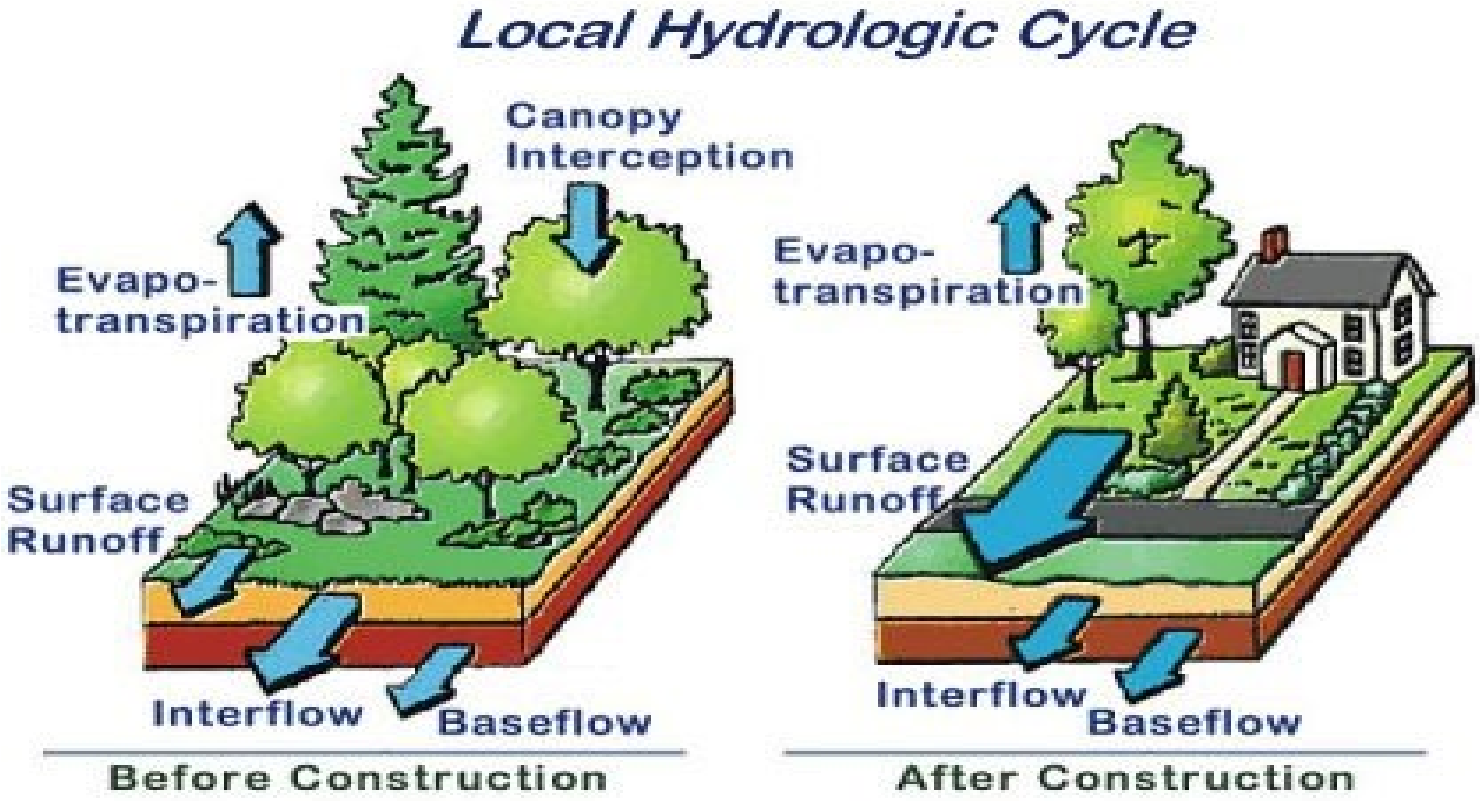
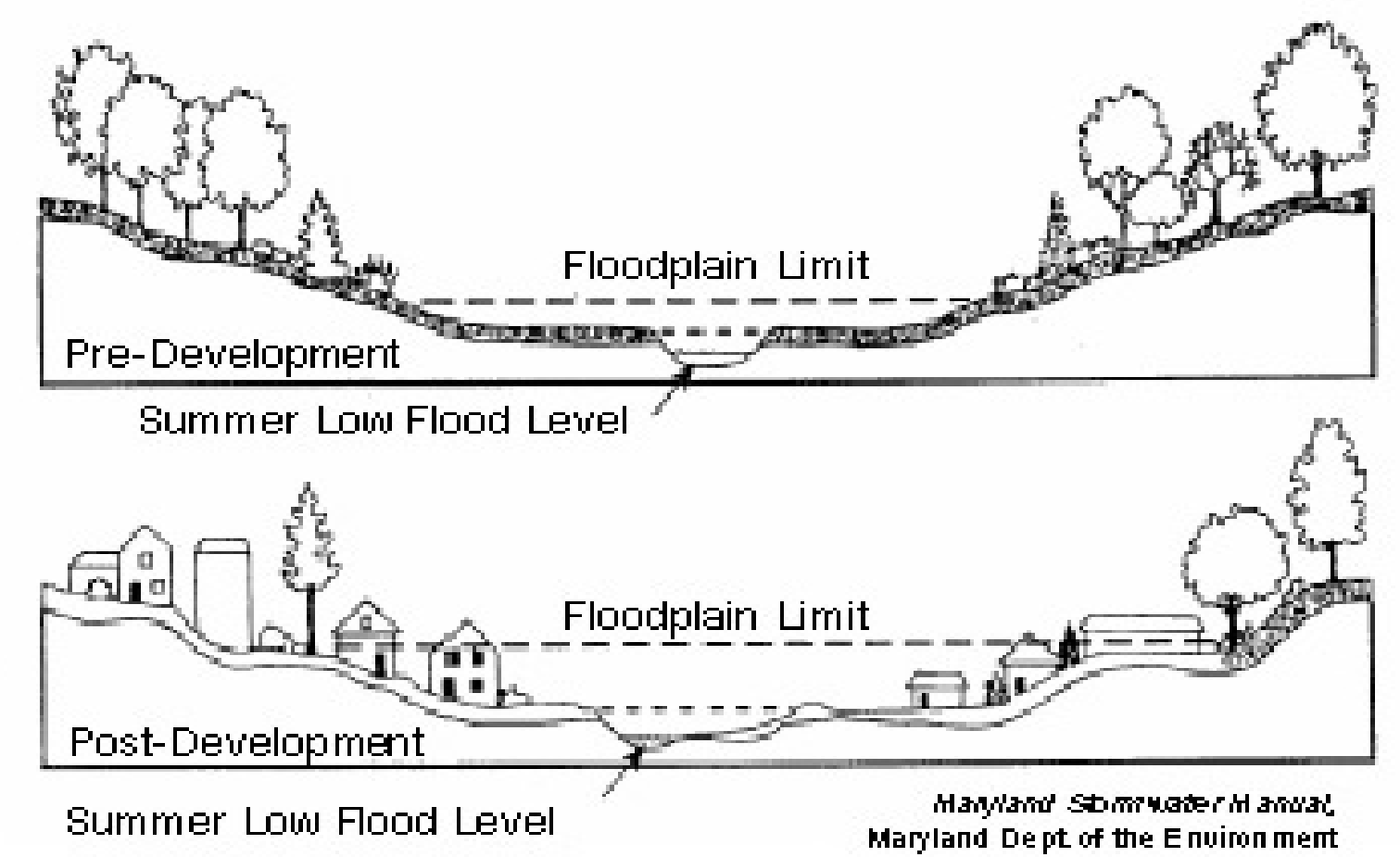
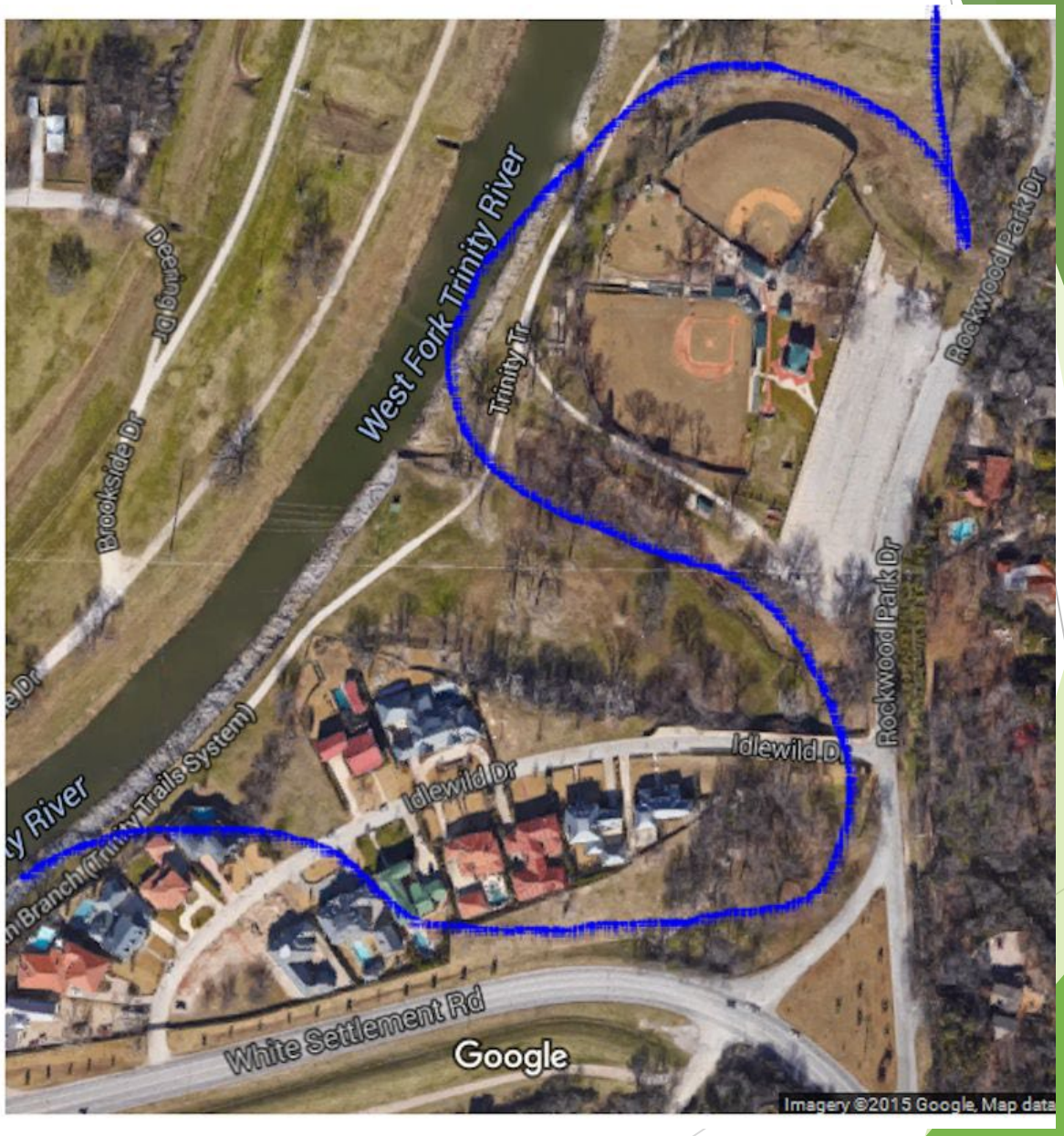
Urban vs. Natural



Why is Stormwater a Concern?

Why is Stormwater a Concern?




West Fork Trinity River
Brookside Dr
Trinity Tr
Rockwood Park Dr
Idlewild Dr
White Settlement Rd
Google
Imagery ©2015 Google, Map data

Eutrophication

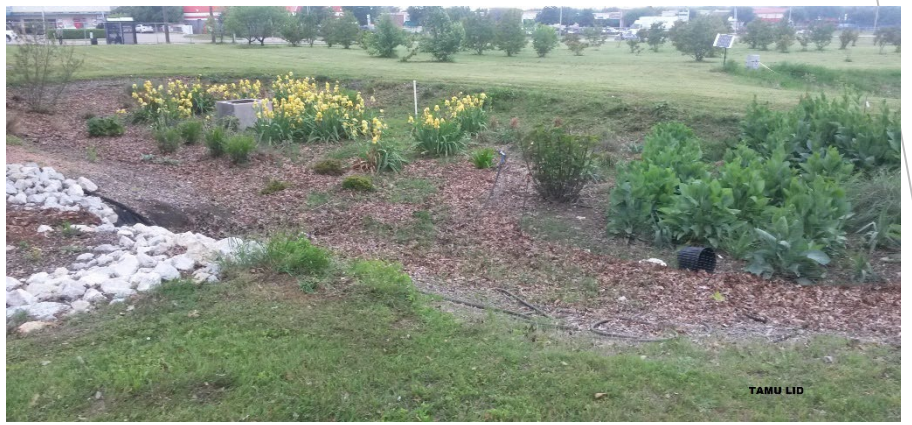
- Impacts due to urbanization:

  Impact to aquatic habitat:
  Degradation of habitat structure, loss of pool-riffle structure, reduction in base flow, increased stream temperature, and decline in abundance and biodiversity.

Fish kill at Lake Granbury.

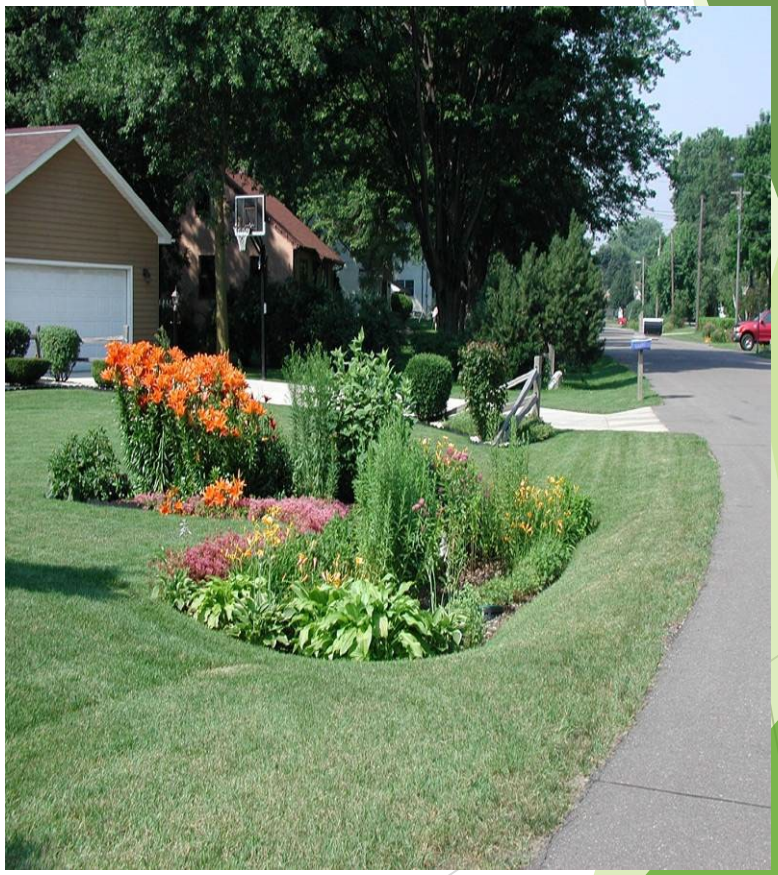
Green Stormwater Infrastructure

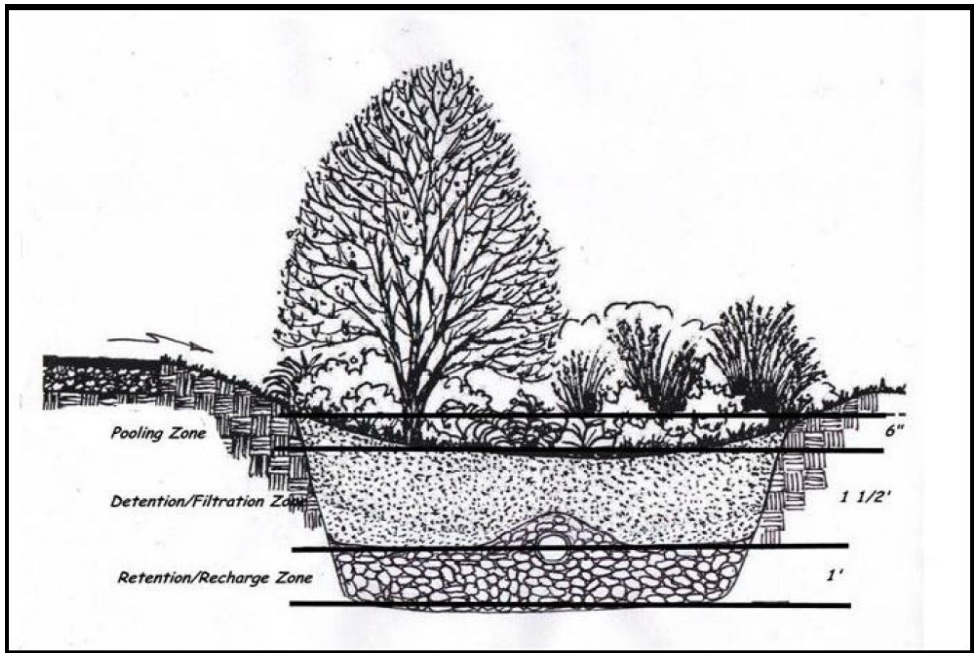
- Rain garden-bioretention areas
- Porous pavements
- Green roofs
- Rainwater harvesting



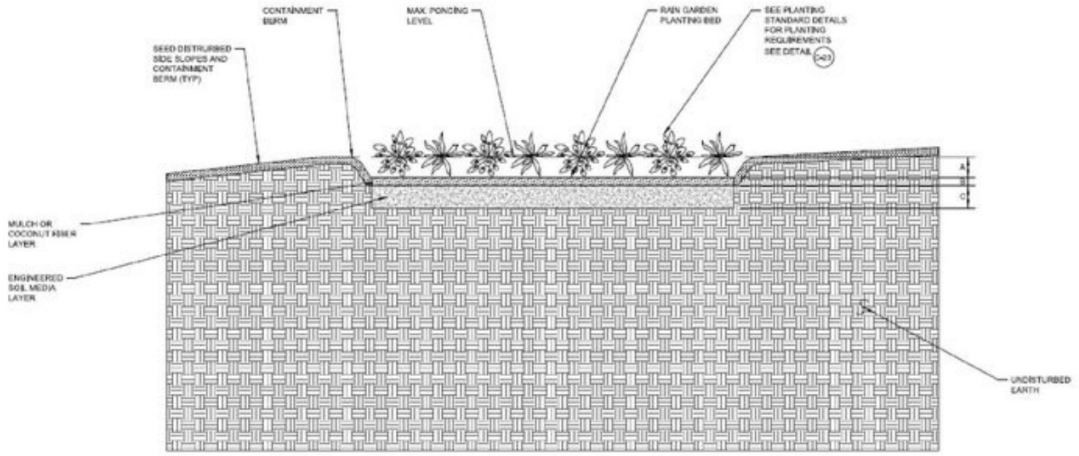
What is a Rain Garden (Bioretention)?

A rain garden is a beautiful landscape feature consisting of a planted shallow depression that collects rainwater runoff from roofs, parking lots and other impervious surfaces.




Pooling Zone
6"
Detention/Filtration Zone
1 1/2'
Retention/Recharge Zone
1'


3 Feet
0.5 foot to edge of garden
Existing Drainage Canal
1 foot
Original ground
Selected fill
Excavation line
Overflow box
Peforated pipe


CONTAINMENT BERM
MAX. PONDING LEVEL
RAIN GARDEN PLANTING BED
SEE PLANTING STANDARD DETAILS FOR PLANTING REQUIREMENTS SEE DETAIL
SEED DISTURBED SIDE SLOPES AND CONTAINMENT BERM (TYP)
MULCH OR COCONUT FIBER LAYER
ENGINEERED SOIL MEDIA LAYER
UNDISTURBED EARTH

Home Rain Garden

Bioretention in Parking Lot

Bioretention in Road Median

What is Porous Pavement?

- Porous pavement is a permeable pavement surface with a gravel reservoir underneath.
  - it temporarily stores surface runoff before infiltrating it into the subsoil
  - provides water quality treatment
  - often appears as traditional asphalt or concrete but is without "fine" materials
  - could also allow for grass growth

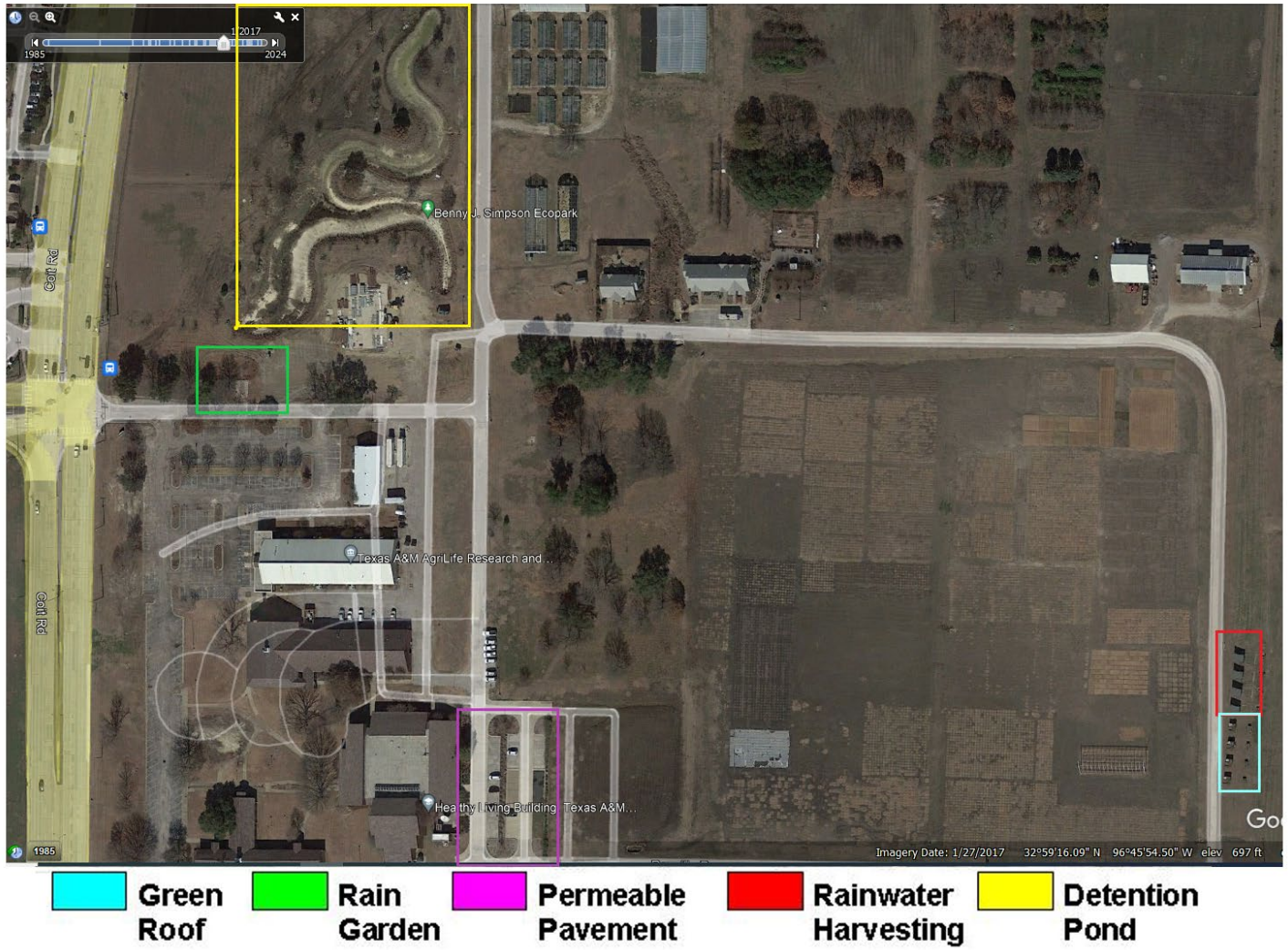

TAMU LID(c)

Green Roofs

Rainwater Harvesting as a Stormwater BMP

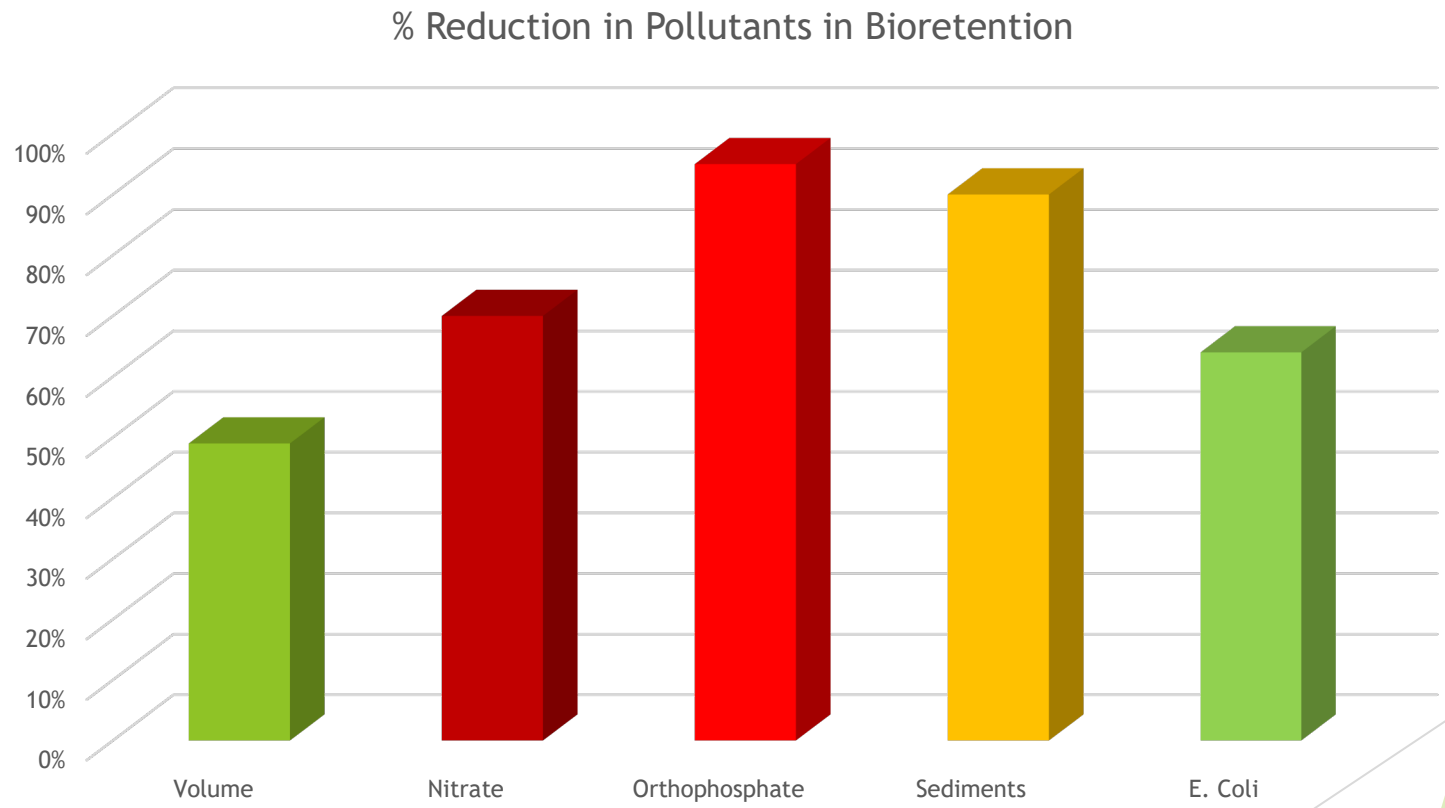
- Retains water on-site
- All water applied on high infiltration areas (yard)
- Reduces total volume and peak flow
- Conserves water

Research Project in Dallas



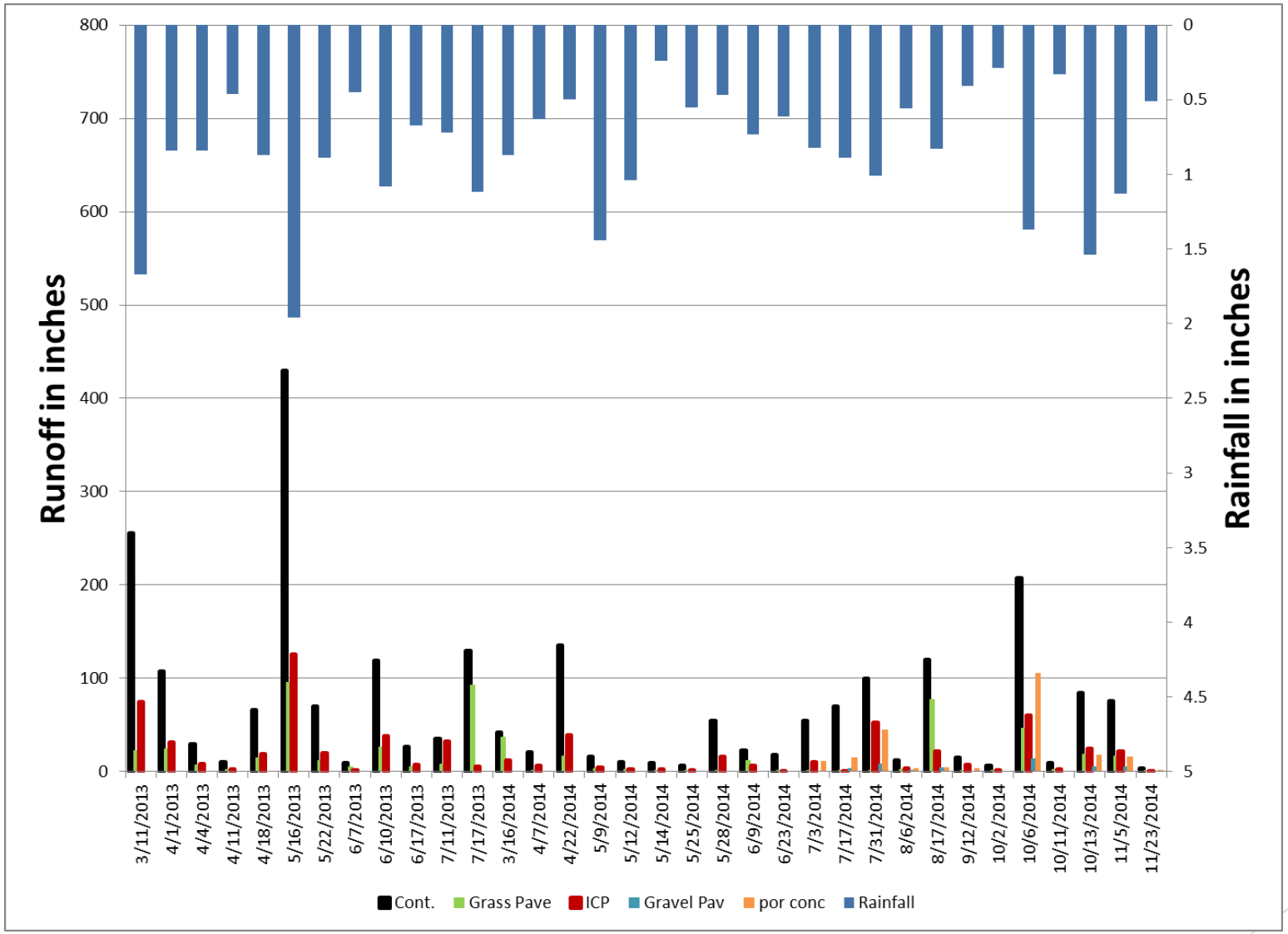
Bioretention cell

Bioretention Volume and Pollutants Reduction



Jaber, 2015

Permeable Pavement Results: Volume



Jaber, 2015

Volume and total suspended solids reduction rates

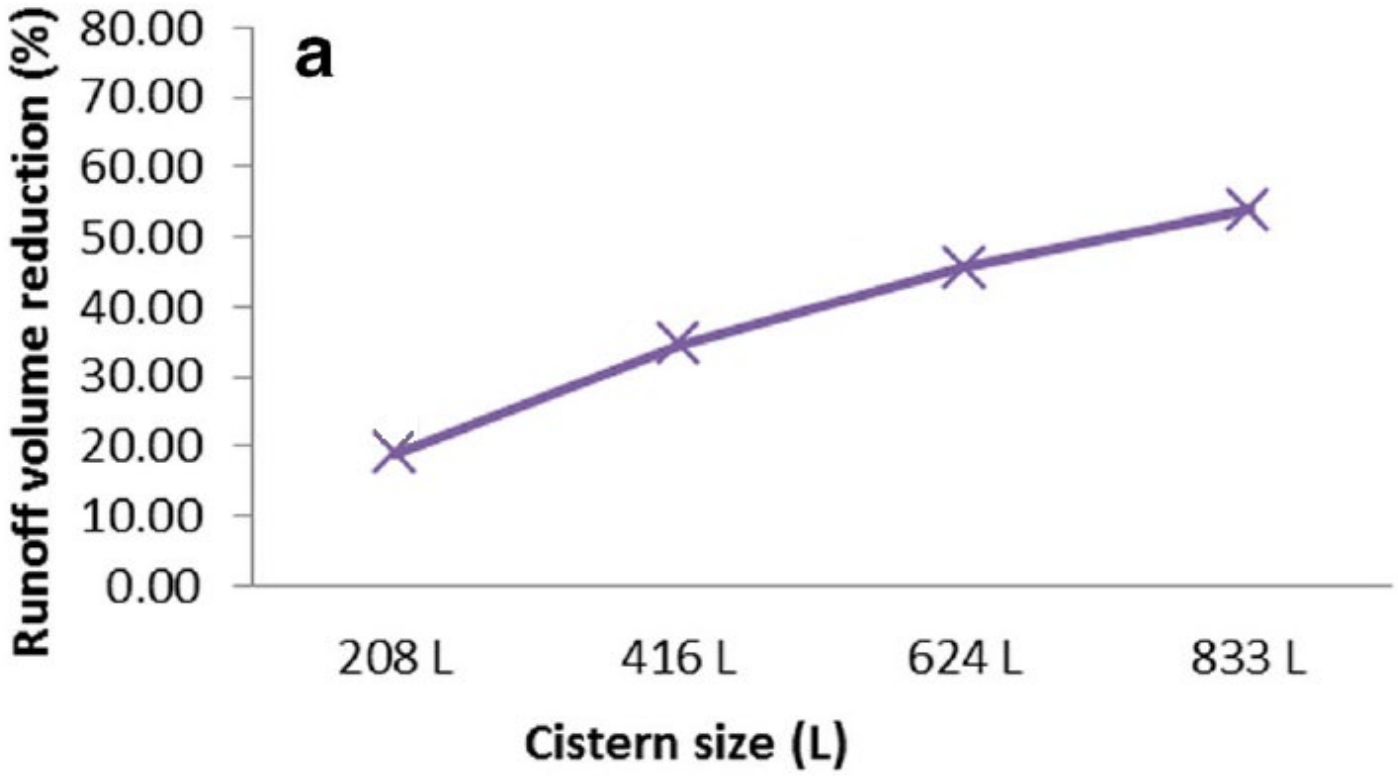
Reduction Rate	PICP	Pervious Concrete	Grass Pavers	Gravel Pavers
Volume	71%	74%	78%	93%
TSS	57%	48%	84%	48%

Volume Reduction

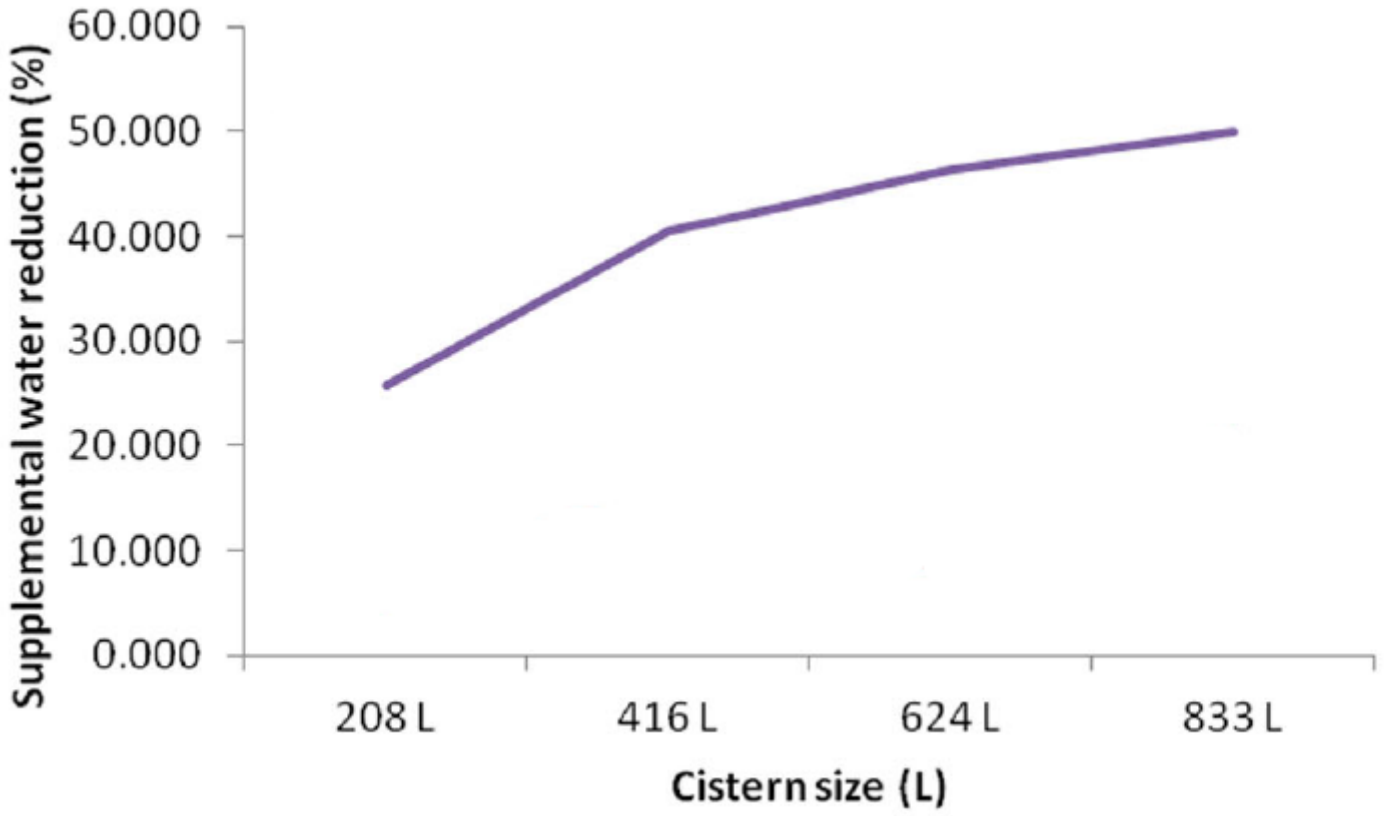
Event	Rainfall	C	H	H reduction	S	S reduction	SD	SD Reduction
Date	inches	gals	gals	%	gals	%	gals	%
05/09/14	Total Volume Reduction from C			65.39%		76.05%		75.33%
05/12/14								
06/09/14								
07/03/14								
07/17/14	0.89	6.7	1.47	0.78	0.1	0.99	2	0.70
07/31/14	1.01	7.7	6.1	0.21	0.24	0.97	1.18	0.85
08/06/14	0.56	2.7	0	1.00	0	1.00	0.29	0.89
08/17/14	0.83	4.7	1.18	0.75	0	1.00	0.29	0.94
10/06/14	1.37	15.8	5.54	0.65	2.47	0.84	4.1	0.74
10/13/14	1.54	22	11.9	0.46	8.7	0.60	9.3	0.58
10/13/14	1.54	22	11.9	0.46	8.7	0.60	9.3	0.58
11/05/14	1.13	9.02	0.17	0.98	0.35	0.96	0.29	0.97
11/23/14	0.51	2.5	0	1.00	0	1.00	0	1.00
12/23/14	0.53	3.89	0.59	0.85	0.35	0.91	0	1.00
01/12/15	0.63	4.5	0.66	0.85	2.4	0.47	0.94	0.79
01/23/15	1.17	7.58	3.56	0.53	3.63	0.52	3.28	0.57
02/02/15	0.72	35.7	25	0.30	1.12	0.97	0	1.00
02/25/15	2.22	15.58	8.63	0.45	1.36	0.91	5.66	0.64
03/06/15	1.1	2.36	0	1.00	1.35	0.43	0.17	0.93


TAMU LID(c)

Runoff Reduction from RWH



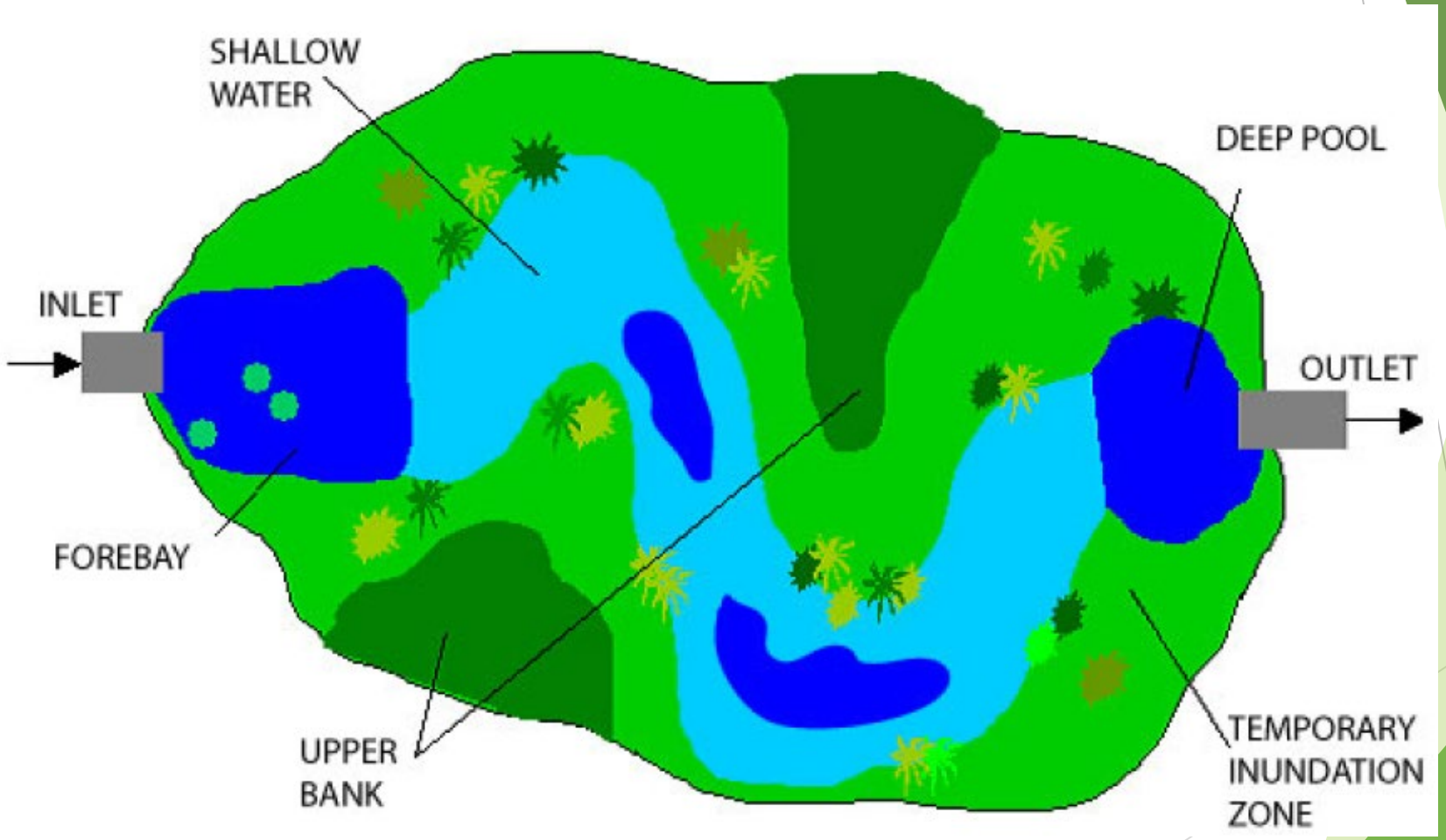
Water savings from RWH



Constructed Wetlands

- Constructed wetlands are best practices to reduce effects of urbanization on stormwater
- Stormwater wetlands are designed to improve water quality, improve flood control, enhance wildlife habitat, and provide education and recreation.

Wetland Features



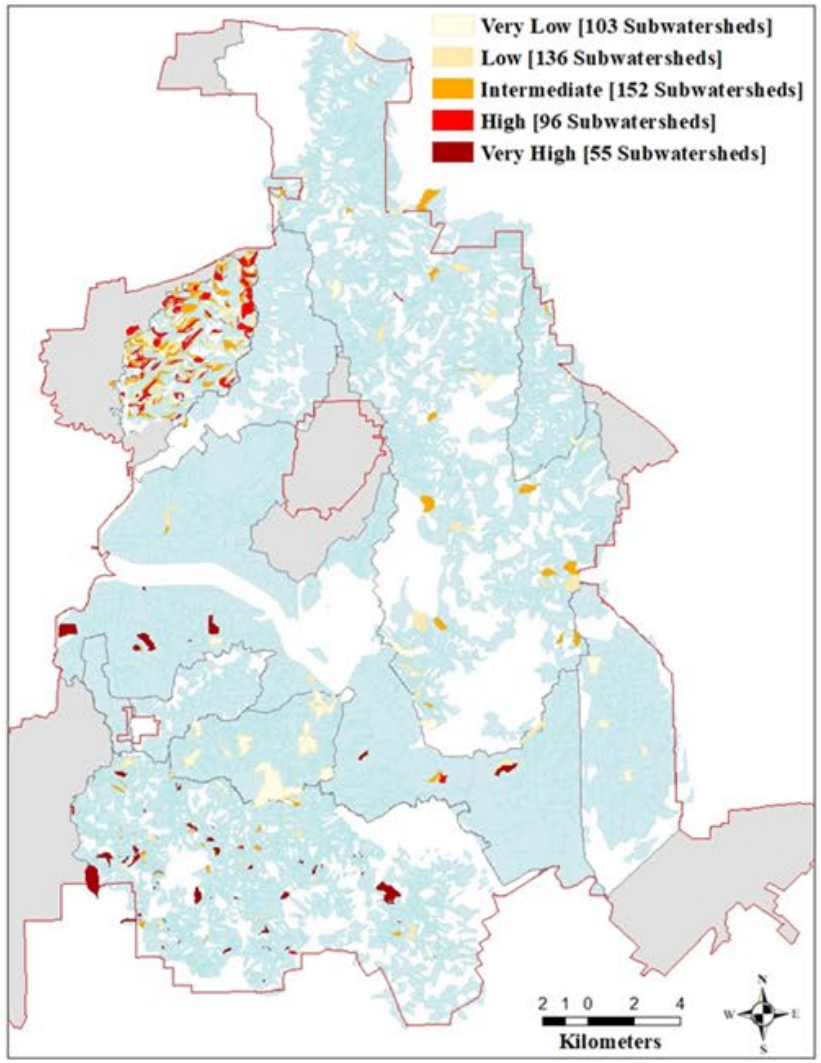
Wetland Effectiveness in Pollutant Removal

Pollutant	Number of samples	Median pollutant removal percentage	Range
Total suspended sediment	35	78%	-29% to 99.5%
Soluble phosphorus	15	40%	-34.5% to 75%
Total phosphorus	35	51%	-9% to 99.5%
Ammonia (as NH_4)	19	43%	-55.5% to 72%
Nitrate-nitrogen	30	67%	-100% to 90%
Organic nitrogen	12	1%	-31% to 43%
Total Khedjahl nitrogen (TKN)	10	14.5%	-10.3% to 81%
Total nitrogen	22	21%	-25% to 83%
Copper	10	39.5%	2% to 84%
Lead	17	63%	23% to 94%
Zinc	16	53.5%	-73.5% to 90%

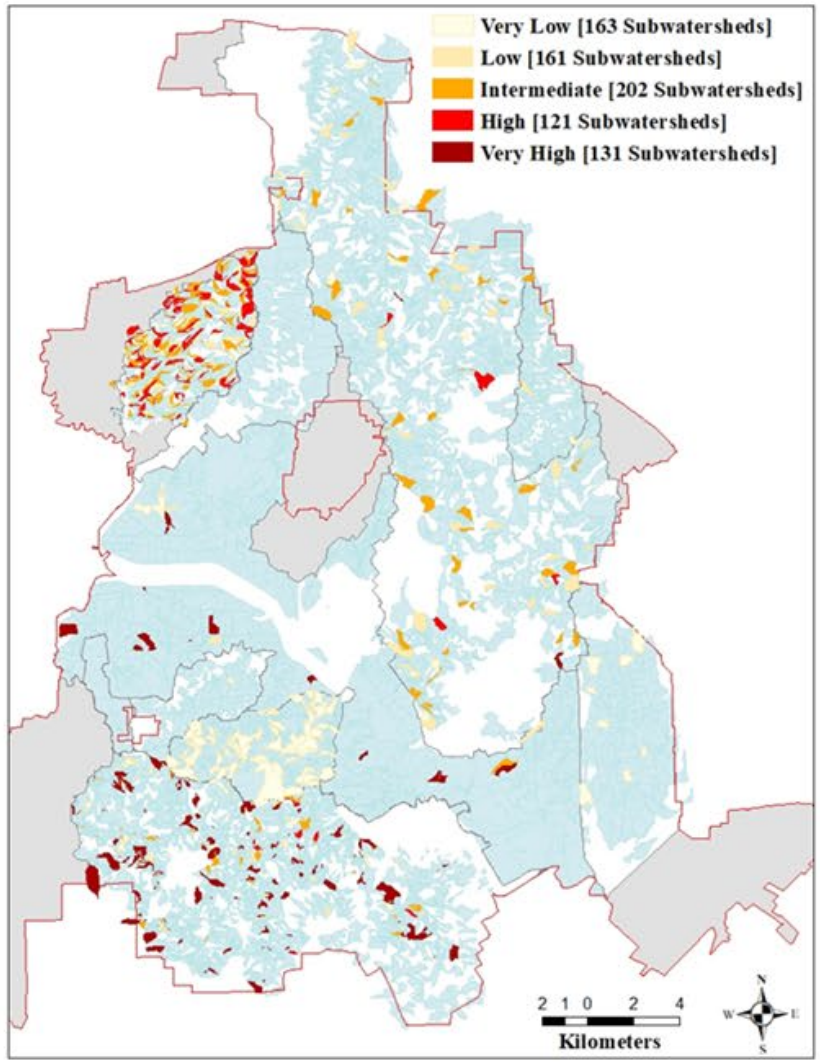
(Adapted from Brown and Schueler, 1997)

GSI Opportunity Subwatersheds for Stormwater Flooding Management, Ranked by Severity

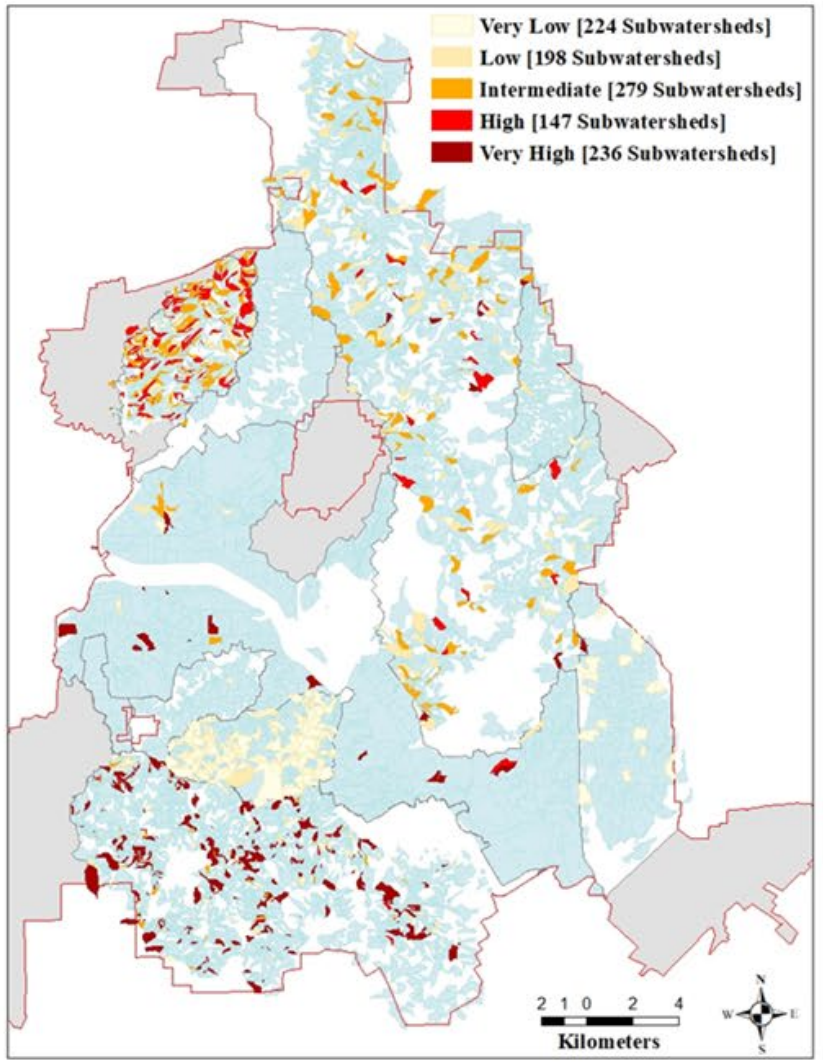
Current Conditions Pre GSI



2-year (50%) storm (4”)



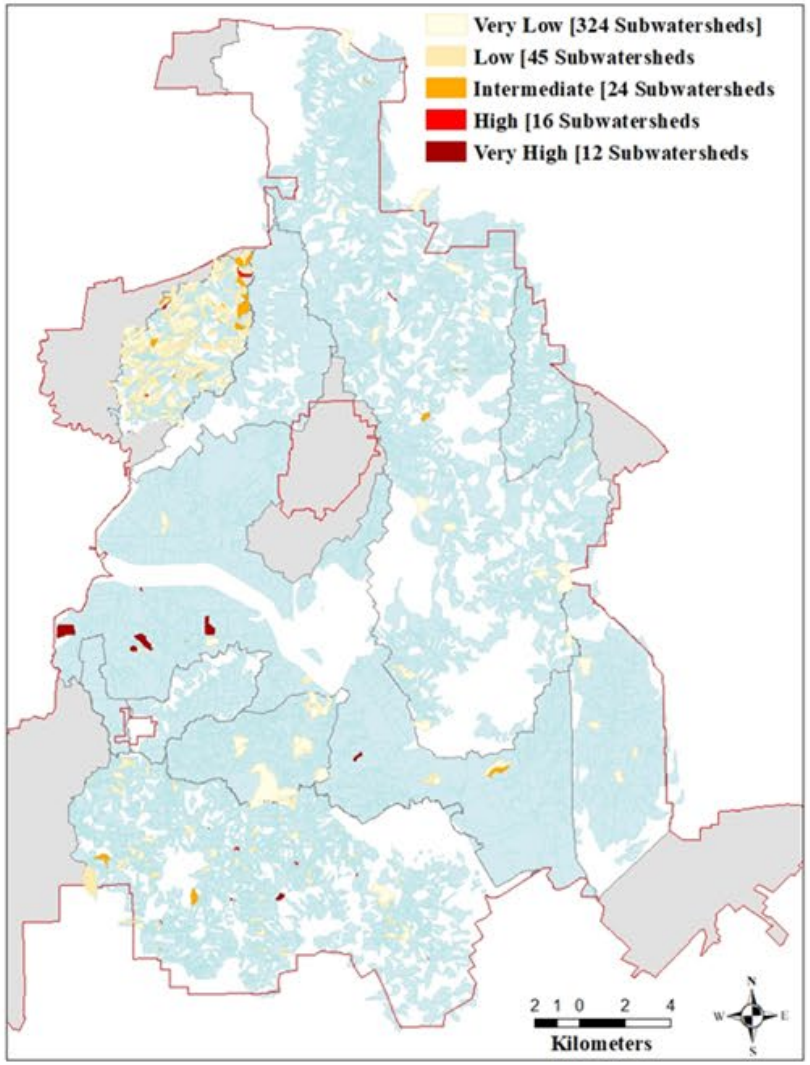
10-year (10%) storm (6”)



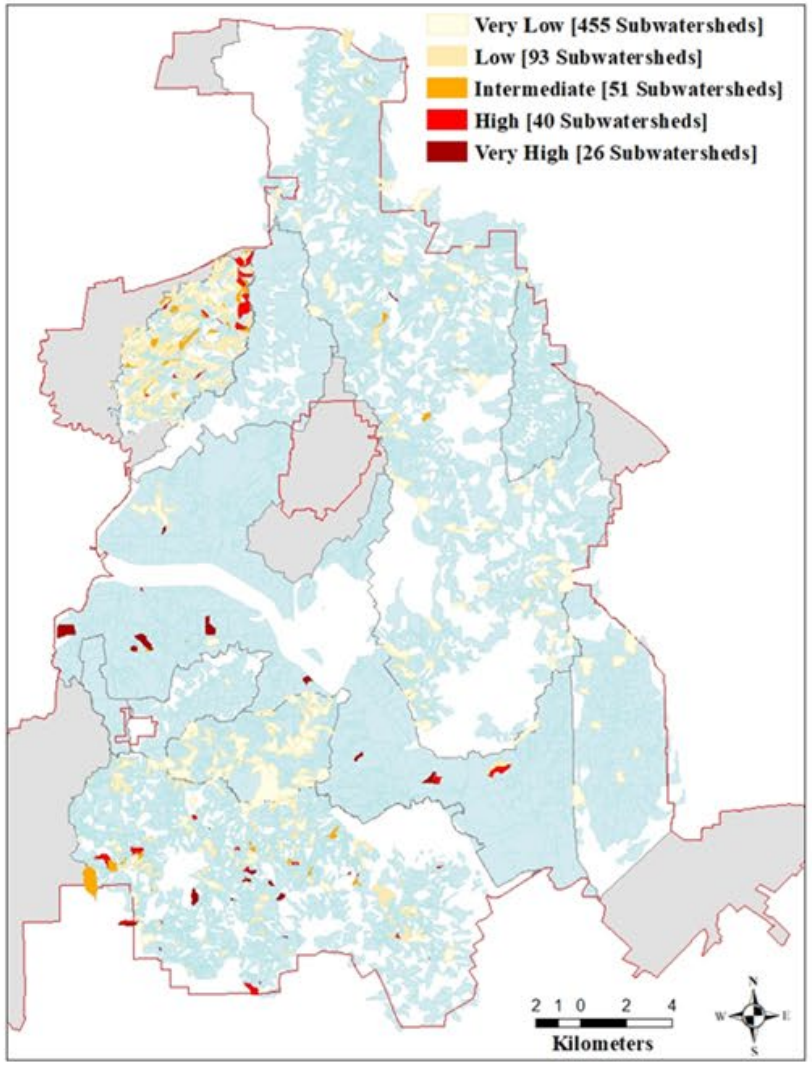
100-year (1%) storm (9.5”)

GSI Opportunity Subwatersheds for Stormwater Flooding Management, Ranked by Severity

Current Conditions Post GSI



2-year (50%) storm (4”)



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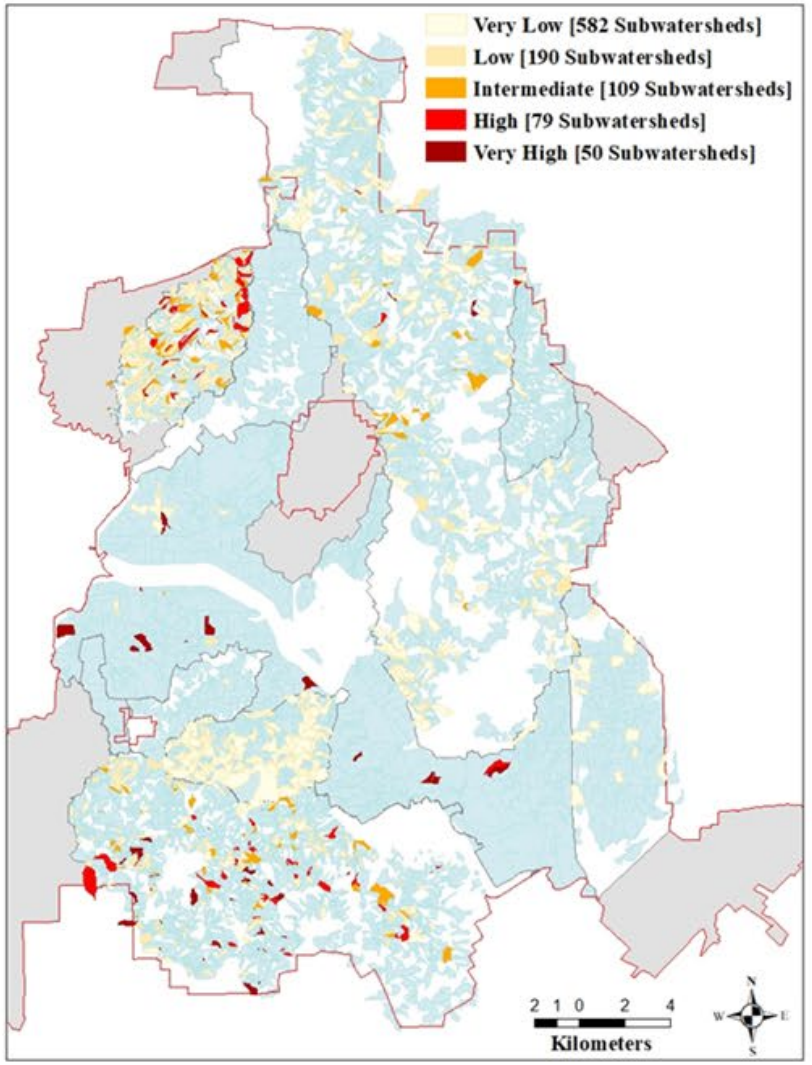

100-year (1%) storm (9.5”)


Alice Branch
South Oak Cliff
Renaissance Park
E Overton Rd


South Oak Cliff
Renaissance Park


What is a Rain Garden?
TEXAS A&M AGRILIFE EXTENSION
The Nature Conservancy

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