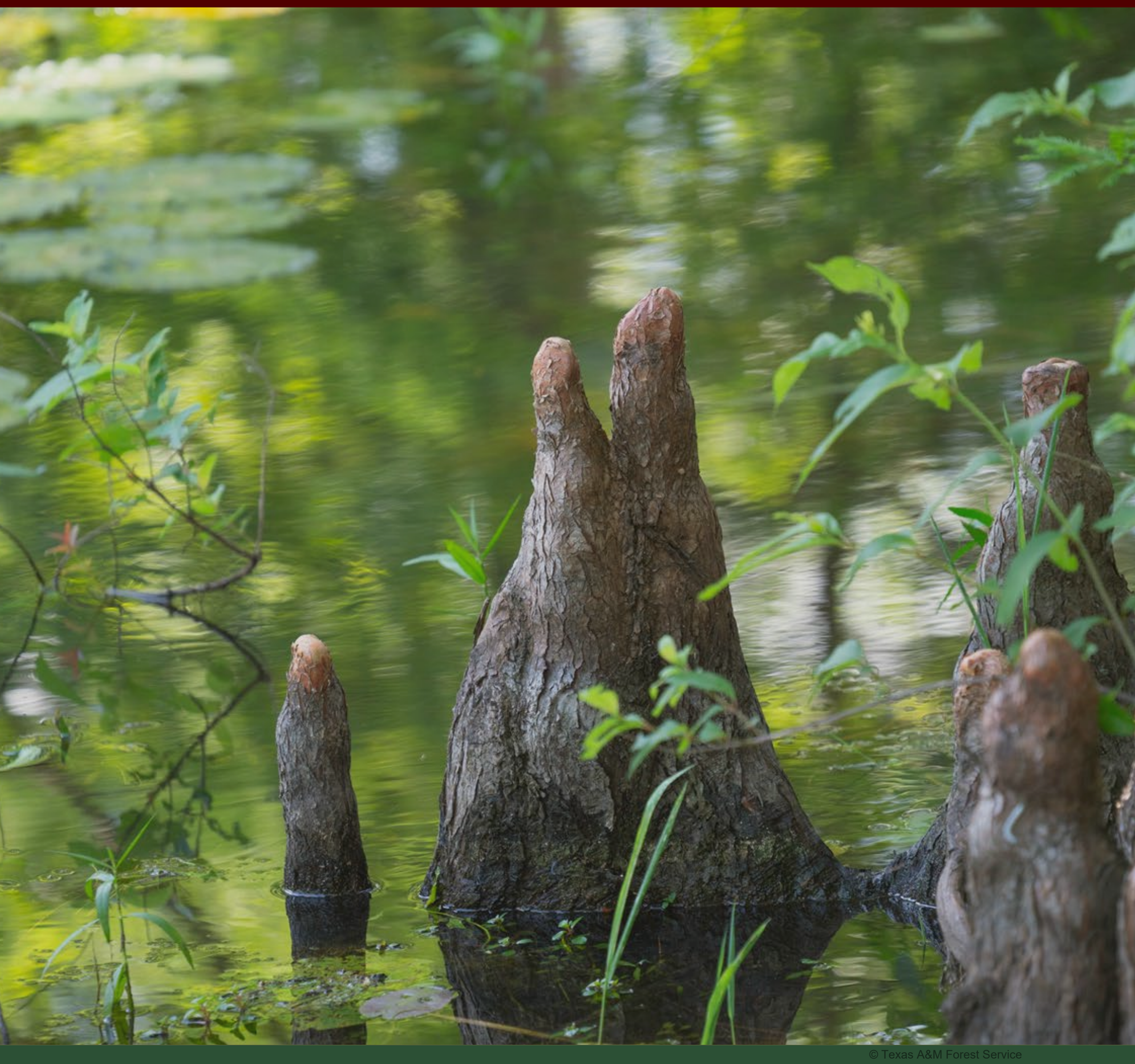




The Role of Forests and Trees in Watershed Protection

*Cotton Bayou
Watershed Riparian &
Stream Restoration
Workshop*

August 24, 2026

CONSERVE. PROTECT. LEAD.

Texas A&M Forest Service | Water Resources Program

Stewarding Texas' forests by fostering partnerships and delivering technical assistance related to the forest - water relationship.

Current program areas:

- Silviculture and timber harvest BMPs
- Fireline BMPs
- Education and outreach
- Watershed planning
- Grants for water resources related forestry practices
- Restoration and recovery



Water Resources Program

Justin Kendall
Program Leader
College Station



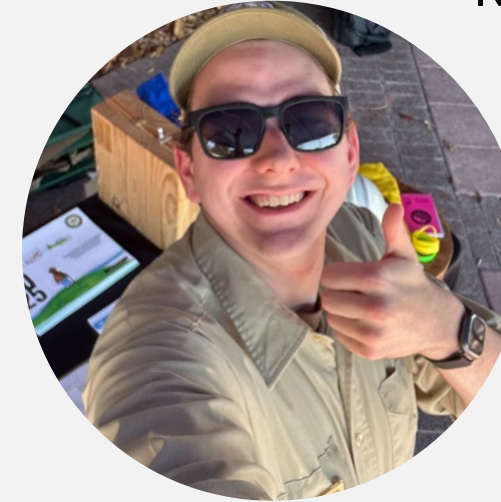
Erin Davis
Program Specialist
(Texas Resilient
Landscapes)
Kerrville



Jeff McFall
Staff Forester
San Antonio



Ryan Edmondson
BMP Ecologist
Dallas



Julia Schmidt
BMP Coordinator
Lufkin



Donna Work
Biologist
Lufkin



Sam Hill
Woodland Ecologist
Houston



Presentation Overview

- The Forest/Water Relationship
- Implementing the Forest/Water Relationship
 - Planning Around Streams and Riparian Areas
 - Stream Type Review
 - Best Management Practices
 - Tree-scale
 - Restoration-scale
 - Community-scale



Middle Lake at the W.G. Jones State Forest, Conroe, Texas.



The Forest/Water Relationship



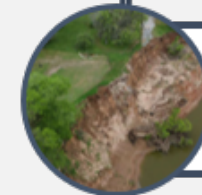
Slow down runoff



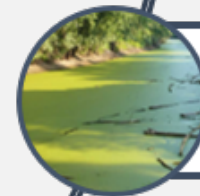
Prevent and reduce flood impacts



Stabilize soils



Reduce erosion



Filter and trap pollutants



Maintain ideal stream parameters for wildlife



Rainfall Interception

1

Interception of rain

by tree leaves,
branches, and trunk

3

Reduced impact

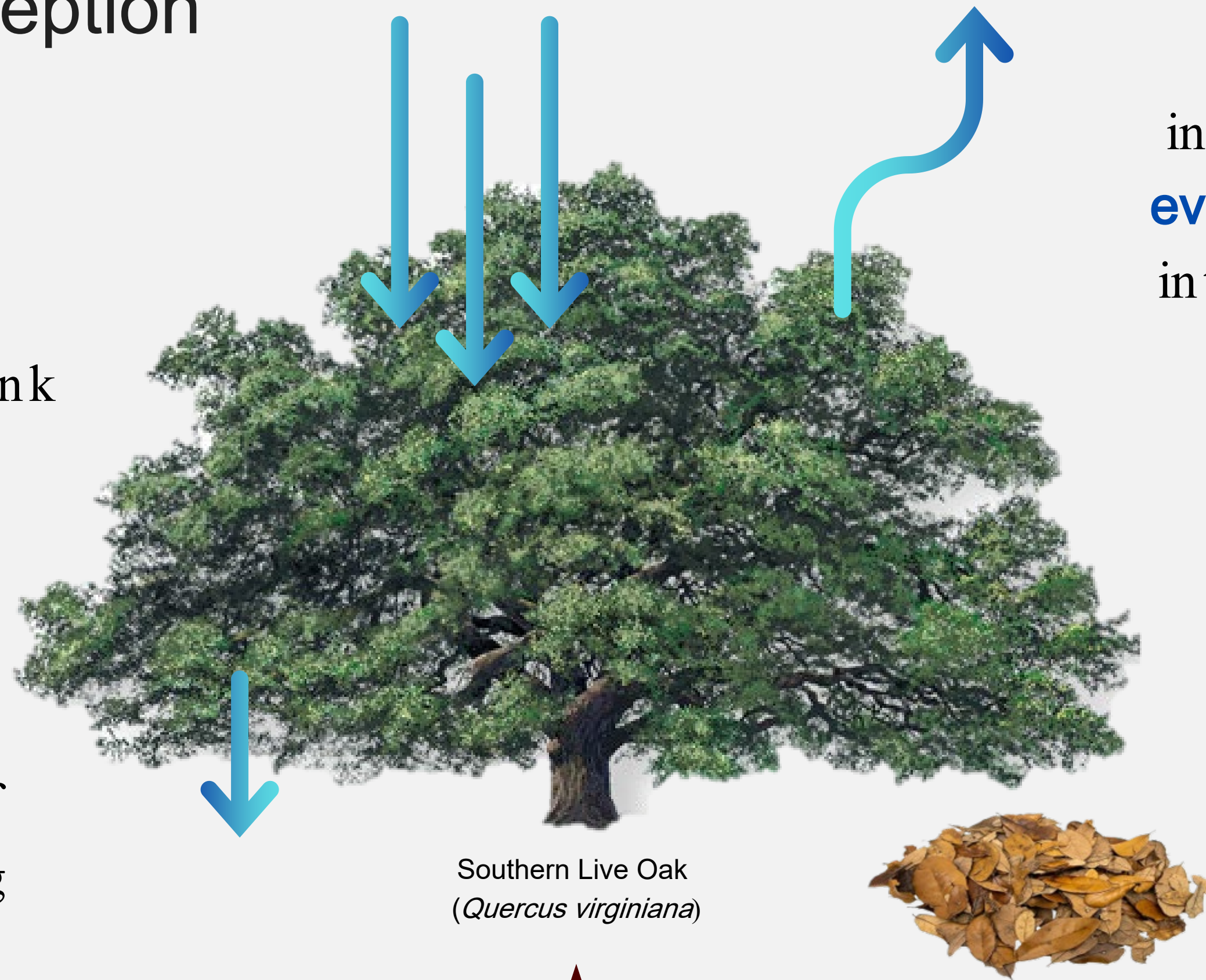
force and speed of
rain droplets hitting
soil

2

Portion of
intercepted rain
evaporates back
into atmosphere

4

Leaf litter
**reduces rainfall
impact**, aids in
soil recharge



Southern Live Oak
(*Quercus virginiana*)



Trees are Stormwater Infrastructure

Storm Water Mitigation \$26.72

Runoff Avoided	2,989.82 gal
----------------	--------------

Rainfall Intercepted	93,024.65 gal
----------------------	---------------

- In addition to intercepting rainfall and reducing runoff, **trees are water sinks**
 - Mature trees can hold hundred to thousands of gallons of water



i-Tree's *MyTreeweb* application calculates the ecosystem benefits of individual trees.

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© Texas A&M Forest Service

MyTree Benefits



Over 20 years.

Pecan, (*Carya illinoensis*)

Serving Size: 24.00 in. diameter

Condition: Excellent

Location: Mont Belvieu, Tx, United States

Expected i-Tree benefits

over 20 years: \$1,238.15

Discover benefits of all your [community trees!](#)

Carbon Dioxide Uptake \$672.03

Carbon Sequestered ¹	3,106 lbs
---------------------------------	-----------

CO ₂ Equivalent ²	11,388.67 lbs
---	---------------

Storm Water Mitigation \$26.72

Runoff Avoided	2,989.82 gal
----------------	--------------

Rainfall Intercepted	93,024.65 gal
----------------------	---------------

tfsweb.tamu.edu⁶

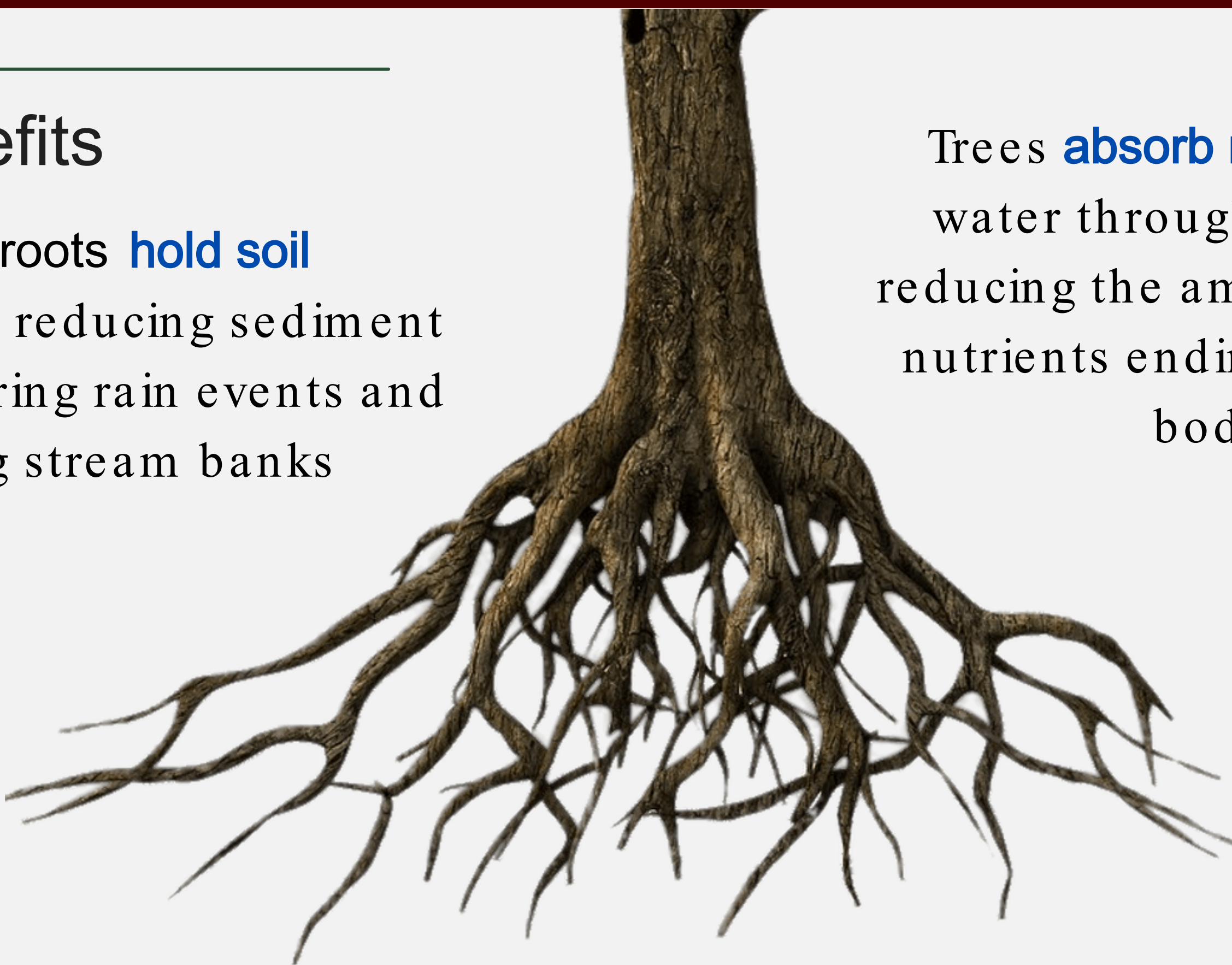
Root Benefits

Tree roots **hold soil together**, reducing sediment runoff during rain events and along stream banks

Roots **create macropores** which hold water, increasing soil storage capacity

Trees **absorb nutrients** in water through their roots, reducing the amount of excess nutrients ending up in water bodies

Roots support communities of organisms that **break down organic materials and toxins** found in runoff



Forests Are Pollutant Filters

Phosphorous Filtration

- Roots hold soil together
 - Phosphorous binds to soil particles in top layer of soil

In a 2004 study investigating water quality in 16 streams in Pennsylvania, **riparian forests were found to remove between 200 -800% more nitrogen than non -forested stream segments .**

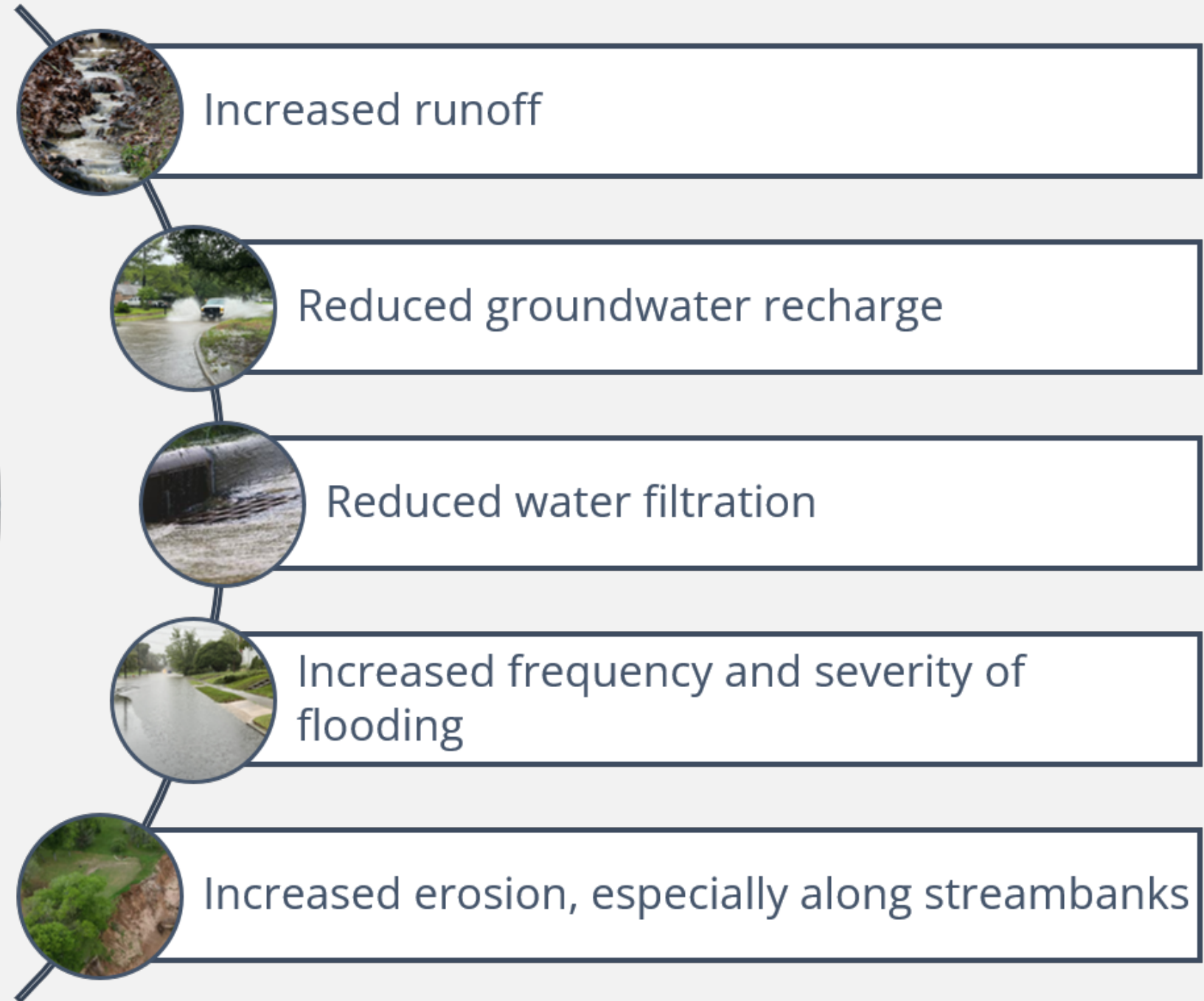
(Sweeney, et al. 2004)

Nitrogen Sinks

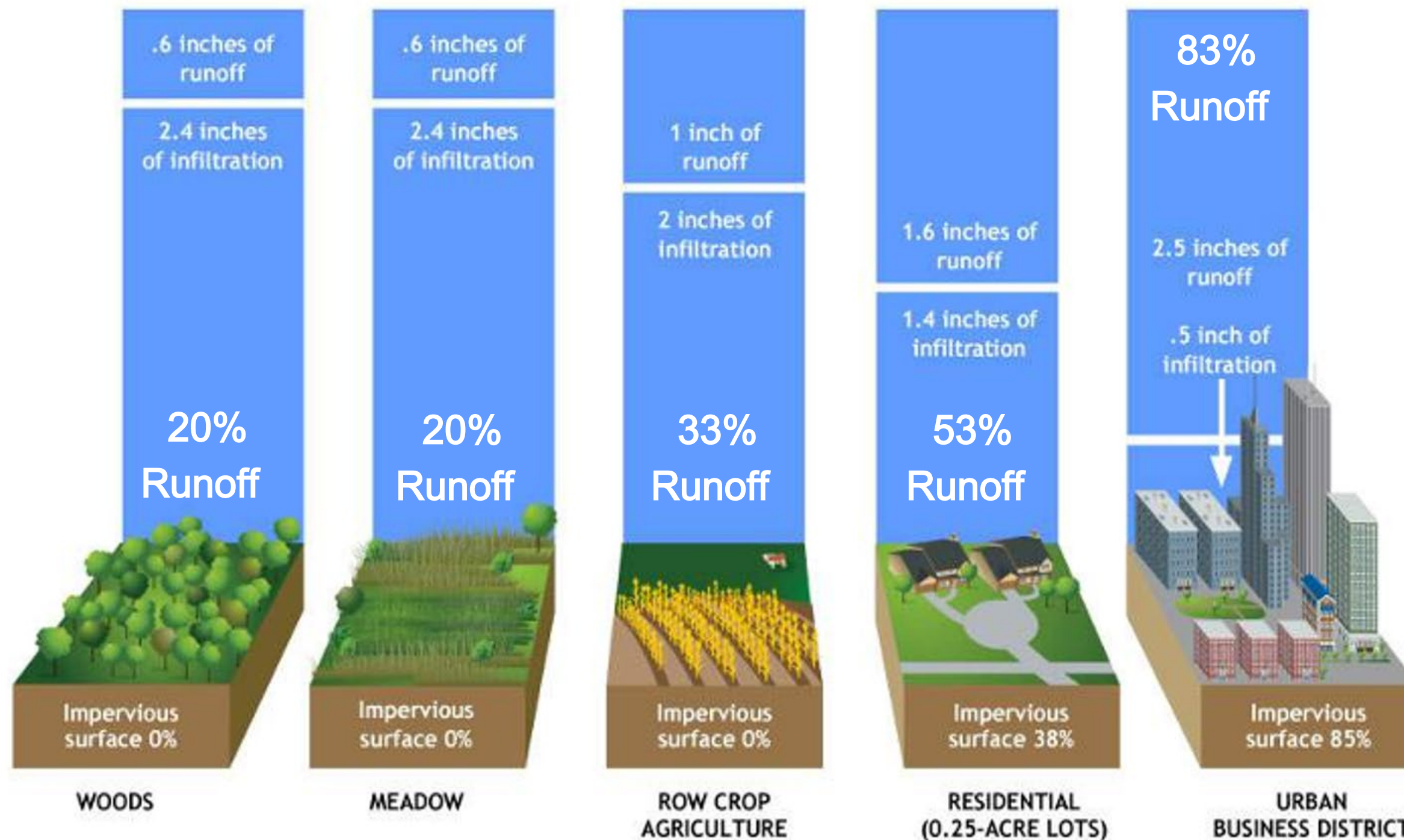
- Trees promote healthy soil structure, housing communities of **bacteria and fungi**
- **Bacteria metabolize nitrogen** , making it bioavailable for plants
- Plants store nitrogen in biomass



Without Native Vegetation



Comparison of Surface Types



Infiltration rates of various surface types following a 3 -inch rainstorm.

Graphic adapted from *Landscape for Life*, Colorado State University Extension.



What's In The Runoff?

Nonpoint Source Pollution

- Home and commercial **fertilizers, herbicides, insecticides, cleaners, pet and yard waste**
- **Sediment**
- **Salt** from irrigation practices
- **Bacteria and nutrients** from wildlife, pet, and livestock waste, faulty septic systems
- **Temperature**



An educational sticker next to a suburban stormwater drain.



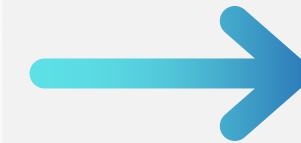
Urban Stormwater Life Cycle



Stormwater runs off impervious surfaces



Stormwater, **pollutants, and trash** enter storm drain system



Polluted stormwater is deposited directly into streams **without being treated**

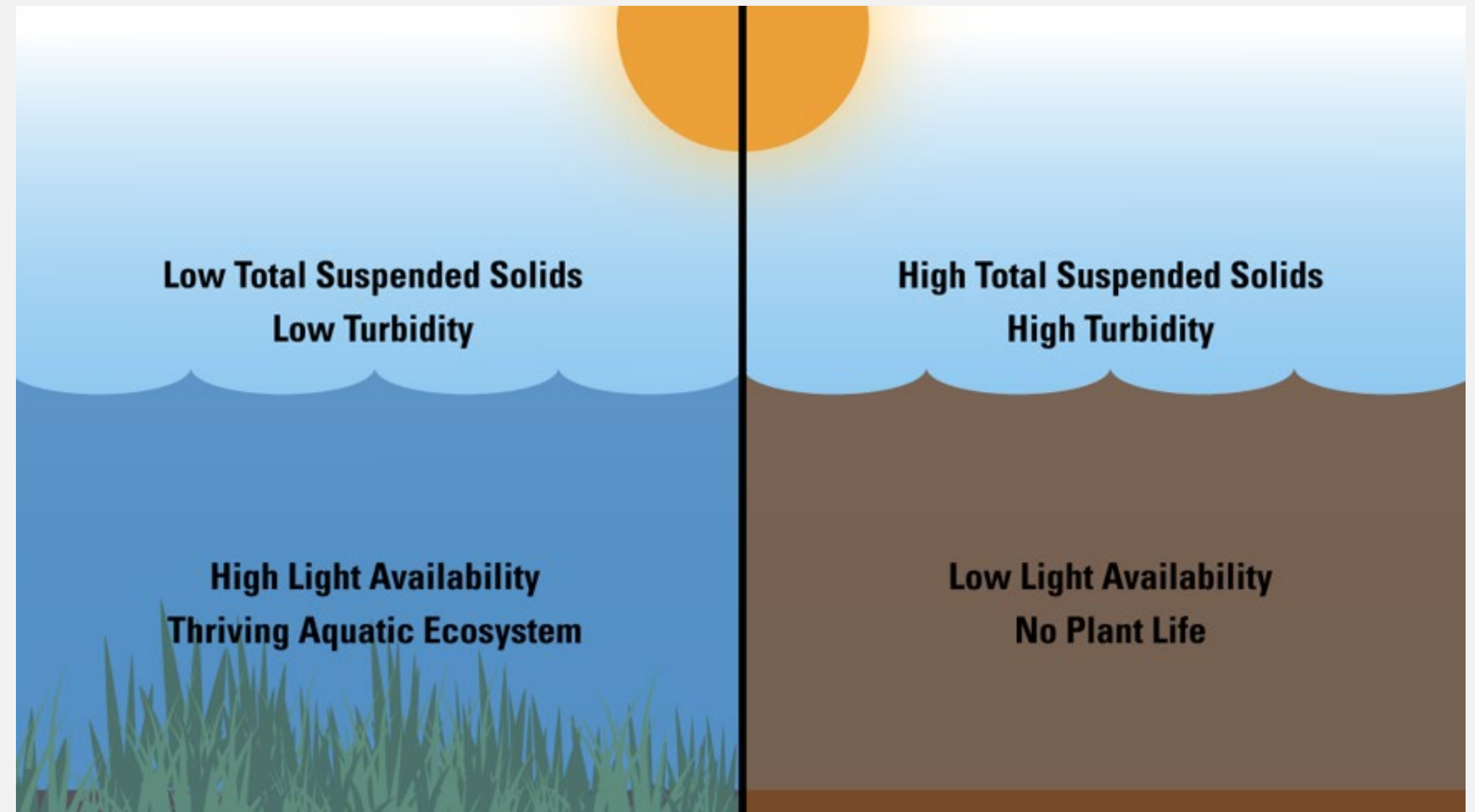


Effects of Increased Runoff on Stream Health

Increased Runoff Negatively Impacts Stream Health

Increased **sediment** input
→ reduced **light**
infiltration

Increased **water**
temperature → reduced
dissolved oxygen



Comparison of stream health due to sedimentation.
(USGS Virginia and West Virginia Water Science Center).



Forests and Water Temperature

- Trees **shade streams** , lowering water temperature
 - Cooler water holds more dissolved oxygen
 - Water temperature affects the **feeding, reproduction, and metabolic processes** of aquatic species
- Water that has infiltrated soil **enters streams at lower temperatures** than surface runoff from paved areas



Freshwater species like largemouth bass (*Micropterus salmoides*) require specific ranges of dissolved oxygen.
(Illustration by TPWD).



Riparian Trees Are Habitat

- **Snags decrease flow rate** and create riffles
 - Large sediment falls out of current
- Tree debris **creates habitat for wildlife**, including juvenile fish
- Biofilms accumulate on debris and become **food source** for invertebrates
- Riparian trees create habitat for birds, small animals, insects



A rookery of neotropic cormorant (*Nannopterum brasilianum*) at Smith Oaks Sanctuary, High Island, Texas.
(Photo by Sam Hill, Texas A&M Forest Service)





BMP Planning Tools and Site Classification

*Best Management
Practices that support the
forest/water relationship*

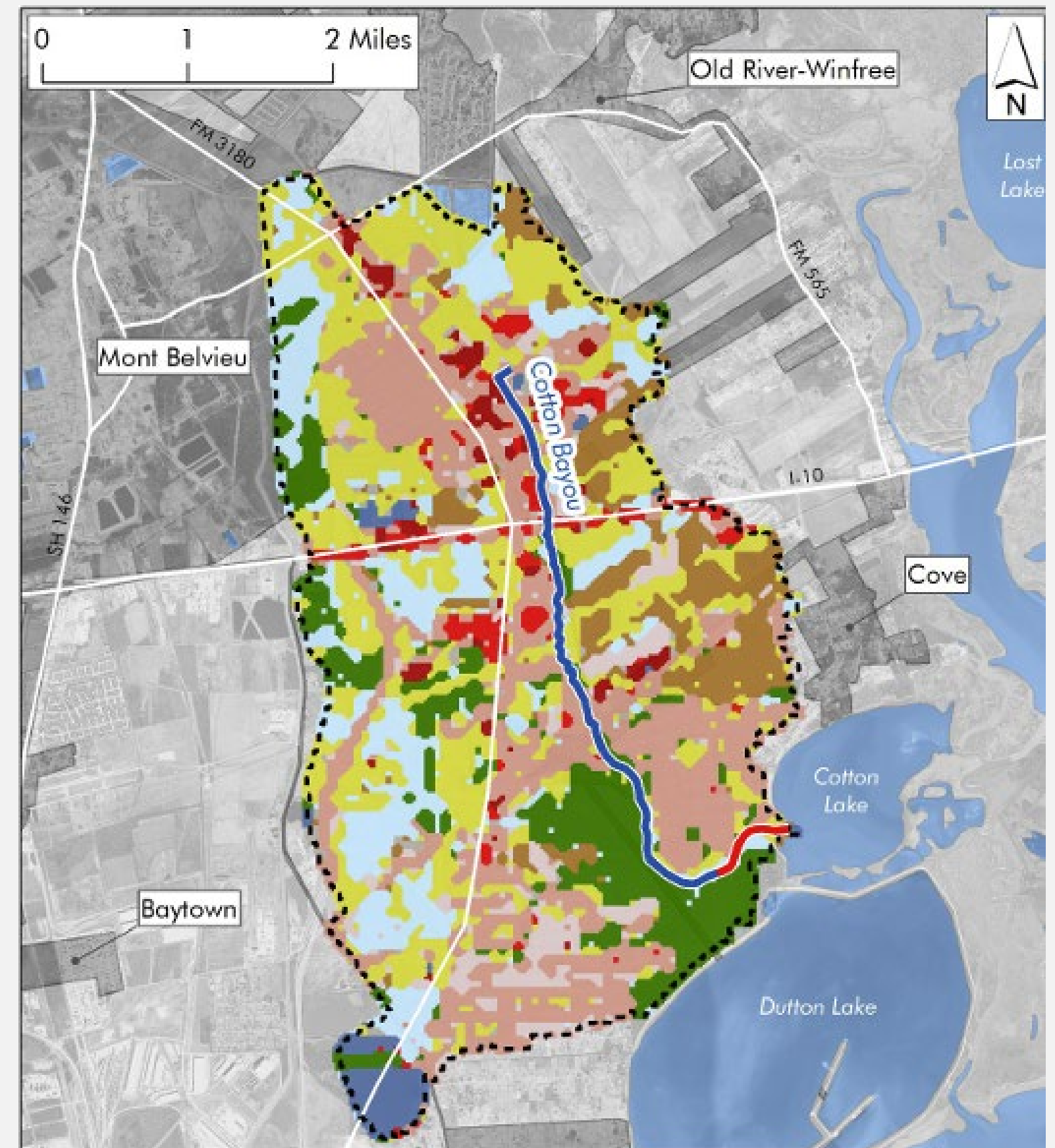
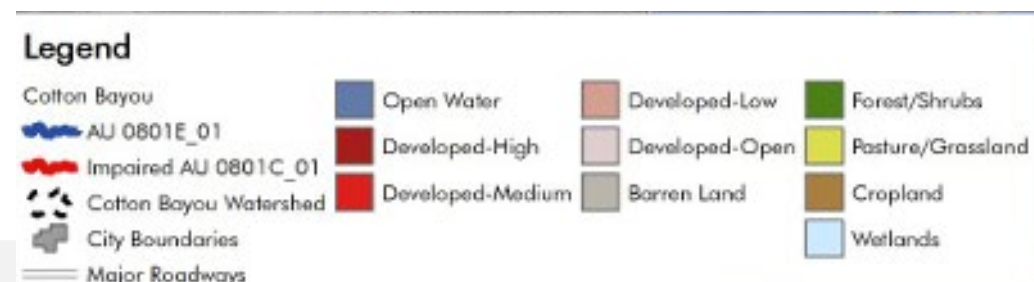
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Why Implement BMPs?

A land use map of the Cotton Bayou Watershed.
(Houston Galveston Area Council).

Practices Upstream Improve the Watershed

- Texas is mostly privately owned
 - 95.8% private
 - 4.2% public
- Best management practices (BMPs) at the property-level protect statewide natural resources



Why Implement BMPs?

Texas is Growing and Changing

- Texas population will grow from 34.2 to over 52.3 million between 2030 and 2080 (*Draft 2027 State Water Plan*)
 - Population growth largely around 'Texas Triangle'
- Land parcel **fragmentation increasing**

Population data from U.S. Census Bureau (2025).

Chambers County population grew 23.8% from 2020-2025.

Mont Belvieu population grew 38.1% from 2020-2025.

Only 36.2% of Cotton Bayou Watershed remains as natural space or cropland

Cotton Bayou Tidal TMDL Technical Support Document (HGAC)

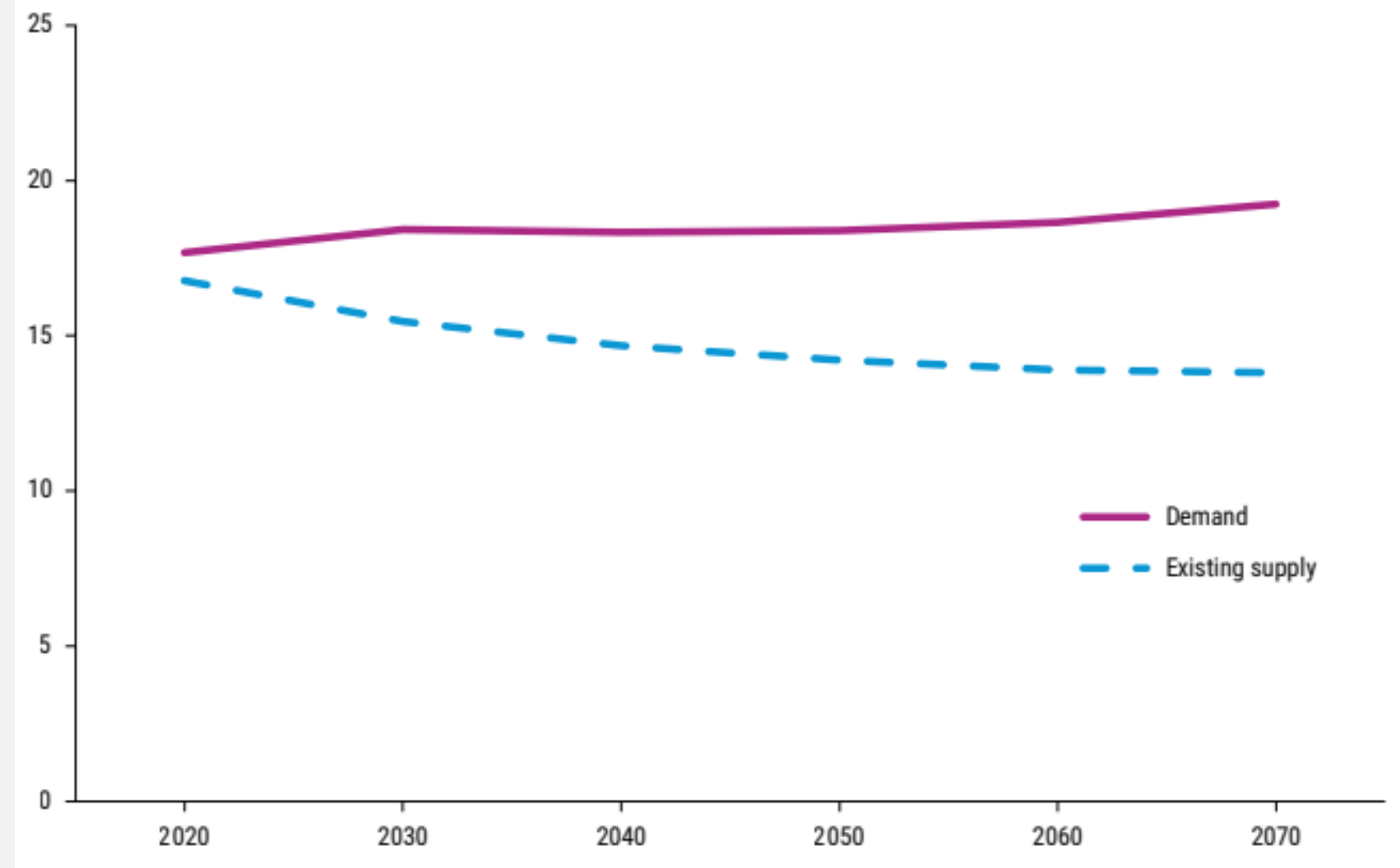


Why Implement BMPs?

Texas Needs Clean Water

- Texas does not have enough clean water to meet projected demands
- More than half the drinking water in the U.S. originates in forests
 - Native vegetation reduces drinking water treatment costs by municipalities
- Texas economy is tied to water

Figure ES-3. Projected total annual water demand and existing water supply for all sectors in Texas (millions of acre-feet)



(Water for Texas / 2022 State Water Plan, Texas Water Development Board).



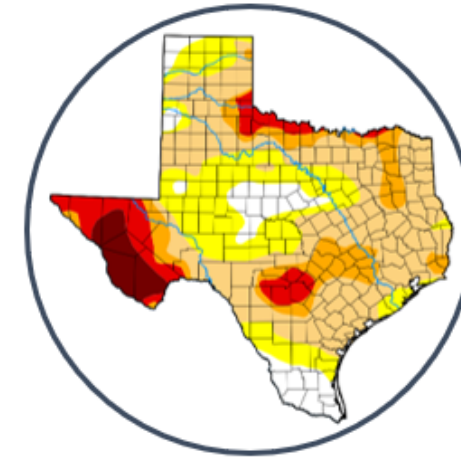
How to Determine Stream Type



Maps and Geographic
Information Systems
(GIS)



Historical Knowledge



Time of Year/Current
Weather Patterns

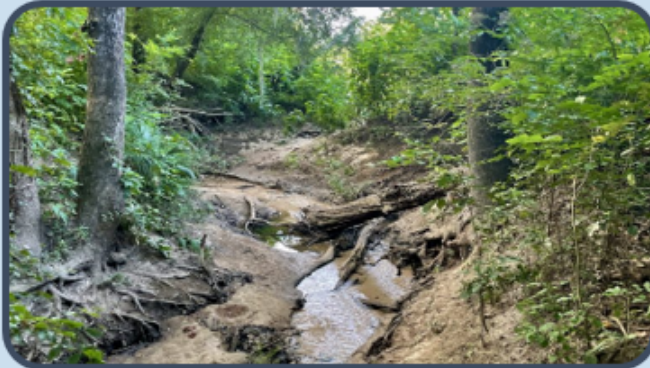


Stream Types



Perennial

- **Flows 90% of the time during a normal year**; may pool up or dry during drought years
- Well-defined channels in a **serpentine pattern**
- **Little to no vegetation growing in the channel**
- May have visible aquatic insects and wildlife present



Intermittent

- **Flow 30-90% of the time during a normal year**; may pool up or dry during summer months
- Well-defined channels usually in a **serpentine pattern**
- **Some growing vegetation may be present in the stream channel**



Ephemeral

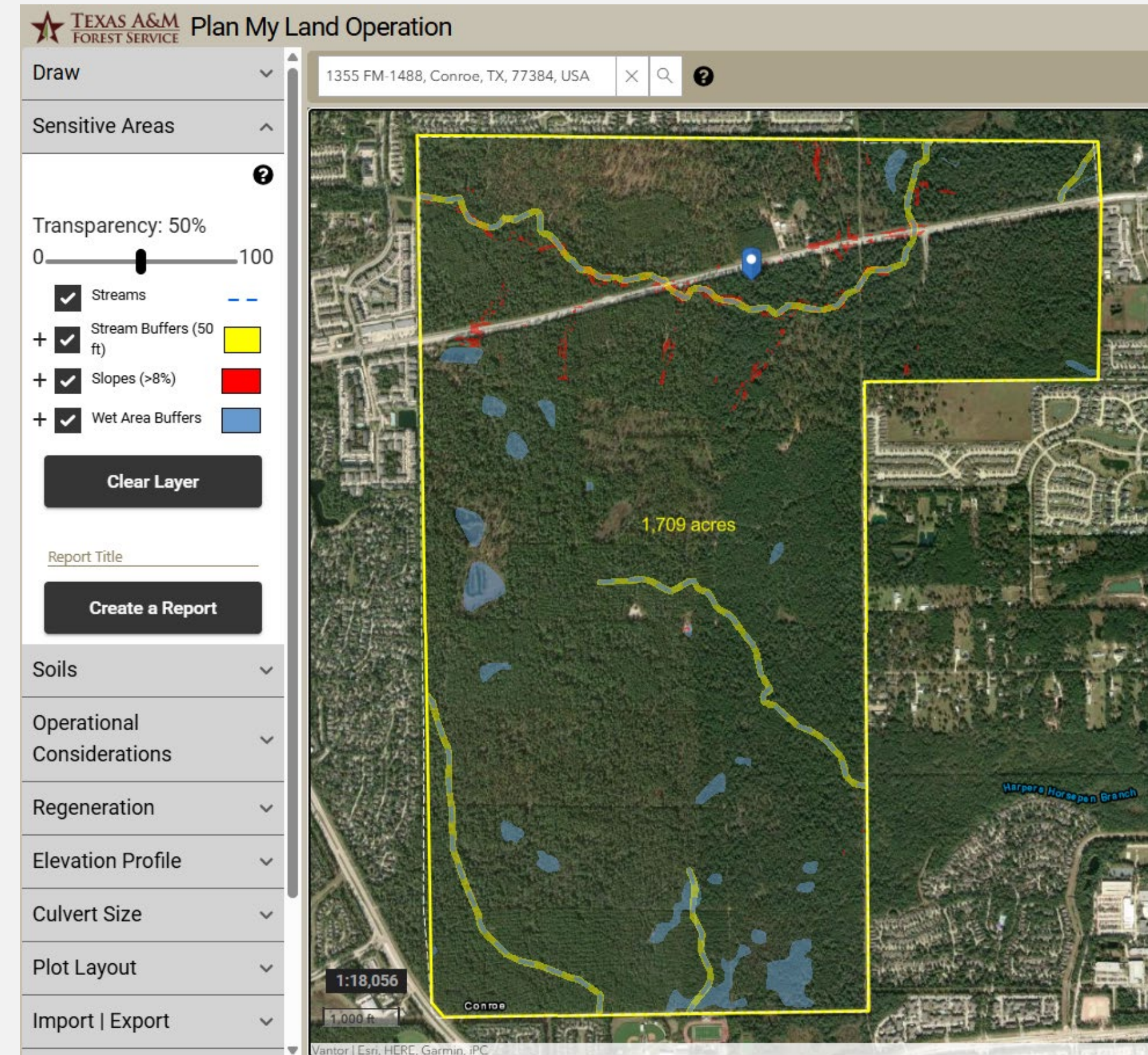
- **Flow less than 30% of the time during a normal year**, usually immediately after rain events or shortly thereafter
- May or may not have well-defined channels; **channel is primarily straight**
- Growing vegetation may be present in the stream channel



Know Your Land

Plan My Land Operation

- Identify property boundaries or upload shape file
- Identify sensitive areas
 - Adjustable parameters



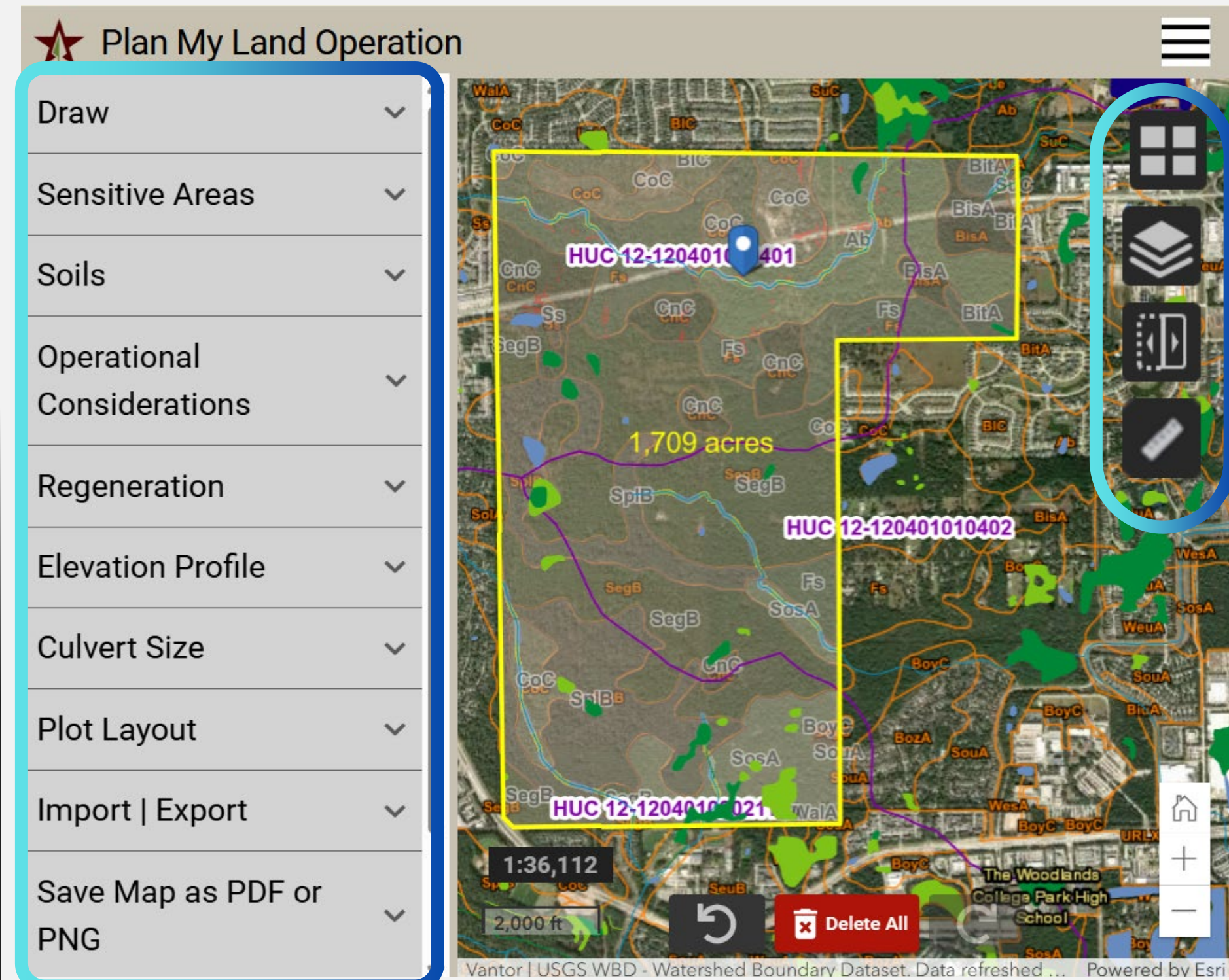
A map of the W.G. Jones State Forest (Conroe, Texas) made using *Plan My Land Operation*, identifying sensitive areas.



Know Your Land

Plan My Land Operation

- Multiple map layers available
- Layers for *City Boundaries, Weather Outlooks, Watersheds and Wetlands*
- Side-by-side comparison tool
- Measurement tool



A screenshot of a map of the W.G. Jones State Forest (Conroe, Texas), highlighting additional PMLO features.





TreeScale Stewardship

*Improving water quality
with forestry and tree
BMPs at the property level*

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Individual Tree BMPs

Quality of trees is just as (if not more) important than **quantity** for ecosystem benefits.



Plan for installation of utility structures



Plant trees properly to ensure longterm health



Avoid improper mulching (i.e. mulch volcanoes)



Avoid compaction of soil in tree drip zone



Tree Selection

Need help finding the right tree for your property? Visit the *Texas Tree Planting Guide* for a custom tree selector tool, tree planting and care tips.



Right Tree, Right Place

Before planting, consider:

- Estimated **mature tree height** and **canopy width**
- Proximity to utility lines, safety signs, buildings, etc.
- Tree growth conditions such as water and light requirements



Topped trees for line clearance.
(Joseph OBrien, USDA Forest Service, Bugwood.org)



Tree Planting BMPs

Set Up for Success

- Keep root flare above grade
- Remove temporary nursery stakes, ties, etc.



The best time to plant trees in Texas is **between Halloween and Valentine's Day**, when trees are dormant.

Texas Arbor Day is the first Friday in November.

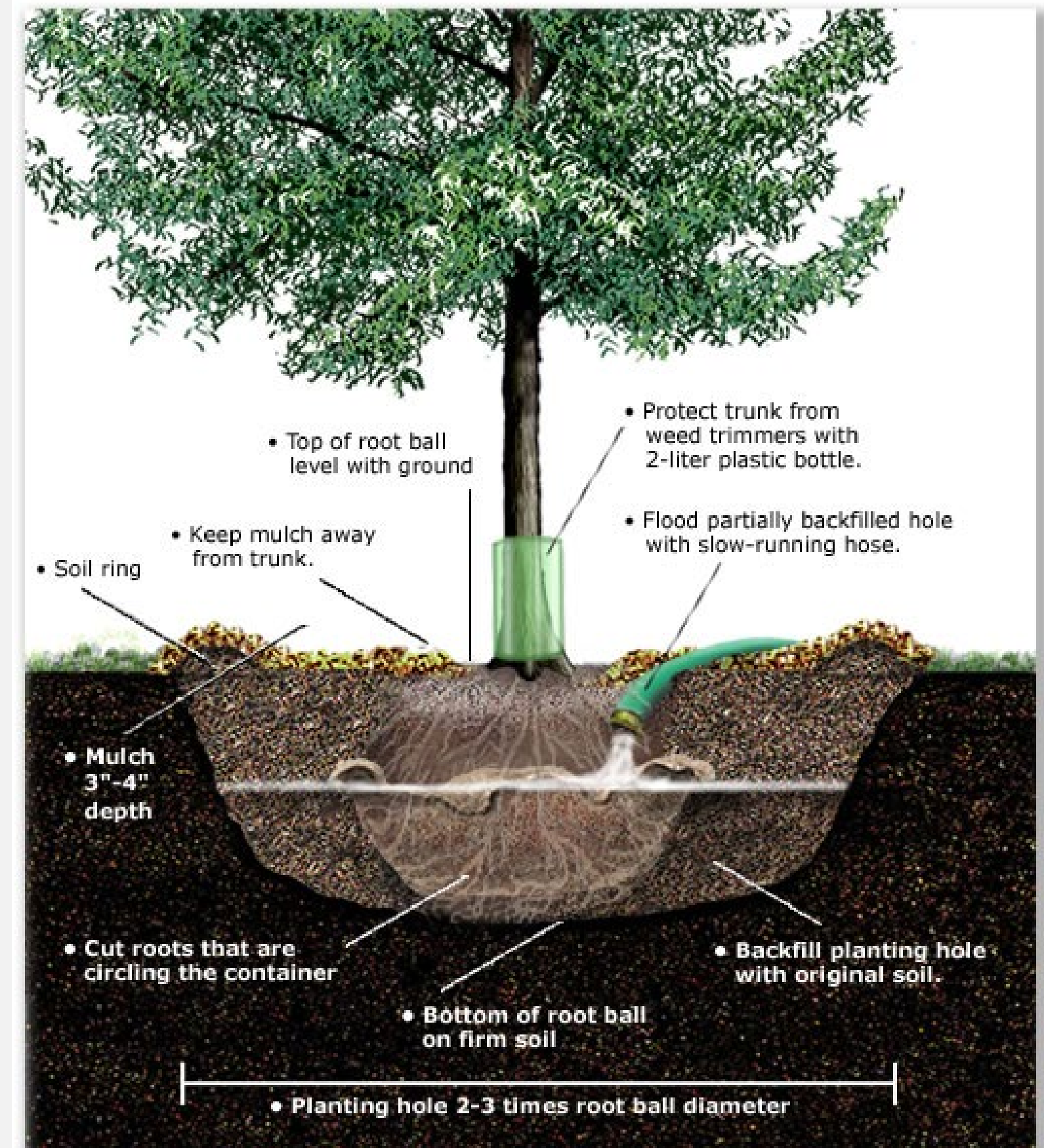


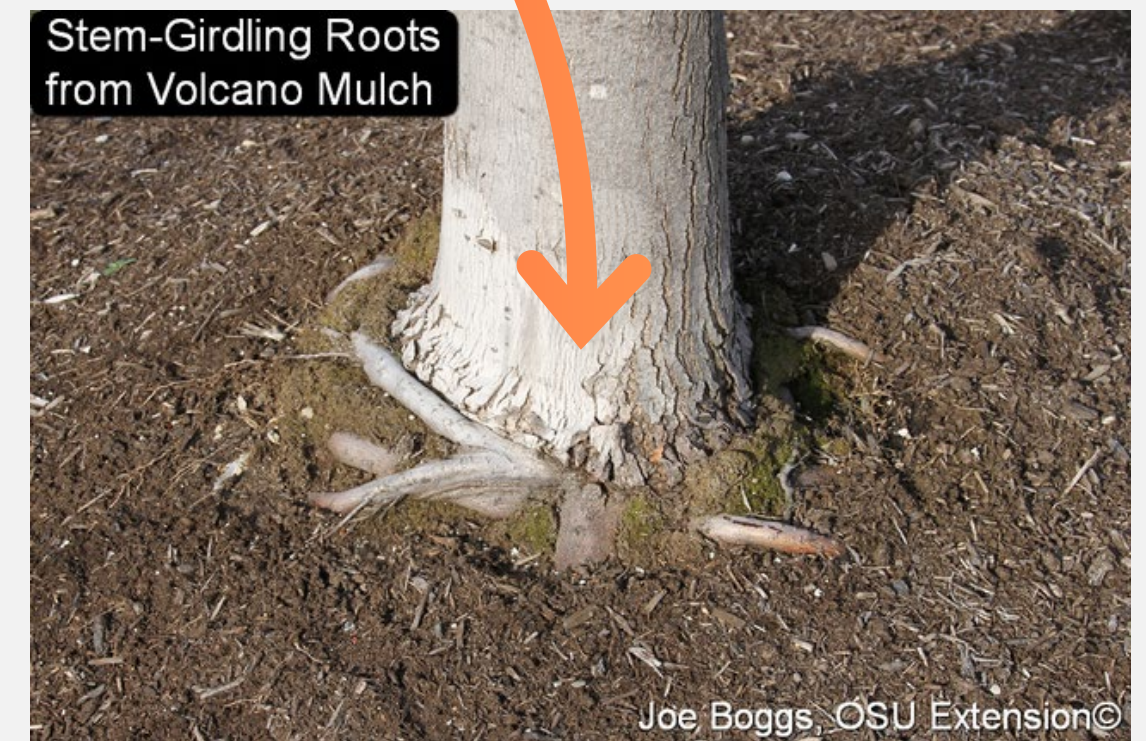
Illustration Copyright © Robert O'Brien



Mulching Trees

Do “Donut”

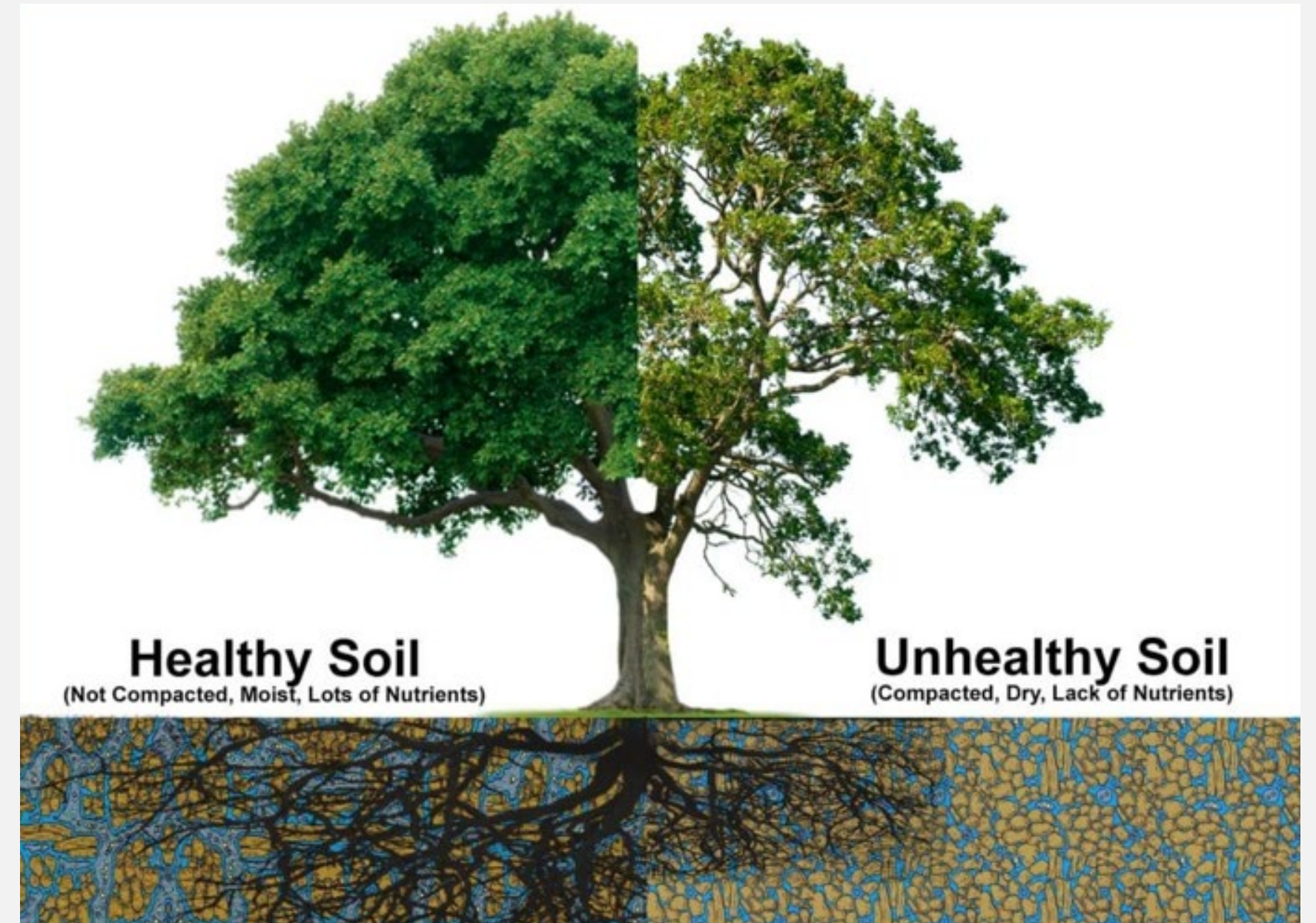
- Mulch should **never** touch the tree trunk
- Improper mulching encourages pests and slowly kills the tree



Prevent Soil Compaction

Soil is a Sponge

- Limit disturbance (**construction**) in the root zone
- Compacted soils destroy macropores, reducing air and water percolation
- Compacted soils limit root growth



Prevent Soil Loss

DIY Erosion Mitigation

Hill Country Alliance's
*Hillside Stewardship
Guide* details how to
construct various small-
scale erosion-mitigation
measures

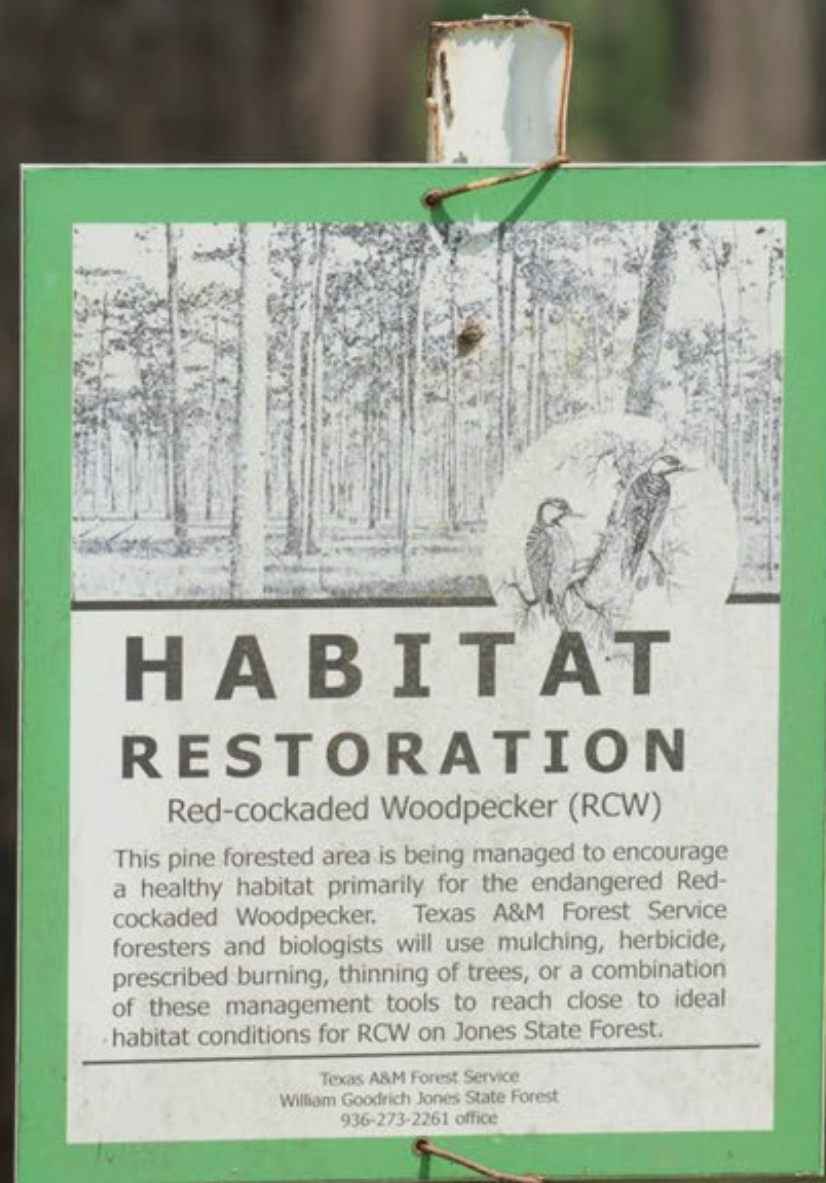


Above: Repurposed
brush to slow runoff and
catch sediment

Below: Log and
rocks to correct
channelization



Restoration Scale Stewardship



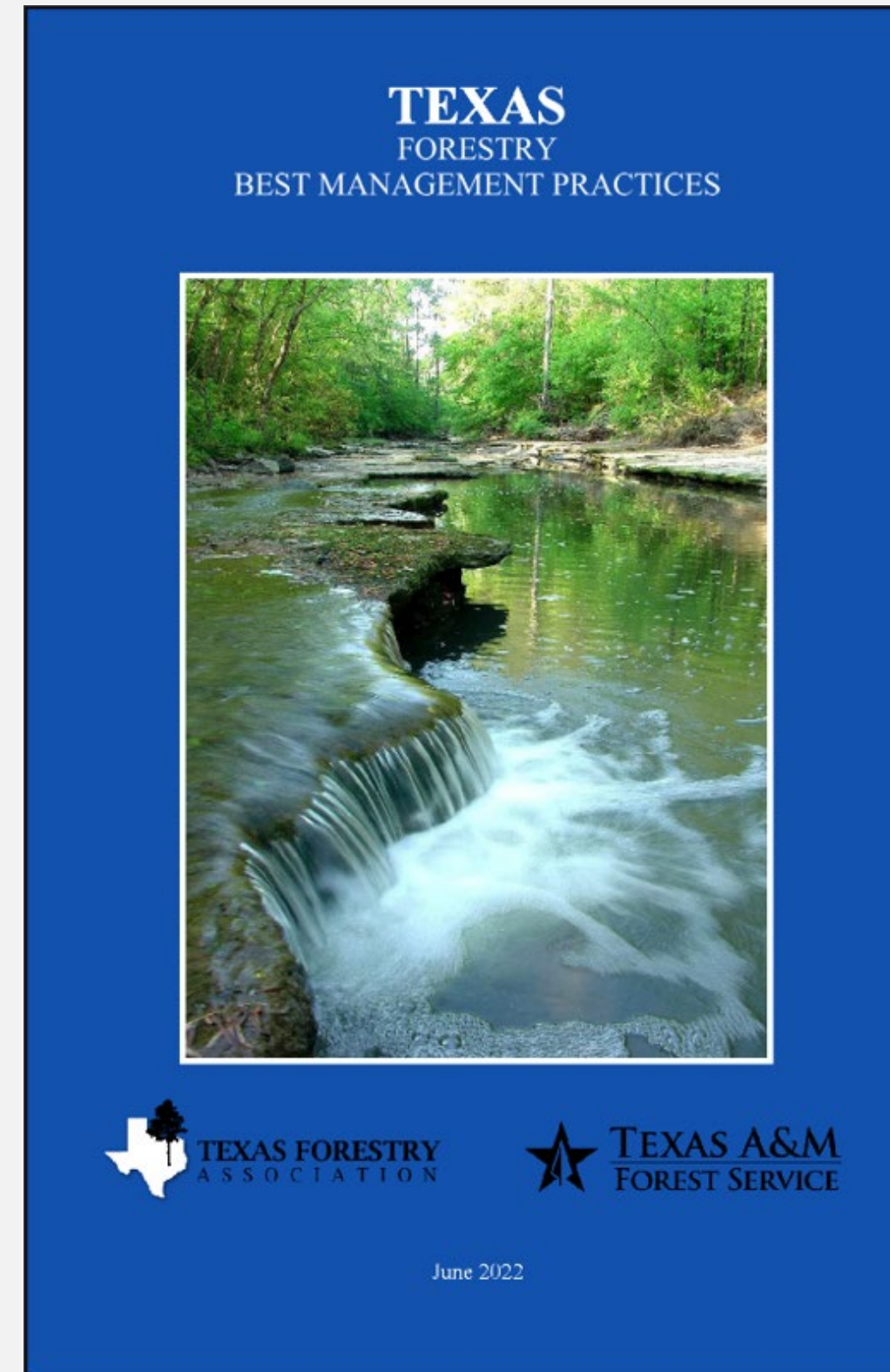
*Improving water quality
with forestry and tree
BMPs at restoration scale*

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Texas Forestry BMPs

The 'Blue Book'

- Designed to protect water quality during and after forest management activities
- Though originally developed for silvicultural operations, Forestry BMPs have a **wide range of applications** in urban forestry and riparian restoration



Blue Book PDF



BMP App



Riparian Buffers

- Prioritize preservation and restoration of the **riparian area**, especially **riparian buffers** (also called streamside management zones, or SMZs)
- Buffer width varies with topography, soil type, etc., but ideally should be **at least 50 ft wide on each side** of the stream



Stabilize
soil

- Slow overland flow of runoff
- Reduce rainfall impact
- Decrease sediment entering stream

Provide
shade for
streams

- Prevent water temperature increases
- Keep ideal concentrations of dissolved oxygen present

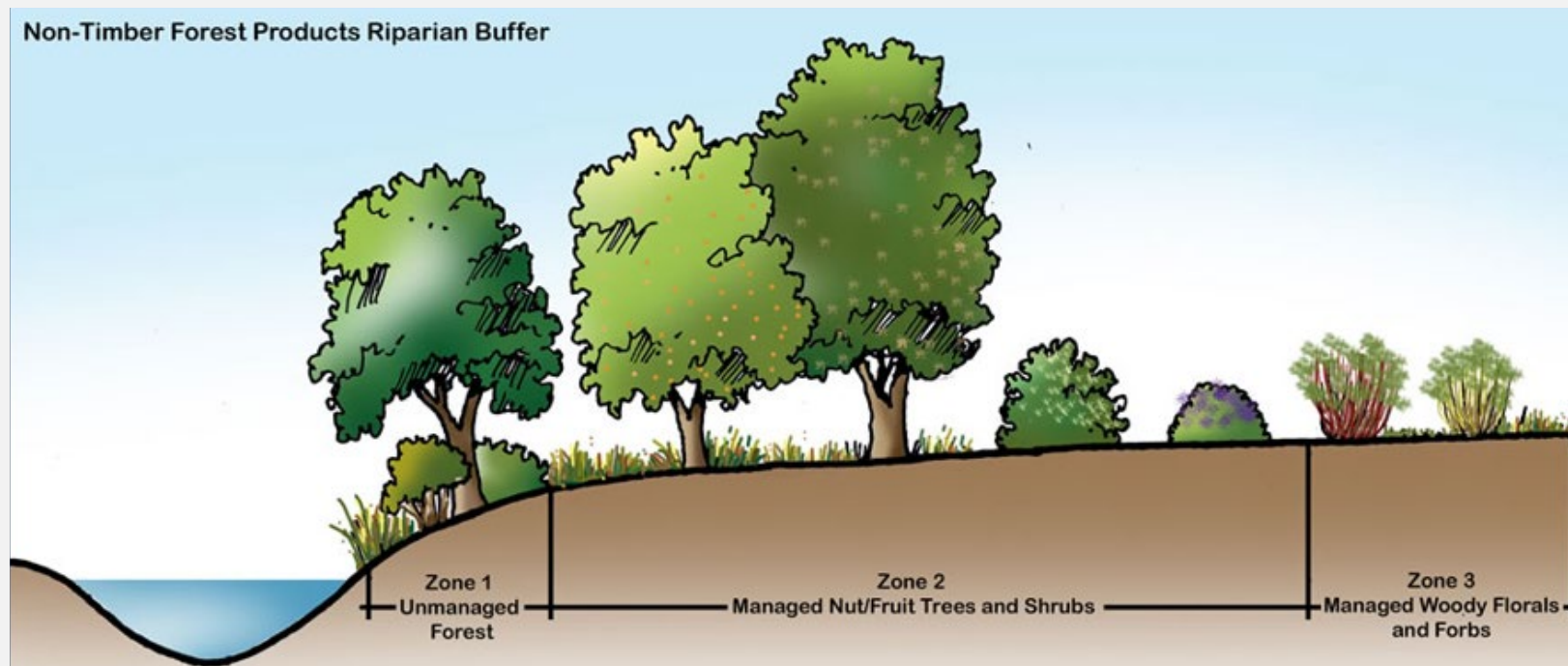
Create
wildlife
habitat

- Habitat diversity
- Wildlife corridors
- Food

Cotton Bayou Implementation Plan Management Measure: *Manage/protect riparian corridors.*



Riparian Buffer Zones



(U.S. Forest Service)

Cotton Bayou Implementation Plan Management
Measure: *Develop stormwater/riparian
demonstration project.*

Zone I

- Adjacent to stream
- Native trees, shrubs, forbs adapted to floodplains
- **Obligate Wetland (OBL), Facultative Wetland (FACW) plants**

Zone II

- 4-5 rows of trees
- **Fast growing** riparian trees, higher-value hardwoods and shrubs
- **Facultative (FAC) plants**

Zone III

- Grass zone, next to cropland
- Native grasses
- **Facultative Upland (FACU), Obligate Upland (UPL) plants**



Establishing Riparian Buffers

- Protect young trees from herbivory
 - Tree tubes, cages
- Reduce competition
 - Selective mulching, mowing, thinning, or herbicide application until trees have established

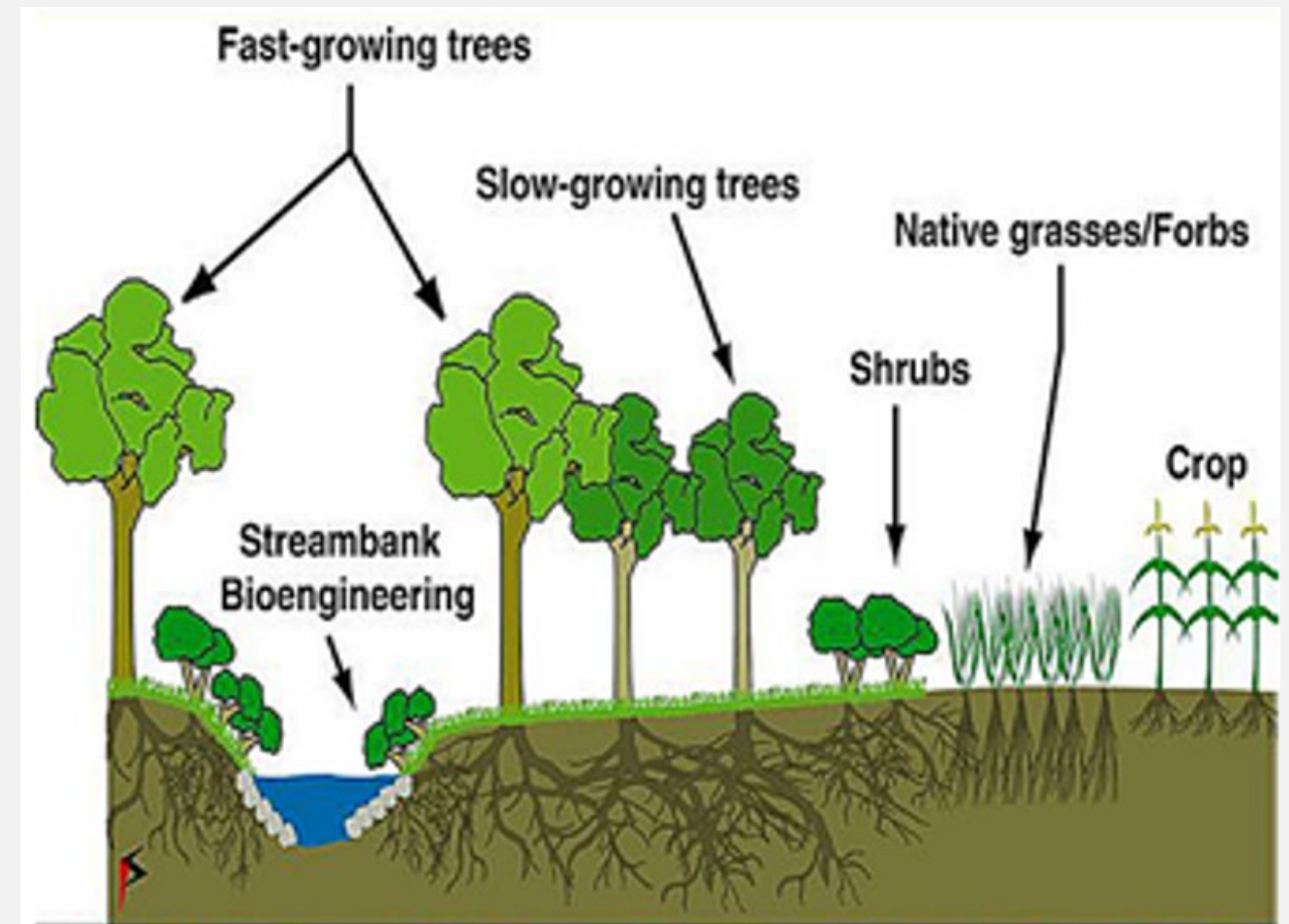
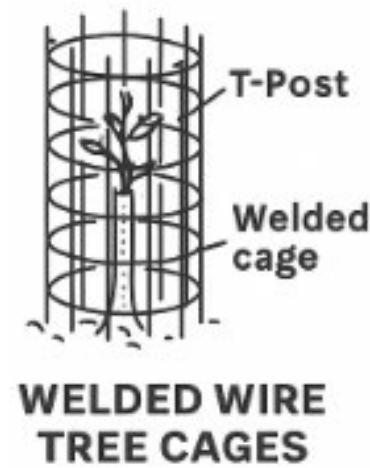
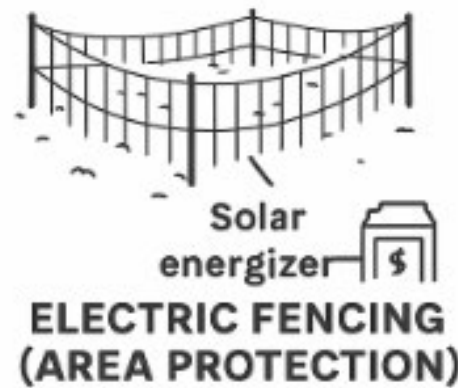


Figure 4: Selecting the appropriate species for a riparian buffer will help ensure its success and longevity. Source: North American Agroforestry, Third Edition. Edited by Garrett, Jose, and Gold. American Society of Agronomy, Inc. 2022. Chapter 8



Getting to the Stream Road BMPs

Water Bars and Wing Ditches

- Can be constructed on roads , trails
- Designed to **slow the flow** of water and **direct water offroad** into vegetated areas
- Runoff control structures **should not discharge directly into streams**
- Construct roads **along contour** when possible



Properly constructed wing ditch with water bar directing flow.



Getting to the Stream Road BMPs

Minimize Soil Compaction

- Avoid operating machinery on saturated soils
- Use wide-tire equipment to disperse force
- Use geo-textile or geo-grid fabric, boards/wooden mats to increase soil bearing capacity

Severe rutting which has altered drainage patterns.



Getting to the Stream Road BMPs

Only Cross When Necessary

- **Never use dirt crossings**
 - Alters or impedes flow of water
 - Causes excess sedimentation
- Cross at **right angle** where **bank is even** and stream **channel is straight**

Permanent
Bridge



Culvert
Crossing

Low-water
Crossing



Prescribed Burns

Learn about prescribed fire grants
offered by the Texas A&M Forest
Service.



Playing with Fire

Site prep burns are often the most severe (hottest), with greatest potential for **increased surface runoff** and **soil erosion**

- Avoid burning along steep slopes or on highly erodible soils
- Use water control structures on firebreaks



A Texas A&M Forest Service wildland firefighter assists with a controlled burn.





Community Scale Stewardship

*Improving water quality
using forests and trees at
the watershed level*

CONSERVE. PROTECT. LEAD.

Watershed-scale Stewardship

What can I do?



Watershed-scale Stewardship

Use **best management practices**

Steward your land

Advocate for **green spaces**

Volunteer your
time and expertise

Get engaged!

Spread the word

Participate in **Watershed Protection
Plan** development

Implement **Conservation
Easements**



Cotton Bayou Implementation Plan Management
Measure: *Support voluntary adoption of [...] conservation management plans.*

We're Here to Help

- Forest technical assistance
- Five- to ten -year stewardship plans
- Land management and forest health questions
- Financial assistance
- Education and outreach



Protect Your Land

Use the Texas Land Trust Council's *Texas Land Trust Directory* to search for land trusts serving you.



Conservation Easements

- Transfers of some property rights (usually related to development) **without removing the property from private ownership**

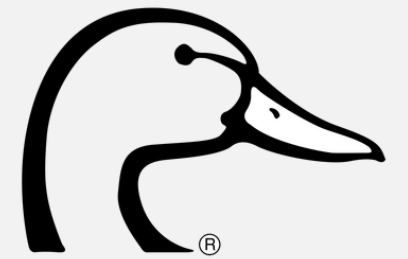


Learn more about the Agency's *Forest Legacy* program, which preserves working forestland.



TEXAS
LAND TRUST
COUNCIL

The Nature
Conservancy



DUCKS
UNLIMITED



GALVESTON BAY
FOUNDATION



Coastal
Prairie
Conservancy
Formerly Katy Prairie Conservancy



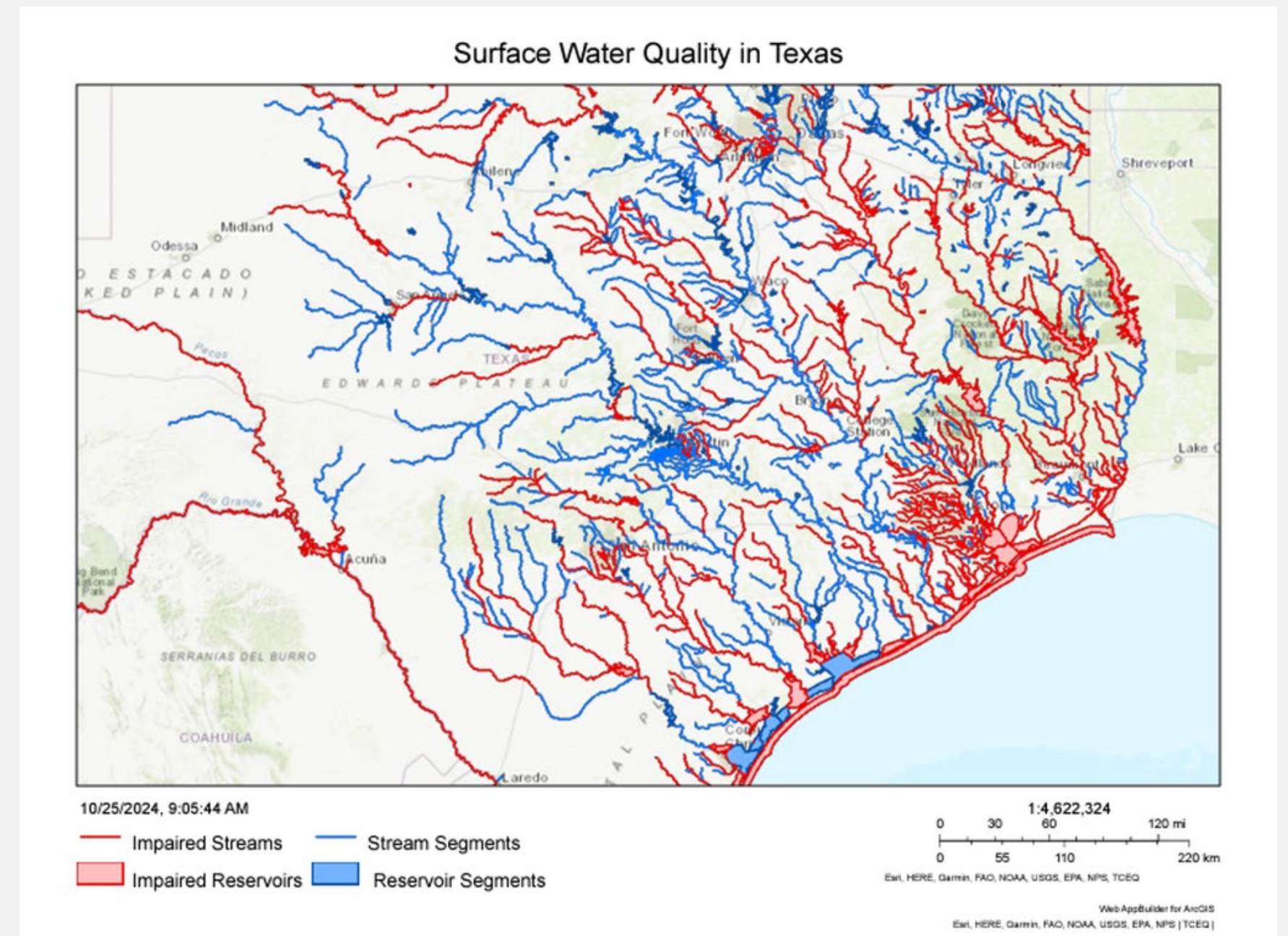
Represent Your Community

Watershed Protection Plans

- Stakeholder -developed plans to address and mitigate water impairment
 - Scientific assessments, local knowledge, community partnerships



The Houston-Galveston Area Council (HGAC) is the facilitator for Greater Houston WPPs



Advocate for Best Practices

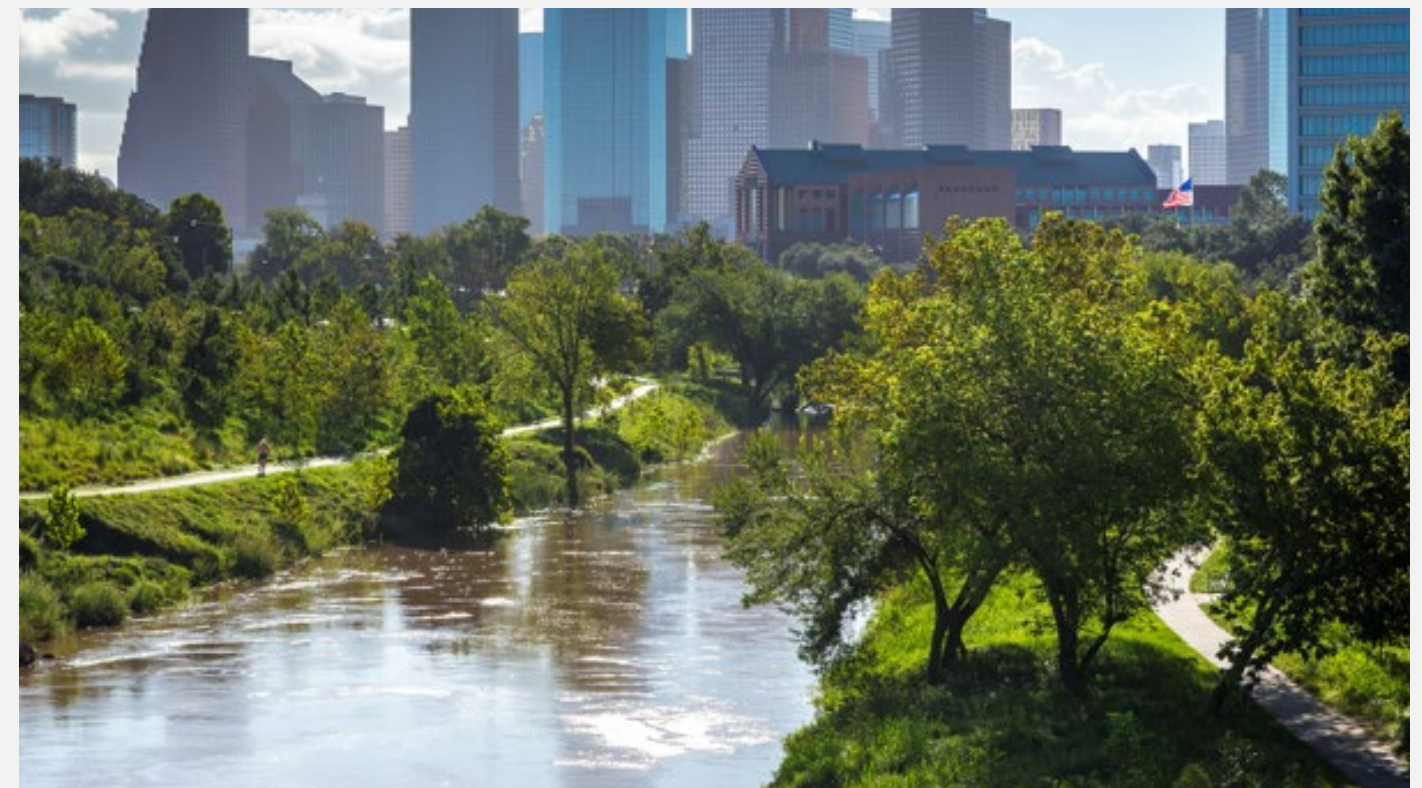
Let It Flow

- Embrace **natural structure and function** of streams
- Retain **ecosystem benefits**
- Preserve natural beauty while creating **recreation spaces**

A channelized section of Brays Bayou (top) vs. riparian buffer along Buffalo Bayou (bottom), both in Houston, Texas.



VS



Support Your Local Green Space

Green Spaces are Flood Infrastructure



HARRIS COUNTY PRECINCT 4
COMMISSIONER
LESLEY BRIONES

Archbishop Joseph Fiorenza Park in Houston, a constructed wetland linking two detention ponds along Brays Bayou.



A map of Houston Parks Board's *Bayou Greenways* project, linking recreational greenspaces along the bayou system.



Contact

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Learn More



Texas A&M Forest

Service Homepage



Agency Water

Resources Program



Texas Forest

Information Portal

