Forest Action Plan

A comprehensive analysis of forest-related conditions, trends, threats, and opportunities in Texas and a strategy to address them

Texas A&M Forest Service

December 2020

Amended July 2021

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Produced by

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Acknowledgements & Contributions

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Abbreviations Used

AgriLife	Texas AgriLife Extension Service
AMO	Atlantic Multi-Decadal Oscillation
AON	Assessment of Need
BLM	Bureau of Land Management
BMP	Best Management Practices
CARS	Community Accomplishment Reporting System
CCX	Chicago Climate Exchange
CFAA	Cooperative Forestry Assistance Act
CFLA	County Forest Landowners Association
CTCP	Central Texas Conservation Partnership
CWPP	Community Wildfire Protection Plan
EOC	Emergency Operations Center
EPA	Environmental Protection Agency
FEMA	Federal Emergency Management Agency
FEPP	Federal Excess Personal Property
FIA	Forest Inventory Analysis
FLP	Forest Legacy Program
FMAG	Fire Management Assistance Grant
FRD	Forest Resource Development
FRP	Forest Resource Protection
FSP	Forest Stewardship Program
GIS	Geographic Information System
GLO	Texas General Land Office
ICS	Incident Command System
IFRA	Important Forest Resource Area
IMT	Incident Management Team
IPCC	Intergovernmental Panel on Climate Change
ISA	International Society of Arboriculture
MOU	Memorandum of Understanding
NASA	National Aeronautics and Space Administration
NASF	National Association of State Foresters
NFGT	National Forests and Grasslands of Texas
NGO	Non-Government Organization
NIMS	National Incident Management System
NIPF	Non-Industrial Private Landowner
NLCD	National land Cover Database
NPS	Nonpoint Source Pollution
NRCS	Natural Resource Conservation Service
NUCFAC	National Urban and Community Forestry Advisory Committee
NWCG	National Wildfire Coordinating Group
PDO	Pacific Decadal Oscillation
PLT	Project Learning Tree
PSF	Permanent School Fund
PTAD	Property Tax Assistance Division
RAWS	Remote Automated Weather Station
REIT	Real Estate Investment Trust
RIMT	Regional Incident Management Team
RVFDA	Rural Volunteer Fire Dept. Assistance Program
S&PF	State & Private Forestry
SADL	Spatial Accomplishment Data Loader
SAP	Spatial Analysis Project
SFLA	Southern Forest Land Assessment
SGSF	Southern Group of State Foresters
SIP	State Implementation Plan
SMZ	Streamside Management Zone
SPB	Southern Pine Beetle
SRS	Southern Research Station
SSCC	State Stewardship Coordinating Committee
SouthWRAP	Southern Wildfire Risk Assessment
SGCN	Species of Greatest Conservation Need
SMART	Stewardship Mapping and Reporting Tool
SSURGO	Soil Survey Geographic Database
SWFRA	Southern Wildland Fire Risk Assessment
TAMU	Texas A&M University
TAMUS	The Texas A&M University System
TCAP	Texas Conservation Action Plan
TCEQ	Texas Commission on Environmental Quality
TDEM	Texas Division of Emergency Management
TFA	Texas Forestry Association
TAMFS	Texas A&M Forest Service
TICC	Texas Interagency Coordination Center
TIFMAS	Texas Intrastate Fire Mutual Aid System
TIMO	Timberland Investment Management Organization
TLTC	Texas Land Trust Council
TPWD	Texas Parks & Wildlife Department
TSSWCB	Texas State Soil & Water Conservation Board
TxWRAP	Texas Wildfire Risk Assessment
TWAP	Texas Wildlife Action Plan
TWDB	Texas Water Development Board
TWPP	Texas Wildfire Protection Plan
U&CF	Urban and Community Forestry
UAV	Unmanned Aerial Vehicle
UFORE	Urban Forest Effects
USDA	U.S. Department of Agriculture
USACE	U. S. Army Corps of Engineers
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Services
UWI	Urban Wildland Interface
VFA	Volunteer Fire Assistance
VFD	Volunteer Fire Department
VOC	Volatile organic compound
WIRES	Wildfire Incident Response System
WGFTIP	Western Gulf Forest Tree Improvement Program

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FROM THE STATE FORESTER AND DIRECTOR OF TEXAS A&M FOREST SERVICE

Tom Boggus
State Forester & Director

The year 2015 marked the 100th anniversary of Texas A&M Forest Service. As we embark on the next century of service to Texas, our state looks much different than it did when we started. There are 27 million Texans, and approximately 1,000 more move here every day; Texas is one of the fastest urbanizing sates in the nation and is also in the top three for most natural disasters. This is why every person and every program of this agency is aimed at building the capacity of others. To do this effectively, the agency must lead in a thoughtful, strategic direction. The Forest Action Plan for Texas incorporates significant employee and stakeholder input, closely aligns resource allocation with strategic priorities, and supports the vision of the agency's preferred future.

Mission Statement

Texas A&M Forest Service provides statewide leadership to assure the state's trees, forests and related natural resources are protected and sustained for the benefit of all.

Vision

Conserve

Texas A&M Forest Service will ensure the state's forests, trees and related natural resources are conserved and provide a sustainable flow of environmental and economic benefits today and for future generations.

Protect

Texas A&M Forest Service will be the lead agency for the state for all-hazard responses, including the suppression of wildfires and the management of state disasters.

Lead

Texas A&M Forest Service will employ and depend upon a dedicated, well-trained workforce of leaders. We will be recognized as "standard-setters," because many agency employees are selected for key leadership positions in local, state, and national organizations.

INTRODUCTION

The Cooperative Forestry Assistance Act (CFAA) of 1978, as amended by each Farm Bill, provides the authority for a broad range of State and Private Forestry (S&PF) programs of the United States Department of Agriculture (USDA) Forest Service (USFS). In 2007, the USFS worked closely with the National Association of State Foresters (NASF) to conceive and develop a new approach for delivering these S&PF programs. The purpose of this effort was to shape and influence the use of forestland to optimize benefits from trees and forests for both current and future generations.

Three national themes were established to guide S&PF program delivery:

- Conserve working forest landscapes
- Protect forests from harm
- Enhance public benefits from trees and forests

The 2008 Farm Bill codified this approach in the CFAA and required states to develop Forest Action Plans. These plans include both an *assessment* of forest conditions and trends within the state and a *strategy* for addressing the issues, threats, and opportunities facing these forests. In the initial Texas Forest Action Plan (2010), the assessment and strategy were produced as separate documents. In 2015, the strategy was reviewed and updated. In this current 2020 update, the two documents have been combined into one.

The *statewide assessment of forest resources* helps ensure that S&PF resources are being focused on high priority areas with the greatest opportunity to achieve meaningful outcomes. States, tribes, and islands work collaboratively with the USFS and other key partners to conduct a comprehensive analysis that:

- Describes forest conditions on all ownerships in the state
- Identifies forest-related benefits and services
- Identifies threats to the forest resources
- Highlights issues and trends of concern as well as opportunities for action
- Delineates high priority forest landscapes to be addressed
- Utilizes the best available data and is geospatially based

The *forest resource strategy* was developed on the basis of the state assessment by identifying landscapes and projects where an investment of federal competitive grant funding could most effectively accomplish goals or leverage desired action. In order to receive federal funding under the S&PF Landscape Scale Restoration Program, projects must follow the annual national direction developed by the USFS, directly address one or more of the three National Themes, and align with the respective state Forest Action Plan.

The Southern Group of State Foresters (SGSF) and USFS Southern Region have identified the following common set of regional priority issues or opportunities that southern states may want to consider collectively while guiding their own assessment process:

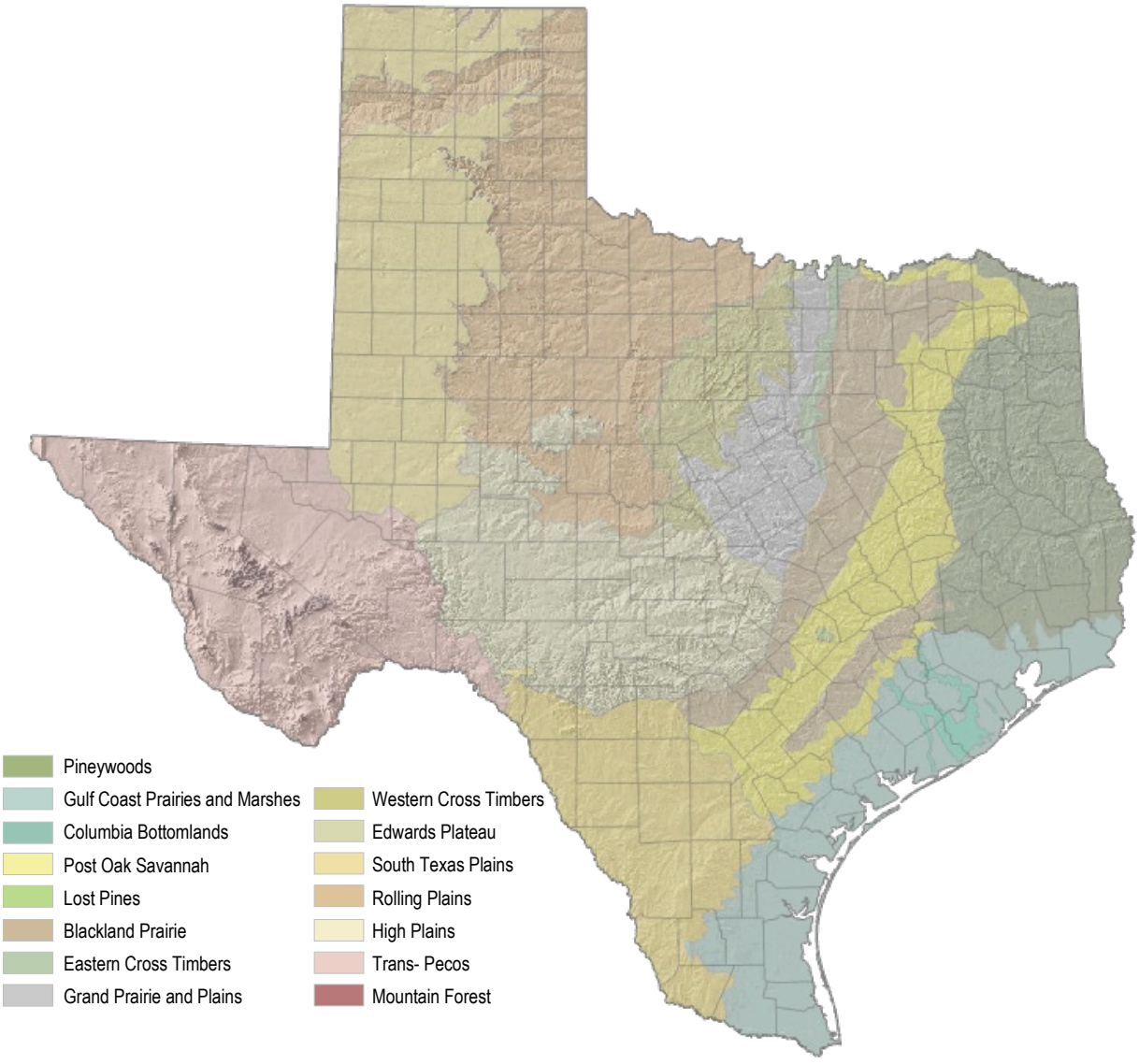
- Significant forest ecosystems and landscapes
- Urbanization, fragmentation, and loss of forestland
- Fire
- Forest health
- Water quality protection and watershed management
- Wildlife habitat and species conservation
- Forest resource market opportunities

CONDITIONS AND TRENDS

Texas Ecoregions

Texas is a vast and diverse state with areas that are like both Georgia to the east and Arizona to the west. There are nine primary ecoregions as defined by Level III Ecoregions of the Environmental Protection Agency (EPA) (Figure 1).

Figure 1
Texas Ecoregions as Defined by a Slight Modification of EPA's Level III Ecoregions to Emphasize Forested Areas †



† This map is a version of the EPA's Level III Ecoregions modified to emphasize forested regions that are not delineated by Level III Ecoregions. The Cross Timbers and Prairies ecoregion has been subdivided to include several, but not all, of EPA's Level IV ecoregions. Also, the Lost Pines, Mountain Forest, and Columbia Bottomlands regions have been added. Two Level III ecoregions were combined to form the Rolling Plains. Most of the descriptions of the various ecoregions were taken from the *Plant Guidance by Ecoregions* web pages maintained by the Texas Parks and Wildlife Department. Also, some of the Level III names were changed to more closely agree with common terminology used in Texas.

Pineywoods

The Pineywoods (aka *Western Gulf Coastal Plain*) of East Texas is the western extension of the Southern Pine Region. It ranges from gently rolling hills to flatwoods and receives between 35 and 55 inches of rain each year. About half of the region is forested and is where most commercial forestry operations occur in the state. These rich timberlands contain not only southern pine—loblolly (Figure 2), shortleaf, and longleaf—but a diverse mixture of upland and bottomland hardwoods common to the rest of the South.

Figure 2
Loblolly Pine Stands in the Pineywoods Support Wood Product Industries, Wildlife, Recreation, Watersheds, and Other Desirable Resources

Gulf Coast Prairies and Marshes

The Gulf Coast Prairies and Marshes is a narrow band about 60 miles wide along the coast of Texas. It is a nearly level, slowly-drained plain dissected by streams and rivers that flow into highly productive estuaries and marshes. The region receives between 20 and 50 inches of annual rainfall.

Columbia Bottomlands

The Columbia Bottomlands contain mixed hardwood forests stretching across the floodplains of three rivers—Colorado, San Bernard, and Brazos—and their associated floodplains. This region occurs in portions of Brazoria, Fort Bend, Matagorda, and Wharton counties. Tree species found here include green ash, honeylocust, hickory, Carolina laurelcherry, American beech, and pecan.

Post Oak Savannah

Immediately west of the Pineywoods is the Post Oak Savannah (aka *East Central Texas Plains*) that emerges almost imperceptibly with subtle changes in soil and vegetation. This gently rolling to hilly land receives annual rainfall of 35 to 45 inches. The Post Oak Savannah is punctuated by

scattered oaks—mainly post oak (Figure 3). Elm, sugarberry, eastern redcedar, and persimmon are also widespread. This scattering of trees among the grassland gives the landscape a very park-like appearance and was especially attractive to early settlers. Today the region is mostly improved pasture with vast acreages seeded to Bahiagrass and bermudagrass.

Figure 3
The Post Oak Savannah is Characterized by Woodlands of Post Oak, Elm, and Other Hardwoods, Interspersed with Farms and Pastures

Lost Pines

The Lost Pines is actually a part of the Post Oak Savannah but is similar to the Pineywoods in that it is the westernmost extension of the native range of loblolly pine. Being the westernmost extension, the pines growing here are more tolerant of drought than those in the Pineywoods. The distinctive sandy soils of the Lost Pines harbor one of the last refuges for the endangered Houston toad.

Blackland Prairie

The fertile, dark clay soils of the Blackland Prairie (aka *Texas Blackland Prairies*) are some of the richest soils in the world. These gently rolling to nearly level grasslands are just west of and, in some cases, surrounded by the Post Oak Savannah. Pecan, cedar elm, various oaks, and hackberry dot the landscape with mesquite invading in much of the area. Today less than half of the original area remains in true prairie condition as much of it is plowed for crops. Annual rainfall is between 30 and 40 inches.

The Cross Timbers and Prairies

This region includes Grand Prairie and the Lampasas Cut Plains with the Cross Timbers to the east and to the west. It is characterized by alternating bands of woodlands scattered throughout a

mostly prairie region. Annual rainfall ranges between 25 inches in the west to 35 inches in the east. Texas mulberry, American elm, and Osage-orange are more common here than they are to the east. In the west, blackjack oak and live oak become more important, largely replacing post oak, a species more common to the east.

Edwards Plateau

Nearly 24 million acres dominated by Ashe juniper, live oak, and mesquite comprise the beautifully rugged, semi-arid region of the Edwards Plateau in Central Texas. The region overlays the immense Edwards Aquifer, which feeds many clear streams. Annual rainfall ranges from a meager 15 inches in the west to more than 33 inches in the east. The moist river corridors are lined with baldcypress, pecan, hackberry, and sycamore. The region is also host to spectacular wildflower displays featuring bluebonnets, Indian paintbrush, and Gaillardia (Figure 4).

Figure 4
Live Oaks and Wildflowers Abound in the Edwards Plateau Ecoregion of Central Texas

South Texas Plains

East of the Rio Grande River and south of the Balcones Escarpment lies a relatively unpopulated region known as the South Texas Plains (or South Texas Brush Country). This warm region that receives annual rainfall between 16 and 30 inches is a land of recurring drought, a factor that distinctly marks the landscape. The region owes its diversity to converging elements of the

Chihuahuan Desert to the west, the Tamaulipan thornscrub and subtropical woodlands along the Rio Grande, and the coastal grasslands to the east. The region is cut by arroyos and streams and is blanketed with low-growing, mostly thorny vegetation. Where conditions allow, a dense understory of small trees and shrubs develops, hence, the name "brush country."

Rolling Plains

The Rolling Plains is the southern extent of the great continental prairie ecosystem—the Great Plains. This region is east of the Caprock Escarpment and receives 22 to 33 inches of rainfall each year. It is gently rolling grasslands that originally included midgrass to tallgrass communities, but overgrazing has allowed mesquite, shinnery oak, and other species to invade the native prairie. Trees, such as cottonwood, are common along the waterways. The gently rolling hills and broad flats of the Rolling Plains harbor the headwaters of several Texas rivers, including the Canadian, the Colorado, the Concho, and the Red rivers.

High Plains

Like the Rolling Plains, the High Plains region is at the southern end of the Great Plains. This ecoregion is a relatively high and level plateau separated from the Rolling Plains to the east by the Caprock Escarpment. The winters here are the coldest in Texas and annual rainfall averages 12 to 21 inches. The High Plains has been described as a sea of waving grasslands and is composed of shortgrass prairie vegetation. Mesquite and yucca have invaded some of the areas that were once free of trees and brush, and sand sage and shinnery oak have spread across most of the sandy lands. The once luxuriant growth of willows and cottonwoods along the Red and Canadian rivers has now been largely replaced by two introduced species, Russian olive and tamarisk, or salt cedar. Today, most of the High Plains is irrigated by the vast Ogallala Aquifer. The region's other name, "Llano Estacado," or "Staked Plains," refers to the stakes that Spanish explorers drove into the ground to help guide them across this featureless region.

Trans Pecos and Mountain Forest

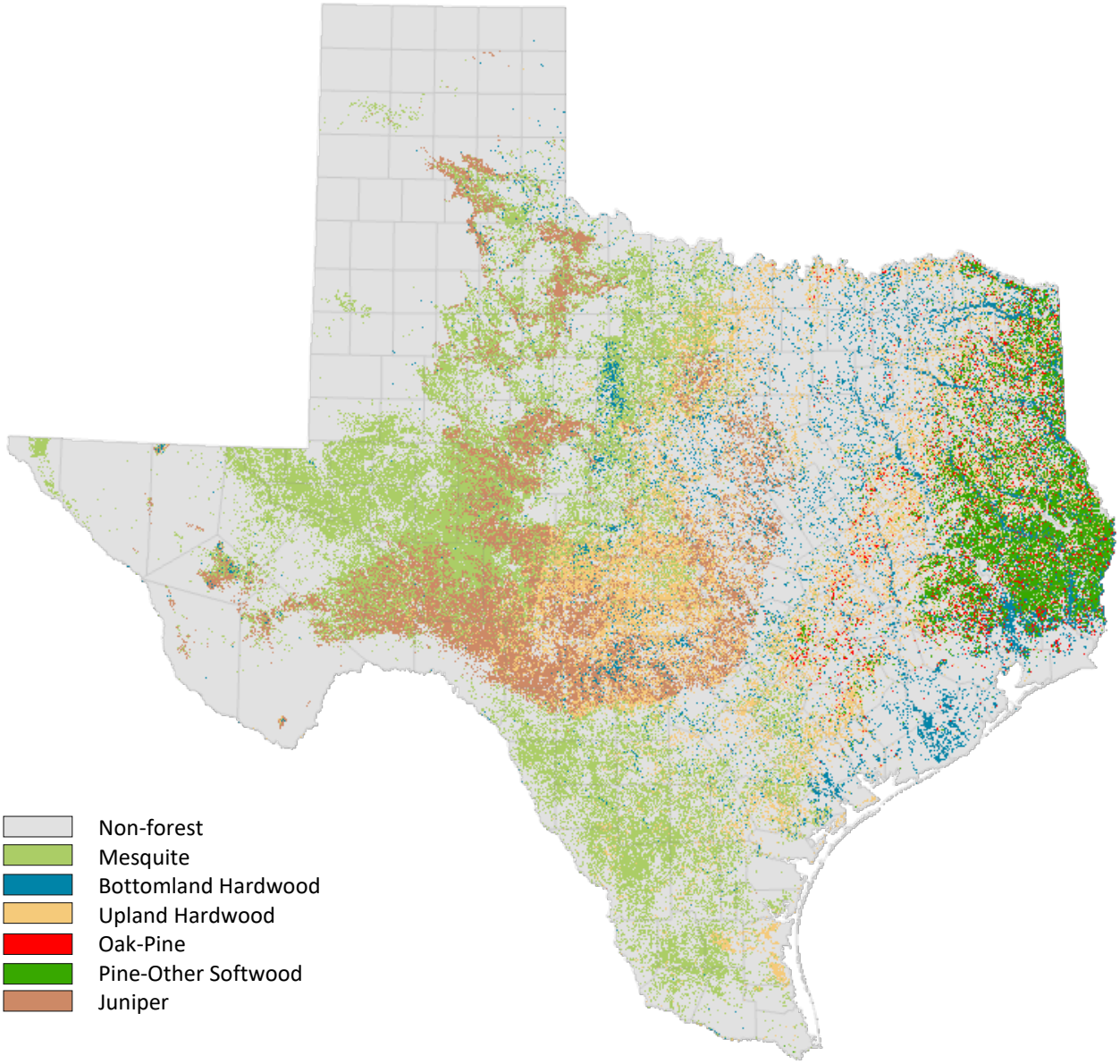
Perhaps the most spectacular ecoregion in Texas is the Trans-Pecos, offering both breathtaking landscapes and incredible biodiversity. West of the Pecos River, this region contains impressive desert grassland, desert scrub, salt basins, and rugged plateaus to wooded mountain slopes. Parts of the region are the hottest and driest of the state, with some areas receiving less than 8 inches of annual rainfall. Since precipitation increases with elevation, more of the moisture-loving plant communities are found in the mountains. Creosote-tarbush desert-scrub grasslands are the dominant features, but forests of pinyon pine, ponderosa pine, and oak intersperse these areas at the higher elevations (Figure 5).

Figure 5
The Davis Mountains, Trans Pecos Ecoregion, Support Forests of Western Juniper, Pinyon Pine, and Ponderosa Pine

Status of Forest Resources

Texas A&M Forest Service, in cooperation with the Southern Research Station of the USDA Forest Service, conducts a forest inventory to measure the status of all the forest resources in the state. The Forest Inventory and Analysis (FIA) program is the vehicle that determines the extent, growth, composition, and mortality of forests, as well as land-use changes and potential for wildfire in the state. The inventory consists of a series of permanent survey plots established in a grid pattern across the state that is remeasured every five years in the eastern 43 counties of the state and every 10 years in the central and western 211 counties. A total of 63 million acres of forest occurs across Texas (Figure 6).

Figure 6
Major Aggregated Forest Types in Texas



East Texas

An inventory of all plots in the 43-county region of East Texas (3,800 plots) was completed in June 2003. Since then, 20 percent of the plots have been remeasured annually, with each year's newly measured data incorporated into the inventory figures. The most recent inventory figures are for 2019.

Forest Area

The 43 counties of East Texas contain 22.4 million acres consisting of 12.0 million acres of forest and 9.4 million acres of non-forest land. Most forest is classified as timberland† (11.8 million acres), while a small portion is classified as productive reserved† (190,000 acres) or woodland† (9,800 acres). The net overall timberland acreage for all East Texas counties in 2007 was the highest ever recorded, showing an increase of 53,300 acres from the 2003 inventory (Table 1). Timberland area has since decreased by 142,000 acres, with conversion primarily occurring in Southeast Texas.

Table 1
Timberland Area by Survey Unit in East Texas, 1975 to 2019

Forest Survey Unit	Survey Year					
	1975	1986	1992	2003	2007	2019
	Thousand acres					
Northeast Texas	4,856	4,906	5,070	5,341	5,260	5,254
Southeast Texas	6,806	6,665	6,703	6,544	6,678	6,542
Total	11,662	11,571	11,774	11,885	11,938	11,796

Forest Ownership

Most timberland (6.0 million acres) in East Texas is in family forest ownership (non-industrial private), making up 50 percent of the total. Forest industry (now classified as corporate and consisting primarily of large timberland investors) follows with 4.6 million acres (37%), then national forests and other public timberlands, with 580,000 acres (5%) and 427,000 acres (4%), respectively.

Distribution of timberland ownership varies between Northeast and Southeast Texas. Family forest ownership is much higher in Northeast Texas, accounting for 3.7 million acres (70% of the region) as compared to 2.3 million acres (34% of the region) in Southeast Texas. Corporate ownership is largely concentrated in Southeast Texas, covering 3.4 million acres compared to 1.2 million acres in Northeast. Similarly, most of the public ownership (73%) occurs in Southeast Texas.

Forest Type

The predominant forest-type group in East Texas is loblolly-shortleaf pine (Figure 6), with 5.5 million acres (46% of all timberland). Next in order are oak-hickory, 2.6 million acres (22%); bottomland hardwoods, 2.2 million acres (19%); oak-pine, 1.3 million acres (11%); and longleaf-slash forest-type groups, 0.1 million acres (1%).

† Timberland is defined by the Forest Inventory and Analysis program as forestland that can produce at least 20 ft^3/ac/yr while woodland is forestland that produces less than 20 ft^3/ac/yr. Productive reserved forest is land that has been withdrawn from timber production by law (e.g. Wilderness).

Figure 6
Commercial Plantations of Loblolly Pine Have Long Dominated the Landscape in East Texas

Thirty-seven percent of the loblolly-shortleaf pine forest type (2.0 million acres) is in Southeast Texas. Most of the oak-hickory forest type (1.6 million acres) is located in Northeast Texas, which constitutes 62 percent of all oak-hickory forest type in East Texas.

Ecological Values

Healthy forests and woodlands provide a full suite of goods and services that are crucial to human well-being such as climate regulation, watershed regulation, wildlife habitat, biodiversity, recreation, and various cultural services. However, most of these services do not have established market values like forest products. Using an analysis of forests resources of the area, results of existing literature, and non-market valuation techniques, TAMFS conducted a statewide assessment of forest ecosystem services. Total value of ecosystem services provided by forests in East Texas has been estimated at $26.3 billion/year of which cultural values contribute more than 50 percent of the total (Table 2).

Table 2
Economic Value of Selected Forest Ecosystem Services

	Total Value (billion $/year) †		
Ecosystem Service	**East Texas**	**Central and West Texas**	**Texas**
Air Quality	0.1	0.1	0.2
Biodiversity	2.9	12.2	15.1
Carbon	1.1	3.3	4.4
Cultural	13.8	45.8	59.6
Watershed	8.4	4.8	13.2
Total	26.3	66.3	92.5

† *Texas Statewide Assessment of Forest Ecosystem Services: A comprehensive analysis of the regulating and cultural services provided by Texas forests. 2013. Texas A&M Forest Service.*

Central and West Texas[1]

An inventory began in January 2004 in the 211 counties not included in the East Texas inventory. There are 25,000 plot locations throughout Central and West Texas with 10 percent being measured annually since 2004. Measurements collected on these plots are identical to those on East Texas plots, with additional measurements taken to account for wildfire fuel and wildlife habitat. This expanded survey will increase knowledge of statewide issues, such as fire fuel loading, tree regeneration rates, invasive species encroachment, and overall forest health. The inventory of the West Texas plots was completed in 2013 with the first 10-year cycle. The most recent inventory figures are for 2016.

Forest Area

Based on the FIA data collected thus far, the 211 counties of Central and West Texas contain 149.5 million acres of which 49.9 million (33%) are estimated to meet the USDA Forest Service definition of forest land (10 percent crown cover or 200 seedlings per acre). Of this acreage, only 1.7 million acres are considered timberland—forestland that produces at least 20 ft^3/acre/year. The remaining 48.2 million acres are considered woodlands.

Forest Ownership

Private entities, including individuals, partnerships, or corporations, own 47.0 million acres (94%) while the remainder is owned by state and local government (2.1 million) and the federal government (708,700 acres). There are 236,000 family ownerships in this region, accounting for approximately 75% of the private ownership.

Forest Type

Mesquite woodlands (Figure 8) make up the largest percentage of forestland with an estimated coverage of 22.8 million acres (46%), followed by 10.0 million acres (20%) of oak/hickory forests, and 9.1 million acres (18%) of juniper woodlands. More than two thirds of the forestland is less than 60 years old. As more data are collected, the analysis will yield more detailed, accurate, and precise details on the forests and woodlands of this region.

Ecological Values

The many ecosystem services that forests provide in areas outside of East Texas is estimated to total $66.3 billion per year, which is 72 percent of the total value for the whole state (Table 2). Cultural value contributes more than two thirds of the total value for this region.

[1] Central and West Texas includes all area outside of the 43 counties of East Texas as designated by the Forest Inventory and Analysis (FIA) program of the USDA Forest Service.

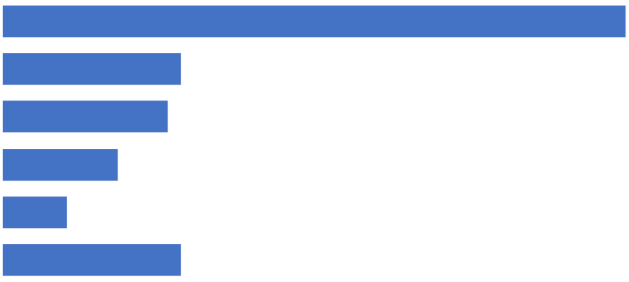
Figure 8
Mesquite Woodlands Make Up the Largest Percentage of Forestland Outside of East Texas

Forest Industry and Economics

There are currently 104 primary mills that receive roundwood in Texas (Figure 9). These include 49 sawmills, 14 post, pole, or preservative treating plants, 13 biomass or wood pellet plants, 9 plywood or oriented strand board (OSB) mills, and 5 chip or pellet mills. Between 2014 and 2018 the average timber harvest was 528 million cubic feet per year (85 percent of which was pine) having a stumpage value of $285.6 million and delivered value of $645.4 million. The timber resource has been used to produce a variety of products including 1.5 billion board feet of lumber, 2.4 billion square feet of structural panel, 2.3 million tons of pulp and paperboard, and 5.7 million green tons of mill by-product.

Figure 9
Primary Wood Processing Mills in Texas

Type of Mill	Number
Sawmill	49
Post, pole, preservative treating plant	14
Biomass, wood pellet, LOF [1]	13
Plywood, veneer, or OSB [2]	9
Paper mill or chip mill	5
Other primary industry	14
Total	104



[1] *LOF = landscape organix facility*
[2] *OSB = oriented strand board*

The Texas forest sector directly produced $18.9 billion of industry output in 2019 (Table 3). The value-added (also known as gross state product) accounted for 27 percent ($5.2 billion) of the industry output. The forest-based industry was one of the top ten manufacturing sectors in the state and the value of harvested timber ranked ninth among Texas' top agricultural commodities behind cattle and calves, broilers, milk, cotton lint, miscellaneous crops, corn, chicken eggs, and sorghum grain. The direct employment of the Texas forest sector was more than 67,000 workers with $3.8 billion in wages, salaries, and benefits in 2019.

Table 3
***Direct* Impact of Texas Forest Sector, 2019**

Sub-industry	Industry Output (million $)	Value Added (million $)	Employment (jobs)	Labor Income (million $)
Forestry	103	77	2,156	35
Logging	221	129	4,334	84
Primary solid wood products	2,493	602	6,739	417
Secondary solid wood products	6,328	2,074	36,321	1,777
Primary paper and paperboard products	2,595	595	3,131	348
Secondary paper and paperboard products	7,143	1,717	14,820	1,129
Total	**18,883**	**5,194**	**67,501**	**3,791**

The impacts of the forest sector are transferred to other sectors of the economy through subsequent household spending. Including direct, indirect, and induced effects, the Texas forest sector contributed $36.7 billion in industry output to the state economy in 2019 (Table 4). Value-added was $15.0 billion, 40 percent of the total industry output. The Texas forest sector generated over 168 thousand jobs and created $9.6 billion in labor income. On average, every dollar generated in the Texas forest sector contributes an additional 94 cents to the rest of the Texas economy. Furthermore, every job created in the Texas forest sector results in 1.49 additional jobs in the state's economy.

Table 4
***Total* Impact of Texas Forest Sector, 2019**

Sub-industry	Industry Output (million $)	Value Added (million $)	Employment (jobs)	Labor Income (million $)
Forestry	183	127	2,990	70
Logging	433	249	6,550	157
Primary solid wood products	5,194	2,081	23,143	1,291
Secondary solid wood products	12,821	5,631	73,572	3,934
Primary paper and paperboard products	5,311	2,094	17,483	1,224
Secondary paper and paperboard products	12,770	4,788	44,457	2,956
Total	**36,711**	**14,970**	**168,194**	**9,633**

The economic contribution of the Texas forest sector varies across sub-industries. Secondary solid wood and secondary paper and paperboard products were the two largest sub-industries in the Texas forest sector in 2019. The secondary paper and paperboard products sub-industry produced the largest output while secondary solid wood products produced the largest value-added output, employed the most labor force, and generated the highest labor income in the forest sector. The majority of the forest sector workforce (54 percent or 36,321 workers) was employed in the secondary solid wood products sub-industry. The secondary paper and paperboard products sub-industry employed 14,820 workers, accounting for 22 percent of the total direct employment.

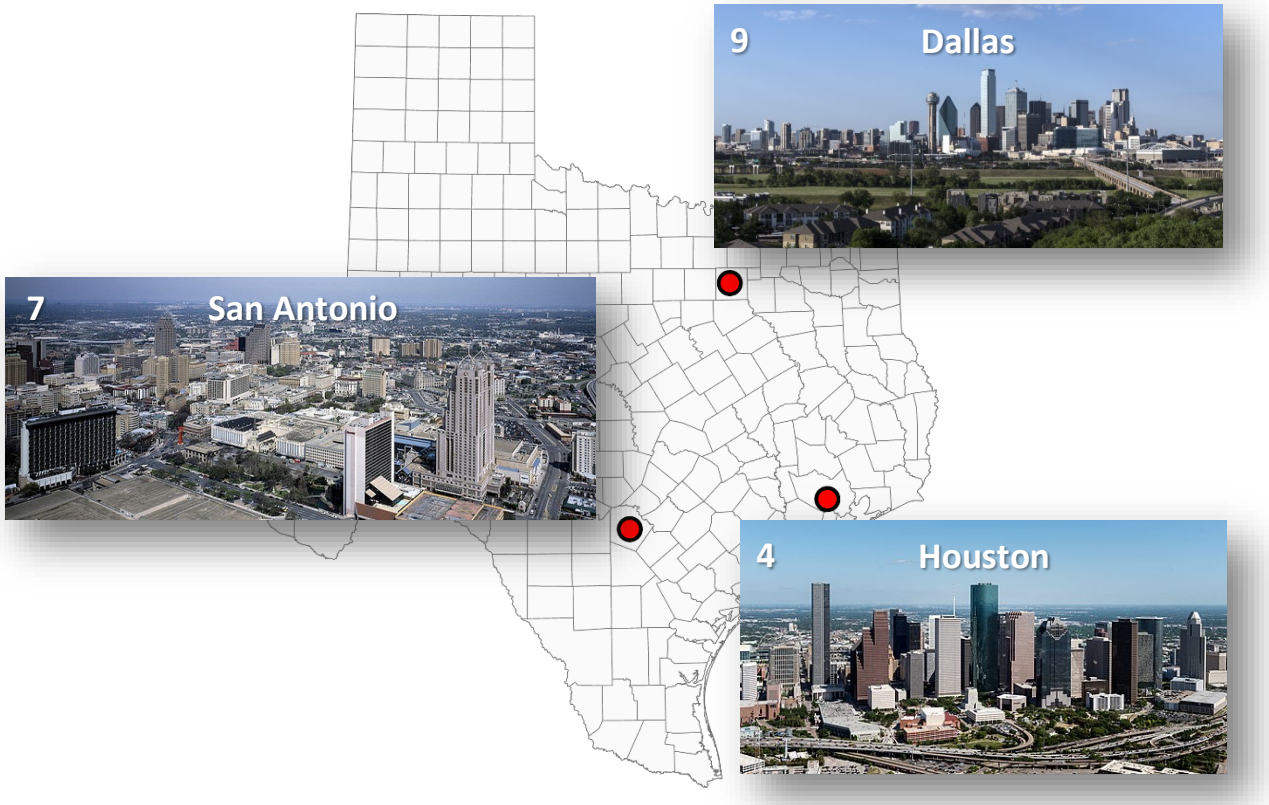
The forestry and logging sub-industries together account for about two percent of the total industry output. Primary products sub-industries include paper and paperboard as well as solid wood. These sub-industries produce about 27 percent of the direct industry output and support nearly 10,000 full and part-time jobs in Texas. Every job in the primary paper and paperboard products sub-industry creates an additional 4.58 jobs in Texas while every dollar generated in the primary solid wood products sub-industry creates an additional $1.08 in the state economy.

Population and Demographics

Texas Is a Big State

Texas is the largest state in the lower 48 and contains the combined area of 17 states at 170 million acres or 261,797 square miles (268,581 square miles if water bodies are included). To put it another way, Texas is as large as all of Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, Pennsylvania, Ohio, and North Carolina combined. It is the second most populous state and has three of the ten largest cities in the nation (Figure 9). In addition, Texas has 25 metropolitan areas as defined by the U.S. Census Bureau (**at least one urbanized area of 50,000 or more inhabitants**), the most in the nation. In 2017, Texas grew by more than 558,000 residents and held three of the ten fastest growing metropolitan areas in the nation—Metroplex, Houston, and Austin. Evidence of the urban nature of Texas is the fact that, as of 2010, 84.7 percent of Texans live in urban areas.

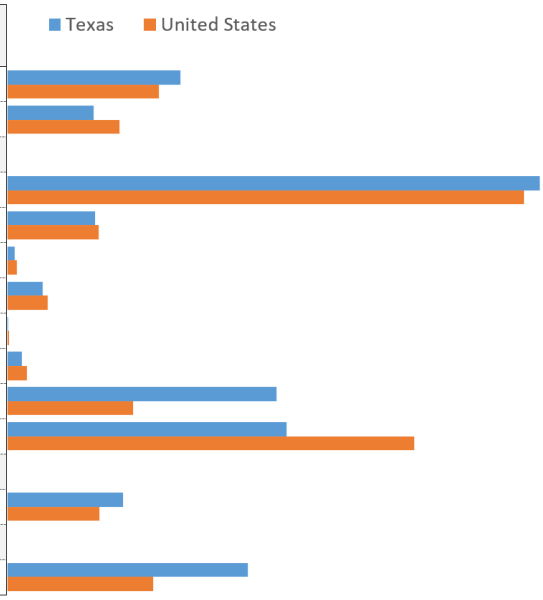
Figure 9
Three of Largest Ten Cities in America Are in Texas
(photos by Carol Highsmith)



The population of Texas was estimated by the U.S. Census to be 29.0 million in 2019, an increase of almost 16 percent over the 25.1 million in 2010. The state's population is younger with 25.5 percent under 18 years old (compared to 22.3% in the U.S.) and 12.7 percent over 65 (16.5% U.S.). Texas is 41.2 percent white (not Hispanic) (60.1 % U.S.), 39.7 percent Hispanic (18.5% U.S.) and 12.9 percent black (13.4% U.S.) (Table 5). The Texas population became less than 50 percent Anglo in 2004. It has 17.0 percent foreign born residents (13.5% U.S.) and 35.5 percent speak a language other than English at home (21.5 % U.S.).

Table 5
Percent Makeup of Texas Population in 2019
(U.S. Census)

Statistic	Texas	United States
Persons under 18 years	25.5%	22.3%
Persons 65 years and over	12.7%	16.5%
White alone	78.7%	76.3%
Black or African American alone	12.9%	13.4%
American Indian and Alaska Native alone	1.0%	1.3%
Asian alone	5.2%	5.9%
Native Hawaiian and Other Pacific islander alone	0.1%	0.2%
Two or More Races	2.1%	2.8%
Hispanic or Latino †	39.7%	18.5%
White alone, not Hispanic or Latino	41.2%	60.1%
Foreign born	17.0%	13.5%
Language other than English spoken at home	35.5%	21.5%



† Hispanics may be of any race, so also are included in applicable race categories.

Future Texas State Demographics

Projections from the Texas State Data Center and Office of the State Demographer indicate that the past pattern of rapid growth will likely continue in Texas. Texas is projected to grow by some 65.5 percent for the 32-year period from 2018 to 2050, adding at least 18.6 million people to the State's population. In comparison, there are currently only four states that have a population over 13 million. Such an increase would be like moving each person from Pennsylvania (the 5th most populous state) to Texas and still have room for all those from Wisconsin.

Texas will also become increasingly diverse with Anglos—already less than half of the population—accounting for no more than three of ten persons by 2050. Hispanics, who made up 10.8 percent of the population in 1970, will be the majority by 2022.

Metropolitan Population Change

Under the most likely population growth scenarios from the State Demographer, metropolitan areas in Texas will grow dramatically (Figure 10 and Table 6). Dallas-Fort Worth-Arlington, with a population of roughly 7.4 million in 2018, is expected to increase to more than 13.2 million by 2050. The equivalent values for Houston-Sugarland-Baytown are 7.1 million in 2018 and 13.2 million by 2050. For San Antonio, with a population of 2.5 million in 2018, projections are 4.5 million; for Austin-Round Rock with a 2018 population of more than 2.1 million, 4.6 million; for El Paso with a population of nearly 866 thousand in 2018, 1,049 thousand; and for McAllen-Edinburg-Mission with a population of more than 851 thousand in 2018, 1,033 thousand in 2050.

Figure 10
The 25 Metropolitan Statistical Areas in Texas

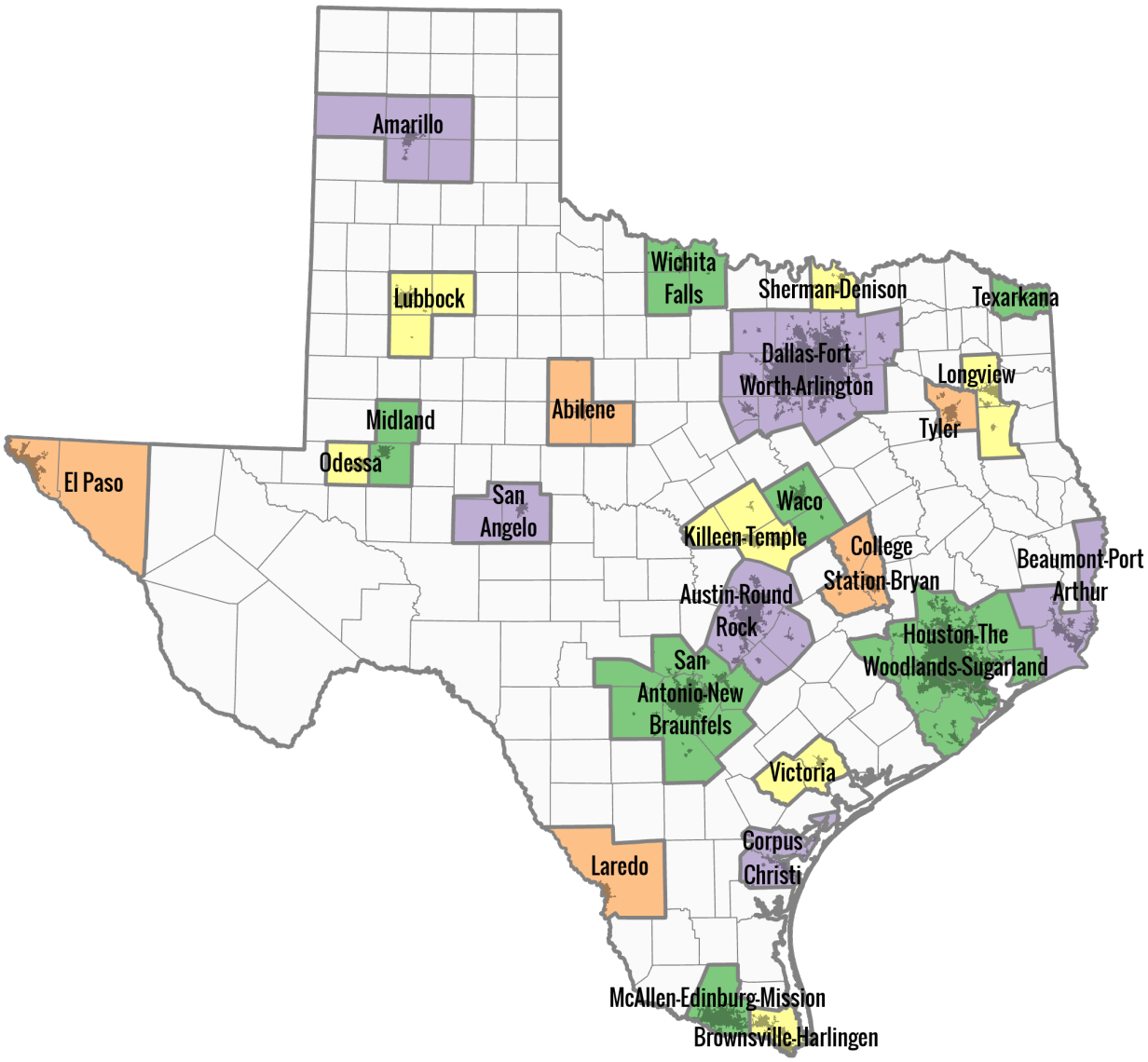
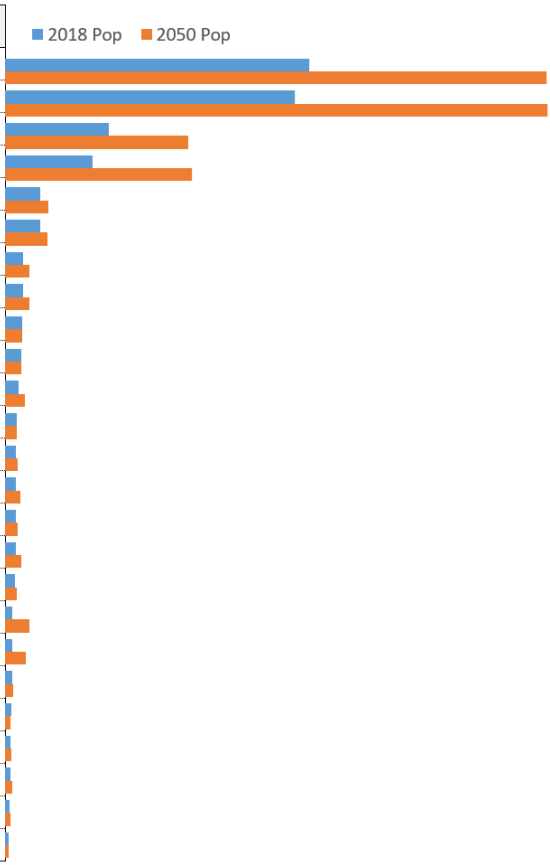


Table 6
Comparison of 2018 Population to 2050 Projected Population for 25 Metropolitan Statistical Areas in Texas

Area Name	2018 Pop	2050 Pop
Dallas-Fort Worth-Arlington	7,409,291	13,186,434
Houston-The Woodlands-Sugar Land	7,064,297	13,209,128
San Antonio-New Braunfels	2,527,512	4,467,980
Austin-Round Rock-Georgetown	2,134,069	4,560,117
El Paso	865,204	1,049,246
McAllen-Edinburg-Mission	851,285	1,032,926
Corpus Christi	444,339	597,814
Killeen-Temple	443,634	593,493
Brownsville-Harlingen	424,462	413,140
Beaumont-Port Arthur	398,899	398,763
Lubbock	320,213	486,128
Longview	286,909	290,083
Laredo	270,758	308,632
Amarillo	266,556	374,668
Waco	266,305	303,692
College Station-Bryan	255,491	401,081
Tyler	230,250	289,751
Midland	180,847	585,685
Odessa	173,797	494,892
Abilene	171,142	186,278
Wichita Falls	151,277	134,359
Sherman-Denison	129,610	152,114
San Angelo	123,112	173,215
Victoria	102,968	134,549
Texarkana (TX Only)	92,615	84,633



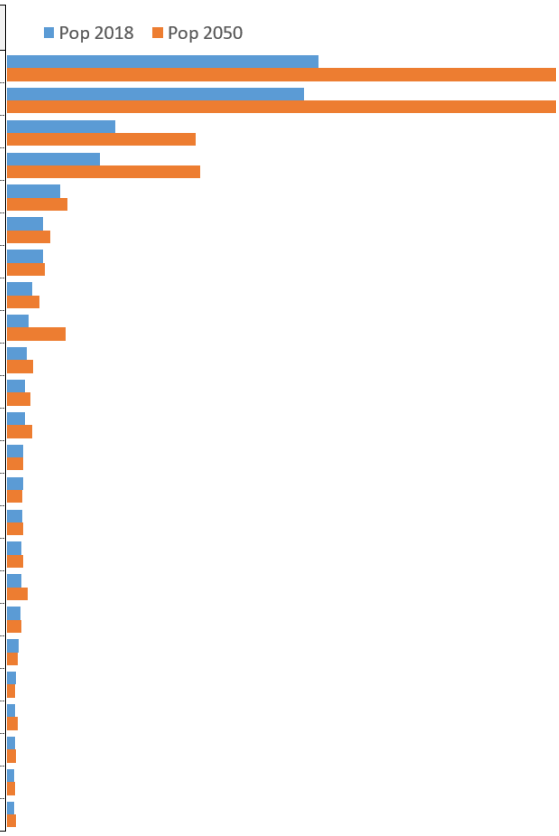
Regional Population Change

The State Demographer also indicates that several regions will grow dramatically (Table 7). The North-Central Texas area is projected to increase by 5.8 to 13.4 million from 2018 to 2050. The Houston-Galveston area is projected to increase 6.2 million by 2040. The Capital Area is projected to increase 2.4 million by 2040. The Alamo Area is projected to increase 2.0 million in population by 2040. By 2050, projections are that the Lower Rio Grande region will have more than 1.5 million people, the Rio Grande 1.1 million, and East Texas will have more than 1.7 million residents.

Table 7

Comparison of 2018 Population to 2050 Projected Population for 24 Regions Defined by the Texas Metropolitan Statistical Areas in Texas Association of Regional Councils

Area Name	Pop 2018	Pop 2050
North Central Texas	7,592,066	13,396,235
Houston-Galveston	7,236,821	13,404,920
Alamo Area	2,640,501	4,601,203
Capital Area	2,254,989	4,703,348
Lower Rio Grande Valley	1,297,909	1,465,300
Rio Grande	885,028	1,062,776
East Texas	867,030	930,792
Coastal Bend	617,431	792,260
Permian Basin	515,726	1,434,890
Central Texas	487,336	633,119
Panhandle	442,611	565,313
South Plains	440,328	604,111
South East Texas	398,899	398,763
Deep East Texas	382,569	364,308
Heart of Texas	363,178	388,973
South Texas	354,375	388,258
Brazos Valley	350,642	507,770
West Central Texas	335,103	346,966
Ark-Tex	284,077	258,416
Nortex	221,537	195,272
Golden Crescent	203,831	261,315
Texoma	203,539	225,028
Middle Rio Grande	175,447	195,224
Concho Valley	165,150	217,545



Population and Land Use Changes

Texas boasts 25 metropolitan areas and 46 micropolitan areas (**at least one urban cluster of at least 10,000 but less than 50,000 population).** The population in these urban areas equals nearly one in four residents of the 13-state USFS Southern Region. In addition, the Texas population growth rate is more than two times the national average.

As communities sprawl outward, this growth results in a permanent removal of natural forest cover for new residential, commercial, industrial, and government developments (Figure 11). Additionally, while large acreages of forestland are converted to development, redevelopment is also destroying large numbers of valuable landscape trees within already developed communities. Forests and trees affected by urbanization are the most critically impacted of all forest resources. Texas has no statewide land conservation initiative, state land-use planning, nor county zoning

authority, and with the projected surge in population growth (28.7 million in 2018 to 47.3 million in 2050), it is likely that the high rate of open space converted to development will continue well into the future. Of all the southern states, the effect of urbanization and associated development is greatest on critical open space and forestlands in Texas.

Forest resources in and around urban areas are the highest value and most critically affected forest resources in the U.S. The Southern Region, and Texas especially, have the most forest resources affected due to rapid population growth and associated development. From 2000 to now, 2018, Texas has added more than 8 million people. To understand the scale of this growth, consider that this 8-million increase in population is greater than the population of 37 of the 50 states. This rapid growth rate and associated conversion of critical forest land to development have created issues that can be addressed, in part, through forestry efforts.

Figure 11
Forest and Agricultural Lands in Many Regions of Texas Are Being Lost to Urban Expansion, Such as this Housing Development Near Austin

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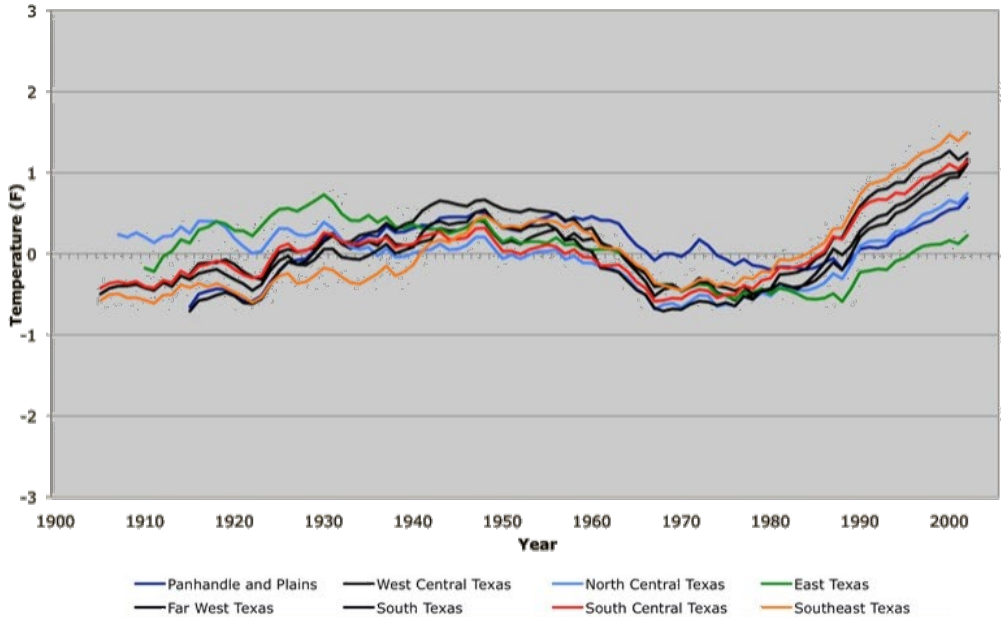
Trees and Forests as Climate Solutions

Changing climate and the associated increase in weather variability and extreme events affects everyone. Utilizing trees and forests to mitigate the negative effects of increasing temperatures and variability on our environment and natural resources is a nature-based solution that can be implemented today.

Climate continually changes—this is true now as it has been in the past. However, in the past, change occurred over long periods, allowing plants and animals to adapt over time. Today, however, this change is faster than the adaptive ability of plants, largely due to global atmospheric carbon dioxide currently increasing about 100 times faster than any previous natural increase.

Carbon that has been stored below the surface of the earth is released into the Earth's atmosphere during the burning of fossil fuels and other means. The addition of carbon in the atmosphere can act as a thermal blanket (greenhouse effect), causing average global temperature increases and sea levels to rise. In fact, every decade since the 1970s has been warmer than the one before (Figure 12). An observable impact in Texas and in many regions of the world is the increase in the number and intensity of extreme weather events.

Figure 12
Mean Annual Temperatures *(Texas State Climatologist, 2013)*



One way to address this issue is to remove carbon dioxide from the atmosphere. Fortunately, forests capture (remove) carbon dioxide from the air as they grow and store carbon in the trees and surrounding soil —a process called carbon sequestration. **Trees and forests are among the most efficient carbon collectors in the natural world, and currently the most cost-effective at carbon sequestration.**

There are numerous ways to increase carbon sequestration and long-term storage by trees and forests. First and foremost, more trees can be planted in areas where they do not currently exist, such as on marginal and highly erodible agricultural land. Additionally, prompt reforestation and sustainable management practices can be implemented to increase the health and vigor of existing forests. This includes thinning overly dense, stagnant, and suppressed trees and leaving healthier trees with more room to grow and greater access to the site's resources, like soil moisture. Prescribed burning, another practice that promotes ecosystem health, reduces the risk of total loss from catastrophic, all-consuming wildfires. Lastly, substituting solid wood products for fossil-fuel intensive building materials not only reduces carbon emissions during manufacturing, but also supports forest retention.

In cities and suburban areas—where much of the state's population lives—air temperatures are typically warmer than surrounding rural areas. Urban areas are more susceptible to the effects of changing climate and weather patterns. **Trees help communities be more climate resilient.** They shade concrete and asphalt, reducing temperatures and energy use while facilitating alternative forms of transportation (thus reducing carbon dioxide emissions) and stormwater management—and provide a host of other social and economic benefits. Nearby forests have temperature stabilizing characteristics on cities, too. Forests absorb heat and cool the air through evapotranspiration. While all trees do this, forests are particularly efficient at stabilizing temperatures, both locally and regionally. Healthy trees and forests make a better world.

With changing climate and weather patterns comes an increase in the intensity and frequency of droughts, floods, hurricanes, ice storms, tornados and wildfires; all which make **tree and forest management more critical than ever.** Species range shifts, migration, or changes in population and density, can be expected with changing climate and weather patterns. As moisture and temperature regimes shift, plant species historically found on a particular site may no longer be the best or even appropriate species for that site. Changing weather patterns also alter insect pest patterns and populations, plant emergence, and invasive species establishment. Knowledge and projections of anticipated environmental conditions for a region is valuable in developing management strategies, determining future fiber supplies, and designing policies for municipalities, public lands, and ecosystem restoration programs.

How Trees and Forests Help

- Trees and forests remove atmospheric carbon added by carbon dioxide emissions.
- Forestland has temperature-stabilizing characteristics, both locally and regionally.
- Through shade and evapotranspiration, trees reduce urban temperatures and energy needs.
- Shaded streets facilitate alternative forms of transportation, reducing carbon emissions.
- Forested wetlands and swamps are natural flood defenses.
- Community trees help minimize stormwater run-off and consequent flooding.
- Agroforestry alternatives help protect the food supply (i.e., rice fields from drowning; grain farms from blowing away or flooding, etc.).
- Forest products offer safer, cheaper, more carbon-sequestering alternatives to metal and plastic products.

What TAMFS is Doing

- Monitoring and assessing the condition and trends of the state's forest resource.
- Developed and providing climate-ready seed stock of select Texas species; these drought-hardy lines of "Texas Tested, Texas Tough" tree species are selected for their ability to thrive in harsh environments.

- Facilitating forests and nature-based solutions for water supply, flood control, and carbon sequestration.
- Educating residents on the connection between climate, human health, and trees and forests.
- Taking the lead in developing new set of protocols that consider the issues and expected impact on forest health, resiliency, and production.
- Helping Texans plan and care for trees and forests to build a more resilient resource that will survive and thrive into the future.
- Promoting and protecting healthy forest economies to ensure the sustainability of resilient and productive forest resources.

REVIEW OF NATURAL RESOURCE PLANS

National guidance on Forest Action Plans and the 2008 Farm Bill require that Forest Action Plans assess commonalities with the State Wildlife Action Plan within a state. The Texas Comprehensive Wildlife Conservation Strategy, or Wildlife Action Plan, was produced by Texas Parks & Wildlife Department (TPWD) in 2005. It was created as a complete wildlife management guide for Texas. The wildlife action plan replaced several other plans previously published to align with required directive elements set forth by the U.S. Fish & Wildlife Service. The plan was subsequently updated in 2012 and is now known as the Texas Conservation Action Plan (TCAP).

Although the Texas Conservation Action Plan was the most inclusive document reviewed, Texas A&M Forest Service also reviewed plans from other agencies and organizations with natural resource responsibilities. These agencies were selected based upon similar interests when managing natural resources, similar organizational structure, and having published resource management plans.

In cases where Texas A&M Forest Service has existing partnerships with other agencies, commonalities were found between Texas A&M Forest Service management plan issues and other agency management plans. Water quality, supply, and use of water were a common issue among many of the agencies. Some organizations mention land management, but forestry and management of forested land are not commonly mentioned. When forestry is mentioned, it is often as a secondary issue instead of a primary management objective. Agencies that did focus on timber product usage and direct forest land management, mentioned in their text conservation of resources, methods for efficient production, and cost-effective use of available resources. Other agencies did not view forests for product use, but rather as potential areas for loss of habitat and further fragmentation created by increased population growth and urban development.

To address land or resource conservation and management, many state agencies provide conservation and education programs to raise citizen awareness. Private landowners, who own 95 percent of land in Texas, manage their own land. Therefore, the state establishes education programs to provide support and partnership to achieve desired land stewardship and conservation goals.

Below is a listing of agencies and documents reviewed.

Alabama-Coushatta Tribe of Texas

The Alabama Coushatta Tribe of Texas developed an environmental assessment in August of 2019 of the *Fire Management Plan* they are following. This assessment provides an alternative to the original plan developed in 1999. The proposed alternative involves the management of wildfires for multiple objectives including suppression, prescribed burn treatments, and mechanical and manual treatments, the same as the original plan, but these activities would be available on all Tribal trust and fee lands.

Bureau of Land Management

The Bureau of Land Management (BLM) administers only one tract in Texas, the Crossbar Management Area in Potter County northwest of Amarillo. It is a 12,000-acre tract originally purchased by the Federal government in 1931. The BLM manages the land in cooperation with West Texas A&M University and other cooperating agencies. No planning documents were found for this property.

Department of Interior

The U. S. Department of Interior operates under their *Strategic Plan for Fiscal Years 2018 – 2022*. Of the 10 bureaus operating under this department, the National Park Service and the Fish and Wildlife Service are especially important in managing lands that are forested. Strategic goals that deal directly with forest resources include

- Utilize science in land, water, species, and habitat management supporting decisions and activities
- Foster partnerships to achieve balanced stewardship and use of public lands
- Ensure public receives fair market value for resources; and recover costs where appropriate
- Focus timber programs on "healthy forests" lifecycle
- Expand hunting, fishing, and other recreation on DOI lands and waters
- Manage wildland fire to reduce risk and improve ecosystem and community resilience

Environmental Protection Agency

The Environmental Protection Agency (EPA) updated its *FY 2018-2022 Strategic Plan* in September 2019. The plan has three primary goals:

Goal 1: A Cleaner, Healthier Environment
Goal 2: More Effective Partnerships
Goal 3: Greater Certainty, Compliance, and Effectiveness

The Agency uses the plan to guide the Agency's path forward, tracking progress, and assessing and addressing risks and challenges that could potentially interfere with EPA's ability to accomplish its goals.

Governor's Task Force on Conservation

Governor George W. Bush charged a task force named the Governor's Task Force on Conservation to serve in an advisory capacity to the Governor. This task force produced a report titled *Taking Care of Texas* that set forth recommendations that will protect and enhance the natural resources of the state, assure outdoor recreation opportunities for all its citizens, and further define Texas as leader in conservation achievements. Recommendations along with specific strategies are organized in three main categories: private lands, public lands, and water. To further essential conservation work, the Task Force recommended that Texas should:

1. Create a statewide Purchase of Development Rights program.
2. Reform tax laws to support conservation.
3. Expend incentives for habitat management and outdoor recreation on private lands.

Although almost 20 years old and completed under a previous governor, this report still offers important recommendations for furthering conservation in the state.

National Forests and Grasslands of Texas

The National Forests and Grasslands of Texas (NFGT) produced their *Revised Land and Resource Management Plan* in 1996. The plan was revised due largely to concerns and court orders involving the red-cockaded woodpecker. The plan guides all natural resource management activities for the Angelina, Davy Crockett, Sam Houston, and Sabine National Forests, and the Caddo and LBJ National Grasslands. It specifically establishes:

- The Forest-wide multiple-use goals, objectives, and desired future condition for the Forests and Grasslands, including estimates of the goods and services expected.
- The management area prescriptions, including associated standards and guidelines, and probable proposed practices to maintain, enhance, or restore natural ecosystems.
- The identification of land suitable for timber production and the allowable sale quantity (ASQ) for timber, and the other resource outputs and values from that land.
- The quality control checks through monitoring and evaluations that are needed to determine how well standards and guidelines are working, and whether goals remain appropriate throughout the Plan period.
- The preservation, protection or enhancement of appropriate important historical, cultural and natural aspects of the National heritage.

Natural Resource Conservation Service

The Natural Resource Conservation Service maintains a strategic plan, the most recent which is the *2016 – 2018 Strategic Plan Update*. This plan focuses on several goals and initiatives including

- Deliver high-quality science and technology for private lands conservation.
- Promote productive working lands and healthy waters.
- Promote and enhance productive agricultural landscapes.
- Supporting healthy watersheds and diverse land use communities.
- Increase organizational effectiveness and efficiency.
- Create climate of inclusion and foster diversity so private lands conservation will thrive.

No specific plans were discovered for Texas.

Railroad Commission of Texas

The Railroad Commission of Texas (RTC) has a current strategic plan for fiscal years 2017 – 2021. RTC is very relevant to forest resources because it regulates the oil and gas industry across the state. Oil well pads and pipelines have a very significant impact on the forest resources of Texas.

Texas A&M AgriLife Extension Service

Texas A&M AgriLife Extension Service is guided by its strategic plan for fiscal years 2017 – 2021. This agency focuses on the agricultural community and has left most all extension service on forest resources to the Texas A&M Forest Service. However, many of its Imperatives and Goals relate to the forest resources of the state since many agricultural practices occur alongside forested areas.

USDA Forest Service

The USDA Forest Service developed the *Southern Forest Futures Project*. This report was published in 2012 and provides a science-based "futuring" analysis of the forests of the 13 southern states. With findings organized in a set of scenarios and using a combination of computer models and science synthesis, the authors of the Southern Forest Futures Project examine a variety of possible futures that could shape forests and the many ecosystem services and values that forests provide. The science findings and modeling results could inform management and policy analysis of the South's forests. Key findings include

1. The interaction of **population growth, climate change, timber markets, and invasive species** will define the South's future forests.

2. **Urbanization** is forecasted to result in forest losses, increased carbon emissions, and stress to other forest resources.
3. Southern forests could sustain higher **timber production** levels, but demand is the limiting factor and demand growth is uncertain.
4. A strong market for **biomass energy** could bring wood demands that are large enough to trigger changes in forest conditions, management, and markets.
5. A combination of factors has the potential to decrease **water availability** and degrade quality; forest conservation and management can help mitigate these effects.
6. **Invasive species** create a great but uncertain potential for ecological changes and economic losses.
7. An **extended fire season** combined with obstacles to prescribed burning would increase wildland fire-related hazards.
8. Private landowners continue to control the future of forests in the South, but **ownership patterns** could change and modify the future.
9. **Threats to species** of conservation concern are widespread but are especially concentrated in the Coastal Plain and the Appalachian-Cumberland subregions.
10. **Increasing populations** would increase demand for forest-based recreation while the availability of land to meet these needs is forecasted to decline.

Texas Commission on Environmental Quality

The Texas Commission on Environmental Quality (TCEQ) regulates air and water quality within the State. Its most recent strategic plan is for fiscal years 2019 – 2023. TCEQ has a *State Implementation Plan* for air quality that contains 2017 amendments for EPA's Regional Haze Rule. These amendments show how the state will reduce regional haze in the air to natural background conditions. This is important to the prescribed fire programs around the state.

TCEQ also coordinates a monitoring program to determine if the state's waterways are meeting water quality standards. Results are published in the Integrated Report on Surface Water Quality, which includes a list of the waterbodies assessed, status in meeting water quality standards, causes of concern, and potential sources of pollution. This information is used as the foundation for protecting and restoring surface water quality in Texas. TCEQ and the Texas State Soil and Water Conservation Board jointly publish the Texas Nonpoint Source Management Program, which includes TAMFS program delivery.

Texas General Land Office

The Texas General land Office (GLO) is the oldest state agency in Texas. It was established in 1836 immediately after the Texas Revolution to manage the public domain. GLO focuses on maximizing and diversifying revenue sources for the Permanent School Fund. The agency operates under a strategic plan with the most recent being for fiscal years 2017 – 2021. Texas A&M Forest Service manages 14 forested GLO tracts totaling 3,743 acres and oversees and executes the total management of these lands.

Texas Land Trust Council

The Texas Land Trust Council (TLTC) is a nonpartisan, nonprofit organization that builds and supports a strong, active coalition of more than 30 organizations working to conserve the lands and waters of Texas. TLTC produces a *Land Trust Standards and Practices* that represent the ethical and technical guidelines for the responsible operation of a land trust. The most recent update of this publication was in 2017.

Texas Longleaf Implementation Team

The *Texas Longleaf Conservation Plan* is intended to help guide the Texas Longleaf Implementation Team (TLIT) through 2025 to re-establish the abundantly biodiverse and wildlife-sustaining habitat of the longleaf pine ecosystem in East Texas. TLIT is comprised of partner organizations as part of the larger, range-wide America's Longleaf Restoration Initiative, whose purpose is to increase longleaf pine acreage from 3.4 to 8.0 million acres by 2025. This conservation plan identifies 12 counties in the Pineywoods of East Texas as areas suitable for longleaf pine ecosystem restoration efforts.

Texas Parks and Wildlife

The 2008 Farm Bill states specifically that each state should review their respective state's *Wildlife Action Plan*. Texas Parks and Wildlife Department developed this plan in 2005. It has since been revised in 2012 as the *Texas Conservation Action Plan (TCAP)*. The revised Texas plan is a series of 11 regionally specific Ecoregion handbooks, a Statewide/Multi-region handbook, and an Overview document. The name change reflects the Plan's intention to be a conservation guide for all natural resources (not just wildlife, which in Texas usually implies game and non-game terrestrial animals).

The Statewide/Multi-region (SMR) Handbook provides information on larger conservation issues in Texas, and a few we share with our neighboring states, other states, Mexico, and Canada. The SMR handbook also presents statewide and multi-region habitats and conservation actions. The statewide compiled Species of Greatest Conservation Need (SGCN) list is linked to that handbook. Each of the 11 Ecoregion handbooks is related to a regional subset of the SGCN list, habitat descriptions, conservation challenges and issues, and conservation actions needed in that specific ecoregion. These handbooks are intended to encourage more local solutions to local needs and collaboration among conservation services providers who work on similar issues.

TPWD also developed an *Energy and Water Management Plan* in 2014. Updated in 2018, it is also known as the *2020 Sustainability Plan*. This plan provides actions for managing and conserving the resources of TPWD through recycling and waste reduction efforts, energy efficiency investments, and water conservation practices in order to protect and preserve natural resources and to set an example as an agency.

The *2015 Land and Water Resources Conservation and Recreation Plan* serves as the strategic visionary document guiding TPWD in achieving its mission to conserve land and water resources and to provide outdoor recreation opportunities for all Texans. This plan is arranged into four goals:

1. Practice, encourage and enable science-based stewardship of natural and cultural resources.
2. Increase access to and participation in the outdoors.
3. Educate, inform, and engage Texas citizens in support of conservation and recreation.
4. Employ efficient, sustainable, and sound business practices.

In 1997, TPWD developed a *Texas Wetlands Conservation Plan* that focuses on non-regulatory, voluntary approaches to conserving the wetlands of Texas. It focused on:

- Enhancing the landowner's ability to use existing incentive programs and other land-use options through outreach and technical assistance.
- Developing and encouraging land-management options that provide an economic incentive for conserving existing wetlands or restoring former ones
- Coordinating regional wetlands conservation efforts.

TPWD also developed the *Texas Monarch and Native Pollinator Conservation Plan* in 2016. The plan acknowledges Texas' unique contribution to the long-term persistence of the North American monarch migration. It outlines actions that will contribute to monarch and overall native pollinator conservation in Texas by highlighting four broad categories of monarch and native pollinator conservation: habitat conservation, education and outreach, research and monitoring, and partnerships.

Texas Water Development Board

Development of the state water plan is central to the mission of the TWDB. Based on 16 regional water plans, the plan addresses the needs of all water user groups in the state. At the end of each five-year regional water planning cycle, agency staff compiles information from the approved regional water plans and other sources to develop the state water plan.

The *2017 State Water Plan* is the tenth state water plan and the fourth plan based on the regional water planning process. In addition to incorporating the regional water plans, the state water plan serves as a guide to state water policy and includes legislative recommendations that the Board believes are needed and desirable to facilitate voluntary water transfers. The plan also identifies river and stream segments of unique ecological value and sites of unique value for the construction of reservoirs that the Board recommends for protection.

U. S. Army Corps of Engineers

The U. S. Army Corps of Engineers (USACE) produced *Environmental Stewardship and Maintenance Guidance and Procedures* in 1996 that establishes guidance for the management of environmental stewardship-related operations and maintenance at USACE civils works water resource projects. The natural resource management mission of USACE is to manage and conserve those natural resources, consistent with ecosystem management principles, while providing quality public outdoor recreation experiences to serve the needs of present and future generations.

U. S. Department of Defense, Fort Hood

Fort Hood is one of the U. S. Army's premier training installations and extends over 300 square miles in Central Texas about 60 miles north of Austin. It manages the largest known populations of the endangered golden-cheeked warbler and black-capped vireo. The facility developed the *Fort Hood Integrated Natural Resource Management Plan FY 2013 – 2017* in cooperation with the U. S. Department of Interior, Fish and Wildlife Service, and Texas Parks and Wildlife Department. The plan guides the natural resources management program at Fort Hood and intends to ensure that natural resource conservation measures and Army activities on Fort Hood land are integrated and consistent with federal stewardship requirements.

U. S. Fish and Wildlife Service

The U. S. Fish and Wildlife Service (USFWS) developed *Strategic Plan for the U. S. Fish and Wildlife Service and Aquatic Conservation program: FY2016-2020* that is built around seven core goals:

- Conserve aquatic species
- Conserve, restore, and enhance aquatic habitats
- Manage aquatic invasive species
- Fulfill tribal trust and subsistence responsibilities
- Enhance recreational fishing and other public uses of aquatic resources

- Increase staffing levels, technical capabilities, and natural and physical assets to fully meet the agency's mission
- Educate and engage the public and partners to advance the agency's conservation mission

The broad framework provided by the plan serves as a foundation for the development and implementation of annual operational plans.

ISSUES FACING FOREST RESOURCES IN TEXAS

The following five forest resource issues were identified as being most critical to the conservation, protection, and enhancement of forest resources in Texas:

Issue 1: Wildfire and Public Safety

Since its inception in 1915, Texas A&M Forest Service has been tasked with the responsibility of wildfire suppression, defending both the property and lives of Texas citizens. This is a growing issue for Texas. Since 1996, the state has seen significant fire seasons. Once primarily a rural concern, wildfires are now clearly a statewide threat. In recent years, wildfires have threatened and, in some cases, burned through small towns and large cities alike, destroying hundreds of homes. Three primary factors are combining to create these intense fire seasons—population growth, changing land use, and increasing drought frequency.

Issue 2: Sustainability of Forest Resources in East Texas

For more than a century, the forests of East Texas have provided a number of economic and societal advantages such as manufacturing, employment, recreation, and environmental protection. Today, pressure on this resource has never been greater. East Texas is experiencing unprecedented change in the management and use of the Pineywoods. Population growth, ownership changes and parcelization, residential development, and non-consumptive demands will impact the forested landscape far into the future.

Issue 3: Central Texas Woodlands Conservation

The woodlands of Central and West Texas are valuable resources for shade, recreation, wildlife, and environmental protection. Yet, these resources are coming under increasing pressure from an exploding population, land fragmentation, wildfires, invasive plants, oak wilt, and other pests. Cooperation and partnerships to protect and conserve these critical resources are essential if the high quality of life residents have come to expect in these regions of the state is to continue.

Issue 4: Urban Forest Sustainability

With the addition of over 4 million residents since 2010, rapid urbanization is creating intense pressure on the sustainability of the trees and forests in Texas communities. Trees provide economic, health, and environmental benefits that are important to the quality of life in Texas communities. It is critical to plant, care for, and conserve the trees in communities where Texans live, work, and play.

Issue 5: Water Resource Protection

Forests and woodlands play an integral role in maintaining a continuous, stable supply of clean drinking water for millions of Texans. In fact, almost 50 percent of the state's freshwater resources originate on forests that cover just over one third of the land area in the state. As these lands are converted to other uses, this critical role is interrupted and water resources are adversely affected. Given the importance of forests to the state's water resources, private land conservation and stewardship are critical factors in meeting the state's water needs in the future.

Overview of Geospatial Analysis

For each stakeholder issue, a separate geospatial analysis was performed to identify areas across the landscape that are important for focusing Cooperative Forestry efforts. Geospatial analysis, or simply spatial analysis, is a way of making sense of how various types of information (e.g. natural resource, environmental, or cultural) are related geographically and expresses this visually as a map.

Spatial analysis involves geospatial layers, or themes. A layer is a thematic set of spatial data representing one type of information, such as land use, cover type, roads, census tracts, or streams. When only two or three layers are overlaid and are made somewhat transparent, the apparent relationship between the two layers can be easily seen and understood. However, as more layers are added, comprehension becomes more difficult, if not impossible. Spatial analysis allows us to simplify and quantify these relationships.

Spatial analysis can be performed in many ways. In producing the priority maps for this state assessment, weighted overlay analysis was used. This technique involves assigning a weight to each of several geospatial layers, overlaying them, and summing the weighted values of coincident pixels for all the layers. Weights are assigned according to the relative importance a particular layer has in addressing the issue. A pixel is a square unit that represents a specific spot on the ground and is the smallest unit of resolution of geographic area used in the analysis. For the Texas assessment, all analyses were done at the 30- by 30-meter pixel size (0.22 acres).

A guiding principle used for all analyses was to take advantage of input data layers that already exist. More specifically, there was a desire to use layers from the Southern Forest Land Assessment. (SFLA). Each of the eight recommended GIS layers, or themes, specified in the Redesign Guidelines for State Assessments is covered by one or more of the layers used in the SFLA, except for the Green Infrastructure theme. This theme is included to address an urban analysis since the SFLA and the associated Forest Stewardship Program's Spatial Analysis Project were designed for rural forestry. To represent Green Infrastructure, two layers from the 2016 National Land Cover Database—Tree Canopy and Imperviousness—were included in the urban analysis. Additional layers were developed for the Urban Forest Sustainability analysis.

For each issue, the layers to be included and the weights assigned to each layer were determined by Texas A&M Forest Service program leaders. Weights were assigned such that they summed to 100 percent. Thus, an individual weight for a particular layer is the percent contribution of that layer to the overall model output.

The weighted values for coincident pixels of the inclusive input layers were then summed resulting in values ranging from 0 to 100 percent of the maximum possible. To simplify results, the composite output index layer was classified into five classes using the Natural Breaks method. This method uses the data to determine where breaks between classes should occur by minimizing variation within classes while maximizing variation among classes. On the maps produced, the classes are referred to as Very Low, Low, Medium, High, and Very High. In addition, the range of pixel values that occur within each class are given. These values range from 0 to 100 percent of maximum possible.

Issue 1
Wildfire and Public Safety

Issue Description

A primary role of government is to help ensure the safety of its citizens. Since its inception in 1915, Texas A&M Forest Service has been tasked with the responsibility for wildfire suppression, defending both the property and lives of Texas citizens. Beginning in the 1990s, TAMFS has provided incident management teams in response to all-hazard incidents that threaten the citizens of Texas.

For Texas these are growing issues. Since 2005, the state has experienced 203,395 wildfires that burned over 11.4 million acres. Additionally, most wildfires threaten homes. Once primarily a rural issue, wildfires are now clearly a statewide threat. Spatial analysis shows that 76 percent of these wildfires occurred within one mile of a community. Since 2005, wildfires in Texas have threatened and, in some cases, burned through small towns and large cities alike destroying a reported 5,374 homes.

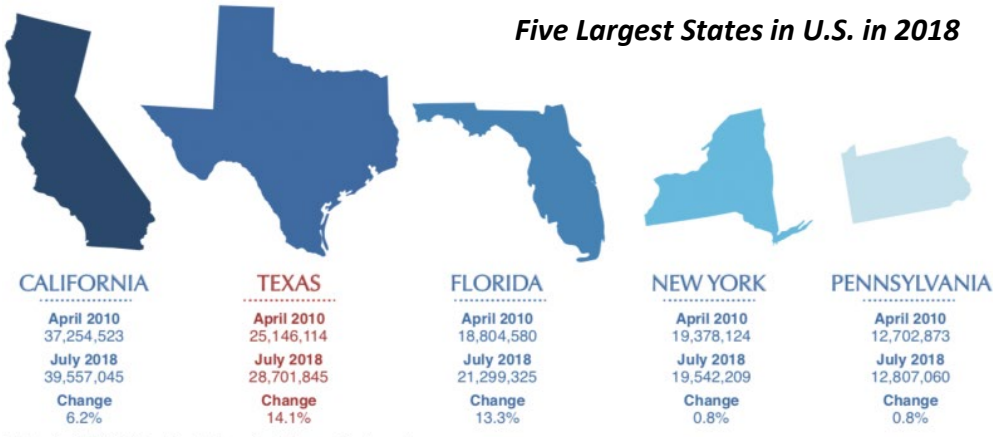
Three primary factors are combining to create these intense fire seasons—population growth, changing land use, and increasing drought frequency.

Non-wildfire disaster response has become commonplace in Texas as well. Along with California and Florida, Texas is one of the top three natural disaster states in the nation. Hurricanes, floods, tornados, and other events requiring state and local disaster response continue to occur with increasing frequency. Texas A&M Forest Service is frequently called on by the state to provide incident management teams for non-wildfire disasters and events of state significance. Population growth and land-use changes are significant causal factors for these disasters as well.

Population Growth

The population of Texas has increased during every decade since Texas became a state, with recent population growth exceeding that of all other states in the nation (Figure 13). While few new communities have been created, many communities and cities have expanded into undeveloped "wildland" with little or no regard for wildland fire protection principles. Fire occurrence statistics show that over 95 percent of wildfires occurring in Texas are human caused. For wildland fires, this continued population growth correlates into both an increase in the number of fires and an increased population and values at risk once a wildfire starts.

Figure 13
Population Trends for Texas from 2010 to 2018
Source: U.S. Census Bureau 2018



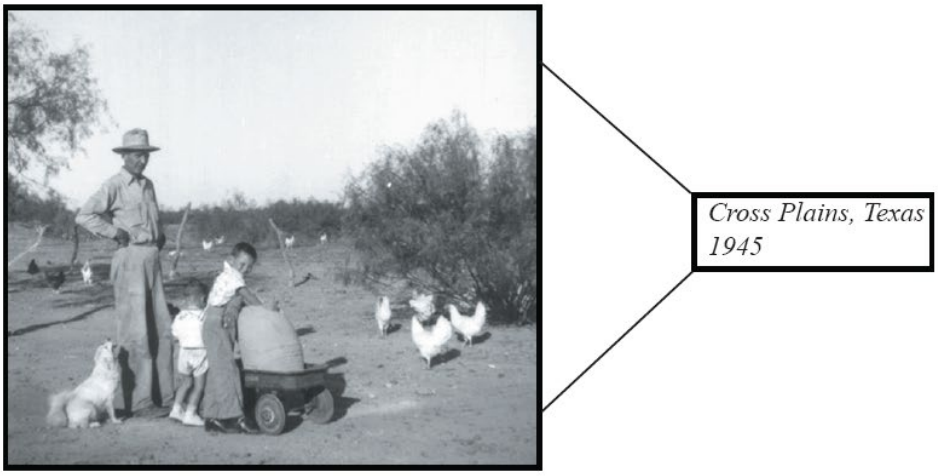
Population growth has a tremendous impact on all types of disaster response, not just wildfires. Disasters are measured in human impact (people displaced, homes and lives lost). A natural phenomenon, such as a flood or tornado, becomes a disaster when people's lives are affected. Add to this the potential for human-caused disasters, and a direct correlation becomes evident between population growth and the increase in occurrence and severity for all types of incidents requiring state disaster response and support.

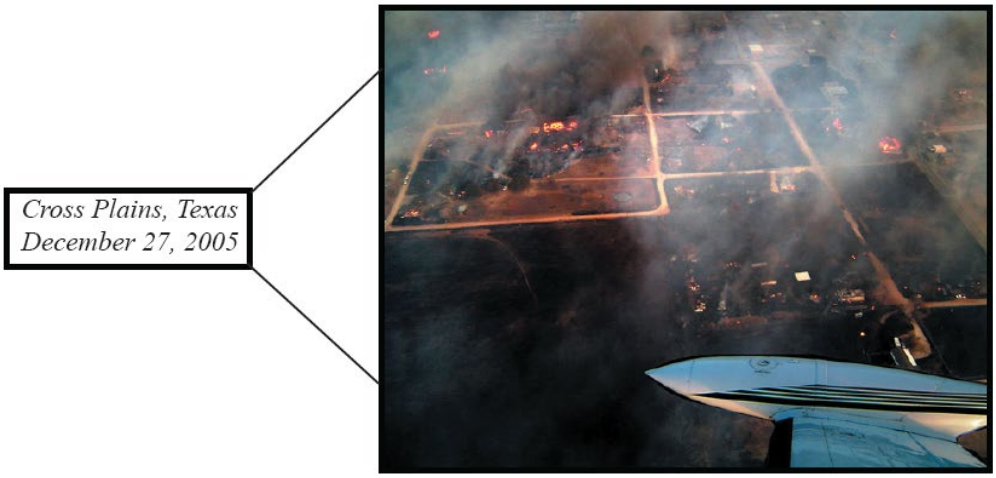
Land Use Changes

Land use patterns have changed over the past century, resulting in significantly more vegetation and fuels available to burn. The town of Cross Plains in North Central Texas was devastated by fire on December 27, 2005. In the early 1900s, this area was used by sharecroppers and farmers, and little or no vegetation remained around the homes, farms, and ranches in the community.

By 2005, a town of 1,076 people had sprung up with the typical Texas landscape—tall grass, trees and other vegetation—surrounding the homes. The devastating fire in December 2005 claimed two lives and destroyed 116 homes (Figure 14).

Figure 14
Cross Plains and the Devastating Fire of 2005
Photos from Texas A&M Forest Service files





Land use changes are also being impacted by expansion of urban, suburban, and rural communities. As the population grows, communities are expanding into previously undeveloped or "wildland" areas at a record pace. Over the last few decades, expansion of these wildland-urban interface (WUI) areas—where homes and other human development meet or intermingle with undeveloped land—has significantly impacted all emergency response and disaster management activities. In many areas, community expansion has outpaced local infrastructure, stretching capabilities of fire, police, and other local emergency services.

On September 4, 2011, the City of Bastrop, located in the Lost Pines region of Texas, experienced one of the most devastating fires in Texas history (Figure 15). At 32,400 acres, the Bastrop Complex was not one of the largest fires in Texas. However, the fast-moving wildfire burned through multiple residential areas and consumed 1,660 homes—most in the first 48 hours.

Figure 15
Bastrop Wildfire Complex of 2011
Photos from Texas Forest Service files

Cross Plains and Bastrop are examples of what happens when a community finds itself in the way of wildfire. Unfortunately, these are not isolated examples. There are currently 14,506 communities in Texas deemed to be at risk to the destructive potential of a devastating wildfire. Surprisingly, many populated areas are more at risk, due to the increased number of human-caused fires.

For wildfires, the WUI creates an environment where fire can move readily between structural and vegetative fuels, increasing the likelihood that wildfires will threaten structures and people.

Drought

In 1999, by analyzing weather data from the past 100 years, Texas A&M Forest Service identified a distinctive drought cycle occurring in Texas. Three separate 25- to 30-year drought periods were recognized, with the current drought cycle beginning around 1998 to 2000. During a drought cycle, rainfall and wet periods continue to occur; however, drought and extremely dry conditions occur

with greater frequency and intensity. Drought becomes the "normal" pattern rather than the exception. The more frequent and intense droughts result in dryer vegetation that is more likely to ignite and will burn more readily, increasing fire occurrence, intensity, and size.

Coordination and Resources

Under the leadership of TAMFS, Texas has a tiered strategy for fire response to meet this risk. This involves local fire departments, Texas A&M Forest Service, and other state agencies, as well as firefighters and equipment from across the nation.

Local fire departments are the first responders to wildland fires in Texas. They are the first line of defense. However, if they determine that their capacity to control a fire is exceeded, suppression assistance is requested from Texas A&M Forest Service. This may occur quickly or over time after a fire has grown large and becomes destructive.

In Texas, even a moderately sized wildfire may involve from 2 to 10 fire departments, numerous pieces of county equipment, local law enforcement, emergency medical services, and resources from Texas A&M Forest Service, Department of Public Safety, Texas Department of Transportation, Texas National Guard, Governor's Division of Emergency Management, and multiple out-of-state cooperators. All these responders need to be organized before a fire starts in order to maximize safety and effectiveness.

TAMFS is also able to access national response resources from the federal and out-of-state land management agencies. Since 1998, Texas has mobilized more than 63,782 personnel, 1,160 aircraft, 1,380 engines, and 1,451 dozers for wildfire and emergency response. Approximately 77 percent of these responders were from out of state. These resources have been vital to fire suppression efforts in recent fire seasons. Without out-of-state resources, the wildfires would not have been suppressed. However, there are disadvantages to continuing to mobilize national resources. Aerial firefighting equipment and firefighting personnel are not always readily available and there is a three- to five-day lag time in mobilizing out-of-state resources. In addition, national mobilization costs generally three to four times greater per unit than Texas resources.

Spatial Analysis

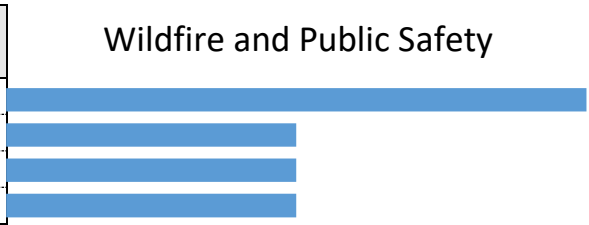
In the previous Forest Action Plan, the layer used for the Wildfire and Public Safety issue was the Level of Concern layer developed for the Southern Wildfire Risk Assessment and which was also used in the Southern Forest Land Assessment. That layer is no longer used in the SWRA and thus a new layer was developed called Wildfire Threat.

Wildfire Threat integrates four layers including Burn Probability, Characteristic Fire Intensity Scale, Community Protection Zone, and Pine Plantation Value index. Burn Probability is taken from National Burn Probability data developed by the1 U.S. Forest Service while the other three layers are taken from the Texas Wildfire Risk Assessment. Description of these layers and their preparation for analysis is provided in the Appendix.

Table 8 shows the layer weights assigned to each of the four layers that were used in the raster overlay analysis.

Table 8
Layer Weights Used in Geospatial Analysis for Wildfire and Public Safety

Layer Rank	Layer Name	Layer Weight
1	Pine Plantation Index	40
2	Community Protection Zone	20
3	Characteristic Fire Intensity	20
4	Burn Probability	20
	TOTAL	100



Results

Results from this overlay analysis are shown in Map 1A and 1B. Map 1A shows results on a 30-meter pixel basis and Map 1B shows results when pixel data are summarized by county. The analysis resulted in more than 50 million acres occurring in the top four quantiles out of 10 for 30-meter pixels. When county averages are considered, 99 of the 254 counties in Texas, or 38 percent, are in the top four quantiles.

Map 1
Priority Analysis for Wildfire and Public Safety –
30 Meter Pixel Map (A) and County Mean Map (B)

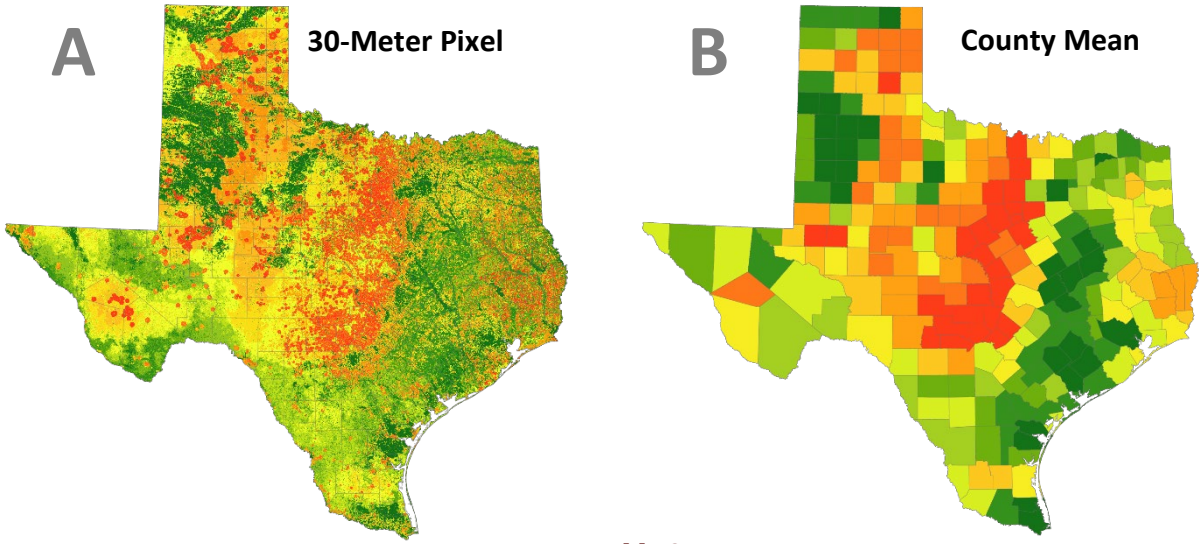


Table 9
Priority Classes and Break Points (quantiles) for Wildfire and Public Safety Geospatial Analysis

30-Meter Pixel				County Mean		
Legend	Layer Value	Priority Value	Million Acres	Legend	Priority Value	Counties
	0	0	19.0			
	10	0 – 8.8	15.4		0 -13.0	29
	20	8.8 – 14.0	15.4		13.0 – 16.1	30
	30	14.0 – 17.4	15.0		16.1 – 17.4	23
	40	17.4 – 21.2	16.6		17.4 – 19.0	24
	50	21.2 – 25.2	23.5		19.0 – 20.5	24
	60	25.2 – 27.2	13.6		20.5 – 22.3	25
	70	27.2 – 29.4	15.8		22.3 – 24.9	26
	80	29.4 – 33.4	11.6		24.9 – 27.9	22
	90	33.4 – 40.2	11.6		27.9 – 30.4	24
	100	40.2 – 89.6	11.5		30.4 – 38.1	27

Since USFS guidance encourages priority areas to be specific geographic areas, expert judgement was used to divide counties into two classes: priority and non-priority counties (Map 2). Priority counties were selected considering the geospatial analysis performed (Map 1) and experience of program leaders from the Forest Resource Protection Division. A total of 122 counties are considered Priority for the Wildfire and Public Safety issue (Table 10).

Map 2
Priority Counties for Wildfire and Public Safety
(Derived through expert judgement based on priority analysis maps)

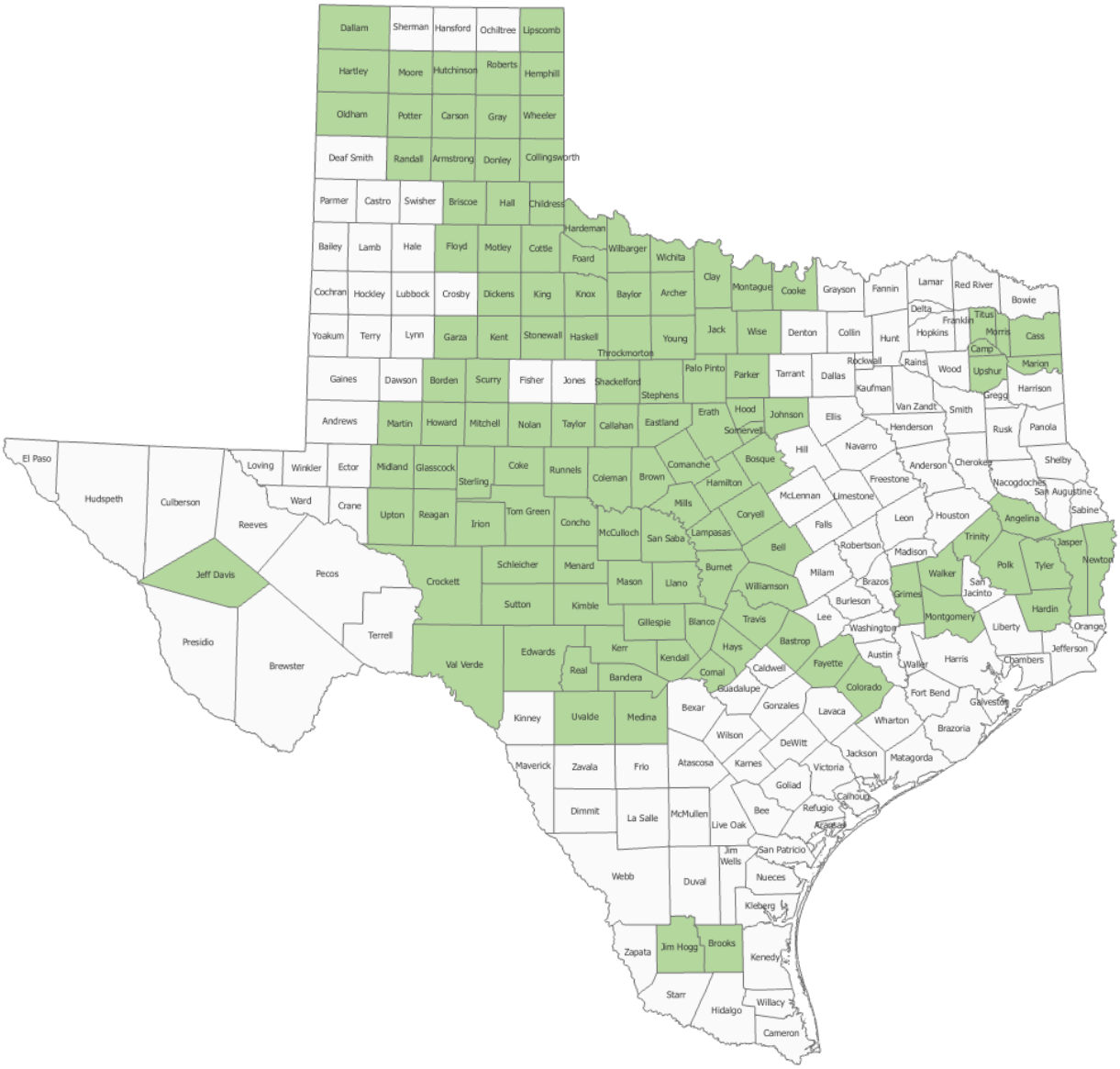


Table 10
Wildfire and Public Safety – Priority Counties

Angelina	Cass	Edwards	Hood	Marion	Polk	Titus
Archer	Childress	Erath	Howard	Martin	Potter	Tom Green
Armstrong	Clay	Fayette	Hutchinson	Mason	Randall	Travis
Bandera	Coke	Floyd	Irion	Medina	Reagan	Trinity
Bastrop	Coleman	Foard	Jack	Menard	Real	Tyler
Baylor	Collingsworth	Garza	Jasper	Midland	Roberts	Upshur
Bell	Colorado	Gillespie	Jim Hogg	Mills	Runnels	Uvalde
Blanco	Comal	Glasscock	Johnson	Mitchell	San Saba	Val Verde
Borden	Comanche	Gray	Kendall	Montague	Schleicher	Walker
Bosque	Concho	Grimes	Kent	Montgomery	Scurry	Wheeler
Brewster	Cooke	Hall	Kerr	Moore	Shackelford	Wichita
Briscoe	Coryell	Hamilton	Kimble	Morris	Somervell	Wilbarger
Brooks	Cottle	Hardeman	King	Motley	Stephens	Wise
Brown	Crockett	Hardin	Knox	Newton	Sterling	Young
Burnet	Dallam	Hartley	Lampasas	Nolan	Stonewall	
Callahan	Dickens	Haskell	Lipscomb	Oldham	Sutton	
Camp	Donley	Hays	Llano	Palo Pinto	Taylor	
Carson	Eastland	Hemphill	McCulloch	Parker	Throckmorton	

State Response Plan

For the past two decades, Texas A&M Forest Service has been developing, using, and refining its operations under the Texas Wildfire Protection Plan (TWPP), a coordinated, interactive effort utilizing multiple components:

- Predictive Services
- Mitigation & Prevention
- Planning & Preparedness
- Applied Technology
- Local Capacity Building
- Rapid Initial Response and Suppression of Wildfires
- Law Enforcement

The TWPP is a proven interagency emergency response model emphasizing ongoing analysis and aggressive response based on the identified risk factors.

Conclusion

Texas A&M Forest Service remains a small agency with a large and expanding mission in one of the top three disaster states in the nation. For the State of Texas and the Texas A&M Forest Service, demand for wildfire and all-hazard emergency response will continue to grow with the population.

To meet these needs Texas A&M Forest Service must continue to implement and develop programs under the Texas Wildfire Protection Plan with an emphasis on:

- Science-based risk and trend analysis to guide development of effective programs and initiatives
- Prevention, risk reduction/mitigation, rapid response, and other cost-effective, proactive efforts focused on addressing identified causal factors

- Coordinated state and community-level programs with a broad cross-section of cooperating parties
- Integrated projects whose results impact multiple priorities
- Strong local support and ownership that supports transition to a long-term community project with minimal state guidance
- Public outreach, education, and training
- Development of response resources and coordinated response efforts
- Effective field deployment of applications and electronic tools to maximize safe and effective operations.
- Automated and publicly available information and tools

The public safety challenges facing Texas A&M Forest Service are significant. While the primary causal factors cannot be eliminated, it is unacceptable to wait for the logical outcome to unfold on the citizens of Texas. To effectively mitigate risks will require continuous, high-level situational awareness coupled with large, ongoing, proactive initiatives in prevention, mitigation, preparedness, capacity building, and rapid response.

Strategy

This section provides goals, objectives, and strategies for addressing the issue of *Wildfire and Public Safety*. Seven goals for this issue are:

1. Integrate climate, weather, and wildland forest fuel conditions into products that will enhance the ability of managers to make sound decisions.
2. Maintain continuous wildfire mitigation and prevention programs that reduce fire occurrence, hazardous conditions, and the risk of loss from wildfires.
3. Work collaboratively with other departments and agencies in planning, developing, implementing, supporting, and evaluating TAMFS emergency response capabilities and needs.
4. Provide leadership in the assessment, development, and successful field deployment of applications, systems, and technological tools to improve employee safety and programmatic delivery.
5. Provide leadership, training, and equipment to strengthen emergency response capabilities of fire departments.
6. Ensure rapid and effective appropriate response to suppress wildfires.
7. Ensure the enforcement of laws pertaining to the protection of forests and grasslands and pursue the prosecution of violators.

The following lists the objectives and strategies for each goal.

Wildfire and Public Safety

Goal 1

Integrate climate, weather, and wildland forest fuel conditions into products that will enhance the ability of managers to make sound decisions

Objective **1.1**	**Determine current and predicted weather conditions throughout the year.**
Strategy **1.1.1**	Develop and maintain remote automated weather station (RAWS) networks and interagency relationships with the USFS, National Weather Service, and other cooperators.
Objective **1.2**	**Monitor the condition of wildland fuels and vegetation.**
Strategy **1.2.1**	Develop and maintain a system and methods to support fuels analysis, including RAWS networks, historic data analysis, live fuel sampling points, FIA data, remote sensing fuels assessments, and GIS analysis capabilities.
Objective **1.3**	**Calculate current and predicted fire behavior to provide decision support documents to firefighters and fire managers.**
Strategy **1.3.1**	Develop and maintain necessary personnel, software applications, and historic datasets to support the continuous daily assessment of conditions, expected fire behavior, critical thresholds, and other indicators.

Objective **1.4**	**Identify and document urban/wildland interface areas and communities at risk.**
Strategy **1.4.1**	Develop and maintain GIS applications and data layers to support identification on UWI areas and communities at risk, along with the primary causal factors in their development.
Objective **1.5**	**Track fire occurrence and ignition sources.**
Strategy **1.5.1**	Monitor TAMFS online fire reporting applications and incorporate data into analysis.
Objective **1.6**	**Disseminate assessment information to cooperators, elected officials, and the public.**
Strategy **1.6.1**	Develop and maintain web-based products and information to provide for the dissemination of wildfire risk and assessment information to citizens, local government, state agencies, and other stakeholders and cooperators.

Priorities

Maintain continuous wildfire mitigation and prevention programs that reduce fire occurrence, hazardous conditions, and the risk of loss from wildfires.

Objective **2.1**

Assign a high priority to mitigation and prevention efforts throughout the year.

Develop and maintain a full spectrum of fire prevention and wildfire risk mitigation programs that provides employees, communities, and cooperators a broad selection of options that most appropriately reduce the risk to lives and property. This may include:

Strategy **2.1.1**

Objective **2.5**	**Strive to empower communities and property owners to mitigate hazards in urban/wildland interface areas.**
Strategy **2.5.1**	Develop and promote effective, community-based risk reduction programs in UWI areas based on community awareness, education, and directed action to provide communities and local homeowners with the ability to implement homeowner and community-based solutions.

Urban/Wildland Interface (definition) – As cities, communities, and suburbia expand into what was once considered rural Texas, this continuing growth brings people and structures into close proximity with large amounts of vegetation. The mixture of homes in areas with flammable grass, brush, and trees is known as the Urban Wildland Interface (UWI), an area extremely vulnerable to wildfire.

Objective **2.6**	**Work with ranchers, state agencies, and other large landowners and cooperators to develop and deliver wildland fuel reduction programs.**
Strategy **2.6.1**	Promote the development, use, and delivery of hazard reductions activities through vegetation removal including mechanical methods—such as mowing or chopping—or prescribed (controlled) fires under manageable conditions.
Strategy **2.6.2**	Work with rural communities, ranchers, and other large landowners to develop and implements measure to protect high-risk communities from wildfires.

Priorities

Goal 3

Work collaboratively with other departments and agencies in planning, developing, implementing, supporting, and evaluating TAMFS emergency response capabilities and needs.

Objective **3.1**	**Analyze predictive services and fire occurrence data to determine local and statewide preparedness levels.**
Strategy **3.1.1**	Monitor statewide wildfire occurrence along with TAMFS and fire department response activity to determine and communicate the appropriate regional and statewide preparedness levels in conjunction with the appropriate Predictive Services and Incident Response staff.
Objective **3.2**	**Ensure prepositioning and availability of resources based on analysis.**
Strategy **3.2.1**	Coordinate the mobilization and demobilization of requested resources at the regional, state, and national level.
Strategy **3.2.2**	Ensure the collection, evaluation, dissemination, and use of resource and incident information to support strategic decision-making, including the repositioning and management of available resources based on current fire risk.
Objective **3.3**	**Maintain a flexible force structure based on risk and occurrence.**
Strategy **3.3.1**	Monitor the category, kind, and type of resources used and their availability; suggest changes as needed based on availability, operational needs, and cost effectiveness.
Objective **3.4**	**Involve local, state, federal, and contract resources.**
Strategy **3.4.1**	Maintain systems, agreements, procedures, and information on incident response resources at the local, state, and national level to ensure agency's capability to respond to wildfires and all-hazard incidents.
Objective **3.5**	**Maintain readiness of qualified resources.**
Strategy **3.5.1**	Maintain wildland firefighter and incident response training, qualifications, and records for state and local personnel.
Strategy **3.5.2**	Order, maintain, and pre-position essential equipment and supply caches across the state to support wildfire and all-hazard response needs.
Strategy **3.5.3**	Ensure that necessary mobilization procedures, response plans, and interagency agreements are developed and maintained to support the mobilization of local, regional, state, and national equipment and personnel.

Priorities

Goal 4

Objective **4.2**	**Coordinate operation and improvement of database and electronic/tech equipment across the Division to ensure cohesive and efficient development and operation.**
Strategy **4.2.1**	Coordinate with FRP Departments on the development and updating of equipment, databases, dashboards, and custom applications to ensure efficient and coherent development and availability.
Strategy **4.2.2**	Work with TAMFS Information Resources and other TAMFS Divisions to coordinate FRP activity and ensure compliance with a System and State required practices.
Strategy **4.2.3**	Maintain and expand existing real-time technology and GIS efforts, particularly those that cross departmental boundaries (Predictive Services, Incident Response, and Planning & Preparedness). Work to further integrate systems and activity between Departments such as TxWRAP, UAV's, WIRES, and Collector.

Priorities

- Enhance existing technological efforts, particularly those that support multiple departments or agencies—such as TxWRAP, SouthWRAP, UAV use, WIRES, Collector, and Fire Connect.
- Lead in the development and implementation real-time data, custom applications, equipment, and dashboards to increase the capabilities of the agency.

Goal 5

Provide leadership, training, and equipment to strengthen emergency response capabilities of fire departments.

Objective **5.1**	**Assist in the development of local fire departments as the primary initial attack resource for rural Texas.**
Strategy **5.1.1**	Ensure that agency personnel develop and maintain a broad knowledge base on all internal and external fire department assistance programs to provide accurate information and timely referrals to all questions.
Strategy **5.1.2**	Ensure that local fire department and local government personnel are recognized as our partners in fire prevention and suppression and are treated with the respect they deserve by all agency personnel.
Objective **5.2**	**Develop and deliver programs committed to training, equipping, and supporting local fire departments and other cooperators.**
Strategy **5.2.1**	Develop, maintain, and deliver a broad range of assistance programs to provide training, equipment, and other identified needs for Texas fire departments.
Strategy **5.2.2**	Design and deliver programs committed to: • Increasing firefighter safety • Increasing local response capabilities • Providing proper stewardship of program resources with a minimum of bureaucracy • Recognizing the independent nature of local government and fire departments • Minimizing limits on local decision-making

Goal 5

Objective **5.3**	**Focus TAMFS fire assistance programs in support of the TWPP.**
Strategy **5.3.1**	Ensure interdepartmental and divisional input and collaboration when developing and revising applications, procedures, and rating systems to promote unified priorities and ease of use for all assistance programs.
Objective **5.4**	**Encourage partnerships between all federal, state, and local cooperators.**
Strategy **5.4.1**	Ensure that departmental staff strives to deliver or work cooperatively with all state and federal assistance programs to achieve the maximum benefit for Texas fire departments.

Priorities

- Enhance local fire department capabilities through the development and delivery of assistance programs to eligible fire departments.
- Maximize the effectiveness of TAMFS capacity building programs through proper stewardship and minimal bureaucracy.

Goal 6

Ensure rapid and effectively appropriate response to suppress wildfires.

Objective **6.1**	**Provide for the safety of emergency responders and citizens.**
Strategy **6.1.1**	Ensure agency personnel participate in appropriate training, qualification, and credentialing systems under NIMS ICS, NWCG, or other relevant systems.
Strategy **6.1.2**	TAMFS response personnel are assigned to work with and support the fire departments within their geographic regions. This should include knowledge of fire departments' capabilities, training, and equipment.
Strategy **6.1.3**	Incident response personnel are expected to know the vegetation, hazards, and risks within their regions, including critical conditions and special tactics or resources that may be required. This knowledge is essential for TAMFS personnel to establish and lead response operations involving local, state, and national resources.
Objective **6.2**	**Conduct response operations in a cost-effective and efficient manner.**
Strategy **6.2.1**	Incident Response personnel, in conjunction with Predictive Services and Planning and Preparedness, will monitor weather, fire occurrence, and fire danger indices to determine appropriate staffing and to release unneeded resources.
Strategy **6.2.2**	During elevated operational periods where external resources are being utilized, departmental staff will establish a Finance Section to monitor daily cost of operation and issue cost-saving recommendations such as identifying individual equipment with the highest cost of operation for prioritized demobilization.

Goal 6		
	Objective **6.3**	**Coordinating the efforts of cooperators to minimize losses.**
	Strategy **6.3.1**	Ensure the development and communications of incident objectives that clearly identify the response objectives and priorities including life safety, known improvements, and hazards. Where possible, ensure the development of a written Incident Action Plan to include incident objectives, operational tactics, and specific resource assignments.
	Strategy **6.3.2**	Ensure operational staff members have access to and are briefed on current and expected conditions, potential hazards, and critical thresholds that may be encountered.
	Objective **6.4**	**Emphasize aggressive initial attack based on fire behavior to prevent project fires that burn for multiple days and occupy resources needed for initial attack.**
	Strategy **6.4.1**	Staff and respond with appropriate resources and tactics to safely suppress fires at a minimal size and duration, preventing large, destructive fires that require long-term resource commitments, resulting in reduced availability of resources for new fires and higher suppression costs.
	Priorities	
		▪ Hire, train, and equip TAMFS firefighters and responders to maximize agency capabilities. • Continue to develop the agreements, systems, and procedures to coordinate the regional mobilization, use, and demobilization of local resources under specific mutual aid programs (TIFMAS and RIMTs).

Goal 7

Ensure the enforcement of laws pertaining to the protection of forests and grasslands and pursue the prosecution of violators.

Objective **7.1**	**Enforce laws relating to wildland fires, including wildfire-cause determination and arson investigation.**
Strategy **7.1.1**	Investigate and assist with prosecution of wildland arson to protect lives, property, and natural resources.
Strategy **7.1.2**	Provide fire-cause determination and investigation for wildland fires at the request of TAMFS and local responders.
Strategy **7.1.3**	Provide training for fire-cause determination to TAMFS firefighters and law enforcement officers.
Objective **7.2**	**Enforce laws relating to timber theft.**
Strategy **7.2.1**	Investigate and assist with prosecution of timber theft to protect timber and forest resources.
Strategy **7.2.2**	Provide timber theft investigation training to TAMFS foresters, resource specialists, and other law enforcement entities.
Objective **7.3**	**Support agency law enforcement needs.**
Strategy **7.3.1**	Provide investigation and security as needed to enhance employee safety and protection of TAMFS offices and property.
Strategy **7.3.2**	Provide investigative and security services as needed to protect and enhance agency programs including VFD vehicle liability insurance, fire department grants, and others.

Performance Outcomes

Goal 1 – *Integrate climate, weather, and wildland forest fuel conditions into products that will enhance the ability of managers to make sound decisions.*

- Internal, external, and public cooperators have web-based access to the risk assessment portals and other Predictive Services tools during decision-making processes.

Goal 2 – *Maintain continuous wildfire mitigation and prevention programs that reduce fire occurrence, hazardous conditions, and the risk of loss from wildfires***.**

- Development and delivery of CWPP's, Firewise Communities, Ranch and other community protections plans and projects to reduce risk and protect Texas homeowners and communities from wildfire.

Goal 3 – *Work collaboratively with other departments and agencies in planning, developing, implementing, supporting, and evaluating TAMFS emergency response capabilities and needs.*

- Development and maintenance of agreements and ICS qualifications by TAMFS personnel and cooperating entities (TIFMAS and RIMT) for in-state and out-of-state deployment.

Goal 4 – *Provide leadership in the assessment, development, and successful field deployment of applications, systems, and technological tools to improve employee safety and programmatic delivery.*

- Improved development and deployment of new technologies to substantially improve TAMFS operations, including TxWRAP, WIRES, Collector and development and use of UAVs.

Goal 5 – *Provide leadership, training, and equipment to strengthen emergency response capabilities of fire departments.*

- Assistance, grants, and equipment provided to Texas fire departments.

Goal 6 – *Ensure rapid and effective appropriate response to suppress wildfires.*

- Decreased losses and increased lives and property saved through rapid and effective emergency response with appropriate resources.

Goal 7 – *Ensure the enforcement of laws pertaining to the protection of forests and grasslands and pursue the prosecution of violators.*

- Statewide leadership provided in the investigation, enforcement, and prosecution of wildfire violations and timber theft.

Issue 2
Sustainability of Forest Resources in East Texas

Issue Description

Since the 1800s, the forests of East Texas have provided immeasurable opportunities for the people of this state. Employment, financial return, cultural stability, recreational opportunities, economic growth, biodiversity, and environmental sustainability are just a few of the benefits from forest land. The pressure on this resource has grown with the population and is creating a changing landscape. The challenge is to conserve these working forests while at the same time protecting this valuable heritage and enhancing the benefits derived from the resource.

For decades, the East Texas Pineywoods was a place loggers cut trees (Figure 16), hunters harvested game, and campers and hikers enjoyed nature. While these activities are still paramount to many, new opportunities for this resource are changing rapidly. Not only do the forests continue to meet traditional needs, but the land itself has become increasingly valuable for non-forest uses. While the FIA data show marginal decrease in acres (-0.1%) of forest land, growth of metropolitan areas and the divestiture of lands owned by integrated forest products companies have converted large, contiguous tracts of forest lands into smaller ownerships. This trend will only continue as the population of the state increases and institutional owners sell properties for their investors.

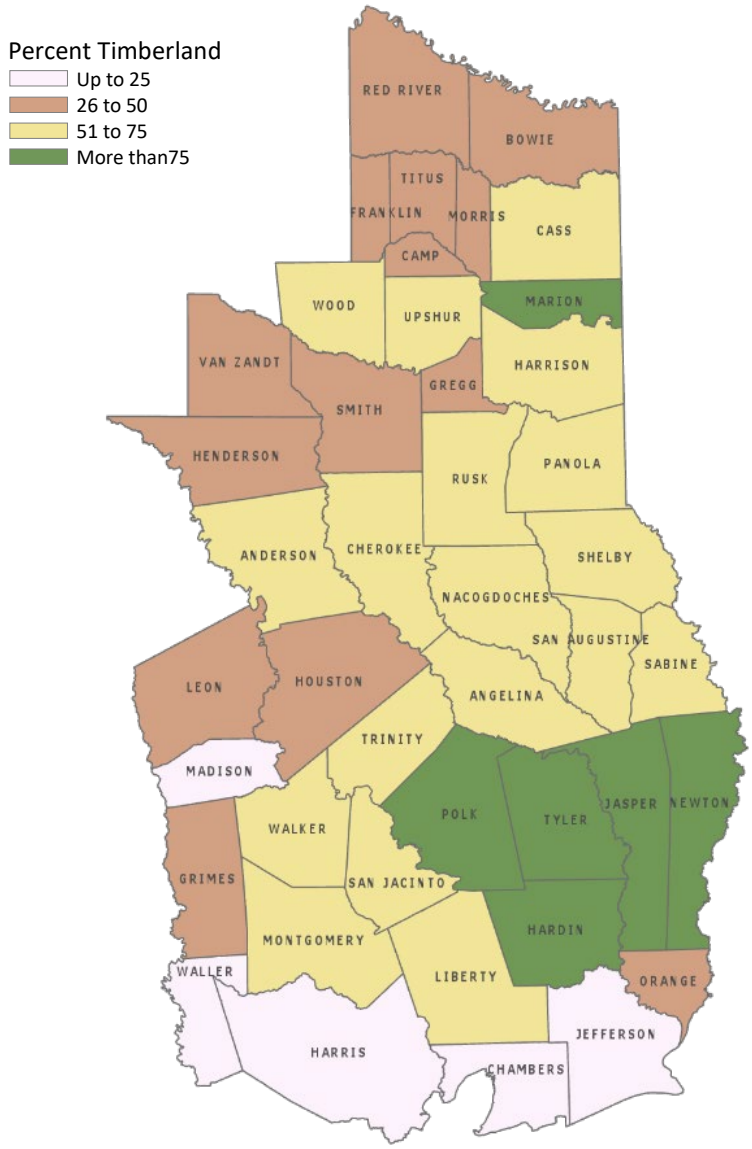
Figure 16
Logging in East Texas

Timberland

East Texas includes 22.4 million acres of total area in 43 counties. Timberland is forestland that is not withdrawn by statute or administrative regulation from the production of wood products and that is capable or growing at least 20 cubic feet per acre per year. There is an estimated 12.0 million acres of timberland, which is 53 percent of the total area of this region.

Percentage of timberland by county is shown in Figure 17. Density ranges from 7 percent to 91 percent. Counties with the greatest densities are in the south central and southeastern counties, with the lowest being along the Gulf.

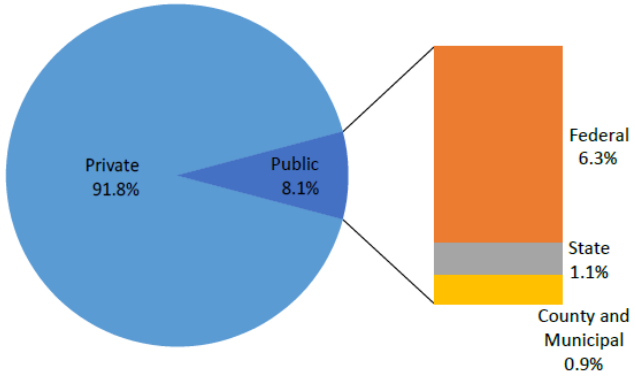
Figure 17
Percentage of Timberland by County in East Texas



Timberland Ownership

In East Texas, 92 percent of the timberland is privately owned (Figure 18). Family forest landowners are by far the largest group of private owners, accounting for 53 percent of all timberland. Timberland once held by corporations that own wood-processing facilities (i.e. vertically integrated forest products companies) has transferred to corporations that do not own wood-processing facilities. These include Timberland Investment Management Organizations (TIMO) and Real Estate Investment Trusts (REIT). TIMOs and REITs currently account for about 24 percent of timberland. Other private ownership classes (i.e. nonindustrial corporate excluding TIMOs and REITs, unincorporated, Native American, and nongovernmental organizations) account for slightly more than 15 percent of all timberland.

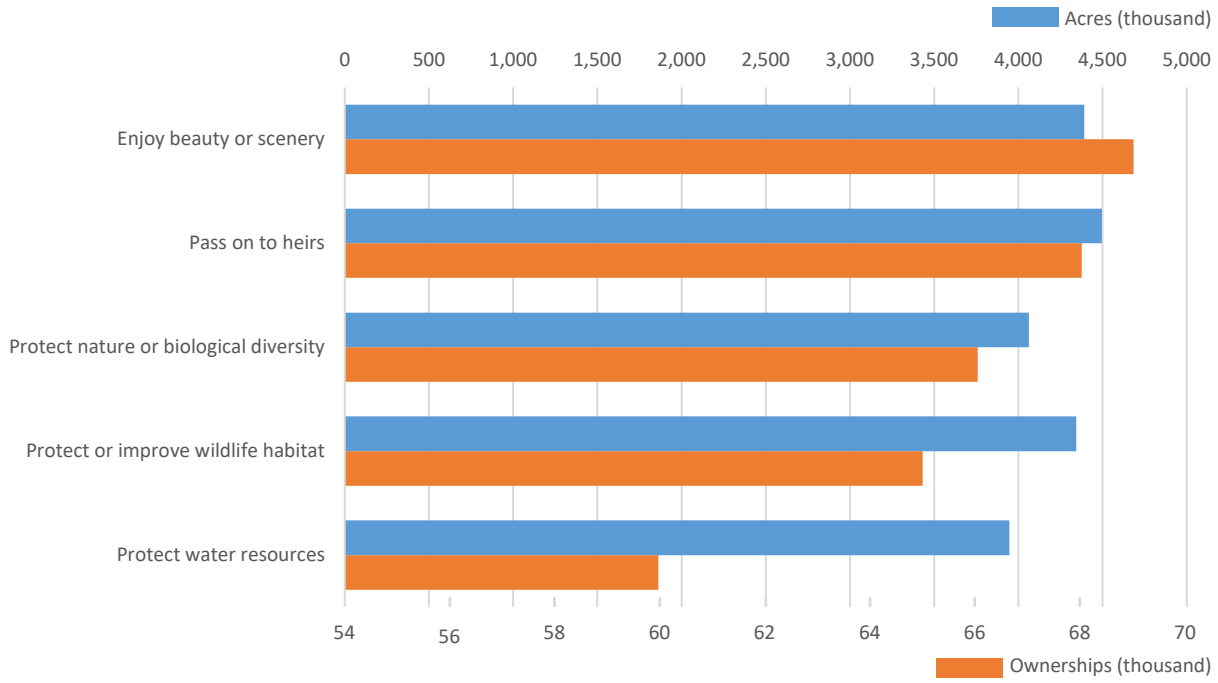
Figure 18
Timberland Ownership



Eight percent of timberland is publicly owned (Figure 18). There is an estimated 573 thousand acres owned by U.S. Forest Service, accounting for 58 percent of all public timberland. The State of Texas and the Department of Defense/Energy account for an estimated 127 thousand and 173 thousand acres, respectively.

East Texas now has more than 200 thousand family forest owners. More than 80 percent of this group own less than 50 acres, representing 5.1 million acres. While many invest in property for traditional, commercial forestry reasons, a growing number of individuals own property for other reasons, such as environmental protection, recreation, ruralism, escapism, and viewing wildlife (Figure 19).

Figure 19
Reasons for Owning Family Forests
FIA's National Woodland Owner Survey (2011-2013)



Change in Forest Products Mills

Manufacturing has also changed over the past decade (Table 11). Several less efficient facilities have closed, including the South's first newsprint mill in Lufkin. The adjustment to these competitive economic times requires more emphasis on highly efficient, modern operations to keep pace with the demands of energy costs, product markets, and company stockholders.

Table 11
Number of Forest Products Mills in 1982, 2008, and 2019

Mill Type	1982	2008	2019
Sawmill	76	50	48
Plywood (Pine Veneer) Mill	8	3	2
Oriented Strand Board (OSB) Mill	0	4	5
Paper and Paperboard Mill	7	4	3
Wood Treating Plant	27	10	10
Large Wood Pellet Facility	0	0	1
Stand-alone Biomass Facility	0	0	1

Total Volume of Timber in East Texas

The East Texas Pineywoods has an estimated timber volume of 17.2 billion cubic feet most of which is in trees having diameters of 20 inches or less (Figure 20). There is an average of 1,438 cubic feet per acre of timberland across the region (Figure 21). Hardwoods account for 42 percent while softwood species account for 58 percent.

Figure 20
Timber Volume by Species Group and Diameter Class

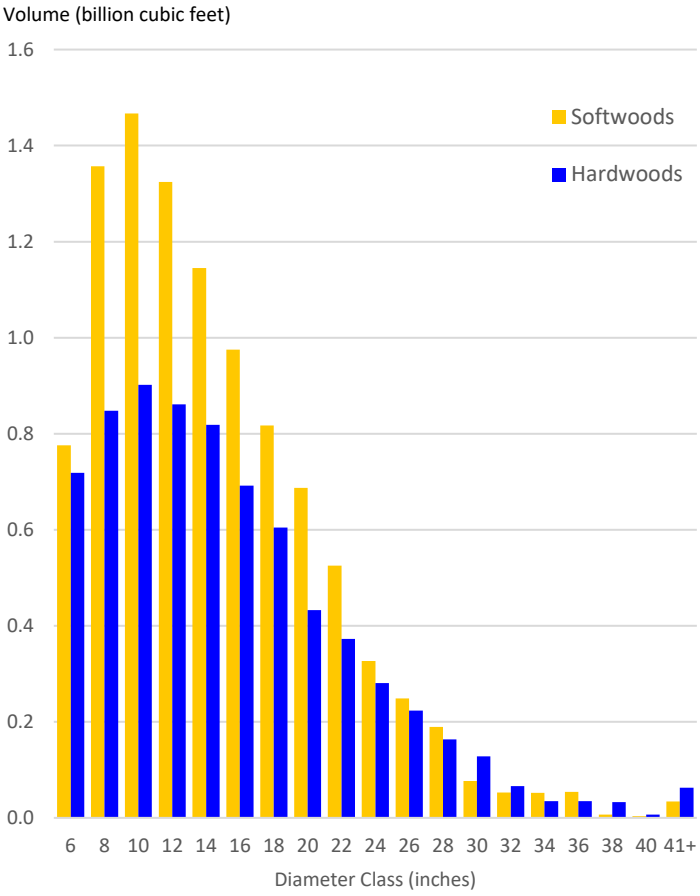
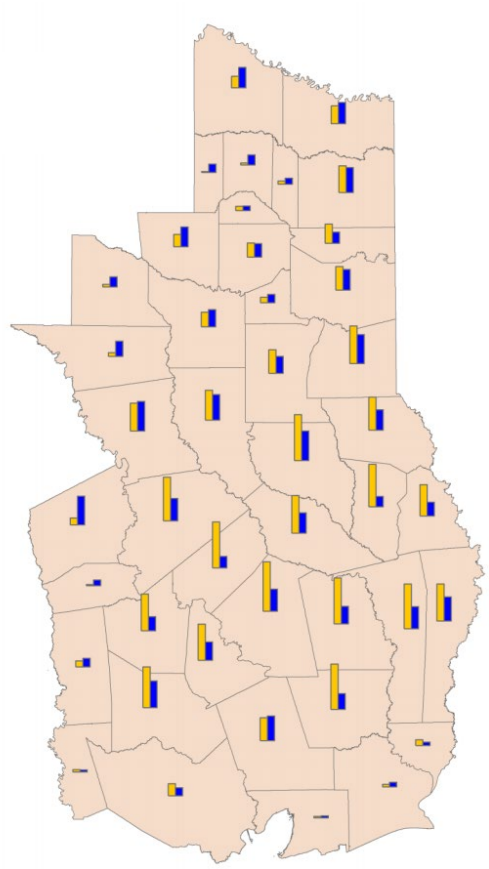


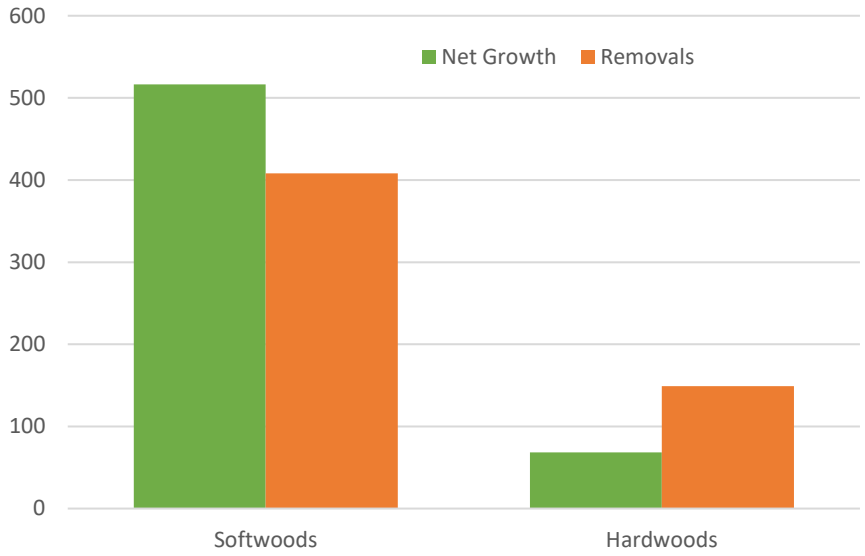
Figure 21
Net Cubic Volume by Species Group and County



Growth and Removals

The average annual net growth of live trees on timberland is estimated at 590.8 million cubic feet throughout East Texas (Figure 21). Average annual removals of live trees on timberland is estimated at 561.3 million cubic feet, with 73 percent of this being softwood. Both these numbers is extremely important to measure sustainability. Currently, overall net growth exceeds removals by 29.5 million cubic feet per year.

Figure 21
Net Growth and Removals of Live Trees on Timberland

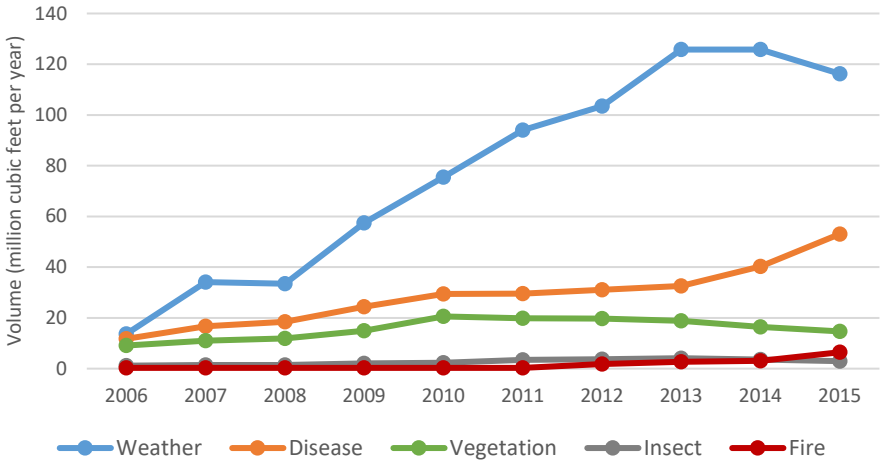


According to Texas A&M Forest Service analysis of current FIA data, the Southeast Texas region enjoys a surplus of timber supply capable of supporting additional forest product manufacturing. Expanding existing production and attracting new business to the area are critical if the industry is to contribute additional economic growth in East Texas. This would also lead to improved forest management and increased reforestation. Working with local leadership, economic development partners, and forestland owners is integral in developing new opportunities for prospective industrial investors.

Mortality

By far, from 2006 to 2015, weather has been the leading cause of mortality among hardwoods (Figure 22). This is especially true after the historic 2011 drought.

Figure 22
Hardwood Mortality by Cause of Death, 2006-2015



Challenges

One of the greatest challenges facing this region is the combined impact of forest conversion, fragmentation, and parcelization, all of which result in reduced ecosystem services provided by forests. Although fragmentation may not decrease the overall amount of forestland like conversion does, wildlife species that require large contiguous tracts can be negatively impacted. Additionally, fragmented landscapes make it increasingly difficult for landowners to obtain management services necessary to maintain healthy and productive forestlands.

While not as pronounced as in Central Texas, landowner demographics, interests, and backgrounds are shifting as younger generations inherit and purchase forest land. Some of these new landowners may not have the knowledge necessary to manage their land effectively to maintain healthy forests. In addition, state forestry programs have historically focused on traditional timber management, which is not always the primary objective for a number of landowners. Resource professionals must recognize this overall changing landscape and when needed, re-tool programs and delivery mechanisms to reach this new audience.

Forest product markets in this region are essential for maintaining a healthy forest ecosystem. Over the years, several mills in Texas have been idled and even closed as result of market conditions and outdated, inefficient manufacturing facilities. Recently, several companies have expanded production capacity and constructed new facilities to offset this loss. Continued research and development can help enhance these markets, resulting in forestland retention.

Maintaining logging and vendor capacity continues to be a challenge for the forest sector. Logging has a proud history in East Texas, and for many in the business, it has been feast or famine over the years. Today's logging operation depends on significant capital investments amidst rising fuel costs, trucking shortages, and an aging and declining workforce.

Wildfires pose a threat to the long-term health and productivity of East Texas forest lands. The sale of industrial forests to timberland investors accelerated the trend of a loss of industrial fire suppression resources. At the same time, local volunteer fire departments have also experienced significant challenges, including frequent turnover and loss of membership, placing increased pressure on state's resources. Collaborative work with local, State, and Federal entities is crucial to implement prevention projects as well as effective and efficient suppression programs.

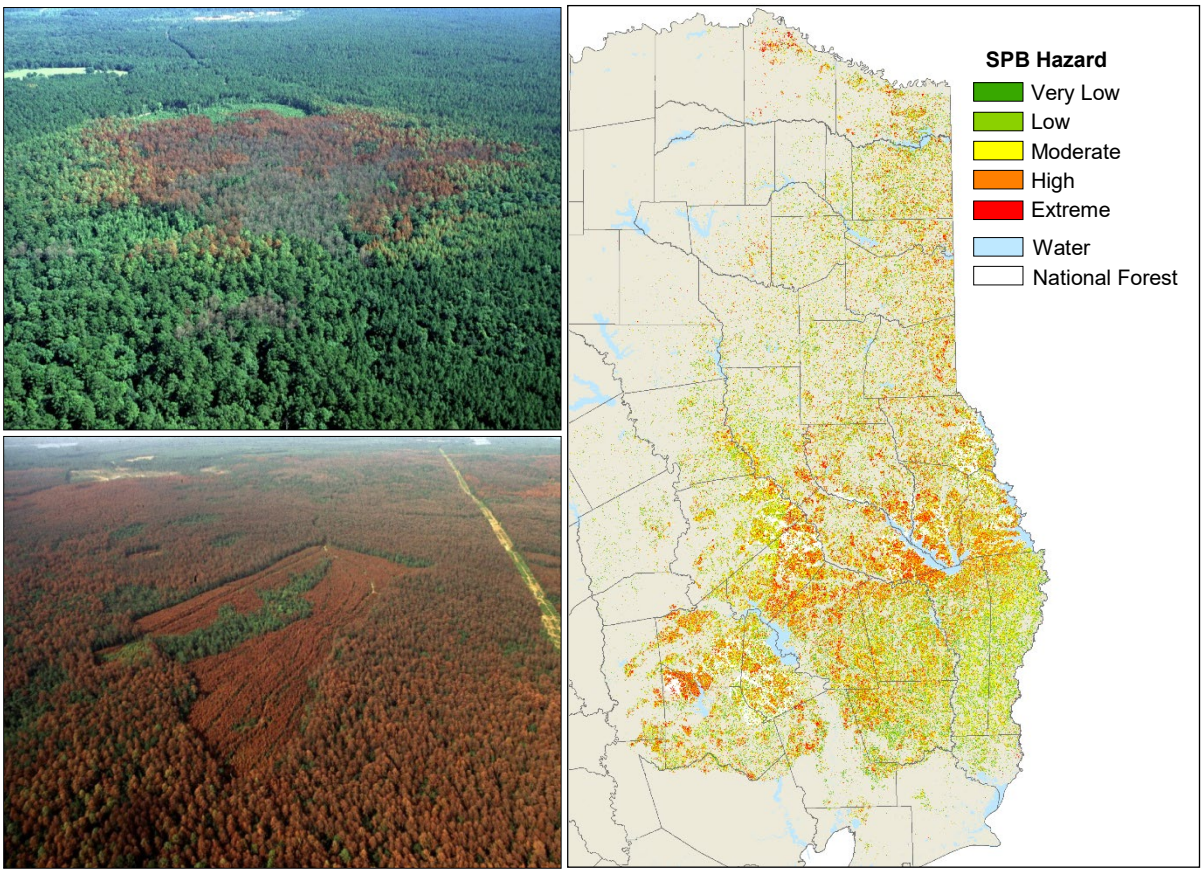
Forest pests can also have a devastating impact on the forest resource. Historically, the southern pine beetle (SPB) has been the most serious pest affecting the pine forests of East Texas, killing hundreds of thousands of acres during the last half of the 20th Century (Figure 23). While there has not been a major outbreak since the late 1990s, landowners should remain vigilant in combatting this destructive pest by practicing good forest management.

Invasive plants, animals, and insects are also problematic to forest ecosystems. Many invasive species such as Chinese tallowtree and Chinese privet have been around for more than a century, while others like Japanese climbing fern, emerald ash borer, and cogangrass have only recently begun to encroach on the East Texas landscape. These species can be introduced through the movement of firewood, nursery stock, imported goods, and even from the accidental planting by unknowing homeowners and landowners.

Figure 23

Uncontrolled Infestations and Hazard Map for Southern Pine Beetle in Texas

Hazard Map Source: USDA Forest Service, Forest Health Technology Enterprise Team, Fort Collins, CO



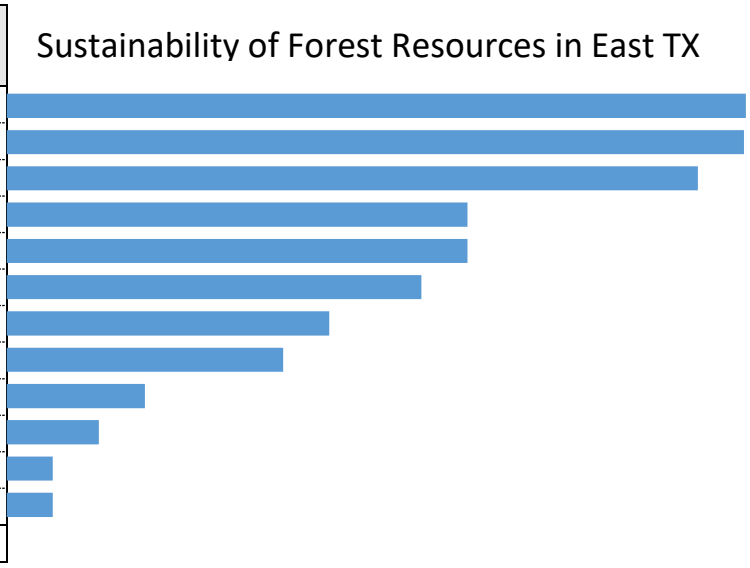
Spatial Analysis

Twelve layers from the Southern Forest Land Assessment were identified as important to the sustainability of the East Texas forest resource. Layer ranking and weighting is based on both statistical hard data (e.g. FIA) and anecdotal reasoning (Table 12). These layers reflect relative importance of the key issues impacting the long-term health and productivity of the forests of the region.

Table 12

Layer Weights Used in Geospatial Analysis Sustainability of Forest Resources in East Texas

Layer Rank	Layer Name	Layer Weight
1	Forest	20
2	Development Threat	16
3	Forest Health	15
4	Forest to Faucet	10
5	Non-TIMO Land	10
6	Wildfire	9
7	Forest Patches	7
8	Site Productivity	6
9	Riparian Areas	3
10	Forested Wetlands	2
11	Protected Areas	1
12	T&E Species	1
	TOTAL	100



Results

Results from the spatial analysis are shown in Map 3. The maps show high priority areas on a 30-meter pixel basis and identifies high priority areas on a county basis. Of the 43 east Texas Counties, 25 are deemed priority (Table 13).

Map 3
Sustainability of Forest Resources in East Texas

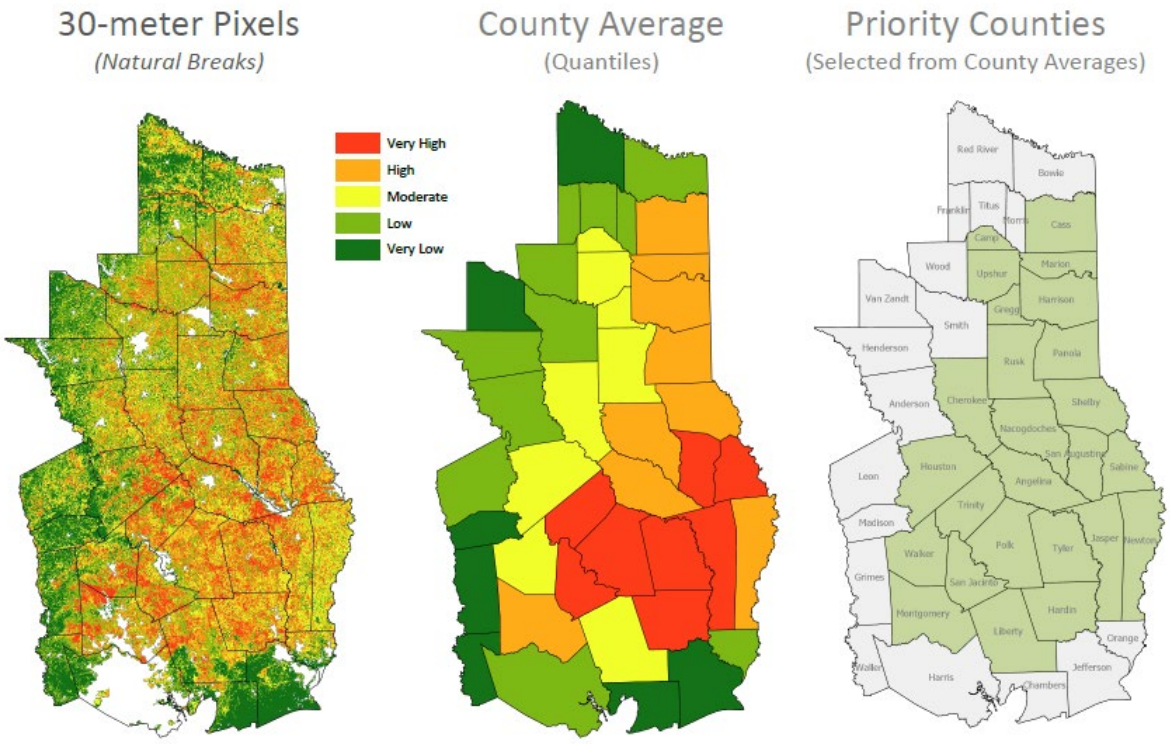


Table 13
Priority Counties for Sustainability of Forest Resources in East Texas

Angelina	Hardin	Marion	Polk	Shelby
Camp	Harrison	Montgomery	Rusk	Trinity
Cass	Houston	Nacogdoches	Sabine	Tyler
Cherokee	Jasper	Newton	San Augustine	Upshur
Gregg	Liberty	Panola	San Jacinto	Walker

Conclusion

Traditional opportunities in forest economic development still exist in East Texas, especially in Southeast Texas, with its surplus of timber supply. Rapid change in timberland ownership, mill closures, maintaining logging capacity, and wildfire and pests pose significant challenges for East Texas. Fortunately, many expanding opportunities exist for East Texas, including new wood technologies.

Strategy

This section provides goals, objectives, and strategies for addressing the issue of *Sustainability of Forest Resources in East Texas*. Three goals for this issue are:

1. Assess and promote the sustainability of East Texas forests.
2. Maintain working forests by improving markets for sustainable forest products.
3. Identify forest economic development opportunities.

The following lists the objectives and strategies for each goal.

Sustainability of Forest Resources in East Texas

Goal 1

Assess and promote the sustainability of East Texas forests

Objective **1.1**	**Analyze the impact of management, harvest, utilization, and regeneration scenarios on the sustainability of forests**
Strategy **1.1.1**	Assess impacts of various management, harvest, utilization, and regeneration scenarios on long-term wood supply.
Strategy **1.1.2**	Maintain knowledge on advancements in regeneration, harvest, utilization, and other silvicultural practices.
Objective **1.2**	**Support the development of healthy, productive forests.**
Strategy **1.2.1**	Develop well-adapted, insect, disease, and drought-resistant planting stock for reforestation, ecosystem restoration, and urban enhancement.
Strategy **1.2.2**	Investigate silvicultural management options for climate resilient species.
Strategy **1.2.3**	Develop practical approaches for monitoring, reducing, and mitigating forest health concerns.
Strategy **1.2.4**	Develop and promote programs that address soil and water resource issues on public and private lands.
Strategy **1.2.5**	Promote the health and sustainability of Texas National Forests through management that is compatible with local and state needs (Shared Stewardship Strategy).
Objective **1.3**	**Identify and mitigate threats to the forest resources of East Texas with a focus on high-priority and threatened landscapes.**
Strategy **1.3.1**	Develop products to identify trends in land-use change.
Strategy **1.3.2**	Predict, monitor, and mitigate wildfire, biological, climate, weather, and other threats to forest health.
Strategy **1.3.3**	Facilitate recovery and restoration of damaged forest landscapes.
Strategy **1.3.4**	Promote the restoration and enhancement of native forest ecosystems.
Strategy **1.3.5**	Provide landowner awareness of potential for timber theft.

Goal 1

Objective **1.4**	**Ensure the relevance of forest resource programs in East Texas.**
Strategy **1.4.1**	Incorporate user needs into program planning and delivery.
Strategy **1.4.2**	Deliver educational resource programs and professional technical assistance to meet the needs of clientele.
Strategy **1.4.3**	Work with partners to help deliver effective financial incentive programs.

Goal 2

Maintain forests by improving markets for sustainable forest products

Objective **2.1**	**Determine the impacts of changes in wood processing facilities on timber supply.**
Strategy **2.1.1**	Develop timber supply projections based on FIA data and likely wood utilization rates of existing and proposed mills.
Strategy **2.1.2**	Monitor and assess the impacts of disasters (hurricanes, wildfire, drought, insects, diseases, etc.) on timber supply.
Objective **2.2**	**Support workforce development and enhancement in the forest sector.**
Strategy **2.2.1**	Investigate strategies to enhance the forest workforce capacity

Goal 3

Identify forest economic development opportunities

Objective **3.1**	**Identify additional forest resource surpluses and deficits.**
Strategy **3.1.1**	Assess needs of existing forest products industries and opportunities for emerging markets.
Objective **3.2**	**Promote the development of ecosystem services markets for forest owners.**
Strategy **3.2.1**	Determine the valuation of forest ecosystem services in Texas.
Strategy **3.2.2**	Facilitate the development of ecosystem service markets in Texas.
Strategy **3.2.3**	Include ecosystem services valuation along with forest products when conducting damage assessments.
Strategy **3.2.4**	Project the change in economic value of various ecosystem services from improved forest health, anticipated climate influence, and land-use change through time.

Performance Outcomes

Goal 1 – *Assess and promote the sustainability of East Texas forests.*

- Monitor and assess the impacts of hurricanes, drought, other weather events, pests, and wildfire on the forest products manufacturing sector.
- Project future fragmentation and resource loss due to real estate development, land conversion, and population growth.
- Predict, monitor, and manage threats to forest health, including invasive plant species, insects, disease, wildfire, land conversion, and fragmentation.
- Increase the number of landowners who actively and sustainably manage their forest and woodlands by five percent annually.
- Re-tool programs and personnel to meet changing landowner needs based on the woodland owners survey.
- Collaborate with steering committees, non-governmental organizations, federal partners, and other cooperators to ensure a synergistic approach to forest health and resource issues.

Goal 2 – *Maintain working forests by improving markets for sustainable forest products.*

- Complete and distribute long-term timber supply and biofuels/bioenergy reports annually.
- Provide market and raw material analyses to potential investors in wood-using industries annually.
- Develop and promote strategies to increase forest workforce capacity.

Goal 3 – *Identify forest economic development opportunities.*

- Develop analysis products to advise potential investors in these markets.
- Serve as the source for unbiased information on carbon and ecosystem services markets.

Issue 3
Central Texas Woodlands Conservation

Issue Description

Rural Central Texas, a region characterized by non-commercial hardwood forests, private livestock ranches, and residential properties, is rapidly changing. A decade-long trend of unprecedented population growth, land fragmentation, and dramatic shifts from traditional to non-traditional land uses is threatening priority rural landscapes. As rapidly expanding urban population centers encroach into surrounding areas, rising land values result in transforming these rural landscapes.

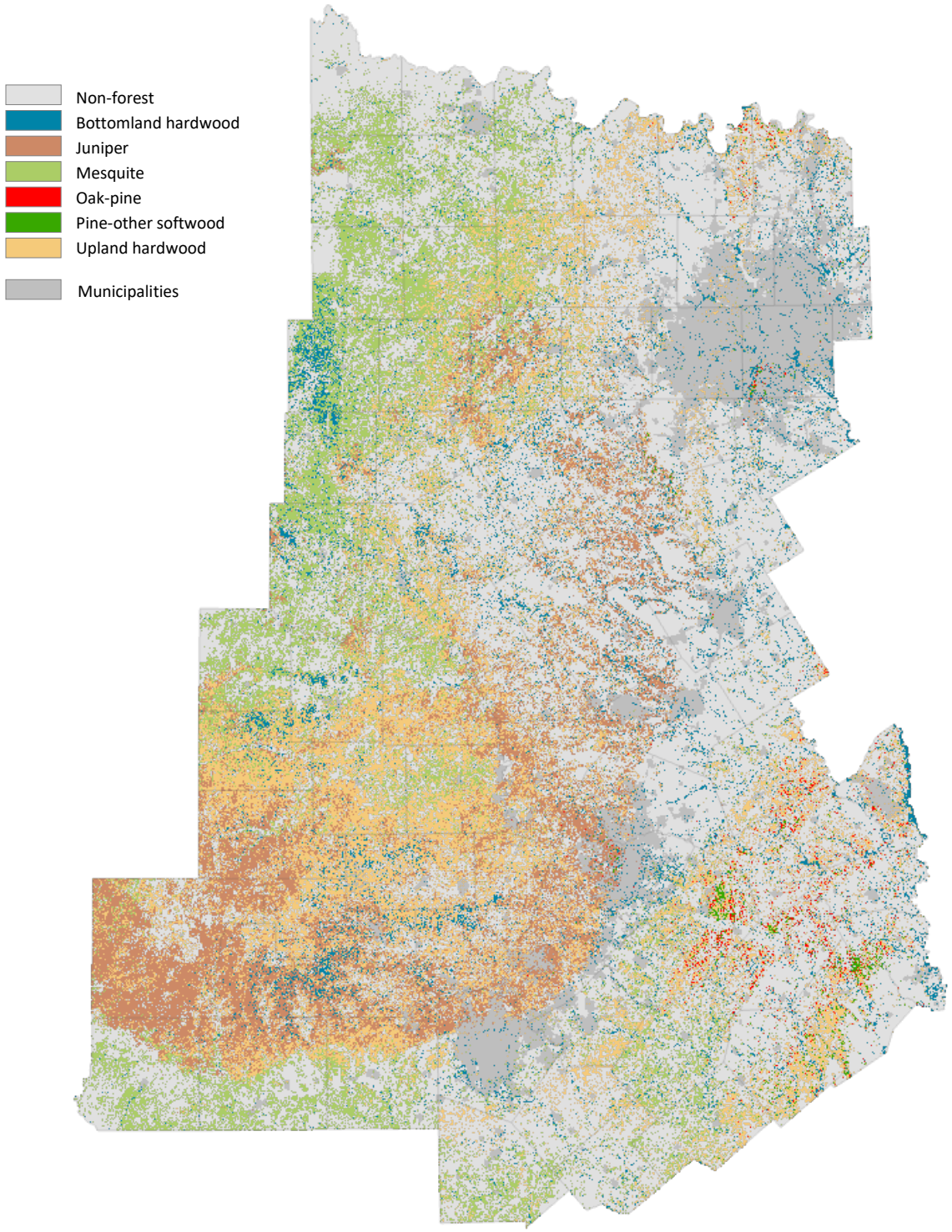
Woodlands in this region also face threats from wildfire, natural disasters, oak wilt, climate change and invasive plants. Additionally, changing landowner objectives and a lack of awareness of land management practices further threaten this landscape. To sustain and protect its valuable woodlands, this region requires a well-integrated conservation initiative that incorporates components of stewardship, oak wilt management, watershed protection and restoration, invasive plant management, and wildfire prevention, among other forestry programs.

Forestland

The portion of the state commonly referred to as Central Texas includes 90 counties, covering approximately 125,000 square miles, and represents 40 percent of the land area of the state. As described in this document, Central Texas includes the following ecoregions: Eastern and Western Cross Timbers, Grand Prairie and Plains, Blackland Prairies, Edwards Plateau, and Post Oak Savannah.

The hardwood forests found in Central Texas differ from the traditional pine and hardwood timberlands that dominate East Texas (Figure 24). Like other Texas forests, the forest woodlands in this western fringe are prized by many for their beauty, shade, erosion control, wildlife, recreation, real estate value, and watershed protection, rather than for manufactured forest products. Conversely, encroaching woodland species have the potential to negatively impact grazing quality, wildlife habitat, wildfire risk, and water supply.

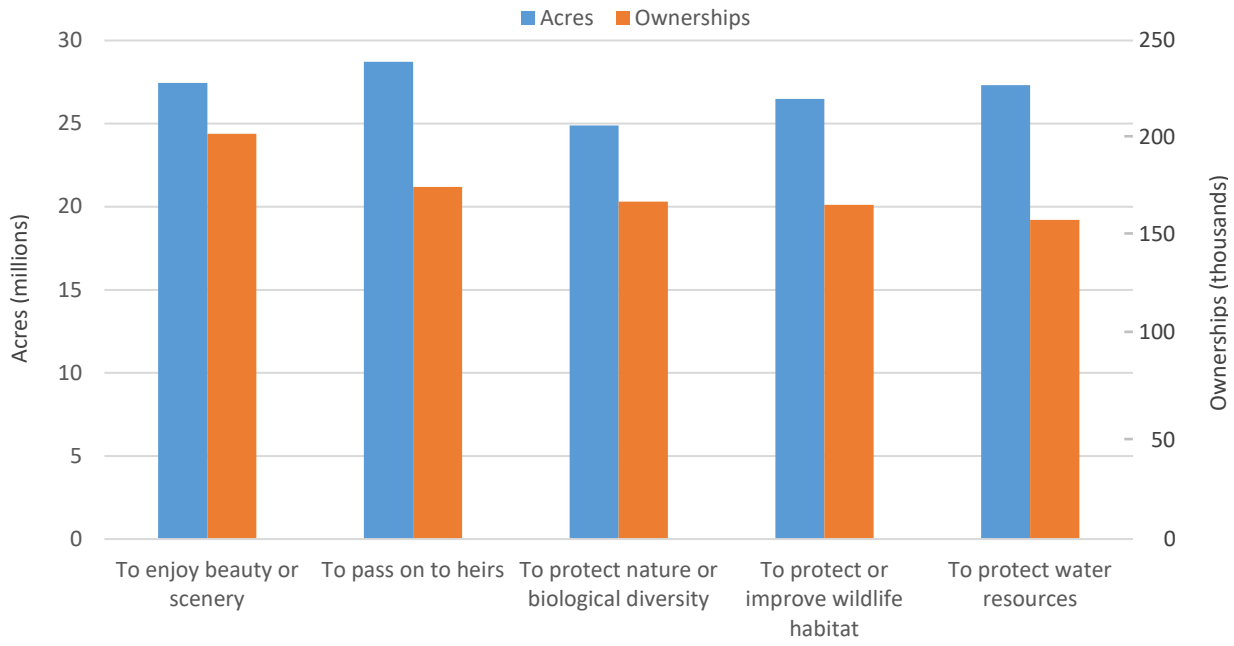
Figure 24
Forest Types of Central Texas Region



Ownership

In Central Texas, 95 percent of the forestland is privately owned. Family forest owners are by far the largest group of private owners, accounting for 71 percent of all forestland. These owners own land for a variety of reasons (Figure 25). The most common reason for owning land is to enjoy beauty and scenery.

Figure 25
Reasons for Owning Land in Central Texas
National Woodland Owners Survey



Population Growth and Fragmentation

Central Texas has experienced explosive population growth and is home to a majority of the 29 million residents of Texas. In recent years, many Texans have chosen to leave suburban areas to purchase and enjoy rural life on sub-divided "ranchettes" in a region once dominated by large ranches. Today's landowners in Central Texas are faced with a changing and more fragmented landscape, an increasing human population, and special protection needs from wildfire, oak wilt, invasive plants, forest fragmentation, and water shortages. Forest resource information from Central Texas has long been lacking.

TAMFS Program Delivery

For the first 70 years of its existence, Texas A&M Forest Service limited its forestry and woodlands protection programs to the 12 million acres of commercial forests in 43 counties of East Texas (with the exception of urban foresters stationed in Dallas/Fort Worth and San Antonio). In 1988, with the initiation of the Texas Cooperative Oak Wilt Suppression Project, services offered by Texas A&M Forest Service were expanded to counties in Central Texas to address a severe problem of oak wilt, a vascular disease that was killing thousands of valuable live oaks and red oaks (Figure 26) (see www.texasoakwilt.org). These same foresters later expanded their services and program delivery on Forest Stewardship throughout the region.

Figure 26
Oak Wilt Has Killed Thousands of Live Oaks and Red Oaks in Rural and Urban Areas of Central Texas

In 1993, Texas A&M Forest Service fire protection and prevention programs were expanded to Central and West Texas. In addition, the agency increased the urban and community forestry program to include urban and community foresters in Alpine, Austin, Dallas, Fort Worth, Houston, Longview, Kingsville, and San Antonio. More recently, in 2004, the Forest Inventory and Analysis (FIA) program for the first time began establishing permanent plots to measure the extent and diversity of woodland resources in Central and West Texas. In 2005, Texas A&M Forest Service initiated a program to detect invasive, non-native plants in various regions of the state. With funding from the U.S. Forest Service, Forest Health Protection, and in partnership with the Lady Bird Johnson Wildflower Center and the Houston Advanced Research Center, Citizen Scientists are being trained to report new invasive plant sightings throughout the state. This cooperative effort is documenting for the first time the extent and severity of exotic plant invasions in different ecoregions of Texas (see www.texasinvasives.org).

Texas A&M Forest Service programs have addressed oak wilt, forest stewardship, forest inventory, and wildfire prevention, though they have historically operated more or less independently and have not been targeted to reach the new generation of landowners. Delivery of an integrated conservation initiative to address the challenges facing this region of the state is required. Since Texas A&M Forest Service has a limited staff in Central Texas, all agency programs must work in concert and partnerships among diverse stakeholders is required in order to be successful.

Following the development of the Texas Forest Action Plan in 2010, such an initiative was established—Central Texas Conservation Partnership (CTCP) (https://www.texasconservation.org/). This partnership is a collaborative effort among ten natural resources agencies or organizations that has developed a well-integrated approach for conservation.

Challenges

Central Texas faces many challenges to its trees and forests—some unique and some not so unique to the region.

One of the greatest challenges is the suppression of oak wilt. Oak wilt is a devastating disease of live and red oaks that is difficult and expensive to control, especially in urban and suburban neighborhoods where the trees are monetarily very valuable. Treatment often requires getting multiple homeowners or landowners to agree to work together cooperatively to install a trench to sever root connections, since a single oak wilt center can occur across several properties. In addition, oak wilt is a disease that likely will never be controlled or eradicated.

Wildfire and other natural disasters also threaten the forests of Central Texas almost every year. Thousands of acres of Central Texas forestland were destroyed during the 2011 fire season. Additionally, the historic drought that same year resulted in widespread mortality throughout this region, with as much as 15 percent of the trees being killed. Flash floods can also cause significant impact to riparian forests in Central Texas. The 2015 Blanco River flood destroyed many picturesque baldcypress trees along the river in Blanco County. However, these challenges offer many opportunities for restoring the ecosystem.

The availability of forest product markets in Central Texas also poses challenges to sustainably managing this resource. Unlike East Texas, which has a very viable and robust market for wood, little exists for marketing wood for wood products in Central Texas. The largest markets are likely for fence posts and firewood. However, potential exists for Central Texas woodlands to provide massive amounts of woody biomass if and when this green, renewable fuel market takes off. Other opportunities include developing markets for ecosystem services.

Landowner demographics and interests are also changing in this region. As the population continues to grow, more and more people are buying property in the woodlands. These landowners may not have the knowledge for managing their land in effective ways to maintain healthy forests and ecosystems. It is our challenge to provide these landowners with as much useful information on land management as they need and want.

Also, during the last decade, due to significant drought and wildfires, ponderosa pine has been declining in the Davis Mountains of the Trans-Pecos region of Texas. Texas A&M Forest Service is partnering with The Nature Conservancy on their Davis Mountains Preserve to investigate successful techniques to restore this important western species. Much work is needed and efforts continue with this endeavor. Although Jeff Davis County is not a county considered to be in Central Texas, because this is such an important undertaking, this county and issue are being included in the Central Texas Woodland Conservation issue.

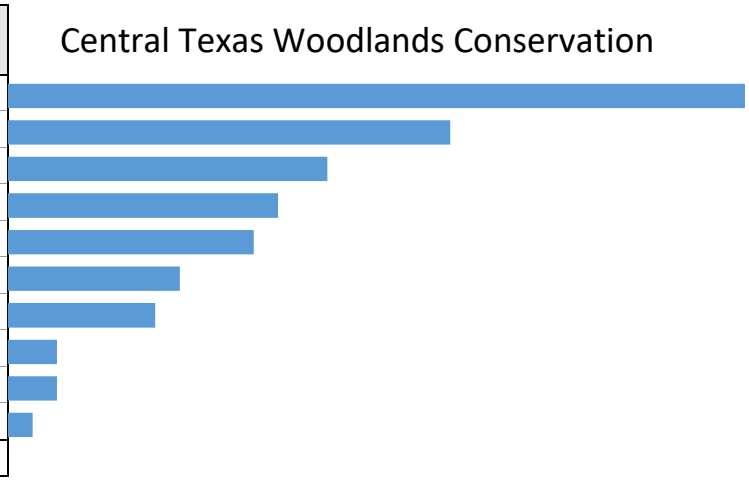
Spatial Analysis

To help guide where to focus efforts, a geospatial analysis was performed as described in the overview on geospatial analysis. Specifically, weighted raster overlay analysis was performed based primarily on seven layers (Table 14): Forest Health Threat (30%), Forestland (18%), Development Threat (13%), Wildfire Threat (11%), Forest to Faucet (10%), Riparian Areas (7%), and Forest Patches (6%).

Table 14

Layers and Layer Weights used in Overlay Analysis for Central Texas Woodlands Conservation Issue

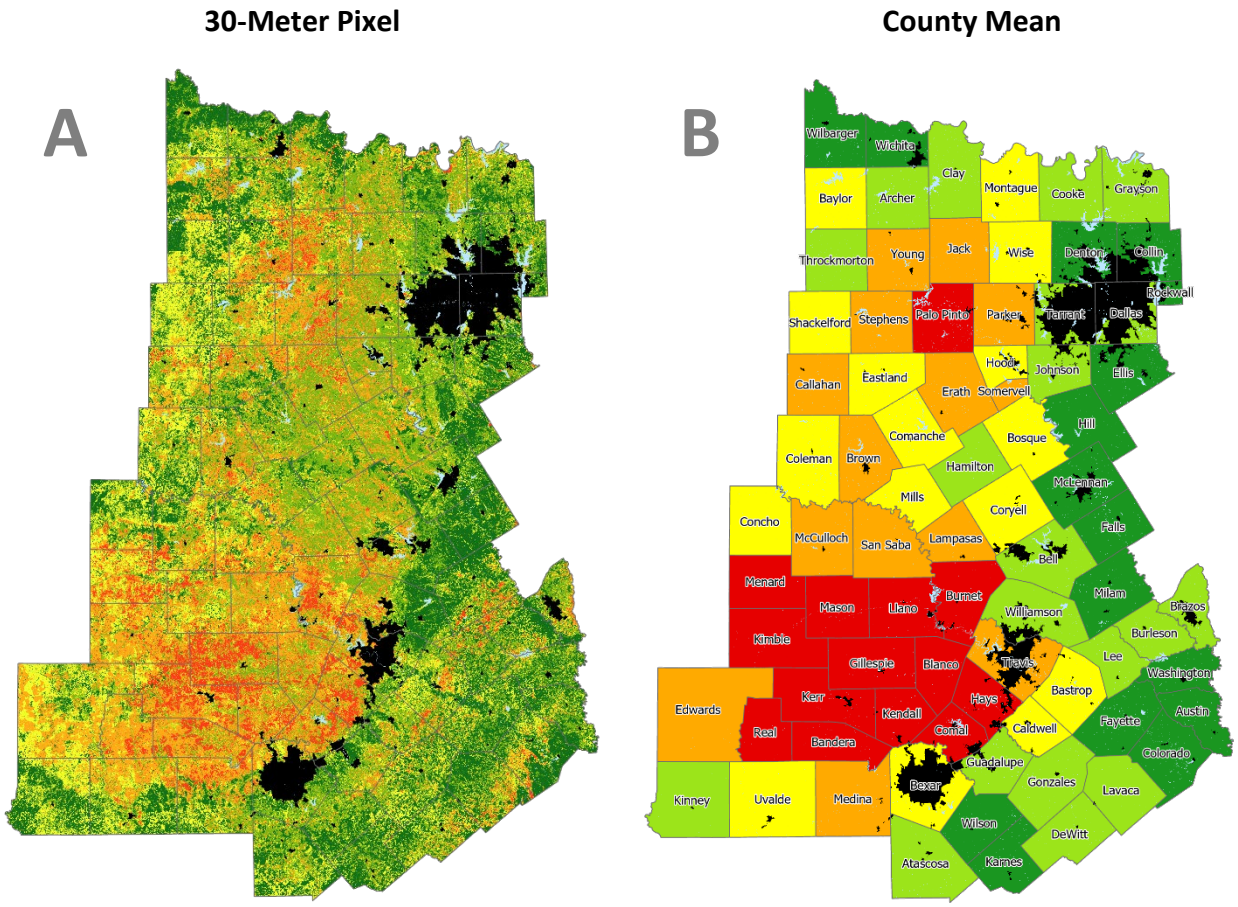
Layer Rank	Layer Name	Layer Weight
1	Forest Health Threat	30
2	Forest	18
3	Development Threat	13
4	Wildfire Threat	11
5	Forest to Faucets	10
6	Riparian Areas	7
7	Forest Patches	6
8	T&E Species	2
9	Forested Wetlands	2
10	Protected Areas	1
	TOTAL	100



Results

Results from this overlay analysis are shown in Map 4A and 4B. Map 4A shows results on a 30-meter pixel basis and Map 4B shows results when pixel data are summarized by county. Very high priority and high priority lands together include 12.3 million acres, or 28.0 percent of the total (Table 15). When county averages are considered, 28 of the 80 counties in Central Texas, or 35 percent, are considered very high or high priority (Table 16).

Map 4
Priority Analysis for Central Texas Woodlands Conservation – 30 Meter Pixel Map (A) and County Mean Map (B)



Priority Class

- Very High
- High
- Moderate
- Low
- Very Low
- Urban
- Water

Percent of Potential Maximum

Priority Class	30-Meter Pixel	County Mean
Very High	40.2 – 93.0 %	27.2 – 37.0 %
High	29.5 – 40.2 %	21.4 – 27.2 %
Moderate	18.7 – 29.5 %	16.7 – 21.4 %
Low	8.1 – 18.7 %	12.4 – 16.7 %
Very Low	< 8.1 %	< 12.4 %

Table 15
Area within Each Priority Class for the Central Texas Woodlands Conservation Issue

Priority	Acres	Percent of Total
Very High	2,888,759	6.6 %
High	9,397,798	21.4 %
Medium	9,364,085	21.4 %
Low	10,412,332	23.8 %
Very Low	11,766,313	26.8 %
TOTAL	43,829,288	100.0 %

Table 16
Number of Counties by Priority Class for the Central Texas Woodlands Conservation Issue

Priority	Number	Percent of Total
Very High	14	17.5 %
High	14	17.5 %
Medium	16	20.0 %
Low	20	25.0 %
Very Low	16	20.0 %
TOTAL	78	100.0 %

Since U.S. Forest Service guidance encourages priority areas to be specific geographic areas, expert judgement was used to divide the counties into two classes: priority and non-priority counties (Map 5). Priority counties were selected considering the geospatial analysis performed (Map 4) and experience and judgment of program leaders for this area of Texas. As explained earlier, Jeff Davis County in the Trans-Pecos Region of Texas was also included due to the importance of ponderosa pine restoration. Priority counties for the Central Texas Woodlands Conservation Issue include 41 of 81 counties (Table 17).

Woodlands conservation in Central Texas would contribute to and support the Texas Conservation Action Plan developed by the Texas Parks and Wildlife Department. By protecting and enhancing Central Texas woodlands and water resources, as well as habitat for endangered and threatened species, conservation efforts would directly supplement the Land and Water Resources Conservation and Recreation Plan, a major component of the Texas Wildlife Plan. Though almost all the woodlands in Central Texas is privately owned, coordinated conservation efforts encompass all ownerships, including state- and federally owned properties.

Map 5

Priority Counties for Central Texas Woodlands Conservation

(Derived through expert judgement based on priority analysis maps)

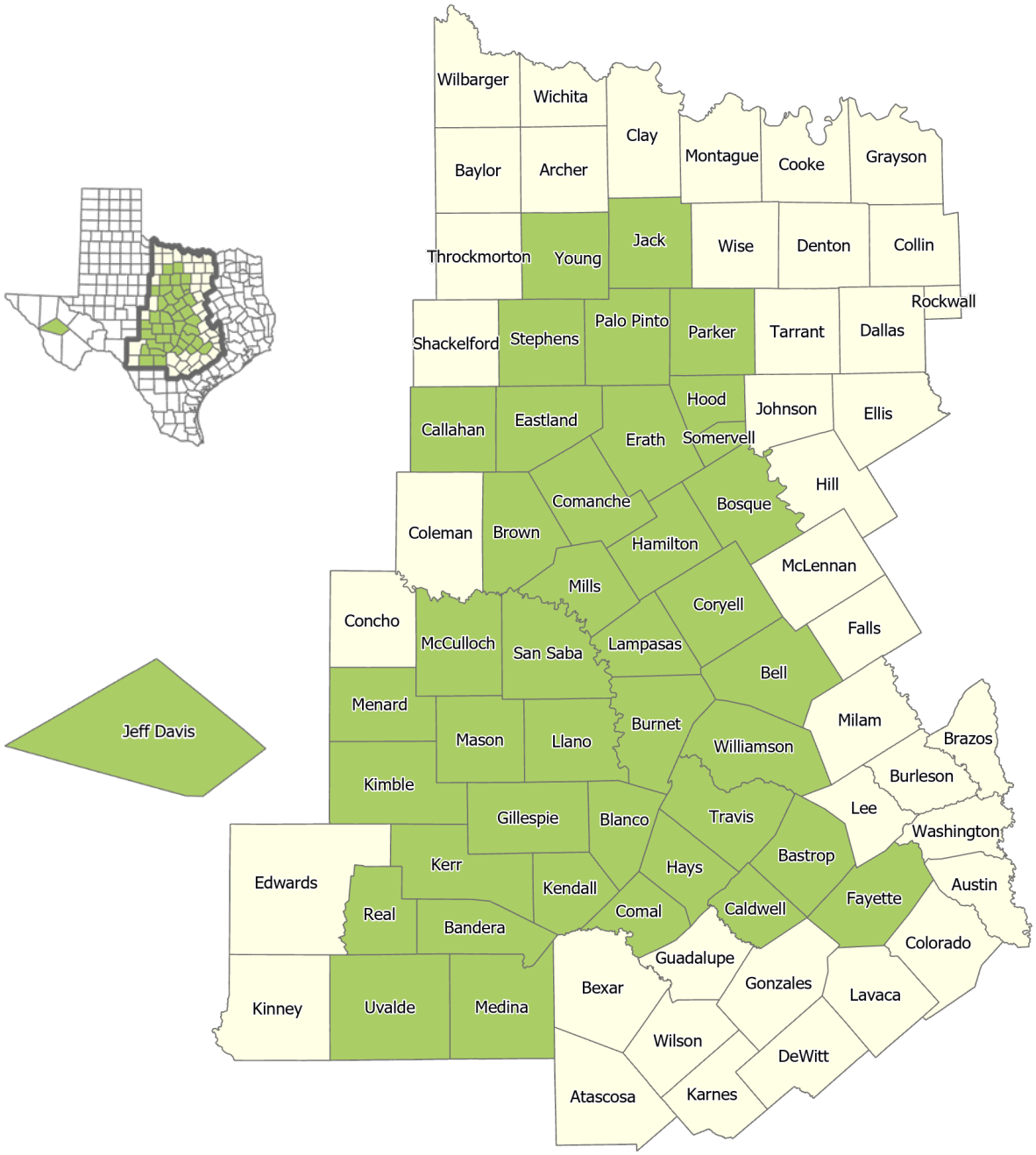


Table 17

Central Texas Woodlands Conservation – Priority Counties

Bandera	Caldwell	Fayette	Kendall	Medina	Somervell
Bastrop	Callahan	Gillespie	Kerr	Menard	Stephens
Bell	Comal	Hamilton	Kimble	Mills	Travis
Blanco	Comanche	Hays	Lampasas	Palo Pinto	Uvalde
Bosque	Coryell	Hood	Llano	Parker	Williamson
Brown	Eastland	Jack	Mason	Real	Young
Burnet	Erath	***Jeff Davis***	McCulloch	San Saba	

Strategy

This section provides goals, objectives, and strategies for addressing the issue of *Central Texas Woodlands Conservation*. Three goals for this issue are:

1. Improve the health of forests and woodlands in Central and West Texas.
2. Assess and promote the conservation of forests and woodlands in Central and West Texas.
3. Promote and maintain forests by improving markets for sustainable forest products and services.

The following lists the objectives and strategies for each goal.

Central Texas Woodlands Conservation

Improve the health of forests and woodlands in Central and West Texas

Goal 1

Objective **1.1**	**Identify and mitigate threats to the forest and woodland resources of Central and West Texas with a focus on high-priority and threatened landscapes.**
Strategy **1.1.1**	Develop products to identify trends in land-use change.
Strategy **1.1.2**	Predict, monitor, and mitigate wildfire, biological, climate and weather, and other threats to forest health.
Strategy **1.1.3**	Facilitate recovery and restoration of damaged forest landscapes.
Strategy **1.1.4**	Promote healthy forest ecosystem programs through landowner meetings, social media, web sites, news releases, and other outlets.
Objective **1.2**	**Ensure the relevance of forest and woodland resource programs to Central and West Texas.**
Strategy **1.2.1**	Incorporate user needs into program planning and delivery.
Strategy **1.2.2**	Deliver educational resource programs and professional technical assistance to meet the needs of clientele.
Strategy **1.2.3**	Work with partners to help deliver effective financial incentive programs.

Goal 2

Assess and promote the conservation of forests and woodlands in Central and West Texas

Objective **2.1**	**Analyze the impact of population growth, development, and land fragmentation scenarios on the sustainability of forests and woodlands.**
Strategy **2.1.1**	Communicate the impacts of population growth and changes in land use on forest and woodland resources.
Strategy **2.1.2**	Maintain knowledge on advancements in policy, technology, assistance programs, and other resources that conserve, protect, and enhance forests and woodlands.
Objective **2.2**	**Support the sustainability of healthy, productive forests and woodlands.**
Strategy **2.2.1**	Promote the use of well-adapted insect, disease, and drought resistant planting stock for reforestation, ecosystem restoration, and urban enhancement.
Strategy **2.2.2**	Investigate silvicultural / horticultural / agroforestry management options that include the use of non-invasive and climate resilient species.
Strategy **2.2.3**	Develop practical approaches for assessing, monitoring, reducing, and mitigating the impacts of forest health concerns.
Strategy **2.2.4**	Develop and promote programs that address oil and water resource issues on public and private lands.
Strategy **2.2.5**	Monitor and assess the impacts of disasters (hurricanes, wildfire, drought, insects, diseases, etc.) on forests and woodlands.

Goal 3

Promote and maintain forests by improving markets for sustainable forest products and services

Objective **3.1**	**Identify forest and woodland economic development opportunities.**
Strategy **3.1.1**	Assess needs of existing forest products industries and opportunities for emerging markets in Central and West Texas.
Strategy **3.1.2**	Develop wood supply projections using FIA data and proposed utilization rates.
Objective **3.2**	**Promote development of ecosystem services markets for forest owners.**
Strategy **3.2.1**	Determine the valuation of forest ecosystem services in Texas.
Strategy **3.2.2**	Facilitate the development of ecosystem service markets in Texas.
Strategy **3.2.3**	Include ecosystem services valuation along with forest and woodland products when conducting forest health surveys, stewardship planning, and damage assessments.
Strategy **3.2.4**	Project the change in economic value of various ecosystem services from improved forest and woodland health, anticipated climate influence, and land-use change through time.

Performance Outcomes

Goal 1 – *Improve the health of forests and woodlands in Central and West Texas.*

- Produce educational materials and programs for private landowners to improve the productivity and health of forests and woodlands in the region.
- Lead the development and promotion of silvicultural, horticultural, and other sustainable land-use practices that mitigate fuels, conserve water resources, and reduce the impacts of climate variability on forest and woodland productivity and health.
- Conduct forest health assessments and monitor forests and woodlands for invasive insects, diseases, plants, and other potentially harmful pests.
- Promote the importance of professional land management planning to landowners within high priority landscapes.

Goal 2 – *Assess and promote the conservation of forests and woodlands in Central and West Texas.*

- Reduce resource losses through education and coordination of prevention, mitigation, and suppression projects for major forest, woodland, and tree stressors.
- Conduct rapid damage assessments of natural and man-caused disasters and the impacts on forest/woodland health and productivity.
- Establish and maintain strong relationships with Federal, State, and local partners to ensure effective and efficient delivery of collaborative, landscape programs within the high priority landscapes.

Goal 3 – *Promote and maintain forests by improving markets for sustainable forest products and services.*

- Partner with industry in Texas to promote the use of local / genetically improved plant selections and facilitate the distribution of novel cultivars to tree seed and seedling producers.
- Incorporate ecosystem services valuation information into Forest Stewardship plans, forest health, and damage assessments.

Issue 4
Urban Forest Sustainability
Rapid Population Growth, Land Use Changes, and Natural Disasters Threaten Urban Forestry Sustainability

Issue Description
Trees and forests in urban and community areas represent valuable natural and cultural resources. Traditional methods for calculating these values have focused on the replacement cost of individual trees (Guide for Plant Appraisal, 2018), but computer models (USDA Forest Service's iTree and Urban Forest Inventory & Analysis) can also evaluate the functional values of trees in cities, including air pollution removal, energy savings, stormwater runoff, and carbon sequestration and storage. Other values often assigned to urban trees include real estate values, recreation, health benefits, psychological well-being, and aesthetic appeal (Figure 27). These other values are perhaps harder to quantify but are no less real to the residents of our cities and towns.

Figure 27
Community Trees Provide Shade and Many Other Benefits Where Citizens Live, Work, and Play

This wide range of benefits is key to understanding the role urban trees and forests play in improving quality of life and the environment. Urban forest sustainability can be described as the measure of how well the network of trees, forests, and related natural resources help maintain the health of ecosystems in cities. But conversely, program delivery can focus on particular places where sustainability is low, using the restorative powers of trees—their functional values—to help solve landscape-scale problems that affect millions of people, including urbanization, air quality, water quality, climate change, energy consumption, natural disasters, and even public health issues.

Urban and Community Land

Urban and community forest land is present in all 254 counties in Texas. The definition of community land is based on jurisdictional or political boundaries delimited by the U.S. Census Bureau definition of places. Community lands are places of established human settlement that may include all, some, or no urban land within their boundaries. Urban land or areas, also defined by the U.S. Census Bureau, are a densely settled core of census tracts or blocks that meet minimum population density requirements. In 2010, there were 5.6 million acres of urban/community land in Texas, of which approximately 26.7 percent was under tree cover. This figure is up from 4.4 million acres of urban/community land in 2000 (Nowak and Greenfield, *J. For.* 2018).

Ownership

Ownership of urban/community forestland varies significantly across the state. The trees and forest land in many smaller communities may be almost exclusively privately owned, whereas larger cities tend to have more public recreation lands. In Austin, for example, over 50 percent of the forest land is publicly-owned.

Population Growth

Texas is a desirable place to live and work; its population is projected to exceed 50 million people, by 2050. The impact of this rapid growth shows up on the landscape as urbanization—the conversion of rural open space to urban uses. Between 1982 and 2017, a total of 4.3 million acres were converted to developed land (https://www.nrcs.usda.gov/Internet/NRCS_RCA/reports/nri_dev_tx.html).

Water Quality

While Texas sees its share of extreme weather, most rain events are more moderate. Any time rain falls on the impervious surfaces of our cities, it picks up debris, chemicals, sediment, and other pollutants and delivers them to either a city stormwater system or directly to a stream, lake, or river—often a source of public drinking water. In addition, these pollutants can make their way down to bays and estuaries on the Texas Coast. The impacts of this urban non-point source pollution can be significant and removing it is both critical and costly.

Many studies have documented the benefits of urban trees in reducing the amount of stormwater that enters a watershed following a rain event (American Forests, USFS). Leaves and branches intercept and hold rain droplets, reducing volume and delaying peak flows; rooting space occupied by trees increases infiltration rates and the water-holding capacity of soil; tree canopies reduce the impact of raindrops on barren soil, thus reducing erosion; and transpiration by leaves moves water from the soil back to the atmosphere, reducing the amount of water entering surface water bodies (USFS: *Interior West Community Tree Guide*, 2007).

Trees and forests in urban areas also provide a valuable buffer for streams by filtering chemicals from subsurface flows through the soil. Nitrogen and phosphorus from fertilizers are actively removed from water in the upper layers of the soil as it moves through the roots of trees. Forest soils also serve as sponges that hold significant amounts of stormwater, allowing it to infiltrate and thus reduce peak runoff and flash flooding.

Air Quality

Urban areas around the country are routinely cited as having the worst air quality, particularly from ground-level ozone. Under the Clean Air Act (1990 amended), the EPA is charged with setting limits for pollutants and regulating the sources of those pollutants through state regulatory

authorities. The basic federal standard is now 75 parts per billion, averaged over an 8-hour period (the 8-hour standard). In Texas, the Texas Commission on Environmental Quality (TCEQ) prepares State Implementation Plans (SIP) for regions of the state where measurements exceed the federal standard—deemed "non-attainment" areas.

Trees and vegetation contribute to both the problem and the solution to air quality in and around our cities. Certain tree species (oaks, pines, sweetgum) emit volatile organic compounds (VOC) from their leaves that add to the VOCs in the region (called "biogenic" emissions). On the other hand, trees transpire water from their leaves during photosynthesis, which in turn cools the air and reduces the rate of the chemical reaction that forms ozone in the first place.

The net effect of urban trees on regional air quality is generally a positive one. In Houston alone, trees removed a total of 2,415 tons of ozone, sulfur dioxide, nitrogen dioxide, and particulate matter in 2015 (USFS, Urban Forest Inventory & Analysis: *Houston's Urban Forest,* 2015). Adding new trees to mitigate ground-level ozone has been accepted by the EPA in SIPs around the country as a voluntary measure for meeting federal air quality standards. It is also logical to predict that preserving existing tree canopy would prevent the worsening of regional air quality, but state regulatory agencies and EPA have been reluctant to accept that argument in a SIP.

Energy Consumption

The Intergovernmental Panel on Climate Change (IPCC) has concluded that global concentrations of carbon dioxide, methane, and nitrous oxide (the primary greenhouse gases) have increased since 1750. The primary reasons for these increasing levels are the burning of fossil fuels and land-use change. As a result, this segment of the scientific community predicts rising sea levels, loss of sea ice, and increased frequency of drought, heat waves, and heavy precipitation events over the next century. (IPCC, 2019*: Summary for Policymakers* https://www.ipcc.ch/site/assets/uploads/sites/2/2019/05/SR15_SPM_version_report_LR.pdf).

Even if the projected impacts of this "greenhouse effect" do not materialize, Texas cities in the summer are already uncomfortable places, with temperatures regularly reaching 100˚F. Central sections of major cities often have so much impervious surface that they form "urban heat islands," with temperatures 2 to 10˚F hotter than nearby rural areas. This temperature difference results in increased peak energy use, higher air conditioning costs, increased air pollution levels, and heat-related illness or even death (EPA: http://www.epa.gov/heatisland/index.html). Any climate change that results in more days of extreme temperatures in Texas cities can only increase costs and risks to human health.

Trees can directly affect the consumption of energy used to cool buildings by shading windows and roof surfaces from direct sunlight. Studies have shown the benefits of strategically planted trees, particularly on the east-, south-, or west-facing sides of one- and two-story buildings (Sacramento Municipal Utility District: http://www.smud.org/residential/trees/index.html). The Houston Urban Forest Inventory & Analysis calculated direct energy savings of $54 million annually, with additional savings in avoided carbon emissions from power plants.

Trees also produce indirect effects that benefit climate, at least at the local level. When planted near buildings and along streets, urban trees cool impervious surfaces that could result in a reduced "urban heat island" effect. They can combine to cool the air through the process of transpiration, although this effect is most noticeable in dry-climate cities like El Paso rather than humid cities like Houston. Shade from trees over public spaces like sidewalks, streets, and parks makes a city more tolerable for outdoor activities during summer months, which supports human health and is a significant indicator of quality of life for urban residents.

Public Health

While increased urban tree canopy reduces the potential for heat-related illnesses and encourages outdoor activity, recent studies have documented other therapeutic impacts of trees on human health. In particular, accessibility to trees has been shown to have a positive influence on mental health, obesity, and chronic disease. Higher residential tree cover and proximity to treescapes, especially for vulnerable populations, correspond with improved health metrics (https://healthytreeshealthylives.org/).

TAMFS Program Delivery

State forestry agencies have worked for more than two decades to provide technical, financial, and educational assistance to create the infrastructure for communities to deliver U&CF programs to their citizens. This annual assistance has led to certain organizational milestones that communities accumulate over time. Four performance measures are tracked annually for each community in the state and reported in the Community Accomplishment Reporting System (CARS) developed by the USFS: professional staffing, tree ordinances, management plans based on scientific inventories, and tree advocacy groups that provide citizen support. When a community achieves all four of these key measures, it is considered actively managing its urban forest resource.

In addition to the three broad national themes established by the USFS for state and local programs, the 2016-2026 National Ten-Year Urban and Community Forestry Action Plan developed by the National Urban and Community Forestry Advisory Committee (NUCFAC) and approved by the National Association of State Foresters (NASF) has established seven specific urban forestry goals that link to the national themes (Table 18).

Table 18
U&CF Goals and National Themes

Urban & Community Forestry (U&CF) Goals	National Theme
1. Integrate Urban & Community Forestry Into all Scales of Planning	Conserve Working Forests
2. Promote the role of Urban & Community Forestry in Human Health and Wellness	Enhance Public Benefits
3. Cultivate Leadership and Opportunity within the Urban Forestry Community	Enhance Public Benefits
4. Strengthen Urban & Community Forest Health and Biodiversity for Long-Term Resilience	Protect Forests From Harm
5. Improve Urban & Community Forest Management, Maintenance, and Stewardship	Enhance Public Benefits
6. Diversify, Leverage, and Increase Funding for Urban & Community Forestry	Conserve Working Forests
7. Increase Public Awareness and Environmental Education to Promote Stewardship	Enhance Public Benefits

In Texas, the analysis of urban forest sustainability focused on these seven goals and identified priority landscapes where state programs and local projects can have the greatest positive impact.

Challenges

As new development expands outside city limits, forest fragmentation and conversion can occur. Unpopulated tracts of forest, suitable for timber harvesting or prescribed burning, become bisected by new roads, separated by housing subdivisions, or divided into smaller parcels. Small towns and rural areas experiencing development pressure often see conflict between owners of traditional agricultural and forest lands and new homeowners wanting a more suburban lifestyle, resulting in increased demand for education and technical assistance from state forestry agencies.

Additionally, growing communities in Texas sometimes have limited authority over the development process outside of their city limits. While municipal governments may choose to plan

for the protection of natural resources inside the city through their development code, tools to address growth in the "extra-territorial jurisdiction" (ETJ)—the zone outside city limits in which they have the legal right to annex land—are often very limited. Managing growth by county governments outside the ETJ is even more limited. One common result of this gradient of development restrictions from urban to rural lands is that new construction often flows to areas with lower costs, both for land and for lack of regulation.

Trees and their associated benefits are not always equitably distributed across urban populations. This can sometimes result in unequal access to environmental benefits for underserved neighborhoods and groups. Forest inventory and census data can be analyzed to identify environmentally deficient neighborhoods where tree planting efforts should be focused, positively impacting human health and well-being.

While there is a growing body of research that reports how trees and forests positively impact human health, adoption by the medical community has been slow. Some of this can be attributed to uncertainty in patient health outcomes, siloed educational initiatives, and even limited access to community greenspaces.

Lastly, urban areas can be harsh environments for vegetation. Impervious cover, compacted soil, water availability, and pollutants are all hindrances to tree establishment and growth. Following the principles of *Right Tree, Right Place* can help overcome some of these challenges, along with securing maintenance agreements are part of any tree planting program.

Natural Disasters

Urban trees and forests are subject to the extreme forces of nature, just like rural forest landscapes. Tree canopy loss from storms can have a significant impact on benefits and services provided to residents. Storm damage to trees in cities has an immediate impact on public safety because trees bring down power lines, damage homes, and block roadways for emergency vehicles and evacuation. Furthermore, communities are faced with decisions regarding high-risk tree removal and debris management.

Wildfires also impact tree canopy and public safety. Fires often consume vegetation on site and are largely preventable. State forestry agencies across the country invest significant resources to educate residents about fire danger throughout the year, help them manage fire fuels around homes, and develop emergency plans for fire suppression and evacuation.

Texas weather is highly variable, both seasonally and geographically, with average annual precipitation ranging from less than 8 inches in El Paso to more than 48 inches in Beaumont. Rain events can be quite dramatic, such as Hurricane Harvey on August 26–27, 2017 when 60 inches of rain set the U.S. storm record in Nederland, TX. Texas is also known for its intense droughts. In 2011, nearly 88 percent of the state was in Exceptional Drought. The changing climate and associated increase in extreme weather events and variability also influence pest, disease, and invasive species patterns, making tree and forest management more critical than ever.

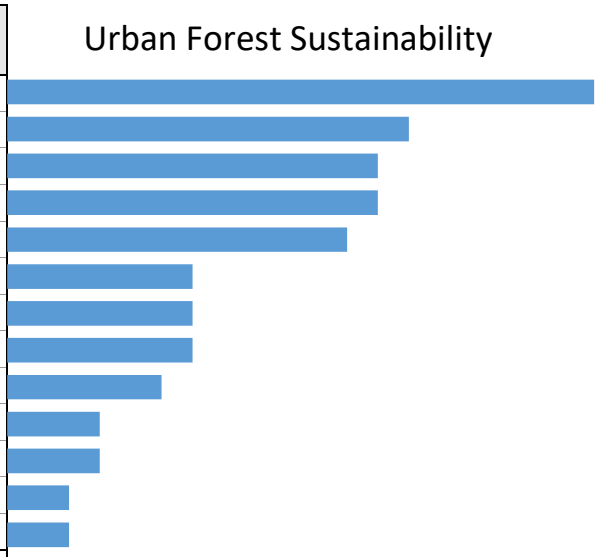
Spatial Analysis

Geospatial analysis for the Urban Forest Sustainability issue was performed similar to what was done for Important Forest Resource Areas and the other issues, which was described in the *Overview of Spatial Analysis* section of this document. Specifically, weighted raster overlay analysis was performed using thirteen layers to prioritize cities and communities where urban forestry technical assistance should be emphasized. Layers and the weights assigned them are provided in Table 19. Only three layers—Development Threat, Forest to Faucet, and Riparian Areas—from the Southern Forest Land Assessment and other issue analyses were used here. The remaining 10 were built specifically for the urban analysis. Descriptions of these layers and all other layers are provided in the appendix.

Although this analysis was similar to that done for the other issues, there was one significant difference. While all other analyses produced a "wall-to-wall" output layer across the whole state with urban and water areas masked out, the urban analysis was done for cities and communities (2018 US Census Places) and their extraterritorial jurisdictions (ETJs). This allowed for considering the likely future growth zones for each city or community along with area within each one's respective boundary. Another difference was the use of five quantiles for aggregating the resulting priority index values into classes as opposed to Natural Breaks as done for other issues. In addition, instead of summarizing by county, the urban analysis summarized by place and its ETJ. ETJs were clipped from the final priority-by-place map.

Table 19
Layers and Layer Weights used in Overlay Analysis for Urban Forest Sustainability Issue

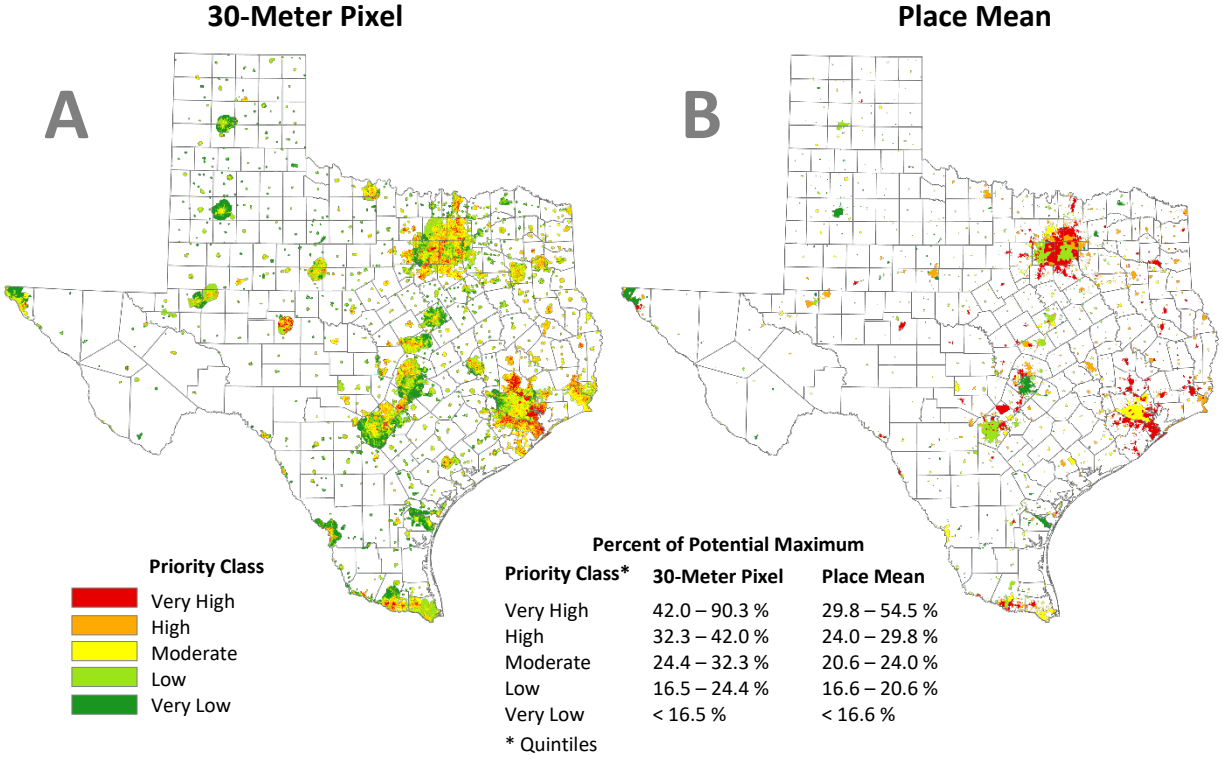
Layer Rank	Layer Name	Layer Weight
1	Development Threat	19
2	Imperviousness	13
3	Tree Canopy	12
4	Total Population	12
5	Population Density by Block Group	11
6	Forest to Faucet	6
7	Ozone Nonattainment Area	6
8	Impaired Watersheds	6
9	No Professional Staff	5
10	No Management Plan	3
11	No Tree Ordinance	3
12	No Advocacy Group	2
13	Riparian Areas	2
	TOTAL	100



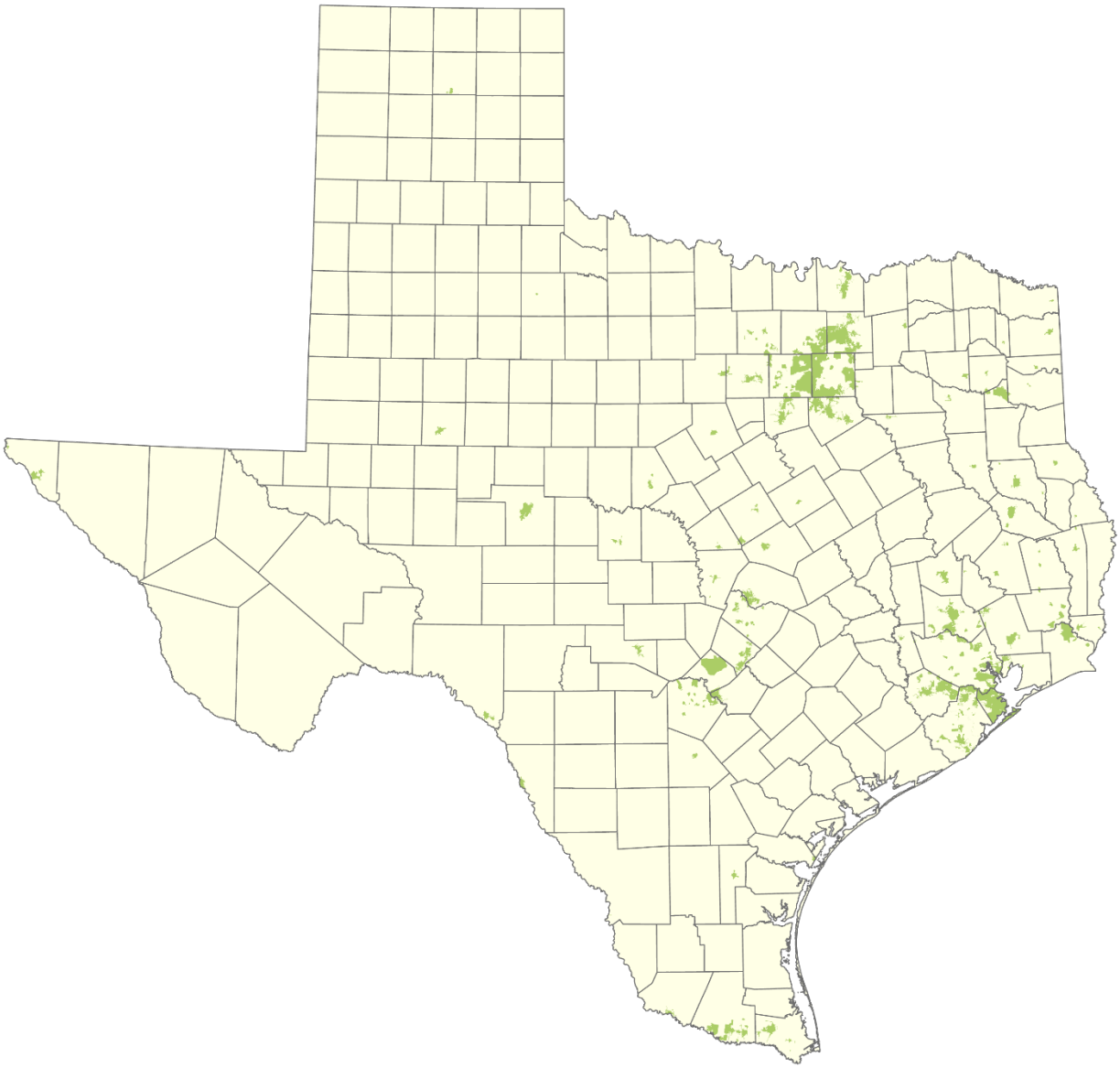
Results

Results from this overlay analysis are shown in Map 6A and 6B. Map 6A shows results on a 30-meter pixel basis and Map 6B shows results when pixel data are summarized by place. A Total of 350 places are included in the top quintile (20 percent) and are deemed priority (Map 7 and Table 20).

Map 6
Priority Analysis for Urban Forest Sustainability –
30 Meter Pixel Map (A) and Place Mean Map (B)



Map 7
Priority Places for Urban Forest Sustainability
Top 20 Percent (350 Places)



The top 10 of the priority places include Arlington, Irving, Grand Prairie, Frisco, McKinney, Pasadena, Mesquite, Carrolton, Sugar Land, and Richardson, all but one of which are in the Metroplex. All have populations in 2018 of more than 120 thousand. Sugarland, the only one not within the Metroplex, is a southern suburb of Houston.

Table 20
Priority Places for Urban Forest Sustainability
Top 20 Percent (350 Places) Sorted by Population (2018)

Place	Population	Place	Population	Place	Population	Place	Population
Arlington	391,413	Copperas Cove	33,082	Anna	13,549	Gun Barrel City	6,157
Irving	245,653	Cleburne	32,329	Richmond	13,420	Palmview South CDP	6,083
Grand Prairie	194,284	Harker Heights	32,001	Azle	13,322	Hutchins	6,040
Frisco	188,522	Southlake	31,316	Glenn Heights	13,301	Windcrest	5,874
McKinney	182,199	Weatherford	30,897	Red Oak	13,039	Lake Jackson	5,797
Pasadena	153,662	Cibolo	30,333	Selma	13,027	Mont Belvieu	5,782
Mesquite	141,777	Eagle Pass	28,750	Lumberton	12,853	Wake Village	5,734
Carrollton	141,128	Big Spring	28,172	Manvel	12,662	Rusk	5,706
Sugar Land	128,311	Alvin	28,004	Forest Hill	12,645	Scenic Oaks CDP	5,703
Richardson	123,548	Midlothian	27,306	Borger	12,508	Atlanta	5,676
Pearland	122,242	Converse	27,120	Freeport	12,411	Sansom Park	5,622
The Woodlands CDP	120,978	Canyon Lake CDP	26,484	Fulshear	11,990	Brady	5,604
Beaumont	119,435	Sachse	26,296	Clute	11,984	San Leon CDP	5,593
Lewisville	109,983	Brushy Creek CDP	26,117	Webster	11,822	Willow Park	5,507
League City	107,435	Kirby	25,487	Tomball	11,606	Sparks CDP	5,401
Allen	103,144	Balch Springs	25,351	Melissa	11,565	Pinehurst CDP	5,378
San Angelo	99,833	University Park	25,164	Leon Valley	11,467	Diboll	5,364
Conroe	85,616	Denison	25,139	Princeton	11,085	Nolanville	5,364
Mission	85,515	Fresno CDP	24,561	Galena Park	11,079	Center	5,327
Longview	82,642	Cinco Ranch CDP	24,539	Vidor	10,944	Terrell Hills	5,309
Baytown	81,089	Cloverleaf CDP	24,472	Pleasanton	10,731	Livingston	5,257
Pharr	80,967	Prosper	24,432	Jacinto City	10,551	Shady Hollow CDP	5,114
Missouri City	79,317	Watauga	24,378	Bacliff CDP	10,017	Gilmer	5,069
Atascocita CDP	77,631	Saginaw	23,635	Liberty	9,591	Hunters Creek Village	4,894
Cedar Park	72,985	Benbrook	23,394	Commerce	9,564	Rio Bravo	4,862
North Richland Hills	70,819	Corinth	22,906	Woodway	9,183	Wilmer	4,640
Harlingen	68,241	Universal City	21,648	Eidson Road CDP	9,124	Castle Hills	4,494
Spring CDP	67,774	Stephenville	21,472	Fairview	9,092	Meadows Place	4,458
Rowlett	67,090	Dickinson	21,092	Murillo CDP	8,953	Cockrell Hill	4,456
San Marcos	64,538	Ennis	20,992	Roanoke	8,917	Spring Valley Village	4,290
Euless	56,401	Murphy	20,880	Aransas Pass	8,764	Lopezville CDP	4,219
Leander	55,643	Angleton	20,518	Highland Park	8,710	Richwood	4,160
Little Elm	53,669	Alamo	20,031	Cleveland	8,505	Nassau Bay	4,149
DeSoto	53,462	Pecan Grove CDP	19,892	Alamo Heights	8,267	Sweeny	4,086
Grapevine	53,383	Brownwood	19,867	River Oaks	8,036	Savannah CDP	4,016
Wylie	52,297	Horizon City	19,637	Jersey Village	8,013	Las Quintas Fronterizas CDP	4,001
Cedar Hill	51,049	Stafford	19,313	Los Fresnos	8,000	Shavano Park	3,956
Texas City	50,956	Alice	18,875	Lancaster	7,925	Bunker Hill Village	3,915
Bedford	50,220	Sienna Plantation CDP	18,752	Richland Hills	7,899	Cross Mountain CDP	3,662
Galveston	49,573	Bellaire	18,398	Hitchcock	7,878	Taylor Lake Village	3,627
Kemah	47,350	South Houston	17,701	Highlands CDP	7,844	Barrett CDP	3,477
Burleson	46,247	Aldine CDP	17,693	Lucas	7,726	Brazoria	3,416
The Colony	45,948	Jones Creek	17,612	Jasper	7,646	Waller	3,402
Channelview	45,852	White Settlement	17,587	Cameron Park CDP	7,530	Oak Ridge North	3,379
Mission Bend CDP	44,968	Donna	17,289	Hempstead	7,418	Balcones Heights	3,367
Sherman	43,539	Highland Village	17,119	Elsa	7,210	Barton Creek CDP	3,347
Haltom City	43,334	Mineral Wells	17,097	Palmview	7,139	Las Lomas CDP	3,232
Coppell	41,958	Buda	16,915	Lago Vista	7,094	Fifth Street CDP	3,227
Huntsville	41,521	Seagoville	16,858	Canutillo CDP	7,016	West Lake Hills	3,197
Schertz	41,414	Timberwood Park CDP	16,558	Willis	7,004	Shenandoah	3,073
Rosenberg	41,411	Live Oak	16,059	Bridgeport	6,975	Paloma Creek CDP	3,059
Weslaco	40,857	Groves	15,943	Decatur	6,969	Edgecliff Village	3,034
Duncanville	40,478	Humble	15,871	Silsbee	6,843	Crosby CDP	2,838
Farmers Branch	40,209	West University Place	15,753	Gladewater	6,833	Westworth Village	2,759
Friendswood	40,184	Four Corners CDP	15,647	Keller	6,799	Woodville	2,754
Lantana CDP	39,034	Gatesville	15,567	Bee Cave	6,755	Beach City	2,714
Hurst	38,822	Crowley	15,465	Burnet	6,755	El Lago	2,638
San Juan	37,768	Rio Grande City	15,018	Mila Doce CDP	6,719	Hedwig Village	2,623
Waxahachie	37,476	Rendon CDP	14,167	Sunnyvale	6,647	Wild Peach Village CDP	2,612
Lufkin	36,869	Seabrook	13,971	White Oak	6,465	Holly Lake Ranch CDP	2,476
Del Rio	35,880	Trophy Club town	13,877	Everman	6,326	Blue Mound	2,468
Deer Park	34,590	Hidalgo	13,811	Briar CDP	6,276	Anahuac	2,467
Socorro	34,541	Wells Branch CDP	13,601	Lindale	6,234	Pantego	2,447
Nacogdoches	33,542	Santa Fe	13,591	Kerrville	6,170	Olmos Park	2,414

Table 20 – *Continued*

Place	Population	Place	Population	Place	Population	Place	Population
Daingerfield	2,380	Bayou Vista	1,633	Beasley	785	Keene	349
Dalworthington Gardens	2,350	Shoreacres	1,579	Hillcrest	764	Bonney	346
Panorama Village	2,349	Rollingwood	1,577	Westover Hills	751	Kennedale	330
Arcola	2,288	Aurora	1,529	Lake Worth	695	Cross Timber	322
Pinehurst	2,162	Boyd	1,458	Plum Grove	691	North Cleveland	291
Splendora	2,117	Woodbranch	1,426	Knollwood	667	Nesbitt	267
Magnolia	2,108	Old River-Winfree	1,394	La Marque	626	La Porte	258
Sheldon CDP	2,073	Cut and Shoot	1,380	Cushing	615	Oakhurst CDP	240
Jefferson	2,054	Palm Valley	1,265	Stagecoach	604	Woodloch town	212
Patton Village	2,026	Bevil Oaks	1,231	Colmesneil	603	La Feria	212
Roman Forest	2,020	Holiday Lakes	1,226	Pleasant Hill CDP	581	Browndell	199
Siesta Acres CDP	1,991	Clear Lake Shores	1,176	Surfside Beach	579	Cool	182
Porter Heights CDP	1,947	Wildwood CDP	1,173	Annetta North	567	Lampasas	178
Iowa Colony	1,931	Oyster Creek	1,171	Liverpool	561	Guthrie CDP	169
Las Palmas II CDP	1,895	Kendleton	1,153	Cove	550	Quintana	110
Rhome	1,870	Hill Country Village	1,089	Paradise	547	Del Mar Heights CDP	100
Southside Place	1,844	Jamaica Beach	1,070	Lake Dallas	539	San Fernando CDP	71
Meadowlakes	1,840	Tiki Island	1,063	Briaroaks	504	Santa Cruz CDP	59
La Puerta CDP	1,796	Fabrica CDP	975	Kountze	464	Lackland AFB CDP	54
Joshua	1,762	Villa Verde CDP	846	Redfield CDP	430	El Mesquite CDP	43
Lowry Crossing	1,731	Pineland	818	Rose Hill Acres	424	Fernando Salinas CDP	13
Pinewood Estates CDP	1,679	Hilshire Village	815	Chireno	389		
Corrigan	1,660	Bailey's Prairie	787	Kyle	387		
Brookside Village	1,637	Garza-Salinas II CDP	785	Morgan's Point	363		

Conclusion

Trees and forests in urban areas provide a wide range of benefits that are essential to improving the quality of life for Texans. Unmanaged community growth threatens the sustainability of this resource throughout the state. The top 20 priority places identified by the spatial analysis include fast-growing cities in three of Texas major metro areas (Dallas-Fort Worth Metroplex, Houston-The Woodlands-Sugarland, and McAllen-Edinburg-Mission) as well as West Texas (San Angelo) and Northeast Texas (Longview). Focusing program delivery in these areas can help solve landscape-scale problems that affect millions of people, including urbanization, air quality, water quality, climate change, energy consumption, natural disasters, and public health issues.

Strategy

This section provides goals, objectives, and strategies for addressing the issue of *Urban Forest Sustainability*. Seven goals for this issue are:

1. Integrate urban and community forestry into all scales of planning.
2. Promote the role of urban and community forestry in human health and wellness.
3. Cultivate leadership and opportunity within the urban forestry community.
4. Strengthen urban and community forestry forest health and biodiversity for long-term resilience.
5. Improve urban and community forest management, maintenance, and stewardship.
6. Diversify, leverage, and increase funding for urban and community forestry.
7. Increase public awareness and environmental education to promote stewardship.

The following lists the objectives and strategies for each goal.

Urban Forestry Sustainability

Goal 1 — *Integrate urban and community forestry into all scales of planning*

Objective **1.1**	**Engage with government and non-governmental organizations (NGOs) on local, regional, and state plans.**
Strategy **1.1.1**	Participate in county and regional open space and natural resource planning efforts.
Strategy **1.1.2**	Educate local stakeholders on community forestry compatibility with other planning goals.
Objective **1.2**	**Encourage best practices for protecting high-value forest landscapes in and around urban areas.**
Strategy **1.2.1**	Support a green infrastructure approach for assessing and prioritizing forest landscapes.
Strategy **1.2.2**	Support local land conservation groups to locate and protect high-value forest landscapes.

Goal 2

Promote the role of urban & community forestry in human health and wellness

Objective **2.1**	**Support community forest management for public health benefits.**
Strategy **2.1.1**	Develop recommendations for strategic placement of trees to optimize human health impact.
Strategy **2.1.2**	Develop partnerships with public health stakeholders, health care providers, and other groups to support and promote the therapeutic benefits of trees.
Objective **2.2**	**Support tree planting as an energy-saving practice.**
Strategy **2.2.1**	Strengthen partnerships to advance local programs to plant residential trees as an energy efficiency measure.
Strategy **2.2.2**	Develop recommendations for using vegetation to break up urban heat islands.
Objective **2.3**	**Support local, regional, and statewide water quality and air quality programs and initiatives**
Strategy **2.3.1**	Support urban stream restoration programs in local communities.
Strategy **2.3.2**	Work with local water utility managers and public works directors on policies that support the contribution of urban trees and forests in water quality and quantity management
Strategy **2.3.3**	Work with public and private partners to promote the use of vegetation to improve air quality in and around urban areas

Goal 3

Cultivate leadership and opportunity within the urban forestry community

Objective **3.1**	**Develop the next generation of community forestry stakeholders.**
Strategy **3.1.1**	Provide outreach and education to underserved populations.
Strategy **3.1.2**	Demonstrate forestry and natural resources as a viable career option to youth and incoming college students.
Objective **3.2**	**Support statewide, regional and local tree advocacy and trade groups.**
Strategy **3.2.1**	Provide education and support to tree boards, non-profit groups, and councils.
Strategy **3.2.2**	Encourage industry-Certified Arborist and Tree Worker credentialing.

Goal 4

Strengthen urban & community forest health and biodiversity for long-term resilience

Objective **4.1**	**Improve disaster preparedness and response following major events affecting trees in a community setting.**
Strategy **4.1.1**	Assist vulnerable communities with inventory and plan writing; pre-locate debris holding or processing sites.
Strategy **4.1.2**	Certify TAMFS urban foresters and ISA-certified arborists as Strike Team leaders, task specialists, and Public Information Officers.
Strategy **4.1.3**	Conduct rapid assessments to estimate tree debris from natural disasters.
Objective **4.2**	**Monitor the impact of land-use change on urban forests in Texas.**
Strategy **4.2.1**	Identify communities where land-use change and urbanization are occurring at a rapid pace.
Strategy **4.2.2**	Through Urban Forest Inventory & Analysis and high-resolution imagery, maintain the urban tree assessment program for major metropolitan areas of Texas.

Goal 5

Improve urban and community forest management, maintenance, and stewardship

Objective **5.1**	**Establish and increase the skills of municipal tree care managers through effective tree care and protection practices.**
Strategy **5.1.1**	Provide technical and financial support to increase the number of municipal tree managers who are ISA Certified Arborists and Municipal Specialists.
Strategy **5.1.2**	Provide opportunities for training workshops and deliver technical assistance to municipal tree managers to increase their effectiveness and enhance performance.
Objective **5.2**	**Support scientific inventory systems that provide resource data and management plans for local tree care managers.**
Strategy **5.2.1**	Support community tree assessments by coordinating sample inventories and management recommendations.
Strategy **5.2.2**	Promote community-scale canopy studies to identify the loss/gain of trees over time and recommend plans to enhance forest cover and associated benefits.

Goal 6

Diversify, leverage, and increase funding for urban and community forestry

Objective **6.1**	**Educate and engage leaders and citizens in urban forestry projects and issues.**
Strategy **6.1.1**	Support educational programs on a variety of urban tree and natural resource issues, including invasive plants and insect pests.
Strategy **6.1.2**	Assist local leaders to ensure the elected officials are aware of the importance and value of urban forest resources in their communities, districts, and state.
Strategy **6.1.3**	Promote environmental equity to disproportionately impacted neighborhoods and communities.
Objective **6.2**	**Strengthen existing partnerships and develop new relationships.**
Strategy **6.2.1**	Develop new partnerships with stakeholder groups of tangential issues, such as public health, oil and gas, and transportation.
Strategy **6.2.2**	Cultivate corporate partners interested in environmental sustainability programming.
Strategy **6.2.3**	Facilitate community networks to support urban waste wood utilization initiatives.

Goal 7

Increase public awareness and environmental education to promote stewardship

Objective **7.1**	**Promote community forestry literacy in Texas and support significant tree programs.**
Strategy **7.1.1**	Support official Arbor Day ceremonies and Arbor Day Foundation core programs.
Strategy **7.1.2**	Deliver the Texas Big Tree Registry and Famous Trees of Texas programs.
Objective **7.2**	**Embrace new technologies to create self-directed learning opportunities for citizens, teachers, and students.**
Strategy **7.2.1**	Develop mobile applications for the online Texas Tree Planting Guide and the Texas Tree ID websites.
Strategy **7.2.2**	Expand the use of social media and online learning platforms.

Performance Outcomes

Goal 1 – *Integrate urban and community forestry into all scales of planning.*

- Incorporate urban tree canopy into community and regional planning initiatives.

Goal 2 – *Promote the role of urban and community forestry in human health and wellness.*

- Optimize the public health impact of trees within communities.
- Encourage communities to protect air and water quality through urban and community forestry programs.

Goal 3 – *Cultivate leadership and opportunity within the urban forestry community.*

- Support urban and community forestry partners attendance at the TAMFS Leadership Institute.

Goal 4 – *Strengthen urban and community forest health and biodiversity for long term resilience.*

- Minimize the risk and impact of catastrophic events.
- Reduce the impacts of land-use change, fragmentation, and urbanization.
- Develop genetically superior seedlings that will survive harsh urban environments.

Goal 5 – *Improve urban and community forest management, maintenance, and stewardship.*

- Increase the number of Texans living in communities that have effective urban and community forestry programs.

Goal 6 – *Diversify, leverage, and increase funding for urban and community forestry.*

- Advance urban wood waste utilization in Texas metropolitan areas.

Goal 7 – *Increase public awareness and environmental education to promote stewardship.*

- Increase the awareness of the extent and benefits of trees and forests.

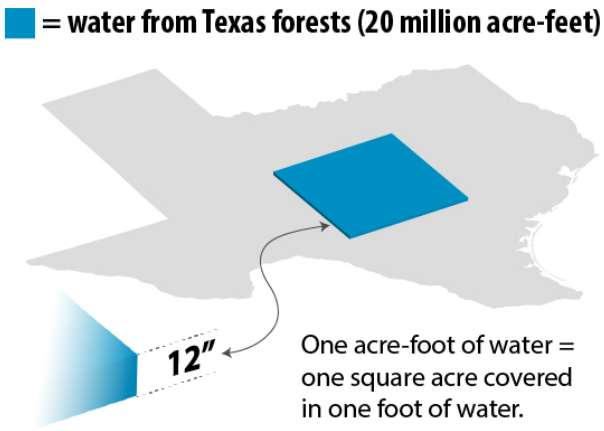
Issue 5
Water Resource Protection

Issue Description

Forests and woodlands play an integral role in maintaining a continuous, stable supply of clean drinking water for millions of Texans. In fact, almost 50 percent of the state's freshwater resources originate on forests that cover just over one-third of the land area in the state. This amounts to an estimated 20 million acre-feet of water (Figure 28). In addition to providing the cleanest water of any land use, these landscapes also absorb rainfall, reduce flooding, recharge aquifers, and provide habitat for wildlife. As these lands are converted to other uses, this critical role is interrupted and water resources are adversely affected.

Increasing population, water demand, and the frequency of extreme and persistent drought events have resulted in water scarcity concerns in some regions of the state. Conversely, flooding has been exacerbated in other areas where forests and woodlands have been converted to impervious surfaces. Given the importance of forests to the state's water resources, private land conservation and stewardship are critical factors in meeting the state's water needs in the future.

Figure 28
Amount of Water Originating from Texas Forests and Woodlands



Forest and Water Relationship

Forests are very effective at capturing, filtering, storing, and steadily releasing water over time. Precipitation is partially intercepted by tree canopies, reducing the speed and energy of raindrops that fall to the forest floor, protecting the soil surface from erosion. Forest soils function like a sponge, absorbing large amounts of water that reaches the ground through a process called infiltration. Water that infiltrates into the soil is either absorbed by tree roots, percolates down into underground aquifers, or slowly released over time into nearby creeks, streams, and rivers.

Only a small portion of water remains as runoff, which is slowed and filtered by trees and underlying vegetation, further enhancing water quality. The cumulative effects of these functions result in much more consistent and high quality baseflows in streams, rivers, and lakes. Collectively, this process is known as the forest-water relationship, or watershed ecosystem services, and is valued at $13.2 billion annually in Texas.

Water Availability

Climate, extreme and persistent weather events, land use, and population growth are all factors that impact water availability. While rainfall patterns (Figure 29) are the primary driver, individual watersheds can have variable rates of infiltration, storage, and discharge due to differences in soil, vegetation, topography, and geology. Researchers at the USFS Southern Research Station utilized the Water Supply Stress Index (WaSSI) model, accounting for these variables, to identify areas of the nation (Figure 30) where future water supplies may be vulnerable and could become stressed under various climate, population growth, and land use change scenarios.

Figure 29
Annual Precipitation for Texas

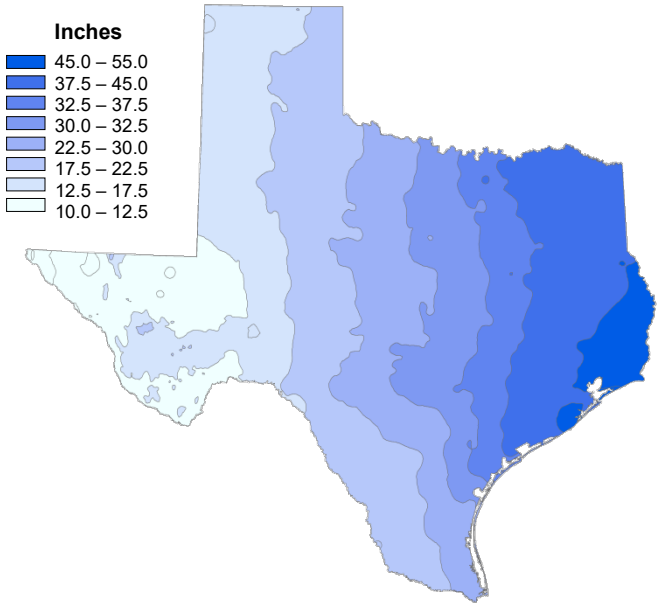
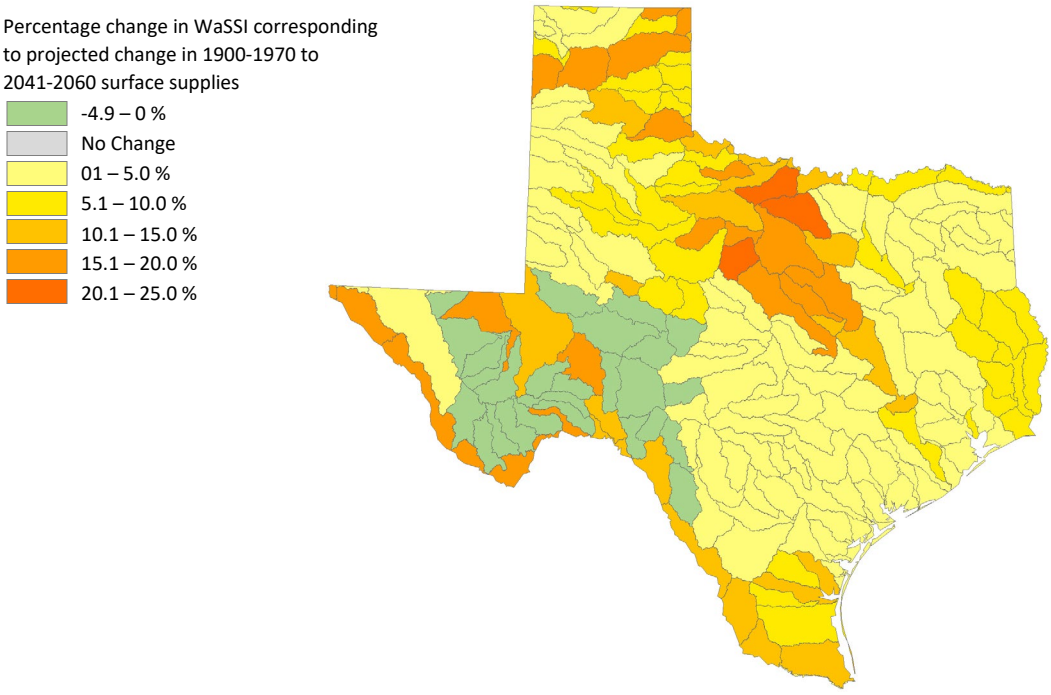


Figure 30
Water Supply Stress Index (WaSSI) for Texas



Texas population growth is forecasted to increase by more than 80 percent over the next 30 years, leading to significant changes in land use across the state. Not only will this growth result in higher water demands, it will also lead to increases in impervious cover, exerting greater pressure on forested watersheds. This growth will not be spread evenly throughout the state, primarily being concentrated near population centers, major travel corridors, and coastal regions.

Land conversion that reduces the amount of water infiltrating into the soil also leads to greater stormwater runoff and peak flows. This results in a flashier hydrology for urban streams. Large volumes of runoff flowing quickly into nearby streams and rivers can quickly exceed channel capacities, causing more frequent and intense flooding. While there are short-term increases in streamflow, there is a reduction in the total amount of water available for human consumption.

Additionally, decreases in water infiltration can reduce groundwater recharge in aquifers and lower local water tables. This further impacts the hydrology of local streams through declining baseflows, causing normally perennial streams to become intermittent during periods of dry weather. Some researchers have found that for every one percent increase in impervious cover, baseflow is reduced by two percent. Flow depletion is considered to be the number one cause of species imperilment.

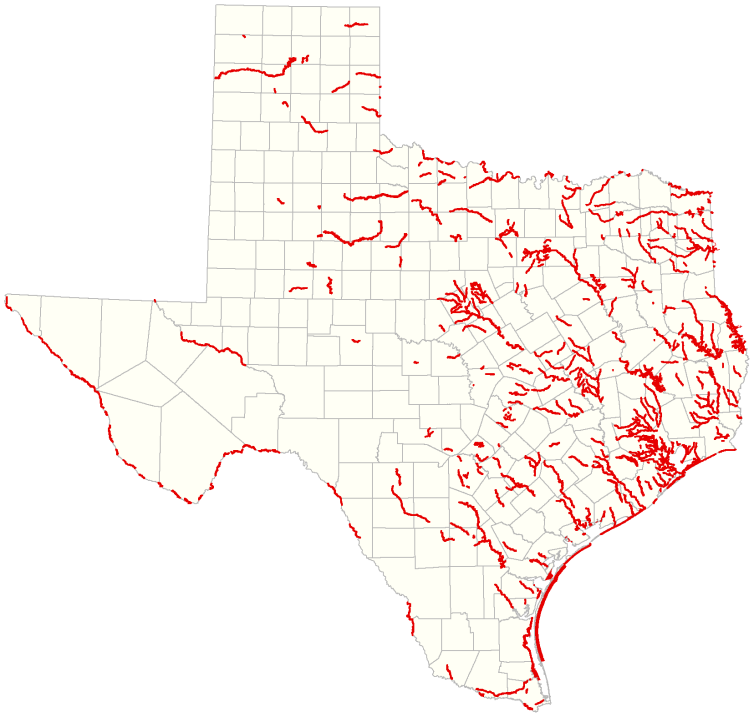
Aquifer recharge zones should be conserved to ensure groundwater resources are not depleted or contaminated. Intensively disturbing these areas can reduce percolation into the aquifer as well as cause it to become polluted. Karst topography, characteristic of the Hill Country, offers little to no filtering capacity, allowing water to flow unimpeded through cracks, crevices, and caves directly into groundwater (Figure 31). With over 50 percent of the Texas water supply coming from groundwater, it is imperative to protect these critical zones.

Figure 31
Caves and Limestone Bedrock are Typical Characteristics of Karst Topography
Photos by Hughes Simpson

Water Quality

Texas Commission on Environmental Quality sets water quality standards for the state's waterbodies and coordinates a monitoring program to determine if these waterways are meeting those standards. Through this assessment, water samples from over 1,800 sites across the state are collected and analyzed, for physical, chemical, and biological properties. Results are published in the Integrated Report on Surface Water Quality, which includes a list of the waterbodies assessed, status in meeting water quality standards, causes of concern, and potential sources of pollution. Waterbodies not meeting the water quality standards are deemed impaired and are reported on the 303(d) list. (Figure 32).

Figure 32
Impaired Waterbodies in Texas



Forest conversion, regardless of the type of new land use, results in changes in the quality of downstream waters. This is especially true in areas where bare soil and impervious cover have increased over time. Precipitation that falls on these surfaces mix with sediment and pollutants and is later delivered to streams through the storm drain network. Researchers have studied this effect for years, referring to these hydrologic changes as the "urban stream syndrome." In many areas, the pollutants in these water bodies are a threat to human health.

Establishing and maintaining forests adjacent to waterbodies can help mitigate these hydrologic effects. Riparian forests function as "nature's kidneys," slowing down stormwater runoff long enough for sediment, nutrients, and other pollutants to be deposited or absorbed before reaching waterbodies. Research has shown that maintaining a forest buffer as small as 50 feet along streams and rivers can reduce sediment delivery by 75 – 90 percent.

Improperly conducted land management operations also have the potential to negatively impact water quality. Best Management Practices (BMPs) are the principle means by which the forest sector protects water resources through sustainable land management. These non-regulatory conservation practices are designed to provide an economical way of protecting soil and water resources, two key elements necessary for healthy, sustainable, and productive forests and woodlands. Texas A&M Forest Service, with significant support from the forest industry, has led the way in institutionalizing BMPs in the forest sector for over 30 years.

Threats to Forest and Woodlands

Land conversion is the number one threat to forests and woodlands, especially near population centers and travel corridors. Additionally, forests may also become more susceptible to insect, disease, and invasive species in the future that will affect watershed function. The Southern Pine Beetle, Oak Wilt, Emerald Ash Borer, and other pests have the potential to cause widespread mortality and changes to species composition. To counteract this, sustainable management can improve forest health and vigor, promoting resilience.

Weather-related natural disasters over the last 15 years have decimated forest resources in parts of Texas. Hurricanes Rita (2005), Ike (2008) and Harvey (2017), along with historic drought, unprecedented wildfires, and extensive flooding have caused widespread damage and destruction that has touched every region of the state.

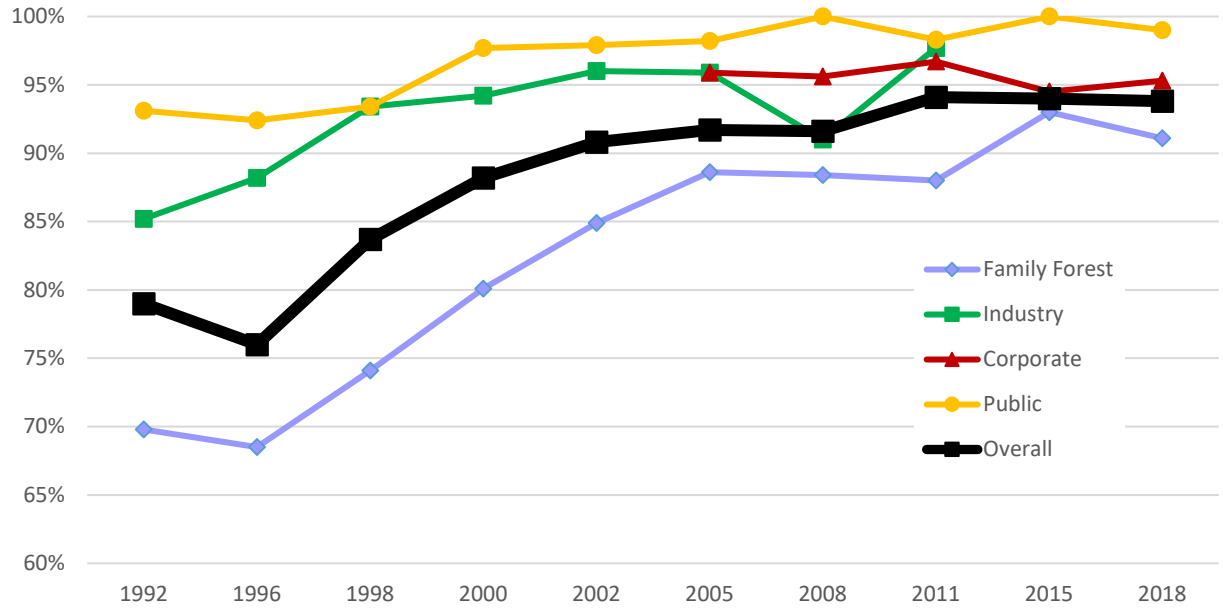
These events can have lasting impacts on watershed function. Hurricane Rita caused significant damage to riparian forests and Streamside Management Zones, since wind speeds were able to strengthen in the surrounding open areas of lakes, reservoirs, and young forests. Intense wildfires can consume all of the vegetation on site, increasing the probability of severe erosion and sedimentation, as was the case in the Bastrop Wildfire Complex (2011). Major flood events alter drainage paths, deliver pollutants to waterbodies, and impact transportation infrastructure.

TAMFS Program Delivery

The mission of the Water Resources program is to protect, conserve, and enhance Texas water resources through the sustainable use of forestlands. This objective is accomplished through the development of science-based, non-regulatory/voluntary Best Management Practices (BMPs), effective coordination with numerous partners, an aggressive education/technical assistance/outreach campaign, and a monitoring program designed to measure the implementation and effectiveness of these practices.

Since these BMPs were established in 1989, TAMFS staff has effectively promoted their importance through logger training, landowner education, and public outreach, a strategy recommended by the Texas Conservation Action Plan. Monitoring conducted by TAMFS shows that 94 percent of sampled operations across all timberlands in East Texas utilized these practices (Figure 33). TAMFS uses these results, along with new research and technology, to identify and target future efforts. Based on previously conducted monitoring, focused training workshops have been delivered.

Figure 33
BMP Implementation Rate by Ownership and Year



The Texas Statewide Assessment of Forest Resources (September 2008) and Texas Statewide Forest Resource Strategy (June 2010) identified a need to expand the program's focus to address statewide water resource issues and concerns. As a result, TAMFS established new program offices in Houston, San Antonio, and Temple. Staff work closely with partners to advance forest watershed initiatives, such as riparian education, green infrastructure, wildfire remediation, and land stewardship training for farm and ranch contractors.

The 2012 State Water Plan identified a very sobering message: In serious drought conditions, Texas does not and will not have enough water to meet the needs of its people, businesses, and agriculture enterprises. Based on this message, TAMFS began pursuing creative opportunities to engage and add value in how Texas manages the state's water resources.

Recognizing the strong connection between forests and water supply, TAMFS and Texas Rural Water Association organized the first-ever Texas Forests and Drinking Water Forum in 2015. Water utilities, forest managers, academia, state and federal agencies, industry, and conservation groups met to explore ways to work together to continue to sustain these two important and interdependent resources. There was widespread agreement at the Forum that a continued collaborative relationship was necessary to ensure the viability of both sectors, resulting in the development of the Texas Forests and Drinking Water Partnership. TAMFS continues to provide leadership and support for this initiative.

The focus of the Partnership is to identify mutual goals, interests, programs, potential barriers, and possible opportunities for pursuing forest conservation and stewardship as a source water protection strategy. Healthy, sustainable forests can help protect and enhance drinking water supplies while also providing economic benefits. Promoting ecosystem service markets and incentives for private landowners to conserve their forests and woodlands are cornerstone approaches of the Partnership.

Recent devastating flood events across the state highlight the need for comprehensive planning and coordinated mitigation to address this growing problem. Nature-based solutions, working in conjunction with traditional engineering approaches, can enhance flood mitigation. Trees and forests help regulate streamflow and mitigate stormwater runoff through canopy interception, transpiration, and increased soil infiltration capacity. TAMFS participates in watershed planning efforts, providing technical assistance on BMPs and green infrastructure activities that are synergistic with water supply efforts.

Challenges

Increasing the awareness and understanding of the importance of forests and woodlands to providing clean drinking water is a tremendous challenge. Utilities sometimes fail to recognize this connection, are reluctant to invest in forest-based source water protection strategies that are already provided free of charge, or have aging infrastructure needs that take priority on already stressed budgets. Additionally, providers often face public pressure to keep water rates constant.

Similarly, engineers, planners, and city officials may not be as familiar with or have training in designing nature-based solutions to manage water quantity concerns. As a result, green infrastructure projects are not as widely implemented as traditional engineering approaches, such as dams, detention facilities, levees, and channel improvements.

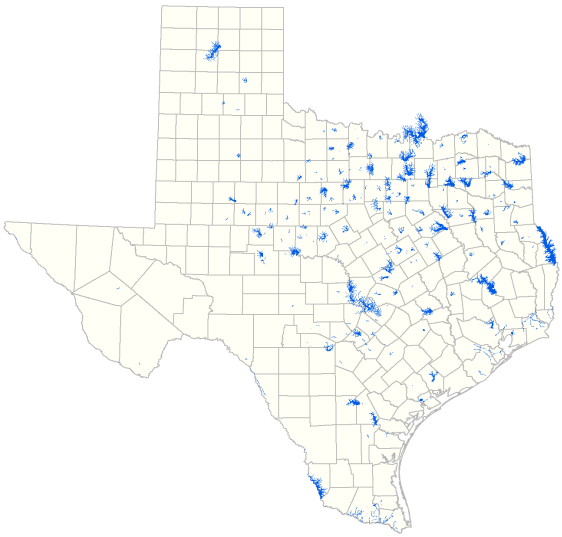
In recent years, many Texans have chosen to leave suburban areas to purchase and enjoy rural life on smaller, sub-divided plots of land. This change is creating a diversity of landowner interests and understanding of sustainable, land management practices. Regional differences also contribute to challenges with private land stewardship. Outside of East Texas, market-based solutions for BMP implementation are limited. Ecosystem service markets, while promising, are complex, slow to develop, and difficult for family forest owners to access.

Spatial Analysis

The geospatial priority layer used for the Water Resource Protection issue is derived from a layer produced in-house and adapted from the U.S. Forest Service's Forest-to-Faucet study. This layer prioritizes Texas watersheds by forest importance to surface drinking water for source water protection. Four main factors are considered: (1) watershed importance for surface drinking water, (2) forest importance to surface drinking water, (3) threats to forests, and (4) potential for partnership. The analysis was performed at the 12-digit HUC level. Please refer to the description of the Forest-to-Faucet layer in the appendix on how it was developed. Results from this analysis

were compared to the TCEQ assessment "Area of Primary Influence for Surface Drinking Water" (Figure 34).

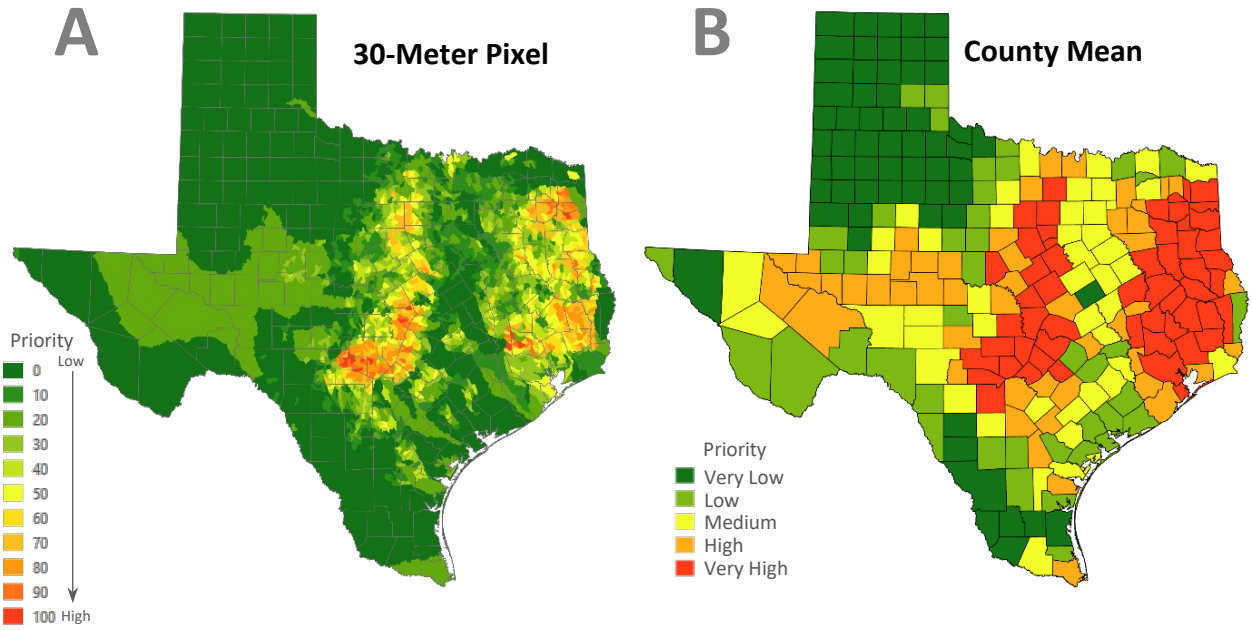
Figure 34
Area of Primary Influence for Surface Drinking Water
Texas Commission on Environmental Quality



Results

Results for the analysis are shown in Map 8. Map 8A shows a 30-meter pixels divided into 11 classes (0 to 100 in increments of 10) and Map 8B shows the county means for the 30-meter pixel layer.

Map 8
Priority Analysis for Water Resource Protection –
30 Meter Pixel Watershed Map (A) and County Mean Map (B)



Since U.S. Forest Service guidance encourages priority areas to be specific geographic areas, expert judgement was used to divide counties into two classes: priority and non-priority counties (Map 9). Priority counties were selected considering the geospatial analysis performed (Map 8), and experience of the Water Resources program leader. Priority counties for the Water Resource Protection issue total 109 counties (Table 21).

Map 9

Priority Counties for Water Resource Protection

(Derived through expert judgement based on priority analysis maps)

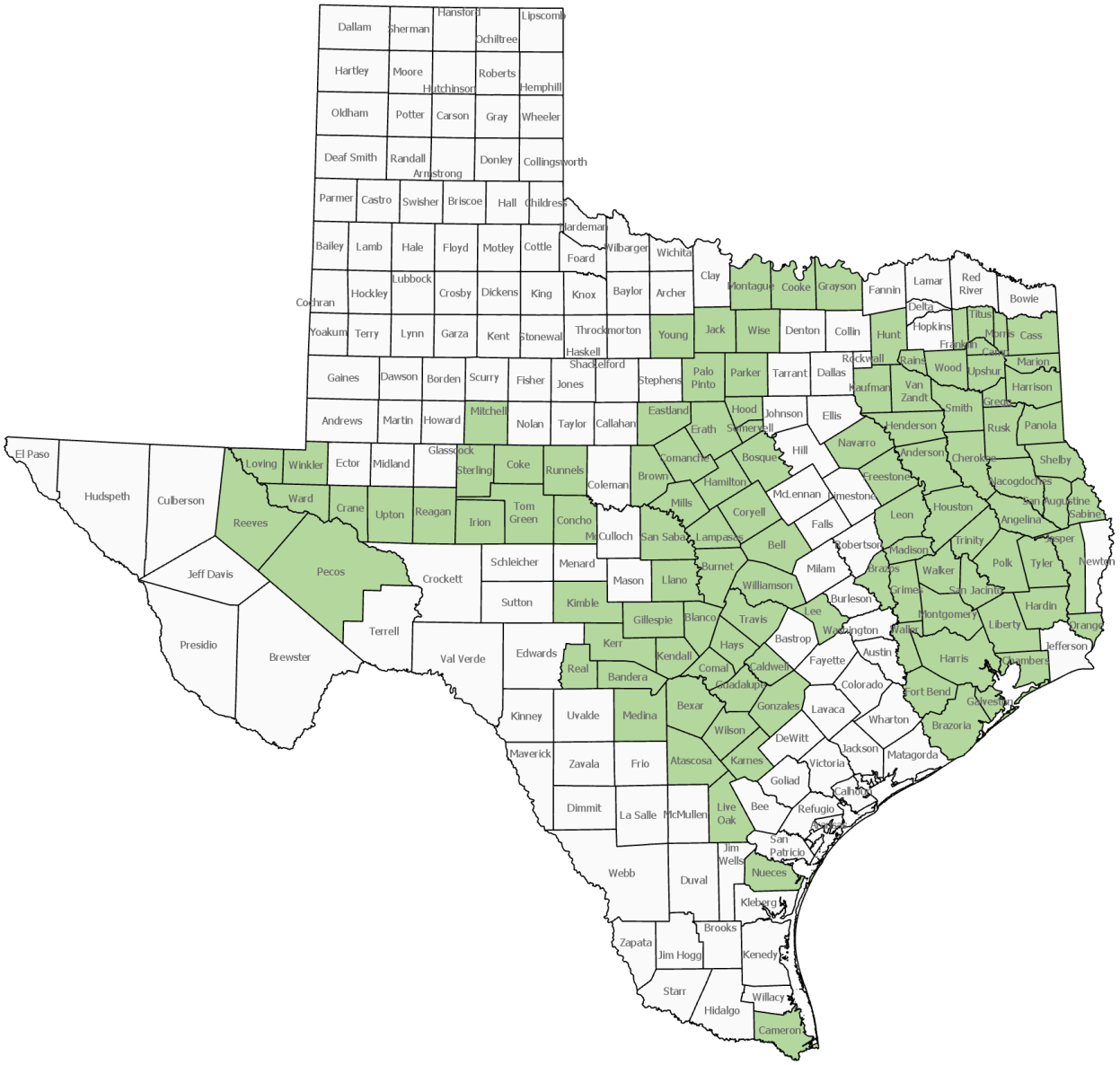


Table 21
Water Resource Protection – Priority Counties

Anderson	Chambers	Gonzales	Jasper	Mills	Real	Tyler
Angelina	Cherokee	Grayson	Karnes	Mitchell	Reeves	Upshur
Atascosa	Coke	Gregg	Kaufman	Montague	Runnels	Upton
Bandera	Comal	Grimes	Kendall	Montgomery	Rusk	Van Zandt
Bell	Comanche	Guadalupe	Kerr	Morris	Sabine	Walker
Bexar	Concho	Hamilton	Kimble	Nacogdoches	San Augustine	Waller
Blanco	Cooke	Hardin	Lampasas	Navarro	San Jacinto	Ward
Bosque	Coryell	Harris	Lee	Nueces	San Saba	Williamson
Brazoria	Crane	Harrison	Leon	Orange	Shelby	Wilson
Brazos	Eastland	Hays	Liberty	Palo Pinto	Smith	Winkler
Brown	Erath	Henderson	Live Oak	Panola	Somervell	Wise
Burnet	Fort Bend	Hood	Llano	Parker	Sterling	Wood
Caldwell	Franklin	Houston	Loving	Pecos	Titus	Young
Cameron	Freestone	Hunt	Madison	Polk	Tom Green	
Camp	Galveston	Irion	Marion	Rains	Travis	
Cass	Gillespie	Jack	Medina	Reagan	Trinity	

Conclusion

The geospatial analysis identified three primary areas in which future efforts should be concentrated—East Texas, the Interstate-35 corridor region of Central Texas, and the Trans-Pecos. These efforts include expanding the education and technical assistance functions of the Water Resources program, developing new partnerships with water utilities, local governments, and floodplain managers, exploring opportunities for ecosystem service markets, and engaging in source water protection efforts in priority watersheds. Focusing attention on these critical areas can help manage and sustain the state's water supply.

Strategy

This section provides goals, objectives, and strategies for addressing the issue of *Water Resource Protection*. The goals for this issue are:

1. Promote the role of trees and forests in maintaining watershed function.
2. Enhance water quality through Best Management Practices.
3. Protect drinking water supplies in priority watersheds.

The following lists the objectives and strategies for each goal.

Water Resources

Goal 1

Promote the role of trees and forests in maintaining watershed function

Objective **1.1**	**Integrate trees, forests, and woodlands in watershed planning.**
Strategy **1.1.1**	Develop cooperative relationships with organizations in support of clean water goals.
Strategy **1.1.2**	Raise the awareness of the value of forested watersheds and urban tree canopy.
Strategy **1.1.3**	Engage in watershed and resource planning efforts in priority watersheds.
Objective **1.2**	**Work with communities to manage water resources in urban environments.**
Strategy **1.2.1**	Provide education and technical assistance on green infrastructure.
Strategy **1.2.2**	Assist local governments with planning and implementing drainage operations.
Strategy **1.2.3**	Support riparian and stream restoration efforts.
Objective **1.3**	**Restore and enhance degraded and fragmented forests and woodlands.**
Strategy **1.3.1**	Provide technical assistance to landowners in riparian forest establishment, management, and restoration.
Strategy **1.3.2**	Develop ecosystem service markets to keep forests intact.
Strategy **1.3.3**	Facilitate land recovery and restoration efforts after natural disasters to promote watershed function.

Goal 2

Enhance water quality through Best Management Practices

Objective **2.1**	**Develop and promote Best Management Practices (BMPs) on land management operations.**
Strategy **2.1.1**	Develop and promote BMPs for land management operations.
Strategy **2.1.2**	Support applied watershed research that adds to the collective knowledge base of forest and woodland hydrology.
Strategy **2.1.3**	Monitor and report the implementation of BMPs on forest operations in East Texas.
Strategy **2.1.4**	Review BMPs periodically with partners to ensure their continued effectiveness in protecting water quality.
Objective **2.2**	**Promote continual improvement of BMP implementation.**
Strategy **2.3.1**	Expand innovative, educational efforts to reach new landowners, loggers, and contractors.
Strategy **2.3.2**	Target education, outreach, and technical assistance to deficient areas identified through monitoring.

Goal 3

Protect drinking water supply in priority watersheds

Objective **3.1**	**Advance source water protection in priority drinking water supply watersheds.**
Strategy **3.1.1**	Provide leadership and support to the *Texas Forests and Drinking Water Partnership*.
Strategy **3.1.2**	Identify priority drinking water supply watersheds.
Strategy **3.1.3**	Target private land stewardship efforts in drinking water supply watersheds.

Performance Outcomes

Goal 1: *Promote the role of trees and forests in maintaining watershed function*

- Establish sound, technical silvicultural guidelines for the establishment, management, and restoration of riparian forests.
- Assist local governments with green infrastructure, stormwater mitigation and drainage operations.
- Provide technical assistance to facilitate restoration/recovery of lands affected by natural disasters (wildfire, floods, hurricanes, tornadoes, etc.) to promote watershed function.

Goal 2: *Enhance water quality through Best Management Practices*

- Increase BMP implementation on forestry operations to 95 percent through an aggressive, targeted, education, outreach, and technical assistance campaign.
- Develop and promote new, innovative, online technology transfer applications to increase land stewardship and water resource protection.

Goal 3: *Protect drinking water supply in priority watersheds*

- Lead the Texas Forest and Drinking Water Partnership to increase communication and collaboration between the forest and water utility sectors.
- Deliver education, outreach, and technical assistance resulting in improved land management within aquifer recharge zones.

IMPORTANT FOREST RESOURCE AREAS FOR THE FOREST STEWARDSHIP PROGRAM

The Forest Stewardship Program (FSP) now requires that each state spatially identify and delineate important forest resources areas, or priority areas, across the state where program outreach and activity will be emphasized. In fact, it is now a requirement that FSP funds allocated to states must be spent on activities within those defined areas.

Background

Important forest resource areas (IFRAs) in the Forest Stewardship Program has its origins in the Spatial Analysis Project (SAP). This project was initiated as a pilot phase in the early 2000s in the Northeastern Area of USDA Forest Service State and Private Forestry. Four states—Connecticut, Massachusetts, Maryland, and Missouri—were the first states to participate in this pilot phase. In 2005, eight additional states joined the project—Delaware, Indiana, Iowa, Rhode Island, and West Virginia in the Northeast Area and Alaska, Oregon, and Colorado in the West.

Following this pilot phase, the requirement for spatially defining important forest resource areas was included in the FSP National Standards and Guidelines in late 2005. Subsequently, all 50 states and territories joined the Spatial Analysis Project in 2006.

The Spatial Analysis Project is comprised of two primary components:

1. Statewide Assessment – Geospatial analysis of all lands eligible for the Forest Stewardship Program that considers the resource richness across the state and known threats to forest and other natural resources.
2. Stewardship Plan Database – An inventory of existing Forest Stewardship Plans that the state tracks through time.

The statewide assessment is a compilation of geospatial layers that address the resources, issues, and opportunities within the state. The original thirteen core layers—nine resource richness layers and three resource threat layers—include the following.

Forest Resource Richness *Forest Resource Threat*

applying a weight to each layer relative to their importance to the other layers or to the overall analysis, and then overlaying the layers and summing the weighted values for each layer at coincident locations. The resultant index layer is then classified into three priority classes—High, Medium, and Low—using the Natural Breaks method[2].

Southern Forest Land Assessment

All 50 states and territories completed an SAP assessment. The South went one step further and conducted the analysis at a regional scale. The Southern Forest Land Assessment (SFLA) was a cooperative project of the Southern Group of State Foresters that served as the assessment component of the Spatial Analysis Project. Three primary reasons the SGSF partnered in this effort were (1) to pool resources and take advantage of an economy of scale, (2) to standardize data and analyses, and (3) to complement the Southern Wildfire Risk Assessment, another regional cooperative project.

The Southern Forest Land Assessment followed the methodology established for the SAP with two modifications. In addition to the 12 standard cores layers, the South included a Site Productivity layer based on site index as provided by NRCS's SSURGO (Soil Survey Geographic Database). Also, instead of using one set of weights for the various layers, SFLA used a separate set for each ecoregion (2001 NLCD Mapping Zones).

The SFLA layers were updated in 2019 through a Landscape Restoration Project by the North Carolina Forest Service. Most southern states used some or all of these layers to update their Stewardship IFRAs and for other issue analyses for their Forest Action Plan.

SMART

In 2012, the U.S. Forest Service deployed the Stewardship Mapping and Reporting Tool (SMART). SMART is a platform for writing Forest Stewardship Plans and storing them in a national centralized database. Both geospatial (polygons) and non-spatial attribute information are stored. While some states around the nation use it as designed, as a Stewardship Plan writer, all states in the South use it simply as a repository for their Forest Stewardship Plans. These states instead produce Stewardship Plans in their own systems and then once a year, upload the plan boundaries and required attributes into SMART using SADL (Spatial Accomplishment Data Loader).

States also submitted their Important Forest Resource Areas layer for loading into SMART. This allows the SMART system to conduct a geospatial analysis to determine how much of a Stewardship Plan occurs in a defined Important Forest Resource Area. Up until 2020, IRFAs consisted of a layer with a separate priority value assigned to each individual 30-meter pixel based on the overlay analysis. Accordingly, an individual pixel could be considered a priority area. This has changed. The U.S. Forest Service has directed that, beginning in 2020, priority areas will be specific geographic areas on the landscape. This is interpreted to mean that priority area should be based on some designated geographic area, such as a county, watershed, or administrative area. Alternatively, this specific geographic area could also be a hand-drawn polygon that encompasses large collections of high priority value pixels.

Maximum Acreage Restriction

The U.S Forest Service has mandated that Important Forest Resource Areas cannot exceed 50 percent of eligible acres defined as the sum of total NIPF acres of holdings greater than 10 acres and

[2] Natural Breaks, also called Jenks natural breaks classification method, is a data clustering method designed to determine the best arrangement of values into different classes and seeks to reduce the variance within classes and maximize the variance between classes.

10 percent of erodible agricultural land. For Texas, this maximum allowable area is 32,489,700 acres.

Update of Important Forest Resource Areas for Texas
Texas used many of the updated Southern Forest Land Assessment layers for conducting its geospatial analysis. However, several layers were replaced with new ones deemed more appropriate for the state. Below is a list of layers that were different from those produced by North Carolina.

- **Forestland** – Texas developed its own layer where total forestland acreage matches that estimated by the Forest Inventory and Analysis (FIA) program.
- **Forest Patches** – This layer was rebuilt using the new Forestland layer.
- **Forest to Faucets** – Priority Watershed and Public Drinking water layers were replaced with this layer, which was previously developed following methodology set forth by the Forest to Faucets project of the U.S. Forest Service.
- **Wildfire Concern** – A Wildfire layer was produced because the updated SFLA layer was the same layer used in the original SFLA. This original layer was actually the Wildfire Level of Concern (LOC) layer used in the Southern Wildfire Risk Assessment (SWRA). This LOC layer is no longer used in the SWRA. The new layer was developed from four data layers: the National Burn Probability layer from the U.S. Forest Service, and Fire Intensity Scale, Community Protection Zone, and Pine Plantation Value layers from Texas Wildfire Risk Assessment.
- **Slope** – Slope was dropped from the analysis because its original intent was as an indicator of equipment operability, which was deemed unnecessary.

Each individual layer is described and displayed in the Appendix.

Following SAP methodology, the Important Forest Resource Area layer for Forest Stewardship was produced by weighted overlay analysis. Before analysis, each layer was scaled from 0 to 100. Weights were assigned each layer such that they summed to 100 percent (Table 22). To simplify the process, one set of weights was assigned across the whole state. Weights used were those from the SFLA.

Results

Overlay analysis produced a layer where priority was calculated for each 30-meter pixel[3] (Map 10A). Because the Forest Stewardship Program now requires "specific" geographic areas as Important Forest Resource Areas, county means were calculated (using Zonal Statistics in Spatial Analyst) to produce a Priority by County map (Map 10B). For both the Priority by 30-Meter Pixel map and the Priority by County Mean map, Natural Breaks was used to aggregate the priority values into five classes (Very High, High, Moderate, Low, and Very Low).

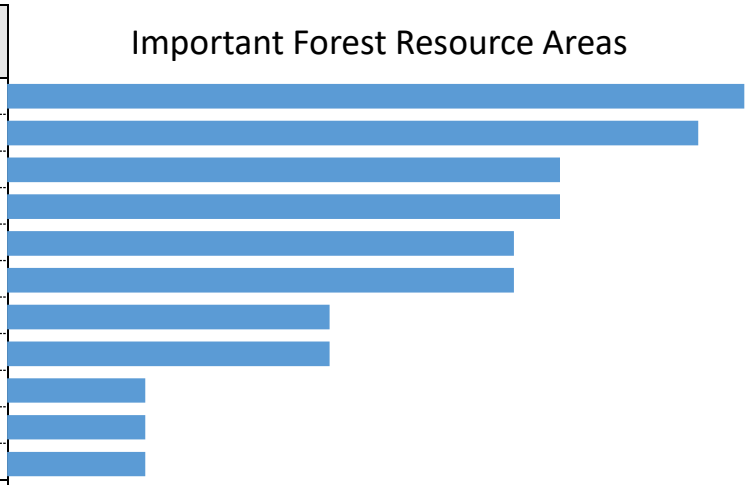
For the final step in the process of determining FSP Important Forest Resource Areas, the Stewardship Coordinator and other relevant program leaders used the two maps described above as guides to assign priority to selected counties. This step produced a final map showing FSP Priority counties (Map 11). In addition, the maps show land ineligible for Stewardship Plan development, which includes urban, water, and public land.

Of the 254 counties in Texas, 88 are priority counties for the Forest Stewardship Program (Map 11 and Table 23).

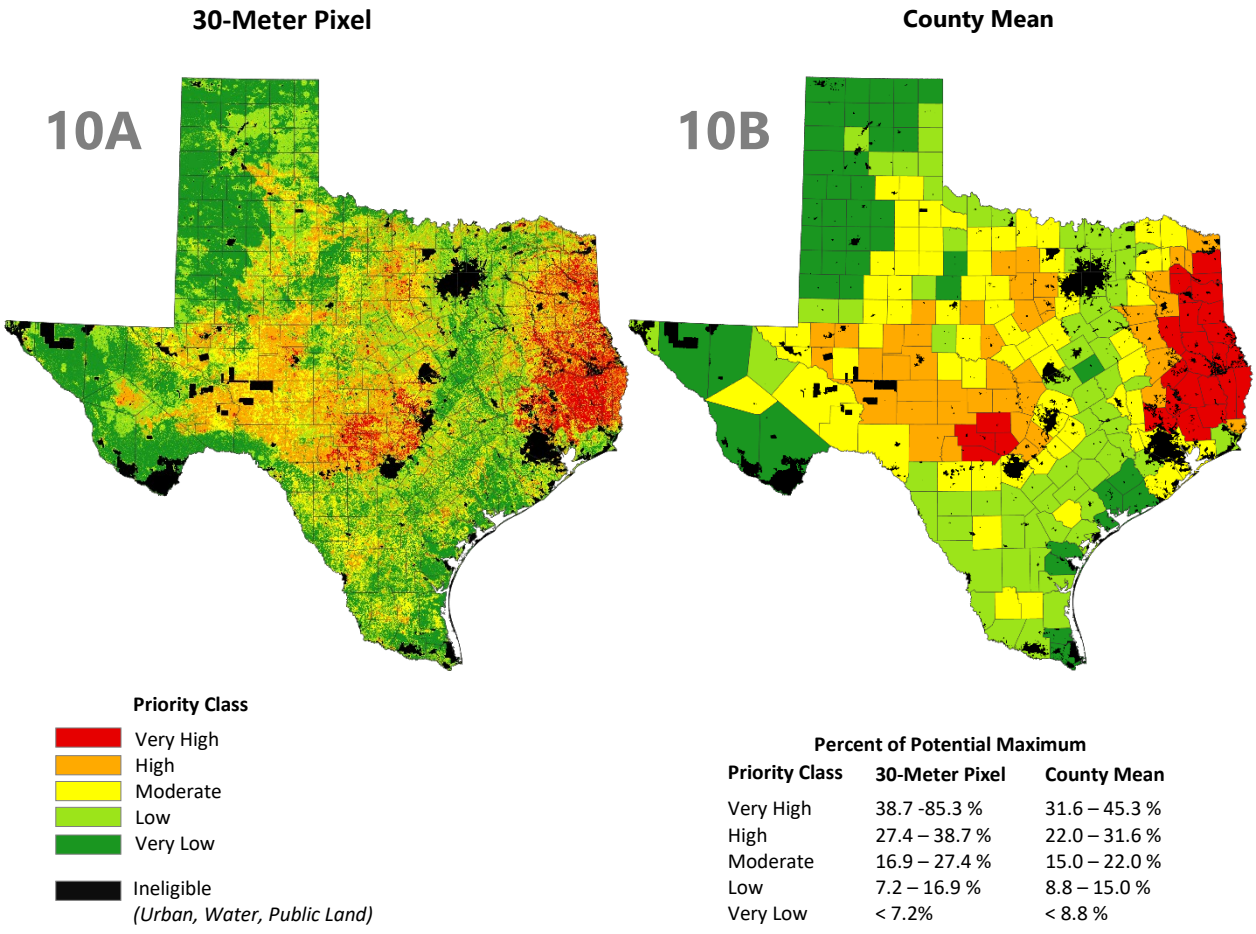
[3] A pixel is the smallest unit of information in an image or raster map, usually square. Pixel is often used synonymously with cell. A 30-meter pixel represents a 30-meter by 30-meter square on the ground and covers 0.222 acres.

Table 22
Layer Weights Used in Geospatial Analysis to Determine Important Forest Resource Areas

Layer Rank	Layer Name	Layer Weight
1	Forest	16
2	Development Threat	15
3	Wildfire Threat	12
4	Site Productivity	12
5	Forest Health Threat	11
6	Forest to Faucet	11
7	Riparian Areas	7
8	Forest Patches	7
9	T&E Species	3
10	Protected Areas	3
11	Wetlands	3
	TOTAL	100



Map 10
Important Forest Resource Areas – 30 Meter Pixel Map (A) and County Mean Map (B)



Note: Classes derived using Natural Breaks.

Percent of Potential Maximum

Priority Class	30-Meter Pixel	County Mean
Very High	38.7 -85.3 %	31.6 – 45.3 %
High	27.4 – 38.7 %	22.0 – 31.6 %
Moderate	16.9 – 27.4 %	15.0 – 22.0 %
Low	7.2 – 16.9 %	8.8 – 15.0 %
Very Low	< 7.2%	< 8.8 %

Map 11
Important Forest Resource Areas – Priority Counties

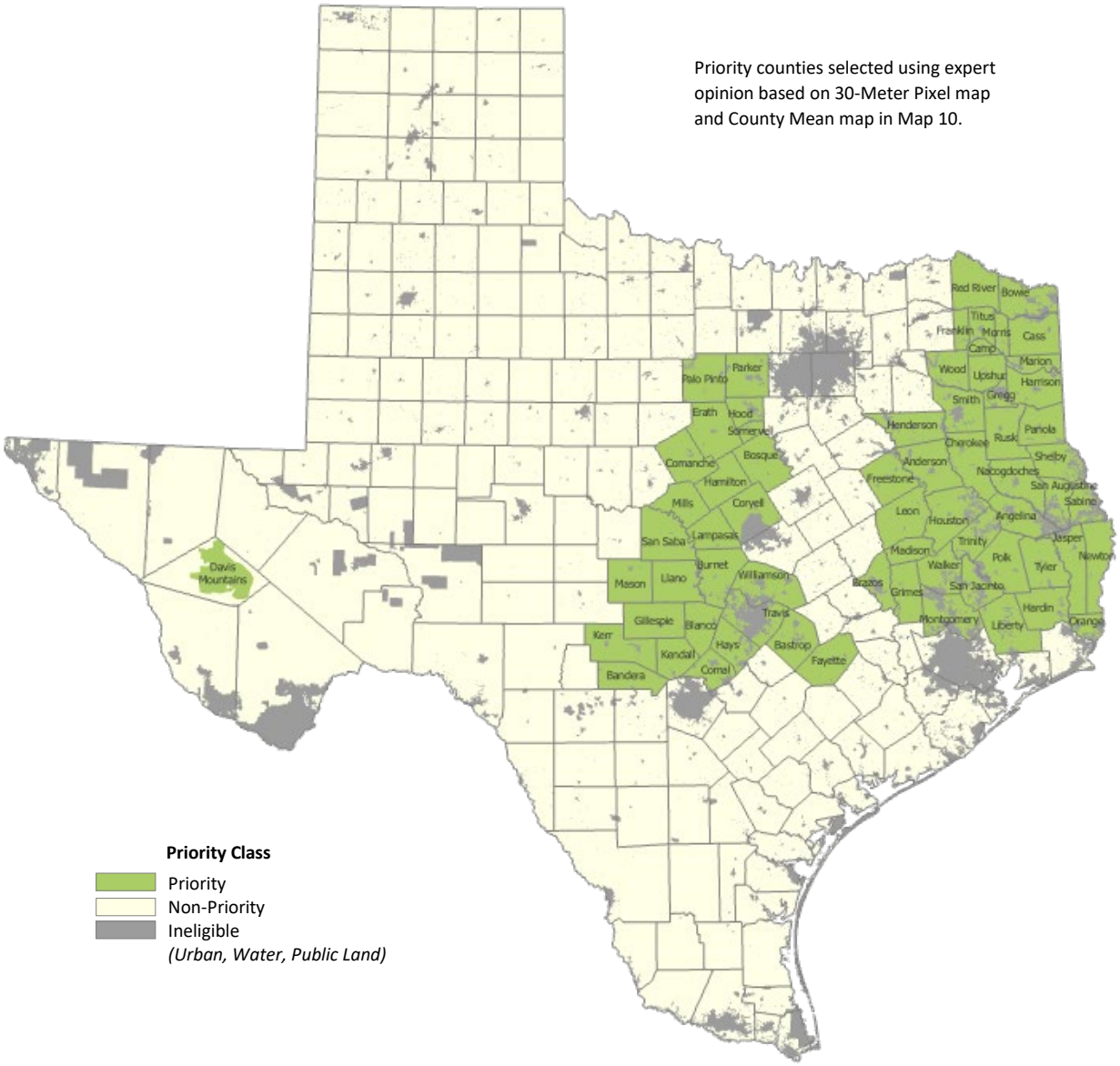


Table 23
Important Forest Resource Areas – Priority Counties
(32.0 million acres)

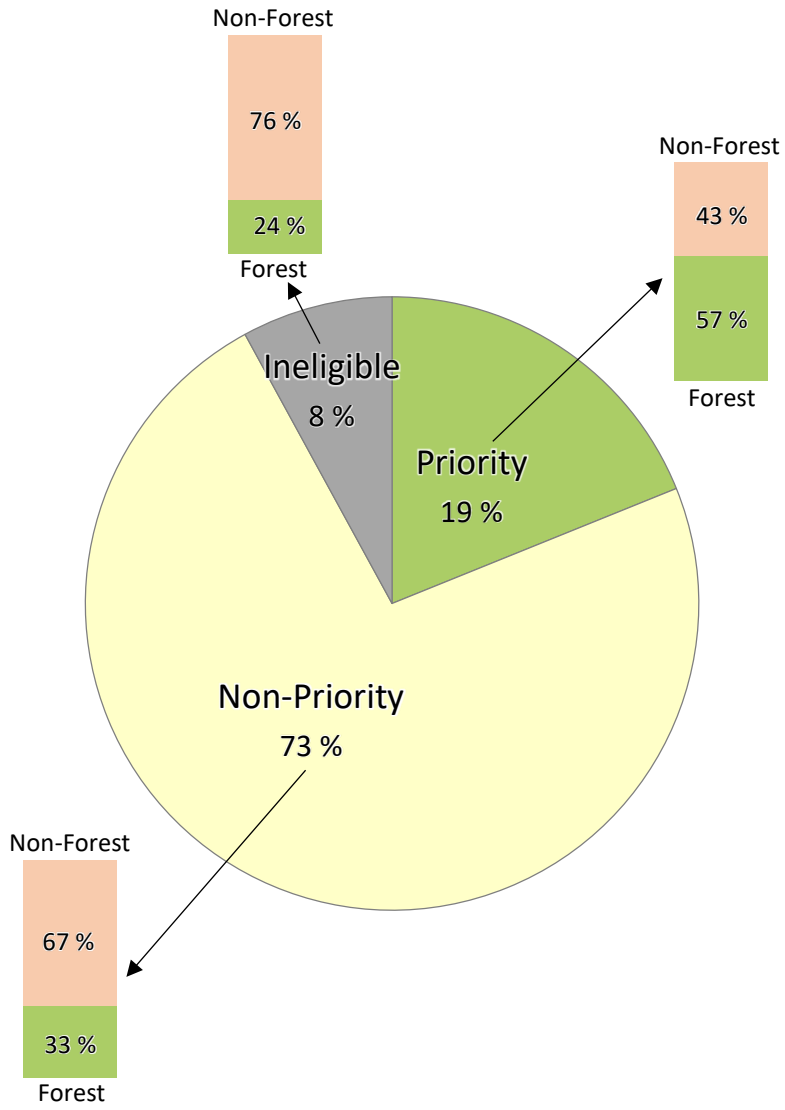
Anderson	Comal	Hardin	Llano	Parker	Travis
Angelina	Comanche	Harrison	Madison	Polk	Trinity
Bandera	Coryell	Hays	Marion	Red River	Tyler
Bastrop	Davis Mountains[1]	Henderson	Mason	Rusk	Upshur
Blanco	Erath	Hood	Mills	Sabine	Walker
Bosque	Fayette	Houston	Montgomery	San Augustine	Williamson
Bowie	Franklin	Jasper	Morris	San Jacinto	Wood
Brazos	Freestone	Kendall	Nacogdoches	San Saba	
Burnet	Gillespie	Kerr	Newton	Shelby	
Camp	Gregg	Lampasas	Orange	Smith	
Cass	Grimes	Leon	Palo Pinto	Somervell	
Cherokee	Hamilton	Liberty	Panola	Titus	

[1] *Davis Mountains is mountain range, not a county.*

Table 24
Area of Priority Land by Class

Class	Forest	Non-Forest	*TOTAL*
	---------- million acres ----------		
Priority	18.3	13.7	**32.0**
Non-Priority	41.4	82.5	123.9
Ineligible	3.3	10.2	13.5
TOTAL	62.9	106.4	169.3

Figure 35
Area of Priority Land by Class



OVERALL STATEWIDE PRIORITY AREAS

Although Texas developed priority areas for each of five issues along with Important Forest Resource Areas (IFRAs) for the Forest Stewardship Program, new requirements for the Landscape Scale Restoration (LSR) grant program requires that each state produce a single statewide priority layer that can be used to spatially compare LSR project areas with a single Forest Action Plan priority layer.

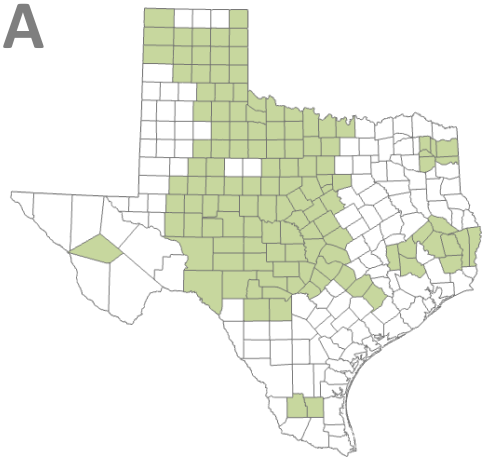
Priority areas for each issue and for IFRAs are at the county level except for Urban Forest Sustainability, which is at the Place level (village, town, city, and Census Designated Place) (Map 12A – Map12F). An overall priority value was calculated for each county as the number of issues determined to be priority for that county. This value ranged from 0 to 4 (a value of 5 is not possible since the East Texas and Central Texas counties do not overlap). The map produced from this overlay was also compared to Urban Forest Sustainability Priority Places (Map 13).

Counties for which two or more issues were priority were deemed priority for the overall FAP priority layer. To ensure representation for the Urban Forest Sustainability issue, any additional counties where significant priority Places occur (including their ETJs) were determined to be priority (Map 14). In addition, any counties that were in the FSP's Important Forest Resource Areas were made priority since FSP guidelines encourage that IFRAs be a subset of the Forest Action Plan priority areas. Across the state, 114 counties are considered priority (Table 25).

Map 12
Priority Areas for FAP Issues and FSP IFRAs

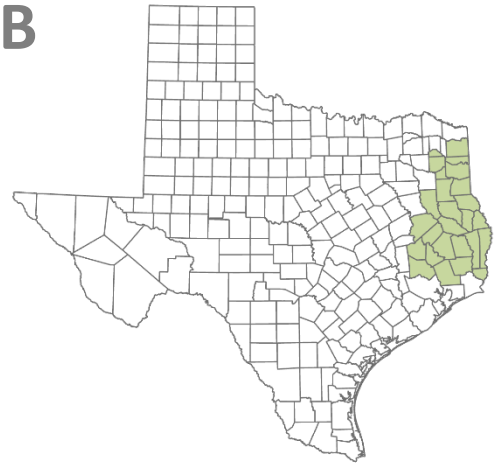
Wildfire and Public Safety

A



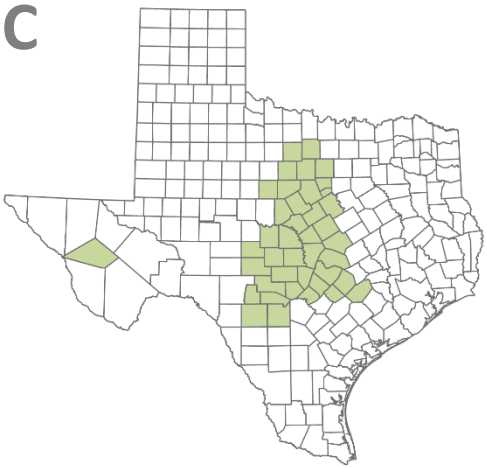
Sustainability of Forest Resources in East Texas

B



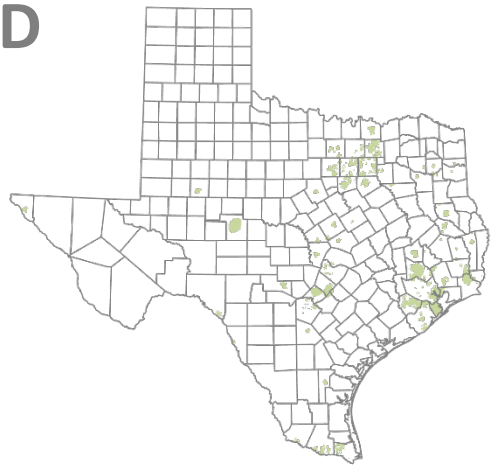
Central Texas Woodlands Conservation

C



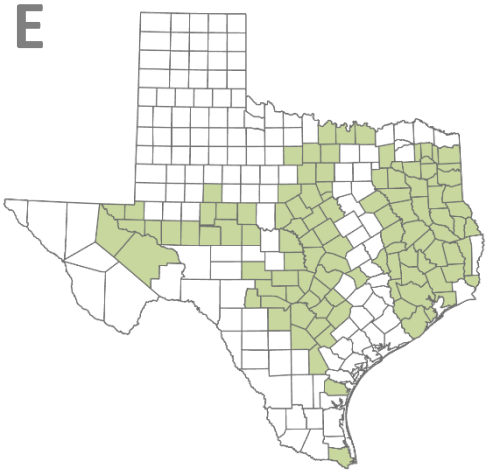
Urban Forest Sustainability

D



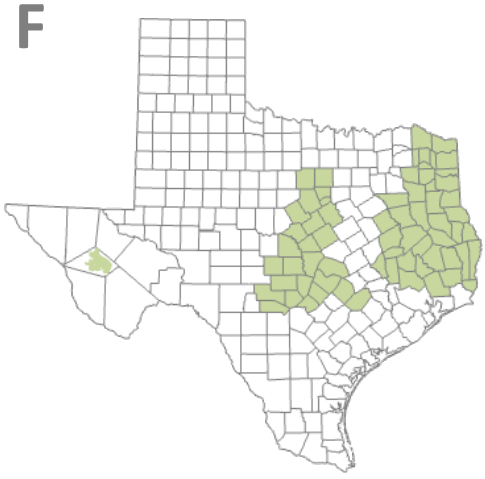
Water Resource Protection

E

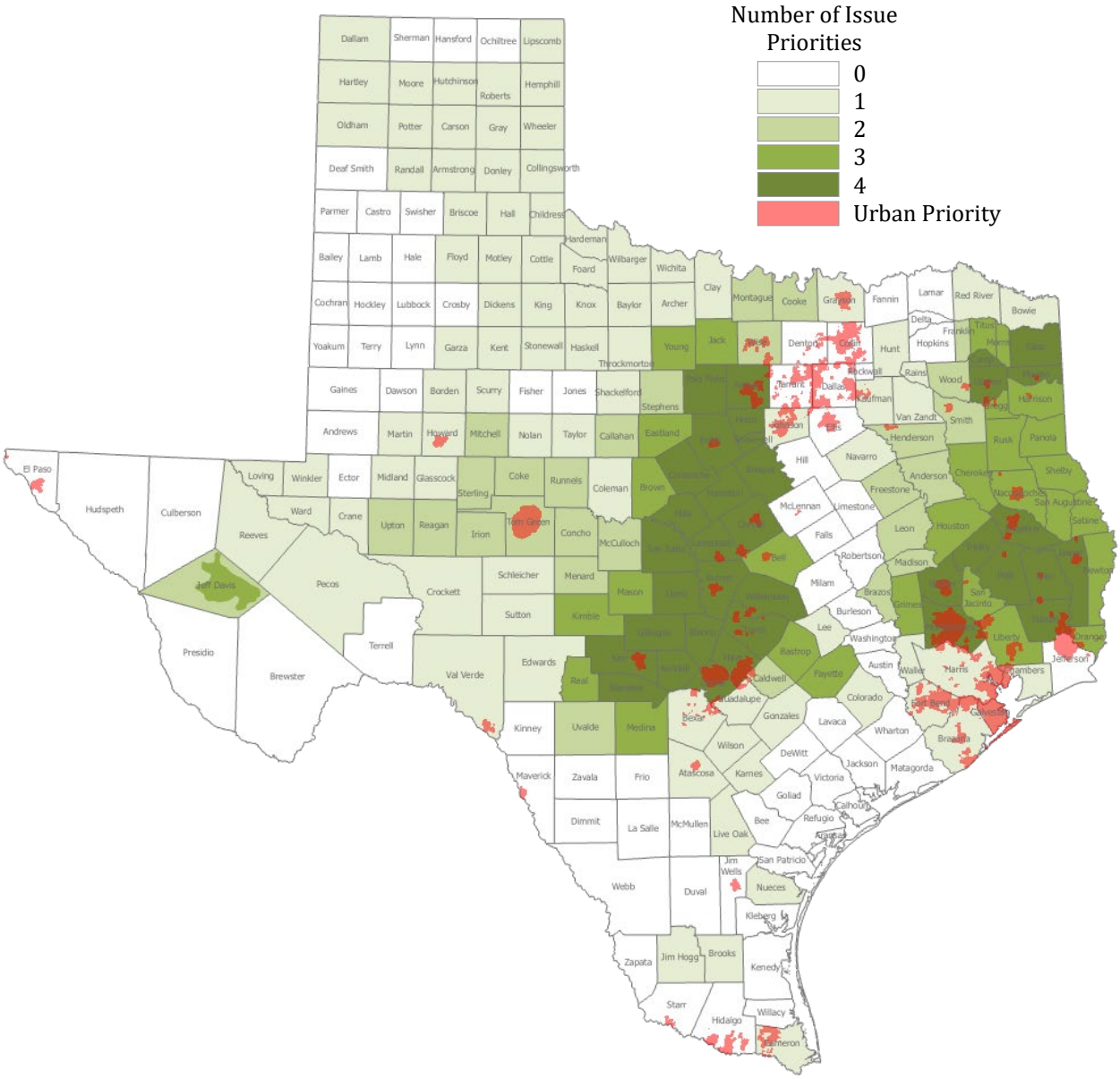


FSP Important Forest Resource Areas

F



Map 13
Overlapping Priority Issues Along With Priority Places



Map 14
Overall Priority Counties for Forest Action Plan

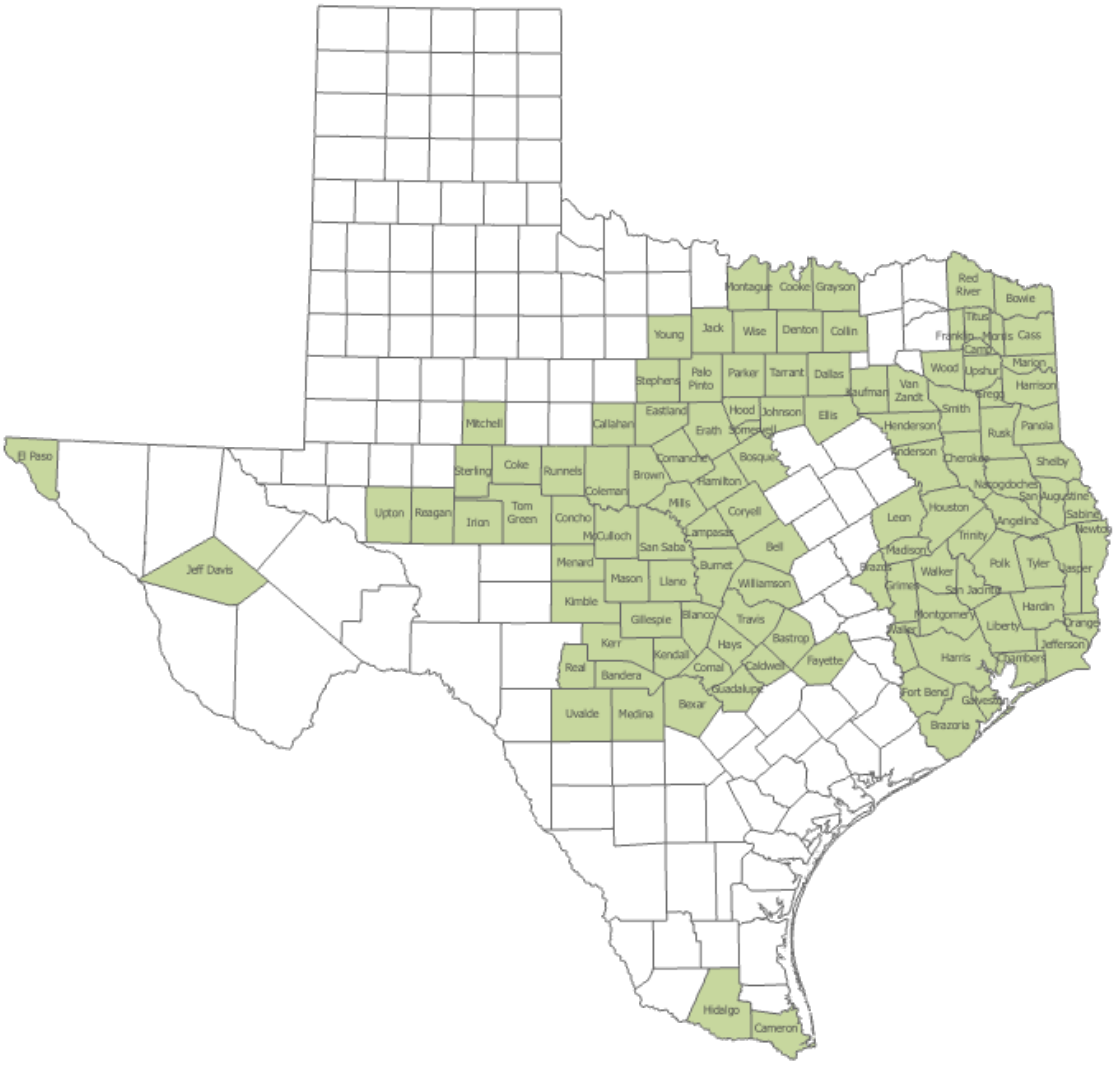


Table 25
Overall Priority Counties for Forest Action Plan

Anderson	Cameron	Eastland	Harris	Kerr	Montgomery	San Augustine	Upton
Angelina	Camp	El Paso	Harrison	Kimble	Morris	San Jacinto	Uvalde
Bandera	Cass	Ellis	Hays	Lampasas	Nacogdoches	San Saba	Van Zandt
Bastrop	Chambers	Erath	Henderson	Leon	Newton	Shelby	Walker
Bell	Cherokee	Fayette	Hidalgo	Liberty	Orange	Smith	Waller
Bexar	Coke	Fort Bend	Hood	Llano	Palo Pinto	Somervell	Williamson
Blanco	Coleman	Franklin	Houston	Madison	Panola	Stephens	Wise
Bosque	Collin	Galveston	Irion	Marion	Parker	Sterling	Wood
Bowie	Comal	Gillespie	Jack	Mason	Polk	Tarrant	Young
Brazoria	Comanche	Grayson	Jasper	McCulloch	Reagan	Titus	
Brazos	Concho	Gregg	Jeff Davis	Medina	Real	Tom Green	
Brown	Cooke	Grimes	Jefferson	Menard	Red River	Travis	
Burnet	Coryell	Guadalupe	Johnson	Mills	Runnels	Trinity	
Caldwell	Dallas	Hamilton	Kaufman	Mitchell	Rusk	Tyler	
Callahan	Denton	Hardin	Kendall	Montague	Sabine	Upshur	

TEXAS A&M FOREST SERVICE PROGRAMS

Guide to Agency Programs

The following section includes 21 programs the Texas A&M Forest Service (TAMFS) delivers within its two divisions; the Division of Forest Resource Development (FRD) and the Division of Forest Resource Protection (FRP).

Those programs included in detail in the Issues Section are described briefly in this section. For those programs that are not described specifically or in detail in the Issues Section, a more detailed description and more information about that program are included in this section.

Forest Resource Development & Sustainable Forestry

- East Texas Program Delivery
- West Texas Program Delivery and West Texas Nursery
- Tree Improvement Program and Western Gulf Forest Tree Improvement Cooperative
- Forest Inventory and Analysis
- Ecosystem Services
- Water Resources
- Forest Taxation
- Forest Economics and Resource Analysis
- Urban Forestry and Community Forestry Program
- Forest Health Program and Forest Pest Management Cooperative
- Stewardship Programs
- Rural Forestry Assistance and Forest Stewardship Program
- Forest Legacy Program
- Conservation Education
- State Lands Management

Wildfire & Public Safety Programs

- Predictive Services
- Mitigation and Prevention
- Planning and Preparedness
- Applied Technology
- Local Capacity Building
- Incident Response
- Law Enforcement

East Texas Program Delivery

Program Description

East Texas Program Delivery consists of operations that serve as the implementation mechanism in the field offices for all TAMFS programs in East Texas listed in this report. District offices serve as the point of contact for landowners, communities, fire departments, and other stakeholders. As of 2019, a total of 152 employees in East Texas delivered programs of both the Resource Development and Resource Protection Divisions of the agency. Activities of these programs are divided into four broad functional areas: landowner assistance, emergency response, community forestry, and outreach.

Landowner assistance: District-level staffs provide technical expertise, education, and consultation to private property owners to help them maintain healthy forests and develop and implement long-term forest management plans that reflect their goals and address the needs of the forest. Activities include:

- Diagnosing and recommending treatments for tree- and forest pests.
- Identifying potential wildfire hazards and where these hazards can be mitigated.
- Providing technical assistance regarding timber theft.
- Maintaining lists of private forestry vendors, consultants, and arborists that perform recommended practices.
- Consulting with landowners to develop forest management plans (known as Forest Stewardship Plans) that are specific to each landowner's forest and include detailed descriptions for the current forest and other cover types, soils descriptions, commercial producing capacity of the forest, referrals to private vendors, educational materials on wildlife, water, and aesthetics management, reforestation recommendations, maps, helpful information sources, and recommended practices to improve the forest.
- Assist landowners with participating in available cost share programs. Without these programs many landowners would be unable to implement Forest Stewardship Plans and the management activities needed to maintain their forests and the receive benefits they provide.

Emergency response: District level activities include rapid local response to wildland fires and non-fire emergencies. TAMFS field foresters and resource specialists respond to emergency calls in their local districts as well as dispatch zones statewide, work with VFDs, and promote fire prevention. Activities include the following:

- Maintaining active fire prevention campaigns in the field through Smokey Bear appearances, media releases, and school and civic presentations.
- Sustaining trained and equipped local personnel to maintain a high level of readiness.
- Recruiting and retaining seasonal firefighters to provide backup to full-time wildland fire fighters.
- Monitoring local wildfire conditions and supporting burn ban decisions.
- Maintaining working relationships among local firefighting organizations (Department of Public Safety, Volunteer Fire Departments, and municipal fire departments).

Community Forestry: Activities include educating East Texas communities to recognize the importance and value of trees and forests and helping them build urban forestry programs. Activities include:

- Working with local leaders and interest groups on tree planting projects to ensure the establishment, care, protection, and perpetuation of urban forests.
- Assisting local governments in the development and strengthening of urban forestry policies.
- Assisting communities to meet the National Arbor Day Foundation's Tree City USA qualifications.
- Consulting with individual homeowners and neighborhoods regarding tree health and maintenance.

Outreach activities: Local level conservation education programs educate and inform the public about the wise use and sustainability of forests and natural resources. Activities include:

- Working with County Forest Landowner Associations (CFLAs) who are interested in managing forests for timber production, wildlife, and environmental services.
- Providing news articles and news releases about forestry issues and events to local media.
- Providing presentations for local civic groups and organizations about proper forest management.
- Providing school programs for students using national initiatives such as Project Learning Tree, the Arbor Day Foundation's poster contest, and locally organized Forest Awareness Tours that are hands-on, interdisciplinary, and meet Texas Education Agency requirements.

Priority Areas

East Texas Program Delivery will occur in all counties in East Texas. Priority of a county depends on the issues. See Issues Section for issues.

Goals, Objectives, and Strategies

The agency is responding to changes in the goals of a new group of landowners that has emerged, often referred to as non-traditional family forest owners. While the traditional goals of timber production, wildlife, and soil and water conservation remain important, these non-traditional owners have additional goals. New goals include increased emphasis on aesthetics, privacy, non-traditional forest product production, outdoor recreation, and protection of the natural resources on a landscape scale. TAMFS continues to update trainings for its staff to address these new landowner goals.

East Texas Program Delivery activities impact all East Texas citizens and affect a significant number of citizens in Texas residing outside of East Texas. The effect is realized in the agency's advocacy of the proper and appropriate management of the natural resources of Texas. The resulting effect can be seen in the better management of commercial timber, improved air and water quality, and improved forest health and wildlife habitat. These actions create and maintain jobs in timber operations, processing, lumber production, manufacturing, transportation, and support industries such as equipment dealers, mechanics, parts dealers, recreational equipment and services, and others who receive a direct benefit from the perpetuation of healthy private forests. All landowners with an interest in sustaining their forest land are eligible for all of the TAMFS landowner assistance programs. The general public is welcome to attend all TAMFS outreach and community forest programs.

Generally, a district office is comprised of a District Forester (DF), four to five Resource Specialists (RS), and in some cases, an Office Associate (OA). District Foresters provide leadership, supervision, administration, and fiscal stewardship for each of the local districts. They are involved

in community events, are recognized leaders in all forestry concerns, respond to emergencies, and are responsible for the delivery of all TAMFS programs in East Texas.

Resource Specialist duties include preparation of tract/stand maps, collecting property and soils data, direct interaction with clientele, reforestation and management planning, and delivery of forest health and fire protection outreach programs including the Southern Pine Beetle Prevention Program, VFD capacity building, conservation education, fire prevention, and special projects. Each RS also serves as a wildland firefighter and/or emergency responder who also operates heavy firefighting equipment and uses hand firefighting tools.

Performance Measures

The efficiency of East Texas Program Delivery activities is captured when district staff report activities through a TAMFS reporting system called TexSARS (Texas Spatial Accomplishment Reporting System) and a USFS reporting system called SMART (Stewardship Mapping and Reporting Tool) with its associated tool, SMARTar (SMART Accomplishment Reporting). Examples are presented below:

- Number of Stewardship Plans written.
- Number of acres included in Stewardship Plans.
- Number of non-Stewardship management plans written.
- Number of acres included in non-Stewardship management plans.
- Number of assists to landowners.
- Number of referrals made to private forestry consultants.
- Number of outreach events presented.
- Number of fire department/emergency management contacts made.

West Texas Program Delivery and West Texas Nursery

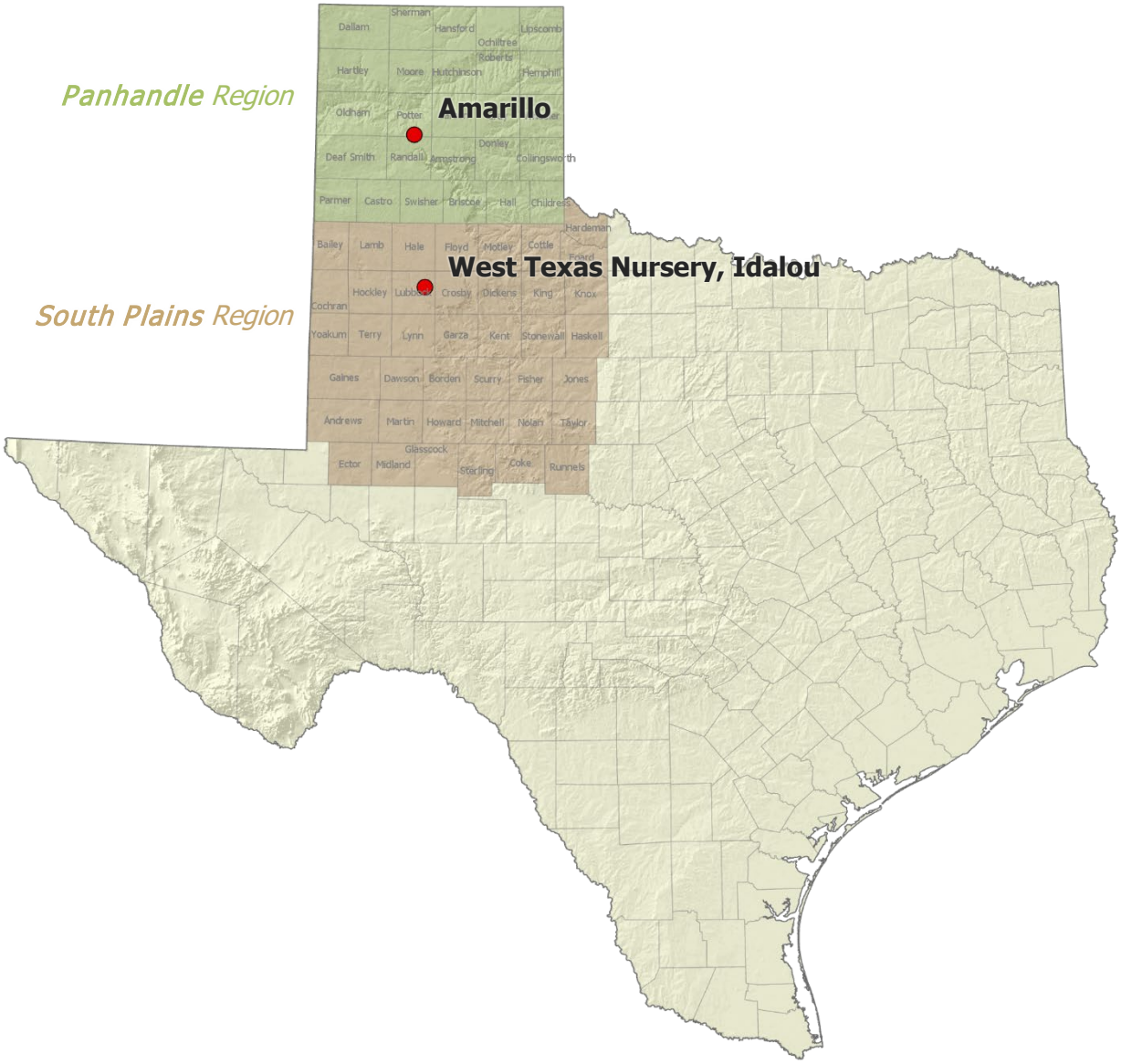
Program Description

There are an estimated 32 million acres of cropland in the state of Texas. More than 40 percent (12.8 million acres) of this cropland has soils that are classified as "highly erodible." As a result, the state loses an average of 14 tons of topsoil per acre each year. This makes Texas one of eight states having the worst soil erosion rates in the nation. In response, TAMFS established West Texas Nursery, and has strategically positioned staff to serve the landowners and communities of this region. The intent of the agency is to aggressively promote the adoption of agroforestry practices, such as windbreak plantings, and other applicable conservation and restoration tree planting applications. These are programs designed to conserve topsoil and support the booming agricultural market in this region of Texas. In addition, TAMFS has assumed a lead role in the promotion and delivery of urban and community forestry programs in this region. The goal of the TAMFS urban and community forestry program is to empower Texas communities to improve the quality of life for citizens living in both urban centers and small communities throughout the Texas High Plains region.

Program Priority Areas

All programs delivered by TAMFS in the Texas High Plains region are developed to meet the interests of private non-industrial landowners, non-profit organizations, cities, counties, and municipal governments located within the defined program delivery area (Figure 36).

Figure 36
Delivery Area for Texas A&M Forest Service High Plains Program



Goals, Objectives, and Strategies

TAMFS first employed a Forest Silviculturist in Lubbock in 1971. Then in 1978, West Texas Nursery opened for business at the Texas Agricultural Experiment Station north of Lubbock.

The overarching goal of establishing this forestry position and seedling nursery in the Texas High Plains region was, and still is, to provide technical assistance for landowners in the region to properly establish windbreak and conservation planting schemes for the protection of their land, and to create a source of high-quality, low-cost, locally-grown tree seedlings to enhance the forests and related natural resources of the region. In 1973, the role of this forestry position was further expanded to address urban and community forestry issues in surrounding cities and communities.

Since their initial establishment in the High Plains region in 1971, TAMFS operations, as well as landowner and community support programs, have steadily expanded to meet the growing demands within this region of the state. Significant changes and advancements over the last 48 years have included:

- Nursery staff size has grown to five full-time nursery employees.
- A new nursery facility was constructed in 2007 just east of Lubbock in Idalou. This property features over 40 acres of available space for field compartments to produce bareroot hardwood stock. It also includes an office facility as well as a state-of-the art greenhouse, lath house, and packing facility to accommodate production of container-grown evergreen windbreak species and hardwood conservation species.
- The nursery has been involved in numerous custom contract-growing operations for various ecological and environmental restoration projects throughout the state.
- Foresters were located in Idalou and Amarillo to promote agroforestry, restoration plantings, and forestry-based land conservation programs, while also assisting private landowners, cities, and communities in need of technical information and support for both rural as well as urban and community forestry practices.

Program function and oversight for the TAMFS West Texas Program, which includes both West Texas Nursery and West Texas Technical Assistance, are provided by the Associate Director of the Forest Development Division. Management of the West Texas Nursery is provided by the on-site West Texas Nursery Program Leader. Nursery operations and production are overseen by the Forest Nursery Operations Coordinator. Technical assistance for landowners and communities is provided regionally by the West Texas Nursery Program Leader in the South Plains Region and the Woodland Ecologist from the Amarillo FRDSF office in the Panhandle Region.

Various collaborative outreach endeavors, technical assistance, and conservation awareness projects involving other local, state, and federal agencies are a common and strongly encouraged practice for TAMFS program staff in the High Plains Region. Cooperating agencies include: Texas A&M AgriLife Extension Service, Texas Soil and Water Conservation Districts, USDA National Resource Conservation Service, U.S. Fish and Wildlife Service, Texas Parks and Wildlife Department, High Plains Underground Water District, The Nature Conservancy, Texas Department of Transportation, U.S. Army Corps of Engineers, Arbor Day Foundation, and the cities of Idalou, Lubbock, and Amarillo, along with more than fifty additional communities in the program delivery region.

Performance Measures

The effectiveness and efficiency of TAMFS conservation programs in the High Plains can best be conveyed by quantifying the “on-the-ground” impact of the seedlings produced by West Texas Nursery and the conservation program support provided by regional staff. In the period from 2011 to 2019, West Texas Nursery produced and distributed nearly 500 thousand low-cost windbreak and conservation seedlings. These seedlings have provided critical erosion control and other associated environmental benefits to an estimated 25 thousand acres of property in Texas.

While promoting the benefits of windbreak and conservation plantings in the High Plains, the regional staff also promotes the substantial benefits of implementing forestry-based programs in growing urban areas and also smaller rural communities.

Tree Improvement Program and Western Gulf Forest Tree Improvement Cooperative

Program Description

The genetic improvement of southern pines was initiated in 1952 by TAMFS. This program was the first of its kind and served as a model for silvicultural research cooperatives subsequently organized around the nation. TAMFS conducts tree breeding programs for reforestation, urban plantings, and Christmas tree production. These programs field-test trees for adaptation, disease resistance, stem quality, and growth rate. A unique part of the TAMFS effort is the Urban Tree Improvement Program, the only in the nation, that tests local sources of native species for use in Texas cities. The TAMFS is also partnered with the Texas Christmas Tree Growers Association to provide Virginia pine seed to its members. The TAMFS actively manages three seed orchard complexes to provide improved seed from these programs to produce seedlings that are sold to landowners through private nurseries.

The TAMFS also provides technical leadership for a regional tree improvement program, the Western Gulf Forest Tree Improvement Program (WGFTIP). The WGFTIP is a collaborative effort supported with dues and in-kind contributions from three state forestry agencies (Arkansas, Oklahoma, and Texas) and nine commercial concerns. These 12 organizations produce approximately 300 million seedlings used to reforest 500 thousand acres annually. Because of TAMFS and the WGFTIP, all the planted loblolly and slash pine seedlings since the 1950s in the Western Gulf Region of the United States have been genetically improved.

Program Priority Areas

Outstanding trees identified in the TAMFS program are transferred to commercial partners who then make seedlings available to both non-industrial private and commercial forestland owners. Landowners benefit directly from more lucrative harvests. The regional economy benefits as an improved resource base supports primary and secondary manufacturing, supporting businesses and taxing authorities. Positive environmental impacts include more disease resistant and better adapted forest plantations that store more carbon and relieve harvest pressure on ecologically sensitive areas.

Goals, Objectives, and Strategies

The Tree Improvement Program functions as a part of the Forest Systems department. The program is directed by the Tree Improvement Coordinator/WGFTIP Director who oversees a Geneticist and Tree Improvement Specialist out of the Forest Science Laboratory in College Station and an Operations Coordinator at Magnolia Springs Seed Orchard in Jasper County. The Operations Coordinator, in turn, oversees three Resource Specialists located at the Magnolia Springs Seed Orchard. Operational direction is provided by the Tree Improvement Coordinator/WGFTIP Director to carry out the independent TAMFS Tree Improvement Program and to meet the obligations that result from participation in the WGFTIP.

The technical direction of the WGFTIP is provided by staff employed by TAMFS. The WGFTIP operates under the guidance of Executive and Steering committees representing the membership of the WGFTIP. The Executive Committee, comprised of a representative from each member organization, meets annually to obtain a report of progress. TAMFS, in addition to serving as the hosting organization, has a representative on the Executive Committee. The Steering Committee meets three times each year to provide periodic oversight.

TAMFS coordinates its Tree Improvement Program with similar and complementary programs operated by the forestry agencies in the states of Oklahoma and Arkansas.

Performance Measures

Breeding and testing efforts within the WGFTIP have captured an average of 0.75- to 1.0-percent improvement in growth rate each year. Cumulative benefits have resulted in more than 40-percent improvement in growth rate for loblolly pine. Potential growth rates of 5.75 tons per acre per year for unimproved planting stock have been increased to 7.50 tons for increases in marginal Net Present Values of $150 to $300 per acre. This represents a current value increase of $75 to $150 million in the regional wood supply. Tree improvement can also enhance native forest restoration, insect/disease resistance, and forest resilience. Other performance measures include:

- Productivity gains of improved species
- Pounds of improved seed collected annually
- Acres and species represented in TAMFS seed orchard complex
- Preservation of plant material to support restoration

Forest Inventory and Analysis

Program Description

The Forest Inventory and Analysis (FIA) Program supports the overall mission of the agency by providing objective and scientifically credible information about the growth, extent, composition, and mortality of the state's forests and woodlands. The FIA program works in cooperation with the Southern Research Station (SRS) of the USFS. The inventory, which is like the Census for trees, is conducted through a series of approximately 28 thousand permanently- established plots that are remeasured on a 5-year cycle in the 43 timber-producing counties of East Texas and on a 10-year cycle in the remaining 211 Central and West Texas counties. Each plot represents approximately 6,000 acres with 20 percent of the plots measured each year in East Texas and 10 percent measured each year in Central and West Texas. Results from the inventory are available through an online data query system and reports published by TAMFS and SRS.

Program Priority Areas

The FIA program has been conducted in the 43 timber-producing counties of East Texas since the 1930s. Initially, the program was administered solely by the USFS and plots were measured periodically by federal crews with state and local assistance. These inventories were conducted during 1935, 1955, 1965, 1975, 1985, and 1992. The 1998 Farm Bill altered the program nationally in many ways which positively affected the Texas inventory process. The inventory methods were mandated to become standardized nationally and the inventory was changed from periodic to annual to provide more real-time data through use of a rolling average. The inventory was also expanded to include all forested lands of the United States regardless of their timber-producing capability. The USFS was encouraged to enter into cooperative relationships with state agencies to better facilitate collection of the data on an annual basis.

TAMFS entered into a cooperative relationship with the USFS Southern Research Station in 2001. Due to the need for current data on the forest resource, the decision was made to expedite the survey from its prescribed five-year cycle to a two-year cycle, then perform all future measurements on the five-year measurement cycle. TAMFS began collecting data for the seventh inventory of the 43 East Texas counties in June of 2001 and completed the measurement in August 2003. Measurement of the eighth inventory was begun in October 2003 and has continued the five-year cycle since. As of 2019, TAMFS has begun the eleventh remeasurement of plots in East Texas.

TAMFS initiated the inventory of the 211 Central and West Texas counties which were previously unmeasured in January 2004. The inventory of these counties is done on a 10-year cycle, measuring 10 percent of the plots per year. The initial inventory of the 211 previously unmeasured counties was completed in 2015. As of 2019, TAMFS has re-measured 40 percent of the plots in this region.

Goals, Objectives, and Strategies

Data provided by the FIA program is utilized by federal, state, and local government as well as private companies that utilize or produce forest products. The USFS utilizes the data to determine distribution of federal money based on amount of forested land and ownership patterns. TAMFS utilizes the data to identify program needs such as targeting reforestation efforts and economic development opportunities and local governments use the data to assess status of the forest resource following disasters such as fire, drought, and hurricanes. Forest industry utilizes the data when making business decisions such as where to locate new mills based on wood availability.

The FIA program is in the FRDFA Division and is administered through a Department Head and a Program Leader. Data collection is accomplished by 12 crews consisting of one Staff Forester and one Resource Specialist. They are in 11 strategically located field offices throughout the state. Program administrators develop operational protocol based on program goals, TAMFS administrative procedures, and national FIA technical protocols. The Program Leader serves as the point of contact between the field crews and USFS Southern Research Station.

The TAMFS FIA Program is the only program that provides objective and scientifically credible information about the growth, extent, composition, and mortality of the state's forests that accounts for all ownerships and is nationally standardized.

The TAMFS FIA Program works primarily with the Southern Research Station of the USFS. TAMFS has entered into a cooperative agreement with the SRS where TAMFS collects all data from the plot locations and SRS performs the data analysis.

Performance Measures

- Number of plots re-measured in East Texas.
- Number of plots re-measured in Central and West Texas.
- Above average quality assurance scores.

Ecosystem Services

Program Description

The Ecosystem Services program supports the overall mission of TAMFS by educating the public on the value of ecosystem services and working to create marketable value for the numerous benefits forests provide, such as clean air, clean water, wildlife habitat, flood control, and aesthetics. Marketing these services allow landowners to generate additional revenue from their forestland, reducing the likelihood they will convert it to another land use unable to provide these same environmental benefits. To date, wetland and stream mitigation banking has garnered the most interest from Texas landowners, though there is increasing promise in payment for watershed services.

The program's objective is accomplished through the development of market expertise and an effective education/technical assistance/outreach campaign.

The Ecosystem Services Program was established in 2005 as a pilot project with the USFS and Forest Trends, a nonprofit organization, to "Keep Forests in Forests." The idea came from the release of the Southern Forest Resource Assessment in 2002, a report that identified urban sprawl as one of the biggest threats to southern forests.

In November 2006, private carbon credit aggregation firms entered Texas to enroll forest landowners in the Chicago Climate Exchange (CCX) forest carbon offset program. These landowners turned to TAMFS for assistance. At the request of our cooperators, TAMFS became the first and only state forestry agency to be approved as an authorized verifier for the CCX.

TAMFS conducted verification on the initial group of Texas landowners that enrolled in the CCX forest offset program in 2008, certifying that a total of 210,000 carbon credits followed all market rules and procedures. Required annual and final pool verifications were conducted through 2010, when CCX was converted to a carbon registry.

A survey of forest landowners was conducted in 2010, helping the agency understand their motivations and barriers to participating in these emerging markets. TAMFS received more than a thousand responses, providing valuable insight into their willingness to participate, required price points, and general knowledge and views on ecosystem services.

In 2013, TAMFS released the "Texas Statewide Assessment of Forest Ecosystem Services" and corresponding web application, Forest Ecosystem Values. This assessment quantified and valued the cultural and regulating (air pollution removal, biodiversity, climate, and watershed) services provided by Texas forests at $93 billion annually. In addition to raising the awareness of the overall importance of forests, this assessment and web application can also be used to support smart land-use planning, forest conservation, and natural resource damage assessments.

Program Priority Areas

The Ecosystem Services Program ultimately effects all Texans based on its objective to "keep forests in forests," enabling the public to continue enjoying the numerous environmental benefits this resource provides. Developing these markets is one of the most promising solutions for forestland conservation. This program has focused efforts on the more than 200 thousand East Texas family forest owners to help them generate additional revenue from their lands, enabling them to afford to

keep their forestland. If these markets become established, landowners throughout the state may be able to participate, further expanding expected environmental benefits. Companies and organizations will have additional ways to demonstrate their commitment to environmental stewardship and sustainability.

Goals, Objectives, and Strategies

The goal of the Ecosystem Services program is to "Keep Forests in Forests" through the development of marketable values for the numerous benefits our forests provide. This is accomplished through the development of market expertise, and education/technical assistance.

Texas A&M Forest Service strives to stay informed on the latest developments in ecosystem services markets. Without this knowledge, these opportunities would develop at a much slower rate in Texas. To sustain this expertise, personnel closely monitor market protocols and transactions, maintain strong professional networks, stay abreast of research/pilot projects, and track potential legislation that may impact these markets.

Education and technical assistance are critical to achieving the goal of this program. Ecosystem services markets are complex in nature, and without an aggressive outreach program, landowners will not engage. Texas A&M Forest Service, through the development of market expertise, can assimilate this information into an understandable format, create tools that facilitate market participation, and host workshops that distribute this information.

This program works closely with federal and state units of government to effectively coordinate efforts to carry out its mission. As these markets continue to develop, TAMFS will look to develop key partnerships with the Texas Parks and Wildlife Department, Texas Commission on Environmental Quality (TCEQ), Environmental Protection Agency, Natural Resource Conservation Service, academia, and non-governmental organizations.

Performance Measures

The effectiveness of this program can partially be measured through the development and participation in these new, emerging voluntary markets. During the mid to late 2000s registered, verified, and marketed carbon credits generated from their forestland in a voluntary, pre-compliance carbon offset market. Activity has been slow to develop, though there are now new potential opportunities through voluntary and regulatory markets.

Another measure of the effectiveness of this program will be how other states establish similar programs. The TAMFS program is recognized as a model for the nation, and as such, the agency has been inundated with information requests from around the country regarding these markets and how other organizations can get involved. TAMFS has conducted numerous presentations and participated in training sessions on this subject across the country.

Water Resources

Program Description

The Water Resources Program was developed after the passage of the Federal Clean Water Act of 1972, which directed all states to take measures to reduce nonpoint source (NPS) water pollution. The Texas Legislature assigned responsibility for abating and mitigating NPS pollution from agricultural and silvicultural operations to the Texas State Soil and Water Conservation Board (TSSWCB). TSSWCB, in turn, began contracting with TAMFS to coordinate the silvicultural aspect of this responsibility.

In 1989, the *Texas Forestry Best Management Practices Handbook* was developed, published, and widely distributed throughout the forestry community. A FY 1990 Clean Water Act Section 319 (h) grant from the Environmental Protection Agency through TSSWCB provided additional funding to support the mission of the program. Strategic monitoring of forest operations began in 1991 to evaluate the level of BMP implementation, and ultimately the effectiveness of the educational program, with the first report being published in 1992. Subsequent reports have been published in 1996, 1998, 2000, 2002, 2005, 2008, 2011, 2015 and 2018.

Results from the initial report of BMP implementation monitoring led to the revision of the *Texas Forestry Best Management Practices Handbook*. This handbook was also revised in 1995, 2004, 2010, and 2017. To improve BMP implementation, TAMFS developed a logger training BMP workshop in 1995. To date, more than three thousand loggers have attended this workshop, and account for approximately 90 percent of the timber harvested annually in Texas. Major forest products companies now include this training in their mandatory requirements before loggers can deliver wood to their facilities.

In 1998, TAMFS began coordinating Sustainable Forestry Initiative (SFI) sponsored landowner workshops around the state. These workshops focused on sustainable forestry, with topics such as BMPs, wildlife, and reforestation. Since their inception, more than 460 workshops have been conducted reaching more than five thousand landowners.

The 77th Texas Legislature also showed support for the TAMFS Water Resources Program. The Texas Reforestation and Conservation Act of 1999 (SB 977) provided property tax incentives for landowners choosing to protect water quality by implementing buffer strips, or streamside management zones (SMZs), on their property.

In 2003, the Water Resources Program began an intensive, highly technological stream monitoring project designed to test the effectiveness of BMPs in protecting water quality. After four years of data collection, the results prove that Texas BMPs, when applied properly, are effective in protecting water quality.

Program efforts were expanded in 2011 to address water resource issues throughout the state. Major initiatives focusing on vegetation management, riparian management/restoration, wildfire rehabilitation, and land stewardship were delivered to further protect critical water resources.

Program efforts were expanded again in 2015 to address urban water resource issues in Houston and San Antonio. Major focal areas include promotion of forest and trees as a strategy for producing and maintaining high quality drinking water, using green infrastructure as a flood mitigation strategy, and working with partners to increase awareness among urban and suburban residents as to where their drinking water originates.

Program Priority Areas

The 2012 Texas State Water Plan identified a very sobering message: *In serious drought conditions, Texas does not and will not have enough water to meet the needs of its people, businesses, and agriculture enterprises.* Based on this message, TAMFS began pursuing creative opportunities to engage and add value in how Texas manages the state's water resources for drinking water, recreation, and other high-quality uses.

To determine program priority areas, a geospatial watershed assessment was conducted following the U.S. Forest Service *Forests to Faucets* methodology. This assessment prioritizes Texas watersheds by forest importance to surface drinking water for source water protection, accounting for forest threats and the potential for partnership within the watershed. The analysis, performed at the 12-digit HUC level, identified three key regions to focus program delivery – East Texas, the Interstate-35 corridor region of Central Texas, and the Trans-Pecos.

Goals, Objectives, and Strategies

The goal of the Water Resources Program is to protect, conserve, and enhance the state's water resources through the sustainable use of forests and woodlands. This objective is accomplished through the development of science-based, non-regulatory conservation measures, or Best Management Practices (BMPs), effective coordination with numerous cooperators, innovative partnerships, an aggressive education/technical assistance/outreach campaign, and a monitoring program designed to measure the implementation and effectiveness of these practices

Forestry BMPs have been revised over the years to account for new research, operational methods, and concerns identified through monitoring. These practices have been empirically shown to be effective at protecting water resources repeatedly. Future strategies include modifying these practices to address water quantity issues, other land intensive operations, and activities outside of the traditional commercial timber belt.

The education and technical assistance component of this project continues to develop innovative ways to promote BMPs and water resource protection. This proactive approach has led to the agency receiving many regional and state environmental awards from EPA, USDA, and TCEQ. However, with rapidly changing landscapes, ownership, and objectives, an expanded educational effort is paramount to the sustainability of this resource. Monitoring results can help identify areas to target these efforts.

Coordinating project efforts is a key aspect of an effective program. Texas A&M Forest Service works closely with the forest sector, state and federal agencies, academia, and other non-governmental organizations. To promote project collaboration, the Water Resources Program hosts meetings for cooperators to discuss current activities, issues, and potential partnership efforts regarding forests and water resources. Additionally, staff regularly engage in watershed planning initiatives across the state. Developing and enhancing partnerships is critical to finding solutions to address the water issues facing Texas. Potential partners include local governments, water suppliers, floodplain managers, energy companies, land developers, and other organizations collaborating on diverse strategies, including watershed planning, ecosystem services marketing, source water protection, and stormwater management. The Texas Forests and Drinking Water Partnership is a prime example. The focus of the Partnership is to identify mutual goals, interests, programs, potential barriers, and possible opportunities for pursuing forest conservation and stewardship as a source water protection strategy. Healthy, sustainable forests can help protect and enhance drinking water supplies while also providing economic benefits. Promoting ecosystem service markets and incentives for private landowners to conserve their forests and woodlands are cornerstone approaches of the Partnership.

Performance Measures

The effectiveness of this program can partially be measured through BMP implementation monitoring, a statistically sound, objective method in which personnel evaluate the degree at which BMPs are implemented on forest operations. Monitoring results provide a clear assessment of the effectiveness of the education, technical assistance, and outreach efforts of this program, and identify areas that the program needs to target for improvement. Currently, overall BMP implementation on forest operations is 93.8 percent representing a 20-percent increase since the monitoring program began in the early 1990s. Additionally, recognition and support by water utilities, floodplain managers, and other organizations on the critical role of forests to water resources can also measure effectiveness. Other key measures of the Water Resources Program are as follows:

- Water utility investment in forest source water protection
- Number of watershed plans that include forest stewardship strategies
- Number of local governments implementing green infrastructure
- Number of loggers trained in BMPs.
- Percent of wood harvested by BMP trained loggers.
- Logger training course recommendation rate.
- Number of landowner workshops.
- Number of landowner training contact hours.

Forest Taxation

Program Description

TAMFS Forest Taxation Program is one of the official sources of data for timberland valuation mandated by the Texas Tax Code. The program provides stumpage prices, timberland management costs, and timber growth data to the Property Tax Assistance Division (PTAD) of the State Comptroller's Office of Public Accounts to determine timberland appraised value for their annual Property Value Study. The Forest Taxation Program is also responsible for assisting the Director of Texas A&M Forest Service with designating qualified timberland as Aesthetic Management Zones and issuing determination letters of restricted-use forest zone applications upon request from District Chief Appraisers and taxing units, pursuant to the Tax Code, §23.9806 and §23.9801(1)(B).

The Forest Taxation Program also provides assistance on administrative rules and training on forest zone determination in accordance with the Tax Code, Chapter 23, and Subchapter H. In addition, the program staff monitors timberland tax appraisals, conducts timberland property tax research and federal income tax seminars, and provides regular assistance to the public on timber tax issues.

Program Priority Areas

The Forest Taxation Program mainly affects private timberland owners, county appraisers, forestry professionals, and tax professionals. However, due to local governments' heavy dependence on property tax, the program may affect a wide segment of the population throughout the state, especially in the 43 East Texas counties.

The data provided to the State Comptroller's Office is used to develop timberland productivity values for property tax purposes. There are approximately 200,000 private non-industrial (family forest) owners in East Texas. Since forestry professionals and tax professionals provide technical assistance to timberland owners, the program can affect them as well.

The TAMFS Forest Taxation Program has published the *Texas Timber Price Trends* bi-monthly since 1983. Originally, the publication was intended to give timber growers access to market prices and trends. In 1996, the Comptroller's Office adopted a revised manual for the appraisal of timberland, which expressly refers to the publication as a "readily available and official source of stumpage price data" for use in timberland appraisal for property tax purposes.

Since 1996, the program has had an annual interagency cooperation contract with the Comptroller's Office to deliver the Timberland Management Cost Study. The study estimates the average annual timberland management costs of a prudent, profit-seeking private timberland owner in East Texas using a cost model approach.

SB 977, passed by the 76th legislature in 1999, amended the Tax Code by adding Subchapter H to Chapter 23 for restricted-use timberland appraisal. The Forest Taxation Program was directed to adopt an administrative rule governing the requirements for land to qualify as being in special forest zones. The act mandated that, before a Chief Appraiser can deny an application for restricted-use timberland appraisal based on aesthetic management, critical wildlife habitat, and or streamside management zones, TAMFS must determine the validity of the zone. TAMFS's determination is conclusive. In addition, landowners are required to ask for a determination letter from TAMFS first before they apply to the Chief Appraiser if they are applying for a Unique or Special Aesthetic Management Zone designation.

SB 1646, passed by the 78th legislature in 2003, mandated that the timber growth and stumpage prices reported by the program should be expressed in tons and dollars per ton, respectively. In addition, the act required inclusion of small pine saw logs as a product, including cutting contract and gate wood sales (wood purchased by a contractor and delivered to a mill) to estimate average stumpage prices, and merging northeast and southeast Texas into one region.

Goals, Objectives, and Strategies

Stumpage Prices

A database is maintained to collect stumpage prices of timber sales in East Texas. Data is from actual timber sales reported by as many as 60 voluntary cooperators active in East Texas timber markets. Every two months, a survey form is sent to the reporters for their timber sale information during the previous two months. Data from the returned surveys is collected and compiled by the Forest Taxation Program staff. Average stumpage prices by forest product and region are reported in the bimonthly publication, *Texas Timber Price Trends*. In early February each year, annual average stumpage prices by forest product are estimated based on timber sales information in the preceding year and reported to the Comptroller's Office.

Timberland Management Cost Study

The Forest Taxation Program conducts a survey of accountants, independent contractors, surveyors, and forestry consultants, asking for unit costs of services and stand management practices, such as tax preparation, consulting, surveying, and building and maintaining boundaries, fire lines, and roads. Every five years, the program surveys major corporate timberland owners (TIMOs and REITs) in East Texas for their timberland management styles by timberland type. A cost model approach is adopted to estimate management costs associated with management regimes typical of prudent landowners in the region based on the unit cost and management practices information from the surveys. The program prepares a Timberland Management Cost Study report for the Comptroller Office's by early December each year.

Timber Growth

The Forest Taxation Program updates annual timber growth data upon its availability. The Manual adopted by the Property Tax Division mandates the USFS as the official source of the growth data.

TAMFS conducts the FIA program, a continuous survey in cooperation with USFS which determines, among other things, growth of the state's forest resources.

Special Forest Zone Determination

Before a Chief Appraiser can deny a restricted-use application, the appraiser must first request a determination letter from TAMFS as outlined in Chapter 215, Title 4 of Texas Administrative Code. To apply for a designation of timberland as Aesthetic Management Zone–Special or Unique area, the applicant must apply to TAMFS and provide required information.

Tax Seminars

The Forest Taxation Program regularly conducts seminars on timberland property tax valuation. Occasionally, our specialists are invited to make presentations on this subject for various groups such as professional associations, landowners, and District Appraisers. Each year, the program hosts timber income tax seminars. National timber taxation specialists are invited to be instructors along with our specialists.

Performance Measures

Qualified forestland is appraised at its timberland productivity value instead of market value, which is usually much higher. This is intended to promote timber production and encourage landowners to keep timberland forested.

SB 977, passed by the 76th legislature, allows qualifying timberland to be appraised at its restricted-use value, which is normally half of the timberland productivity value, to encourage reforestation, wildlife management, and stream water protection. The act authorizes TAMFS to adopt administrative rules and determine certain special forest zones upon request.

The program publishes a bimonthly publication, *Texas Timber Price Trends*, showing stumpage prices received in East Texas since the 1980s. It is used widely as a guide to general timber prices in the region by landowners, forestry professionals, and industries. There are approximately 150 subscribers. The publication is also posted on the web free of charge. Statistics show that on average it is visited and downloaded more than 8,000 times each year.

The following activities serve as benchmarks for the program:

- Collecting and compiling stumpage price data from actual timber sales in the East Texas timber market, publishing a bi-monthly stumpage price report, *Texas Timber Price Trends*, and providing annual average stumpage prices to the PTAD of the Comptroller's Office.
- Conducting the annual Texas Timberland Management Cost Study.
- Providing timber growth information to PTAD of the Comptroller's Office
- Periodically conducting timberland property tax seminars for appraisal districts, landowners, forestry professionals, and tax professionals.
- Conducting federal income tax seminars for landowners, forestry professionals, and tax professionals each year.
- Conducting research on and analyzing fiscal impacts of potential changes related to timberland property taxation and providing advice to the Comptroller's Office.

Forest Economics and Resource Analysis

Program Description

The mission of TAMFS Forest Economics and Resource Analysis Program is to provide factual information and in-depth analysis of the resources and economics of the Texas forest sector in the development of forest-based markets as well as methods to utilize the wood resources of Texas. It works with local economic development professionals, forest products industries, and landowners on various economic development initiatives to expand current and attract new businesses that utilize forest resources wisely, and it promotes the wise, efficient, and sustainable harvesting, utilization, and marketing of wood products.

TAMFS Forest Economics and Resource Analysis Program has three primary sections:
Resource Analysis, which conducts assessments of the wood resources within the state;
Forest Economics, which performs analyses to enhance the economics of the Texas forest sector;
and Wood Utilization and Marketing, which conducts studies and leads initiatives that promote the wise, efficient, and sustainable harvesting, utilization and marketing of wood products.

The USFS also conducts timber supply analysis and produces publications that are similar in nature to those developed by this program. However, their analyses and publications are regional and national in scope. The information they collect and disseminate is not specific to Texas. The Forest Economics and Resource Analysis Program works closely with the Texas AgriLife Extension Service to provide information to forest landowners in Texas, those interested in managing natural resources in Texas, and those interested in establishing wood-processing facilities in the state.

The staff of TAMFS Forest Economic and Resource Analysis Program, partners with local, regional, and federal units of government. They occasionally work with local governments to determine the economic impact that the addition of wood-processing facilities may have on their local economy. Recently, the State Legislature asked TAMFS to examine wood waste biomass supply for the use of this resource to generate energy. Other agencies contact the program for help in valuing woody resources, determining optimal harvesting methods, utilizing trees, and assessing wood supply. Our timber damage assessment reports developed after major hurricanes and wildfires are used by local, state, and federal agencies to determine extent of damage.

To avoid duplication of projects with the USFS, our assessments are limited in scope to only those forests existing in Texas and those companies wanting to establish wood-processing facilities in Texas. Since our assessments are specific to Texas specific rather than regional or national in scope, we avoid duplicating their resource and economic analyses. By working closely with individuals associated with the Texas AgriLife Extension Service, duplication of effort is avoided. In fact, the two programs often work together on projects. Unlike members of universities, who usually conduct their assessments to develop new methods of analyzing data, our purpose is to apply existing methods to address a need and to disseminate knowledge about existing methods.

Program Priority Areas

In 2019, the wood-based industry employed more than 67,000 people and was one of the top 10 manufacturing sectors in the state. In 33 of 43 East Texas counties, the forest sector was one of the two largest manufacturing employers. The value of timber ranked ninth among Texas' top agricultural commodities. There are approximately 200,000 private non-industrial timberland owners and dozens of corporate owners (TIMOs and REITs) with 11.8 million acres of timberland in East Texas.

However, almost all people within the state of Texas are indirectly affected by this program. For example, the attraction of industries to develop and maintain forest product facilities or to generate electricity impacts almost all people within the state, especially when local jobs are created. By promoting the wise and efficient harvesting of woody products, this program helps to increase the long-term productivity of forestlands, enhance water quality and reduce soil erosion, and to provide habitat for animals and fish, which ultimately affects all Texans.

Goals, Objectives, and Strategies

Major program activities include the following:

- Estimating the amount of available woody biomass for energy in Texas.
- Determining the potential long-term sustainability of market-driven resources.
- Monitoring the demographics of forest landowners and their desires.
- Annually publishing a report quantifying the amount of wood harvested and produced within Texas.
- Conducting growth/drain projections that quantify the amount of wood volume removed versus the amount of volume grown.
- Determining the feasibility of adding wood processing facilities throughout the state.
- Quantifying the economic impact of events such as hurricanes and wildfires that affects the timber resources of the state.
- Determining trends in wood-based markets and identifying new markets that can utilize resources obtained from forestlands in Texas.
- Identifying and promoting innovation and new technologies in support of ongoing and new forest-based economic activities.
- Providing up-to-date information and assistance to Texas landowners, manufacturers, distributors, and the public on the utilization of wood and the manufacturing and marketing of wood products.
- Assisting in the conservation of Texas' forests and the retention and recruitment of the forest products industries in Texas.

Performance Measures

Forest Economics and Resource Analysis Program receives numerous requests for assessments of wood resources in the state. Its publications are routinely used as guides in developing policy and when public and private entities make investment and management decisions. Additionally, other state agencies contact program staff to conduct assessments of the impact that large-scale operations may have on the availability of wood resources.

A variety of organizations and entities use the program's forest economic assessments. Organizations interested in establishing wood-based facilities such as those for producing timber, plywood, oriented strand board (OSB), paper, and those for producing energy from biomass and

those interested in producing biofuels, routinely contact this program's staff to conduct assessments of resource availability and the potential economic returns from such investments.

The program established a Rapid Damage Assessment Protocol to assess timber damage from hurricanes and other natural disasters within days of the occurrence. The protocol integrates weather data, historical damage information, aerial reconnaissance, point surveys, and Forest Inventory and Analysis (FIA) data to produce timely, high quality timber damage information for assisting disaster relief and salvage operations. The program produced timber damage assessment reports 6 days after Hurricane Rita in 2005 and 4 days after Hurricane Ike in 2008. The hurricane reports are widely used and cited by federal, state, and local governments to determine policy related to utilizing wood resources following such disasters. The Rapid Damage Assessment Protocol was widely recognized as setting the bar for other states in terms of accuracy, detail, credibility, and speed. During the 2010/2011 fire season, the Rapid Damage Assessment Protocol was extended to include assessments of major fires in timber areas within a few days of containment.

Forest Economics and Resource Analysis staff also conducts economic assessments of internal programs. For example, TAMFS provided reforestation assistance on 22,174 acres of private forest land in the 2010 planting season and determined the annual direct economic impact to be $15.0 million over a typical 25-year rotation.

Urban and Community Forestry

Program Description

The objective of the Texas A&M Forest Service Urban and Community Forestry (U&CF) Program is to help communities build sustainable programs that provide Texans with healthy trees and forests.

U&CF does this by assisting communities with:

- Development of professionally based resource assessments and management plans.
- Establishment and training of professional staff.
- Development and review of tree ordinances and policies.
- Establishment or improvement of the effectiveness of advocacy/advisory organizations.
- Education of citizens, businesses, agencies, and groups on proper tree planting, care, removal, and protection, and the economic, environmental, and social benefits of trees.

Texas was an early national leader in urban forestry. In the early 1970s, TAMFS realized that rapid urbanization was leading to loss of valuable forest resources and their economic, social, and environmental benefits. TAMFS opened offices in Houston and Dallas/Fort Worth to assist communities and citizens with urban forest resource issues. In 1978, the Cooperative Forestry Act provided a small amount of financial assistance to Texas. In the 1990 Farm Bill, the USFS authority was expanded to include urban forestry and funding to states increased. As the Texas population has almost tripled since 1970, the U&CF has added more resources to assist communities. However, almost all the additional resources added have been from federal funding via the USFS since state funding for the program has remained fairly constant. While the number of communities served has grown over time with the increase in federal funding, the mission to help local communities manage and protect their forest resources has remained the same.

Program Priority Areas

The U&CF Program seeks to leverage its resources to serve the greatest number of Texans possible. It does this by primarily providing technical forestry services to groups, including cities, counties, regional Councils of Governments, environmental non-profit organizations, schools, “green” trade groups, and others.

The U&CF Program is in the FRD Division. It is administered by an Urban Forestry Program Leader and an Urban Forestry Partnership Coordinator. These positions are stationed in Austin and College Station, respectively, and are required by the USFS under their program guidelines.

The program is decentralized to better serve customers with regional offices in Houston, Dallas, Fort Worth, Amarillo, Austin, Alpine, San Antonio, Conroe, Longview, and Kingsville. Houston has two Regional Urban Foresters on staff while all other offices have one. In addition, several TAMFS Staff Foresters are in offices around the state who have urban forestry responsibilities as a minor part of their jobs.

Goals, Objectives, and Strategies

The goals, objectives, and strategies of the U&CF program are described in detail in the Issues Section of this document.

Performance Measures

The Federal guidelines for the U&CF Program detail activities and measurements. State funding is competitive and based on these measurements including outcome, outputs, demands, and efficiency measures. These are reported nationally each year in the Federal community:

- Percent of population living in communities managing programs to plant, protect, and maintain their urban and community trees and forests.
- Percent of population living in communities developing programs and/or activities to plant, protect, and maintain their urban and community trees and forests.
- Number of people living in communities provided educational, technical, and/or financial assistance.
- Number of people living in communities that are developing programs/activities for their urban and community trees and forests.
- Number of people living in communities managing their urban and community trees and forests.
- Number of communities with active urban and community tree and forest management plans developed from professionally based resource assessments/inventories.
- Number of communities that employ or retain through written agreement the services of professional forestry staff who have at least one of these credentials: (1) degree in forestry or related field and (2) ISA certified arborist or equivalent professional certification.
- Number of communities that have adopted and can present documentation of local/statewide ordinances or policies that focus on planting, protecting, and maintaining their urban and community trees and forests.
- Number of communities with local advocacy/ advisory organizations, such as active tree boards, commissions, or non-profit organizations that are formalized or chartered to advise and/or advocate for the planting, protection, and maintenance of urban and community trees and forests.
- Number of hours of volunteer service logged. (An agency-wide consistent methodology is to be developed to track volunteer hours).
- State-offered community grant program in current fiscal year.
- Number of communities receiving financial assistance awarded during the Federal FY 2009 through a state-managed community grant program.
- Amount of Federal (USFS) funding to States.
- Federal (USFS) dollar cost or expenditure per capita in community assisted.

Forest Health

Program Description

The Forest Health Program (FHP) is responsible for maintaining the health of rural and urban forests and woodlands throughout Texas. The program consists of a Program Leader located in College Station and two regional forest health coordinators located in Austin (Central and West Texas program delivery) and Longview (East Texas program delivery). The Forest Health Program, previously known as the Forest Pest Control Section, was established in 1963 in response to a severe outbreak of the southern pine beetle (SPB) in East Texas. The program has expanded in recent decades to address all forest pests throughout the state.

The FHP staff is charged with organizing and delivering a forest health program for the entire State of Texas. Traditionally, major pests have included the southern pine beetle and oak wilt. In recent years, the Forest Health Program has been expanded to include other native insect and disease pests, as well as invasive insects, diseases, and plants. FHP personnel are charged with training TAMFS field personnel on pest identification and management as well as responding to public inquiries on pests of trees and forests in both residential and rural areas. Typical activities include monitoring forest pest activity on nonfederal forest lands throughout the state, organizing and delivering prevention and suppression programs on major pests, including federal costs shares, documenting losses to forest pests, and increasing public awareness of forest health issues. Federal pest suppression and prevention projects (e.g., oak wilt and southern pine beetle) are administered by the FHP Program Leader but delivered in the field by TAMFS foresters and resource specialists in Central and East Texas.

Program Priority Areas

Priority areas for forest health in Texas, as identified in the state assessment, are a) southern pine beetle b) oak wilt, c) invasive nonnative insects, and d) invasive nonnative plants.

Goals, Objectives, and Strategies

<u>Southern Pine Beetle Goal:</u> To develop and make available practical tools, training and public awareness campaigns for the prevention and suppression of SPB infestations in East Texas.

SPB Objectives

- Increase public awareness of SPB and how to prevent and/or control infestations.
- Provide training to Texas A&M Forest Service field personnel and other nonfederal stakeholders in East Texas on SPB identification and management.
- Monitor SPB hazard conditions at a landscape scale in East Texas (see Figure 37 for SPB hazard map).
- Deliver information and federal cost shares when available for the prevention of SPB infestations.
- Monitor SPB activity and predict pending SPB outbreaks in East Texas.
- Implement an effective SPB suppression program when an SPB outbreak occurs in East Texas.
- Develop practical methods of direct suppression of SPB infestations.

SPB Strategies

- Provide educational outreach to landowners throughout East Texas utilizing periodic news articles, workshops, newsletters and by providing up-to-date information about current SPB trends in Texas on the TAMFS website.
- Train TAMFS staff, as well as other nonfederal stakeholders, on SPB identification and management through classroom training and field demonstrations should neighboring states experience an SPB outbreak.
- Continue to utilize current technology and analyses to determine priority areas throughout East Texas.
- Continue to administer and deliver the SPB Prevention Project and meet routinely with the SPB Advisory Committee made up of state, federal, academia, forest industry, and private landowners to discuss current program status and how to better direct future program activities.
- Conduct annual spring trapping surveys in key East Texas counties to predict SPB infestation levels and trends, following the protocol developed by FHP and used across the South and Northeast.
- Continue to maintain the Texas SPB Strategic Plan for responding to future SPB outbreaks. This plan outlines the protocols to be enacted should SPB become established in commercial timberlands that allows for the quick identification of SPB activity and implementing mitigation strategies to minimize the number of acres infested.
- Continue to work with southern state forestry agencies, forest industry, and universities to pursue research and development of new and practical direct control methods for SPB infestations.

Oak Wilt Goal: Provide the leadership and support required to deliver an effective oak wilt management program in Central Texas.

Oak Wilt Objectives

- Provide public education and awareness of oak wilt in Texas.
- Monitor for the presence of oak wilt centers and spread of oak wilt in Texas.
- Work with landowners and homeowners to mitigate the spread of oak wilt from active centers to unaffected neighboring trees.
- Continue to work with state and federal partners to support the Texas Oak Wilt Suppression Project.
- Identify priority areas throughout Texas for focusing financial assistance to landowners and homeowners for controlling the spread of oak wilt through mechanically trenching around active centers or removing infected red oaks.
- Provide education and technical assistance for injecting threatened live oaks with fungicide to aid them in surviving of oak wilt.
- Continue to maintain the website, https://texasoakwilt.org/, to provide up-to-date information on oak wilt in Texas and science-based strategies for managing oak wilt.
- Continue providing training on identification and management of oak wilt to natural resource management groups such as Master Gardeners, Master Naturalists, and Certified Arborists.

Oak Wilt Strategies

- Continue efforts to inform the public of the extent and nature of oak wilt and provide general information on available prevention and control methods.
- Utilize current aerial and satellite imagery to identify areas of mortality that may be active oak wilt centers.
- Provide technical assistance to landowners and homeowners for oak wilt diagnosis and specific management recommendations controlling the spread of oak wilt.
- Continue to promote science-based management strategies for controlling the spread of oak wilt. Strategies include mechanically trenching (approximately 4 feet deep) around an active oak wilt center severing grafted root systems creating a barrier for the spread of the disease and/or removing infected red oaks to prevent the development of fungal mats which aid in the spread of oak wilt.
- Create a barrier to underground disease spread by use of a trench to sever interconnected roots systems.
- Support the protection of individual high value live oak trees by using a systemic injection of the fungicide Alamo™ or a similar chemical formulation of propiconazole. These treatments are time sensitive and trees must be retreated over time to maximize protection against contracting oak wilt.
- Maintain the oak wilt informational website, https://texasoakwilt.org/, which provides the latest information about oak wilt in Texas including current distribution of the disease, how to identify oak wilt, science based management strategies, and how to get help.
- Continue to expand the capacity of TAMFS in providing educational and technical assistance to a variety of clients in Texas by providing oak wilt training to groups interested in the ability to identify and control the deadly disease. Groups such as Master Gardeners, Master Naturalists and International Society of Arboriculture Certified Arborists receive a designation of "Oak Wilt Specialist" once completing an intensive training.

Nonnative Forest Insects and Diseases Goal: To address the detection, monitoring, prevention and control on invasive nonnative forest insects and diseases in a timely and effective manner.

Invasive Insect Objectives:

- Monitor the presence of invasive, nonnative forest pests in Texas.
- Increase public awareness for prevention and detection of invasive insect and disease pests that threaten trees in Texas.
- Increase collaboration among state and federal agencies, NGOs, and other stakeholders involved with invasive pests in Texas.
- Work with other southern forestry agencies, academia, forest industry, NGOs, and private landowners to conduct field studies to increase knowledge of distribution, biology, and seasonal habits of invasive insect and disease pests affecting trees in Texas and other southern states, especially Western Gulf states (Arkansas, Louisiana, Oklahoma and Texas).

Invasive Insect and Disease Strategies:

- Identify current and future threats to Texas trees and forests through annual trapping, collaboration with USDA-APHIS and Texas Department of Agriculture to monitor ports of entry for incoming invasive pests and develop long-term strategies for mitigating the effects of introduced pests.
- Utilize the federally supported Early Detection and Rapid Response program for identifying and combating invasive pests that pose threats to Texas trees and forests.
- Continue public education on threats posed by invasive pests including how to recognize these pests, actions they can take to minimize the establishment and spread of invasive pests, and who to contact for technical assistance.
- Continue to maintain the Texas Invasives website (https://www.texasinvasives.org/) that hosts information on a variety of invasive pests that threaten Texas trees, forests and native ecosystems.
- Texas A&M Forest Service will continue to participate on state, regional, and national forest health committees charged with identifying forest health threats and developing synergy among state and federal agencies to combat current and future threats to forested ecosystems.
- Currently, the principal invasive pests of concern are the emerald ash borer, redbay ambrosia beetle, soapberry borer, which all exist in Texas. Other invasive pests not currently found in Texas but that warrant a diligent eye include spotted lantern fly, gypsy moth, and Asian longhorned beetle, among others. If established these pests pose serious threats to forested ecosystems across the Texas landscape.

Invasive Plants Goal: Take a leadership role in the detection, prevention, and management of invasive plants affecting forests and woodlands in Texas.

Invasive Plants Objectives

- Increase public awareness of invasive plants affecting forests and woodlands in Texas.
- Collaborate with other state and federal agencies and NGOs involved with invasive plants in Texas.
- Support the detection and reporting of invasive plant species in Texas.
- Contribute to efforts to eradicate invasive plants on public and private lands in Texas.

Invasive Plant Strategies

- Continue to provide public training, education, and outreach on invasive plant species and the effects they can have on native ecosystems.
- Continue to support the Texas Invasives website (https://www.texasinvasives.org/), which hosts information related to a variety of invasive plant species including identification, how to control and/or eradicate species, and who to contact for technical assistance.
- Utilize the federally supported Early Detection and Rapid Response program for identifying and combating invasive pests that post threats to Texas trees and forests.
- Texas A&M Forest Service will continue to participate on state, regional, and national forest health committees charged with identifying forest health threats and developing synergy among state and federal agencies to combat current and future threats to forested ecosystems.
- Continue to promote and support the Citizen Scientists program through which Texans are trained how to identify and report invasive plant species so that state agencies better understand where these species exist and programs to target control can be developed.
- Continue to train TAMFS staff, natural resource managers, landowners, and homeowners on how to identify and control invasive plant species, reestablishing areas with native plant species, and better understand the effect invasive plants have on native ecosystems if allowed to proliferate.
- Contribute to the treatment and control, when feasible, of invasive plants that have yet to become well established in Texas, such as cogongrass, Japanese climbing fern, and kudzu. Cooperate with other agencies in invasive species eradication efforts.
- Give priority to treatment of invasive plants on the State Forests as demonstration sites.

Performance Measures

Performance Measures for SPB

- Number of SPB high-hazard-rated acres treated through the SPB Prevention Financial Assistance Program. Areas are identified through geospatial analysis of current forested cover in East Texas. Treatments can include thinning, prescribed burning, and reforestation of native tree species.
- Pheromone traps will be used to annually monitor SPB population levels and to detect if SPB is present and/or if population numbers are increasing.
- Should SPB become established in East Texas, SPB spots will be detected on state, federal, and private forestland using aerial flights and other emerging technologies aerially on state, federal, and private lands.
- Ground check a statistically sound percentage of spots identified for the presence of SPB.
- Should SPB become established in East Texas, TAMFS will work with a variety of partners including forest industry and landowners to minimize the total acres lost or damaged through rapid detection and implementation of science-based control measures.

Performance Measures for Oak Wilt

- Number and total feet of containment trenches installed per year in Central Texas utilizing the Oak Wilt Suppression Financial Assistance Program as well as number and total feet of containment trenches installed outside the program for which data can be collected.
- Number of training sessions for Certified Arborists, Master Gardeners and/or Master Naturalists offered per year to train oak wilt specialists.
- Number of acres assessed using aerial imagery per year to update oak wilt detection maps.

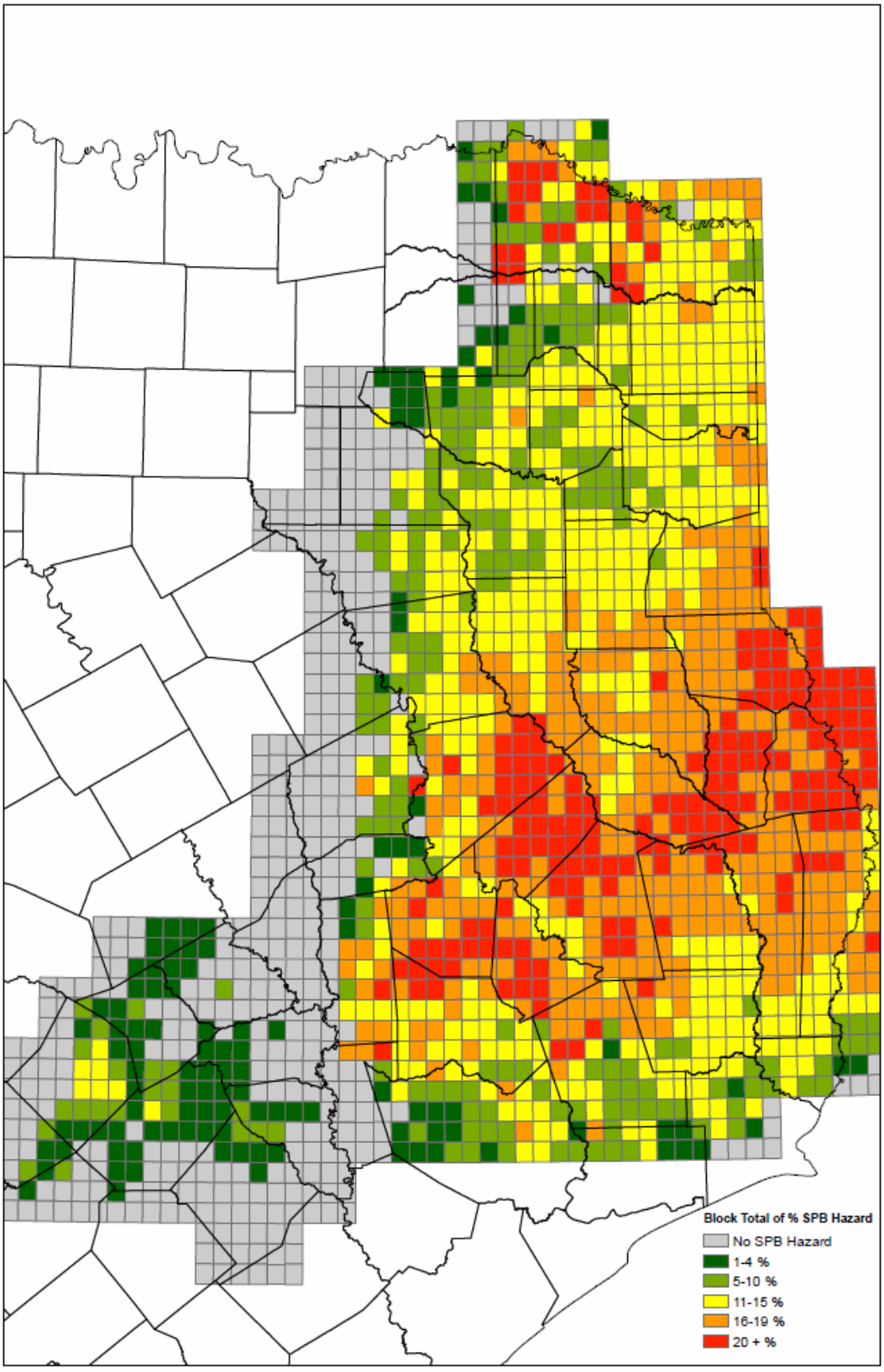
Invasive Insect Performance Measures

- Develop preparedness and response plans for invasive pests that threaten Texas trees, forests, and woodlands as needed.
- Number of educational events, such as trainings and workshops, held annually.
- Maintain coordination among state and federal partners such as USDA-APHIS, USDA Forest Service, and Texas Department of Agriculture for invasive pest monitoring and detection.
- Texas A&M Forest Service Forest Health staff will participate in state, regional, and national meetings as they relate to current and future invasive pests that threaten forested ecosystems.

Invasive Plant Performance Measures

- Number of educational events such as trainings and workshops held annually.
- Number of attendees to workshops and trainings held annually.
- Continue efforts to prevent invasive plant species, such as cogongrass, from becoming established in Texas.
- Number of acres treated annually for the control of invasive plant species.
- Maintain coordination among state and federal partners such as USDA-APHIS, USDA Forest Service, and Texas Department of Agriculture for invasive plant monitoring and detection.
- Texas A&M Forest Service Forest Health staff will participate in state, regional, and national meetings as they relate to current and future invasive pests that threaten forested ecosystems.

Figure 37
Aggregated SPB Hazard by TAMFS Grid Block



Rural Forestry Assistance

Rural Forestry Assistance in Texas currently consists of four functional areas—Forest Stewardship, Forest Legacy, Conservation Education, and State Lands Management. Because TAMFS is fortunate in that each functional area is a stand-alone program managed by individual program managers, they are described here as separate programs. The programs are delivered by the two delivery programs discussed earlier: East Texas Program Delivery and Central/West Texas Program Delivery. The next four sections describe the Rural Forestry Assistance Program.

Forest Stewardship

Program Description

Authorized by the Cooperative Forestry Assistance Act of 1978, the Forest Stewardship Program (FSP) provides technical assistance, through state forestry agencies, to non-industrial private forest (NIPF) owners to encourage active long-term forest management. Texas A&M Forest Service works closely with the USFS Region 8 office in Atlanta, GA and the USFS Washington Office to guide funding formulas and develop program guidelines. See Appendix D.

A primary focus of the FSP is to work with NIPF landowners to development comprehensive, multi-resource management plans that provide landowners with the information they need to manage their forests for products and services. This includes restoring native forest where appropriate.

NIPF Landowner Assistance activities include:

- Facilitating the State Stewardship Coordinating Committee (SSCC) which provides direction and guidance for ensuring that a balanced and effective program reaches landowners statewide and includes West Texas ranchers, East Texas tree farmers, and Hill Country ranchette owners. The SSCC meets at least once per year and consists of members from federal, state, private, and natural resource conservation organizations.
- Recognizing landowners for exemplary efforts through our Certified Forest Steward Program.
- Working with federal and state partners to monitor and provide comment on species of concern that are considered for listing under the Endangered Species Act, educating landowners on the impacts of species listing, provide strategies for non-listing and/or down listing of species, and developing innovative programs that benefit the species of concern while also allowing landowners to manage their forestland.
- Enrolling landowners in the Safe Harbor program under the Red-cockaded Woodpecker Habitat Conservation Plan, which encourages East Texas landowners to undertake actions that will benefit this endangered species.
- Providing rural forestry technical assistance to landowners including forest management plans, reforestation, marketing and promotion, surveys of tracts to determine treatment needs, measurements of treatment areas, seedling procurement, training and certification of private vendors, and inspection of plantings to certify compliance with technical guidelines.
- Working closely with county forest landowner associations, including associations for absentee landowners and Central Texas regional and county-level conservation groups.

While the goal of the Stewardship Program has remained the same, new and innovative ways of reaching landowners and delivering services have been developed to meet the needs of both

traditional landowners and new types of landowners. Events such as the Texas Wildlife and Woodland Expo, a variety of demonstration practices on TAMFS state lands, the use of conservation easements in the FLP, and Conservation Education programs for adults and children are a few examples. In addition, new technology such as TexasForestInfo.com, a web portal containing applications designed to assist landowners across the state in the management of their lands, is an innovative way for reaching landowners. Applications include Map My Property, Plan My Land Operation, My Land Management Connector (facilitates communications between landowners who need management services to those that provide those services), and Timber Supply Analysis.

A significant change in the Stewardship Program occurred in 1989 when the program went from primarily an East Texas program to one that is offered to landowners statewide. At that time, Central and West Texas landowners became eligible to participate in Stewardship Programs and "absentee landowner associations" were created in large municipalities to serve the function of county forest landowner associations for landowners who owned forestland in East Texas but resided in a metropolitan area of Texas.

Priorities now include conserving and restoring native forest ecosystems in Central and West Texas such as live oak woodlands and savannahs, hardwood forested slopes, mixed juniper/hardwood forests, the Cross Timbers forest, the post oak savannah, and ponderosa pine in the Davis Mountains. Specific to the Panhandle region, priorities include establishing trees and shrubs for windbreak purposes to reduce soil erosion and establishing wildlife habitat shelterbelts for pollinators, birds, and game animals. This matches existing efforts to re-establish longleaf pine, shortleaf pine, and bottomland hardwoods in East Texas.

Any forest landowner is eligible to participate in the FSP. While TAMFS, NRCS, Texas A&M AgriLife Extension Service, and TPWD have the goal of landowner assistance, conservation education, and protecting Texas' natural resources, each agency commonly coordinates with the other agencies at local, state, and national levels to reduce duplication of efforts. Specifically, TAMFS is jointly funding a silviculturist position with Texas A&M AgriLife Extension. TAMFS has a cooperative agreement with TPWD to provide statewide wildlife expertise for preparation of Forest Stewardship Plans and to provide training and other educational opportunities to TAMFS foresters and Texas landowners.

TAMFS currently has a Memorandum of Understanding (MOU) with NRCS that mirrors a national MOU signed by NRCS, NASF, and USFS in 2008. The MOU allows TAMFS to have an employee within the NRCS state office, which allows for better program coordination and ensures forestry remains relevant in NRCS programs. Through the MOU, TAMFS is provided funds for providing technical assistance to landowners enrolling into conservation programs funded by the Farm Bill and performing all quality assurance inspections for Farm Bill-funded conservation practices.

TAMFS has a formal agreement on cultural resources with the Texas Historic Commission, the USFS, and the National Advisory Council on Historic Preservation. TAMFS employs a part-time archeologist to review cultural resource survey forms and provide archeological training for new and veteran TAMFS foresters to ensure that TAMFS complies with the programmatic agreement.

NRCS, Texas A&M AgriLife Extension Service, and TPWD manage natural resource conservation programs that provide environmental, societal, financial, and technical benefits. As these entities focus on research, recreation, and agriculture, TAMFS coordinates with them at the local, state, regional, and national level to supply the forestry and wildland fire protection components to their programs.

Because of the federal requirements of the program to form the SSCC, TAMFS works frequently at the state level with all of the natural resource conservation and related agencies in the state. TAMFS field staff coordinates landowner services and programs with the field offices of the other natural resource conservation related agencies in the state.

The current updated versions of the Texas Statewide Assessment of Forest Resources along with the Texas Statewide Forest Resources Strategy will serve as the Texas Statewide Stewardship Plan. It is intended that this section and Appendix B serve to meet the requirements of an updated plan.

Program Priority Areas (Map 11)

Priority areas for the Forest Stewardship Program are defined by the Spatial Analysis Project (SAP). Previously, priority areas were defined at the 30-meter pixel level. However, current federal guidance states that priority areas, or Important Forest Resource Areas, should be delineated as specific geographic areas. This is interpreted here to mean "polygonal" in nature, such as using county or watershed boundaries. Texas chose to use the same type of overlay analysis as done in previous SAP analyses to provide a basis for which expert judgement is used to designate counties as either priority or non-priority. The Important Forest Resource Areas, or priority areas, for the Forest Stewardship Program in Texas is provided in an earlier section on pages 102 – 107.

Goals, Objectives, and Strategies

Goal 1: Ensure the Forest Stewardship Program is viewed by partners and the public as a core program for private land forest management planning.

Objective 1.1: Engage each primary partner organization for stakeholder input about Forest Stewardship program implementation and their role in it.

Strategy 1.1.1: Hold annual meetings of the SSCC, where issues and roles are discussed; engage members to encourage ownership in the program; ensure roles of each partner are substantive and understood.

Strategy 1.1.2: Produce a quarterly newsletter for stakeholders.

Objective 1.2: Engage traditionally underserved groups and landowners in priority areas.

Strategy 1:2:1: Work closely with TAMFS communications and conservation education program to create marketing material that peaks the interests of non-traditional NIPF landowners.

Objective 1.3: Build on existing partnerships and create new ones with stakeholder organizations.

Strategy 1.3.1: Develop new and follow existing MOUs and Contribution Agreements with partner agencies such as NRCS, TPWD, Texas A&M AgriLife Extension Service, and State Historical Commission.

Goal 2: Ensure that the Forest Stewardship Program remains relevant and useful to non-industrial private landowners and the forest resource.

Objective 2.1: Ensure that the Forest Stewardship Program is useful to NIPF landowners.

Strategy 2.1.1: Forest Stewardship Plans are up to date and relevant to meet landowner needs statewide.

Strategy 2.1.2: Work with partner agencies such as NRCS, TPWD and Tree Farm Foundation to develop Forest Stewardship management plans that are useful to all partners.

Strategy 2.1.3: Continue to recognize landowners as Certified Stewards when status is obtained.

Strategy 2.1.4: Work with Texas Land Trust Council to educate landowners on the use of conservation easements.

Objective 2.2: Ensure that landowners have access to TAMFS field staff and contractors.

Strategy 2.2.1: Continue to work with county landowner associations and Texas Forestry Association to host workshops and field tours about forestry practices.

Strategy 2.2.2: Maintain a well-trained field staff statewide.

Objective 2.3: Continue to offer interest-specific programs to landowners.

Strategy 2.3.1: Continue RCW and Safe Harbor programs for endangered species.

Strategy 2.3.2: Provide guidance to landowners on non-traditional programs such as ecosystem services, biomass utilization, and other programs that promote sustainable management.

Strategy 2.3.3: Develop sub-committees of the Stewardship Committee to focus on specific issues as needed such as longleaf and shortleaf pine restoration in East Texas, ponderosa pine restoration in the Davis Mountains and forest fragmentation.

Strategy 2.3.4: Coordinate with Central Texas staff, Water Resources staff, and conservation minded organizations and communities to conserve and protect live oak woodlands and savannahs, hardwood forested slopes, mixed juniper/hardwood forests, the cross timbers forest, and the post oak savannah.

Goal 3: Ensure that the Forest Stewardship Program remains relevant and useful as a statewide program.

Objective 3.1: Continue to advocate for a well-funded program.

Strategy 3.1.1: Work with Region 8 (R8) and the Washington office of the USFS to ensure equitable funding formulas for Texas.

Strategy 3.1.2: Continue to submit project proposals when competitive funding is available.

Strategy 3.1.3: Enforce the monitoring program and make adjustments in guidance as needed.

Strategy 3.1.4: Submit required reports to USFS R8 before deadlines.

Strategy 3.1.5: Build partner support for the Stewardship program locally and nationally by demonstrating results quantitatively and telling success stories qualitatively.

Objective 3.2: Coordinate efforts between TAMFS, NRCS, and other state headquarter offices.

Strategy 3.2.1: Within MOUs and Contribution Agreements, place staff in other agency headquarter offices to serve as liaison for forestry programs and provide technical assistance to those offices.

Strategy 3.2.2: TAMFS will serve on the wildlife and forest working groups of the State Technical Committee.

Performance Measures

In the field, the reporting requirements such as number of acres under FSP management and number of landowners served are listed in East Texas Program Delivery and are used to gauge performance. At a higher level, the effectiveness of the Stewardship Program is reflected in the USFS funding formula and consequential allocations to Texas. Texas' ability to receive substantial funding from the USFS reflects the effectiveness of the program.

- Number of new or revised Forest Stewardship Management Plans completed.
- Number of new or revised Forest Stewardship Management Plans completed in important forest resource areas.
- Number of acres covered by current Forest Stewardship Management Plans (cumulative).
- Number of acres in important forest resource areas covered by current Forest Stewardship Management Plans (cumulative).
- Number of acres in Landscape Stewardship Plans.
- Number of acres in important forest resource areas covered by Landscape Stewardship Plans.
- Number of landowners receiving Forest Stewardship Program technical assistance.
- Number of landowners participating in Forest Stewardship Program educational programs.
- Total number of acres in important forest resource areas being managed sustainably, as defined by a current Forest Stewardship Management Plan through a monitoring program.
- Number of new Certified Forest Steward awards.

Forest Legacy

Program Description

Forest Legacy, comprising the Forest Legacy Program (FLP) and the Community Forest Open Space Conservation Program (CFP) is a federal partnership with states to support state efforts to protect environmentally important areas that are threatened by conversion to non-forest uses. Designed to encourage the protection of privately owned forest lands, both CFP and FLP are entirely voluntary programs that seek to conserve exceptional and environmentally sensitive forest lands. Conservation is achieved through fee simple (CFP & FLP) or easement acquisition (FLP). Each program engages unique partners and utilizes different tools for land protection.

The CFP helps ensure access to open space remains following urbanization. Program priorities of the CFP are to enhance local community benefits through sustainable forest management, environmental benefits, experiential learning, and recreational opportunities. Lands that are a minimum of five acres in size and at least 75 percent forested are eligible for acquisition. CFP-funded acquisitions are held by municipalities, tribes, and eligible non-profits. To qualify, applicants must prepare a detailed community forest plan that identifies how the project will meet CFP program priorities.

The FLP focuses on the acquisition of full or partial interests in privately owned forest lands. FLP helps the States develop and carry out their forest conservation plans. It encourages and supports acquisition of conservation easements, legally binding agreements transferring a negotiated set of property rights from one party to another, without removing the property from private ownership. Most FLP conservation easements restrict development, require sustainable forestry practices, and protect other values.

In Texas, FLP focuses on supporting efforts to acquire working forest conservation easements. Easement rights are held by the Texas A&M Forest Service (TAMFS) or another state agency as directed by the State Forester (Director of the Texas A&M Forest Service). FLP-funded acquisitions serve tangible public purposes agreed to by the landowner such as recreational use as well as other public benefits such as ecosystem services as identified in the issues section of this document. Participation in Forest Legacy is limited to private forest landowners. To qualify, landowners are required to prepare a multiple-resource management plan as part of the conservation easement acquisition. The federal government may fund up to 75 percent of project costs, with at least 25 percent coming from private, State, or local sources.

The U.S. Forest Service administers the Forest Legacy Program in cooperation with State partners. FLP also encourages partnerships with local governments and land trusts, recognizing the important contributions of landowners, communities, and private organizations. In a September 2003 letter, Governor Rick Perry designated TAMFS as the lead agency for the FLP in Texas. Texas completed its first FLP Assessment of Need (AON) in 2004. Subsequent required updates to the AON are incorporated into the Texas Forest Action Plan. Components contributing to the AON include:

- Forest resources and benefits
- Present and future threat of conversion to nonforest use
- Historic use
- Current and projected ownership patterns and trends
- Cultural resources
- Outstanding geological features

- Mineral resource potential
- Protected lands (including Federal, State, municipal and private conservation lands)
- Other issues identified by the State Forest Stewardship Coordinating Committee

The Forest Legacy Committee, a seven-member sub-committee of the State Forest Stewardship Coordinating Committee, provides input, governance and program guidance, reviews and selects projects for submission, and provides support for the program locally and nationally. The Forest Legacy Committee includes a diverse set of stakeholders that represents conservation organizations, land trusts, other state natural resource agencies, USFS, and non-industrial private landowners.

The Forest Legacy Program in Texas follows the National Forest Legacy Program guidelines (https://www.fs.usda.gov/sites/default/files/fs_media/fs_document/15541-forest-service-legacy-program-508.pdf). This includes the annual monitoring of each project, spatial reporting of accomplishments, and public involvement in the process of developing program priorities and project criteria.

As of 2020, there are five funded Forest Legacy projects in Texas: Burleson Wetlands (2,907 acres in Smith County), Turkey Creek Phases I and II (10,729 acres in Tyler and Hardin Counties), Longleaf Ridge Phases I and II (10,223 acres in Jasper and Newton Counties), Bobcat Ridge (6,912 acres in Anderson County), and Fox Hunters Hill (2,387 acres in Sabine County).

FLP Priority Areas

The AON includes 59 East Texas counties; roughly 33 million acres (Figure 38). As State & Private Forestry programs are concentrating on focusing and prioritizing resources and demonstrating outcomes, it was suggested that the Texas Forest Legacy Program Area align with the "high" and "very high" priority areas as determined in the Texas Statewide Resource Assessment.

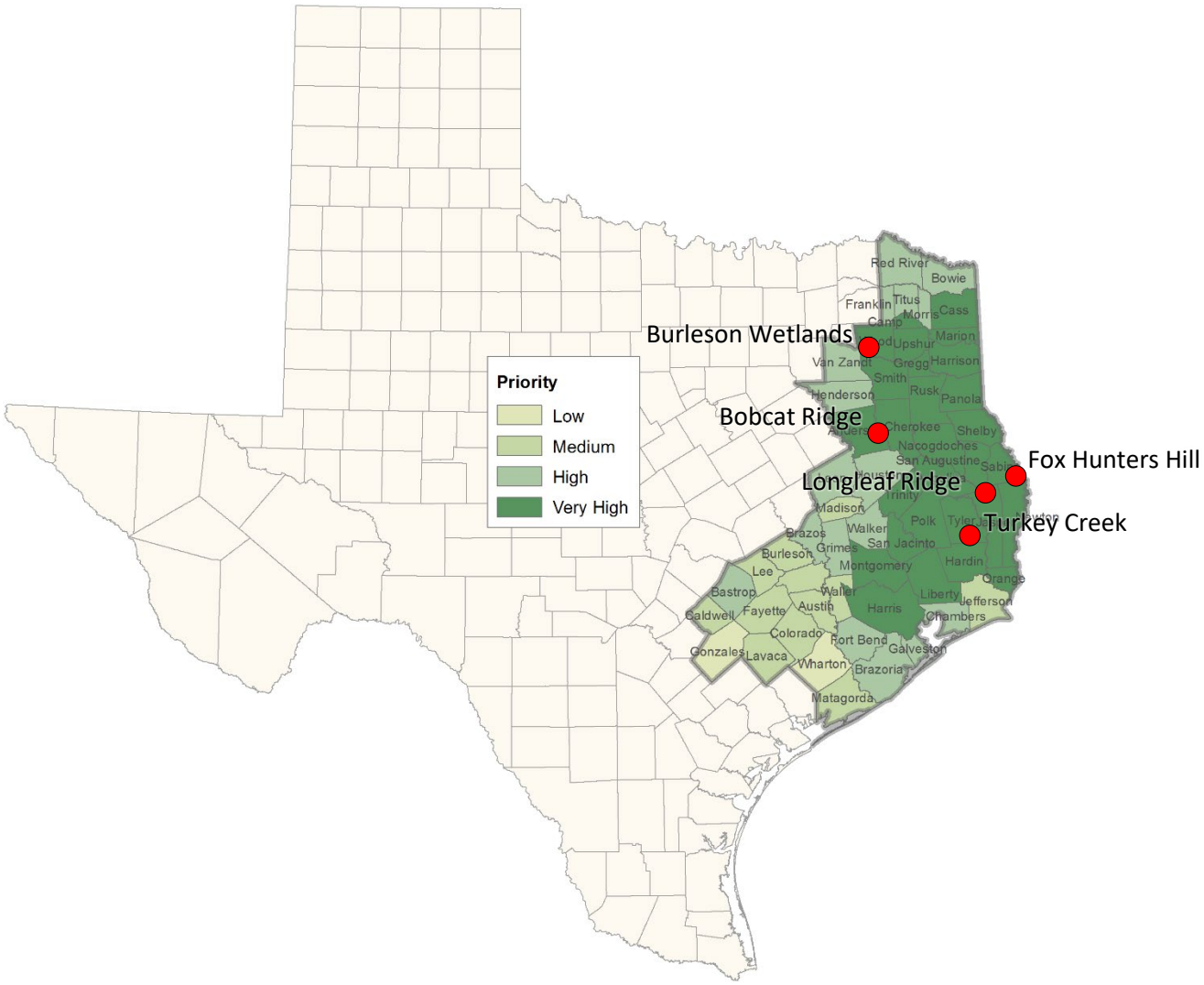
Based on the goals of the program listed in item 3, the focus on East Texas sustainability, and the "high" and "very high" priority counties identified in the Statewide Resource Assessment, the Forest Legacy Area will remain the same from 2020-2030. However, when multiple projects are submitted in one year, priority will be given to a project located in one of the 45 counties with a "high" or "very high" priority value as indicated in the Texas Statewide Assessment.

The Forest Legacy Committee also works with the Longleaf Sub-Committee of the State Stewardship Coordinating Committee to identify possible Legacy projects that include longleaf pine restoration. Other interest-specific committees may form to focus on projects with other interest specific attributes.

Forest Legacy Program Area

Priority	Number of Counties	Million Acres
Very High	28	15.0
High	17	8.7
Medium	12	5.9
Low	2	1.4
TOTAL	59	30.9

Figure 38
Texas Forest Legacy Program Area Showing Active Forest Legacy Projects



The Forest Legacy Area is consistent with the goals of the program in Texas. The FLP in Texas focuses on protecting large blocks of forest land from parcelization and fragmentation in areas that are important for forest products industry, promoting ecological benefits, providing watershed protection, and offering open space for public value. Smaller properties that are either connected or contain key features associated with larger land protection projects will also be a priority. After determining the goals of the Texas FLP based on the benefits the program strives to protect as well as the trends it attempts to prevent, the TFLC established the area of Texas that would most effectively achieve those goals.

The FLA boundary is formed by county boundaries. Priority area delineations within the FLA are also determined by county boundaries. While forests in other areas of Texas possess significant attributes and threats, no other area provides all of the benefits or faces all of the threats as do these 59 East Texas counties. Most notably, when compared to the rest of the state, these 30.2 million acres are most reliant on the timber industry and face the gravest threat of fragmentation—two of the driving forces behind the FLP.

According to National FLP Guidelines, criteria for a FLA should be based upon the FLP purpose to protect environmentally important forest areas that are threatened by conversion to non-forest. FLA boundaries must encompass forestlands with significant environmental- and other resource-based values. Areas may also include non-forested areas such as farms and villages if they are an integral part of the landscape and are within logical boundaries. Since FLA boundaries may not correspond to property boundaries, tracts located partially within the geographically defined FLA are eligible for the FLP upon approval of a boundary adjustment by the USFS Region.

Indian reservations and tribal lands, such as the Alabama-Coushatta Indian Reservation, may have important features on the forested landscape. Indian tribes and states are encouraged to collaborate and to consider only non-trust allotment lands for projects. Other tribal lands are already protected through the trust relationship between the U.S. Department of the Interior and the tribe and are ineligible for the FLP.

The following criteria are used to set priorities for eligible projects:

- Degree of threat: Priority is given to projects on properties that have proof of a high degree of threat of development or parcelization.
- Forest resource economic benefits: Priority is given to properties that are likely to have significant forest resource economic benefits.
- Public benefits: Priority is given to properties that are likely to have direct and indirect scenic, outdoor recreation benefits, and/or other public benefits.
- Water quality and watershed protection: Priority is given to properties that are likely to have significant water quality and watershed protection benefits.
- Ecological/cultural environmental education benefits: Priority is given to properties that are likely to have significant ecological, cultural, and environmental education benefits.
- Proof of readiness: Priority is given to projects that have community support, identified matching funds and partnership involvement.
- Strategic Initiative 1: Priority is given to projects that are in counties with “high” or “very high” priority ratings as identified in the Statewide Forest Assessment.
- Strategic Initiative 2: Priority is given to projects that fit within a larger conservation plan, strategy, or initiative, and connect to or lead to additional conservation investments.
- Clear title and free of encumbrances.
- Landowner is willing to allow access for annual monitoring.
- More than one attribute that can be protected by a Conservation Easement such as cultural resources or outstanding geographic features.
- Conservation Easement will provide for the continuation of working forestland.

The Forest Legacy Committee is responsible for evaluating and prioritizing projects. All interests in lands are made in accordance with Federal appraisal and acquisition standards and procedures. The acquired interests in lands entered into the FLP are adequate for FL purposes and are perpetual. These interests in lands will be managed and administered for goals consistent with conservation purposes declared by the state lead agency. Except for special situations requiring written agreements with partnering state agencies, TAMFS will be responsible for all monitoring and management of conservation easements on land that has entered the FLP to which the agency holds interest.

As the state lead agency, TAMFS prefers to hold interests in lands in the form of conservation easements rather than ownership of land. In special situations, it will be at the discretion of the

State Forester as to whether the state will utilize FLP funding to make fee simple purchases with FLP funding through the State Grant Option.

TAMFS also prefers to act as the sole titleholder of lands or interests in lands that enter into the FLP. However, at the discretion of the State Forester, other state government entities may either hold title to conservation easements or be allowed to own land that has entered into the FLP. For example, there may be projects adjacent to previously protected lands managed by another state agency. In this case, it may be more cost effective for that state agency to monitor the property in conjunction with existing management strategies. Should this occur, it would be expected that the partnering entity will be responsible for monitoring and enforcement of the easement and language in the easement title will define and reflect these agreements.

Projects are selected and funded on a voluntary and competitive basis. Interested landowners will submit a non-binding application that gives pertinent information on the property's resources and expected value.

Landowners who wish to participate in the program may be asked to provide the following information:

- Name, address, and phone number of applicant landowner.
- All other owners of record for this tract, and their addresses.
- Name, address, and phone number of authorized agent representing landowner(s), if applicable.
- Location of property.
- State-approved landowner Forest Management Stewardship Plan or multi-resource management plan.
- List of the significant scenic, natural, recreational, wildlife, timber, and other resource values contained on the property.
- Identification of all dams, dumps, or waste disposal sites on the property.
- Signed statement giving the USFS and State lead agency permission to enter the property for review and appraisal purposes.
- Legal description.
- List any encumbrances or liens existing on the property including, but not limited to contracts, leases, or outstanding rights not of record.
- Copy of plat or survey map of the property, if existing. If only a portion of the property is being offered, identify it on a plat showing the portion offered in the context of the entire tract.
- Tract acreage and total number of acres of forests and cleared/open land.
- List of existing permanent improvements on the tract, including houses, barns, lakes, ponds, dams, wells, roads, and other structures, and total number of acres occupied by improvements.

Projects meeting third party certification, projects with limited or full public access, projects that build upon already invested federal funds, projects that have already been appraised, and projects exceeding the 25-percent minimum private cost-share match will more likely rank higher in the project selection process at both the state and national levels as this certification shows the landowner's commitment to sustainable forest management.

Under Federal land acquisition requirements, an independent appraisal of the real property or interests in real property in the form of conservation easement must be completed and reviewed. The landowner must be informed of the outcome of that process.

Project proposals are accepted from January 1 to August 31. Once a year in September, TAMFS reviews applications and the Texas Forest Legacy Committee ranks projects based on their ability to satisfy the objectives of the program. Proposed projects are then evaluated against other projects in the USFS Southern Region and then nationally. Should the national process timeline change, the lead agency will adjust the timeline for submission accordingly.

Goals, Objectives, and Strategies

The Issues Sections of this document define environmentally important areas, threats to conversion to non-forest uses, and identify traditional forest uses. Additionally, the Sustainability of East Texas section identifies forestland ownership patterns, size of tracts, trends, and projected future forestland ownership patterns in the Texas Forest Legacy Area specifically.

Based on the benefits Texas forests provide as well as the threats they currently face, the Texas Forest Legacy Committee has identified four overall goals of the FLP in Texas that address critical issues as identified by the State Assessment.

Goal 1: Support Texas rural communities, traditional land uses, and cultural heritage.

Objective 1.1: Maintain large privately-owned working forest landscapes managed according to sustainable best management practices.

Strategy 1.1.1: Work with land trusts to identify potential Legacy projects and promote the FLP.

Strategy 1.1.2: Work with forest landowners to identify potential Forest Legacy tracts.

Goal 2: Promote conservation of biological diversity.

Objective 2.1: Protect habitat connectivity, unique ecosystems, and endangered species.

Strategy 2.1.1: Work with conservation organizations to align FLP work with partner conservation initiatives.

Strategy 2.1.2: Work with a longleaf subcommittee of the Stewardship committee to identify projects inclusive of longleaf restoration.

Goal 3: Promote watershed protection.

Objective 3.1: Enhance water quality and quantity and to protect aquatic habitats

Strategy 3.3.1: Work with Texas Statewide Resource Issue Leaders focusing on the Water Quality & Quantity Issue.

Strategy 3.3.2: Work with other state natural resource agencies.

Goal 4: Support open space initiatives

Objective 4.1: Decrease forest fragmentation and reduce negative effects of urban sprawl

Strategy 4.1.1: Promote CFP and FLP program and program concepts in high and very high priority counties identified in State Resource Assessment

Objective 4.2: Protect unique habitats and/or ecological features.

Strategy 4.2.1: Work with conservation organizations and landowners to identify potential Legacy projects with unique habitats or ecological features

Strategy 4.2.2: Tours to promote such projects and partnerships

Performance Measures

- Successful administration of the State's Forest Legacy Program.
- Facilitation, review, and prioritization of Community Forest Open Space Conservation applications.
- Acceptance, review, and prioritization of Forest Legacy applications.
- The coordination of easement acquisitions or interests in land which include but are not limited to gathering the baseline documentation report, Forest Stewardship Management Plan, surveys, appraisal, review appraisal, and final easement language.
- Coordinated acquisition process within State Government.
- Coordination of State Forest Legacy Committee.
- Annual monitoring of completed Forest Legacy Projects.

NOTE: The first Forest Legacy Program Assessment of Need (AON) was approved by USDA in 2004. At that time, states were directed to update their AONs every 5 years. With changes in national guidance and the 2019 Farm Bill, it was determined that states may include the Forest Legacy Program in their State Assessments and State Strategies in lieu of completing new or revised AONs. It is intended that this section meet the requirements and be approved as Texas' ten-year update to the Forest Action Plan.

State Lands Management

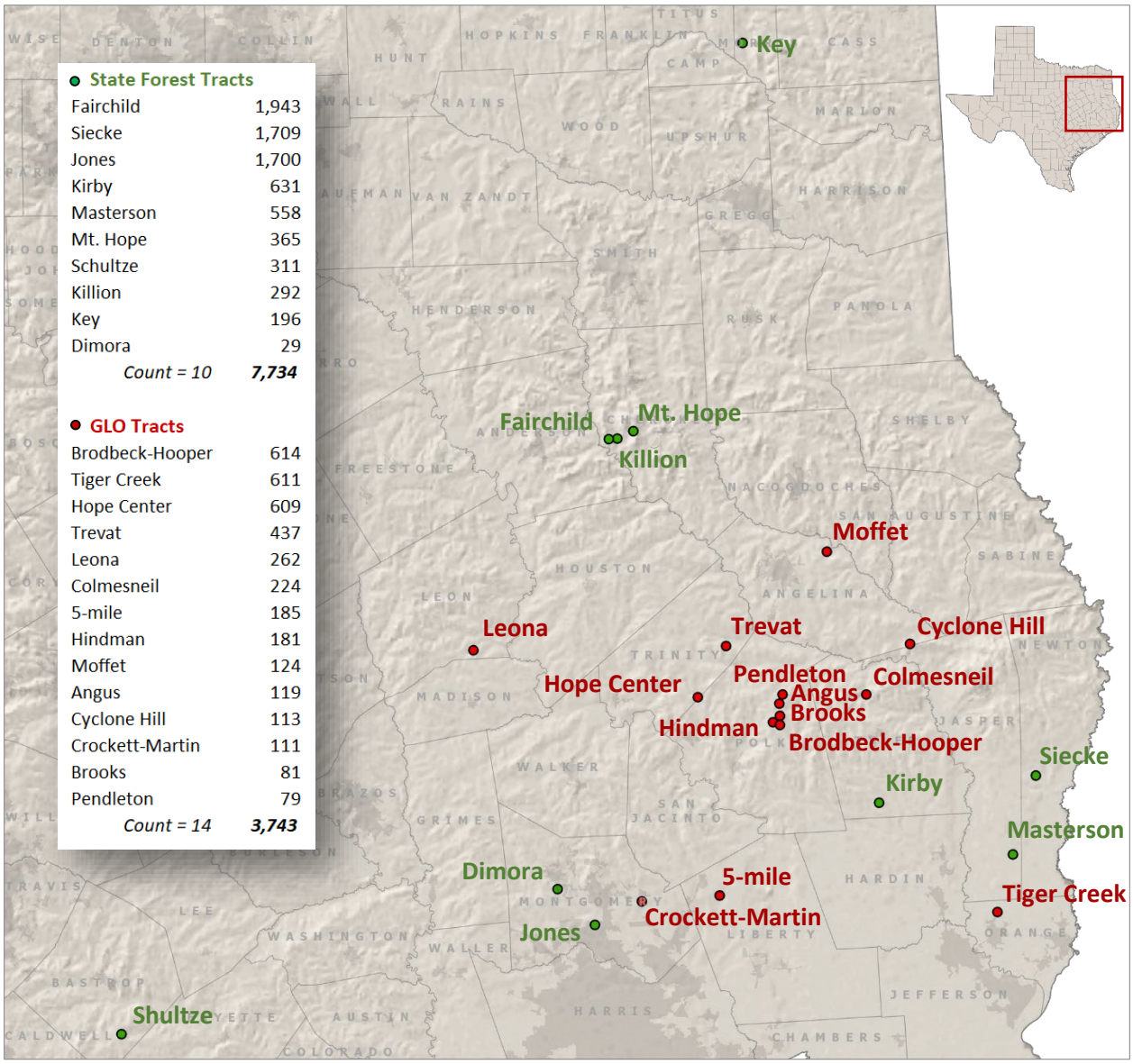
Program Description

The State Lands Management Program oversees TAMFS-owned and TAMFS-managed state lands. TAMFS owns and manages 10 State Forest tracts totaling 7,734 acres. The primary purpose of each state forest is to demonstrate sustainable forest management practices and provide conservation opportunities for landowners and visitors. Two of the state forests, W. Goodrich Jones and I.D. Fairchild, are home to the federally endangered and protected Red Cockaded Woodpecker. The state forests also offer day-use recreational opportunities to visitors including bird watching, hiking, horseback riding, picnics, wildlife viewing, and biking. All forests owned by TAMFS are working forests and public examples of sound forest management, land stewardship, and sustainability.

Program Priority Areas

Included under State Lands Management are tracts of land owned by the Texas General Land Office (GLO) and tracts owned by the Texas A&M Forest Service as state forests (Figure 39). Texas A&M Forest Service manages 14 GLO tracts totaling 3,743 acres and oversees and executes the total management of these lands. TAMFS East Texas District Offices oversee the day-to- day management of these lands. TAMFS is contracted by GLO for these services to ensure that these lands support healthy, thriving, and productive forests while providing revenue for the Texas Permanent School Fund (PSF).

Figure 39
Map of Texas State Forest and GLO Tracts Managed by Texas A&M Forest Service



Goals, Objectives, and Strategies

While some recreational day use occurs on state forests owned by TAMFS, the primary reason the state forests were purchased by TAMFS was to provide areas where forestry practices could be demonstrated to landowners.

Performance Measures

The effectiveness of the State Lands Management Program can be seen through the current condition of Texas State Forests and GLO properties. Each state forest and GLO property serve as demonstration areas for good examples of sound forest management and management regimes including prescribed burning, forest thinning operations, herbicide applications, site preparation, invasive species management, and reforestation activities.

Conservation Education and Outreach

Program Description

Texas A&M Forest Service conservation education and outreach programs train, educate, and provide experiences for people of all ages living and learning among the many diverse ecosystem types across the state.

These programs help translate the complex world of forestry into simple approaches that a wide range of people can follow. In order to help create a healthier Texas and implement effective forestry and land management solutions, especially on a large scale, Texas A&M Forest Service strives to reintroduce these topics back into the everyday lives of urban and rural populations.

Program Priority Areas

Innovating and expanding conservation education focuses on the following priority areas:

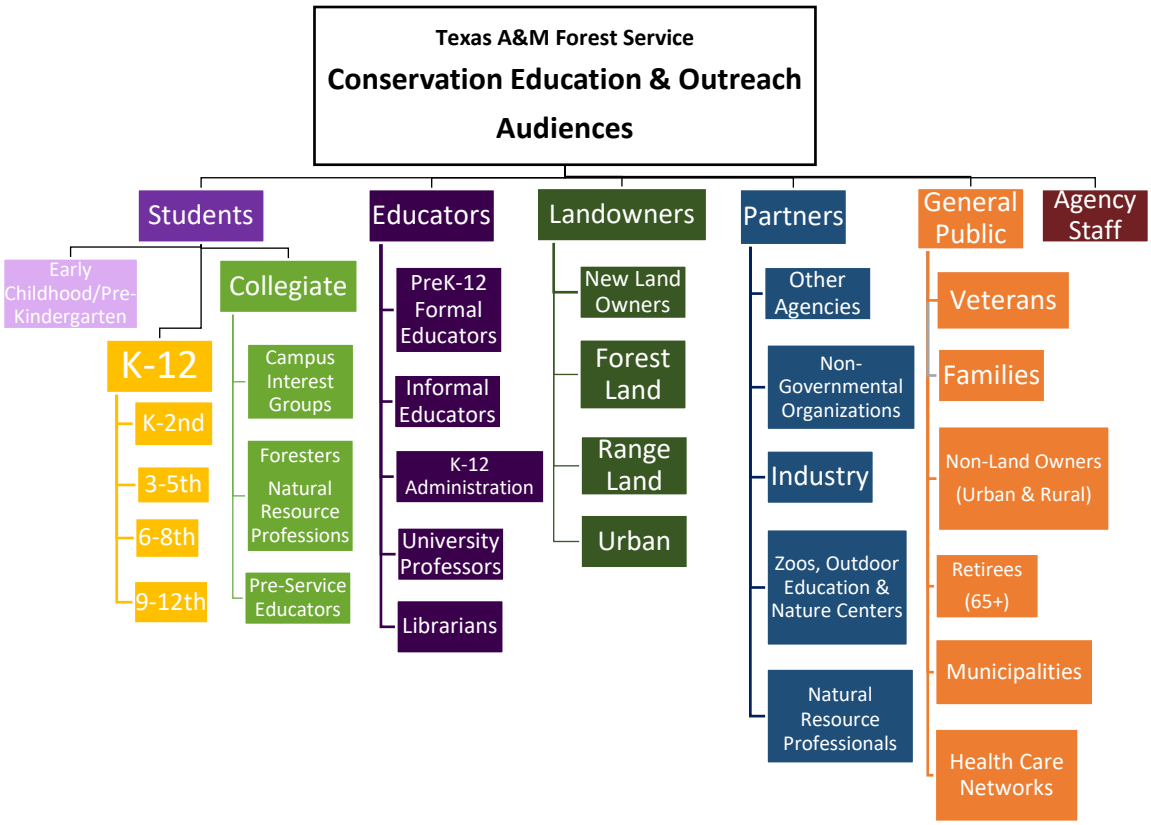
- *Texas Forest Literacy Plan (TFLP)* sets the standard in conservation and environmental education about forests in Texas outlining the essential knowledge of forest topics and themes that the public must have in order to ensure that the resource remains healthy and sustainable into the future, answering:

directly with students at local forests and schools.

- Capacity building, both internally and externally, remains one of the agency's highest conservation education priorities. By training formal and informal educators, as well as better equipping staff to meet the changing education needs of the public, TAMFS is enhancing its effectiveness in education and outreach efforts and continuing to elevate conservation and environmental education priorities in Texas.

- Of the identified conservation education target audiences, youth engagement and outreach to higher education are two of the primary focus areas within the student audiences. This outreach focuses on providing youth, ages 12–18, with opportunities to discover and learn about forests, explore careers, develop essential skills, and begin a long, healthy relationships with Texas' natural resources. Activities include, virtual education, forestry field tours, and forestry days and summer camps. These programs are particularly important among underserved populations in urban and rural areas who experience higher than normal rates of nature deficiency, poor physical and mental health outcomes, and who often lack the opportunity to experience nature on their own. The goal of youth engagement is to ensure that forests and related natural resources remain sustainable into the future by supplying young adults with the knowledge and skills they need to be good environmental stewards. These programs are made possible by cooperation with other state agencies, as well as public and private partnerships.

Program Audiences



TAMFS works directly with communities and partners across the state to provide high-quality education and engagement opportunities for audiences, including programs such as:

- **Teacher Conservation Institute (TCI)**
  TCI is a cooperative program of the Texas Forestry Association which has been successfully training teachers in forestry and PLT curriculum for 25 years. In 2019, TAMFS and Texas Forestry Association offered the first-ever Teacher Conservation Institute: Urban Connections, focusing on urban forestry and identifying the unique challenges forests and natural resource education face in urban environments. The training included lessons in forest ecology and stewardship, the social, economic, and education benefits of urban trees, as well as how to address varying environmental attitudes and inequalities. This model is expected to continue and grow into other urban areas across the state.

  Other Teacher Conservation Institute models include a week-long excursion camp for teachers and the ForesTREE Experience, a shortened, hybrid version of the week-long camp and urban TCI. This two-day model walks formal and informal educators through the full life cycle of a forest and provides them with the knowledge and skills they need to educate their communities about the importance of forests and forest management.

- **K-12 *Discover Forestry* and *Forest Awareness Tours***
  These two programs constitute a large portion of Texas A&M Forest Service's direct interactions with K-12 students. Discover forestry curriculum helps break down complex forestry topics for students, and Forest Awareness Tours get students outdoors, allowing them to learn about forest topics hands-on in wooded and forested areas. This program makes use of state and national lands near schools and community organizations and allows for multi-agency participation in outdoor education.

- **Virtual and Distance Education**
  Through multi-disciplinary partnerships, such as *Virtually Wild*, TAMFS provides distance and virtual learning opportunities for classroom students, allowing teachers and students to watch forest and wildlife management in real time from anywhere. While it is often advantageous to students to spend time learning hands-on outdoors, a variety of health, socioeconomic, or geographic barriers often limit access and feasibility. Therefore, offering distance learning opportunities is essential to reaching a wider audience and growing public awareness of forest related issues and topics, particularly in areas where trees are not a dominate species such as desert and grassland ecosystems.

- **TAMFS Apps for the Classroom**
  Web-based and mobile applications, such as Tree Trails, Famous Trees of Texas, and Map My Property available through Texas Forest Info, allow teachers to implement technology enrichment and extensions into forestry and natural resource lessons. These tools are aligned with the Texas Forest Literacy Plan and allow students to internalize land management concepts through the exploration of new technologies, such as mapping and GIS.

- **Pre-Service Teacher Education Programs,** including:
  Walk in the Forest, a field training day for new and aspiring teachers to learn about how to use and adapt Project Learning Tree curriculum across disciplines and for indoor or outdoor use.

  Stephen F. Austin State University's *Wild about Science* and *Birds, Bees, Bugs, and Butterflies (BBBB)*, a PLT training for education majors in which they can practice their outdoor teaching through hands-on activities with local elementary students.

- ***Healthy Trees, Healthy Lives*** **Education Initiative**
  Through the development of educational partnerships with health agencies and hospital networks, mental health organizations, primary care clinics, and universities, as well as city planners and policy makers we are bringing the influence of nature to the forefront of conversations about health and well-being.

Goals and Targets

The primary directive of conservation education at Texas A&M Forest Service is to improve the health and sustainability of Texas' forests and natural resources through community education and engagement while enhancing agency's reach, effectiveness, and recognition among all Texans. The following goals constitute the broad overview of the agency's approach to conservation education into the future.

Goal 1: Provide "Cradle to Grave" engagement opportunities for all Texas, regardless of age, ability, socioeconomic status, or state geographic region*.

Target 1: Distribute and promote the state-wide adoption of the Texas Forest Literacy Plan among state partners, forestry and natural resource entities, and education networks.

Target 2: Complete, implement, and maintain yearly updates of the Conservation Education Expansion and Strategic Action Plan (CEESAP).

Target 3: Improve effectiveness by enhancing user experience of digital and print education and outreach materials.

Target 4: Create region-specific, tailored content and education materials.

Target 5: Establish region-specific goals and objectives, including an overall increase in the number of reported conservation education events.

Target 6: Create and maintain educational materials and forest series education resources available in English and Spanish.

Target 7: Provide education resource accommodations for the blind or visually impaired individuals.

Goal 2: Expand internal educating capacity and efficacy for conservation education.

Target 1: Implement a continuous and inclusive Conservation Education Staff Development Program available to all TAMFS departments and regions of the state.

Target 2: Develop and implement an analytical metrics and reporting platform for assessing agency-led education presentations.

Target 3: Develop and maintain a forestry agency staff handbook and best practices guide for conservation education.

Target 4: Develop, implement, and maintain an easily navigable staff education resource library for tools, lesson plans, and materials.

Target 5: Integrate fire prevention education materials, lesson plans, and activities, enhancing participation and use of all agency resources and curriculum by Forest Resource Protection and Forest Resource Development.

Goal 3: Expand external educating capacity for conservation education.

Target 1: Expand pre-service education models to at least one education college in each region of the state.

Target 2: Expand and scale training programs for formal and informal educators.

Target 3: Train intrastate and interstate forestry partners in conservation education delivery and maintenance.

Target 4: Develop state and local partnerships for the inclusion of forest topics and themes in state education standards.

Goal 4: Establish and enhance interagency and interdisciplinary partnerships in all regions.

Target 1: Develop multiagency and multidisciplinary cooperation networks in each region, identifying major contributing partners and resources for successful education and events.

Target 2: Incorporate partner themes and content into region-specific education materials.

Target 3: Collaborate with partner organizations to participate in at least three interagency or community partner events yearly in each region.

Goal 5: Increase availability of digital and hands-on engagement opportunities for urban populations.

Target 1: Scale and implement yearly Teacher Conservation Institute: Urban Connections model in Austin, San Antonio, Dallas/Fort Worth, Lubbock, El Paso, Northeast Texas, Southeast Texas, Far South Texas (Brownsville and Corpus Christi).

Target 2: Develop online series education modules and education applications for distance and virtual learning

Target 3: Provide nature and forest-oriented health and wellness promotion opportunities.

Performance Measures

Performance measures reflecting accomplishments in conservation education efforts currently include:

- Project Learning Tree number of teachers trained
- Conservation education event tally, as well as number of participants
- Web-based analytics tracking visitation and usage of online education resources

As a result of the ongoing development of materials and enhanced tracking capabilities, future performance measures will also include:

- Geospatial assessments of county and regional conservation education availability and program gaps
- Number of staff trained in agency-sponsored curriculum, including Project Learning Tree
- Quality assessment surveys of the *Conservation Education Staff Development Program*, as well as voluntary surveys for participating groups to evaluate TAMFS effectiveness of content and delivery
- Web-based analytics tracking additional resources, such as *Texas Forest Literacy Plan*, and utilization of online, series-based education modules

Optimizing the Stewardship of Natural Resources through Forest Literacy

Stewardship begins with a thorough understanding and appreciation of the complexities and importance of forests and related natural resources. Over time that understanding can grow into a sense of responsibility and concern—and then into action.

What is Forest Literacy?

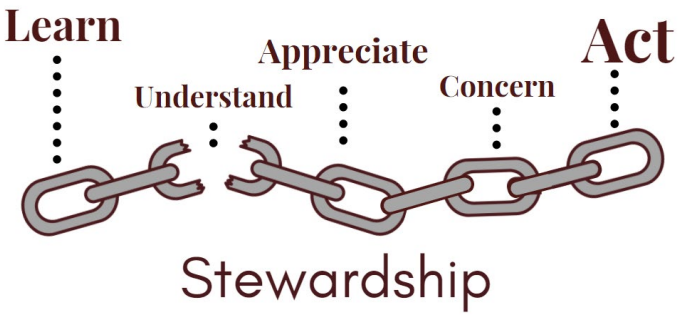
Forest literacy refers to the body of knowledge and skills surrounding forest topics that is foundational for individuals to fully appreciate forests and make informed decisions about land management and use of forest resources.

Though traditionally accessed by forest sector professionals, academic professionals, and conservationists, forest literacy education for the entire population is a critical steppingstone on the pathway to large-scale stewardship—especially when 95 percent of Texas lands are privately owned.

"Amassing population-level forest literacy has never been more important to the future of forests than it is today. Our citizens face risks to forest sustainability because most have never even learned the basics."

There is a Broken Link in the Stewardship Chain

The historic legacy of social learning in forestry, such as the skills and techniques passed down through generations of seasoned forest landowners, has been disrupted. Shifting population dynamics, urbanization, and changes to state-mandated education standards have resulted in the exclusion of forest-related content and lessons spanning decades. This subtraction has resulted in multi-generational deficiencies in forest literacy and broken links in the stewardship chain.



Forest literacy among adults and landowners begins with exposure to fundamental concepts and terms then graduates to more complex themes and ideas over time. This type of learning progression, known here as *a **forest literacy framework***, is rooted in the philosophy that a solid foundation of key concepts and ideas helps build a deep understanding and appreciation for natural resources, ultimately enabling long-term memory formation and lasting behavioral change.

However, due to long-standing deficiencies in social and public education it is unlikely that the population will develop a sense of personal responsibility toward forest resources and therefore may fail to make sustainable decisions.

It is the responsibility of state forestry agencies, industry professionals, and conservation educators to correct this multi-generational knowledge gap—aiming forest education programs not only at students but at individuals across the entire population.

Forest Literacy Frameworks – The Best Place to Start

> ***"Educating an entire population is no easy task, so knowing exactly what to teach is a crucial first step."***

A wide-reaching conservation education program structured around a forest literacy framework is the most effective tool state forestry agencies have in combating forest literacy deficiencies, promoting stewardship, and increasing overall sustainability of forest resources.

A sturdy, consistent foundation of knowledge, skills, and concepts are essential to the future of forest education. By utilizing a forest literacy framework to guide agency conservation education and outreach activities for all audiences, state agencies can be more precise and effective, and begin integrating forests concepts into previously unreached and non-traditional audiences—such as healthcare networks, city planners and manufacturers, public educators, and policy makers.

Texas is Relinking the Chain

Similar to national and state education standards that outline concepts and skills that students should master before they graduate high school, forest literacy frameworks outline concepts Texans need to know about forests to ensure the resource is sustained for the benefit of future generations.

The ***Texas Forest Literacy Plan (TFLP)***, drafted by Texas A&M Forest Service, Texas Forestry Association, university, industry, and public education partners is the Texas forest literacy framework that sets the standard for consistent, fact-based education about forests and trees across agencies, disciplines, external partners, and eventually all southern states. Organized around the four core themes of forest literacy, the TFLP provides an easy-to-navigate learning pathway that prepares Texans to answer the following:

- What is a forest?
- Why are forests important?
- How do we sustain forests?
- What is the public's responsibility toward forests?

Forest literacy is optimizing the stewardship of natural resources in Texas. In knowing the concepts, terminology, and skills outlined within these four core themes, Texans are better informed and personally connected to forests, ultimately increasing the probability that the futures of individual private lands and entire forest ecosystems are secure, conserved, and protected for generations to come.

To view the full Texas Forest Literacy Plan visit, tfsweb.tamu.edu/TexasForestLiteracyPlan/

Predictive Services

Program Description

TAMFS analyzes current and predicted weather conditions, wildfire occurrence, and the presence and availability of vegetative fuels throughout the year to maintain a continual assessment of wildfire risk at the state, regional, and local level. Utilizing this information, agency staff develops daily and seasonal forecasts, as needed, to assist the state and local government entities in preparing for and responding to periods of elevated fire danger (i.e., fire seasons). Where possible, this information is made available to state and local cooperators and the public.

Predictive services (fire weather forecasts, fire danger forecasts, and vegetation and fuels analysis) are standard functions during emergency wildfire response operations. Following the 1998 fire season, TAMFS established the Predictive Services as a permanently staffed unit to provide short- and long-term forecasts and analysis. This was based on increased need and reliance on the Predictive Services' products by TAMFS and by other state and local entities. It also satisfies legislative requirements for the agency to provide drought-determination information for county government as part of fireworks restrictions (beginning in 1997, HB 2049) and county burn bans (beginning in 1999, HB 2620).

This program produces information and products that are utilized at the national, state, and local level by firefighters, elected officials, and public administrators. Most of the products (daily fire danger, drought indices, fuel dryness) have been developed as automated, online, and publicly available resources through a partnership with the TAMU AgriLife Spatial Sciences Laboratory.

At the state level, these analyses are used to guide several program areas within the TAMFS, including wildfire response staffing, pre-positioning and mobilization of resources, fire prevention, risk identification, and mitigation. At the state and federal level, Predictive Services provide a number of decision support products to TDEM to support requests for state and federal disaster declarations, activation of the state emergency response plan, and the activation of other state and federal agency fire suppression and support resources. Fire behavior and fire potential information are also provided to support federal Fire Management Assistance Grant (FMAG) requests seeking Federal Emergency Management Agency (FEMA) declarations on individual wildfires.

At the county and local level, support information is provided for counties considering burn bans, fireworks restrictions, or county-level emergency declarations.

Predictive Services is administered as a Department within the Forest Resource Protection Division of the Texas Forest Service. The department produces both internal and external products. Most products and services are standardized reports and graphics that are made available statewide. Occasional regional products or analysis are produced as needed based for existing or expected fire danger.

Federal Wildland Fire Agencies: TAMFS Predictive Services is a member of a national community of state and federal predictive services units. The department maintains a cooperative relationship with these agencies (USFS, USFWS, etc.). Efforts primarily include the exchange of information and alerts on existing and expected fire danger.

State: At the state and federal level, Predictive Services provides a number of decision support products to TDEM to support requests for state and federal disaster declarations, activation of the state emergency response plan and the activation of other state and federal agency fire suppression and support resources. Fire behavior and fire potential information is provided to support federal Fire Management Assistance Grant (FMAG) requests seeking FEMA declarations on individual wildfires.

County Government: At the county level, support information is provided for counties considering burn bans, fireworks restrictions, or county level emergency declarations.

More TAMFS Predicative Services' products and information can be accessed at http://ticc.tamu.edu/predictiveservices.htm

Program Priority Areas

Remote Automated Weather Stations (RAWS)
Essential in the creation of this capability is the development of a remote, automated weather station network and its integration into geographic information systems, spatial analysis tools, and web-based information products. These weather stations, complete with satellite uplink capabilities, provide crucial information to the state and national datasets.

Web-Based Information Products
One of the primary roles of Predicative Services is the dissemination of information to citizens, local government, state agencies, and other stakeholders and cooperators. Tremendous effort has gone into the development of web-based information products allowing local officials and firefighters access to all fire danger, drought, weather, and fire behavior information. Wildfires pose a critical life-safety risk to firefighters and citizens whether state resources are deployed on a fire or not. Web-based products and information are one of the primary conduits for making this information available to all. The continued development and advertisement of these products remains a significant priority for the agency.

Southern Wildfire Risk Assessment (SWRA)
The SWRA is a GIS-based wildfire risk assessment tool developed by the thirteen southern states. The four-year project was led by the TAMFS Predictive Services Department and included production of publications; acquisition, creation, and conversion of data; analysis and creation of the risk model; and implementation of and training on the GIS application. Change detection and data updates are ongoing, but the system has already provided the ability to quantitatively assess wildfire risk across the state with the ability to analyze risk and causal factors at the local level.

Texas Wildfire Risk Assessment
TxWRAP is the primary mechanism for the TAMFS to provide the risk information and tools developed from the SWRA to the public, local community groups, government officials, professional hazard-mitigation planners, and wildland fire managers across the state. It includes a suite of applications that provide the information needed to identify and manage wildfire risk reduction and prevention efforts at a community, city, county, or individual level. The online application can be found at http://www.texaswildfirerisk.com

Goals, Objectives, and Strategies

- Determining current and predicted weather conditions throughout the year
- Monitoring the condition of wildland fuels
- Calculating current and predicted fire danger and fire potential
- Identifying and documenting Urban/Wildland Interface areas
- Tracking fire occurrence and ignition sources
- Disseminating assessment information to cooperators, elected officials, and the public

Performance Measures

The TAMFS Predictive Services Department's products are regularly used and requested by cooperators at the state, county, and local level. TAMFS Predictive Services staff and products are used by the Governor's staff to determine the need for wildfire disaster declarations. The Texas Division of Emergency Management (TDEM) frequently requests short- and long-term assessments of fire danger for the state or for specific areas. County officials also utilize Predictive Services' products when considering county burn bans or firework restrictions. In fact, TAMFS was specifically selected by the state legislature as the source for drought information utilized by county officials when considering outdoor burn bans and fireworks restrictions (Local Government Code Sections 352.081 and 352.051).

Mitigation and Prevention

Program Description

Texas is experiencing "high-velocity" change through rapid population growth and development. According to the US Census Bureau, Texas is the fastest growing state in the nation. Throughout Texas, the majority of the state's new development growth is encroaching on undeveloped wildland areas. As cities, communities, and suburbia expand into what was once considered rural Texas, this continuing growth and encroachment bring people and structures into proximity with large amounts of vegetation. The junction in which homes and structures intersect with undeveloped wildland areas that contain flammable grass, brush, and trees is known as the Urban Wildland Interface (UWI). The placement of people, homes, and structures within the UWI renders them extremely vulnerable to wildfire. Texas is prone to wildfires due to development and population increases within the UWI, climate conditions, and changes in agricultural, forest, and ranch land use. Wildfire occurrence statistics in Texas show that over 95 percent of all the wildfires are caused by human activity and 76 percent of Texas wildfires occur within one mile of a community. Continued rapid population-and development growth within the UWI, increasing drought and changes in land use, directly correlates into a sharp increase in the total number of Texans at risk to wildfires.

TAMFS is committed to continuous wildfire mitigation and prevention programs that reduce hazardous conditions, which lower the risks from wildfires. TAMFS's wildfire mitigation and prevention initiatives are based on integrating local involvement at the county, city, community, and individual level which produce self-sustaining proactive programs that help Texans help themselves.

These programs have gained importance over the last 25 years with the recognition that they are essential for the agency to address the significant causal factors that lead to development of large, damaging wildfires that destroy homes and threaten the citizens of the state. One significant programmatic change that has taken place is the realization that the state, through the TAMFS, cannot directly deliver these services on a citizen-by-citizen or acre-by-acre basis. To successfully impact a population and area the size of Texas requires program delivery at a community or county-based level with interactive local cooperators.

The first fire prevention team was mobilized in Texas in 1997 in the Panhandle region of Texas. Prevention teams were again successfully utilized during the 1998 fire season. These activities were led by existing TAMFS staff as assigned additional duties. During this same time frame, the danger inherent in unmanaged population growth into UWI areas, where vegetation is a source of fuels, was gaining prominence as an issue for Texas and the nation.

This program produces information and educational products that are utilized by citizens, homeowners and land owners, local associations, community planners, fire departments, local governmental entities, elected officials, and public administrators. Many of the basic informational products are publicly available online. Direct assistance by agency personnel is also available statewide.

Mitigation and Prevention is administered as a department within the Forest Resource Protection Division of Texas A&M Forest Service. The department produces both internal and external products. Products are normally informational in nature and based on public or community

requests. Detailed assessments and analyses are also produced as needed. Most departmental services are based on public or community requests. Department personnel, utilizing existing risk assessment tools, also work to identify communities at risk across the state and initiate pro-active contact with community leaders in these areas.

TAMFS focuses is on preventing wildfires from occurring based on behavior factors outside of the person's home and on teaching people how to make their homes and property safe from wildfire through on-going practical Firewise programs and the Firewise Communities USA program and to have local governmental entities adopt a CWPP in their county or city to address wildfire and UWI issues. In addition, TAMFS is actively engaged in fuel mitigation work.

Federal Wildland Fire Agencies: The TAMFS Predictive Services Department maintains a cooperative relationship with the federal wildland agencies (USFS, USF&WS, etc). Efforts primarily include the exchange of information and alerts on existing and potential treatment areas. Where CWPPs impact areas adjacent or near federal lands, representatives from the federal agencies are brought in to the plan development process.

State Agencies: Where CWPPs impact areas adjacent to or near state lands, representatives from the state agencies are brought into the plan development process.

TAMFS provides subject matter expertise services to the TPWD and GLO regarding fuel mitigation and reduction efforts. The TAMFS provides fuel reduction work for the State of Texas Adjutant General's Department-Texas National Guard-managed properties.

County/City Government: County and local government entities are primary cooperators in prevention and mitigation efforts. TAMFS employees work as subject matter experts and catalysts to bring local and community leaders together to address identified problems, issues and communities at risk. Decision support information is also provided for counties considering burn bans, fireworks restrictions, or county level emergency declarations. The major focus is to engage local government towards approving CWPPs.

Program Priority Areas

Community Wildfire Protection Plans (CWPP)
A CWPP is a plan developed by a local government entity at either the county or municipal level in an area at risk from wildfire. The CWPP development process is collaboration among the local government entity, stakeholders, individuals, and various agencies interested in reducing wildfire risk.

Firewise Programs
There are two major Firewise programs. The first type of Firewise program is an on-going, practical program aimed at educating and empowering property owners, stakeholders, and individuals located in the UWI to mitigate wildfire hazards themselves and modify their landscaping and land use so that it will be fire adaptive. This Firewise program includes Firewise landscaping, the Citizen Wildfire Ecology Specialist Certification (targeting Master Naturalists and Master Gardeners), the Community Wildfire Preparedness Library (provides Firewise reference materials to public libraries), and UWI training for fire departments and community planners.

The second type of Firewise program is the Firewise Community/USA program which is aimed at small communities, community associations, and master-planned communities to assess risk and to

create a network of cooperating homeowners, organizations within the community, and the community's fire department. The community identifies and implements local solutions to address mitigating wildfire hazards. The community can be recognized by Firewise Community/USA as a nationally recognized Firewise Community. Being recognized as a Firewise Community requires that the community has an on-going commitment towards mitigating wildfire hazards within their community.

Ready, Set, Go Program

Preparing for wildfire at an individual level is critical to the success of mitigation efforts. The Ready Set Go (RSG) program offers Texans the information needed to implement a personal wildfire preparedness plan. TAMFS has conducted 898 RSG workshops for 46,042 Texans and provided 82 RSG train-the-trainer sessions to 134 fire departments.

Fuel Reduction – Mitigation

One of the tools in hazard reduction efforts is the removal of heavy vegetation growth under controlled conditions to reduce the fuels available to future wildfires. Vegetation is generally removed using mechanical methods—such as mowing or chopping—or prescribed (controlled) fires under manageable conditions. Removal of the excess vegetation will aid in wildland fire suppression in treated areas for years to come. TAMFS completes fuel reduction mitigation programs as a result of the development of established CWPP, Firewise Communities and working with state and federal cooperators. The Mitigation and Prevention Department manages the Community Protection grant program in Texas. The Community Protection grant program provides grants to private sector certified burn managers who have been contracted by private landowners adjacent to USFS forests.

Wildfire Prevention Programs

Wildfire prevention programs are either campaign-based or ongoing proactive education programs. Campaign wildfire prevention programs are aimed at preventing fires at the area, regional, or the statewide level, where there are emerging conditions that will increase the number of wildfires or are conducted during a recognized wildfire season. The long-term solution towards preventing wildfires is proactive education programs aimed at children (e.g., Smokey Bear's Only You Can Prevent Wildfires).

Emerging Communities Initiative

As the state population continues to grow, many Texas communities are experiencing high velocity change and development. TAMFS's participation in the Emerging Communities Initiative helps small communities with high growth potential prepare and plan to alleviate the potential wildfire problems that will be created as they grow. The Emerging Communities' focus is issues related to enhancing quality of life that are connected to land management, stewardship, and preserving and creating an urban tree canopy; however, UWI issues are directly affecting Texas' emerging communities. The Mitigation and Prevention Department works directly with these Texas emerging communities in completing their CWPPs and presenting on-going practical Firewise programs.

Texas Ranch Wildfire Program

North Texas, the Rolling Plains and the Panhandle have a long history of large, fast-moving grass fires, particularly when dry and windy conditions combine winter-cured grasses. Between 2005 and 2017, this area of the state recorded twenty-two Southern Plains Wildfire Outbreaks (SPO) a weather phenomenon characterized by extreme winds and low relative humidity – conditions that created some of the largest, fastest-moving wildfire in Texas. The TRWP initiative focuses on the

working with large landowners in these high-risk areas to promote integrated wildfire response planning and community protection projects to protect communities from these fast-moving disasters. The Ranch Response Planning component allows ranchers (and other large landowners) to document and map landowner priorities, resources, hazards, values at risk, water sources, fences, gates and other key items. These response plans are used to help guide and inform state and local firefighting response efforts. The second component of the TRWA is the identification and performance of mitigation measures to protect these rural communities within the sea of grass. Ranch Community Protection Projects involve community leaders, private landowners (ranchers), TAMFS fire specialists and other cooperators to develop and perform prescriptive treatments such as prescribed grazing, prescribed burning, blackline construction, mechanical firebreaks, green firebreaks and windbreak tree planting to protect these communities.

Wildfire Case Studies

Following the Cross Plains Fire in December of 2005, that burned through the town of Cross Plains, destroying 116 homes and taking two lives, TAMFS mitigation staff performed a detailed assessment of the fire area, homes lost, and homes remaining. The resulting case study was compiled to help guide future risk mitigation programs and activities based on the specific lessons learned from the homes saved and lost in the Cross Plains Fire. Since the Cross Plains report, seven other studies have been completed following large, destructive fires in different areas of the state.

Goals, Objectives, and Strategies

- Maintain continuous wildfire mitigation and prevention programs that reduce fire occurrence, hazardous conditions, and the risk of loss from wildfires.
- Assign a high priority to mitigation and prevention efforts throughout the year.
- Base efforts on local assessment information
- Initiate prevention efforts prior to a developing fire season.
- Involve cooperators in designing and delivering programs.
- Strive to empower communities and property owners to mitigate hazards in urban/wildland interface areas.
- Work with ranchers, state agencies and other large landowners and cooperators to develop and deliver wildland fuel reduction programs.

Performance Measures

Development and delivery of CWPP's, Firewise Communities, Ranch and other community protections plans and projects to reduce risk and protect Texas homeowners and communities from wildfire.

Community Wildfire Protection Plans

Mitigation and Prevention

Community Wildfire Protection Plans (CWPPs) are designed to be created and implemented on a municipal to county level for an area that has a wildland-urban interface, which most cities in Texas do. A CWPP will described the community o a broad level, identify areas at risk for wildfire, and put forth suggestions for mitigation. A CWPP is community driven and must be accepted and supported by the local government. It can be an important step for the possibility to receive assistance from the Texas A&M Forest Service and the Federal Government. To learn more about CWPPs, visit https://www.nfpa.org/Public-Education/Fire-causes-and-risks/Wildfire/Firewise-USA.

CWPPs are a mechanism for communities to address their wildfire risk. These plans promote collaboration and local action and can work in partnership with Firewise activities.

Background

Destructive wildland fires in 2002 were a catalyst for Congress to pass the Healthy Forests Restoration Act (HFRA) in 2003. The intent of the HFRA was to provide funding and guidance for better forest management practices throughout wildland areas and the wildland urban interface. One of the key outcomes of the HFRA was to incentivize communities to create a Community Wildfire Protection Plan. An approved CWPP can influence and prioritize future funding for hazardous fuel reduction projects, including where and how federal agencies implement fuel reduction projects on federal lands.

CWPP Criteria

Community Wildfire Protection Plans must meet three basic criteria including:

- ***Collaboration*** – A CWPP must be collaboratively developed by local and state government representatives, in consultation with federal agencies and other interested parties.
- ***Prioritized Fuel Reduction*** – A CWPP must identify and prioritize areas for hazardous fuel reduction treatments and recommended the types and methods of treatment that will protect one or more at-risk communities and essential infrastructure.
- ***Treatment of Structural Ignitability*** – A CWPP must recommend measures that homeowners and communities can take to reduce the ignitability of structures throughout the area address by the plan.

Firewise-friendly CWPPs

A community that is writing a CWPP can align its recommended measures with Firewise. In fact, a Firewise plan is already one that identifies steps, which homeowners and the Firewise Community will take to reduce home ignitability and treat hazardous fuels and vegetation in the home ignition zone. For example, Firewise principles recommend that homeowners thin trees and landscaping around each house and design structures with heat-resistant building materials.

By signing up to become Firewise, a community is already on its way to meeting some of the CWPP requirements. Conversely, if recommendations are needed for a CWPP, Firewise should be a top priority. Together, CWPP and Firewise efforts strengthen the success and outcomes of each.

CWPP Proclamation

A proclamation is a public and official announcement. In reference to a CWPP, a proclamation needs to be made by the governing body of the community or county. The proclamation announcements to the public that they are intending to pursue the creation of a CWPP. TAMFS personnel providing technical assistance should be able to answer questions about the importance

of a CWPP, what outcome to expect, how the community will be affected, how much time and money will be required, etc.

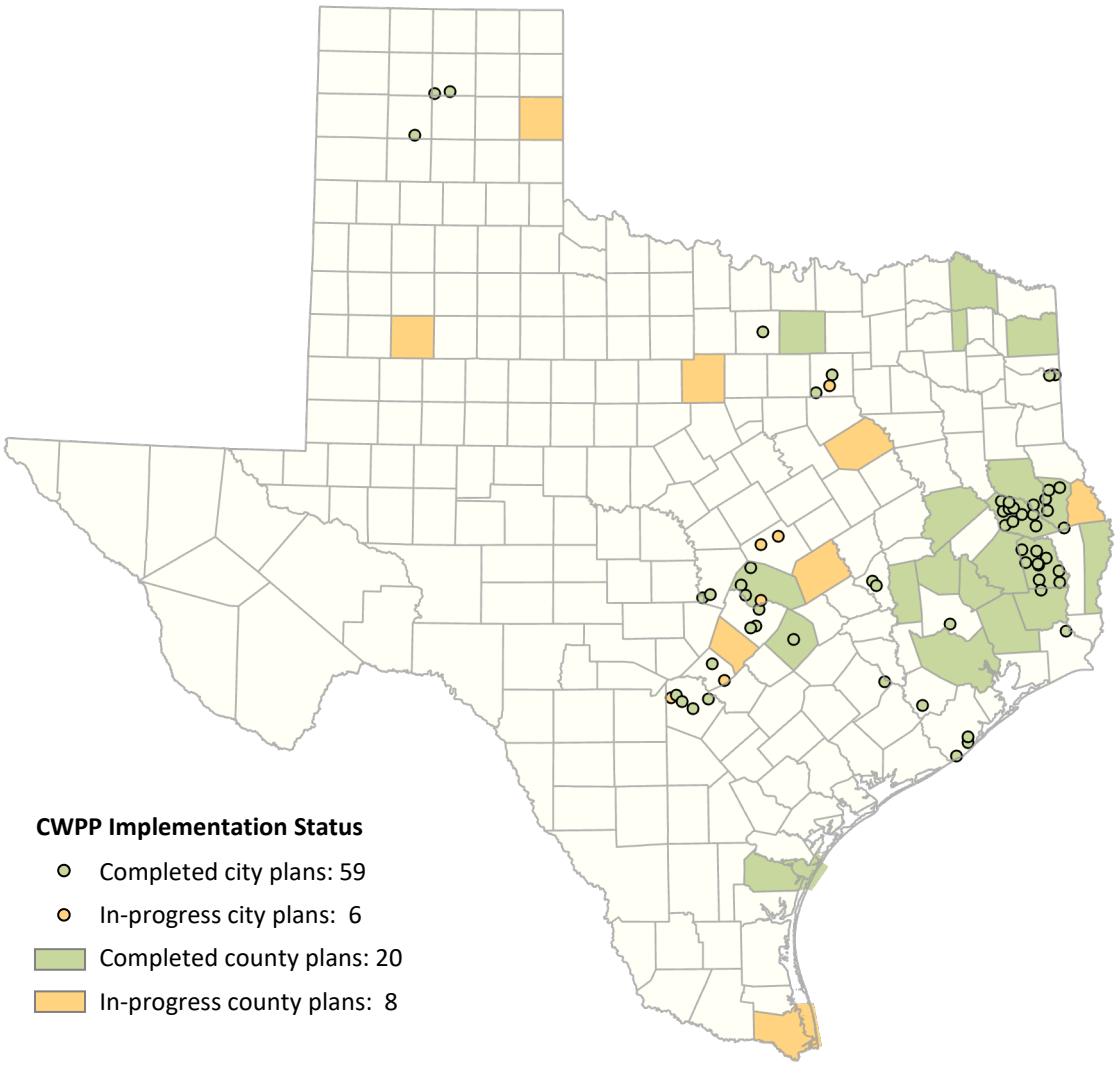
A central database is maintained that contains basic information about each CWPP including:

- County name
- Community name
- TAMFS contact
- Who created the plan (TAMFS, contractor, local FDs that helped, etc.)
- Coordinates of the county or community (latitude/longitude)
- Electronic copy of the plan (when completed)

A CWPP is not considered in progress until a Proclamation has been signed. This is to show the commitment from the county or community on working towards completing a CWPP.

Figure 40 shows the status of communities and counties that either have completed a plan or are in progress of developing one as of December 19, 2019.

Figure 40
Community Wildfire Protection Plan
Implementation Status for Texas Counties and Cities



Planning and Preparedness

Program Description

The TAMFS Planning & Preparedness Department works across agency boundaries to enhance the effective implementation of the Texas Wildfire Protection Plan (TWPP). Department staff works collaboratively with other agencies, departments, and personnel in planning, developing, implementing, supporting, and evaluating TAMFS response capabilities and needs.

Planning personnel work in conjunction with TAMFS Predictive Services to monitor conditions and determine the needed preparedness levels. Based on this analysis, resources are mobilized and pre-positioned in areas of the state deemed to be at risk. The response resources utilized must be flexible, based on the current fire risk and occurrence, and involve the most appropriate available local, state, federal, and contract resources. The Incident Response Department coordinates placement and daily management of assigned fire resources. In turn, the Planning & Preparedness Department manages availability, qualification determinations, ordering, tracking, mobilization, and demobilization of personnel.

In Texas, even a moderately-sized wildfire may involve from two to 10 fire departments, numerous pieces of county equipment, local law enforcement, emergency medical services, and resources from TAMFS, Texas Department of Public Safety, Texas Department of Transportation, Texas National Guard, TDEM, and multiple out-of-state cooperators. All of these responders need to be organized before the fire starts in order to maximize safety and effectiveness.

Statewide, a fire season can easily involve hundreds of pieces of equipment and thousands of firefighters. Good planning and preparedness allow for a more effective and faster response, thereby reducing both losses and suppression costs.

Although primarily focused on wildfire response, these functions must also support the agency's roles in the State Emergency Management Plan for all-hazard emergencies such as hurricanes, floods, tornados, and other domestic incidents.

In 1993, the 73rd Legislature passed HB 842, making TAMFS responsible for the "coordination of the response to each major wildfire or potentially major wildfire in the state" and directing TAMFS to establish a statewide fire coordination center.

In 1998, Texas Interagency Coordination Center (TICC) was established by TAMFS, the US Fish & Wildlife Service, USFS, the National Park Service, the Bureau of Indian Affairs, and the Nature Conservancy to serve as a single coordination and support center for wildland fire agencies in Texas.

The TAMFS Emergency Operations Center (EOC) was opened as a permanent, dedicated facility in March of 2005 to provide and maintain statewide situational awareness, strategic oversight, and management of TAMFS fire and emergency operations.

In 2007, the EOC and the state mobilization functions at TICC were combined into the Planning & Preparedness Department.

Planning & Preparedness is administered as a department within the Forest Resource Protection Division of the Texas A&M Forest Service.

In all cases, the mobilization of fire and emergency response resources must be authorized by the appropriate authority at the state or national level before proceeding. Mobilization agreements and authorities include:

- The State Emergency Management Plan
- USFS Cooperative Agreement
- USFS Annual Operation Agreement
- USFS Southwest/Southern Regions Memorandum of Understanding
- South-Central Forest Fire Compact
- Department of Interior Memorandum of Understanding
- Texas Parks and Wildlife Memorandum of Understanding

State and federal resources are ordered and tracked through the Resource Ordering and Status System (ROSS). More information on this system is available at http://ross.nwcg.gov/
Mobilization Guides and Procedures utilized include:

- National Interagency Mobilization Guide
- Southern Area Mobilization Guide
- Texas Fire Response Handbook
- Texas Intrastate Fire Mutual Aid System (TIFMAS) Mobilization Guide

More information on Texas Interagency Coordination Center is available online at:

http://ticc.tamu.edu/

Program Priority Areas

The Planning and Preparedness Department primarily works within the wildfire and emergency response community at the state and federal level. At the state and federal level, these programs provide situational awareness of resource availability, fire occurrence, and catastrophic events to responders and decision makers. This program area also maintains, mobilizes and demobilizes supplies, resources, and personnel across the state as needed to support emergency response operations.

At the regional, county, and local level, the department coordinates the mobilizations systems for TIFMAS with the Texas Fire Chiefs Association and the RIMT programs.

In all cases, the mobilization of fire and emergency response resources must be authorized by the appropriate authority at the state or national level before proceeding.

Texas Interagency Coordination Center (TICC)

TAMFS maintains a joint coordination center with the USFS and the Department of the Interior to coordinate the mobilization, demobilization, and tracking of state and federal wildfire resources and personnel. The center receives and maintains personnel qualifications and training records for Texas-based firefighters and resources in the national dispatch system, including TAMFS, TIFMAS and RIMT personnel. Additionally, TAMFS personnel also maintain the records system and ordering for supply and equipment caches located across the state.

Emergency Operations Center (EOC)
TAMFS maintains an emergency operations center at the agency headquarters in College Station to provide statewide situational awareness, strategic oversight, and management of all TAMFS emergency response activities. The EOC continually monitors fire risk, state, and local fire occurrence, and the availability and utilization of firefighting resources, equipment, and personnel across the state.

Aviation and UAS
Aircraft and UAS equipment are essential components in wildfire detection, assessment, and suppression. Aviation specialists and UAS use is developed, managed, and coordinated by the TAMFS Planning & Preparedness Department to ensure safe and effective operations. In addition to managing aircraft and support personnel staffing and use, the department maintains all tanker base facilities, equipment, and agreements.

Training
TAMFS also provides nationally certified wildfire and emergency management training to fire departments and agencies across the state. TAMFS provides local classes and regional academies to promote firefighter and fire department development and safety. Wildfire and emergency management training is coordinated under the Planning & Preparedness Department to coordinate with qualifications management, tracking and needs.

Goals, Objectives, and Strategies

- Analyze predictive services and fire occurrence data to determine local and statewide preparedness levels.
- Ensure prepositioning and availability of resources based on analysis.
- Maintain a flexible force structure based on risk and occurrence.
- Involve local, state, federal, and contract resources.
- Maintain readiness of resources.
- Provide intelligence to internal and external customers to promote safety and efficiency.
- Provide leadership in delivering wildland fire and incident management training.

Performance Measures

- Development and maintenance of agreements and ICS qualifications by TAMFS personnel and cooperating entities (TIFMAS and RIMT) for in-state and out-of-state deployment.

Applied Technology

Program Description

The rapid development and implementation of new technologies is critical to the success of TAMFS and has become one of the core functions the state of Texas and Texas A&M University System expect from the agency. Real-time data, custom applications and dashboards are now part of what TAMFS brings to emergency response and recovery. The increased complexity of TAMFS's in-house applications, such as WIRES, Collector, FireConnect and others also continues. The Applied Technology Department brings personnel and resources together—similar to the mission assignments during Hurricane Harvey—to focus on the rapid, effective and sustainable development, delivery and maintenance of technological tools, systems and applications.

In addition to new development, Applied Tech coordinates operation and improvement of existing databases, applications and electronic/tech equipment across the Division to insure cohesive and efficient development and operation

Program Priority Areas

The department provides technical support, project maintenance and new project development for Predictive Services, Incident Response, Planning & Preparedness as well as all FRP departments and programs. It assesses new technology and works with field personnel to evaluate potential use to the agency and guides successful implementation of new capabilities. The Applied Technology Department prepares TAMFS to best support state-requested emergency response and recovery efforts by TAMFS, AgriLife and other System components – such as the apps created for the A&M System (Rebuild Texas), AgriLife (Animal Supply Points) and TDEM (commodity tracking and distribution).

<u>Existing Applications, Systems and Databases</u>

In addition to new development, Applied Tech coordinates operation and improvement of existing databases, applications and electronic/tech equipment across the Division to insure cohesive and efficient development and operation. Existing system maintenance, development and updates for:

- WIRES
- Collector for ArcGIS
- TxWRAP
- SouthWRAP
- FireConnect
- GIS
- ReBuild Texas (with Texas A&M System)
- Disaster Animal Supply Points (with Texas A&M AgriLife Extension)
- Commodity Distribution Apps and Dashboards (with Texas Division of Emergency Management)

Development of New Technology

The rapid development and successful implementation of new technologies is critical in today's world. The development and maximization of real-time data, custom applications and dashboards are essential for safe and effective emergency response and recovery. Applied Technology serves as the front door and subject-matter-experts to assess, develop, and implement potential innovations in areas such as:

- UAS and UAV use
- Geo-tracking and Geo-fencing of response resources
- Maximization of field-deployed smartphone and tablets
- Real-time wildfire modeling
- Real-time wildfire and disaster information

Goals, Objectives, and Strategies

- Evaluate and guide the implementation of new technologies and applications useful to the agency and cooperators.
- Coordinate operation and improvement of database and electronic/tech equipment across the Division to insure cohesive and efficient development and operation.
- Work with TAMFS Information Resources and other TAMFS Divisions to coordinate FRP activity and ensure compliance with a System and State required practices.

Performance Measures

- Improve development and deployment of new technologies to substantially improve TAMFS operations, including TxWRAP, WIRES, Collector and development and use of UAVs.

Local Capacity Building

Program Description

Local fire departments are the primary initial response resources for wildfire suppression in Texas. TAMFS is committed to train, equip, and assist them in support of the TWPP.

The TAMFS Capacity Building programs were initiated to help increase fire protection capabilities at the local and community level across the state, with an emphasis on smaller or rural communities. Program funding and operation are intended to assist locally formed and operated fire departments with essential or key needs, thereby raising their capacity to respond and protect their communities.

Program eligibility is usually defined by state legislation or by federal program regulations. For the assistance programs initiated prior to 2001, eligibility is limited to volunteer fire departments (i.e., a department run by its members on a not-for-profit basis). This includes both volunteer and combination departments (volunteer departments with some paid personnel). The Rural Volunteer Fire Department Assistance Program and the Rural Fire Department Insurance Program are legislatively limited to volunteer or combination departments with 20 or fewer paid members. The Rural Volunteer Fire Department Insurance Program has the added stipulation that the department participate in a firefighter certification program under the Texas Commission on Fire Protection, the State Fireman's and Fire Marshals' Association of Texas or the National Wildfire Coordinating Group.

TAMFS does award some federal source funds under the Volunteer Fire Assistance program that carry the additional stipulation that the receiving department must be compliant with the National Incident Management System.

Equipment received through the Federal Excess Personal Property program may also be placed with county firefighter associations and fire training facilities, within certain restrictions.

Based on our most recent information, there are 1,871 fire departments in Texas. Almost all these fire departments (92%) have received some type of assistance from TAMFS.

Over the past three years, TAMFS Fire Department Assistance Programs have collectively provided an average of 3,723 assists to Texas fire departments each year. This includes an average of $21 million per year in grants and equipment provided.

Capacity Building is administered as a department within the Forest Resource Protection Division of TAMFS. The department is responsible for the delivery of the TAMFS fire department assistance programs.

Authority for program administration is usually placed with the TAMFS Director/State Forester by state legislation or federal program regulations. Oversight and administration of the programs are delegated to the Capacity Building Department Head, with designated staff responsible for day to day program delivery.

Federal agencies: VFA and FEPP are federal programs, delivered by Texas A&M Forest Service, under agreement with the USFS. These programs must operate in compliance with federal program guidelines and are subject to federal audit and review.

Local government: The TAMFS Capacity Building programs work with volunteer or smaller combination fire departments across the state.

More information on the TAMFS Capacity Building programs can be accessed at:

http://texasforestservice.tamu.edu/main/article.aspx?id=1536
http://ticc.tamu.edu/firedepartment.htm

Program Priority Areas

Rural Volunteer Fire Department Assistance Programs (RVFDAP)
Created by the 77th Texas Legislature (HB 2604) RVFDAP provides grants to volunteer fire departments for fire and rescue equipment, training tuitions, tankers, brush trucks, vehicle chassis', slip-on units, protective clothing, dry hydrants, and computers.

Volunteer Fire Assistance
Volunteer Fire Assistance is a federal-source program delivered through the TAMFS. Currently these funds are being utilized in conjunction with the Rural Volunteer Fire Department Assistance program to provide grants to fire departments for wildland protective clothing, structural protective clothing, and firefighter training.

Rural Volunteer Fire Department Insurance
The Rural VFD Insurance Program was also created by the 77th Texas Legislature (HB 3667) to provide grants for volunteer firefighters to obtain workers compensation and death and disability insurance.

Helping Hands
Created by the 75th Texas Legislature (HB 680) the Helping Hands Program provides liability relief to industry, business, cities and others to donate surplus fire and emergency equipment to TAMFS. Donated equipment can then be distributed by Texas A&M Forest Service to fire departments around the state.

Federal Excess Personal Property (FEPP) and Firefighter Protection Program (FFP)
FEPP and FFP are federal-source surplus equipment programs that allow TAMFS to acquire excess federal vehicles and equipment and assign the equipment to fire departments. Departments are responsible for the care and maintenance of all assigned property. Under FEPP, the federal government maintains title to all assigned equipment. Under the newer FFP program, title on military equipment is assigned to the receiving fire department.

Firesafe
The Firesafe Program helps to provide low-cost wildland and structural protective clothing to rural and small community fire departments. New gear is purchased in volume by the agency and then resold, with the savings being passed along to the fire department. Through this program, eligible fire departments can get quality protective clothing at savings of 30 to 40 percent.

Fire Quench

Through the Fire Quench program, fire departments can purchase low-cost Class A foam concentrate, a specialized surfactant that increases the effectiveness of water in extinguishing fires. Fire Quench is produced by Texas Correctional Industries.

Volunteer Fire Department Vehicle Liability Insurance (Riskpool)

The Riskpool program was created by the 74th Texas Legislature (SB 1232). Through the program, TAMFS provides low-cost vehicle liability insurance to volunteer fire departments at a greatly reduced cost.

Goals, Objectives, and Strategies

- Enhance local fire department capabilities through the development and delivery of assistance programs to eligible fire departments.
- Maximize the effectiveness of TAMFS capacity building programs through proper stewardship and minimal bureaucracy.

Performance Measures

Provide assistance, grants and equipment to Texas fire departments.

Incident Response

Program Description

Since its inception, one of the primary missions of TAMFS has been the suppression and extinguishing of forest fires. Beginning in 1915, the agency was instructed to "Take any action deemed necessary…to prevent and extinguish forest fires." In 1993, the mission was expanded to include "Coordination of the response to each major or potentially major wildland fire in the state…" The role of the Incident Response Department of Texas A&M Forest Service is to ensure the rapid and effective response of appropriate resources, as needed, to suppress and extinguish wildfires in Texas. Rapid initial response to wildland fires is essential to suppress wildfires during high fire danger conditions, limit losses, and provide for the safety of emergency responders and citizens. The task is to do so in a cost-effective and efficient manner.

Texas uses a tiered approach to wildfire response and suppression. Local fire departments and counties are the first responders, with state response being activated as fires or conditions exceed the local ability to control. TAMFS is the lead state agency for wildfire response in Texas. As the suppression resources of TAMFS and other state agencies are depleted, out-of-state resources are brought in, under state control, to meet essential needs. TAMFS works with local fire departments under a unified incident command system to coordinate the efforts of all cooperators and minimize losses. Safe, but aggressive initial attack is emphasized, based on forecasted fire behavior. Rapid response and the utilization of appropriate resources are also essential in preventing project fires – large, destructive fires–that burn for multiple days and tie up resources needed to respond to new fires that may occur. To ensure safe and effective operations requires a coordinated effort well before the fire starts, including programs such as common training and certification, common communications and command structure, full situational awareness, utilization of predictive services information, constant analysis of needs, risk, available resources and response times, and the utilization of a flexible force structure with appropriate kinds and types of resources.

In addition to the firefighting mandate, TAMFS is routinely called upon under the State Emergency Management Plan to assist during all-hazard emergencies such as hurricanes, floods, tornadoes, oil spills, and domestic situations that need to be managed by an incident command staff. The incident command system provides a means to coordinate and manage personnel, equipment, facilities, and communications to effectively accomplish emergency response operational requirements at incident sites.

TAMFS has designated roles in the State Emergency Management Plan under Annex F (Fire) and Annex N (Command and Control). The agency also has support roles in 9 other annexes. This includes lead or supporting roles for incidents ranging from wildfires, industrial/petrochemical fires, floods, hurricanes, tornados, bioterrorism, the Strategic National Stockpile, the Regional Strategic Stockpile, and foreign animal disease. The Incident Response Department works cooperatively with the other state agencies and cooperators involved under the state plan.

One recent innovation to the state's response has been the increased use of local resources. Over the last fifteen years, TAMFS and TDEM have been working to make statewide use of local fire and emergency management resources. Utilizing Texas emergency responders and equipment from unaffected areas of the state, TDEM and TAMFS are creating the capacity to meet essential emergency response needs while reducing the state's reliance on out-of-state resources. The Texas

Intrastate Fire Mutual Aid System (TIFMAS) and the Regional Incident Management Team (RIMT) programs are clear examples of Texans helping Texans.

In 2003, HB 2650 created the Public Safety Radio Communications Council to oversee the implementation of a statewide, integrated radio communications system for public safety and homeland security purposes. TAMFS was named as a council member. This program area works with fire departments, county governments, Texas agencies, and national cooperators to coordinate the response to each major or potentially major wildland fire in the state. This includes wildfire response activity on state and private lands.

Incident Response is administered as a Department within the Forest Resource Protection Division of TAMFS. Field operations are divided into geographical areas and managed by administrative regions. Training and communications are coordinated on a statewide basis. During wildfire and emergency response, operations personnel will work within assigned roles under the NIMS ICS structure.

The TAMFS Incident Response Department maintains a cooperative relationship with the federal wildland agencies (USFS, USF&WS). Efforts primarily include the sharing of equipment and personnel for wildfire suppression and emergency response. During state response operations, command and control of all resources are maintained by TAMFS under standard incident management protocols.

The Incident Response Department works cooperatively with local fire departments, counties, and emergency responders under a unified incident command system to coordinate the efforts of all cooperators and minimize losses from wildfires and other disasters.

Program Priority Areas

Cooperative Response and Resource Management

Wildfire suppression in Texas is a cooperative effort. TAMFS response personnel are expected to know, work with, and support the fire departments within their assigned regions. This should include knowledge of each fire department's capabilities, training, and equipment. Response staff should also serve as the local point of contact and information on TAMFS Capacity Building (and other) programs for both fire departments and TAMFS staff at the state program level. Incident response personnel are expected to know the vegetation, hazards, and risks within their regions, including critical conditions and special tactics or resources that may be required. These networks and knowledge are essential for TAMFS personnel to establish and lead response operations involving local, state, and national resources.

Incorporating Local Priorities into Wildfire Response on Private Lands

Wildland fire response operations must be based on a defined set of objectives and priorities to be effective. During both initial attack operations and extended project fires, a defined set of objectives and priorities should be used to guide all strategic and tactical decisions. Reflecting both jurisdictional responsibilities and land management goals, these objectives may vary considerably between different landowners and jurisdictional authorities.

To better identify and respond to local priorities and objectives (particularly during large fire operations) TAMFS is working with Texas A&M AgriLife Extension, Texas and Southwestern Cattle Raisers Association and Texas Sheep and Goat Raisers Association to ensure quick and meaningful communications are in place.

Radio Communications

Accurate and clear communication is an essential function during emergency response. This can be particularly problematic when utilizing a mix of response resources from multiple departments and agencies. Personnel within the TAMFS Incident Response Department maintain the radio systems, towers, and communications plans that are essential to response operations. Activities in this area include participation on the State Communications Coordination Group, the Texas State Interoperability Executive Committee, and the establishment of three statewide fire mutual aid frequencies for use by local, state, and national resources.

Texas Intrastate Fire Mutual Aid System (TIFMAS)

In cooperation with the Texas Fire Chief's Association, TAMFS has developed the capability to mobilize local (Texas) fire suppression resources to provide regional mutual aid during large-scale disasters. Under TIFMAS, local, in-state suppression resources are utilized to meet emergency response needs in other areas of the state.

Regional Type III Incident Management Teams (RIMTs)

TAMFS is also working with the TDEM to develop RIMTs as an added component to wildfire and all-hazard response. These teams are formed by personnel from local and municipal entities that are trained and mobilized by TAMFS to provide support as needed. The RIMT program was initiated in 2006 by Governor Rick Perry's Executive Order RP57 and is delivered by the TAMFS with program funding by TDEM.

These teams work under the direction of the TAMFS Lone Star State IMT to support impacted communities in managing security and continuity of government issues, assessment of critical infrastructure, and restoration of essential services following a catastrophic incident. There are 466 RIMT members statewide, representing all first responder disciplines.

Goals, Objectives, and Strategies

- Provide for the safety of emergency responders and citizens.
- Conduct response operations in an efficient and cost-effective manner.
- Coordinating the efforts of cooperators to minimize losses.
- Emphasize aggressive initial attack based on fire behavior to prevent project fires that burn for multiple days and occupy resources needed for initial attack.
- Support state and federal disaster operations by providing all-hazard incident management personnel and response teams.

Performance Measures

Decrease losses and increase lives and property saved through rapid and effective emergency response with appropriate resources.

Law Enforcement

Program Description

Since its inception in 1915, one of the primary missions of Texas A&M Forest Service has been to "enforce all laws pertaining to the protection of forests and woodlands and prosecute violations of those laws."

To accomplishment this, the Director "may appoint not to exceed 25 employees of the Texas A&M Forest Service who are certified by the Commission on Law Enforcement Officer Standards and Education as qualified to be peace officers to serve as peace officers under his direction in executing the enforcement duties of that agency." "Any officer commissioned under this section is vested with all the powers, privileges, and immunities of peace officers in the performance of his/her duties. The officer shall take the oath required of peace officers."

One of the primary rolls of TAMFS law enforcement is to provide wildfire arson investigation and training as requested by TAMFS personnel, local fire departments, the State Fire Marshal's Office, or other law enforcement agencies. TAMFS law enforcement officers work both misdemeanor and felony investigations. The Department also maintains an arson hotline to enable reporting of suspected wildland arson.

TAMFS law enforcement officers also work with timber theft cases both by direct investigation and by serving as subject matter experts for other state or local law enforcement units. The agency maintains a Timber Theft Hotline to enable public reporting of suspected of timber theft activity.

For most of the agency's history, law enforcement activities have centered on the investigation of wildfire causes and origins, for both misdemeanor (escaped fires) and felony (arson) cases. Prior to 1990, the agency had one full-time law enforcement officer/supervisor with the other commissioned personnel performing law enforcement duties as needed. With the sharp rise in timber prices in the early 1990s and the predominance of absentee landowners, timber theft became a significant issue for law enforcement in East Texas, forcing the agency to expand its services and support of local law enforcement in this area.

In 1995, with the passage of HB 1232, the agency initiated the VFD Motor Vehicle Self-Insurance program and incorporated agency law enforcement into field verification / investigation of accidents on vehicles insured under the program. In 1999, under HB 722, the State Legislature increased the number of allowable TAMFS law enforcement officers to 25.

As demand for these services has increased, the agency has slowly converted more of its officers to full-time law enforcement duties. Today, the agency has ten full-time law enforcement (LE) officers, with the others still serving as "additional duty LE officers."

Law Enforcement is administered as a Department within the Forest Resource Protection Division of TAMFS. Field operations are divided into geographical areas and managed by administrative regions. Agency law enforcement personnel include officers that perform law enforcement duties full-time and employees that serve multiple program areas, including law enforcement duties on an "as needed" basis.

Program Priority Areas

This program works with local, state, and federal law enforcement, prosecutors, and the public. Agency law enforcement officers provide direct investigation and services and serve as subject matter experts in the fields of wildland arson and timber theft. Assistance is provided as requested or as enforcement needs are identified.

Goals, Objectives, and Strategies

- Enforce laws relating to wildland fires, including wildfire cause determination and arson investigation.
- Enforce laws relating to timber theft.
- Support agency law enforcement needs, including security and investigation of activity on state forests and agency property.
- Missing property investigations for federal excess property assigned to fire departments.
- Accident investigation on vehicles insured through the VFD Vehicle Liability Insurance Program.

Performance Measures

Provide statewide leadership in the investigation, enforcement and prosecution of wildfire violations and timber theft.

- Misdemeanor fire offense investigations.
- Wildland arson investigations.
- Timber theft investigations.

MULTI-STATE PROJECTS, PROGRAMS & INITIATIVES

TAMFS is already involved in or plans to develop several multi-state projects or programs that are of regional priority. Below is a list and short description of some of these initiatives.

Southeastern Partnership for Forests and Water

TAMFS, USDAFS – Region 8, US Endowment for Forestry and Communities, and the South Carolina Rural Water Association established the Partnership in 2012 to promote the importance of healthy, well-managed forests to the Southeast's water supply. Since establishment, this regional initiative has supported the development of local partnerships in eight states (AL, AR, FL, GA, NC, SC, TX, VA). For more information on the Partnership, go to https://southeasternpartnership.org.

Southern Wildfire Risk Assessment Portal

TAMFS, in cooperation with SGSF, developed this web application to provide a consistent, comparable set of scientific results to be used as a foundation for wildfire mitigation and prevention planning in the South. Data is updated regularly, and enables states to prioritize where tactical analyses, community education, or mitigation treatments are necessary to reduce risk from wildfires. For more information, go to https://www.southernwildfirerisk.com/.

Longleaf Implementation Team

TAMFS, USFS National Forests and Grasslands in Texas, and thirteen other public, private, and non-profit conservation organizations have joined together to promote the restoration and enhancement of the Longleaf pine ecosystem in Texas as part of a range-wide initiative across the Southern United States. The *America's Longleaf Restoration Initiative's* purpose is to increase longleaf pine acreage from 3.4 to 8.0 million acres in the next 15 years. A Range-wide Conservation Plan and for Longleaf Pine serves to guide actions and strategies of the Initiative. For more information on the Texas Longleaf Implementation Team, go to https://txlongleaf.org

Southern Timber Supply

TAMFS recently developed an online application that provides estimates of timberland area, standing timber, growth, and removals within a user defined area in the Southern United States. This application uses Forest Inventory and Analysis data to produce maps and reports that can support economic development and forest conservation. For more information on this application, go to https://southerntimbersupply.com

Healthy Trees Healthy Lives

TAMFS, in cooperation with SGSF, is leading efforts to raise awareness of the critical positive impact that trees have on human health. This initiative is putting an ever growing body of research to work by connecting with non-traditional partners in the healthcare, education, and recreation sectors to bring about social change in the United States. For more information, go to: https://www.southernforests.org/urban/healthy-trees-healthy-lives

Southern Pine Beetle Prediction

TAMFS entomologists developed a reliable means to forecast outbreaks of the southern pine beetle (SPB) (*Dendroctonus frontalis*), the most destructive insect pest of commercial pine forests in the South. This prediction system involves deploying pheromone-baited survey traps in pine-forested areas for 4 weeks during March and/or April each year. Based on numbers of adult SPB and its major predator (clerid beetle, *Thanasimus dubius*) captured in the traps, the infestation trend and level is predicted for the remainder of the year. This system has been adopted by 16 states in the

South and Northeast extending from Texas to New Jersey where SPB is a major pest. Trap data from each state are submitted annually to the Texas A&M Forest Service and TAMFS entomologists compile the region-wide data to make predictions for all cooperators. Survey results and predictions are posted on the TAMFS webpage. The system, in use since 1986, has predicted SPB outbreaks or declines with nearly 80 percent accuracy, providing useful information for improved management of this important forest pest.

Southern Pine Beetle Portal

TAMFS entomologists are collaborating with entomologists from other southern states and the US Forest Service, Forest Health Technology Enterprise Team to develop and implement a standard method for reporting and mapping southern pine beetle (SPB) infestations and related resource losses. This Internet-based system relies on a few standard core values required by all state cooperators (infestation number, location, date of detection, acreage affected, timber volumes and values affected). In addition, each state will be able to record any other specific information needed to manage outbreaks of this destructive forest pest. Data submitted is used to generate up-to-date maps of existing outbreaks and record economic losses throughout the range of this pest in the South. This represents the first standardized reporting system for southern pine beetle shared by all state and federal agencies involved with SPB management.

Cogongrass Collaboration

Cogongrass (*Imperata cylindrica*) is an aggressive invader of natural and disturbed areas throughout the Southeast. It disrupts ecosystem functions, displaces native forest plants, and increases the severity of wildfires. Texas represents the western extension of this invasive weed and to date only two counties are known to harbor cogongrass infestations (Tyler and Brazos County). But the potential for spread within the state and increased economic impact are of major concern. Accordingly, The Texas A&M Forest Service is contributing to a multi-state effort to eradicate this noxious, invasive weed. Other partners in this campaign include state and federal agencies in Florida, South Carolina, Georgia, Alabama, Mississippi, Tennessee, and Louisiana. Detection and mapping of all known infestations followed by treatment with prescribed fire and herbicides to eventually eradicate this invasive plant from the South are the goals of this collaborative program.

Urban Forestry Trees for Energy

This project is a multi-state project to research and develop programs that will demonstrate the use of trees as an energy efficiency technology that can mitigate climate variability and conserve energy. Coalitions will be formed in each state and incentive programs developed that will be used to plant trees to shade residential structures. These coalitions will vary slightly in each state but will be made up of utility regulators, tree non-profits, municipal governments, foundations, neighborhood groups, nursery and landscaper professionals and citizens. The focus of these groups will be to create systems that can plant thousands of trees for energy efficiency for both investor owned and municipal utilities. Trees for Energy Efficiency and Savings will provide a national model that will demonstrate how S&PF programs can use trees to address critical national issues of energy conservation, climate variability, economic development, and job creation.

Western Gulf Forest Tree Improvement Program

TAMFS established this collaborative, public – private partnership in 1969 to coordinate and advance tree improvement efforts in the Western Gulf region of the Southeast. Members include state and private organizations in Arkansas, Louisiana, Mississippi, Oklahoma, and Texas. This program has realized a 1.0% gain in pine volume annually.

RESOURCE NEEDS: AGENCY AND ORGANIZATIONAL ROLES MATRIX, CORRELATION TO PROGRAM AND CORRELATION TO NATIONAL PRIORITIES

The following matrix indicates:

- A role of a program or organization to work cooperatively on implementing strategic activities given the Strategic Issue and state forestry agency program.
- How a given Strategic Goal and Program is meant to address a USFS S&PF National Priority.
- The relationship between Issues and S&PF Programs.

	S&PF Programs									Organizations										National Priorities		
Goals, Objectives, Strategies	Fire Management Program	Forest Health Program	Forest Legacy Program	Forest Stewardship Program	U & C Forestry Program	Outreach & Other S&PF	USFS Nat. Forest Systems	USFS Research & Other USFS	NRCS/FSA & Other USDA	Other Federal Agencies	Texas Parks & Wildlife	Other State Agencies	Land Trust, Wildlife & Conserve. Orgs.	Universities & Schools	TX Forestry Assoc. & CFLAs	Other Forestry Organizations	Municipalities & Cities	Fire Depts: VFD & Cities	**Protect**	**Conserve**	**Enhance**
Issues, Goals, Objectives & Strategic Actions																					
Issue 1: Wildfire and Public Safety																					
Goal 1	**Integrate climate, weather, and wildland forest fuel conditions into products that will enhance the ability of mangers to make sound decisions**																				
Objective 1.1: Determine current and predicted weather conditions throughout the year																					
Strategy 1.1.1: Weather station networks	■								■					■					■		
Objective 1.2: Monitor the condition of wildland fuels and vegetation																					
Strategy 1.2.1: Support fuels analysis	■								■					■					■		
Objective 1.3: Calculate current and predicted fire behavior to provide decision support documents to firefighters and fire managers																					
Strategy 1.3.1: Maintain people and data	■								■					■					■		
Objective 1.4: Identify and document urban/wildland interface areas and communities at risk																					
Strategy 1.4.1: Maintain GIS applications	■								■					■					■		
Objective 1.5: Track fire occurrence and ignition sources																					
Strategy 1.5.1: Online fire reporting	■								■					■					■		
Objective 1.6: Disseminate assessment information to cooperators, elected officials, and the public																					
Strategy 1.6.1: Web-based information	■								■					■					■		
Goal 2	**Maintain continuous wildfire mitigation and prevention programs that reduce fire occurrence, hazardous conditions, and the risk of loss from wildfires**																				
Objective 2.1: Assign a high priority to mitigation and prevention efforts throughout the year																					
Strategy 2.1.1: Fire prevention programs	■								■					■					■		
Objective 2.2: Assign a high priority to mitigation and prevention efforts throughout the year																					
Strategy 2.2.1: Predictive personnel	■						■		■	■	■			■			■	■	■		
Objective 2.3: Initiate prevention efforts to a developing fire season																					
Strategy 2.3.1: Monitor fire risk indices	■						■			■	■	■		■			■	■	■		
Objective 2.4: Involve cooperators in designing and delivering programs																					
Strategy 2.4.1: Integrate local involvement	■						■			■	■	■		■			■	■	■		
Objective 2.5: Strive to empower communities and property owners to mitigate hazards in wildland-urban interfaces																					
Strategy 2.5.1: Risk reduction in WUI	■						■			■	■	■		■			■	■	■		
Objective 2.6: Work with ranchers, state agencies, and other large landowners and cooperators to develop wildland fuel reduction programs																					
Strategy 2.6.1: Vegetation removal	■				■		■			■	■	■		■			■	■	■		
Goal 3	**Work collaboratively with other departments and agencies in planning, developing, implementing, supporting, and evaluating TAMFS emergency response capabilities and needs**																				
Objective 3.1: Analyze predictive services and fire occurrence data to determine local and statewide preparedness levels.																					
Strategy 3.1.1: Monitor wildfires	■									■	■	■		■			■	■	■		
Objective 3.2: Ensure prepositioning and availability of resources based on analysis																					
Strategy 3.2.1: Coordinate resources	■						■			■	■	■		■			■	■	■		

Goals, Objectives, Strategies	S&PF Programs: Fire Management Program	Forest Health Program	Forest Legacy Program	Forest Stewardship Program	U & C Forestry Program	Outreach & Other S&PF	Organizations: USFS Nat. Forest Systems	USFS Research & Other USFS	NRCS/FSA & Other USDA	Other Federal Agencies	Texas Parks & Wildlife	Other State Agencies	Land Trust, Wildlife & Conserve. Orgs.	Universities & Schools	TX Forestry Assoc. & CFLAs	Other Forestry Organizations	National Priorities: Municipalities & Cities	Fire Depts: VFD & Cities	Protect	Conserve	Enhance
Strategy 3.2.2: Coordinate strategic resources	■						■			■	■	■		■			■	■			
Objective 3.3: Maintain a flexible force structure based on risk and occurrence																					
Strategy 3.3.1: Monitor resources used	■						■			■	■	■		■			■	■			
Objective 3.4: Involve local, state, federal, and contract resources																					
Strategy 3.4.1: Maintain agreements	■						■			■	■	■		■			■	■			
Objective 3.5: Maintain readiness of qualified resources																					
Strategy 3.5.1: Maintain qualifications	■						■			■							■	■			
Strategy 3.5.2 Pre-position equipment	■						■			■							■	■			
Goal 4 **Provide leadership in the assessment, development, and successful field deployment of applications, systems, and technological tools to improve employee safety and programmatic delivery**																					
Objective 4.1: Evaluate and guide the implementation of new technologies and applications useful to the agency and cooperators																					
Strategy 4.1.1: Incorporate new technology	■							■		■		■					■	■			
Strategy 4.1.2: Deploy innovative tech to field	■							■		■		■					■	■			
Strategy 4.1.3: Support AgriLife Emergency Mgmt	■									■		■		■			■	■			
Objective 4.2: Coordinate operation and improvement of database and electronic/tech equipment across the Division to ensure cohesive and efficient development and operation																					
Strategy 4.2.1: Coordinate resources	■																				
Strategy 4.2.2: Ensure compliance	■											■		■							
Strategy 4.2.3: Cross-departmental technology	■																				
Goal 5 **Provide leadership, training, and equipment to strengthen emergency response capabilities of fire departments**																					
Objective 5.1: Assist in the development of local fire departments as the primary initial attack resource for rural Texas																					
Strategy 5.1.1: Knowledge for external assistance	■						■			■	■	■					■	■			
Strategy 5.1.2: Partner recognition	■						■			■	■	■					■	■			
Objective 5.2: Develop and deliver programs committed to training, equipping, and supporting local fire departments and other cooperators																					
Strategy 5.2.1: Fire department needs	■																■	■			
Strategy 5.2.3 Support local fire departments	■																■	■			
Objective 5.3: Focus TAMFS fire assistance programs in support of the TWPP																					
Strategy 5.3.1: Easy-to-use assistance programs	■																■	■			
Objective 5.4: Encourage partnerships between all federal, state, and local cooperators																					
Goal 6 **Ensure rapid and effective appropriate response to suppress wildfires**																					
Objective 6.1: Provide for the safety of emergency responders and citizens																					
Strategy 6.1.1: Agency training	■									■											
Strategy 6.1.2: Assign personnel	■											■					■	■			
Strategy 6.1.3: Know local conditions	■									■		■					■	■			
Objective 6.2: Conduct response operations in a cost-effective and efficient manner																					
Strategy 6.2.1: Monitor conditions	■									■		■					■	■			
Strategy 6.2.2: Financial section	■						■			■		■					■	■			
Objective 6.3: Conduct response operations in a cost-effective and efficient manner																					
Strategy 6.3.1: Response objectives	■						■			■		■					■	■			
Strategy 6.3.2: Operational staff access	■						■			■		■					■	■			
Objective 6.4: Emphasize aggressive initial attack based on fire behavior to prevent fires that burn for days																					
Strategy 6.4.1: Appropriate response	■						■			■		■					■	■			
Goal 7 **Ensure the enforcement of laws pertaining to the protection of forests and grasslands and pursue the prosecution of violators**																					
Objective 7.1: Enforce laws relating to wildland fires, including wildfire cause determination and pursue the prosecution of violators																					
Strategy 7.1.1: Assist with arson prosecution	■						■			■	■	■					■	■			
Strategy 7.1.2: provide fire cause determination	■						■			■	■	■					■	■			
Strategy 7.1.3: Provide fire cause deter. training	■						■			■	■	■					■	■			
Objective 7.2: Enforce laws relating to timber theft																					
Strategy 7.2.1: Assist w/ timber theft prosecution	■						■			■		■									

Goals, Objectives, Strategies	S&PF Programs: Fire Management Program	Forest Health Program	Forest Legacy Program	Forest Stewardship Program	U & C Forestry Program	Outreach & Other S&PF	Organizations: USFS Nat. Forest Systems	USFS Research & Other USFS	NRCS/FSA & Other USDA	Other Federal Agencies	Texas Parks & Wildlife	Other State Agencies	Land Trust, Wildlife & Conserve. Orgs.	Universities & Schools	TX Forestry Assoc. & CFLAs	Other Forestry Organizations	Municipalities & Cities	Fire Depts: VFD & Cities	National Priorities: Protect	Conserve	Enhance
Strategy 7.2.2: Timber theft training	■						■			■		■							■		
Objective 7.3: Support agency law enforcement needs																					
Strategy 7.3.1: Protection of TAMFS employees	■																		■		
Strategy 7.3.2: Security for agency programs	■																		■		
Issue 2: Sustainability of Forest Resources in East Texas																					
Goal 1 Assess and promote the sustainability of East Texas forests																					
Objective 1.1: Analyze the impact of management and regeneration scenarios on the sustainability of forests																					
Strategy 1.1.1: Assess mgmt on wood supply				■			■	■	■	■			■	■	■	■					■
Strategy 1.1.2: Knowledge in forestry practices				■		■	■	■	■	■	■	■	■	■	■	■					■
Objective 1.2: Support the development of healthy productive forests																					
Strategy 1.2.1: Adapted planting stock		■		■	■	■	■	■	■	■			■	■	■	■					■
Strategy 1.2.2: Silviculture for climate		■		■	■	■	■	■	■	■	■		■	■	■	■					■
Strategy 1.2.3: Invasive species		■		■	■	■	■	■	■	■	■	■	■	■	■	■					■
Objective 1.3: Identify and mitigate threats to the forest resources of East Texas with a focus on high-priority and threatened landscapes																					
Strategy 1.3.1: Trends in land use change			■	■	■	■		■		■		■	■	■	■	■					■
Strategy 1.3.2: Threats to forest health		■		■	■	■	■	■	■	■	■	■	■	■	■	■				■	■
Strategy 1.3.3: Landscape restoration		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■				■	■
Objective 1.4: Ensure the relevance of forest resource programs in East Texas																					
Strategy 1.4.1: Incorporate user needs		■		■	■	■				■			■	■					■	■	■
Strategy 1.4.2: Needs of clientele		■		■	■	■				■			■	■					■	■	■
Strategy 1.4.3: Effective financial incentives		■	■	■	■	■			■	■				■	■				■	■	■
Goal 2 Maintain working forests by improving markets for sustainable forest products																					
Objective 2.1: Determine the impacts of additional and closures of wood-processing facilities on timber supply																					
Strategy 2.1.1: Timber supply projections				■			■	■		■				■	■	■				■	■
Strategy 2.1.2: Impacts of natural disasters		■					■	■		■	■			■	■	■				■	■
Objective 2.2: Quantify the impact of proposed biomass utilizing facilities on timber supply																					
Strategy 2.2.1: Biomass supply projections				■			■	■		■	■	■		■	■	■				■	■
Strategy 2.2.2: Identify sources of biomass			■	■			■	■		■	■	■	■	■	■	■				■	■
Goal 3 Identify forest economic development opportunities																					
Objective 3.1: Identify additional forest resource surpluses and deficits																					
Strategy 3.1.1: Assess needs and opportunities								■		■	■	■		■	■	■				■	■
Objective 3.2: Promote the development of ecosystem services markets for forest owners																					
Strategy 3.2.1: Valuation of Ecosystem Services			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		■	■
Strategy 3.2.2: Ecosys. values damage assess				■	■		■	■	■	■	■	■	■	■	■	■	■	■		■	■
Strategy 3.2.3: Projected Ecosys. values			■	■	■		■	■	■	■	■	■	■	■	■	■	■	■		■	■
Issue 3: Central Texas Woodlands Conservation																					
Goal 1 Improve the health of forests and woodlands in Central and West Texas																					
Objective 1.1: Identify and mitigate threats to the forest and woodland resources of Central and West Texas with a focus on high-priority and threatened landscapes																					
Strategy 1.1.1: Trends in land use change	■	■		■	■	■		■	■	■			■	■					■	■	■
Strategy 1.1.2: Threats to forest health	■	■		■	■	■		■	■	■			■	■			■		■	■	■
Strategy 1.1.3: Landscape restoration	■	■		■		■		■	■	■			■	■					■	■	■
Strategy 1.1.4: Landowner educationl	■	■		■	■	■		■	■	■			■	■			■		■	■	■
Objective 1.2: Ensure the relevance of forest and woodland resource programs to Central and West Texas																					
Strategy 1.2.1: Incorporate user needs	■	■		■	■	■		■		■				■			■		■	■	■
Strategy 1.2.2: Education and assistance	■	■		■	■	■		■		■				■			■		■	■	■
Strategy 1.2.3: Financial incentives programs	■	■		■	■	■				■				■						■	■
Goal 2 Assess and promote the conservation of forests and woodlands in Central and West Texas																					

Goals, Objectives, Strategies	S&PF Programs: Fire Management Program	Forest Health Program	Forest Legacy Program	Forest Stewardship Program	U & C Forestry Program	Outreach & Other S&PF	Organizations: USFS Nat. Forest Systems	USFS Research & Other USFS	NRCS/FSA & Other USDA	Other Federal Agencies	Texas Parks & Wildlife	Other State Agencies	Land Trust, Wildlife & Conserve. Orgs.	Universities & Schools	TX Forestry Assoc. & CFLAs	Other Forestry Organizations	Municipalities & Cities	Fire Depts: VFD & Cities	National Priorities: Protect	Conserve	Enhance
Objective 2.1: Analyze the impact of population growth, development, and land fragmentation scenarios on the sustainability of forests and woodlands																					
Strategy 2.1.1: Communicate impacts	■	■		■	■	■		■		■	■		■	■			■			■	■
Strategy 2.1.2: Maintain knowledge	■	■		■	■	■		■		■	■		■	■			■			■	■
Objective 2.2: Support the sustainability of healthy, productive forests and woodlands																					
Strategy 2.2.1: Promote resistant planting stock	■	■		■	■	■		■		■		■	■	■			■	■		■	■
Strategy 2.2.2: Investigate options	■	■		■	■	■		■		■		■	■	■			■	■		■	■
Strategy 2.2.3: Develop practical approaches	■	■		■	■	■		■		■		■	■	■			■	■		■	■
Strategy 2.2.4: Promote programs for water	■	■		■	■	■		■		■		■	■	■			■	■		■	■
Strategy 2.2.5: Assess impact of natural disasters	■	■		■	■			■		■		■		■			■	■	■	■	■
Goal 3 Promote and maintain working forests by improving markets for sustainable forest products and services																					
Objective 3.1: Identify forest and woodland economic development opportunities																					
Strategy 3.1.1: Assess needs and opportunities	■	■		■				■		■	■	■		■				■		■	■
Strategy 3.1.2: Develop wood supply projections	■	■		■				■		■	■	■		■				■		■	■
Strategy 3.1.3: Survey mills for estimated output	■	■		■				■		■	■	■		■				■		■	■
Objective 3.2: Promote the development of ecosystem services markets for forest owners																					
Strategy 3.2.1: Valuation of Ecosystem Services	■	■		■	■	■		■		■	■	■	■	■			■	■		■	■
Strategy 3.2.2: Ecosys. values damage assess	■	■		■	■	■		■		■	■	■	■	■			■	■		■	■
Strategy 3.2.3: Projected Ecosys. values	■	■		■	■	■		■		■	■	■	■	■			■	■		■	■
Issue 4: Urban Forest Sustainability																					
Goal 1 Integrate Urban and Community Forestry into all scales of planning																					
Objective 1.1: Engage with Government and non-governmental organizations (NGOs)																					
Strategy 1.1.1: Open space planning efforts					■							■									■
Strategy 1.1.2: Educate local stakeholders					■																■
Objective 1.2: Encourage best practices for protecting high-value forest landscapes in and around urban areas																					
Strategy 1.2.1: Support green infrastructure					■								■							■	■
Strategy 1.2.2: Support land conservation groups					■								■							■	
Goal 2 Promote the role of Urban and Community Forestry in human health and wellness																					
Objective 2.1: Support community forest management for public health benefits																					
Strategy 2.1.1: Tree placement for human health					■									■							■
Strategy 2.1.2: Develop partnerships					■																■
Objective 2.2: Support tree planting as an energy-saving practice																					
Strategy 2.2.1: Strengthen partnerships					■																■
Strategy 2.2.2: Vegetation for urban heat islands					■															■	■
Objective 2.3: Support local, regional, and statewide water quality and air quality programs and initiatives																					
Strategy 2.3.1: Urban stream restoration					■							■	■							■	■
Strategy 2.3.2: Trees and water resources					■															■	■
Strategy 2.3.3: Vegetation to improve air quality					■															■	■
Goal 3 Cultivate diversity, equity, and leadership within the Urban Forestry Council																					
Objective 3.1: Develop the next generation of community forestry stakeholders																					
Strategy 3.1.1: Outreach to underserved					■																■
Strategy 3.1.2: Forestry as viable career option					■									■							■
Objective 3.2: Support statewide, regional, and local tree advocacy and trade groups																					
Strategy 3.2.1: Support tree boards, etc.					■																■
Strategy 3.2.2: Encourage ISA credentials					■																■
Goal 4 Strengthen urban and community forest health and biodiversity for long-term resilience																					
Objective 4.1: Improve disaster preparedness and response following major event affecting trees in a community setting																					
Strategy 4.1.1: Assist communities in plan writing					■																■
Strategy 4.1.2: Strike Teams and PIOs					■															■	■
Objective 4.2: Monitor the impact of land-use change on urban forests in Texas																					
Strategy 4.2.1: Identify changing communities					■								■	■						■	■

Goals, Objectives, Strategies	S&PF Programs: Fire Management Program	Forest Health Program	Forest Legacy Program	Forest Stewardship Program	U & C Forestry Program	Outreach & Other S&PF	USFS Nat. Forest Systems	USFS Research & Other USFS	NRCS/FSA & Other USDA	Other Federal Agencies	Texas Parks & Wildlife	Other State Agencies	Land Trust, Wildlife & Conserve. Orgs.	Organizations: Universities & Schools	TX Forestry Assoc. & CFLAs	Other Forestry Organizations	Municipalities & Cities	Fire Depts: VFD & Cities	National Priorities: Protect	Conserve	Enhance
Strategy 4.2.2: Urban tree assessment program					■																■
Goal 5 Improve urban and community forest management, maintenance, and stewardship																					
Objective 5.1: Establish and increase the skills of municipal tree care managers through effective tree care and protection practices																					
Strategy 5.1.1: Support ISA certification					■																■
Strategy 5.1.2: Training for tree managers					■																■
Objective 5.2: Support scientific inventory systems that provide resource data and management plans for local tree care managers																					
Strategy 5.2.1: Support tree assessments					■															■	■
Strategy 5.2.2: Promote canopy studies					■									■						■	■
Goal 6 Diversify, leverage, and increase funding for Urban and Community Forestry																					
Objective 6.1: Educate and engage leaders and citizens in urban forestry projects and issues																					
Strategy 6.1.1: Support educational programs					■																■
Strategy 6.1.2: Inform local elected officials					■														■	■	■
Objective 6.2: Strengthen existing partnerships and develop new relationships																					
Strategy 6.2.1: Partnerships with tangential groups					■																■
Strategy 6.2.2: Cultivate corporate partners					■															■	■
Goal 7 Increase public awareness and environmental education to promote stewardship																					
Objective 7.1: Promote community forestry literacy in Texas and support significant tree programs																					
Strategy 7.1.1: Support Arbor Day					■																■
Strategy 7.1.2: Big Trees and Famous Trees					■																■
Objective 7.2: Embrace new technologies to create self-directed learning opportunities for citizens, teachers, and teachers																					
Strategy 7.2.1: Mobile tree ID and planting apps					■																■
Strategy 7.2.2: Expand use of social media					■																■
Issue 5 Water Resources																					
Goal 1 Promote the role of trees and forests in maintaining watershed function																					
Objective 1.1: Integrate trees, forests, and woodlands in watershed planning																					
Strategy 1.1.1: Establish partnerships	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		■	■	■
Strategy 1.1.2: Forest watersheds value	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		■	■	■
Strategy 1.1.3: Watershed planning	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		■	■	■
Objective 1.2: Work with communities to improve water resources in urban environments																					
Strategy 1.2.1: Green infrastructure			■	■	■	■	■	■	■	■	■	■	■				■		■	■	■
Strategy 1.2.2: Drainage				■	■	■		■	■	■		■					■		■	■	■
Strategy 1.2.3: Stream restoration			■	■	■	■	■	■	■	■	■	■	■		■		■		■	■	■
Objective 1.3: Restore and enhance degraded and fragmented forests and woodlands																					
Strategy 1.2.1: Riparian forests			■	■	■				■				■				■		■	■	■
Strategy 1.2.2: Ecosystem service markets			■	■	■		■			■	■	■	■				■		■	■	■
Strategy 1.2.3: Facilitate restoration			■	■	■		■						■				■		■	■	■
Goal 2 Enhance water quality through Best Management Practices																					
Objective 2.1: Develop Best Management Practices (BMPs) for land management operations																					
Strategy 2.1.1: Develop and promote BMPs				■																■	
Strategy 2.1.2: Watershed research								■		■				■					■	■	■
Strategy 2.1.3: Monitor BMPs			■	■			■		■						■	■			■	■	■
Strategy 2.1.4: Review BMPs periodically				■																■	
Objective 2.2: Promote continual improvement of BMP implementation																					
Strategy 2.2.1: Expand educational efforts				■												■				■	
Strategy 2.2.2: Target outreach				■												■				■	
Goal 3 Protect drinking water supply in priority watersheds																					
Objective 3.1: Advance source water protection in priority drinking water supply watersheds																					
Strategy 3.1.1: Lead Texas Partnership			■	■															■	■	■
Strategy 3.1.2: Target priority watersheds		■	■	■		■	■		■	■			■		■	■	■		■	■	■
Strategy 3.1.3: Land stewardship			■	■			■		■		■		■		■				■	■	■

	S&PF Programs								Organizations											National Priorities		
Goals, Objectives, Strategies	Fire Management Program	Forest Health Program	Forest Legacy Program	Forest Stewardship Program	U & C Forestry Program	Outreach & Other S&PF	USFS Nat. Forest Systems	USFS Research & Other USFS	NRCS/FSA & Other USDA	Other Federal Agencies	Texas Parks & Wildlife	Other State Agencies	Land Trust, Wildlife & Conserve. Orgs.	Universities & Schools	TX Forestry Assoc. & CFLAs	Other Forestry Organizations	Municipalities & Cities	Fire Depts: VFD & Cities	**Protect**	**Conserve**	**Enhance**
TAMFS Programs																					
East Texas Program Delivery	■	■	■	■	■	■			■	■	■	■	■		■	■	■	■	■	■	■
West TX Program Delivery and West TX Nursery	■	■		■	■	■			■	■	■	■	■				■	■	■	■	■
Tree Improvement Program and WGFTIC		■				■		■		■			■			■				■	
Forest Inventory and Analysis				■		■	■	■	■						■	■				■	
Ecosystem Services		■	■	■		■		■	■	■	■	■	■	■	■	■	■			■	■
Water Resources		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		■	■	■
Forest Taxation				■		■	■		■		■		■	■						■	■
Forest Economics and Analysis						■		■	■	■		■		■	■	■			■	■	■
Urban and Community Forestry		■			■	■				■	■	■	■			■	■		■	■	■
Forest Health		■		■	■	■	■	■		■	■	■		■	■	■	■		■	■	
Rural Forestry Assistance and Forest Stewardship	■	■	■	■		■	■		■	■	■	■	■		■	■			■	■	■
Forest Legacy			■	■			■		■		■		■						■	■	
Conservation Education and Outreach	■	■	■	■	■	■	■		■	■	■	■	■	■	■	■	■		■	■	■
State Lands Management	■	■				■					■	■							■	■	■
Predictive Services	■					■	■	■	■	■		■						■	■		
Mitigation and Prevention	■	■		■	■	■	■	■	■	■		■							■		
Planning and Preparedness	■				■		■	■	■	■		■						■	■		
Applied Technology	■						■	■		■		■		■			■	■	■		
Local Capacity Building	■						■			■		■					■	■	■		
Incident Response	■						■			■	■						■	■	■		
Law Enforcement				■		■						■			■				■		

APPENDICES

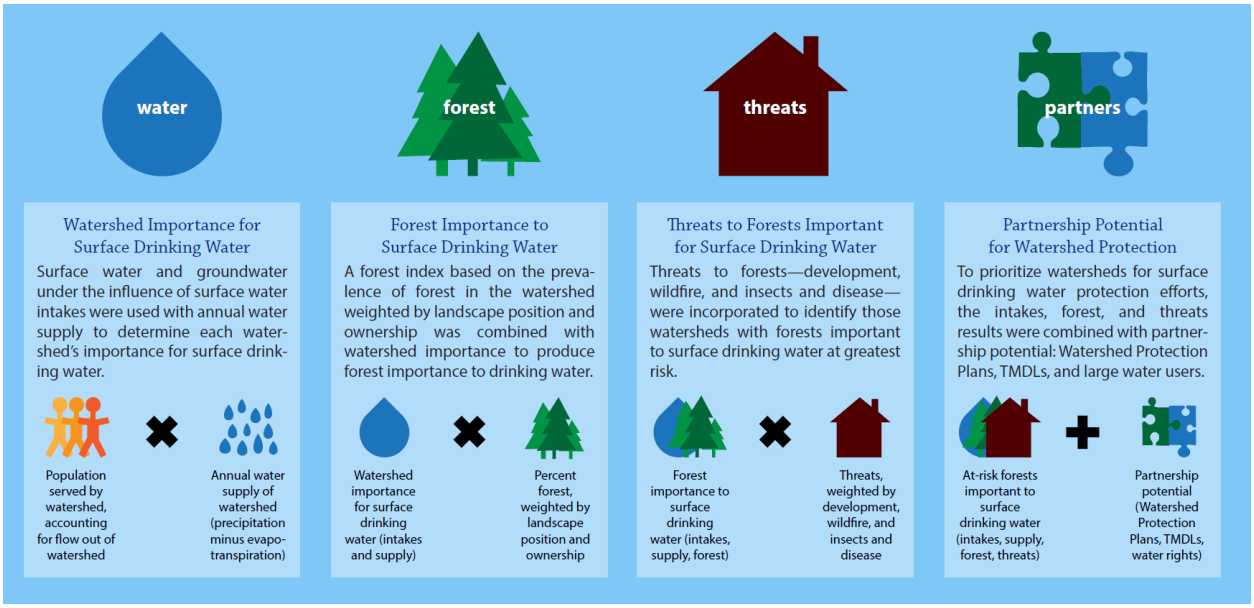
APPENDIX A — DATA LAYERS USED FOR GEOSPATIAL ANALYSIS

Layer	FSP	Fire	ETX	CTX	Urban	Water	Total	Page
Forest to Faucet							5	A-201
Development Threat							4	A-205
Wildfire Threat							4	A-207
Riparian Area							4	A-210
Forest							3	A-211
Forest Patches							3	A-213
Forest Health Threat							3	A-214
T&E Species							3	A-215
Protected Areas							3	A-216
Forested Wetlands							3	A-217
Site Productivity							2	A-218
Non-TIMO Land							1	A-219
Imperviousness							1	A-220
Tree Canopy							1	A-221
Total Place Population							1	A-222
Population Density							1	A-223
Ozone Non-Attainment Area							1	A-224
Impaired Watersheds							1	A-225
No Professional Staff							1	A-226
No Management Plan							1	A-227
No Tree Ordinance							1	A-228
No Advocacy Group							1	A-229
Place Growth Zone							1	A-230
Total	11	1	12	10	13	1		

Forest to Faucets

A Forest-to-Faucets layer (Figure A-1) was used in Forest Action Plan analyses where Public Drinking Water and Priority Watersheds were used in the 2010 analyses.

To prioritize Texas watersheds by forest importance to surface drinking water for source water protection, four main factors were considered: (1) watershed importance for surface drinking water, (2) forest importance to surface drinking water, (3) threats to forests, and (4) potential for partnership. The methods used are adapted from the US Forest Service's Forest to Faucet study. Please refer to the Forest to Faucet methods paper, "From the Forest to the Faucet: Drinking Water and Forests in the US," by Emily Weidner and Al Todd (2011) for background and technical details. The analysis was performed at the 12-digit HUC level.



1. Watershed Importance for Surface Drinking Water

The spatial and hydrological relationship between each watershed and surface water intake, the population served by each intake, and the annual available water supply were analyzed to produce an index of watershed importance to surface drinking water.

Drinking Water Protection Model (PR)

The number of people served by each surface water (SW) and groundwater under the influence of surface water (GUI) intake was determined using information from the TCEQ online Water Utility Database. For Public Water Systems with both SW and GUI intakes, it was assumed that the SW intakes served 75% of the population while any GUI intakes served the remaining 25% (collectively). Population was divided equally among intakes of the same type. Additionally, it was assumed that intakes with an operational status of operating are online 100% of the time, those with demand status are online 35% of the time, and emergency intakes are online 5% of the time. When overlapping in online time, equal distribution was assumed between the intakes. If the PWS had both a demand and an emergency intake, it was assumed that the 5% online time of the emergency intake was concurrent with the online time of the demand intake. A given watershed serves the population that uses the intakes within the watershed, but it also serves people using intakes located downstream in other watersheds. Or, from the perspective of the intake, an intake

is influenced not only by its own watershed but also by the watersheds upstream from it. To account for this, the population served by a watershed was calculated as the sum of the watershed's intake population plus a portion of the population of intakes downstream as a function of distance. Full details of the method employed are given by Weidner and Todd (2011). The result is an index of surface drinking water protection (PR) based on population and hydrologic flow.

Index of Importance to Surface Drinking Water (IMP)

To gain a measure of the importance of each watershed to surface drinking water, the drinking water protection model (PR) is combined with annual water supply (Q). The result is an index that highlights areas important to supply, demand, and linking supply and demand. Water supply data was obtained from Brown et al (2008). The index is obtained simply by multiplying PR and Q for each watershed and dividing the nonzero results into 100 quantiles.

$$IMP = PR \times Q$$

2. Forest Importance to Surface Drinking Water

A forest index, taking into account landscape position and ownership, was combined with the outcome of the first step to create an index of forest importance to surface drinking water by watershed.

Forest Index (FOR)

The forest map used is based on the FIA forestland map produced by Wilson et al (2012), as described in "Texas Statewide Assessment of Forest Ecosystem Services" (2013).

Weighting of forest by landscape position

The percent of each watershed covered by wetland (w), riparian (r), and upland (u) forest was calculated. These values were then weighted according to likelihood of landowner engagement in protection strategies. The results were scaled such that the maximum value would be 100.

$$FOR_{LP} = ((0.55 \times u + 0.25 \times w + 0.20 \times r) / \text{max value}) \times 100$$

Weighting of forest by ownership

The percent of each watershed covered by forest with a public owner was calculated, and watershed scores were assigned as follows.

Percent Public Forest	0%	0-10%	10-25%	25-50%	>50%
FOR_{own}	0	25	50	75	100

Weighting of FOR_{LP} and FOR_{own}

The forest landscape position and ownership indices were combined using the following formula to develop an overall forest index, giving most of the weight to landscape position.

$$FOR = 0.9 \times FOR_{LP} + 0.1 \times FOR_{own}$$

Forest Importance (FIMP)

The forest index was then combined with the importance to surface drinking water index to produce an index of forest importance to surface drinking water.

$$FIMP = IMP \times FOR / 100$$

3. Threats to Forests Important to Surface Drinking Water

Threats to forests—development, wildfire, and insects and disease—were incorporated to identify at-risk watersheds. The threat maps in "Texas Statewide Assessment of Forest Resources" (2009) were utilized for this purpose.

Threats (THR)

Development

The threat of development (dTHR) was calculated as the percent of forest in the watershed with a development level score of 70 or higher in the state assessment.

Wildfire

The threat of wildfire (wTHR) was calculated as the percent of forest in the watershed with a wildfire risk score of 70 or higher in the state assessment.

Insects/Disease

The threat of insects and disease (iTHR) was calculated as the percent of forest in the watershed with a forest health score of 70 or higher in the state assessment.

Weighting Threats

The three threats were weighted to give an overall threat index as follows,
with development receiving the bulk of the weight, followed by wildfire and then insects and disease.

$$THR = 0.75 \times dTHR + 0.15 \times wTHR + 0.10 \times iTHR$$

Threats and Forest Importance to Surface Drinking Water (TFIMP)

Combining the threats with the index of forest importance yields an index showing watersheds that are important for surface drinking water, have significant forestland, and have forestland at risk. The nonzero results were split into 10 quantiles.

$$TFIMP = FIMP \times THR + 0.15 \times wTHR + 0.10 \times iTHR$$

4. Partnership Potential for Watershed Protection

Potential partners were identified based on existing watershed protection plans, TMDLs, and water rights.

Partnership Potential (PP)

Watershed Protection Plans (WPP)

Watersheds were given 0 points if they did not have a Watershed Protection Plan, 5 if they had one sponsored by a 3rd party, and 10 if they had one sponsored by a state agency.

Total Maximum Daily Loads (TMDL)

TMDL watersheds were identified by TCEQ and were given 10 points; other watersheds received 0 points.

Water Rights (WR)

Large corporate water users were identified from TCEQ permitted water rights holder information. Each watershed was given 0 points if there were no large water users in the encompassing 8-digit HUC watershed, 5 if there was 1, and 10 if there were 2 or more.

Watershed Priority

Partnership potential was combined with the threats and forest importance to surface drinking water index to produce an overall prioritization for targeting drinking water source protection efforts.

$$\text{Priority} = 0.75 \times \text{TFIMP} + 0.20 \times (\text{WPP} + \text{TMDL}) + 0.05 \times \text{WR}$$

Sources

Brown, T.C., M.T. Hobbins, and J.A. Ramirez. 2008. "Spatial Distribution of Water Supply in the Coterminous United States." Journal of the American Water Resources Association 44 (6): 1474–87.

Simpson, H., E. Taylor, Y. Li, and B. Barber. 2013. "Texas Statewide Assessment of Forest Ecosystem Services." Texas A&M Forest Service.

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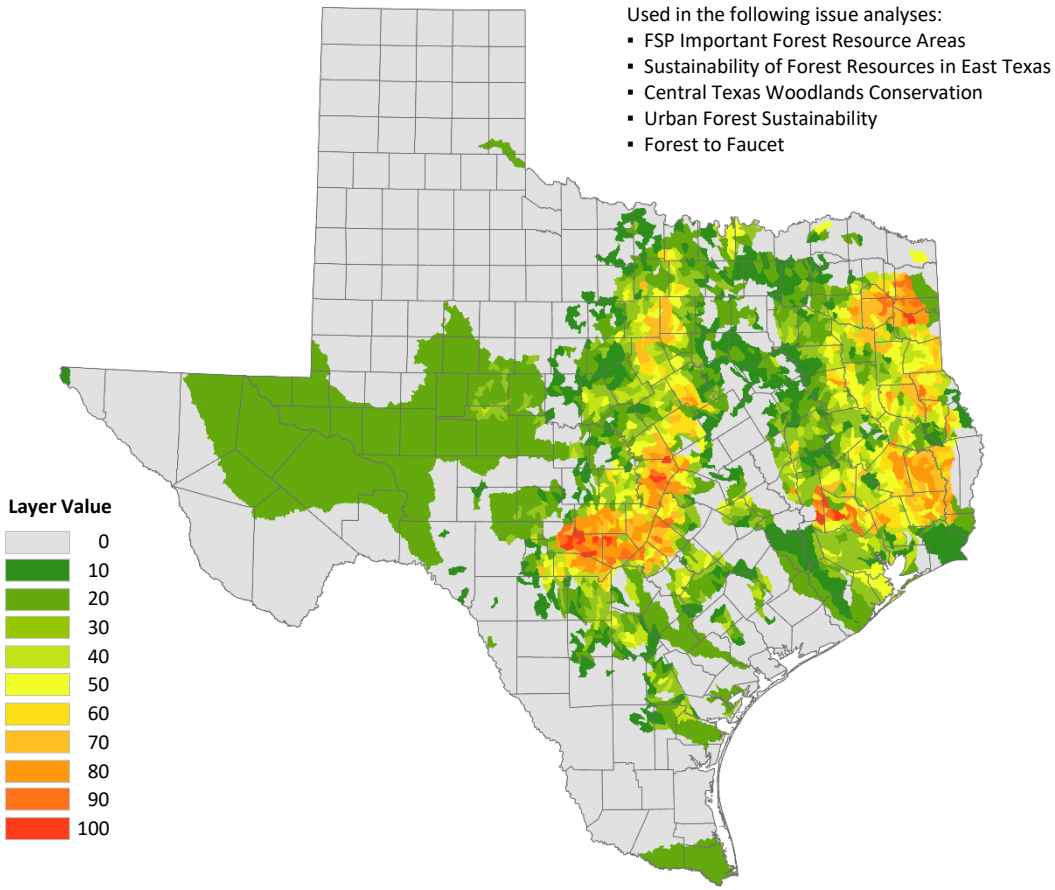
Weidner, E., and A. Todd. 2011. "From the Forest to the Faucet." USDA Forest Service.

Wilson, B.T., A.J. Lister, and R.I. Riemann. 2012. "A Nearest-Neighbor Imputation Approach to Mapping Tree Species over Large Areas Using Forest Inventory Plots and Moderate Resolution Raster Data." Forest Ecology and Management 271 (0): 182–98.

Figure A-1
Forest to Faucet



Development Threat

The Development Threat layer used in the analyses in the Forest Action Plan was that produced for the update of the Southern Forest Land Assessment. In the SFLA, this layer was based on projected change in housing density from 2000 to 2030. The original layer used David Theobalds's layer produced from his SERGoM model. His model projected the housing density into 15 classes. This model was used in the Integrated Climate and Land-Use (ICLUS) version 1 model.

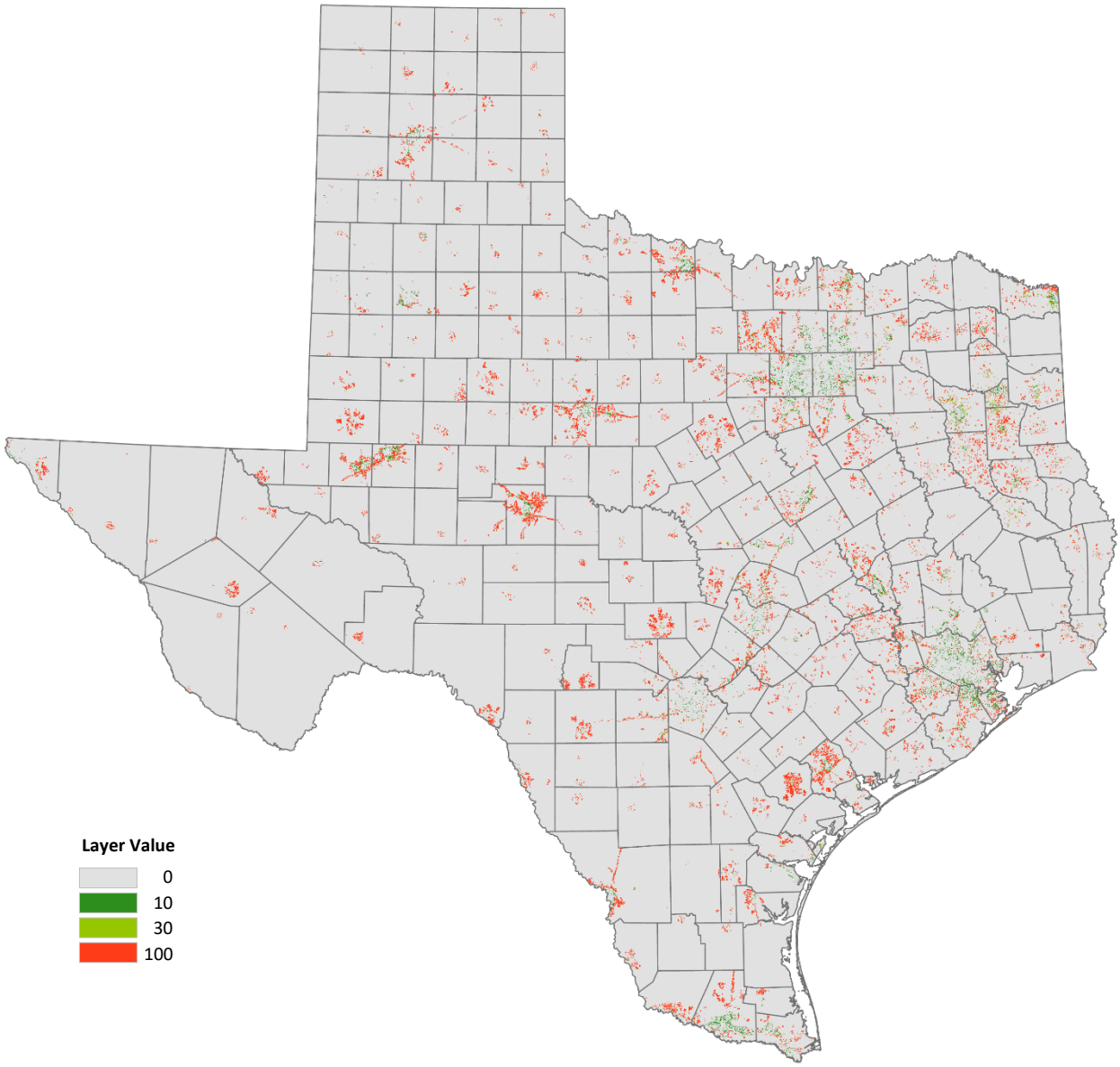
The layer developed for the updated SFLA and used here was derived from a more recent version of the ICLUS model. ICLUS version 2 is designed to be consistent with a more recent Intergovernmental Panel on Climate Change (IPCC) scenarios framework, drawing from two Share Socioeconomic Pathways (SSPs) and two Representative Concentration Pathways (RCPs). ICLUS v2 uses a deterministic demand-allocation approach, similar to the Theobald's SerGoM, which assumes many aspects of future growth will resemble the recent past (i.e., 2000 to 2010), though over time, land use changes would result in different overall patterns. Different from ICLUS v1, v2 sequentially allocates patches from 7 of the 19 discrete land use classes (LUC) used in ICLUS v2: five levels of residential, plus commercial and industrial. Improvements include the uses of updated input data, integration of changing climate variable within the migration model, inclusion of transportation network capacity and increase over time, growth in commercial and industrial land uses, and the use of population density-driven demands for residential housing, as well as commercial and industrial development. However, ICLUS v2 does not model housing density explicitly, and instead projects change to seven "developed" land use types. The land use categories are based on Theobald's National Land Use dataset and each are grounded in ranges of housing density values. Transitions from rural to the five levels of residential and the less dense residential categories to more dense residential categories are then used to define the layer value scheme shown in Table A-1. SSP projections should be used as a conservative estimate of population growth.

Table A-1
Housing Density Classes and layer value scheme for Development Threat

	Land Use 2040		Exurban, low density	Exurban, high density	Suburban	Suburban	Urban, high density
	Class		Exurban	Exurban	Suburban	Urban	Urban
	Code		**10**	**11**	**12**	**13**	**14**
Land Use 2010	**Class**	**Code**	100	100	100	100	100
Wetlands	Rural	**2**	100	100	100	100	100
Timber	Rural	**4**	100	100	100	100	100
Grazing	Rural	**5**	100	100	100	100	100
Pasture	Rural	**6**	100	100	100	100	100
Cropland	Rural	**7**	100	100	100	100	100
Exurban, low density	Exurban	**10**	0	30	30	30	30
Exurban, high density	Exurban	**11**		0	10	10	10
Suburban	Suburban	**12**			0	0	0
Urban, low density	Urban	**13**				0	0
Urban, high density	Urban	**14**					0

The layer as used in the Forest Action Plan analyses is shown in Figure A-2.

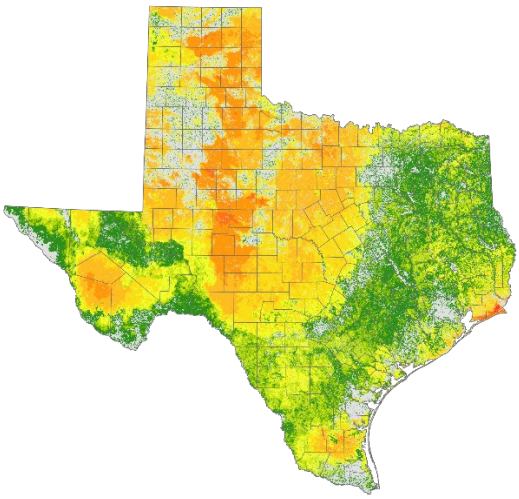
Figure A-2
Development Threat



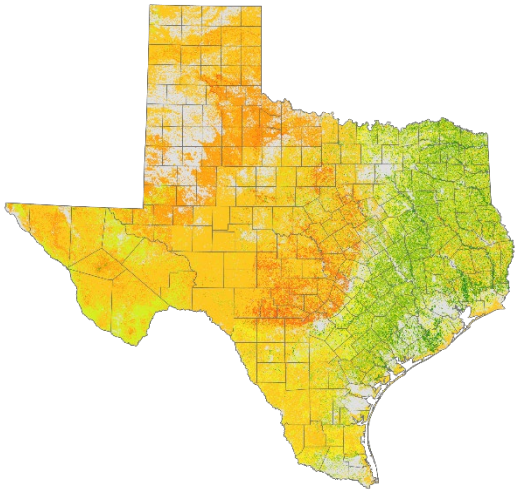
Wildfire Threat

This layer replaces the previous layer used in SFLA and the Forest Action Plan, Wildfire Risk (WR). Wildfire Risk was actually the Level of Concern layer developed as part of the Southern Wildfire Risk Assessment. This layer is no longer used. The layer provided by North Carolina for the update of the SFLA layers was actually simply this old layer that was based on even older data. Instead of using this old layer for the Wildfire Risk layer for the Forest Action Wildfire issue and as a component layer of the Forest Stewardship geospatial analysis, new layer was developed. With consultation among several TAMFS geospatial wildfire experts, a new layer was developed. The group also decided that Wildfire Risk was not an appropriate name for this layer and so Wildfire Threat was selected.

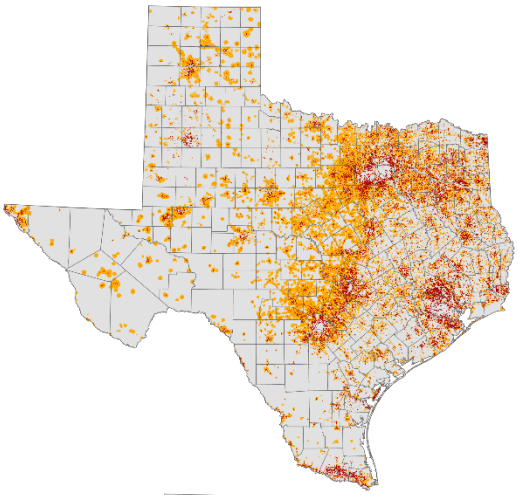
Wildfire Threat (WT) integrates four layers, as described below, and includes Burn Probability, Characteristic Fire Intensity Scale, Community Protection Zone, and Pine Plantation Value Index.



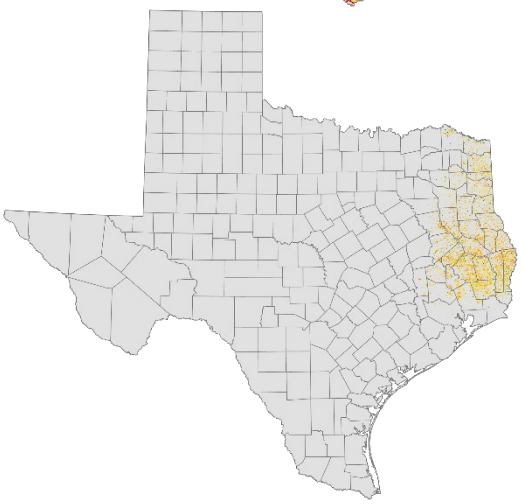
Burn Probability (BP) – This layer was derived from the National Burn Probability data that was generated for the conterminous US using a geospatial Fire Simulation (FSim) system developed by the US Forest Service Missoula Fire Sciences Laboratory to estimate probabilistic components of wildfire risk (https://www.fs.usda.gov/treesearch/pubs/39312). The FSim system includes modules for weather generation, wildfire occurrence, fire growth, and fire suppression. FSim is designed to simulate the occurrence and growth of wildfires under tens of thousands of hypothetical contemporary fire seasons in order to estimate the probability of a given area (i.e., pixel) burning under current landscape conditions and fire management practices. The data presented here represent modeled BP. The raw data, which ranged from 0.000050 to 0.089557 was reclassified using a Geometric Interval to values of 10 to 100 in increments of 10. NoData values, which represent unburnable areas, were given a value of 0.



Characteristic Fire Intensity Scale (FIS) – Taken from the Texas Wildfire Risk Assessment, Characteristic Fire Intensity Scale specifically identifies areas where significant fuel hazards and associated dangerous fire behavior potential exist based on weighted average of four percentile weather categories. Similar to the Richter scale for earthquakes, FIS provides a standard scale to measure potential wildfire intensity. FIS consist of 5 classes where the order of magnitude between classes is ten-fold. The minimum class, Class 1, represents very low wildfire intensities and the maximum class, Class 5, represents very high wildfire intensities. The raw data actually contains 9 values ranging from 1 to 9. Nonburnable areas have a value of NoData. For analysis here, the layer was prepared for analysis by reclassifying the 9 values from 11 to 100 and NoData to 0.



Community Protection Zone (CPZ) – Taken from the Texas Wildfire Risk Assessment, Community Protection Zones represent those areas considered highest priority for mitigation planning activities. CPZs are based on an analysis of the Where People Live housing density data and surrounding fire behavior potential. Rate of Spread data is used to determine the areas of concern around populated areas that are within a 2-hour fire spread distance. The raw data includes 1 = primary, 2 = secondary, and NoData outside the zones. The data were reclassified so that primary CPZs had a value 100 and secondary CPZs had a value of 75. NoData, areas outside CPZs, were reclassified to 0.



Pine Plantation Value Index (PPV) – Taken from the Texas Wildfire Risk Assessment, The Pine Plantation Response Index layer is a rating of the potential impact of a wildfire on pine plantations. The key input, Pine Plantation Age, represents the age of pine plantations across Texas and reflects the potential susceptibility to damage from wildfire. The Pine Plantation Response Index is derived using a Response Function modeling approach. Response functions are a method of assigning a net change in the value to a resource or asset based on susceptibility to fire at different intensity levels, such as flame length. These net changes can be negative (adverse) or positive (beneficial). The theoretical range of values is from -9 to 9, with -9 representing the most adverse impact and 9 representing the most positive impact. Zero reflects no impact. The practical range is typically much smaller, however. For the TWRA, the range of values is from -9 to 3. Zero values are not included because they reflect no impact to the value or asset. For Pine Plantations, wildfire could have both adverse and beneficial impacts based on the age of the plantation and the corresponding fire intensity level. To calculate the Pine Plantations Response Index, the Pine Plantation Age data was combined with Flame Length data, and response functions were defined to represent potential impacts. The response functions were defined by a team of experts led by the Texas A&M Forest Service mitigation planning staff. By combining flame length with the Pine Plantation Age data, you can determine where the greatest potential impact to pine plantations is likely to occur. Raw data values were rescaled as 3 = -38, 2= -25, 1 = -12, 0 = 0, -1 = 12, -2 = 25, -3 = 38, -4 = 50, -5 = 62,, -6 = 75, -7 = 88, and -8 = 100.

Overlay Model

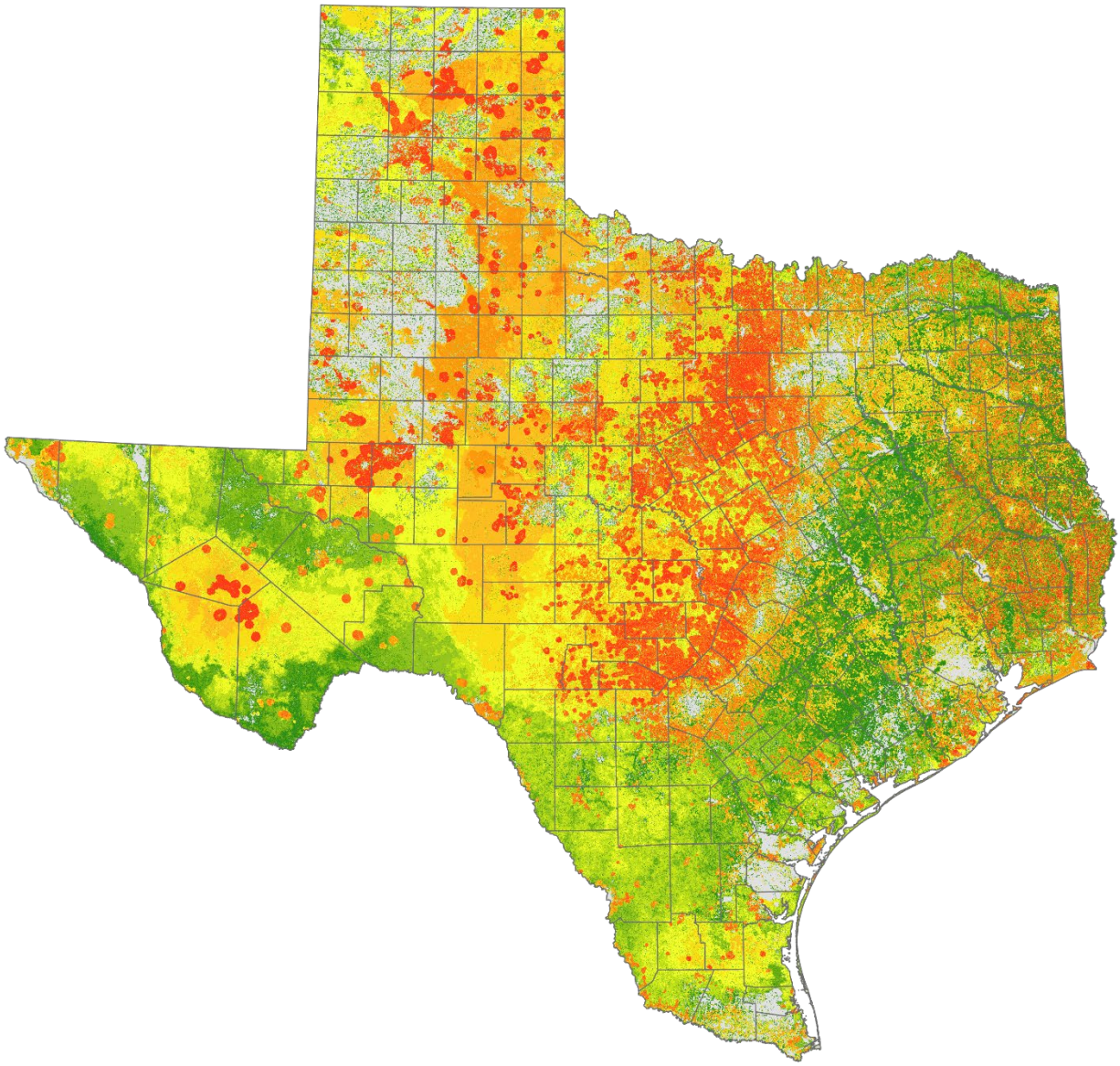
A weighted raster overlay model was used to develop Wildfire Threat. The four components of the model were assigned the following weights that summed to 100.

Layer Name	Layer Abbreviation	Layer Weight
Burn Probability	BP	20
Characteristic Fire Intensity Scale	FIS	20
Community Protection Zone	CPZ	20
Pine Plantation Value Index	PPV	40
		100

WT = BP*20 + FIS*20 + CPZ*20 + PPV*40

The resulting Wildfire Threat layer is shown in Figure A-3.

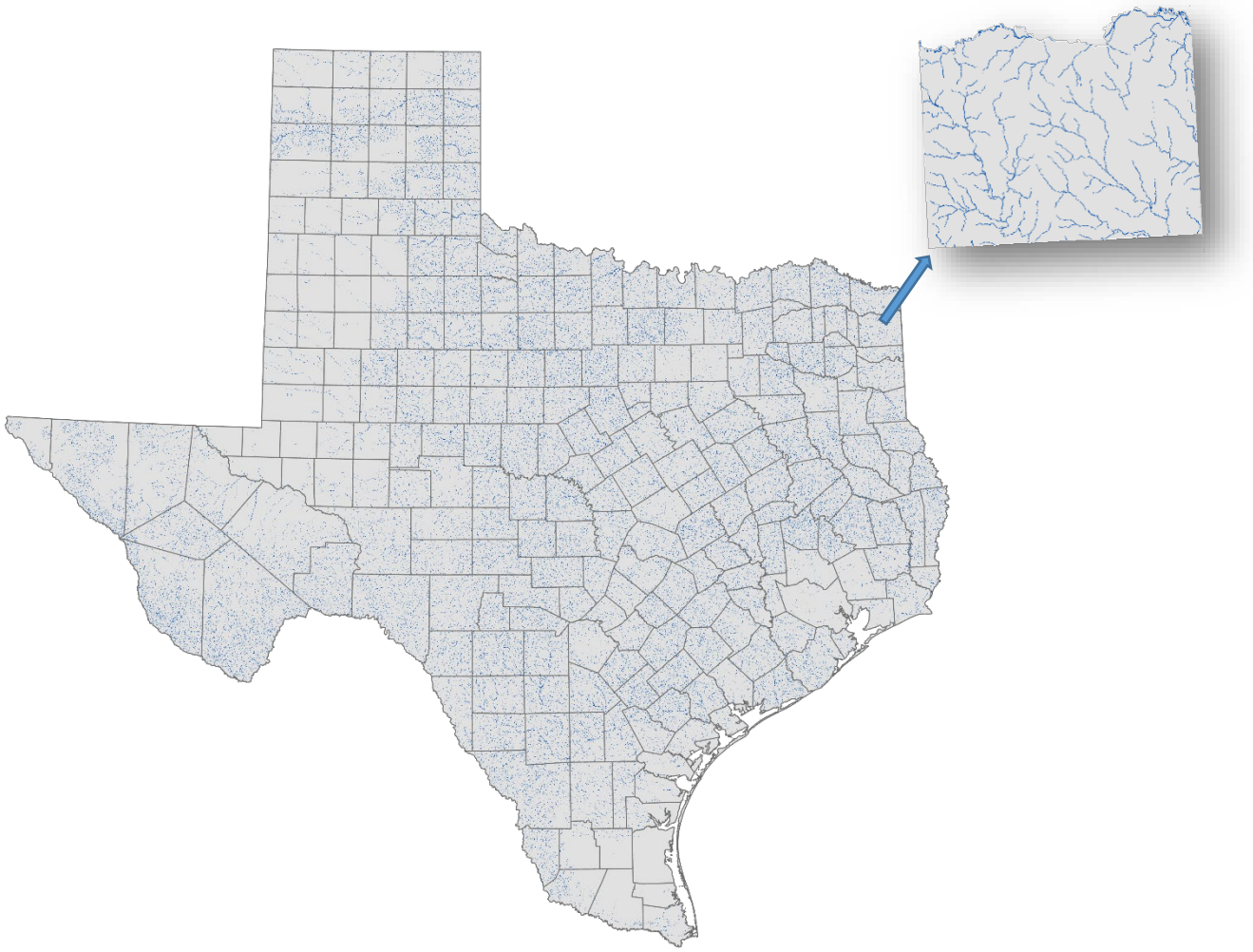
Figure A-3
Wildfire Threat



Riparian Areas

The Riparian Areas layer (Figure A-4) places importance on river and stream corridors where buffers of forest vegetation cover can have a positive or restorative effect on water quality and riverine ecosystems. This layer is a modified version of the updated Southern Forest Land Assessment (SFLA) layer in that only buffered NHD flowlines were used. The updated SFLA layer is based on the NHDPlus of the National Hydrography Dataset (NHD) high-resolution flowline data. The NHD is a feature-based database that interconnects and uniquely identifies water-related entities, such as industrial discharges, drinking water supplies, fish habitat areas, and wild and scenic rivers. The updated SFLA also used Flood Plain data from FEMA. However, since it appeared that this data was incomplete for many counties in Texas, only the flowline data was used. Stream segments, or reaches, were buffered by one of two distances based on the Strahler stream order. Segments with stream orders of 1 through 4, i.e. stream segments closer to the headwaters, were buffered by 50 meters. All remaining segments were buffered by 100 meters. Area within buffers were given a value of 100 and area outside buffers were given a value of 0.

Figure A-4
Riparian Areas



Forest

The original SFLA created a Forest layer using NLCD 2001. However, forested land estimated by the Forest Inventory and Analysis (FIA) Program provides almost double the amount of forestland. In 2016, Texas A&M Forest Service developed a geospatial forest layer that produces the same acreage of forest as done by FIA† (62.9 million acres).

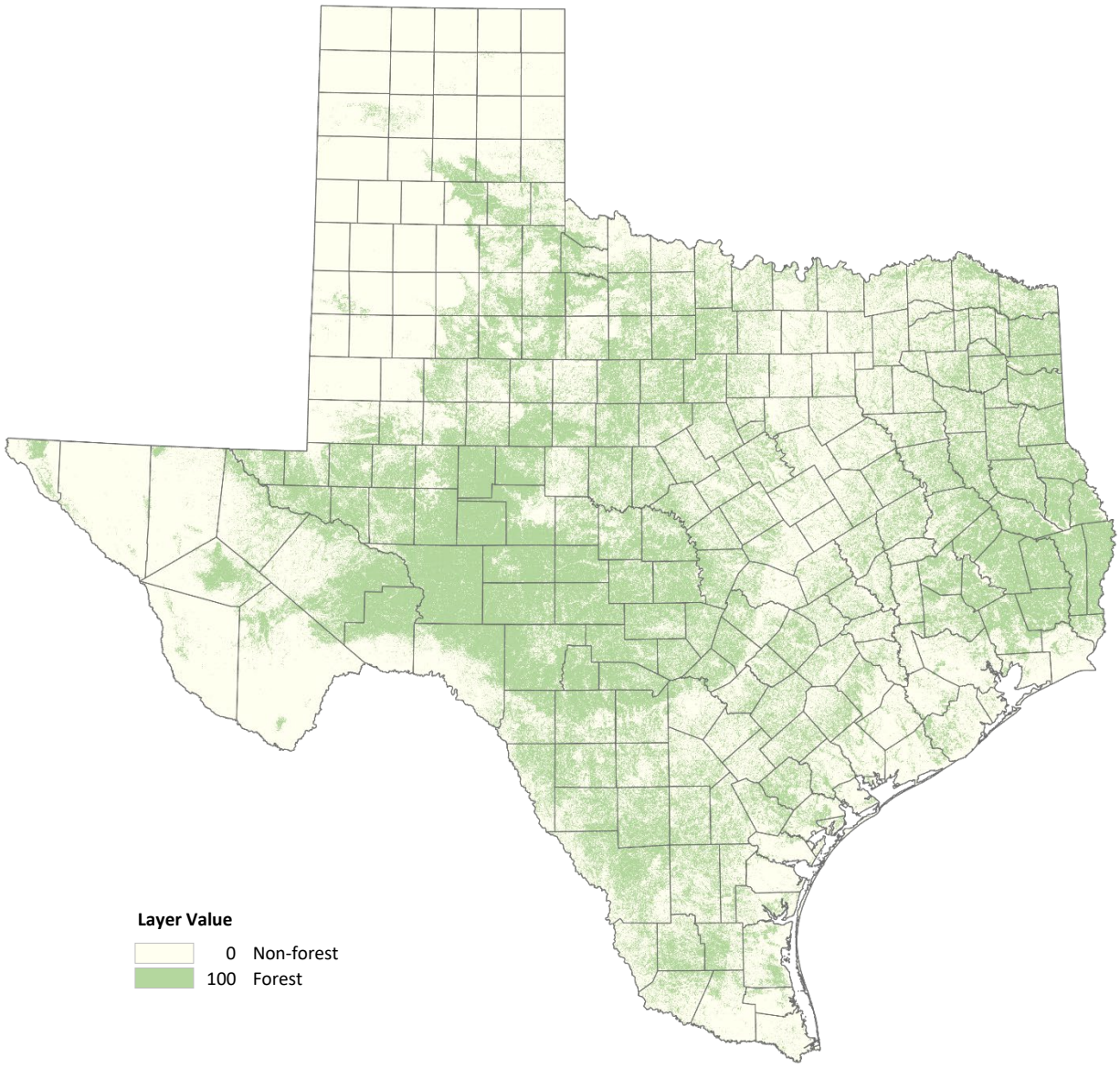
Landsat imagery and a suite of environmental variables was used to predict the occurrence of forestland by a statistical modelling approach—Random Forests—that related the environmental variables to FIA plot data. Predictions were made at the 30-meter level.

Predictors included the following:

Topography

† For users interested in knowing the accuracy of FIA data, the EVALIDator application (https://apps.fs.usda.gov/Evalidator/evalidator.jsp) maintained by the U. S. Forest Service can be used to determine confidence intervals.

Figure A-5
Forest



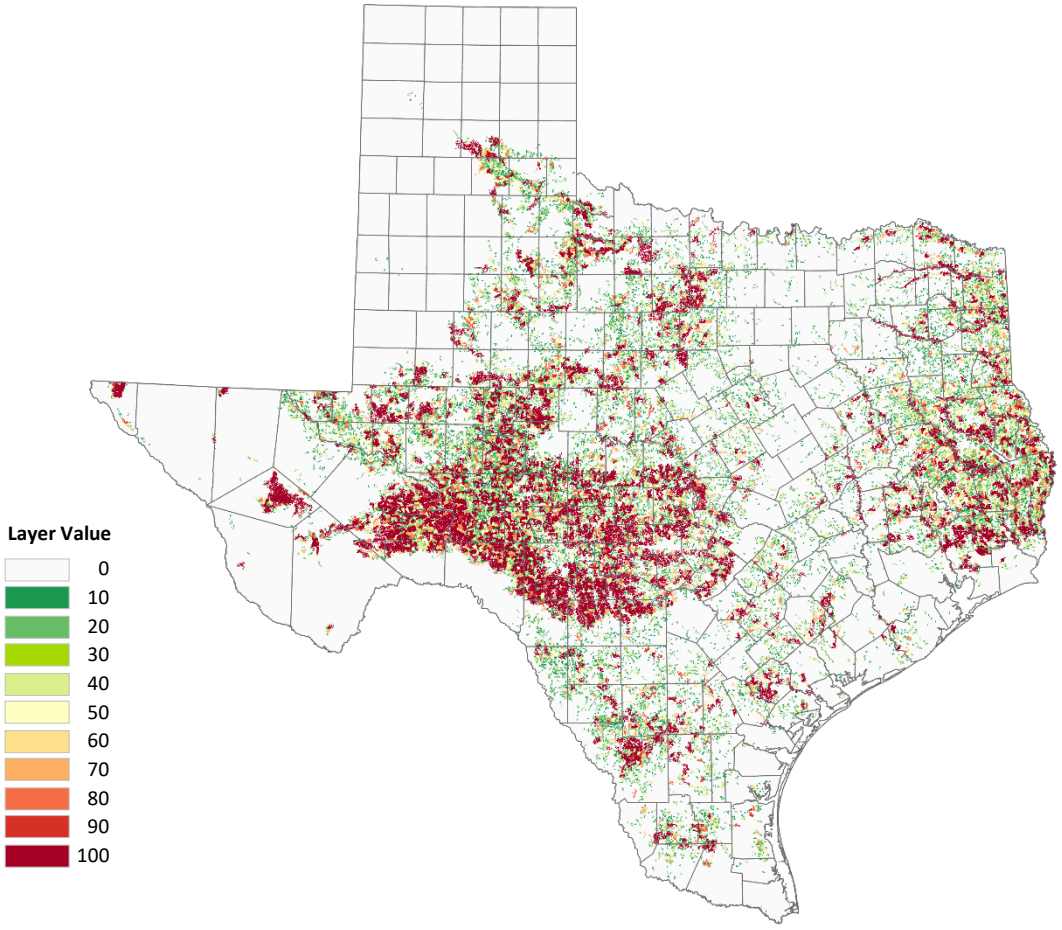
Forest Patches

The Forest Patches layer (Figure A-6) is intended to emphasize forest of ecologically and/or economically viable size. Forest patches were created by first subtracting from the Forest layer described earlier a buffered (15 m on each side) rasterized road layer and then using the Region Group and Zonal Geometry tools within ArcGIS to group contiguous forest grid cells into patches. The road layer used was OpenStreetMap (OSM) and included both roads and railroads. Values for grid cells are the area in square meters of the forest patch in which a cell belongs. For a cell to be contiguous with an adjacent cell, there must be at least one side common to both cells. Corners simply touching does not constitute contiguousness. The layer is further processed within the SFLA models to produce layer values ranging from 0 to100 based on patch size. The layer values scheme used is given in Table A-1.

Table A-2
Layer Value Scheme for Forest Patches

Layer Value	Patch Size (square meters)	Patch Size (acres)
0	< 2,019,382	< 500
10	2,019,382 – 4,042,809	400 – 999
20	4,042,810 – 6,066,237	1,000 – 1,499
30	6,066,238 – 8,089,665	1,500 – 1,999
40	8,089,666 – 10,113,093	2,000 – 2,499
50	10,113,094 – 12,136,521	2,500 – 2,999
60	12,136,522 – 14,159,949	3,000 – 3,499
70	14,159,950 – 16,183,377	3,500 – 3,999
80	16,183,378 – 18,206,805	4,000 – 4,499
90	18,206,806 – 20,230,233	4,500 – 5,000
100	> 20,230,233	> 5,000

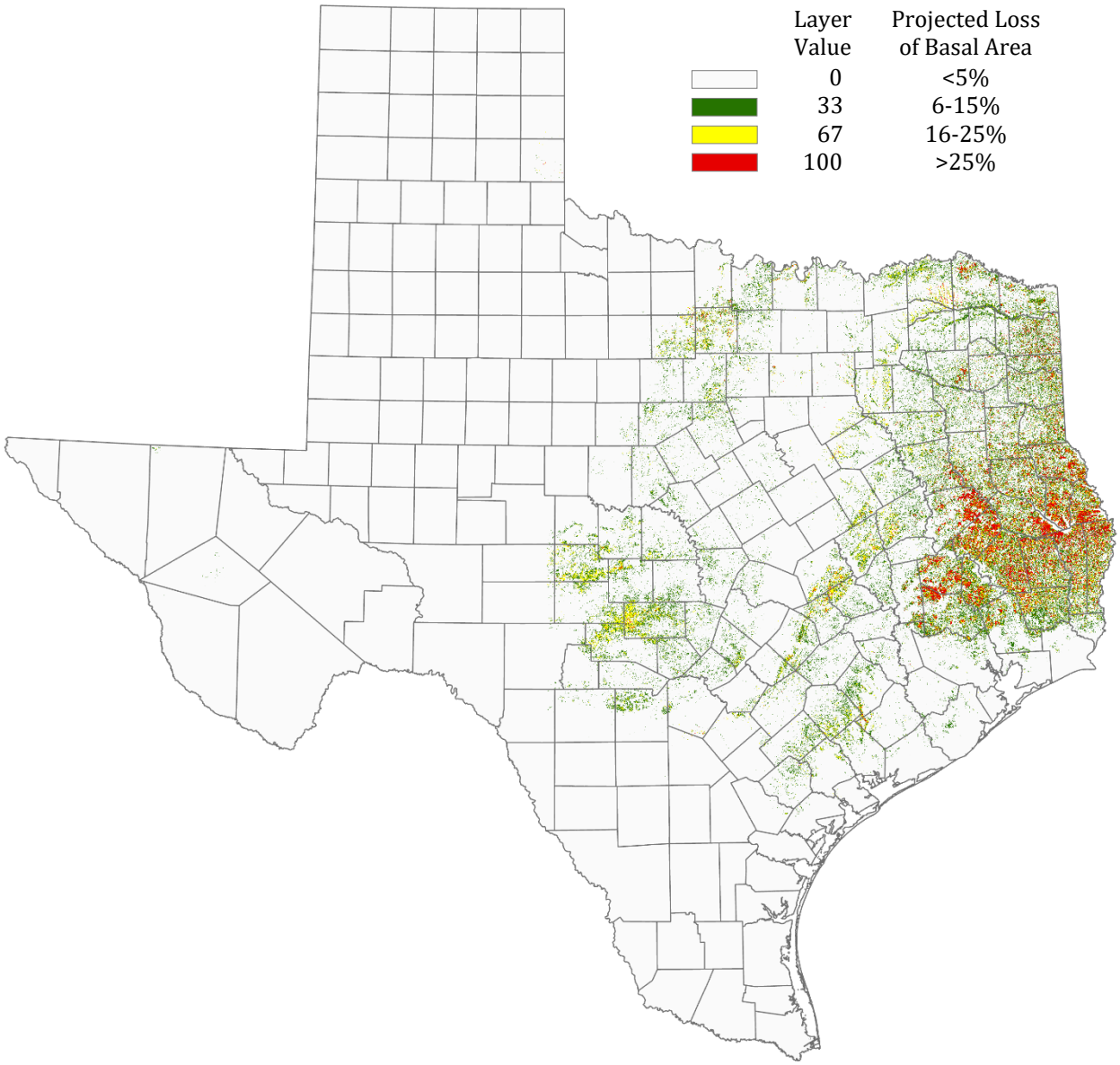
Figure A-6
Forest Patches



Forest Health Threat

The Forest Health Threat layer used in geospatial analyses in this Forest Action Plan is derived from National Insect and Disease Risk Map (NIDRM) (https://www.fs.fed.us/foresthealth/applied-sciences/mapping-reporting/national-risk-maps.shtml). NIDRM is a nationwide strategic assessment and database of the potential hazard for tree mortality due to major forest insects and diseases. The risk map was completed in 2012 but was updated in 2018. Threats included in the map for Texas include cottonwood decline, emerald ash borer, engraver beetles, fusiform rust, oak decline and defoliators, oak wilt, root diseases, and southern pine beetle. Data was received as percent of total basal area projected to be lost between 2013 and 2027 and was reclassified into four classes as shown in Figure A-7.

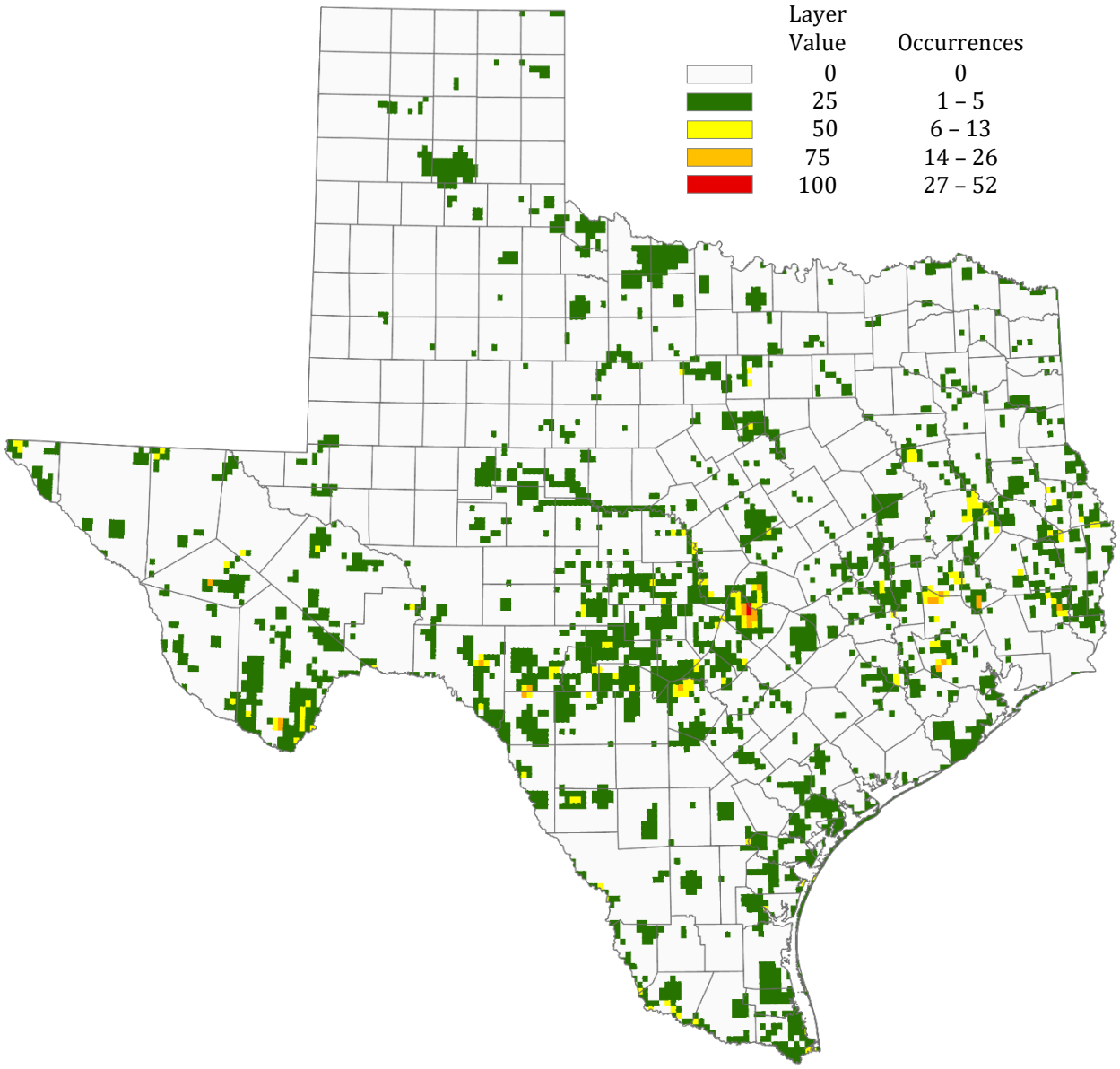
Figure A-7
Forest Health Threat



Threatened and Endangered Species

The Threatened and Endangered Species layer used in the geospatial analysis for the Forest Action Plan was obtained from North Carolina who had contracted with Nature Serve to provide a layer based on their Natural Heritage Element Occurrences database. The layer includes Element Occurrence Totals for G1/T1 – G2/T2 and Federal Endangered Species Act Status Species by quarter quad for the Southeastern United States. The data represent information on locations believed to be "potentially current and extant." Data were excluded where EO rank indicates that the population is extirpated (EO Rank = "X") and the last observation date was more than 40 years ago. (previous to 1978). The data were reclassified into four quantiles plus zero as shown in Figure A-8.

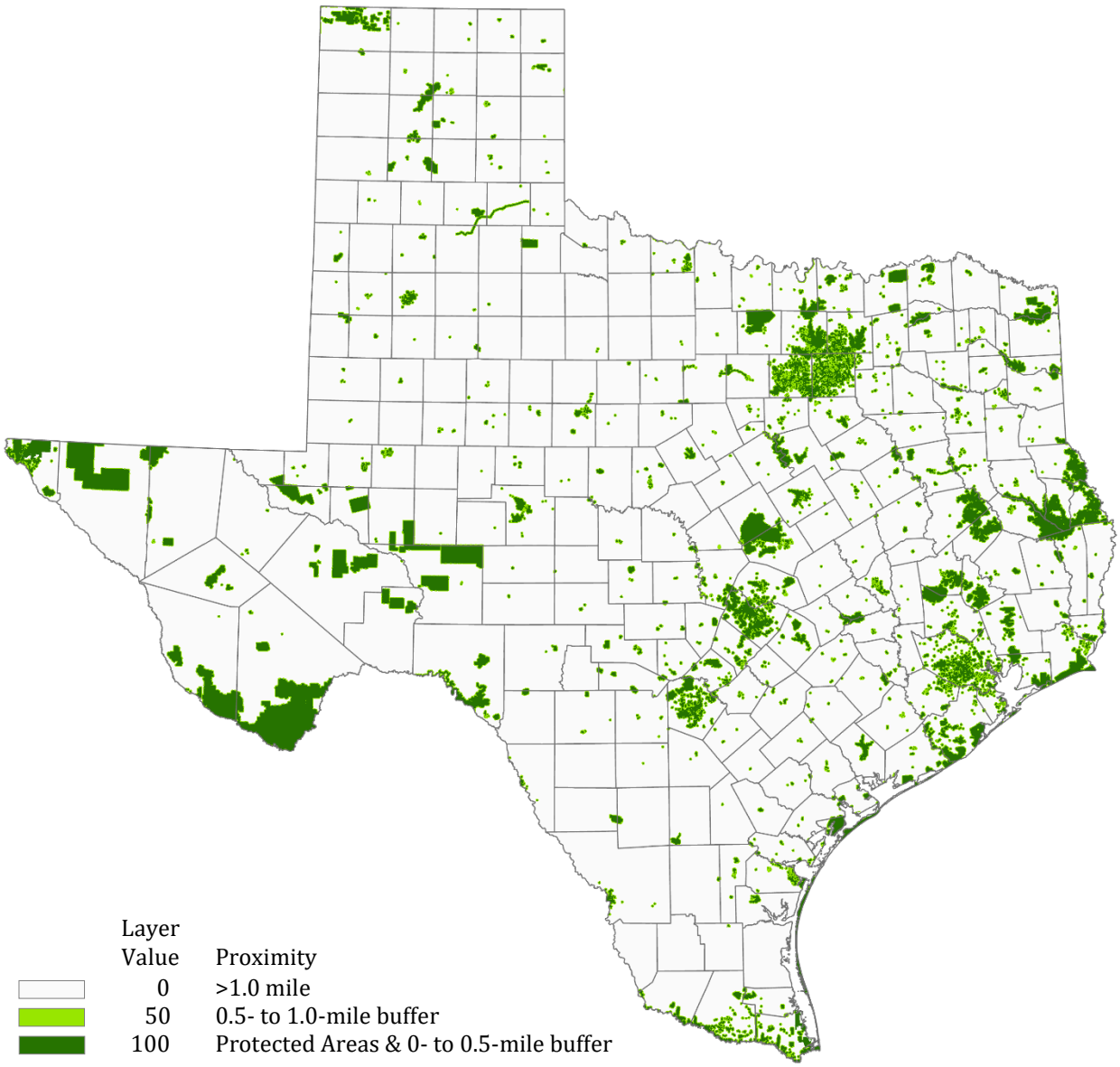
Figure A-8
Threatened and Endangered Species



Protected Areas

The Protected Areas layer (Figure A-9), also known as *Proximity to Public Land*, emphasizes areas that are assumed to be permanently protected (and managed) and thus contribute to a viably large, interconnected forest landscape. This layer is based on the assumption that public lands are in a permanently protected status and is intended to include private lands in a permanently protected status (easements or other). The layer was obtained from North Carolina Forest Service who had built the layer using data from the Protected Areas Database of the United States (PAD-US) version 1.4. Each polygon was buffered for 0.5 mile and 1.0 mile. Areas inside the protected areas and within 0.5 mile were assigned a value of 50 while areas between 0.5 and 1.0 mile were assigned a value of 100. All other areas were given a value of 0.

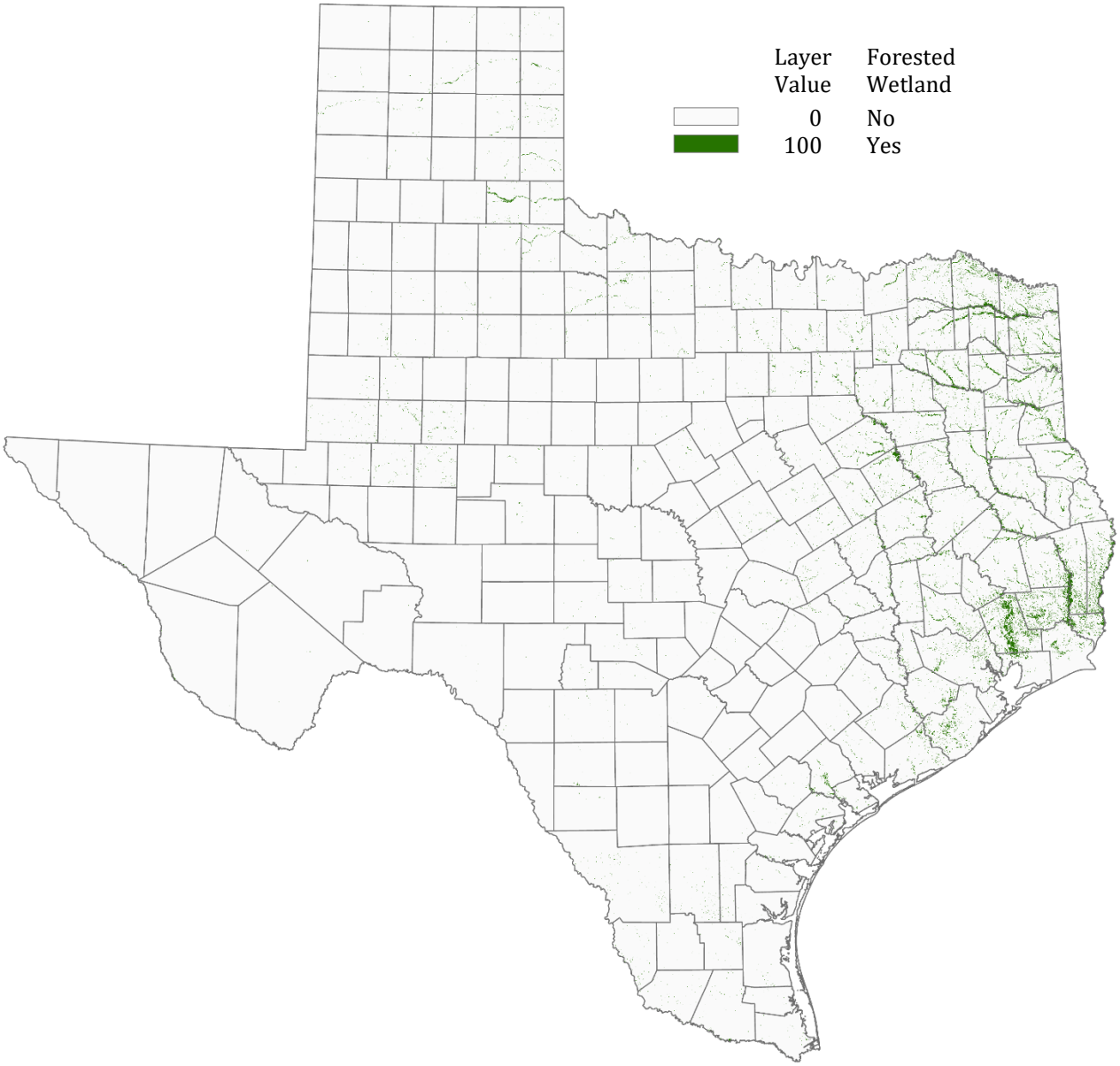
Figure A-9
Protected Areas



Forested Wetlands

The Forested Wetlands layer (Figure A-10) identifies forested wetlands where planning and management can achieve a higher degree of protection for purposes including water quality and wildlife habitat. The North Carolina Forest Service created this layer from the 2016 National Wetlands Inventory (NWI) dataset maintained by the U. S. Fish and Wildlife Service (https://www.fws.gov/wetlands/). The Forested Wetlands layers was made from only those polygons that are "Freshwater Forested/Shrub Wetland". Areas within the polygons were assigned a value of 100 while all other areas were given a value of 0.

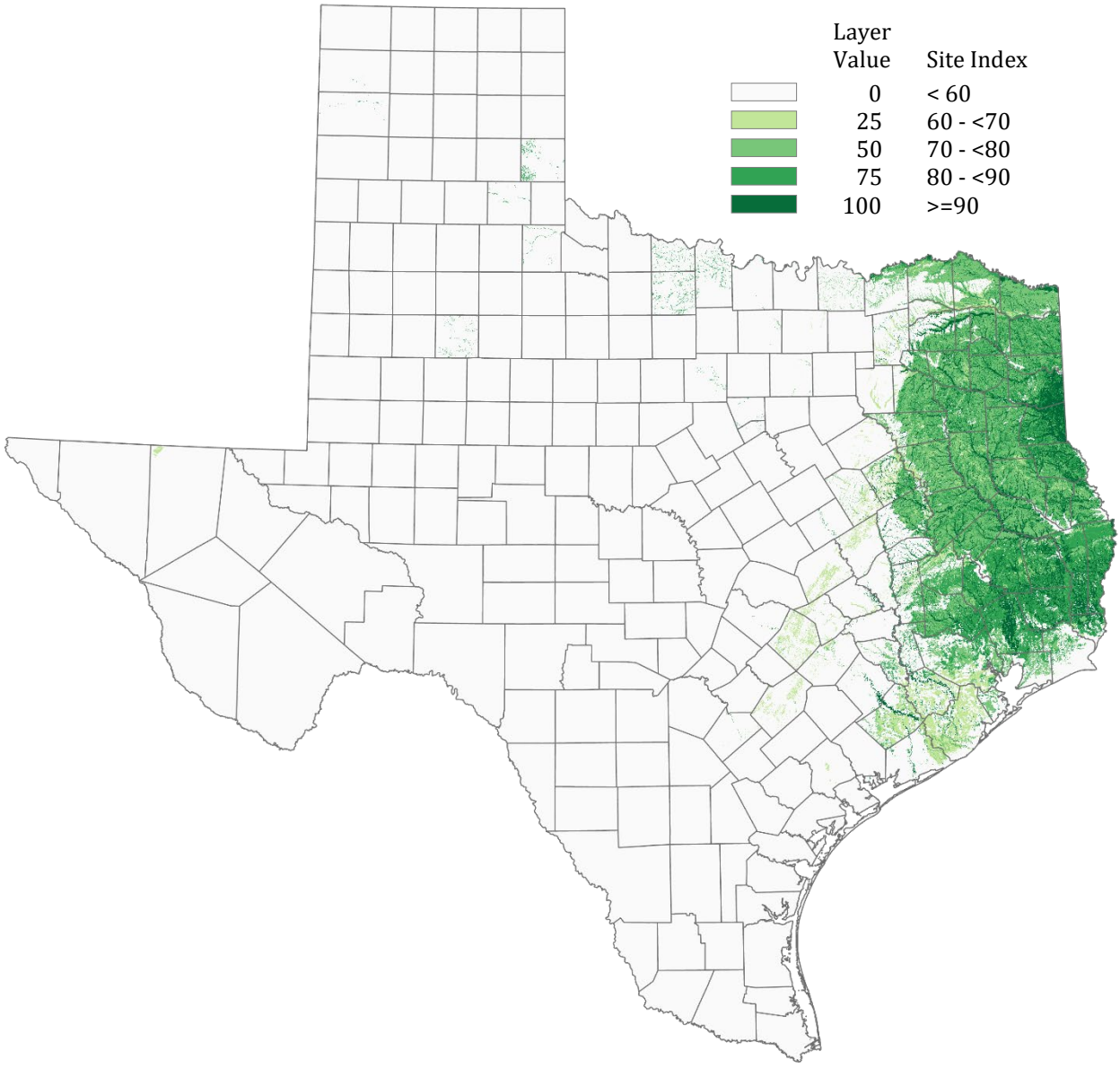
Figure A-10
Forested Wetlands



Site Productivity

The Site Productivity layer (Figure A-11) emphasizes areas with higher potential productivity in terms of timber production. Site index (tree height at age 50 years) as determined by the NRCS is used as the measure for site productivity. This data came from the NRCS Soil Survey Geographic Database (SSURGO) as provided in 2018. Site index values were reclassified into five classes to layer values ranging from 0 to 100 in increments of 25.

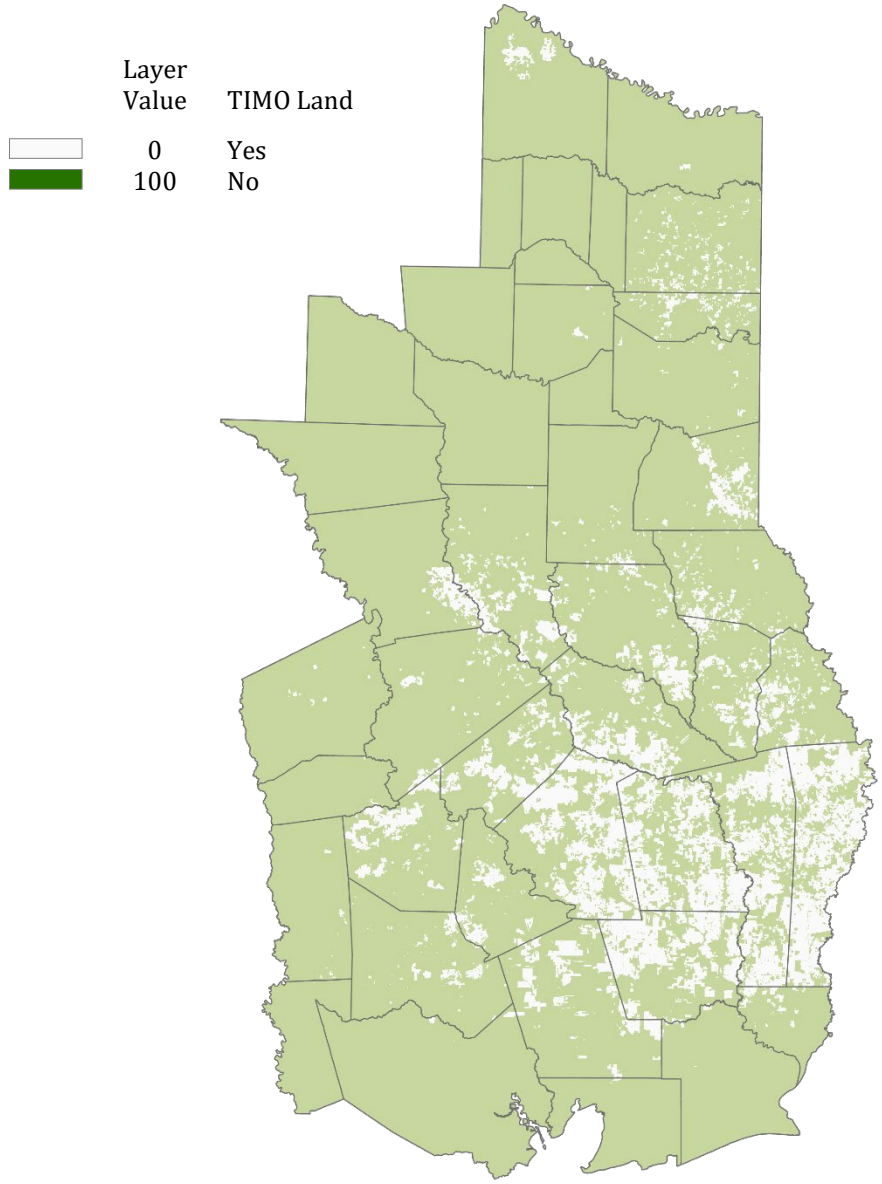
Figure A-11
Site Productivity



Non-TIMO Land

The Non-TIMO layer (Figure A-12) emphasizes areas where more opportunities exist for TAMFS to provide technical Assistance to family forestland owners. A Timberland Investment Management Organization (TIMO) is a management group that aids institutional investors in managing their timberland investment portfolios by fining, analyzing, and acquiring investment properties that would best suit their clients. The TIMO is given the responsibility of actively managing the timberland to achieve adequate returns for the investors. Since a TIMO manages their clients' land, there is little need for TAMFS technical assistance on these lands. For this layer, areas not managed by TIMOs were given a value of 100 and areas managed by TIMOs were given a value of 0. Because this layer is used only for the Sustainability of Forest Resources in East Texas issue, the layer is limited to the 43 East Texas counties.

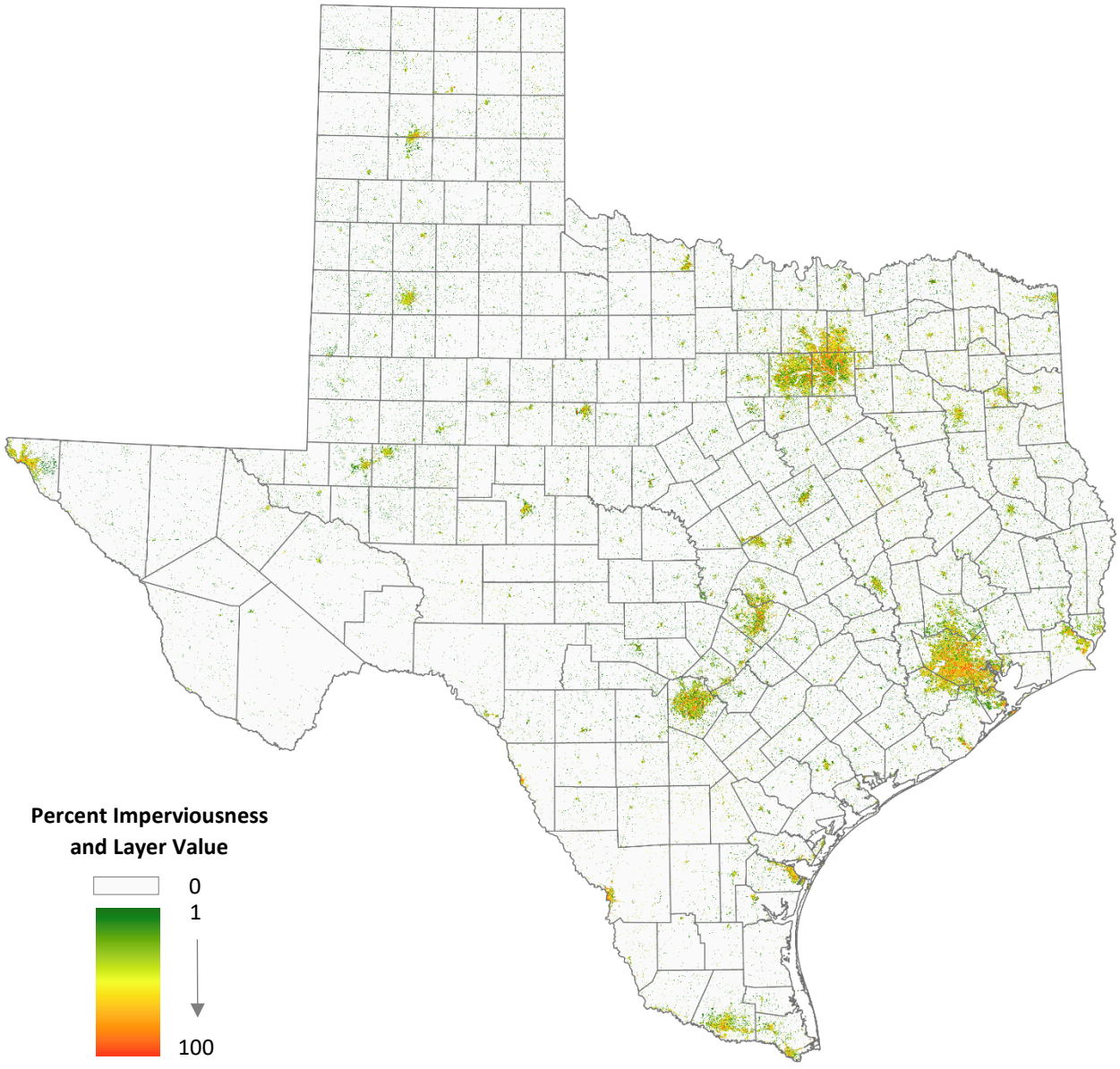
Figure A-12
Non-TIMO Land



Imperviousness

Impervious surface (Figure A-13) is a derivative of the NLCD 2016 and refers to impenetrable (to water) surfaces such as rooftops, roads, or parking lots. Imperviousness offers a relatively objective measure of urban density and provides a forum for its classification. The NLCD 2016 imperviousness quantifies the spatial distribution of impervious surfaces as a discrete integer variable for urban area from 0 to 100 percent (in increments of 1).

Figure A-13
Imperviousness

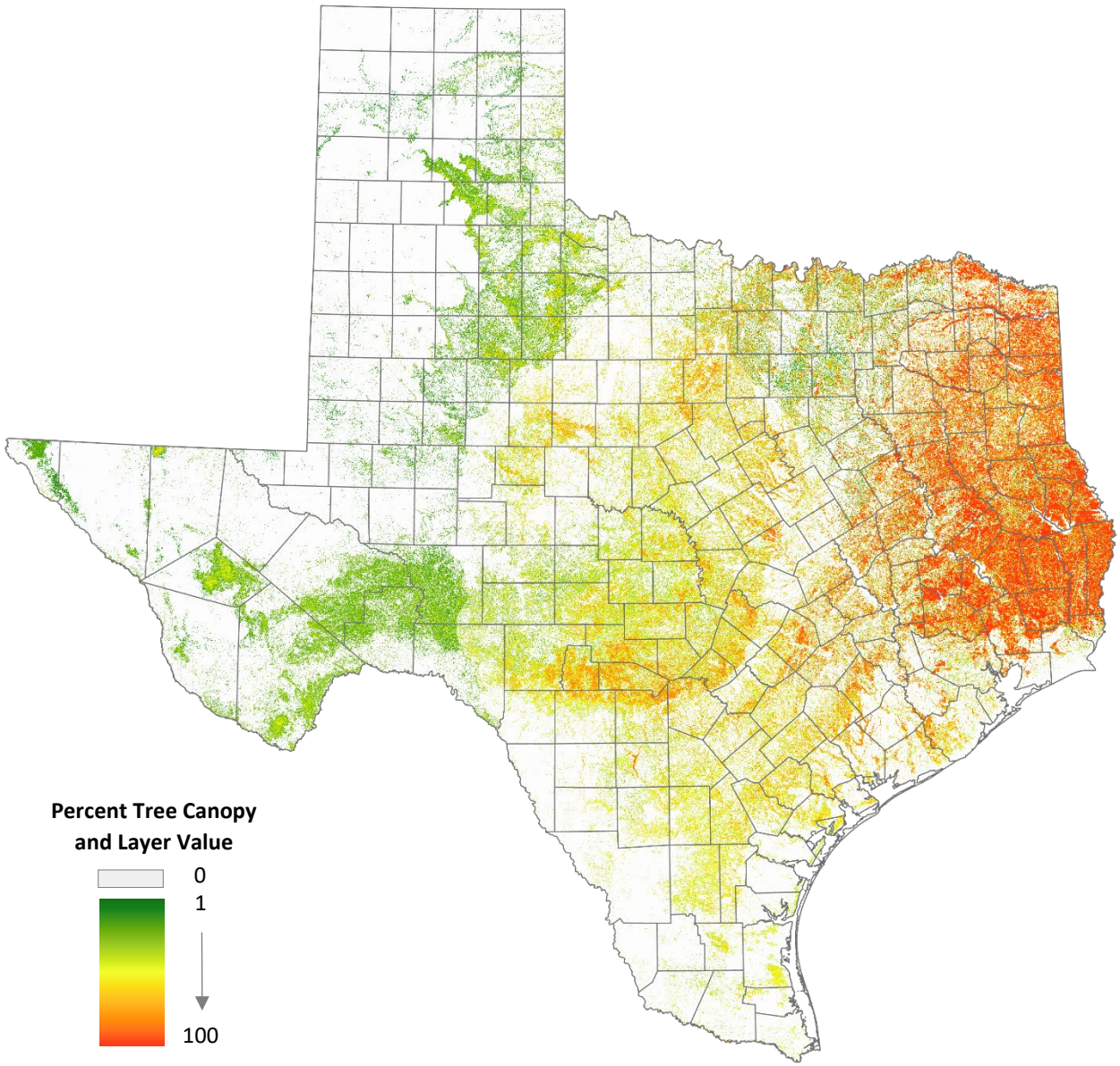


Tree Canopy

Tree Canopy (Figure A-14) is a derivative of the NLCD 2016 that quantifies spatial distribution of tree canopy from 0 to 100 percent. When comparing Tree Canopy to Forestland, several key points are informative:

- Pixel value for Tree Canopy is a discrete variable that can range from 0 to 100 percent (in increments of 1) while Forest is a discrete variable that can have a value of either 0 or 100.
- The minimum size of a Forest mapping unit is approximately 1 acre (four pixels).
- To be classed as Forest, tree canopy must be at least 20 percent.

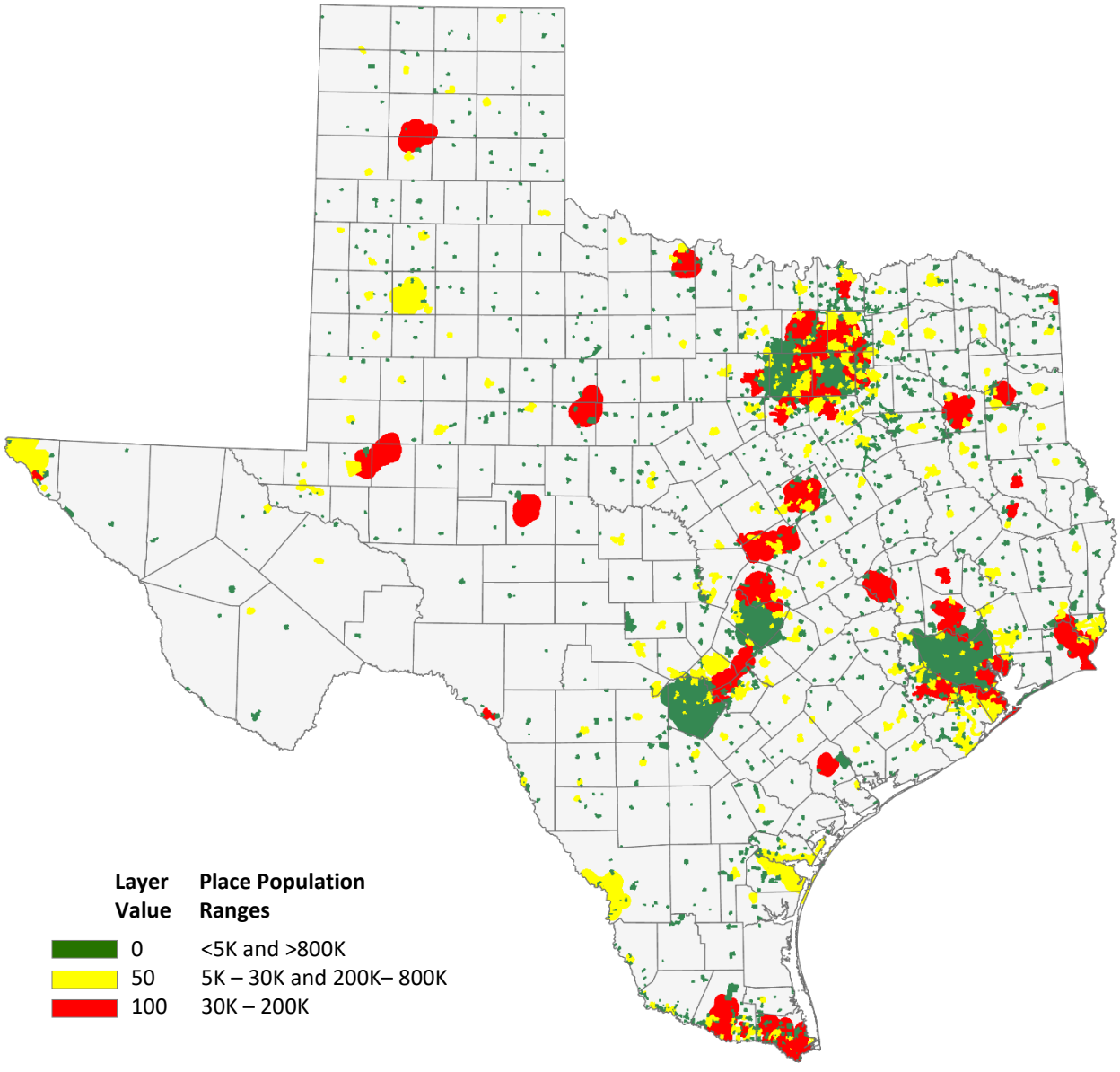
Figure A-14
Tree Canopy



Total Place Population

Total Place Population (Figure A-15) is used in the Urban Forest Sustainability analysis. Places consist of villages, towns, cities, and census designated places (CDPs). A CDP is a community that lacks separate government but otherwise resembles incorporated places. Place spatial data and place population estimates were obtained from the U. S. Census Bureau for 2018. The data were classified into three classes and rasterized to 30 meters. The objective was to emphasize mid-size cities where the need for urban forest assistance is probably greatest. Total place populations of less than 5,000 and greater than 800,000 were assigned a value of 0. Populations between 5,000 and 30,000 and between 200,000 and 800,000 were assigned a value of 50. A high value of 100 was assigned places with populations between 30,000 and 200,000. For analysis, each place included its Place Growth Zone, which is based on the extra-territorial jurisdiction of the place, so that all layers included in the urban analysis were based on the same area. Refer to the Place Growth Zone layer for its description.

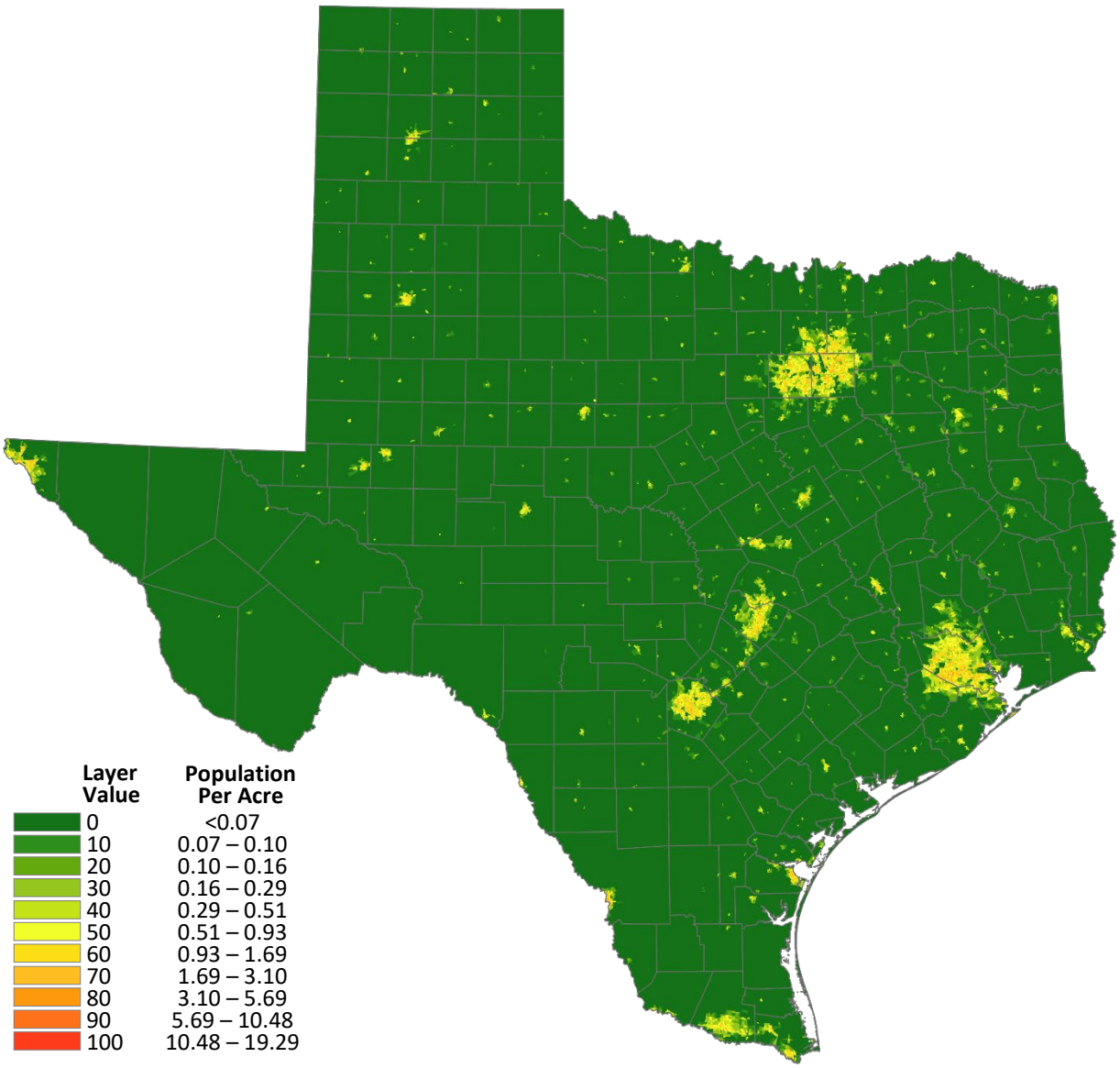
Figure A-15
Total Place Population
(Expanded to Place Growth Zone)



Population Density

Population Density (Figure A-16) is used in the Urban Forest Sustainability analysis. Population Density is given in number of people per acre by U. S. Census Group Block. Data were obtained from the U. S. Census Bureau and were classified into 11 Geometric Interval classes and given values of 0 to 100 in increments of 10.

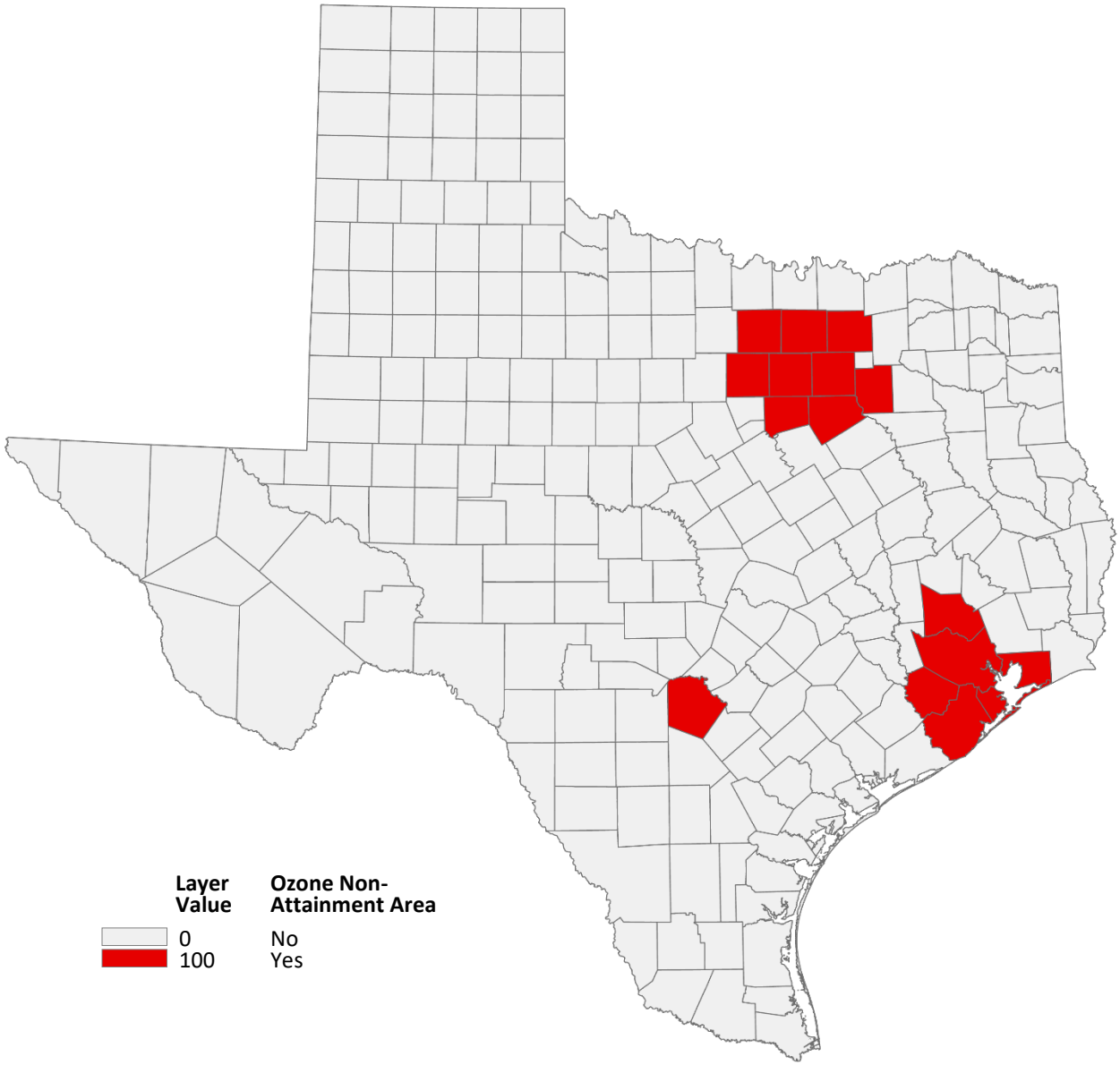
Figure A-16
Population Density



Ozone Non-Attainment Areas

The Ozone Non-Attainment Areas layer (Figure A-17) is used in the Urban Forest Sustainability Issue analysis. The data were obtained from the Texas Commission on Environmental Quality (TCEQ). Non-attainment is an area that has not achieved compliance with the eight-hour ozone U.S. National Ambient Air Quality Standards (NAAQS).

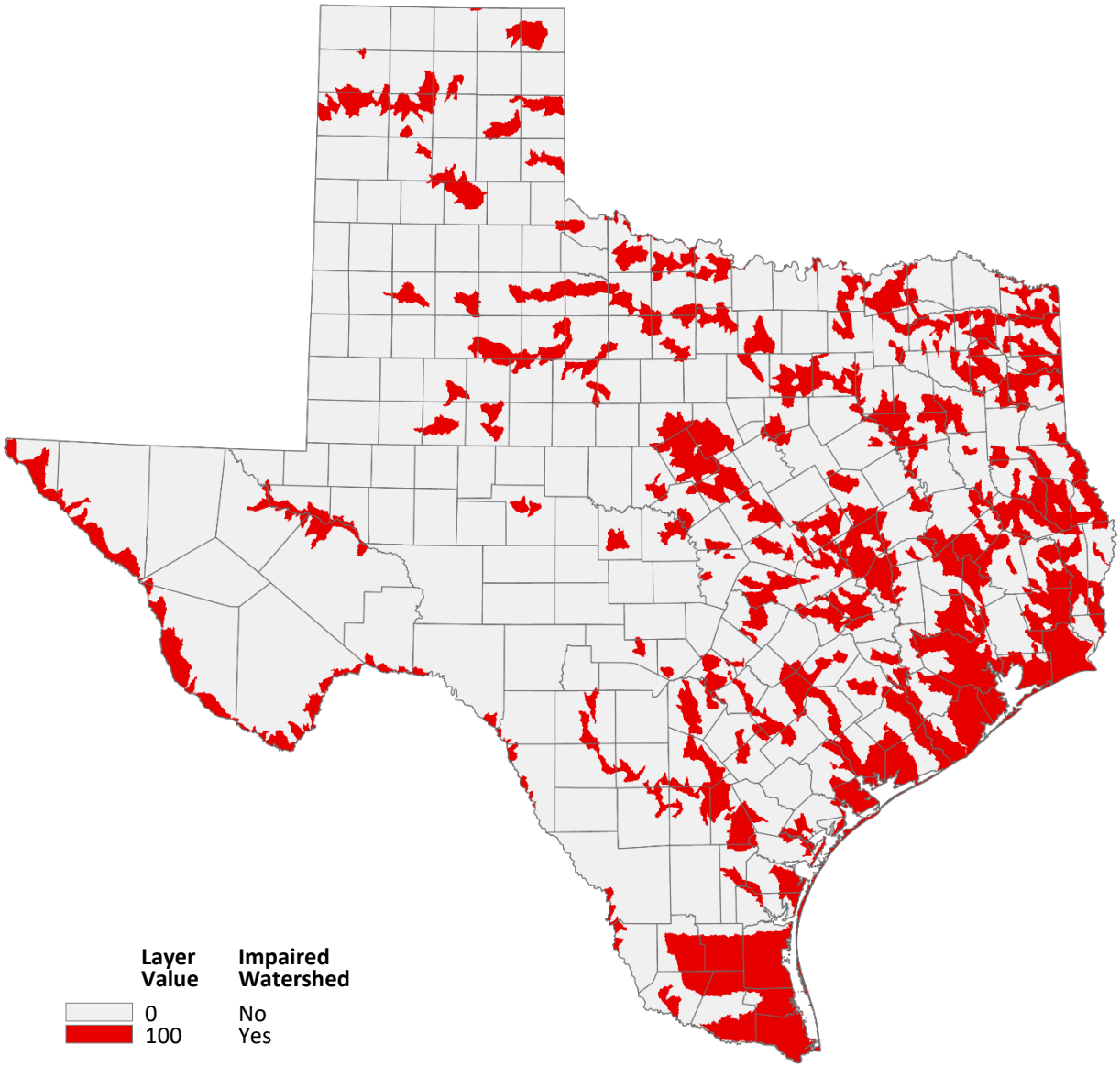
Figure A-17
Ozone Non-Attainment Areas



Impaired Watersheds

The Impaired Watersheds layer (Figure A-18) is used in the Urban Forest Sustainability Issue analysis. Impaired Watersheds are defined here as 12-digit HUC watersheds that contain at least one EPA Section 303(d) listed impaired stream segment or water body.

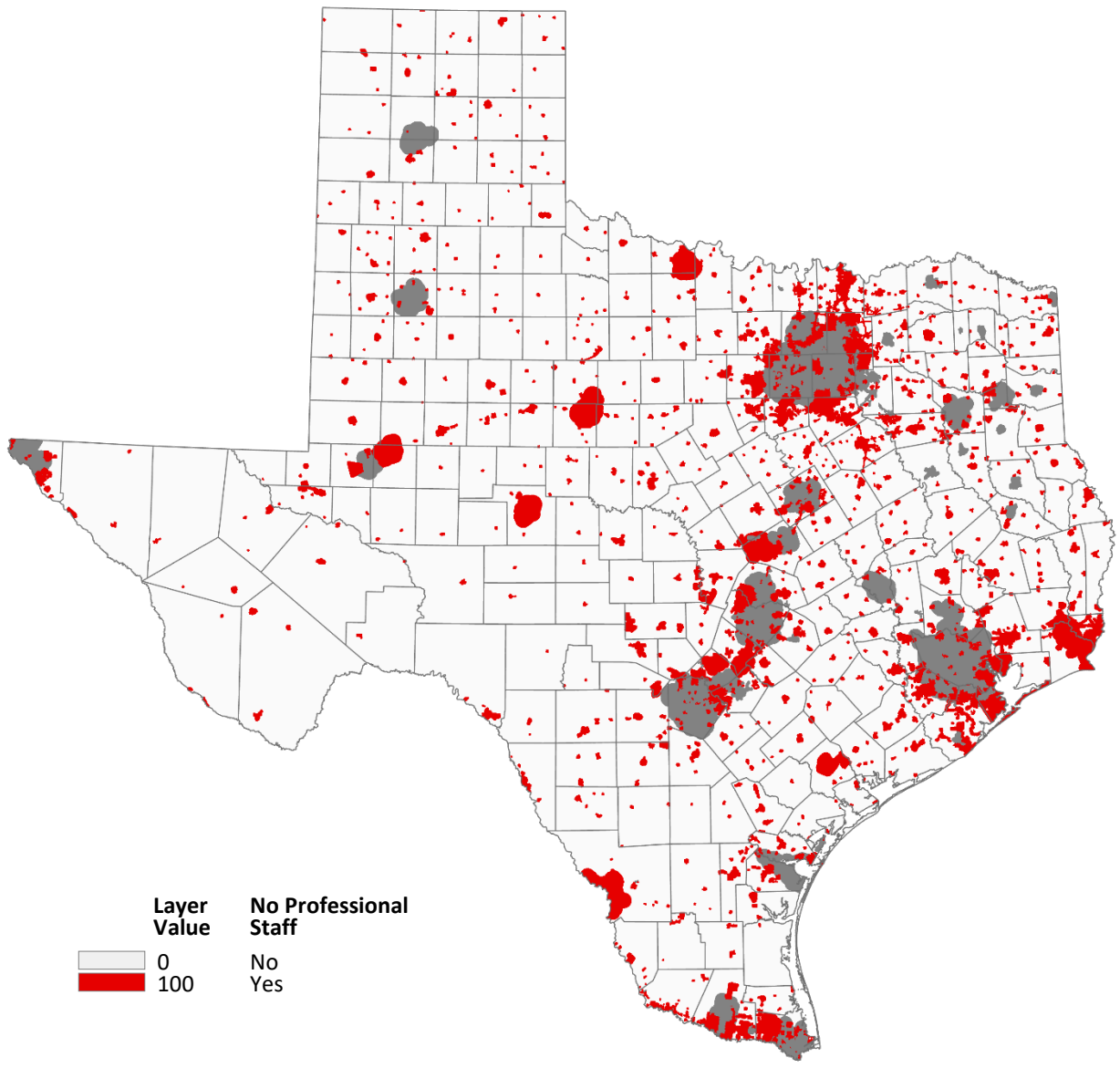
Figure A-18
Impaired Watersheds



No Professional Staff

No Professional Staff (Figure A-19) is used in the Urban Forest Sustainability Issue analysis. It indicates cities and communities that do not employee a professional forestry staff that have degrees in forestry or a related field and/or are arborists certified through the International Society of Arboriculture (ISA). U. S. Census Bureau geospatial data for Places were combined with data maintained by TAMFS in the Community Accomplishment Reporting System (CARS). For analysis, each place included its Place Growth Zone, which is based on the extra-territorial jurisdiction of the place, so that all layers included in the urban analysis were based on the same area. Refer to the Place Growth Zone layer for its description.

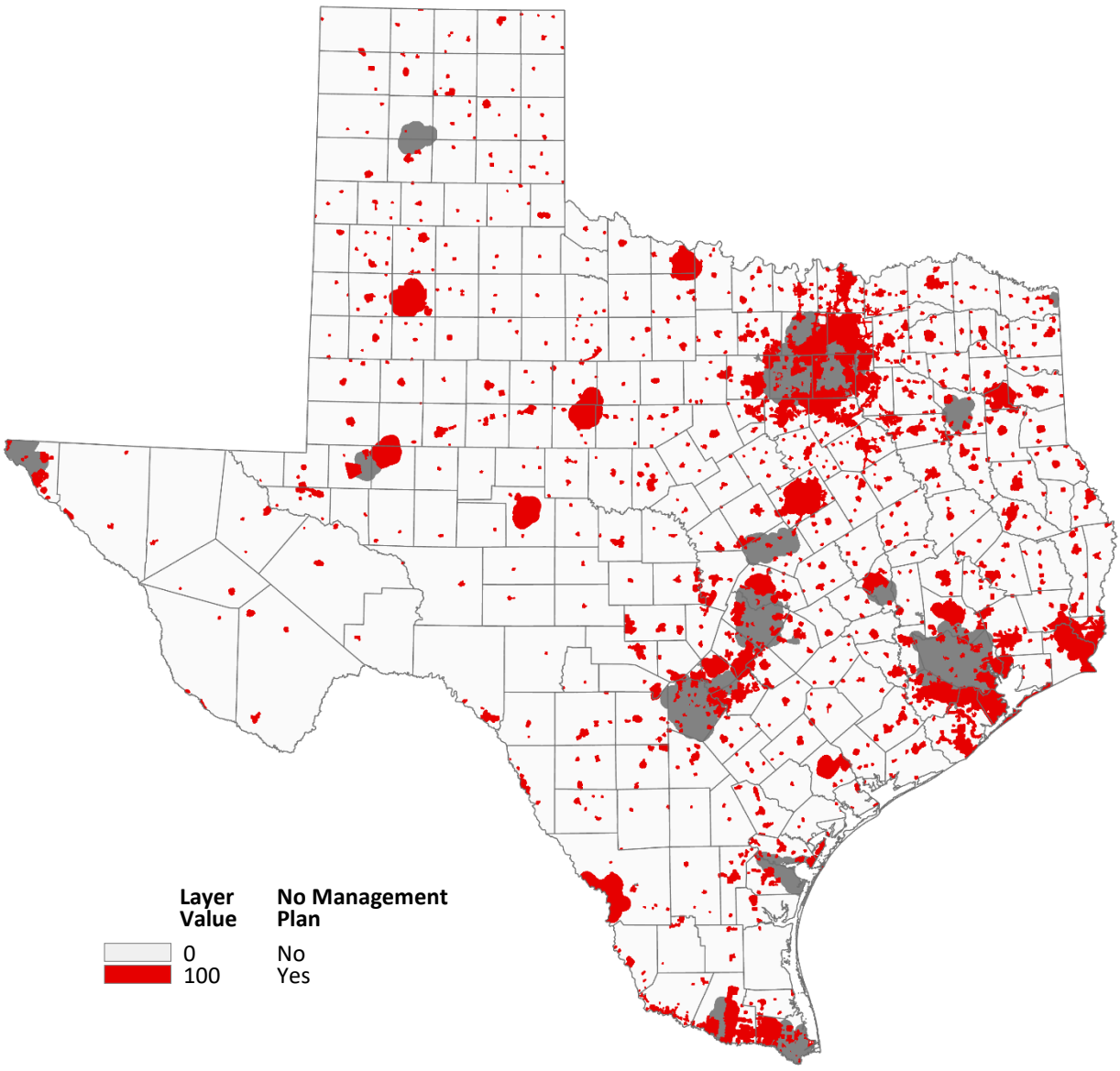
Figure A-19
No Professional Staff



No Management Plan

No Management Plan (Figure A-20) is used in the Urban Forest Sustainability Issue analysis. It indicates existence/absence of an active urban forest management plan developed from professionally based resource assessments or inventories. U. S. Census Bureau geospatial data for Places were combined with data maintained by TAMFS in the Community Accomplishment Reporting System (CARS). For analysis, each place included its Place Growth Zone, which is based on the extra-territorial jurisdiction of the place, so that all layers included in the urban analysis were based on the same area. Refer to the Place Growth Zone layer for its description.

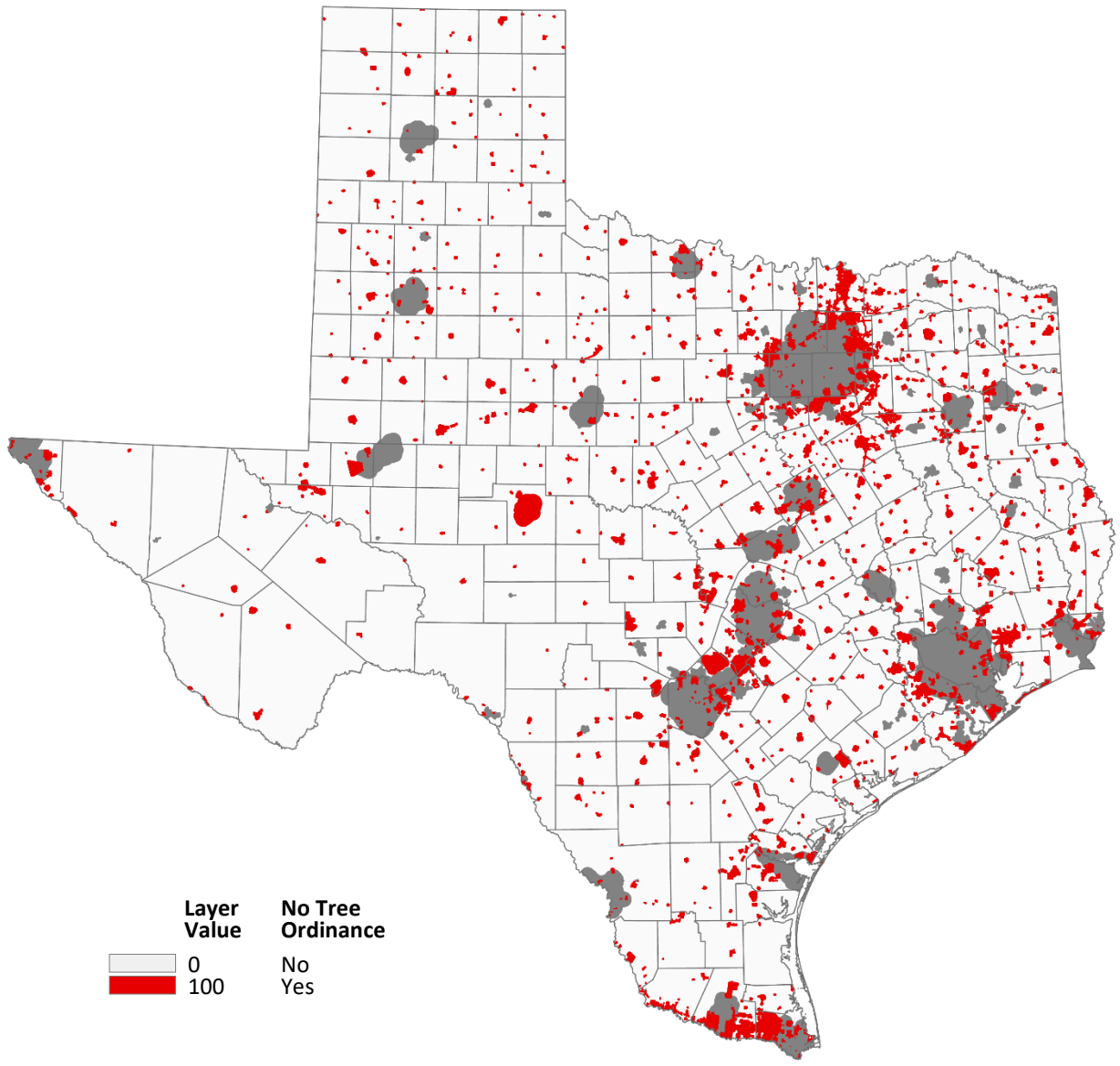
Figure A-20
No Management Plan



No Tree Ordinance

No Tree Ordinance (Figure A-21) is used in the Urban Forest Sustainability Issue analysis. It indicates lack of existence and adoption of ordinances or policies that focus on planting, protecting, and maintaining their urban and community trees and forests. U. S. Census Bureau geospatial data for Places were combined with data maintained by TAMFS in the Community Accomplishment Reporting System (CARS). For analysis, each place included its Place Growth Zone, which is based on the extra-territorial jurisdiction of the place, so that all layers included in the urban analysis were based on the same area. Refer to the Place Growth Zone layer for its description.

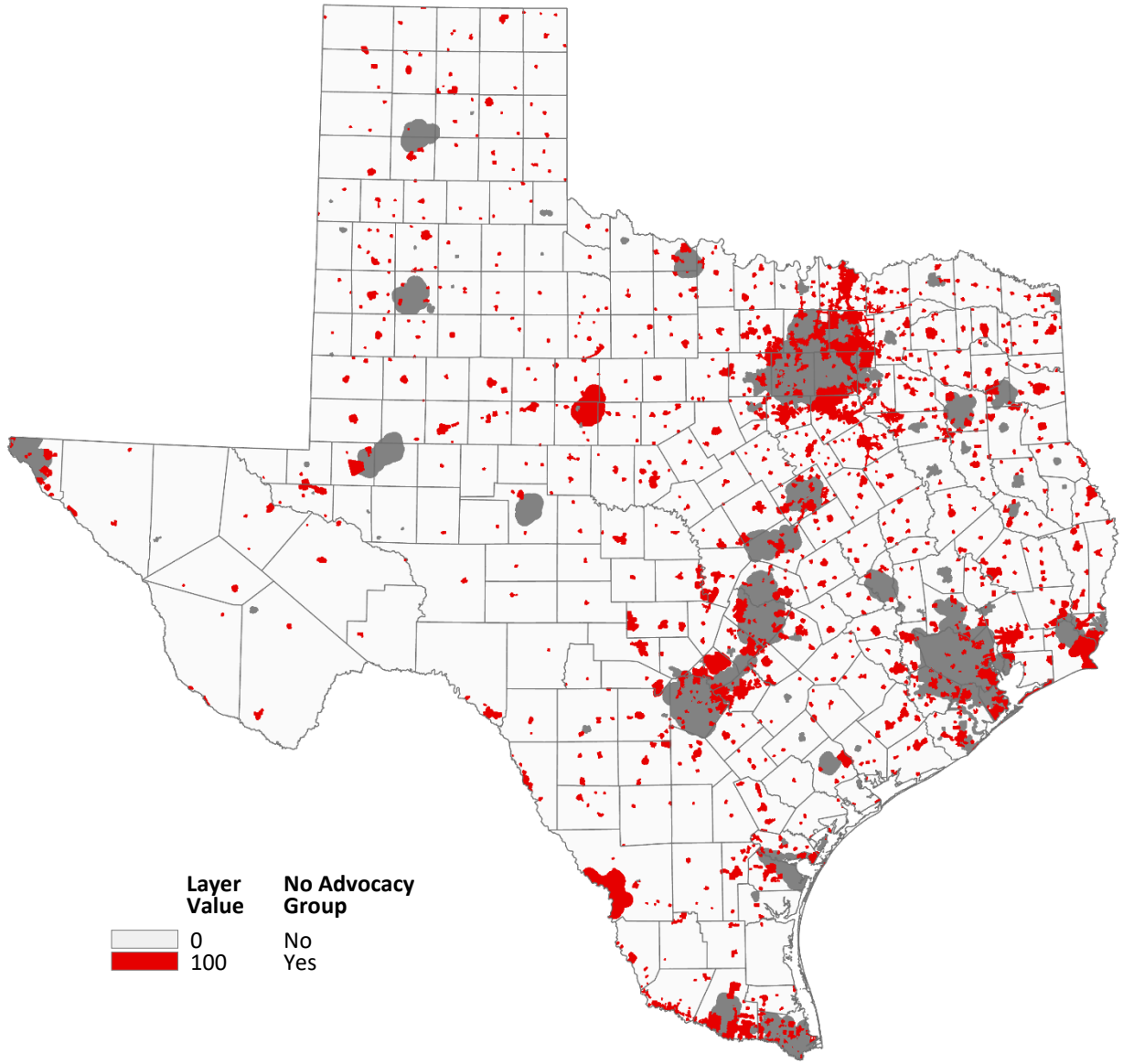
Figure A-21
No Tree Ordinance



No Advocacy Group

No Advocacy Group (Figure A-22) is used in the Urban Forest Sustainability Issue analysis. It indicates lack of existence of local advocacy/advisory organizations, such as active tree boards, commissions, or non-profit organizations that are formalized or chartered to advise and/or advocate for the planting, protection, and maintenance of urban and community trees and forests. U. S. Census Bureau geospatial data for Places were combined with data maintained by TAMFS in the Community Accomplishment Reporting System (CARS). For analysis, each place included its Place Growth Zone, which is based on the extra-territorial jurisdiction of the place, so that all layers included in the urban analysis were based on the same area. Refer to the Place Growth Zone layer for its description.

Figure A-22
No Advocacy Group



Place Growth Zone

For the Urban Forest Sustainability issue, a layer was created to represent growth zones outside city limits. The widths of these zones are based on the Texas rules for the width for each community's extra-territorial jurisdiction (ETJ). The ETJ of a municipality is the unincorporated area that is contiguous to the corporate boundaries of the municipality, the width of which varies by population (Table A-3). U.S. Census Designated Places (CDPs) were also included in the analysis, though under Texas law they do not have ETJs.

Table A-3
Width of Extra-territorial Jurisdiction by Size of Population

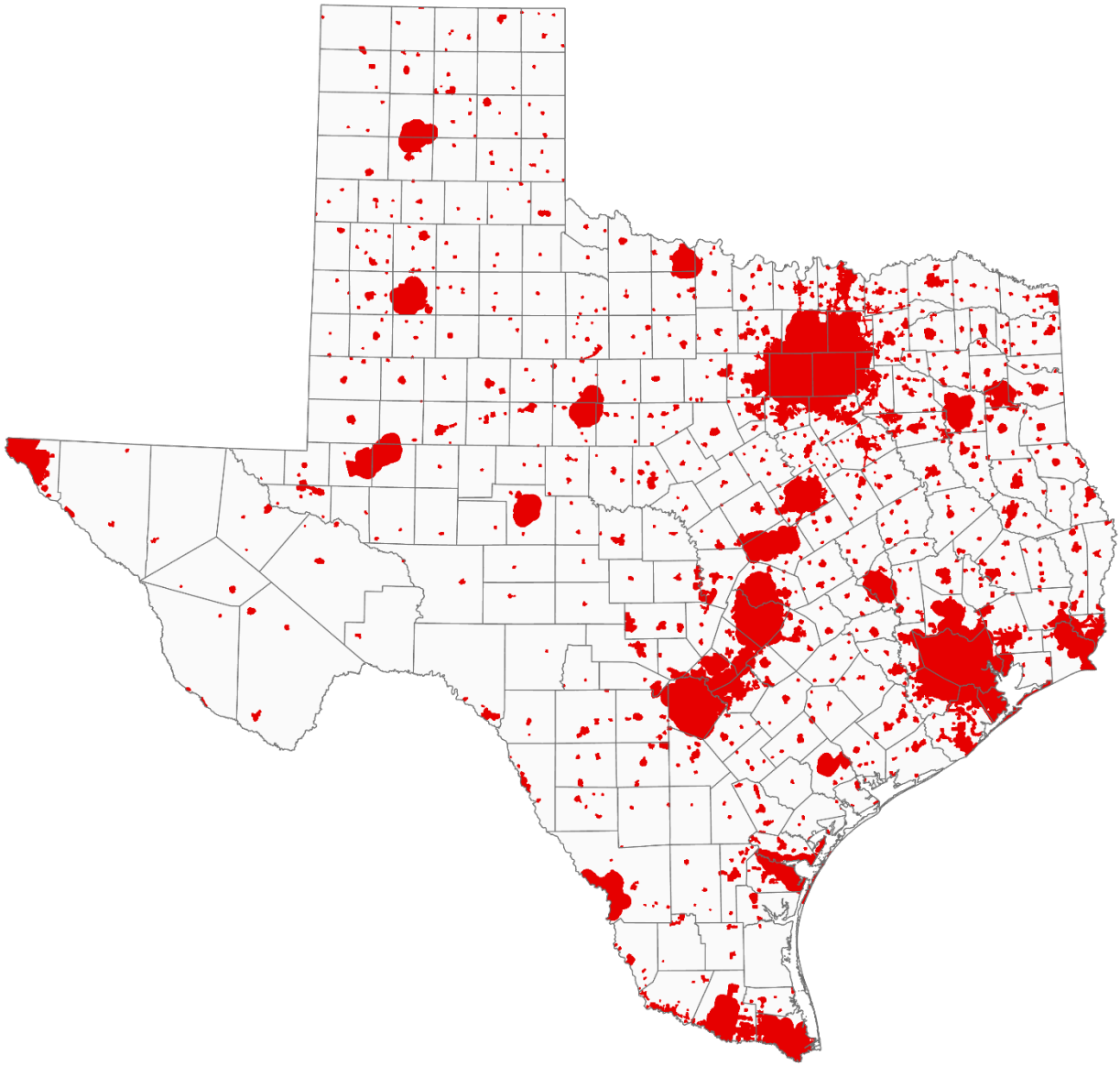
Municipality Population	Width of ETJ (miles)
< 5,000	0.5
5,000 –24,999	1.0
25,000 – 49,999	2.0
50,000 – 99,999	3.5
≥ 100,000	5.0

Each pixel of the growth zone layer was identified to a specific Place. This was done by first rasterizing a Place shapefile to 30-meter resolution and then using the Straight Line Allocation function in ArcGIS Spatial Analyst (Spatial Analyst>Distance>Allocation) and setting the maximum distance to the width of the ETJ (in meters). This function creates a new raster layer and assigns each cell, or pixel, the value of the source to which it is closest, in this case, Place. This was done five times, one for each of the five ETJ widths. For each of these five layers, a separate Place layer that had been filtered to include only those places with a population of at least the minimum required for a given ETJ distance was produced and rasterized.

After all five raster layers were produced, they were mosaiced together using the ArcGIS Mosaic to New Raster tool in ArcGIS Toolbox. To ensure that overlapping ETJs were assigned the correct Place, the raster layers were placed in increasing order of ETJ width within the tool and the *Mosaic Method* set to *First*. Although ArcGIS is supposed to automatically determine the correct *Pixel Type*, a software bug was discovered that gave false results for one of the layers unless the *Pixel Type* was set to *32 Bit Signed*. The resulting layer, which is Places with associated ETJ, is shown in Figure A-21.

The layer described above was produced to be able to summarize by ETJ. The actual Growth Zone layer was produced by creating a raster layer where the area within the Place boundaries were given a layer value of 100 and the ETJs outside the Place boundaries were given a value of 0.5. All other areas were given a value of 0. This Place Growth Zone layer is shown in Figure A-22.

Figure A-22
Place Growth Zone



APPENDIX B — STAKEHOLDER INPUT

Texas A&M Forest Service solicited comments and feedback from interested stakeholders and the public several ways:

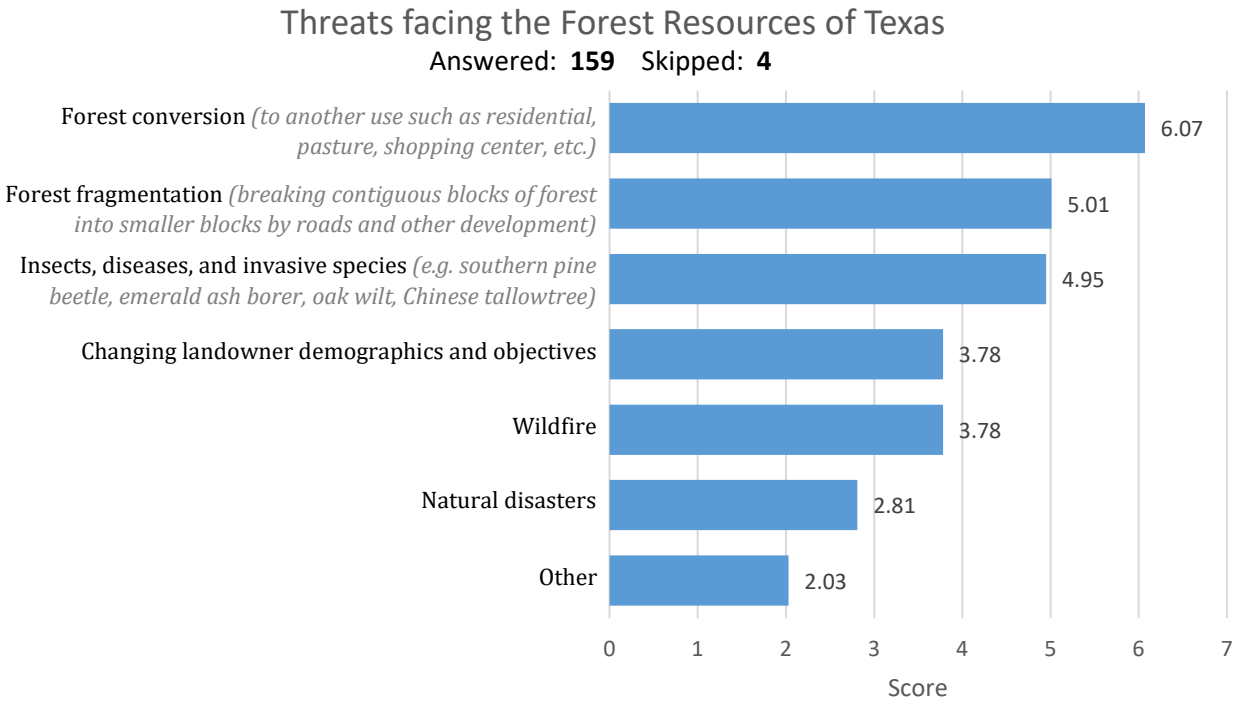
Online survey on important issues facing the forest resources of Texas

In September 2019, TAMFS deployed an on-line survey to solicit comments from interested stakeholders and the public in general to aid in the development of the 2020 Texas Forest Action Plan. The survey was announced at various stakeholder meetings, such as the State Forest Stewardship Coordinating Committee, on the TAMFS website, and the Texas Forest Action Plan web application on the Texas Forest Information Portal (http://texasforestinfo.com). The survey was left open through June 2020 and generated over 160 responses.

Following are summaries and list of responses to questions included in the survey.

Question 1

Please rank the following threats facing the forest resources of Texas, 1 being most important.



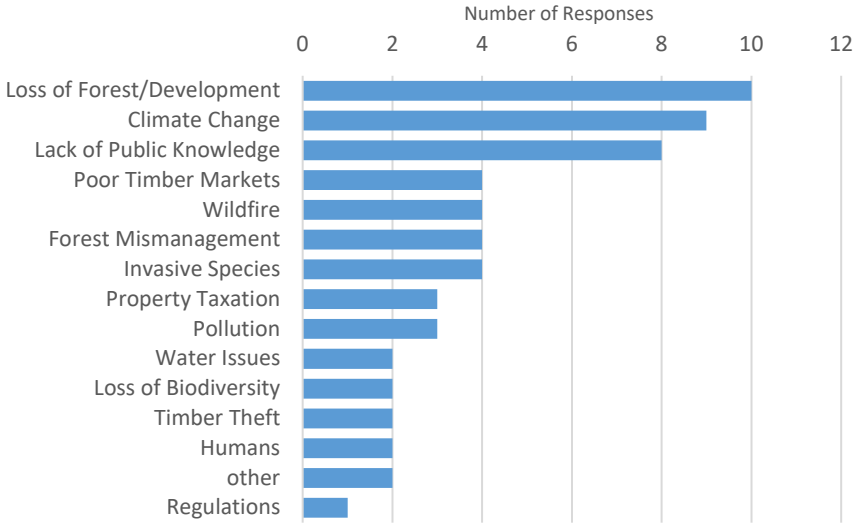
Respondents to the survey ranked Forest Conversion highest of the given threats (1-57%, 2-19%, 3-11%). Forest Fragmentation ranked second (1-14%, 2-31%, 3-22%). Insects and Disease was a close third (1-14%, 2-28%, 3-24%).

Respondents were given the opportunity to name any other threats they felt were important in Texas. Responses for Other were categorized by keywords. The most common categories were Loss of Forest/Development, Climate Change, and Lack of Public Knowledge.

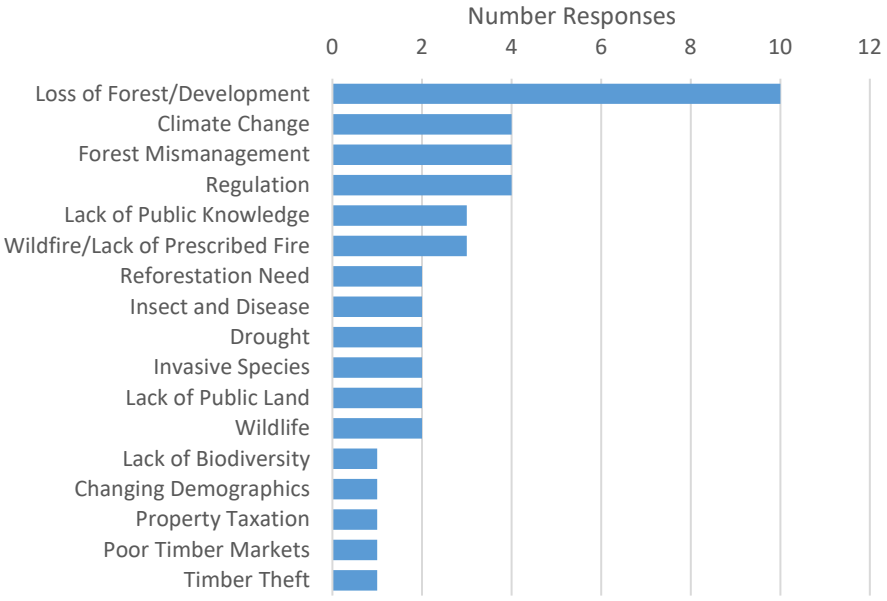
Respondents also were able to provide comments on threats facing Texas forest. By far, the greatest frequency of responses were under Loss of Forest/Development, more than twice that of the next three tying categories: Climate Change, Forest Mismanagement, and Regulation. The fifth and sixth category of responses were Lack of Public Knowledge and Wildfire/Lack of Prescribed Fire.

Individual responses are provided in a table following the charts.

Other Threats



Threats *Comments*



Responses to **Threats Facing the Forest Resources of Texas**.

Other (71 answered – 92 skipped)	**Comments** (54 answered – 109 skipped)
Climate change	
Climate change	
Climate change	
Politicians and citizen lack of understanding of the importance of forests to Texas economy and overall health.	
Lack of foresters willing to work with small landowners.	
Us – we are the biggest threat to destroying mother nature.	
Theft/vandalism	
Climate change affecting long-term sustainability.	We should focus on urbanization of our forests.
Markets, lack of loggers, and vendors	
Lack of respecting Deed Restrictions for the original gift.	I have continually responded to these inquiries but never seen any change of direction from Forest Service or even a response to suggestions.
Municipal owned forests being misused.	
Urban sprawl, highways	Instead of leaving the future of our environment/land in the hands of private owners (95% of land in TX of privately owned), TX and counties need to start buying huge amounts of land. Increase fuel prices to pay for management.
	Forests require active management to remain healthy. What you see all over the state are big tracts that have been purchased by good people who want to do good, but don't have the education or understanding of what that looks like. Often these places go un-managed, letting "nature take its course" and thinking they are doing good. By far the biggest threat we see.
Litter	I have noticed that resources inside the park are deteriorating. Picnic tables are falling apart or covered in weeds. Signs that use to give information are now blank.
Humans	Mismanagement by so call professionals over 100 years +.
	Excessive herbivory in streams overpopulated by beaver and poor regeneration due to whitetail deer browse.
Industry, oil, gas, etc.	
	Fragmentation and the spread of invasives, especially non-native invasives and the lack of management are destroying forests. East Texas.
	Legislation enforced conservation is crucial.
Invasive plants	
Diversity	We should consider diversity of pine species native to Texas, and diversity of hardwoods native to Texas, possibly reintroducing some that were previously in healthy populations. The 'war department' took/purchased all the walnut trees from our family property for WW2 guns. We can't be the only ones this happened to. Thnx
Citizen apathy towards deforestation.	I think more education on Natural Resources in general is needed for the general public.
	For the most part, literally any human involvement aside from conservation efforts is a threat to forests.

	Please plant more trees after removing dying or diseased trees.
Tree Canopy coverage is getting reduced quickly in DFW.	Please visit Colleyville Nature Center and report on it to the City of Colleyville. It is filled with private volunteers, invasive vine including an abundance of poison ivy. A homeowner has been seen using Roundup which is a known carcinogen.
Healthy groundwater.	
Lack of public education, and awareness.	Changing climate results in native or established species dying. Need more research on replacement trees to plant proactively now. Urban forestry also needs support.
Maintenance of historical forest in agriculture esp. rangeland (ie Eastern Hill Country/ golden-cheeked warbler historical range)	We should be redirecting the E. Hill Country – it's historically the land cover, it's better wildlife habitat (especially since these converted forests are terrible rangeland typically dominated by KR bluestem), it's better for rainwater capture and infiltration, it builds soils, it sequesters carbon better, it's more resilient for droughts and floods!
Poor markets for forest products.	
	Drought isn't stated, but I assume it is included under disasters.
Lack of corridors and ecosystem management.	Such a response could go on for pages. Needless to say that wetlands, streams, upland hardwoods, sensitive habitats and species are disappearing and human-caused climate change is making things worse.
Lack of active management especially on national forests. This provides a breeding ground for insects, disease, and invasives to flourish when conditions get	In areas of East TX, forest fragmentation and conversion due to energy industry needs is drastic and changing our landscape tremendously. We are losing a lot of timberland due to this every year.
Having enough resources.	Tornado not enough vegetation.
Mining and oil exploration depleting the water table and putting trees in danger.	The rate at which we clear land and destroy vegetation is alarming. We have no statewide tree policy and no statewide policy for replacing destroyed trees if even a fraction (like planting some amount of trees on parking lots). It is up to each city and that is very spotty to non-existent except for progressive cities (Austin might be it). We will rapidly destroy what canopies we have left and be left with a paved-over earth especially along major roads and highways. It seems with some policy change, some care, and standing up to the ever-increasing development is a good idea and one that is overdue. Trees are our friends and we don't have a way of defending a part of our community that helps us in so many ways.
	Have visited Friends in Switzerland, the first time in 2000. I was impressed with the length of time their land use, including forests and farms, has been highly regulated. It is all based on quality of life for all. We have to sustainably use our land, otherwise the natural beauty around us will be destroyed. Once gone it is difficult to restore. Farmland is still farm land. Incentives are in place so people will want to live on the land and farm. Same true for forests. I am not familiar with their laws. I just remember that they have not been able to raze forests or cut down trees at will in a very long time. We often think Texas is so big we can do what we want. Property rights are at a height, as is the almighty dollar. In our area we have a rich history of people giving away their land for the common good: to build schools, roads, parks, etc. We must have laws and ordinances to preserve what we have in the way of forests. It appears that some natural wildfires are good, burning away debris in the forest floor in a rather cold fire which doesn't harm trees. Prescribed burns probably accomplish the same. We need a state plan for land use. I think everything you list is potentially harmful to our forests: breaking it up into unconnected pieces, expansion of residential and commercial space (look at north Fort Worth/Keller). All of the grape growing in the hill country. Disease is harder: is the cause, bringing in crops not here before, does it need to run it's course, is it climate change? You have big and important jobs. I hope you have advocates and a budget which support you. All the best.
Pollution	
Timber Theft	Timber theft should continue to be one of the State's objectives to protect forest land owners.
High fuel loads on un grazed pasture land.	Wildland fires and prevention through prescribed burns should be more emphasized and promoted than what currently is.
Excessive taxation forcing landowners to sell, often to foreign buyers.	

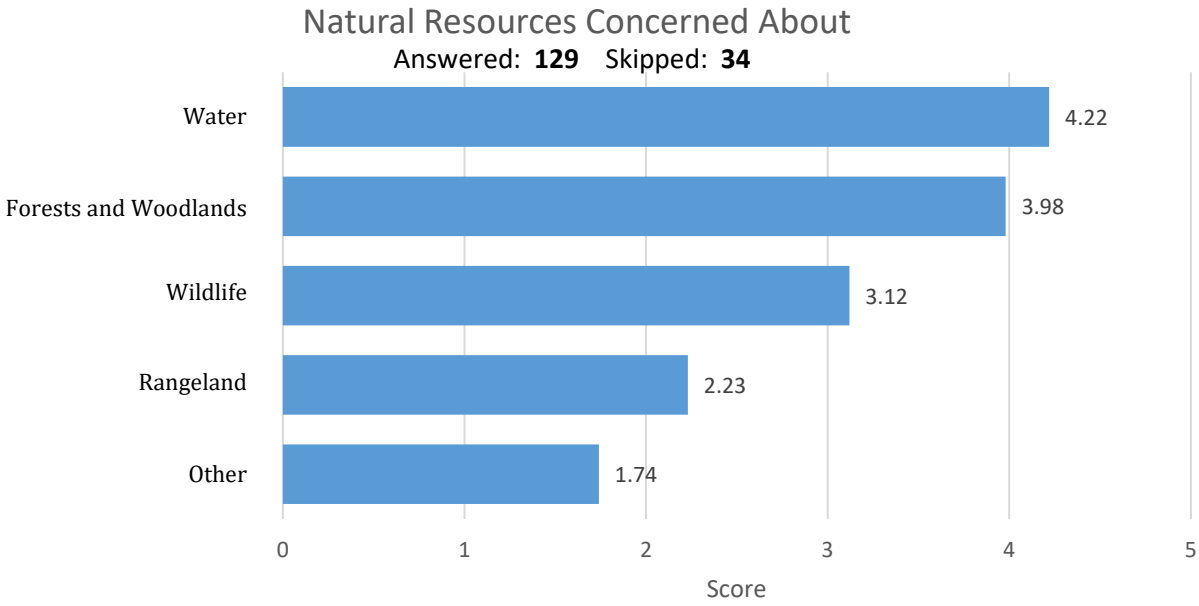
	Too many city folks moving out to the country, buying large tracts of land that used to be a large ranch, and starting fires while burning brush. There are large amounts of dead trees from diseases and drought, which doesn't help. I think Central Texas is due for a very large fire like we have never have seen before.
Unregulated residential companies destroying urban forests and a lack of environmental education.	
Effects of Climate Change.	How will the Texas Forest Plan address the impact of Climate Change?
Lack of markets	
	Oak wilt - it is the worst tree-related disaster this state has ever experienced 1) study inclusion of silvicide into tools for long term trench success and where trenching not feasible. 2) Increase message and cooperative funding for scouting and removal of red oak species and bur oaks with fungal mats; go after the source – there are leas mats then beetles and wounds (painting wounds message doesn't help with natural wounds that often occur) 3) Push for actual research on the "resistance" level of native white oaks and those white oak species dominating our state nursery sales 4) Make the very first recommendation for all oak wilt ordinances/rules that only ISA-certified arborists be allowed to acquire tree pruning permits
Climate change	Fragmentation of riparian corridors, road construction, development, climate change.
Careless landscapers/ naive landowners, lack of living for your land – keeping good habits.	Same
Lack of Rx fire in Forest Management	All of the threats listed lead to forest fragmentation. Restoration and management and the use of Rx fire is not mentioned.
Loblolly infestation	
Over use of timber, and oil/industry expansion.	
	These threats should be mitigated by forest consumers by replanting.
	I am concerned that the habit of clear-cutting all but oaks persists to this day. This is confounding the serious environmental threat that exists in areas where oaks are predominant. I would like to see some provision for stopping people from essentially clear-cutting. If their intention is to create a pastoral landscape or to leave remaining hardwood for communities, either way they are making a mistake that affects all of us and our heritage, our trees.
	For rank #4, Invasive species in my opinion is a far greater threat than insects and diseases.
Introduction of non-native wildlife (axis deer, aoudad, other ungulates) that browse tree regeneration.	Changing landowner demographics is both a threat and an opportunity: many landowners are buying land because they care about nature/wildfire, but they need better information about land management (e.g., not clearing every single Ashe juniper as soon as they buy their property).
	TAMFS needs to work with city/county development groups to ensure the health and well-being of existing woodlands.
Public indifference	I believe another threat to Texas state forests is lack of access to the state forests by the residents of the state of Texas. This means people will feel more removed from nature, value it less, and not support the state forest service politically. Would be nice to establish more forests in close proximity to lower income communities that don't have the means to travel long distances to appreciate the beauty of nature!
Ag Valuation 1d1 change to land cover	Biggest threat is landowner taxation. Need to move from present 1d1 timber valuation to a more equitable formula for vegetation cover benefiting humans, cities, health, etc.
	Large private landowners can change the landscape dramatically.
Climate change	
Political interference in forest management, either by taxation or legislation.	The public is easily manipulated into believing that forest landowners are a rich, greedy, bunch of robber barons exploiting land that should properly be managed by incompetent government regulators for "sustainability." Nothing could be farther from the truth. Nobody

	wants my land to be better utilized than I do. I want that land to provide clean air, clean water, and adequate income to my family for many generations to come.
Low market demand for timber.	Negative public policy and urbanization of the state could potentially have negative consequences on timber valuation for ad valorem timber valuation.
Drought	Ranching seems to be the biggest threat.
FIRE	
Public ignorance/misinformation	
	Avoiding forest conversion and forest fragmentation are both #1 concerns to me. I am a user of the WG Jones State Forest. With the increased traffic and nearby development it is very important to halt any "bites" taken out for neighborhoods, buildings, etc. How wonderful to see the horseback riders yesterday, but disheartening to see cars on the nearby road in the Stillwater neighborhood.
The modern human's separation from nature.	
Pipelines and power lines and lakes.	I want land taken by eminent domain to be rented/leased from me.
Mortgage	
Cutting down cedars, believing they are bad for the land.	
Mismanagement by the Texas A&M Forest Service – would love to see specific plans for Goodrich forest. All I have seen on the service's part is wanton destruction of forest trails.	
Shift in climate due to climate change.	
Pipeline clearing for Permian Highway Pipeline (Kinder Morgan).	
Light pollution	
Edwards Plateau: Cedar, Mountain Juniper, effect on oaks during drought.	Oaks are being choked out everywhere I look, in Blanco and Hays Counties. Sad. Low rainfall is a disaster for choked oaks.
Over developing	
Fires (wildfire) are symptomatic of climate shifts - better Rx fire program in TX would benefit all Texans and not just forest landowners.	Look more into alternative forest planning options – processes rather than high yield loblolly pine – it is not the market for many recreational owners.
Lack of owner knowledge.	Workshops / learning events need to be free & publicized in an event section on website. Please have more events in East Texas area. Do you offer a text group for East Texas events? If so add us 214-555-5555 Please add events to Eventbrite. Thanks for this survey.
	I'm out Hall's Bluff on CR 2035, and beetles are killing all sizes of pines, faster than two of us can cut and burn them. Is there any help, advice you can offer????? In a year, I won't have any pines left on my 200 acres. Please call me. 713-555-5555, B…. P…..
Fire ban should be in force for all of Texas.	
Loss of biodiversity	
Losing large tracks of natural forest for all to enjoy and learn from. Keeping the forest against flooding.	I don't think Texas does a good enough plan to protect wildlife areas. I believe Texas is way too happy to have the taxes from developed land and it is costing us all. We don't need any more strip centers and gas stations.
Low timber prices	

Swarms of bees in the back of forest	These bees or horseflies chased me the whole time I was in the forest
Logging	Trees can live without humans, but humans cannot live well without trees. Thank you for caring for Texas trees!

Question 2

Please rank the following natural resources in Texas in the order in which you are concerned, 1 being most concerned.



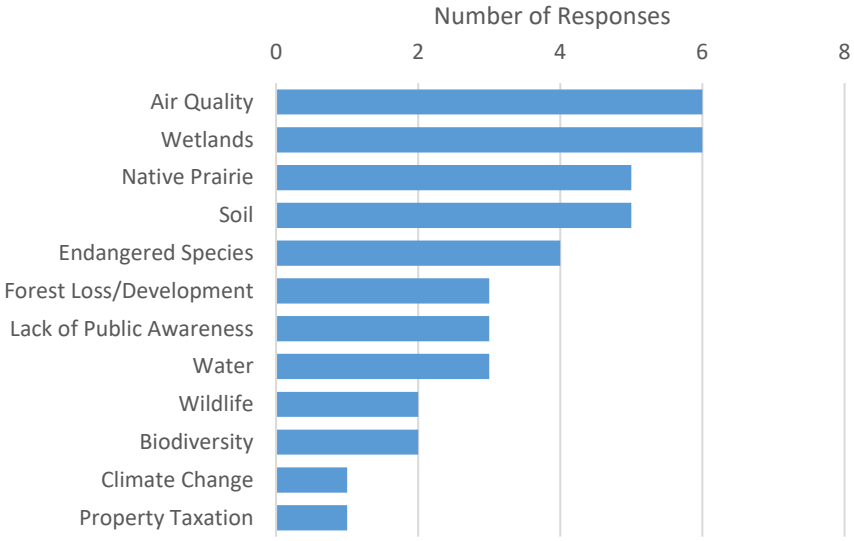
Respondents to the survey ranked Water highest as the natural resource concerned about (1-55%, 2-20%, 3-17%). Forests and Woodlands ranked second (1-27%, 2-50%, 3-17%). Wildlife was third (1-12%, 2-20%, 3-39%).

Respondents were given the opportunity to name any other natural resources they are concerned about in Texas. Responses for Other were categorized by keywords. The most common categories were Air Quality, Wetlands, Native Prairie, and Soil.

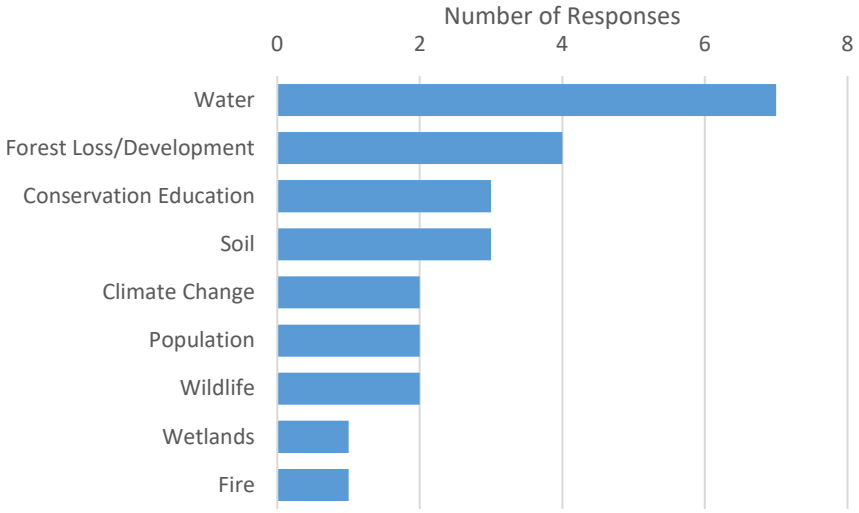
Respondents also were able to provide comments on natural resources of concern. By far, the greatest frequency of responses was about Water. Forest Loss/Development, Conservation Education, and Soil were the next three.

Individual responses are provided in a table following the charts.

Other Natural Resources of Concern



Natural Resources of Concern *Comments*



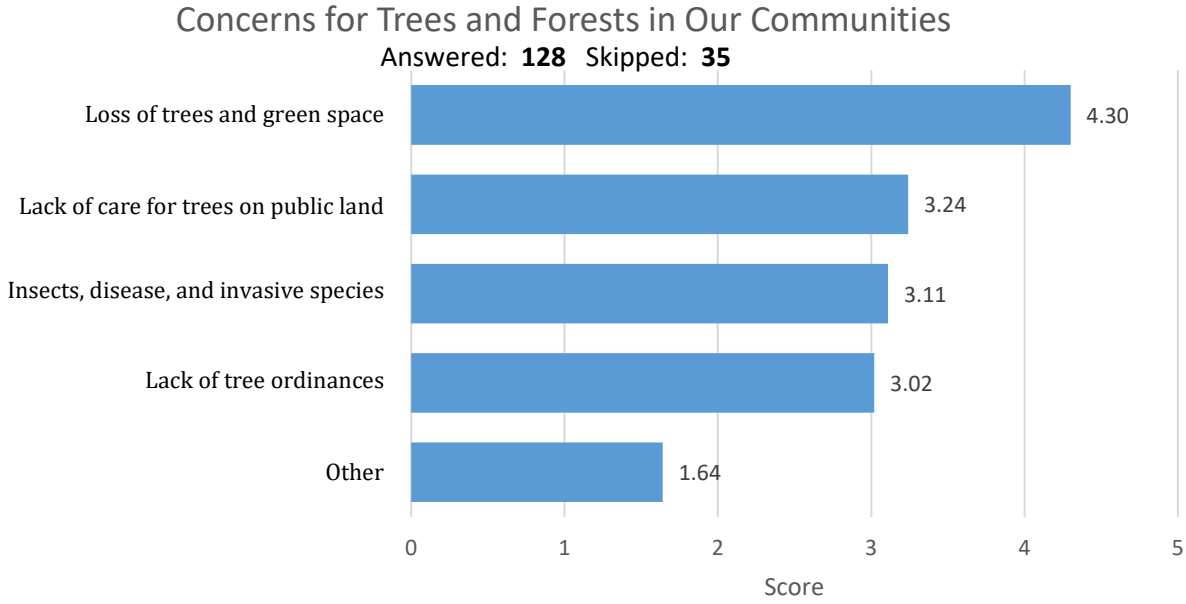
Responses to **Natural Resources of Concern.**

Other (44 answered - 119 skipped)	**Comments** (30 answered - 133 skipped)
How many Texans don't manage their lands for endangered or listed species.	
Swamps and wetlands	
Desert southwest	Rapid population growth in this state.
All of these effect water and habitat.	The elephant in the room is overpopulation...exacerbated by climate change. None of this will matter in a couple of hundred years.
Prairies	Keep the oil in the ground. Foster and create strong protections for our water and other land resources (eg. The Devil's River – water must stay local, don't let them pump and sell)
air	All these are linked. Improve the air, water and you will have a better land. improve water, forests and woodlands you will have better wildlife, water and all the rest.
Contiguous pathways for wildlife, both water QUANTITY/REUSE and QUALITY, and air.	
Air Quality and Endangered species, unidentified plants.	Human health has been damaged as a result of delays in Forest Conservation especially in urban areas such as Colleyville, and other cities around DFW airport.
Coast.	Need to support coastal stabilization and increase/ enhance wetlands
Soils	We need to focus on retaining water, slowing runoff, and building soils.
Grasslands other than rangeland	
Seeps, springs, high water tables, shallow groundwater, and groundwater and surface water connections and how these express themselves as water-dependent habitats.	Our water-dependent habitats are disappearing due to human destruction and degradation and climate change.
	Water – training and education about water conservation/use should be a top priority. Most people think we have an endless supply. We must change that mindset. The previous year of record amounts of rainfall throughout our state has further exacerbated the mindset of excessive use. The next drought will be a good opportunity to start enacting this change of mindset. I don't think anyone will listen until then.
Personal availability and free training.	Need to have free training program.
Land consumed by landfills; need more efforts to produce less trash to reduce consuming land for landfills.	Border wall will be a disaster for wildlife and water; not sure what Texas can do other than keep opposing the Border Wall.
These are all so interrelated. Wetlands, green belts, sustainable green farming.	
Education of ranchers and landowners.	More education on prescribed burns to ranchers and landowners is needed.
Soil	Soil loss, destruction of soil structure, and pollution from chemicals and plastics concern me greatly. All things rely on soil.
Oil, Gas, Minerals	All the above impact each other in direct relationship and ultimately impacts overall quality of life.
Power Generation	I wish there was more done to control Mountain Juniper, or cedar trees. They are the devil, both for fire development and water usage.
Parklands and endangered species	

	It's hard to rank these when wildlife, water quality, and forests/plant life are intricately dependent on one another.
Rare plant and invertebrate species	
Soil. Land level. Yard drainage	Irrigation. Low land level.
Non-urbanized and industrialized land that is natural habitat land free of major intervention by humans.	
Clean air	
	Conservation should be the key element of any program.
	The use of game proof or "high-fencing" across Texas will eventually cause a major decline in the states whitetail deer herd due to inbreeding. It's just a matter of time.
Air quality (carbon and air pollution)	The ability of forests/rangelands to sequester carbon and improve air quality is not fully appreciated in Texas. More attention the benefits of trees/shrubs in removing carbon and air pollutants may encourage better land management.
	After water, forests and woodlands are critical to all other natural resources.
Prairies and wetlands	I'm worried about the health of all complex ecosystems, including forests, woodlands, prairies, and wetlands for the ecosystem services they provide such as cleaning air, water, and providing large carbon sinks. Healthy ecosystems include a healthy balance or predator and prey species and keystone species as well. I believe rangeland in Texas suffers from fragmentation, which is debilitating to many species, but I'm less concerned about it than others.
1d1 ag timber valuation changed to land-use for benefit to	
Wetlands	
Native Prairie	
Biodiversity	
Urban/suburban/exurban sprawl	
Rivers and lakes	
Native grasslands	
	Native grasslands
Soil	It is a waste of energy and resources to transport water long distances.
Air Quality and Light Pollution	
Coastal Wetlands and Wildlife	
SOIL	So much soil is being lost to erosion and ending up in our water sources because of irresponsible development. We need to empower more landowners with knowledge, resources, and management to develop responsibly and regeneratively for our ecosystems.
Keeping the state forests and parks totally natural for all.	
Recreation and population dynamics	Concerned about human population and its effects on recreational areas.
Wildflowers	Texas is a very diverse state. Beauty and historical. Nature is the most important resource here, including Great Bend National Park. Must find the best way to way to live and care for nature.

Question 3

Please rank the following concerns you may have for trees and forests in our communities and urban areas, 1 being most important.



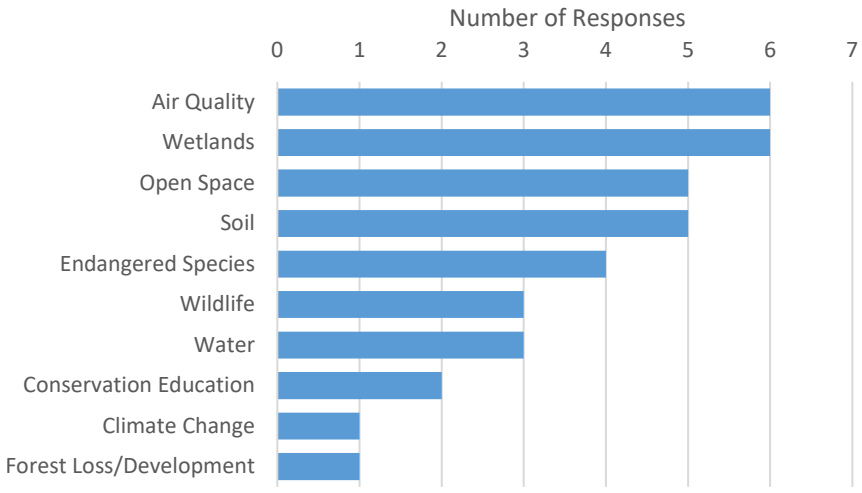
Respondents to the survey ranked Loss of Trees and Green Spaces the highest concern for trees and forest in communities (1-63%, 2-18%, 3-7%). Lack of Care for Trees on Public Land ranked second (1-7%, 2-36%, 3-33%). Insect and Disease was third (1-16%, 2-17%, 3-31%).

Respondents were given the opportunity to name any other concern they may have for trees in communities. Responses for Other were categorized by keywords. The most common categories were Air Quality, Wetlands, Open Space, and Soil.

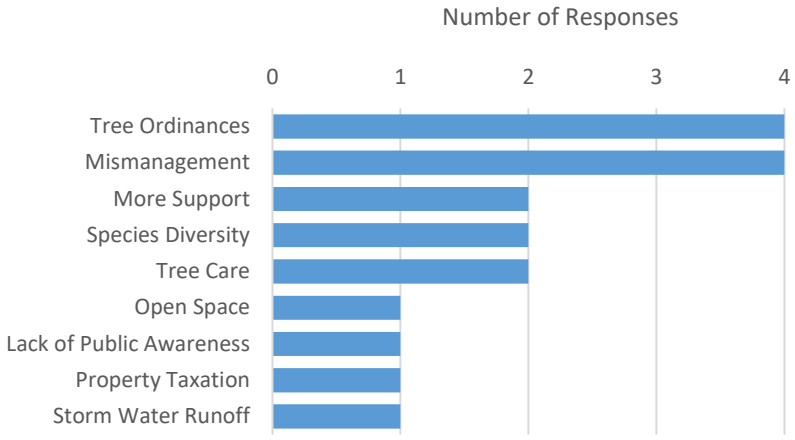
Respondents also were able to provide comments on concerns for trees in communities. The two highest, with the same number responses, were Tree Ordinances and Mismanagement.

Individual responses are provided in a table following the charts.

Other Concerns for Communities



Concerns for Communities *Comments*



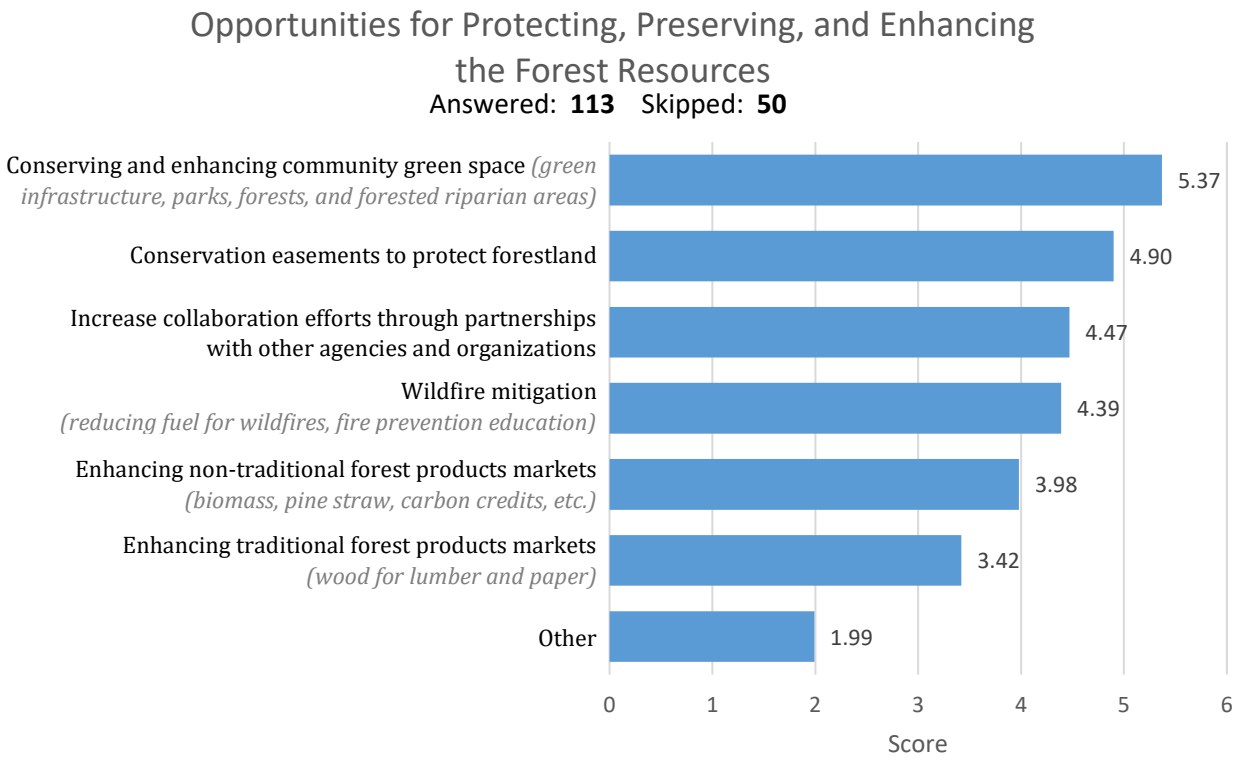
Responses to **Concerns in Communities**.

Other (40 answered – 123 skipped)	**Comments** (30 answered – 133 skipped)
Lack of understanding about ecosystem services provided by trees.	
Veridian Community in Tarrant County destroying thousands of acres of wetland in flood plain.	
Commercial over development.	We need to set aside more open space in urban areas.
New developments should be required to plant a minimum of four long living, large, trees per lot, and no fences allowed (unless they are small to contain a pet) to allow wildlife to pass through.	The urban forest departments of cities need to overlap efforts with other departments, such as the energy conversation and efficiency programs, water conservation, health, economic development, etc. Trees are beneficial in so many ways.
Urban expansion	Lack of regulation of builders who indiscriminately clear lots in rural developments.
People	
Lack of education in the benefits of native species.	Most people cannot afford to care.
Lack of strength and enforcement of Tree Ordinances.	New trees continue to be planted too deep, encircled roots and "permanent staked too long with straps and ties left on that tree gets strangled. I see it over and over. Cities should be encouraged to inspect the new trees and correct these problems.
No support for urban forestry plans, planting, education.	Need state program to support urban forestry plans.
Using existing parklands to reforest areas.	Trees are a no-brainer in urban areas – they provide shade, hold moisture, sequester carbon and air pollutants, build soils, hold landscapes.
Drought	
Loss of den trees, cavities, downed wood, snags, and other biological legacies.	Humans "clean up" forests and we lose biological legacies which provide the landscape diversity and heterogeneity that is needed for a healthy forest.
Public outreach and education on benefits of trees and forests in our communities.	
Tree stability	Replanting
Pavement/concrete; clearing for parking lots and buildings destroys so many trees; need to replace trees, use permeable concrete to reduce erosion and protect the water table.	
I remember when our church cut down over 200-year-old oaks to make more room for parking. I only knew of it afterward and was sick. Likewise, a person moves to town, buys a lot with one of the grandest oaks I have ever seen, and then builds a McMansion, hiding the oak. Will the oak die.	What about all the water runoff from all the paving, etc. There are ways to landscape to prevent runoff in urban areas, especially, which only adds to pollution of our waterways and more wasted water usage.
Native tree planting.	Need to promote native tree species versus imported trees. Plant what's native to your region.
Other concern: poor pruning practices, too much branch removal during bad pruning, lack of training for tree trimming services; and damage to the base of trees in public spaces by grass-cutting equipment (e.g., in the school yard next to us, the trunks are continually damaged). (BTW, I don't know what is meant by "lack of tree ordinances.")	General lack of care about the welfare of trees. I think public education may be appropriate. Maybe people think trees are so big they can take care of themselves.
Clearcutting for construction.	
Lack of species diversity. Too many live oaks.	

Agencies ignoring tree ordinances, e.g. TxDOT.	
Too much overgrown unattended wild green pastures.	Shrubs and weeds kills giant trees or young fruiting more friendly plants. Overgrown nuisance neighbors in the lawn.
We have too much urbanization in Texas, but this is inevitable to an extent. We need to do better protecting Texas land from becoming the next overpopulated state, with no wildlife/nature.	
Allowing developers to cut established communities of trees and plant cloned twigs as replacements.	Lack of financial consideration for tree loss/natural sound buffer loss/ increase light and sound pollution with state highway widening projects.
Short-sightedness of city officials in managing woodlands.	Our local development corporation wants to clear out an arboretum in town so that the businesses behind it can have a 'clear view' across the woodlands. Shredding everything under a certain caliper, no distinction.
1d1 ag valuation for small land 1 acre up change to land cover use that benefits humans.	Offer 1d1 valuations to all land covers 1 acre up.
Developers must be held accountable.	
Climate change	
Unnecessary mowing of right if ways.	We serve so much money mowing enormous right of ways. Why? Morning a single strip skiing roadways and letting the rest be natural would increase trees and decrease the money we spend and all the fuel it wastes.
Injury/destruction by people.	
Lack of public awareness on these issues.	Replacement/mitigation for trees taken out.
Lack of public education about land management practices.	
Lack of owner knowledge	Searchable by common name or scientific and printable tree care on your site.
Loss of tree diversity.	While there are good tree ordinances in place, I believe there is not enough enforcement or management.
Places for wildlife to thrive and for all to enjoy	
Lack of forest/land management in green spaces and lots.	

Question 4

Please rank the following opportunities for protecting, preserving, and enhancing the forest resources of Texas, 1 being most important.



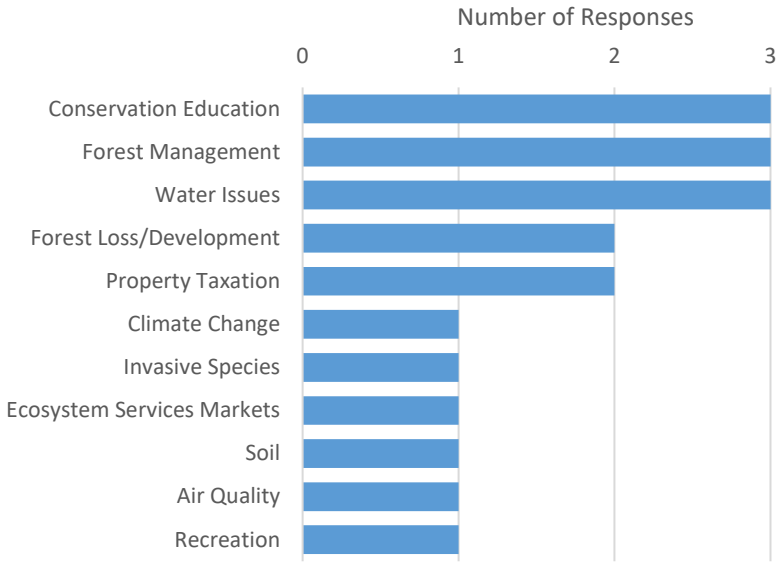
Respondents to the survey ranked Conserving and Enhancing Community Green Space highest for Opportunities for protecting, preserving, and enhancing forest resources (1-30%, 2-27%, 3-15%). Conservation Easements ranked second (1-26%, 2-21%, 3-15%). Collaboration was third (1-10%, 2-12%, 3-28%).

Respondents were given the opportunity to name any other opportunity for protecting and enhancing forests in Texas. Responses for Other were categorized by keywords. The three most common categories were Conservation Education, Forest Management, and Water Issues. The next two highest were Forest Loss/Development and Property Taxation

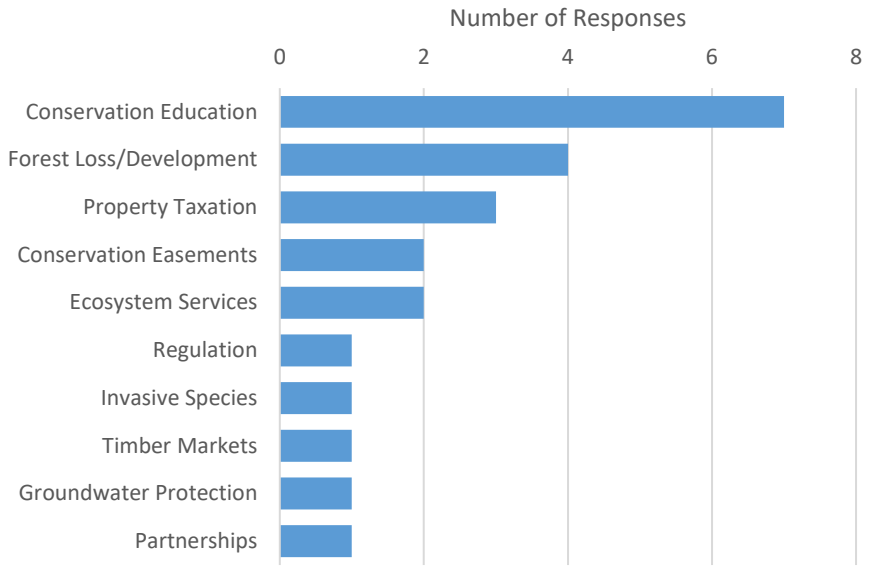
Respondents also were able to provide comments on opportunities for protecting, preserving, and enhancing forest resources. The top three in order are Conservation Education, Forest Loss/Development, and Property Taxation.

Individual responses are provided in a table following the charts.

Other Opportunities



Opportunities
Comments



Responses to **Opportunities for Protecting, Preserving, and Enhancing**.

Other (25 answered – 138 skipped)	**Comments** (29 answered – 134 skipped)
Encourage Forest Management not Plantation Management	
Provide tax breaks for responsible land use.	Reduce tax breaks for urban construction projects.
Lack of loggers and vendors	
	Increasing state- and county-owned land. Increasing conservation easements assistance for sure!! Funding program for land restoration.
Water	Don't cut down the trees. I live in Creekwood Ranch and they are @@@@@@@@@@ all trees!
	Try working with the Texas State Soil and Water Conservation Board. Then work with cities/arborists. Vote Abbott out because he doesn't appreciate trees, and start lobbying elected officials NOW even though we are >1 year from the next legislative session. Make it illegal to plant invasive trees or woody ornamentals.
Water, Air, Soil	Ask Cities to keep greenbelts and commit to conserving post oaks, blackjack oaks etc.
	Organize CITO events (cache in, trash out) with local Geocachers. Geocaching.com
Coastal trees	Coastal trees protect shoreline and can reduce impacts of storms.
Reforesting existing open spaces.	
	I would love to see Texas embrace non-traditional forest products. I have started buying paper-free toilet paper and facial tissues, so there may be a shift away from using forest products for these things.
Mitigate drought and tree loss with water from fracking.	
Using up too much of the forest.	There still is a heavy utilitarian focus on forests. The idea that forests only work when they benefit human economics is archaic and untrue. Ecosystems are what humans depend on the survive. We should protect and restore carefully, with a light hand, ecosystems do their ecological and evolutionary processes can function for all life.
	Traditional forest product markets drive active forest management and sustainability in turn touching and enhancing everything else on this list.
Free training for all	Training
Better use of technology, better government policies for environment	Allow easy ag exemption for keeping land natural with no animal or crop production; program of buying land and preserving through private/public partnership, more restrictions on development to restore and/or preserve.
I visited a state park s few years ago and was dismayed to see elephant ears growing on the edge of the stream. When I pointed this invasive species out to the park employee, she was totally unconcerned.	Again, all the above are interrelated, but you have to start somewhere.
	Continue to educate the public and private landowners about Best Management Practices throughout Texas.
Protecting ground water.	More needs done to protect our ground water.
	I would like to see churches invited to actively participate in conservation education and efforts.

	We need to wake up before we become like California! I was on a fire a few weeks ago and it was a miracle that several homes weren't burned down. Started by homeless people camping in the woods. That's a whole 'nother subject!!
Hiking and canoeing	
Bamboo pine. Oak gravel. Grass	Lots needs to be tended.
Working more closely with local emergency managers, and also regularly working with county Commissioners Courts to establish policies/programs protecting rural Texas land, and Texas Trees from rapid urbanization and industrialization.	
	Timber companies and landowners should leave a percentage of hardwood trees and areas of underbrush when clearing for planting and when harvesting, for birds and wildlife. Total clear-cut of large areas can be very disruptive to both. Also when planting new timber, I think some percentage should be planted with non-timber species unless stumpage is allowed to regrow.
Educating landowners and counties as partners.	
Climate change mitigation	
	Public money working with private organizations could get free labor from community groups to plant trees, especially urban forests, and would develop greater appreciation and motivation to preserve trees.
Public education; non-traditional means if needed.	
	I think the government owning and controlling swaths of land may not be the solution. EDUCATING the public so that more people come to appreciate and respect the forest ecosystem is the key. Books only go so far. The education has to be experiential.
Enhance and protect private forest landowners.	Reduce the burden of taxes on landowners.
	Public service announcement on TV, YouTube, and/or radio plus presence at Earth X in Dallas. Let Texas residents know benefits that forests provide to us as individuals.
	Access to a professionally guided knowledge enhancing landowner group.
	What is meant by "Enhancing" traditional and non traditional forest products?
Carbon and ecosystem services markets	We must make it more attractive to keep forest standing, rather than cutting them down. So, enhancing wood products markets takes us in the wrong direction.

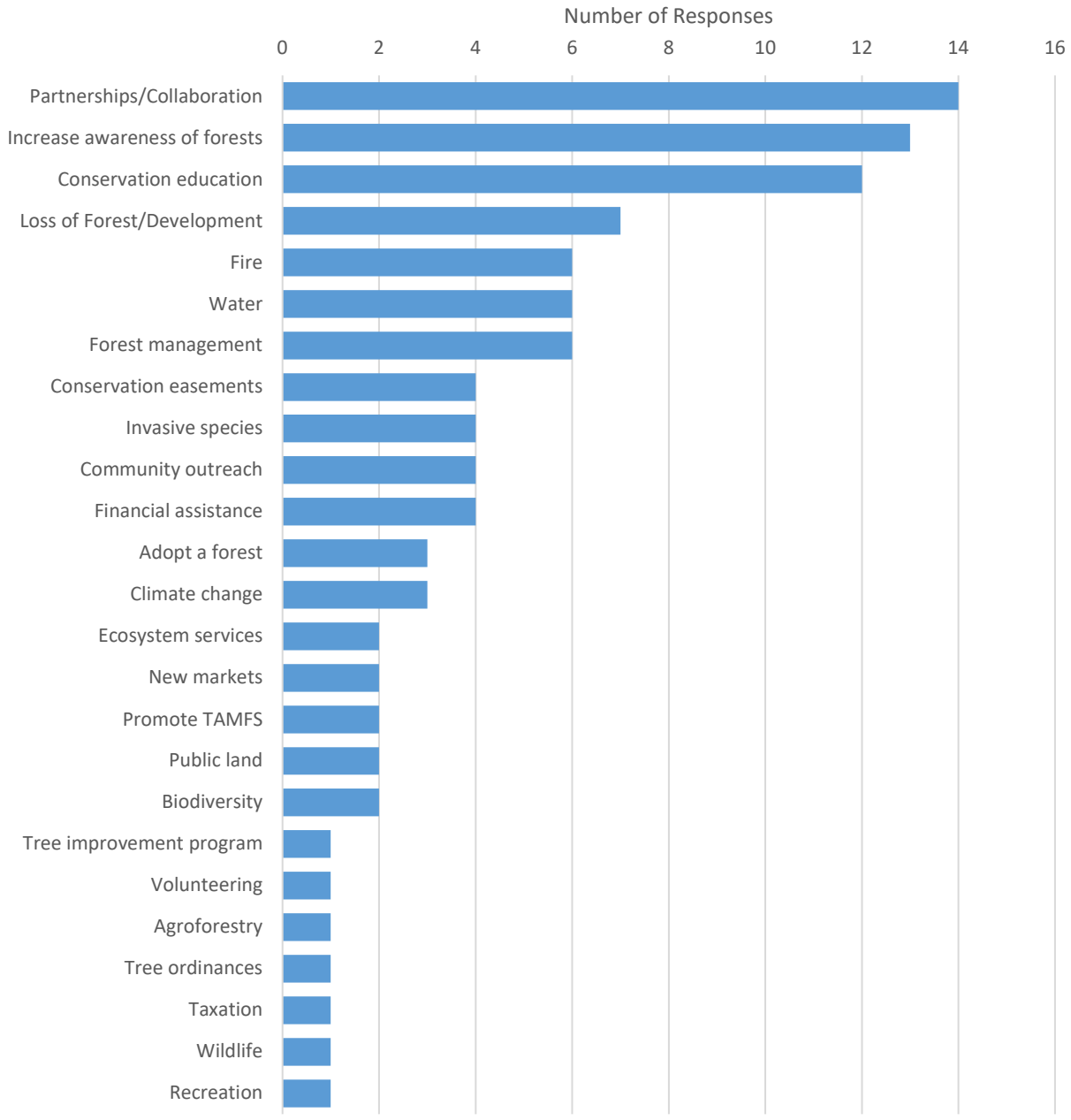
Question 5

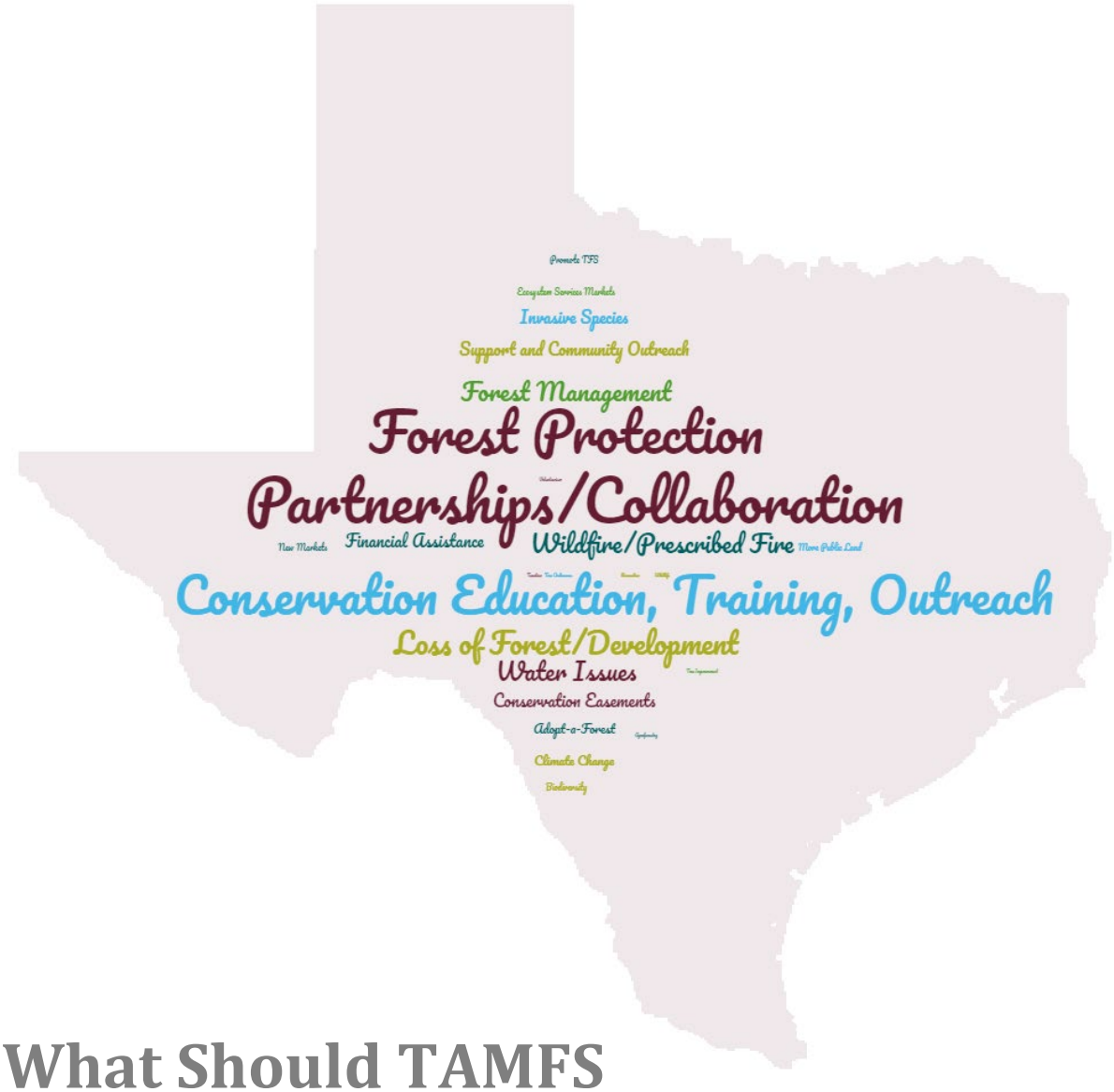
What should TAMFS do to address these threats and opportunities? Answered: **81** Skipped: **82**

A total of 81 responses were received and each one was reviewed and one or more keywords or phrases were assigned each one.

The top three categories were Partnerships/Collaboration, Increase Awareness of Forests, and Conservation Education. These were included in almost twice as many comments as the next four categories or key phrases: Loss of Forest/Development, Fire, Water, and Forest Management.

To understand truly the breadth of comments, the reader is encouraged to review the actual responses provided in the table.





What Should TAMFS Do to Address These Threats and Opportunities

Responses—*What should TAMFS do to address these threats and opportunities?*

Encourage conservation easement, support local municipalities in land protection ordinances and tree removal ordinances, educate about invasive species, and provide collaborative funding for restoration projects.

TAMFS should have more community outreach on a federal, state, and local level. Everyone needs to know the growing threat that climate change and over development has had and will continue to have in Texas.

Collaboration of teams in designated areas.

Better information sharing and transparency. Let's see oak wilt risk. Let's see wildfire risk. Let's see species vulnerability due to climate change. People can be empowered to do something great with this information. We do it with crime stats, floodplain mapping, etc.

Educate staff; educate politicians; educate citizens; lead by example not "do as I say - not as I do"! Make the state forests prime examples of forest and water management, not a plantation crop management system; plus fix the erosion problems TAMFS created with its operations. Why should I as a landowner use BMPs when TAMFS doesn't. Anyone who visits a state forest can see TAMFS isn't serious about what they teach.

Force Viridain in Tarrant county to stop mowing the wetlands and plant forbs and native grasses around them and the man-made lake.

Emphasize urban conservation, support efforts to maintain privately owned open spaces, and encourage (monetarily) production of reusable/recyclable forest products.

Listen and discuss...at least participate in open discussion.

Tax the oil and gas industry, gasoline tax. Pay for programs to increase conservation easements, land restoration, purchase & manage land, create restrictions on suburban development and stop building more highways. Incentivize urban core dwelling and mass transit use. Preserve the nature surrounding cities, and allow access for enjoyment and stewardship. And connect the urban forest to the rest of the wild lands.

Encourage and educate Texans on how to manage the resources to provide the greatest long-term benefits.

Listen to people and educate.

Get the state involved in really protecting the parks and possibly creating more secured land in the future.

Work with landowners to do conservation easements, protect existing areas of forest from destructive human-mediated actions, and control herbivory.

Educate, protect, and plant with the help of communities.

Pursue legislative conservation support via lobbying. Maintain already acquired land for conservation and attempt to acquire more.

Lobby elected officials. Education and outreach. Work with TPWD to determine water-loss amounts on land and in riparian environments.

I think we should attempt to start educating students about Natural Resources; the differences between conservation and preservation; and why our forests and rangelands matter. I would go a step further and say it should be added to the curriculum taught in schools. WILD with TPWD is a great start but I think we need to push further to insure the next generation of citizens cares. As an after-effect, they may bring home the ideas to their families.

Take into account both short- and long-term factors. What is our current problem? What problems do we see 10-20+ years from now? What reasonable action can we take to solve these problems in the near future and what long-term and long-lasting solutions can we implement in the future?

Educate the public on the value trees and parks bring.

Protect our natural forests and greenspaces.

Work with every branch of Texas government and the North Texas Council of Governments all the while keeping NASA's info on the Climate Crisis in mind!

Partner with municipalities or non-profits. Technical assistance grants to develop local forestry plans and programs.

Partner with existing organizations like the Texas Hill Country Conservation Network to increase funding, prioritize protection, guide stewardship, etc. We need more money for protection and stewardship. We need to focus on function on natural areas.

Advertise yourselves. Let more people know who you are and what you do. There are a lot of people moving to forested areas, rural, suburban, and urban, who don't know the importance of forest/natural habitat conservation, or if they do, don't know

how to manage their forested properties or communities. Let them know you're here to train people and get them pointed in the right direction.

Identify ways to educate and engage the public on these things. I don't think many people are even aware of the threats and opportunities. Maybe start with school outreach programs?

Use water that is being disposed of by deep drilling to irrigate and plant trees in land that is otherwise unforested.

Spend more time on education about ecosystems, how they work, how they benefit not just us but all life, and encouraging landowners to protect and restore ecosystems.

Keep on keeping on – I believe the leadership at TAMFS has done a tremendous job keeping up with the changing times. The team that runs the show is committed and cares about more than just the paycheck they receive. Thank You!

Make it happen.

Offer free training to anyone.

No silver bullets – especially in urban areas where trees are not valued by developers and governments can't put a tree policy in place.

Make sure you are promoting your importance to all of us: speaking to clubs, churches. Encouraging volunteering/working. Hiring and keeping people in tune with the mission and not in the pocket of

Continue to provide educational learning opportunities to the private landowners of the state.

Promote protecting our ground water. Encourage conservation. Concentrate on native species. Encourage and promote prescribed burning. Focus on rural areas way more than on cities…concrete doesn't BURN but grass and trees do. Quit worrying about publicity and focus on prevention and education.

Education for the public, education for professionals who encounter trees in their regular work, invite more partnerships, offer coursework and volunteer hours for Texas Master Naturalists and school/college teachers. Thank you.

1.) I would like to see Cedar Tree reduction programs. 2.) I am in a Volunteer Fire Dept and would like to start a Firewise program or Defensible Space type program, but I don't think I have time for that with all of my other responsibilities. 3.) On my personal property, I have so many dead trees (big trees) from the drought or insect damage, that have fallen over, some on the fence. I cannot maintain my fence by myself (I am a widow). I cannot burn the trees due to burn ban. My property used to be beautiful when my husband was alive, even though I did most of the work. He drove the tractor-haha. Anyways, it's right next to the railroad tracks and we are overdue for a fire and the RR right of way is a mess. I wish there was a way to get rid of these trees that I could afford. 4.) Most of the fires we go on, people are clueless about defensible space and pretty much anything to do with wildfires, and my whole area is probably 95% rural.

A great need to plant more trees of diverse species in deforested, denuded and burned over areas. Need to prevent people from building homes in remote areas where they cannot be protected from fire.

More education for property owners about invasive tree species; financial or direct assistance for urban/suburban property owners who lack the resources to manage their trees; programs to support the creation of conservation easements; and clean water programs/identification and punishment of illegal polluters.

On invasives –.advertising campaigns to alert people and landowners to destroy the seed tree Chinese Tallows. Encourage them to plant natives. Develop new markets. Discourage land fragmentation.

More markets, tax relief, prescribed burning assistance.

Enact policies for routine collaboration with and openness to constructive feedback from other tree experts such as BCMA consultants.

Participate with other agencies in conservation efforts, advocate for the state to do more for conservation.

Something think bigger more opportunities.

1. Place "extension agents/ambassadors" in each county for the following areas of concern: -Forest and Rural Land Protection -Conservation/Stewardship -Fire Protection/Emergency Management. These individuals could be volunteers for TAMFS instead of employees. Select local volunteers, one ambassador or extension agent for each area of concern in each county. Train the individuals (online preferably) in the legalities of their area of concern, how to work with county and city officials. TAMFS could provide the extension agent with a TAMFS email address. These individuals already know their area very well, and would be passionate about protecting it. This would also provide minimal to no costs to TAMFS, helping distribute TAMFS literature and educating the public all while fulfilling the mission of TAMFS and building relationships with the public. I would recommend having individuals at least 16 years old for these volunteer positions. 2. TAMFS should offer online public safety courses for first responders -Offer wildland firefighting certification courses online -Offer training that familiarizes first responders with TAMFS protocols and procedures. 3. Offer professional certifications from TAMFS, similar to the DSHS Community Health Worker (CHW) Program, but more applicable to the TAMFS mission. -Professional Forestry Certification(s)

-Forestry Emergency Management -Forestry Disaster Mitigation -Forestry Administrative Worker -Forestry Arson Investigation -Certified TAMFS Extension Agent -Etc. These can be done through an online application similar to the CHW program, and verified through the same system. 4. TAMFS should implement an Adopt a Forest program. -Groups/companies can adopt a forest and work with TAMFS for conservation efforts. -TAMFS could provide training to these groups. 5. TAMFS should make Texas students aware of the effects of forest fires, and arson. TAMFS could accomplish this through creating curriculum for fire/arson prevention in Texas schools, implemented into the Agricultural, Food, and Natural Resources pathway. Work with TEA and the Texas Legislature to mandate those curriculum and place it into the Texas Essential Knowledge and Skills for certain courses. I also recommend better public relations with the TAMFS arson investigators, have them visit schools, name honorary officers, etc. 6. Better inform the public of AHIMT efforts and emergency management. -Online courses -Promotional videos. 7. Reconstruct the TAMFS website, create one with a web address similar to new Texas government pages (gov.texas.gov, them.texas.gov, etc.) for better clarity with the public. Migrate the email addresses to this domain as well. -John.Doe@tamfs.texas.gov

Greater community collaboration with rural and urban stakeholders.

Educate stakeholders.

Based on the individuals I have dealt with directly, I think TAMFS is doing a good job of it now. Just keep on this path and solicit input from the people of Texas every now and again.

Continue collaboration with other agencies/partner organizations; continue outreach to landowners about good land management (coordinate with NRCS, TPWD, AgriLife for a consistent message).

Have a TAMFS forester review/approve local plans to change existing city-owned woodlands.

Change legislation to promote a 1d1 ag land cover valuation that provides ecosystem benefits to Texans.

Bring science to the table in every policy discussion!!! The public, municipalities, agencies, landowners and land users MUST face the reality of the forests' role in climate change, wildlife, quality of life, and natural resource protection. TAMFS employees are experts in forest sciences as well as respected community leaders; their influence, more than the commercial desires of for-profit endeavors, is invaluable for our forest future. Thanks, TAMFS!

1. Provide education on the impacts of climate change on forests and encourage climate change mitigation efforts. 2. Encourage donation of conservation easements on forest lands. 3. Increase education on fire-wise practices. 4. Increase education on and encourage invasive species detection and control. 5. Discourage use of old-growth forests for biomass and other consumptive uses.

Very comprehensive multi-use and detailed state forest plan, with a wide menu of remedy and strategies.

Continue educating landowners about all the benefits their forests offer; improve the amount of wildfire prevention education that occurs; continue the tree improvement program. Increase emphasis on urban forestry in underserved areas.

Already doing a lot...educating public, making programs available to land owners, urban communities, etc.

With the growing acceptance of the looming disaster of climate change, I foresee many groups being open to donating to, or participating in, tree planting initiatives, especially in the urban areas. Creating a program that identifies urban areas that need aforestation, and having a plan already laid out by forestry experts, whereby local organizations could easily contact someone with the program and "adopt" an area to plant trees (similar to the adopt a highway program) would appeal to lots of groups. For example, a Boy Scout troop could adopt a local park and plant the trees specified by forestry service experts, and could be coached on how to water and care for the trees, etc. just like adopt a highway. Groups could have a sign posted, which would attract business groups, like adopt-a-highway does. Feel free to call me if you want to discuss this or some other ideas I have. I love trees.

Find new, effective ways to reach the public sector on the truth about conserving, while still using, natural resources. Try not to duplicate efforts of others; but work together or come up with unique twists to the message.

Work to ensure the general public is aware of issues and is educated as to what we can do to keep our forests.

As an owner/producer who was taught to respect the land and its flora and fauna (my father was part native American), more needs to be done to teach farmers/ranchers about the practices of agroforestry. Even in our property tax exemptions for agriculture, timberland and wildlife management, those things are seen as separate practices with separate requirements that are sometimes in direct conflict with one another. (What happens to the ecosystem every time a timber forest is clear cut?). It is possible to overlap timber, agriculture and wildlife/forest management. They just need to be shown how. Urban sprawl developers of cheap homes on postage stamp lots...another story all together.

Increase education for adult citizens and children regarding all aspects of trees.

Stop being managed by TA&M and become part of a state agency that has oversight and allows real citizen input besides a generic surveymonkey survey.

Increase public education about the benefits of fire and increase prescribed burning.

Less infrastructure and housing building.

Think more about the forest landowner and public of the future – stop managing for the past. Texas has chopped up all the piney woods into private parcels – just now providing incentives to conserve and retain larger blocks of working forests (not high fiber plantations but real Pineywoods with quail and turkey.

Please involve landowners on a local level. More advanced events notice. Is there an easy to find contact person per area on your website? i.e. Find a forester?

Please ensure you have information about all the drinking water source water protection areas (watersheds) and drinking water intake locations (general location) in your plan, and please incorporate strategic actions to ensure that property owners are aware of these drinking water supplies and implement priority BMP's to safeguard drinking water. Thank you!

1. Community Outreach and Awareness (Use major and local newspaper outlets with a weekly/monthly information page. Use Facebook/Twitter with links to Website). 2. Forestry/Wildlife education in Jr. High and High School curriculums. 3. Junior Forestry/Wildlife Clubs in all High Schools.

Increase collaboration with private landowners and other organizations, incentivize conservation, and protection and have a stronger presence in neighborhoods and communities so the people feel a more personal reason, and personal interest to protect the forest resources.

Collaboration with other resource agencies and stakeholders to identify common goals and leverage resources. TAMFS is doing a great job in this aspect. Thank you for the work you do!

Maintain the forests for wildlife management and parks for people to walk around and enjoy. We are losing land for this purpose which is tragic and irreparable. Horrible to consider.

Educate landowners about the value of ecosystem services, provide tools that can quantify and contrast them with timber-based valuation. With time, the ecosystem services become more and more important and valuable, and they can only be provided by large contiguous areas of natural lands. We need to change the policies from exploitation-based to conservation-based.

Develop a plan to prioritize (this survey is a good start!). Know that adaptation will have to occur with how different 2020 is looking compared to what the world looked like in 2019.

Education and providing information to private landowners more in Central and West Texas areas as it relates to land management concerns. Not just fire suppression and awareness.

Pre-2020 FAP comments from Sierra Club

SIERRA CLUB

Houston Regional Group
P. O. Box 3021
Houston, TX 77253-3021
www.sierraclub.org/texas/houston

October 12, 2019

Mr. Burl Carraway
Texas A&M Forest Service
200 Technology Way, Suite 1281
College Station, Texas 77845-3424

Dear Burl,

Thank you for notifying the Lone Star Chapter of the Sierra Club (Sierra Club) about the opportunity to comment on the Texas A&M Forest Service (TAMFS) "Forest Action Plan" (FAP). I have already filled out the survey at the link that you provided. However, the Sierra Club would like to provide additional comments in writing due to the importance of the FAP.

The Sierra Club went to the TAMFS website, found a map, but could not find a definition for the FAP. The Sierra Club assumes that the FAP is linked with the 2015 "Texas Statewide Forest Resource Strategy" (Strategy) and the 2009 "Texas Statewide Assessment of Forest Resources" (Assessment). Below are some issues the Sierra Club believes are crucial for Texas forest resources.

1) **Climate Change** – The TAMFS is part of the Texas A&M System and an organization whose charge includes protection, enhancement, and careful use of the forest resources of the State of Texas. TAMFS's research, management, education, and technical assistance is based upon science. The best, sound, science has concluded that climate change is occurring and is caused, in large part, by humans.

It is crucial for TAMFS to incorporate into its research, management, education, and technical assistance programs climate change, its effects now and in the future, how to reduce climate change, and how to adapt to climate change.

Particularly, in the TAMFS's own operations, the reduction of climate change gases (via reduction of carbon dioxide, methane, and other climate change gases) is needed. The Houston Chronicle published a Bloomberg News article by Rachel Adams-Heard on October 11, 2019, entitled "A&M profs decry leaks of methane for UL land" that 50 professors at Texas A&M had signed a letter in support for a plan to reduce methane air pollution by 50% from land managed and endowed to benefit Texas A&M and the University of Texas systems, including oil/gas operations.

The TAMFS should prepare an inventory of climate change gases for its activities and actions and determine how it can reduce these over the next five years via its TAMFS's research, management, education, and technical assistance programs.

The Sierra Club urges TAMFS to educate forest owners and others on climate change, how to reduce climate change gases, and how to adapt to climate change. This is a public service that is at the heart of TAMFS's mission and would immeasurably assist the people of the State of Texas and protection and management of our forest resources. Now is the time to act and the Sierra Club urges TAMFS to be a leader in this endeavor.

2) **Protection, Creation, and Education About Forest Biological Legacies** – The TAMFS should create, protect, and educate forest owners and others about the importance of forest biological legacies. These biological legacies include the presence of individual and groups of upland hardwood trees (both xeric and mesic upland hardwood trees), cavities, dens, snags, coarse woody debris, logs in streams, thickets, root-wads, etc., that enhance forest growth, ecological health, production, and the operation of ecological processes.

Naturally, hurricanes, storms, and insect like southern pine beetles (SPB's) are natural thinning agents and produce pulses of snags, downed trees, and trees altered by wind which produce micro-niches for plants and organisms. The TAMFS should mimic natural disturbances on its own lands to provide an example to forest owners and others of how to avoid the creation of erosion, sedimentation, compaction, hazardous fuels, and the loss of nutrients and organic matter by the creation and protection of biological legacies to help restore normal forest processes.

The ecological health of the forest is what TAMFS should be most concerned about. Biological legacies should be cultivated so that as a forest matures the full benefit of ecological functions, processes, and diversity are in place and working for the health of the forest.

The TAMFS could assist in this process by preparing recommendations for forest owners and others about how and how many biological legacies should be created and protected in a forest. This could include recommendations about how many snags to leave/acre in different types and ages of forests (upland, slope, bottomland) and how much coarse woody debris (downed wood) should be left to provide wildlife with food, shelter, and act as erosion check dams. This can be done by leaving a percentage or specific number of snags and or downed trees on each acre.

3) **Prescribed and Wildfire Burning** – One method of adapting to climate change is the use of prescribed burning or, within prescription, the use of wildfire to burn forest lands. Additional education, technical assistance, and training is needed for landowners and others to increase the level of fire in Texas forests in a safe manner that assists in the creation of a healthy forest.

4) **Ecosystem Services** – It is crucial that TAMFS educate people about the importance of ecosystems and how they support people and all life on Earth by their natural ecological function. Many forest owners and others do not want to manage for wood production. They want forests that function as natural producers of wildlife, aesthetic and scenic attractions, compatible recreation, and help reduce climate change gases. The more that TAMFS can educate forest landowners and others about how ecosystems are the foundation for human life the more people will be positively drawn to protect and manage forests so that people can survive and benefit from forests.

5) **Fragmentation** – Texas A&M, via its Agri-Life and recreation arms, has put out many reports about the fragmentation and parcelization of forests and other lands in Texas. The Sierra Club believes that the urbanization of all of East Texas is occurring right now.

If we hope to have any ecologically functioning forests that can resist climate change, invasive plants and animals, and other human effects we need intact forests that do not reflect degradation and death "by a thousand cuts" due to fragmentation. TAMFS should address this issue in its research, management, education, and technical assistance programs for its lands and forest landowners and others. TAMFS should teach people about buffers, corridors, and core reserves, on large and small scales, so that forests of all sizes will be healthier, less fragmented, and less degraded.

6) **Land Acquisition and Perpetual Conservation Easements** – Due to fragmentation and other human caused impacts we are in a time where land acquisition and or perpetual conservation easements are crucial to forest protection and existence. In another couple of decades, it will be too late to save the best that is left, save large areas for restoration, and connect one conservation area to another.

The cumulative impacts of fragmentation and the deterioration which starts on the edge of forests is increasing. We need TAMFS to be a leader to advocate for protection of the best and most restorable forest lands left. Otherwise in two decades we lose that opportunity.

7) **Public Participation** – TAMFS must be proactive in its outreach to the public. For example, it is not adequate public participation to put a proposed forest plan on the website and ask for public participation. There must be a bolder public outreach, education, participation, and input plan which is implemented consistently and not subject to budget cuts.

The citizens of the State of Texas own most of the forest land in our State and they own the TAMFS. They need a reliable partner who lets them know what is happening, why it is happening, and what they can do to respond. The Sierra Club urges TAMFS to have a broad, comprehensive, and extensive public outreach, education, participation, and input plan and program. Texas's forest resources depend on an alert and vigilant public. That cannot happen if people do not know what is happening.

One good example of how this can be accomplished is to allow full public participation in the revision of the W. Goodrich Jones State Forest management plan. The public is very interested in the protection and ecosystem management of Jones State Forest. There is a concerned constituency present. It would be great if TAMFS would use this management plan revision as an opportunity to conduct a bolder public outreach, education, participation, and input process. This could be an example, a learning experience, for everyone and the management of Jones State Forest would benefit with greater public support and a sense of ownership.

The Sierra Club appreciates this opportunity to comment on the Forest Action Plan. Thank you.

Sincerely,

Brandt Mannchen
Forest Management Issue Chair
Lone Star Chapter of the Sierra Club
20923 Kings Clover Court
Humble, Texas 77346

Presentations, announcements, and newsletters to stakeholders

Short presentations or announcements asking for comments on the Forest Action Plan were given at meetings of various natural resource organizations or groups across the state. In addition, short descriptions along with a request for comment was included in various natural resource newsletters sent out across the state. These organizations or groups and newsletters are listed in the following table.

Organization, Group, or Newsletter	Date	Attendees
Online Survey for General Public	9/1/2019	160
Texas State Forest Stewardship Coordinating Committee	11/4/2019	30
Forest Stewardship Briefings Newsletter	1/12/2020	2,200
Southeastern Partnership for Forests and Water Newsletter	4/13/2020	500
Partnership for Gulf Coast Land Conservation Newsletter	4/16/2020	750
Texas Longleaf Implementation Team	2/6/2020	25
Texas Forest and Drinking Water Partnership	6/10/2020	16
Online Survey for General Public	7/1/2020	2
County Forest Landowner Association Newsletter	7/17/2020	500
Texas Water Source – Orange County Newsletter	7/24/2020	2,000
Trees Are Key podcast "Action Plan Are Key"	7/24/2020	1,000
Texas Longleaf Implementation Team	7/30/2020	26
TAMFS Department Heads	7/30/2020	16
Texas Forest and Drinking Water Partnership	8/6/2020	200
Regional Urban Forestry Councils	8/11/2020	37
Texas Public Forestry Council	8/11/2020	20
Texas Urban Forestry Council	8/11/2020	8
BMP/Wetland Coordinating Committee	8/19/2020	34
Texas Forest and Drinking Water Partnership	8/28/2020	28
International Society of Arboriculture	9/4/2020	700
NRCS State Technical Advisory Committee	10/20/2020	25
TSAF Annual Meeting	10/21/2020	16
TFA Annual Meeting	10/29/2020	200
Texas State Forest Stewardship Coordinating Committee	TBD	30

Letter from state forester asking for review and comments to members of Texas Public Forestry Council

The state forester—Mr. Tom Boggus—sent a letter to all members of the Texas Public Forestry Council and other public landowners asking for review and comment on the Forest Action Plan. A bound paper copy of the plan was included in this mailed request. The following table lists the members that this letter was sent to.

Name	Organization	Title
Wayne Prokopetz	Big Thicket National Preserve	Superintendent
Herbert Young	Big Thicket Natural Preserve	Chief of Resource Management
Bill Bartush	Lower Mississippi Valley Joint Venture	Partnership Coordinator
Dr. Keith McKnight	Lower Mississippi Valley Joint Venture	LMVJV Coordinator USFWS
Kristy Oates	NRCS – TX	State Resource Conservationist
Dr. Hans Williams	Stephen F. Austin State University	Dean, Arthur Temple College of Forestry and Agriculture
Dr. Jim Gan Gianbang	Texas A&M Agriculture and Life Sciences	Professor Ecosystem and Management (ESSM)
Dr. Kirk Winemiller	Texas A&M Agrilife	Professor and Interim Department Head, Ecology and Conservation Biology
Larry W. Pierce, Jr	Texas A&M Agrilife Extension Service	Regional Program Leader/East Region
Dr. Monty Dozier	Texas A&M Agrilife Extension Service	Associate Professor and Program Director (Disaster Assessment and Recovery Team)
Dr. Jeff Ripley	Texas A&M Agrilife Extension Service	Associate Director - County Operations
Rob Hughes	Texas Forestry Association	Executive Director
Clayton Wolf	Texas Parks and Wildlife Department	Wildlife Division Director
Bill Adams	Texas Parks and Wildlife Department	Pineywoods Ecosystem Project
Rusty Wood	Texas Parks and Wildlife Department	District 6 Leader
Stephen Lange	Texas Parks and Wildlife Department	Regional Director Wildlife Division Region3
Rex Isom	Texas State Soil and Water Conservation Board	Executive Director
John Hamilton	U.S. Army Corps of Engineers	Project Forester
Keith Cook	U.S. Army Corps of Engineers	Environmental Stewardship BLM Fort Worth District USACE
Jeff Reid	U.S. Fish and Wildlife Service	Fish and Wildlife Biologist
Debra Bills	U.S. Fish and Wildlife Service	Field Supervisor, ARLES
Eddie Taylor	USDA Forest Service - NFGT	Forest Supervisor
James Crooks	USDA Forest Service National Forests and Grasslands in Texas	Operations Team Leader-Timber/ Fire Forest Service
Tim Buchanan	U.S. Army Fort Hood	Director of Environmental Division

Online request for comments on draft

Texas A&M Forest Service developed an online survey in Google Forms to provide a means for which interested stakeholders and the public to provide comments on how well the Forest Action Plan addresses the five primary issues: Wildfire and Public Safety, Sustainability for Forest Resources in East Texas, Central Texas Woodlands Conservation, Urban Forest Sustainability, and Water Resources.

Access to the Forest Action Plan and the survey were provided on a Forest Action Plan website on the TAMFS website and through the Forest Action Plan web application accessed through the Texas Forest Information Portal (Texas Forest Info). The draft plan was announced on the TAMFS Home page as a major "campaign".

The number of responses was disappointing in that only two responses to the survey were received. Below are the questions and responses received.

Question 1

How well does the Texas Forest Action Plan address wildfire and public safety? Are there any major issues or opportunities that are omitted or overstated?

Responses

It appears to address wildfire and public safety.

It seems to be very comprehensive. I would have liked to see more emphasis on the impacts of trees on human health. It is there in discussion of water management and ecosystem services but could be stated more clearly.

Wildfire and public safety is addressed great emphasis on suppression. While this is critical and important. I encourage greater consideration be placed on the use of prescribed fire as a management tool which helps prevent wildfire and provide improved vegetative management of fire dependent and/or adapted species

Question 2

How well does the Texas Forest Action Plan address sustainability of forest resources in East Texas? Are there any major issues or opportunities that are omitted or overstated?

Responses

I feel comfortable with plans presented.

This is not my area of expertise!

The Plan provides excellent timberland status in East Texas such as timberland ownership, forest product mills, timber volume by species group and diameter class. It is noted that the plan lacks tables or figures which noted age class distributions, estimates of actual important historic species such as Long Leaf and Short leaf pine. The plan does not mention the decline of their historic ranges which helped to keep our forests resilient. It appears that the plan focuses primarily on Loblolly short rotation tree farming.

The Plan identifies 12 million acres of timberland and notes, "East Texas now has more than 200 thousand family forest owners. More than 80 percent of this group own less than 50 acres, representing 5.1 million acres. While many invest in property for traditional, commercial forestry reasons, a growing number of individuals own property for other reasons, such as environmental protection, recreation, ruralism, escapism, and viewing wildlife" This identifies a significant opportunity for Texas A&M Forest Service to partner with other agencies/organizations to achieve restorative measures (i.e., longleaf and shortleaf) with small forest owners through recurring prescribed fire.

Question 3

How well does the Texas Forest Action Plan woodland conservation in Central Texas? Are there any major issues or opportunities that are omitted or overstated?

Responses

No major issues to the Forest Action Plan.

I think that there is a great deal of need for education in these communities.

The plan addresses Central Texas woodland conservation very well.

Question 4

How well does the Texas Forest Action Plan urban forest sustainability? Are there any major issues or opportunities that are omitted or overstated?

Responses

No major issues.

This should be highlighted as the success story that it is. Although there are lots of challenges associated with urban forestry, many urban areas recognize the importance of trees and have devoted at least some resources to protecting them.

The plan addresses urban forest sustainability well.

Question 5

How well does the Texas Forest Action Plan forest water resources? Are there any major issues or opportunities that are omitted or overstated?

Responses

None that I am aware of. I have lived out of state for eight years and visit area twice a year.

Work with the Texas Water Resources Institute.

The plan addresses urban forest sustainability well.

Question 6

Please provide any additional comments you have on the Texas Forest Action Plan?

Responses

My daughter and son-in-law utilize our property more than I do for recreation.

Texas A&M AgriLife Extension Service
Texas A&M AgriLife Extension Service is guided by its strategic plan for fiscal years 2017 – 2021. This agency focuses on the agricultural community and has left most all extension service on forest resources to the Texas A&M Forest Service. However, many of its Imperatives and Goals relate to the forest resources of the state since many agricultural practices occur alongside forested areas.

This agency also works in urban areas and is a logical partner in water conservation issues.

Issue 4: Urban Forest Sustainability
With the addition of nearly 8 million residents since 2000, rapid urbanization is creating intense pressure on the sustainability of the trees and forests in Texas communities. Trees provide economic, health, and environmental benefits that are important to the quality of life in Texas communities. It is critical to plant, care for, and conserve the trees in communities where Texans live, work, and play.

Issue 5: Water Resources
Forests and woodlands play an integral role in maintaining a continuous, stable supply of clean drinking water for millions of Texans. In fact, almost 50% of the state's freshwater resources originate on forests that cover just over one third of the land area in the state. As these lands are converted to other uses, this critical role is interrupted, and water resources are adversely affected.

Given the importance of forests to the state's water resources, private land conservation and stewardship are critical factors in meeting the state's water needs in the future.

Comments from Sierra Club on draft FAP

SIERRA CLUB

Houston Regional Group
P. O. Box 3021
Houston, TX 77253-3021
www.sierraclub.org/texas/houston

September 18, 2020

Mr. Burl Carraway
Texas A&M Forest Service
200 Technology Way, Suite 1281
College Station, Texas 77845-3424

Dear Burl,

Enclosed are the comments of the Lone Star Chapter of the Sierra Club (Sierra Club) about the draft Texas A&M Forest Service (TAMFS), Forest Action Plan (FAP), December 2020. This FAP is a much better and comprehensive document than the one the Sierra Club reviewed before. The Sierra Club congratulates the TAMFS on this improvement.

1) **Public Involvement and Engagement, Page B-227, Appendix B – Stakeholder Input and Stakeholders Issues, Page 29,** the Sierra Club, on October 12, 2019, submitted comments to TAMFS which stated, "I have already filled out the survey at the link that you provided. However, the Sierra Club would like to provide additional comments in writing due to the importance of the FAP." Those additional comments are found in our October 12, 2019 letter which is attached to this comment letter as part of the Sierra Club's comments on the FAP.

The Sierra Club's October 12, 2019 comments apparently were not taken into consideration in revising the FAP. **Page B-227, Appendix B – Stakeholder Input, FAP,** provides a summary of and refers to the "on-line survey". It says, "In September 2019, TAMFS deployed an on-line survey to solicit comments from interested stakeholders and the public in general to aid in the development of the 2020 Texas Forest Action Plan … The survey was left open through June 2020 and generated over 160 responses … Following are summaries and list of responses to questions included in the survey.".

The FAP does not state that **Appendix B – Stakeholder Input,** includes any comments that were sent via letter. If this is the case, this is not fair or appropriate. All forms of public comment should be considered and should be included in the "Stakeholder Input" appendix.

If the Sierra Club and other comment letters or other forms of public input were included in the stakeholder appendix, then the TAMFS should state this. **If TAMFS did not include other forms of public input, other than the online stakeholder survey, it should, and in the future should ensure that all public comments are included in the FAP via a summary of what the public had to say.**

The Sierra Club stated as part of its October 12, 2019 FAP comments that, "{7) **Public Participation** – TAMFS must be proactive in its outreach to the public. For example, it is not

adequate public participation to put a proposed forest plan on the website and ask for public participation. There must be a bolder public outreach, education, participation, and input plan which is implemented consistently and not subject to budget cuts."

"The citizens of the State of Texas own most of the forest land in our State and they own the TAMFS. They need a reliable partner who lets them know what is happening, why it is happening, and what they can do to respond. The Sierra Club urges TAMFS to have a broad, comprehensive, and extensive public outreach, education, participation, and input plan and program. Texas's forest resources depend on an alert and vigilant public. That cannot happen if people do not know what is happening."

"One good example of how this can be accomplished is to allow full public participation in the revision of the W. Goodrich Jones State Forest management plan. The public is very interested in the protection and ecosystem management of Jones State Forest. There is a concerned constituency present. It would be great if TAMFS would use this management plan revision as an opportunity to conduct a bolder public outreach, education, participation, and input process. This could be an example, a learning experience, for everyone and the management of Jones State Forest would benefit with greater public support and a sense of ownership."

The Sierra Club heard about the revised FAP via the Citizens Environmental Coalition Newsletter, not from the TAMFS, even though the Sierra Club provided comments on October 12, 2019. **It would be appropriate for the TAMFS to let those know who have provided comments that a revised FAP is available for public comments. This was not done for the Sierra Club.**

When the Sierra Club went to the TAMFS website, the announcement of a public comment period for the FAP, was not on the home page of the website. The Sierra Club had to hunt to find the FAP to determine its' availability for comment. **At many websites there is a "something new" or similar heading on the home page that lets the public know that there is important information or an opportunity to comment.**

The Sierra Club encourages TAMFS to do a similar thing. When the public goes to the TAMFS website home page they would see immediately there is a public comment opportunity and would not have to hunt throughout many webpages to find out what is going on at TAMFS.

The Sierra Club urges the TAMFS to provide "a broad, comprehensive, and extensive public outreach, education, participation, and input plan and program" for the FAP and its other programs.

2) **Working Forests, Page 1, Issue 2 Sustainability of Forest Resources in East Texas, Issue Description, Page 50, and Performance Outcomes, Goal 2, Page 61,** from a Sierra Club perspective, all forests are "working forests". Forests do things for themselves, like evolution and survival and successional and disturbance growth and some of those things help humans like oxygen to breathe, climate to moderate via carbon sequestration, wildlife habitat, aesthetic and scenic beauty, nutrient enrichment of soil, erosion protection of soil, protection of water quality and quantity, vegetation communities, biological diversity, etc. It makes sense for the TAMFS to acknowledge this. The Sierra Club believes that it is TAMFS's responsibility to conserve all forest landscapes and not just ones that are used for growing trees, logging those trees, and which are called "working forests".

3) **Forest Fragmentation, Urbanization, and Parcelization, Page 2, Issue 2 Sustainability of Forest Resources in East Texas, Issue Description, Stakeholders Issues, Page 29, Page 50, Performance Outcomes, Goal 1, Page 61, Population Growth and Fragmentation, Page 64, Challenges, Page 78, and Goal 4: Support open space initiatives, Page153,** the Sierra Club commends TAMFS because it mentions the importance that fragmentation, et al., has on forests and emphasizes that this is an important problem.

The Sierra Club urges TAMFS to provide additional goals and objectives that focus on how to reduce fragmentation, other than public information and the Forest Legacy program (which is too small to effectively address fragmentation in any significant way). If legislative action would help. TAMFS should tell the public and the Texas Legislature what type of legislative action may be appropriate. This is not lobbying but telling the truth.

4) **Texas Ecoregions, Page 4,** it would be helpful for the TAMFS to state which ecoregions with forests have been diminished the most and therefore are highest priority to protect. One particular forest that the TAMFS has not mentioned is the Columbia Bottomlands that exist on the lower Colorado, San Bernard, and Brazos Rivers in Wharton, Matagorda, Fort Bend, and Brazoria Counties. This rare coastal forest is significant for many reasons, particularly for wildlife (migratory birds and waterfowl), biological diversity, flood attenuation, and water quality.

The Sierra Club urges the TAMFS to focus on the Columbia Bottomlands, discuss it in the FAP, and provide goals and objectives that will protect a significant portion of the little that is left. The Big Thicket portion of the Piney Woods is another regional forest that should be mentioned in the FAP and significantly protected.

Such conservation initiatives fit in well with what is stated on **Page 1,** "This assessment provides a comprehensive analysis of the forest-related conditions, trends, threats, and opportunities … This statewide forest resource strategy was developed on the basis of the state assessments by identifying landscapes and projects where an investment of federal competitive grant funding … could most effectively accomplish goals or leverage desire action."

5) **Lost Pines, Page 5,** the Lost Pines is really the western and southern most extent of the Piney Woods which is the western and southern most extent of the Great Eastern Coniferous and Deciduous Forest. As such, its ability to withstand drought and other conditions that are more severe than the Piney Woods speaks for its' conservation in the FAP. Very little of the Lost Pines is publicly protected.

A Lost Pines conservation initiative fits in well with what is stated on **Page 1,** "This assessment provides a comprehensive analysis of the forest-related conditions, trends, threats, and opportunities … This statewide forest resource strategy was developed on the basis of the state assessments by identifying landscapes and projects where an investment of federal competitive grant funding … could most effectively accomplish goals or leverage desire action."

6) **Status of Forest Resource, Page 9,** the Sierra Club believes that the description of **Forest Area,** is too dependent upon whether it can be logged (timberland). The focus should be on forest ecosystems and not timberland. Timberland is too simplistic and commercial a description and does not tell the public what the ecological conditions are of various forest ecosystems including age, area covered, unique or rare species of plants or animals, invasive plants or animals, or other conditions that affect or are a characteristic of each forest ecosystem. Timberland is one human

view of forests. It is not the only one or the most important one. We know that ecological services (the ecosystem working forest characteristics) are far more valuable than timber sales.

7) **Forest Ownership, Page 10,** the forest acres for national forests do not add up in this section. There are about 675,816 acres of National Forests and Grasslands in Texas. However the FAP states that "in East Texas … national forests … with 579,500 acres (5%)", and then says that in Northeast Texas there are "510,219 acres of National Forest", and then says "Most of the national forests occur in Southeast Texas, with 69,308 acres".

Just Sam Houston National Forest alone, has 163,030 acres in Southeast Texas and this does not include David Crocket National Forest which has 160,467 acres. The FAP should clearly define what Northeast and Southeast Texas is (counties) and how many acres of national forests are in each.

8) **Central and West Texas, Page 11,** the FAP does not appear to include the forests of South Texas, including the Rio Grande Valley. There are bottomland hardwood or gallery forests and if mesquite is included as a type of forest tree, there are many acres in South Texas.

Certainly, South Texas is not part of **Central (Figure 24) and West Texas.** The TAMFS should provide a definitive map which shows South Texas and the Lower Rio Grande Valley as part the native forest lands of Texas. The forests along the Texas Coast also appear to be absent from TAMFS's mandate to protect and manage forest resources across the State of Texas. All forests in Texas deserve protection and TAMFS concern.

Maps 2, 9, 11, 12, 13, and 14, provide almost no priority to forests in South Texas, the Lower Rio Grande, and coastal forests. This is unfair in these areas that they are not given the TAMFS resources that are needed to protect and conserve their forests.

TAMFS is a statewide agency and must reduce its East Texas bias and spend more time, money, and resources on other forests in the State of Texas. Many of the areas that are ignored have a disproportionate number of low income and minority residents who pay their taxes and deserve TAMFS's expertise on how to protect and conserve their forests. TAMFS must be more inclusive and not so commercial oriented so that it spreads its' expertise and resources to all Texans in all parts of the state.

9) **Forest Area, Page 11,** TPS shows bias by calling 48.2 million acres of forest, "unproductive woodlands". The ecological services that these forests provide make them very productive. The TAMFS should remove this label and use something more appropriate like "they do not have timberland importance".

10) **Texas Is a Big State, Pages 13 and 14,** there is no need to compare Texas in land area to several other states. This has nothing to do with forests, population, and demographics. The TAMFS leaves out the Asian demographic of the Texas population like it does not exist on **Table 2.** This table should be modified to address all the demographic populations in Texas and not just white, Hispanic, and black. Everyone matters.

11) **Regional Population Change, Page 17,** the FAP states that "The Houston-Galveston area will increase 6.2 million by 2040." This is not correct. This is an estimate but has not occurred. TAMFS must use the words like "estimates, projections, or predictions" to make this statement factually correct.

12) **Trees and Forests as Climate Solutions, Pages 19 and 20,** TAMFS should use more recent data than 2013 to document Mean Annual Temperatures, to show the full extent of climate change. Much has changed in the last 7 years.

TAMFS puts more emphasis on the rate of carbon uptake (sequestration). This is in line with an emphasis on more logging and tree growing. But TAMFS should also state that old trees may have a lower rate of carbon uptake but they store more carbon because they are larger and have more biomass that removes carbon from the air. Logging old trees reduces total carbon sequestration and makes climate change worse. That is what climate science says and what TAMFS should tell the public.

13) **References, Page 21,** the references appear to be old and do not reflect the most recent science in climate change and forests. For instance, one reference is 28 years old, another is 16 years old, another is 12 years old, etc. A more recent update of forests and climate change is needed for the FAP.

14) **Review of Natural Resource Plans, Pages 22 through 27,** the TAMFS should review and include in the FAP the Comprehensive Conservation Plans for U.S. Fish and Wildlife Service National Wildlife Refuges, General Management Plans of the National Park Service, Watershed Protection Plans, and TMDLs (Total Maximum Daily Loads) of the TCEQ. TAMFS should also state that TCEQ and local cities and counties monitor the air for criteria air pollutants like ozone.

15) **Stakeholders Issues, Page 29,** the TAMFS does not tell who the stakeholders were, how they were chosen, when their views were solicited, and how these five issues were chosen. The public should be involved in deciding what the priority issues are.

The Sierra Club believes that "Population growth, ownership changes and parcelization, residential development, and on-consumptive demands will impact the forest landscape" will occur not just for "decades to come" but for centuries to come.

16) **Overview of Geospatial Analysis, Page 30,** TAMFS should discuss the legitimacy of "weighted values" and the inexactness of using the words "very low, low, medium, high, and very high" and their relationship, not to natural breaks, but to effects. TAMFS should discuss the use of 2011 National Land Cover Database. This data base is out-of-date to tell the public what has occurred in the past 9 years. The accuracy of Landsat or other aerial images and the pitfalls of their use should be discussed so that the public has some sense of the accuracy of the analysis.

17) **Issue 1 Wildfire and Public Safety, Pages 31 through 49,** the TAMFS should tell the public what the probability (risk) is that a wildfire will burn in an area or on an acre.

In the past 15 years, there have been 203,395 wildfires and the total acres burned is 11.4 million acres, which is an average of 56 acres/wildfire. Since 95% of wildfires are caused by humans (not lightning) this means that 193,225 fires were caused by humans and burned about 10,820,600 acres. This means that an average of 760,000 acres/year burned in Texas.

This means in the past 15 years, there were about 10,170 lightning caused fires which burned about 569,520 acres. These lighting fires are needed for ecosystem health and integrity and whenever possible should be allowed to burn. Most of the time lightning fires are put out (suppressed).

If the State of Texas has 170,000,000 acres and about 760,000 acres burn each year, then there is about a 0.45% probability of each acre being burned/year. The burn probability rate that TAMFS wants to reach should in some way be calculated and provided to the public.

The definition of a "natural disaster" is too broad. It is defined as "when people's lives are affected". Just watching for a wildfire, which does not come, affects a person's life due to concern and worry, but does not mean that they are literally affected by a "natural disaster". The definition of a "natural disaster" should be defined differently so it is not so broad.

A significant part of the problem is that people place themselves in danger in the Urban Wildfire Interface (UWI), do not take steps to reduce their danger around their house and community, and then demand that the State of Texas protect them and risk the lives of others (first responders) in exchange for protection of their lives and property. The TAMFS should recommend that this type of equation be changed so more people are protected, fewer lives lost, fewer injuries are incurred, and less property damage occurs.

One way to address this problem is statewide land use controls. To say on **Page 38,** "While the primary causal factors cannot be eliminated" is defeatist. The State of Texas, if it wants to, can virtually eliminate lives lost, injuries incurred, and property damage in the UWI but it must want to do this and have the will to do so.

Strategies and Objectives, the TAMFS should provide the science of climate change to the public and the future effects it will have on wildfires. TAMFS must let the Texas Legislature know that people who live in the UWI must take the fire-safe precautions just like we require people to be responsible and use seatbelts to save lives. TAMFS needs to push for more prescribed burning in fire-adapted ecosystems and fire cooperatives to ensure that prescribed burning is maximized in Texas.

TAMFS should detail how it will educate and instill in the public the need for fire prevention, prescribed burning, and fire-wise living as much as it pushes fire suppression.

Pages 48 and 49, TAMFS does not show how timber theft is related to Issue 1 Wildfire and Public Safety. Timber theft should be placed in another place in the FAP.

18) **Total Volume of Timber in East Texas, Page 53,** the TAMFS says, "According to Texas A&M Forest Service interpretation of current FIA data". The TAMFS should state whether there are other interpretations for this data and if so, what they are. The way this phrase is worded gives the public the impression that there may be different interpretations and perhaps disagreements about what the FIA data says. The public should be told about these differences of interpretation.

19) **Challenges, Page 55,** the TAMFS states "Coupled with shrinking state and federal budgets, agency ability to deal with long-term and extreme wildfire occurrence or outbreaks of the southern pine beetle have been adversely affected". The Sierra Club assumes other responsibilities of TAMFS have also been adversely affected by the lack of money, personnel, and resources. If this is the case, the public should be told in this in this assessment. TAMFS should provide options to the public about what it can do and what the Texas Legislature can do to address these deficiencies which hurt the public and TAMFS's ability to serve it.

The Sierra Club is concerned that TAMFS's past actions supported cutting and logging wilderness areas when SPB's were found. The five wilderness areas in the National Forests and Grasslands in Texas (NFGT) constitute 38,483 acres of the 12 million acres of forest found in East Texas (0.32%).

The NFGT has reduced clearcutting and basal area density in the past 30 years. The last significant southern pine beetle (SPB) attack in the NFGT was about 1994, or 26 years ago. The SPB reacts to habitat conditions, which were ripe with dense pine plantations in the 1970's 1980's, and early 1990's. There are fewer of these dense forests in the NFGT now. There is more thinning, prescribed burning, and midstory removal which reduces SPB risk.

20) **Spatial Analysis, Page 57,** the Southern Forest Land Assessment (SFLA) was finished 12 years ago. It appears that it needs to be updated to give the FAP the best assessment of existing conditions versus what occurred 12 years ago. TAMFS should update the SFLA and make projections for 5 and 10 years in the future. This gives the public a view of what may occur and gives the TAMFS a vision about how it might change the negative parts of current projections.

The Sierra Club is concerned that timber related elements get higher weights than non-timber related elements even though TAMFS states that things have and are changing for what is important to forest landowners.

Table 9, Page 57, Table 11, Page 67, Table 16, Page 80, and Table 19, Page 105, show the types of elements that people are more interested in. T&E Species, Protected Areas, Forested Wetlands, Riparian Areas, Forest Patches, etc., **(See Page 114),** are given low weights, in general, and the high weights are given to elements that are more timberland related. The Sierra Club believes this shows a bias by TAMFS in its' best professional judgement and is not in line with changing to address the elements that forest landowners value now.

21) **Strategy, Pages 59 through 61,** TAMFS's goals include "Assess and promote the sustainability of East Texas forests". TAMFS has not defined what sustainability is for East Texas and other forests and does not state whether this might be different depending on who the landowner is whether this should be addressed differently for different forests in East Texas and elsewhere.

TAMFS refers to "long-term wood supply" under **Strategy 1.1.1,** but does not define what kind of wood supply this refers to and what this means. TAMFS should define these terms and how they will be achieved.

TAMFS does not define, **there should be a glossary but there is not,** what ecosystem restoration and urban enhancement mean, what climate resilient species mean, what practical approaches for monitoring, reducing and mitigating forest health concerns mean, what are the soil and water resource issue specifically it wants to address, what high-priority and threatened landscapes are, what trends in land use change are most important, specifically how it will predict, monitor, and mitigation threats to forest health, how it will facilitate recovery and restoration od damaged forest landscape, how it defines damaged forest landscapes, how it defines native forest ecosystems, what user needs it wants to focus on, what forest workforce capacity goals it wants to meet, what ecosystem services it wants to market, where it wants to focus on ecosystem service markets, where and how much it specifically wants to reduce fragmentation and resource loss due to real estate development, and conversion, and population growth, what its specific targets are for biofuels/bioenergy, and how it defines "unbiased information on carbon and ecosystem services markets".

One of the problems in the FAP is that the goals, objectives, and strategies, while good in many respects are vague and general with no specific quantitative achievements to be met in a certain timeframe. This weakens the use and effectiveness of the FAP.

22) **Forestland, Page 62,** TAMFS states for Central Texas Woodlands Conservation, that "The forest woodlands … are prized by many for their beauty, shade, erosion control, wildlife, recreation, real estate value, and watershed protection". This is true but also applies to East Texas Forests and their landowners.

23) **TAMFS Program Delivery, Page 65,** TAMFS should state who are the "diverse stakeholders" it wants to partner and cooperate with "to be successful".

24) **Challenges, Page 66,** TAMFS should not say that "public expectations must be managed" but should say that the public will be told the truth, including how much TAMFS can help each landowner and why it cannot do more (money, personnel, resources).

It is important that TAMFS understands and tells the public that when flash floods kill trees on streams that this is okay because it is part of the disturbance/succession process that functions normally in riparian ecosystems but that in many cases is altered via human effects on climate change.

The Sierra Club does not believe that burning wood via biofuels/bioenergy is necessarily green or renewable.

In the long-term, Ponderosa Pine will not be able to withstand the further drying out of West Texas so the program may be a short-term fix until other natural vegetation takes the place of this tree, which is on the western and southern edge of its range in the U.S.

25) **Strategy, Pages 71 through 73,** TAMFS should provide more detail about what it means for each goal, objective, and strategy.

The Sierra Club suggests that TAMFS devise a voluntary "land ethic" based upon the principles of Aldo Leopold's writings and begin to teach people about their connectedness and responsibilities with the land. This, over time, will have a tremendous impact on how forests and other native habitats are protected and treated.

26) **Issue Description, Issue 4, Urban Forest Sustainability, Page 74,** TAMFS should not only focus on the "human quality of life" but also on how human habitation affects or benefits "all living things and ecosystems" or what Aldo Leopold referred to as, "The Land".

27) **Urban and Community Land and Population Growth, Page 75,** more up-to-date information is needed. 2003 and 2010 is 10 years or more out-of-date. The public needs to know what is happening today.

28) **Water Quality, Page 75,** TAMFS should mention that impervious surface also affects bays/estuaries on the Texas Coast, at the end of watersheds.

29) **Challenges, Page 78,** instead of saying that "forest fragmentation and conversion can occur" the TAMFS should say "it does occur". This is a fact.

30) **Natural Disasters, Page 78,** often these are human disasters because people put themselves in "harm's way". Less fire suppression and more prescribed burning is needed across Texas, in forests and grasslands.

31) **Results and Conclusion, Pages 81 through 83,** TAMFS leaves too many people without its' services. This is not fair since all people pay taxes that fund TAMFS.

32) **Strategy, Pages 84 through 88,** TAMFS must be more detailed about what each goal, objective, and strategy will do. TAMFS should state what are "high-value forest landscapes" and where they exist in Texas urban areas. TAMFS should state where "vulnerable communities" are in Texas and define what "environmental sustainability" and "community forestry literacy" is in Texas.

TAMFS should state what "Advance urban wood utilization" is for Texas metropolitan areas. The Sierra Club does not support the transfer of the forestry commodity production mentality found in East Texas timberland areas to urban areas. We need the opposite mentality in urban areas. Trees are not here just to make money. The other benefits are more valuable to urban Texans.

33) **Threats to Forest and Woodlands, Pages 93 and 94,** it is important that TAMFS understands and tells the public that when floods kill trees on streams and rivers that this is okay because it is part of the disturbance/succession process that functions normally but that in many cases is altered via human effects on climate change. Floods are often human disasters because people put themselves in "harm's way".

34) **TAMFS Program Delivery and Challenges, Pages 94 and 95 and Performance Outcomes, Goal 2, Page 101,** the Sierra Club supports a mandatory and regulatory best management practices (BMPs) program for forests because people often do not do what they should voluntarily. Since 1977 or 1978, there has been a non-point source water pollution program in the Houston-Galveston-Brazoria Area. Yet still there is too much sediment, silt, and soil that goes into the streams in this area. Often, people do not take things seriously until they are required to do so. Market-based solutions for BMPs are not the answer.

35) **Strategy, Pages 99 through 101,** TAMFS should provide more detail about what each goal, objective, and strategy means. TAMFS should define "woodland hydrology", "innovative educational efforts", and "land stewardship".

Goal 2, the Sierra Club is concerned that TAMFS believes it has a 94% compliance rate with all landowners and their use of BMPs for all forest activities each year. This is misleading. TAMFS should provide to the public how many forest operations occur in a year, how many of these operations it inspects, how many violations of BMPs occur for each operation, and how many violations can occur for each operations and still receive a passing grade.

TAMFS does should track land conversions for BMP compliance, how many occur (which can replace forests), how many adhere to BMPs, and how many violations can occur during land conversion operations but still receive passing grades.

The Sierra Club appreciates TAMFS's efforts and the difficulty in monitoring logging and other forestry activities in East Texas but does not believe that 94% of the forestry operations that are conducted each year comply with all BMPs.

36) **Important Forest Resource Areas for the Forest Stewardship Program, Background, Pages 100 through 107,** the TAMFS should use the "Protected Areas" layer in this analysis. These areas should have a higher weight given to them because they protect the land better.

Page 103, the High, Medium, and Low classifications used mean little because they are not attached to some specific quantitative environmental standard or limit that the public can understand. We need better performance standards that mean something quantitatively. TAMFS should explain its classifications so the public understands them and can comment on them in a knowledgeable and reasonable manner. Natural Breaks provide no meaningful information to the public.

Page 103, TAMFS should state how the Southern Forest Land Assessment layers were updated in 2019, so the public understands how up-to-date they are for the best, sound, science that is available.

Page 104, TAMFS should state the accuracies and inaccuracies of the FIA data. The public must know where the FIA comes from and how accurate this data is, which is used to estimate forest information for the entire State of Texas via a small group of vegetation plots.

Page 104, TAMFS dropped "slope" from the analysis because it had a "lack of clear understanding of reason used". The Sierra Club suggests that soil moisture is what "slope" indicates.

Page 104, the Sierra Club opposes TAMFS using "one set of weights" across the entire state instead of using different weights for each ecoregion. Accuracy is needed and such simplification is not ecologically justified.

Page 104, TAMFS fails to prioritize if 155 million acres are eligible for the Forest Stewardship Program (FSP) when there are 170 million total acres in Texas (91% of the total land area). TAMFS has prioritized the entire State of Texas for the FSP. This does not help to prioritize where money will be spent.

37) **East Texas Program Delivery, Goals, Objectives, and Strategies and Performance Measures, Pages 114 and 115 and Water Resources, Goals, Objectives, and Strategies, Page 126,** TAMFS states that "New goals include increased emphasis on aesthetics," etc. The public cannot determine or decipher how much of a change has occurred because TAMFS does not provide comparisons. It is the Sierra Club's view, having read the FAP, that the overwhelming focus is still on timberland commodity production.

TAMFS serves all Texans, and not just landowners. In an urban state which becomes more urban each year, TAMFS must direct its message and resources to all Texans including non-landowners. The Sierra Club is concerned that Performance Measures lack quantitative figures that document TAMFS's efforts. We need specific quantitative figures to determine how TAMFS is doing.

38) **Tree Improvement Program and Western Gulf Forest Tree Improvement Cooperative, Performance Measures, Page 120,** TAMFS should state how much improved growth, which appears to be growth rate, impacts carbon sequestration, biofuels, and forest health. There are no performance measures given to document this statement.

39) **Ecosystem Services, Pages 123 and 124,** the values TAMFS refers to are already there, although not marketable. It is important that TAMFS inculcates in people that intrinsic worth and

value, although they may be difficult or impossible to calculate, may be more valuable than market value.

Aldo Leopold stated in, "The Land Ethic", in 1949, that, "To sum up: a system of conservation based solely on economic self-interest is hopelessly lopsided. It tends to ignore, and thus eventually to eliminate, many elements in the land community that lack commercial value, but that are (as far as we know) essential to its healthy functioning. It assumes, falsely, I think, that the economic parts of the biotic clock will function without the uneconomic parts. It tends to relegate to government many junctions eventually too large, too complex, or too widely dispersed to be performed by government."

TAMFS must tell the public that the best things in life: love, honor, spirituality, sense of belonging, wildness, music, and ecosystems, cannot be given price tags or values. It's not clear how much TAMFS has succeeded with ecosystem services because there are no quantitative Performance Measures provided to use as a measure of success.

40) **Water Resources, Program Description and Performance Measures, Pages 125 to 127,** TAMFS refers to holding more than 460 workshops for 5,000 landowners. TAMFS must state over how many years this occurred. Since TAMFS stated there are 200,000 landowners in East Texas, even if all of these workshops for 5,000 landowners were conducted in one year (which did not occur), this means TAMFS only reached 2% of the 200,000 landowners in East Texas. Better quantitative Performance Measures are needed.

41) **Forest Economics and Resource Analysis, Pages 131 to 133,** a 25-year tree rotation is not a good outcome. A forest is more than pine trees planted in rows, grown at the fastest rate, and then cut. A Loblolly Pine has a lifespan of 250 years. Twenty-five year is only 10% of its' lifespan. Other important parts of a forest are left out of commodity value and suffer or disappear. The "2 x 4" which comes from a 25-year old pine tree is inferior wood and we pay more for it. This does not make ecosystem or economic sense.

42) **Urban and Community Forestry, Pages 134 to 135,** TAMFS should manage urban and community forests more on an ecosystem basis instead of a forestry or commodity basis. People like large, old, trees, and instead of growing and taking care of those we have, we grow trees so they are much smaller and younger than they grow in urban settings and then cut them down before they get old and before they develop character. We need better balance in what we do with urban trees and forests or the ecological and ecosystem values will diminish.

43) **Forest Health, Pages 136 through 142,** it is already too late to treat and eradicate Japanese Climbing Fern. The Sierra Club has found this non-native invasive plant species all over the Piney Woods and Gulf Marshes and Prairies Ecoregions. We should control it but its elimination is not likely.

TAMFS should add a feral hog reduction goal, strategy, and performance measure for the FAP. This non-native invasive animal species has a population of 2.5 to 3 million in Texas and damages many of our native trees, native forests, and urban forests.

44) **Rural Forestry Assistance and Forest Stewardship Program, Program Description, Page 144,** the priorities that conserve and restore native forest ecosystems should not just be for Central and West Texas but also for East Texas. East Texas has woodlands and savannahs, hardwood

forested slopes, bottomland hardwood forests, and other forests that should be conserved and restored.

In general, the Sierra Club does not favor biomass utilization, due to pollution, climate change, and other concerns. The Sierra Club supports increased mill efficiency by the use of wood waste from the manufacture of wood products.

45) **Forest Legacy, Pages 148 through 154,** the Sierra Club favors Forest Legacy programs particularly when they protect native forests and associated habitats. **Page 149,** there is no Woodville County. The TAMFS should reveal what county it was referring to here. The Sierra Club supports more funding for the Forest Legacy Program and prefers fee simple purchases over conservation easements because they provide for total permanent protect for forests forever.

Page 153, it is not clear how the TAMFS is going to implement **Goal 4: Support open space initiatives.** A better explanation and the number of initiatives that TAMFS is going to support should be part of the goal.

46) **State Lands Management, Pages 155 through 157,** the Sierra Club supports TAMFS state managed lands and urges that more of these lands be acquired. The Sierra Club also supports a greater TAMFS focus on appropriate and compatible public use for these lands. This fosters education and a protective attitude from citizens.

A good example of how this occurs is at Jones State Forest where people who live nearby have fought to have this state forest protected and not sold or developed by TAMFS. This effort resulted in protective legislation being passed by the Texas Legislature in 2019. More citizen use, when compatible and appropriate, in combination with more education from TAMFS, engenders more citizen protection and a better "Land Ethic".

47) **Conservation Education and Outreach, Pages 158 through 163,** the Sierra Club supports more and better conservation education and outreach. There should be specific quantitative targets for TAMFS so that there is a specific number of actions conducted or people reached.

48) **Mitigation and Prevention, Pages 167 through 170 and Pages 171 and 172, Community Wildfire Protection Plans,** it is important for TAMFS to say, "The placement of people, homes, and structures within the UWI renders them extremely vulnerable to wildfire … essential for the agency to address the significant causal factors that lead to development of large, damaging wildfires that destroy homes and threaten the citizens of the state … the danger inherent in unmanaged population growth into UWI areas". It is people, not forests or weather that are responsible for endangering themselves by placing themselves "in harm's way" in high risk wildfire areas and not treating their homes, properties, and communities to reduce wildfire risk.

49) **Riparian Areas, Appendix A – Data Layers Used for Geospatial Analysis, Page A-205,** TAMFS refers to buffers on streams of 50 and 100 meters. It is important to understand that there are many developed areas, yards, parts of properties, recreational site, and residences that are within these buffers and that they do not provide the ecosystem habitat or protection that they should. Since BMPs are voluntary streamside zones can and are developed and the forests in these areas are destroyed, damaged, or degraded.

50) **Protected Areas, Appendix A – Data Layers Used for Geospatial Analysis, Page A-211,** using a ½ to 1-mile buffer around protected areas gives the impression that these lands are

managed more protectively then they are. Many lands on the boundaries of protected areas are developed and valuable ecosystems are degraded or destroyed.

51) **Forested Wetlands, Appendix A – Data Layers Used for Geospatial Analysis, Page A-212,** the National Wetlands Inventory provides only an approximation of where and how many wetlands there are. It often does not show all wetlands and since the maps are often old does not show where wetlands have been destroyed or developed and may no longer exist.

52) **Imperviousness, Appendix A – Data Layers Used for Geospatial Analysis, Page A-215,** this layer should include all roads, fire lanes, linear rights-of-way, and all other types of roads in it to ensure that imperviousness, which is not just hard concrete but also hard surfaces like compacted dirt, and the fragmentation that it brings, are fully shown and taken into account in the FAP analysis. Road or fragmentation density is an important factor to show and take into account when you talk about ecosystem effects.

The Sierra Club appreciates this opportunity to comment on the FAP. Thank you.

Sincerely,

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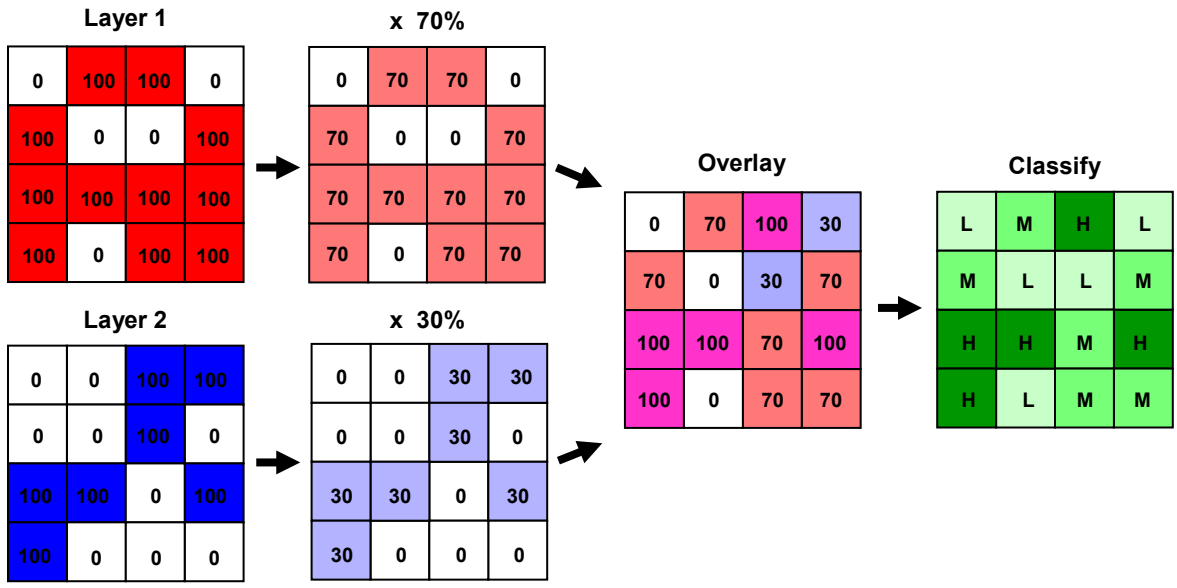
APPENDIX C — SIMPLE EXAMPLE OF WEIGHTED OVERLAY ANALYSIS

Figure B-1 shows a simplified example of the concept of weighted overlay analysis using only two layers. For this example, the two layers can each have layer values of 0 and 100. Each layer is then weighted according to its relative importance to the objective of the analysis such that the weights from the two layers sum to 100 percent. Our example uses a layer weight of 70 percent for Layer 1 and 30 percent for Layer 2 (70% + 30% = 100%). When we apply the weights to the two layers, Layer 1 now exhibits weighted layer values of 0 and 70 and Layer 2 exhibits weighted layer values of 0 and 30. The two layers are then overlaid with each other and the weighted layer values for the two layers are added for each coinciding pixel (same spot on the ground). There are four possible final output layer values for our example: 0 + 0 = **0**; 0 + 30 = **30**; 70 + 0 = **70**; and 70 + 30 = **100**. Although four values are easy to comprehend, when more layers or more layer values are used, the number of values can increase significantly. Therefore, it is often advantageous to classify the output layer values to a smaller number of classes using a classification technique such as Natural Breaks. In the example, output layer values of 0 and 30 are classed as Low, a value of 70 as Medium, and a value of 100 as High.

Figure C-1
Simplified Concept of Weighted Overlay Analysis

Two layers: Layer 1 & Layer 2
Layer values: 0 and 100
Layer weights: Layer 1 = 70%
Layer 2 = 30%
Layer 1 + Layer 2 = 100%



APPENDIX D — LINKS TO NATIONAL PROGRAM GUIDANCE

Forest Stewardship
https://www.fs.fed.us/spf/coop/library/fsp_standards_guidelines.pdf

Forest Legacy
https://www.fs.usda.gov/sites/default/files/fs_media/fs_document/15541-forest-service-legacy-program-508.pdf

Urban and Community Forestry
https://www.fs.usda.gov/managing-land/urban-forests/ucf