2.0 COMMUNITY PROFILE

With almost half of Travis County's population living in the WUI, understanding the landscape, where people live, and where they are likely to live in the future are critical components of a CWPP. An understanding of the governmental framework is also critical for effective implementation of wildfire mitigation efforts. This information provides the basis for understanding how local wildfire behaves, where the greatest risks to life and property are currently located and where and how future wildfire risk reduction efforts -- such as home hardening -- may need to be focused and implemented.

2.1 LOCATION AND GENERAL LANDSCAPE

2.1.1 LOCATION

Travis County is in central Texas (30.3189^0 N, 97.7651^0 W), with the City of Austin its county seat and the state capital. The current combined area of Travis County and the City of Austin is approximately 1,047 square miles (670,080 acres) and consists of approximately 990 square miles of land and 57 square miles of water. The overall population density of Travis County is approximately 1,034 persons per square mile.

The planning area for the Austin-Travis County CWPP includes all communities located within Travis County and the city limits of Austin, including areas of the city located within Hays and Williamson Counties (**Figure 4**).

2.1.2 GENERAL LANDSCAPE

The county is located in a geographically unique region of Texas with the Balcones Escarpment, a geologic fault zone several miles wide, extending north-south through the center and the Colorado River flowing west to east. The Balcones Escarpment separates the Blackland Prairie on the east from the Edwards Plateau on the west. Additionally, a small area of eastern Travis County falls within the East Central Texas Plains. The Edwards Aquifer, a highly productive artesian aquifer, also underlies the Balcones Escarpment in Travis County.

In Travis County, the Blackland Prairie is characterized by gently rolling hills and plains with elevations ranging from approximately 362 to 860 feet. This region of Travis County is composed primarily of grasslands and croplands with corridors of riparian woodlands and

pockets of eastern redcedar (*Juniperus virginiana*) woodlands. Much of the Blackland Prairie within Travis County is cropland, producing corn, sorghum, and winter wheat (National Agricultural Statistics Service 2013).

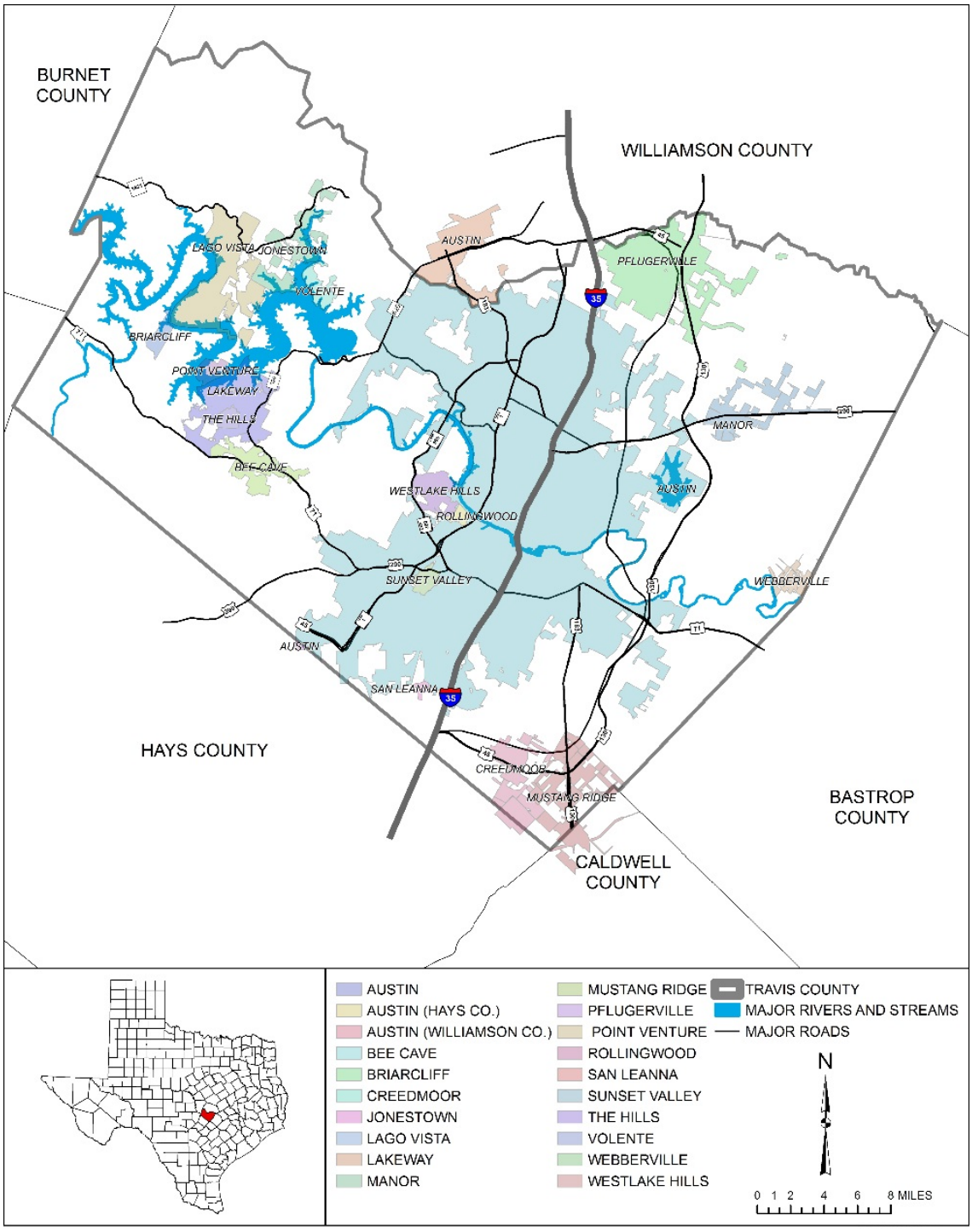

Figure 4. Austin-Travis County CWPP planning area.

The Edwards Plateau in Travis County is characterized by hilly and rugged topography with elevations ranging from approximately 860 to 1,423 feet. This region of the county is composed primarily of Ashe juniper (*Juniperus ashei*) and oak (*Quercus* sp.) woodlands. Historically, the Edwards Plateau part of the county has been more important for livestock grazing than crop production.

The East Central Texas Plains, also referred to as the Post Oak Savanna, is characterized by irregular plains originally covered by post oak savanna vegetation with elevations ranging from approximately 400 to 610 feet within Travis County. This region consists of alternating bands of prairie openings within oak woods and savanna dominated by post oak (*Quercus stellata*) and other tree species such as blackjack oak (*Quercus marilandica*), black hickory (*Carya texana*), and eastern redcedar. Many areas have a dense, underlying clay pan affecting water movement and available moisture for plant growth. Much of this area within Travis County is pasture and range.

Surface water represents approximately five percent of Travis County and encompasses some 57 square miles (36,480 acres). Primary water resources include the Colorado River, Lakes Travis, Austin, Lady Bird, and Decker. Lake Travis is the largest and a major producer of electricity.

Topography varies, ranging from flat to steep slopes. Across the western half, slopes range from zero percent to as steep as 70 percent; however, most range from five to 20 percent. The eastern half of consists of rolling hills intermixed with pasturelands, with typical slopes ranging from zero to 10 percent, although slopes greater than 10 percent occur as well.

2.2 CLIMATE AND VEGETATION

2.2.1 CLIMATE

Travis County has a humid, subtropical climate (Kottek et al. 2006), characterized by hot summers and relatively mild winters. While the region's climate is dominated by tropical air masses from the Gulf of Mexico (Kimmel 2012), colder air masses from the north and west can result in wide temperature variation and severe weather. Prevailing winds are from the south with an annual average speed of approximately eight miles per hour (Kimmel 2012). The strongest winds are from the north and northwest, with recorded gusts in excess of 75 miles per hour (Kimmel 2012). Yearly rainfall averages between 30 and 33 inches with precipitation

amounts decreasing moving westward (Kimmel 2012). Rainfall is generally distributed evenly throughout the year with the greatest amounts falling in May and September (National Weather Service 2013).

According to the National Climate Assessment (Karl et al. 2009), average temperatures have increased throughout the Great Plains region, which includes Travis County. By the end of the century, temperatures in Travis County are projected to increase by five to 10 percent. Concurrently, Travis County is projected to see a five- to 15-percent decrease in overall precipitation with more sustained droughts.

According to the National Integrated Drought Information System (NIDIS), January 2014 in Texas was the fifth-driest January going back to 1895 (and driest January since 1971). Since January 1, 2013, the amount of Texas in drought and severe drought has increased by 30 percent. Long-term (hydrologic) drought remains for the state as a whole. Reservoirs statewide are only at 64 percent of capacity, the lowest since 1990. For a third straight year, water releases from the Colorado River to downstream rice farmers are in jeopardy of being cut off (National Integrated Drought Information System (NIDIS) 2014).

Statewide, the fire environment has changed over the last 10 to 15 years from the impacts of drought, with ignitions down in every element (house, cars, etc.). Wildfires are the exception.

2.2.2 VEGETATION

Vegetation communities within Travis County are as diverse and numerous as the county's ecological regions. Within Travis County, 13 ecological systems are mapped by the Texas Ecological Systems Classification and include 66 unique vegetation mapping systems (**Table 1,** page 82) (Texas Ecological Systems Database (TXESD), Texas Parks and Wildlife Department (TPWD) and Texas Natural Resources Information System (TNRIS) 2009). The most common vegetation communities in Travis County as mapped by the Texas Ecological Systems Classification are Agriculture and other Human-related, Azonal Subsystems (approximately 30 percent of the county) and Edwards Plateau Limestone Savanna and Woodland (22 percent).

Table 1 includes the Texas Ecological Systems Classification descriptions for each of the 13 ecological systems and their associated vegetation mapping systems. The descriptive information provided here covers vegetation found in various locations across the whole plan

area and is intended for use as a broad menu by developers of local-level CWPPs as discussed in **Section 6** and the Tool Kit found in **Appendix E**. Additional information and detailed descriptions for each of the 66 vegetation mapping systems can be found in the *Texas vegetation classification project: Interpretive booklet for Phase 1* (TXESD, TPWD and TNRIS 2009). The information in **Table 1** (page 82) is extensive and included at the end of this section rather than in an appendix because of the correlation between ecological regions and fuel types, which are discussed later in **Sections 3.2.1 and 5.4.5**.

2.3 SENSITIVE ENVIRONMENTS

Sensitive environments consist of general ecological communities as well as specific locations and features that support healthy and diverse communities of native vegetation, native wildlife species and their habitats, clean water, and clean air. Within Travis County and the City of Austin they include environments such as: parks and openspace, preserves, and refuges as described in **Section 1.6.4** and depicted in **Figure 2**.

2.3.1 PROTECTED SPECIES

Travis County contains habitats that support 23 animal and plant species that are considered as threatened or endangered by state and/or federal authorities (TPWD 2012, USFWS 2013). Threatened and endangered species and their habitat are protected by federal, state, and local regulations, even on private property.

2.3.1.1 GOLDEN-CHEEKED WARBLER

The golden-cheeked warbler (*Setophaga chrysoparia*, GCW) is a small, five-inch-long insectivorous bird. Adult males have black on the crown, nape, back, throat, and upper breast. The wings are black with two white wing bars. The cheeks are a bright golden-yellow with a black eyeline. The underparts are white streaked with black on the flanks. Adult females are similar but duller; the crown and back are olive-green with some black streaking (Oberholser 1974; Farrand 1983).

In Texas, the golden-cheeked warbler is an inhabitant of juniper-oak woodlands in the Edwards Plateau, Lampasas Cut-Plain, and Llano Uplift (Wahl *et al*. 1990; USFWS 1992). Ashe juniper (*Juniperus ashei*) and various oak species are the dominant tree species throughout the golden-cheek warbler's breeding range. Spanish oak (*Quercus buckleyi)*, plateau live oak (*Quercus fusiformis*), shin oak (*Quercus sinuata* var. *sinuata*), cedar elm

(*Ulmus crassifolia*), walnut (*Juglans* spp.), hackberry (*Celtis* spp.) and Texas ash (*Fraxinus texensis*) are common; particularly in the central part of the warbler's range (Pulich 1976; Ladd and Gass 1999). Golden-cheeked warblers require some mature Ashe juniper in their nesting habitat. The species uses mature Ashe juniper bark shreds to build its nests, which are well camouflaged and located high in the nest tree, making them difficult to find. Golden-cheeked warblers are typically found in areas of steep slopes, canyon heads, draws, and adjacent ridge tops (Pulich 1976; Ladd 1985).

High-quality GCW breeding habitat is characterized by mature woodlands of Ashe juniper and a mix of oaks and other broad-leaved species with dense canopy cover, as described by Campbell (2003).

2.3.1.2 BLACK-CAPPED VIREO

The black-capped vireo (*Vireo atricapilla*, BCV) is a small, 4.5-inch-long insectivorous bird. Characteristic features of the male include a black crown, nape and face, and white "spectacles" formed by white eye-rings with a white band connecting the eye-rings. Females of the species are similar, but duller and have a slatey-gray cap. The back of the bird is olive green, the wings and tail are blackish with yellow-green edgings, the breast and belly are white with greenish-yellow flanks, and the wings have two pale yellow wing bars (Oberholser 1974; Farrand 1983).

The black-capped vireo uses heterogeneous scrub habitat that has a patchy distribution of shrub clumps and thickets with a few scattered trees and abundant deciduous foliage to ground level (Graber 1957, 1961; USFWS 1991; Grzybowski 1995). Typical plant species in Edwards Plateau black-capped vireo habitat include plateau live oak (*Quercus fusiformis*), shin oak (*Quercus sinuata* var. *breviloba*), and various sumacs (*Rhus* spp.). Less common species include Texas mountain laurel (*Sophora secundiflora*), agarito (*Berberis trifoliolata*), and beebrush (*Aloysia gratissima*). Ashe juniper (*Juniperus ashei*) is usually not the dominant species, although it may be co-dominant with the oaks. The shrub layer in vireo habitat is usually four to 10 feet high, with foliage extending densely to the ground. Vegetation structure at this level is necessary because vireos place their nests at an average height of only about three feet from the ground (Graber 1961; USFWS 1991; Grzybowski 1995).

In many parts of the black-capped vireo range (including the Edwards Plateau), the species uses habitat in vegetation with short-statured trees less than two meters tall frequently maintained by prescribed fire. Closely spaced shrub clusters separated by grassy vegetation

create the heterogeneous cover the species requires (USFWS 1991). The most common and distinguishing habitat element throughout the range of the species is the presence of dense, low, deciduous foliage at ground level to approximately 10 feet (USFWS 1991, Grzybowski. 1995, Maresh 2005). Horizontal woody canopy cover generally averages between 30 and 60 percent or more, with most of this cover from deciduous shrubs (Campbell 2003, USFWS 2007).

2.3.1.3 SALAMANDERS

The Barton Springs salamander (*Eurycea sosorum*) and the Austin blind salamander (*Eurycea waterlooensis*), both federally endangered species, are known to occur only at Barton Springs, which includes four spring outlets (Parthenia, Eliza, Sunken Garden, and Upper Barton Springs) within the City of Austin's Zilker Park. Both of these species depend on high water quality with a narrow temperature, pH, and alkalinity from groundwater sources. They inhabit surface and subsurface habitats for varying amounts of time foraging for amphipods and other small aquatic animals, as well seeking protection from external pressures by predators and drought (USFWS 2005, 78 FR 51278).

The City of Austin manages a Salamander Conservation Program to breed and maintain the endangered Barton Springs salamander and Austin blind salamander in captivity. The purpose of the captive breeding program is to provide individuals to be reintroduced into the wild in the case of a catastrophic event that severely impacts or causes extinction of the wild population. The captive breeding program is a requirement of the city's federal 10(a)(1)(B) permit, which authorizes the use of Barton Springs Pool as a public swimming facility.

The Jollyville Plateau salamander (*Eurycea tonkawae*), a federally threatened species, occurs within the Northern Segment of the Edwards Aquifer and it is known to occur in Brushy, Bull, Cypress, Long Hollow, Walnut, and (possibly) Shoal Creeks in Travis County (Chippendale et al. 2000). This species is also known from the Brushy Creek drainage that drains eastward from the Jollyville Plateau. The Jollyville Plateau salamander, like other salamander species discussed, occurs in springs, spring-runs, and water-bearing karst features within the Jollyville Plateau region of the Edwards Plateau in Travis and Williamson Counties.

2.3.1.4 KARST ENVIRONMENTS

Six federally listed karst-dwelling invertebrates are currently known to occur in Travis County: the Tooth Cave pseudoscorpion, Tooth Cave spider, Tooth Cave ground beetle, Kretschmarr Cave mold beetle, Reddell harvestman, and Bone Cave harvestman. All of these

species are troglobites, that is, they are restricted to the below-ground environment of the karst. Troglobites are generally characterized by such modifications as reduction or loss of eyes and pigment, along with more elongate appendages, more developed tactile and chemosensory detectors, and life history behaviors and strategies adapted to a food-poor environment (Elliott and Reddell 1989).

The endangered invertebrates inhabit small, shallow, dry caves and sinkholes, and their associated subterranean fractures and interconnections in Edwards and Walnut limestones (Veni 1992). Such fractures and interconnections are often difficult to identify, as observable surface indications are usually absent and subsurface indications are at best only partially detectable. Although the fractures and interconnections may be too small for humans to move through, they are large enough for karst invertebrates to traverse.

Karst habitat includes a complex of temperature, humidity, light, and nutrient-input factors that sustain only highly adapted organisms. The karst species are usually more abundant near cave and sinkhole entrances where nutrients from leaf litter, cricket and mammal droppings, and the decomposing bodies of trapped animals help maintain higher populations. During periods of unfavorable environmental conditions, however, karst-dwelling species may move farther back into the fractures and interconnections. Such conditions may be due to variations in temperature or humidity that are attenuated farther underground.

The surface community is an integral part of the karst habitat. Nutrients in the form of leaf litter, animal droppings, and trapped animals originate on the surface and move into the subsurface community via cave and sinkhole openings. Several karst-dwelling species forage on the surface and thus transfer energy and nutrients into the karst.

Karst features and their sensitive and unique biota are threatened by any changes to the humidity, structure, or nutrient flow into the system (Culver 1982). Protection of surface and subsurface drainage areas adjacent to the identified karst feature is needed for karst invertebrate protection.

2.3.2 WATER QUALITY

Sustainable water quality and quantity requires preserving pervious cover, maintaining the basic hydrologic regimen, and directly managing land to maintain proper ecosystem function (Austin Water Utility 2010). The protection and management of water quality and quantity derived from these vital, sensitive natural resources is critical to public health and sustainable

economic development. Additionally, in water-limited environments, the quality and quantity of groundwater recharge and streamflow can be affected by the type and pattern of woody vegetation (Wilcox 2002, Huxman et al. 2005, Scanlon et al. 2005, Newman et al. 2006, Bautista et al. 2007). Vegetation loss often leads to soil loss, increased runoff and erosion, decreases in water quality, lower soil infiltration, and reduced groundwater recharge.

Soil loss in the form of erosion and sedimentation can have devastating impacts on the environment. Erosion strips nutrient-rich topsoil from the land, diminishes productivity, and impedes reestablishment of native vegetation. Excess amounts of fine-grained soil particles lost through erosion pollute surface waters and aquatic habitats. Erosion and subsequent sedimentation requires continuous, ongoing management to prevent, control, and minimize damage to both water quality and the landscape.

2.3.3 FOREST HEALTH CONDITIONS

Maintaining forest health is key to maintaining proper ecosystem function. There are several natural and human-induced threats to forest health within the plan area. Wildfire, drought, tree diseases, invasive species, pests, pest management, and development are all ongoing threats to forest health. When present within the forest landscape, any of these threats may not only influence the function of the ecosystem, but wildfire prevention and wildfire behavior as well.

2.3.3.1 WILDFIRE

While forest fires can benefit an ecosystem, massive fires can do major damage to the landscape – damage that may take the landscape decades to recover from. The key is to reduce fire intensity adjacent to communities and homes. Once ignited, many factors contribute to the spread and intensity of a fire within the forested landscape, including fuel, landscape and topography, and weather. Denuded, severely burned soils become water-repellant and subsequent rains erode topsoil, polluting the surrounding watershed with ash and sediment. This polluted runoff threatens wildlife and the downstream ecosystems, including public water supplies. Severe fires may require revegetating to stabilize soils and prevent takeover by invasive plants. Forests can become more susceptible to wildfire when damaged by infectious disease, insect infestations, or winds and other natural forces.

2.3.3.2 DROUGHT

Drought can stress and promote diseases in several different ways. Drought may alter the plant's physiology, making it more susceptible as well as reduce its ability to produce defensive chemicals or outgrow the disease. More severe drought stress causes physical injury to tissues through drying; damaged tissues are then easily invaded by otherwise less-toxic pathogens. Drought can make the plant more attractive to the insect vectors of some diseases (Dutky 2006). Site conditions, species composition, impacts, and irrigation regimes are all factors that may contribute to individual tree as well as a forests susceptibility or resilience to drought.

2.3.3.3 TREE DISEASES

OAK DECLINE

Since the 1900s, outbreaks caused by a complex interaction of environmental stresses and pests, variously named oak decline, oak dieback, or oak mortality, have been reported across the U.S. Oak decline occurs throughout the range of oaks species, is not limited to one species or group, and occurs in both forest and urban settings (U.S. Department of Agriculture Forest Service (USDAFS) 1983). Other important tree species such as ash, birch, beech, and maple have also declined seriously.

Drought, frost injury, or insect defoliation are the stress factors that most frequently initiate oak decline. Trees on ridge tops and in wet areas suffer most severely from drought; those growing in valleys and frost pockets are often affected by frost. Defoliated trees that releaf the same season may exhibit dieback symptoms the next year. Other factors such as leaf diseases and soils that are waterlogged, compacted, or shallow have occasionally been implicated in oak decline (USDAFS 1983).

OAK WILT

According to the Texas Oak Wilt Information Partnership (www.texasoakwilt.org), oak wilt is an infectious tree disease caused by the fungus *Ceratocystis fagacearum*, which invades and disables the water-conducting system in susceptible trees. All oaks (*Quercus* spp.) are susceptible to oak wilt to some degree, but some species are affected more than others. Red oaks, particularly Spanish oak (*Q. buckleyi*), Texas red oak (*Q. texana*), Shumard oak (*Q. shumardii*), and blackjack oak (*Q. marilandica*), are extremely susceptible. White oaks, including post oak (*Q. stellata*), bur oak (*Q. macrocarpa*), Mexican white oak (*Q. polymorpha*),

white shin oak (*Q. sinuata* var. *breviloba*), Durand oak (*Q. sinuata*), Lacey oak (*Q. laceyi*), and chinkapin oak (*Q. muehlenbergii*), are resistant to the fungus and rarely die from oak wilt. Live oaks (*Q. virginiana* and *Q. fusiformis*) are intermediate in susceptibility to oak wilt, but are most seriously affected due to their tendency to grow from root sprouts and form vast interconnected root systems that allow movement of the fungus between adjacent trees.

Oak wilt is spread from tree to tree by beetles attracted to the sap from fresh wounds on the trunks, limbs, or exposed roots, or via the connected root system of nearby trees. There is no cure for oak wilt, and while it remains a common practice to try and stop the infection of new trees by the removal of diseased individuals and digging a trench 100 feet around the perimeter of the infected area, such practices have not been effective on a large scale. In addition, they are not practicable on a landscape scale since trenching over large areas is not economically feasible and could negatively affect other management priorities.

HYPOXYLON CANKER

Hypoxylon canker is a fungus that causes cankers and death of oaks and other hardwoods. Taking proper precautions to prevent the spread of Hypoxylon canker is essential for retaining the large and valuable trees growing across Travis County. Typically, the fungus does not invade healthy trees but it will readily infect the sapwood of a tree that has been damaged, stressed, or weakened. And once infected a compromised tree typically will die. All oak species, in addition to elm, pecan, hickory, sycamore, maple, beech, and others are susceptible to the Hypoxylon canker fungus (Texas Agricultural Extension Service (TAES) 2004).

Prolonged drought usually increases Hypoxylon canker activity. Trees growing on clay, sandy, rocky or other poor soil types are highly susceptible to the fungus infection, particularly during extended drought. Hypoxylon canker fungus spreads through airborne spores that invade and colonize the inner bark of oaks and other hardwood trees. The fungus can survive for a long time in the inner bark of healthy trees without invading the sapwood, or harming the tree, and it is present in the inner bark of many healthy trees. There is no known control for Hypoxylon canker other than maintaining tree vigor. Since this fungus is so common and it affects only damaged, stressed, or weakened trees, removing infected trees is of little to no value in controlling its spread (Texas Forest Service 2009).

2.3.3.4 NON-NATIVE AND INVASIVE SPECIES

Non-native and invasive plant species are a significant threat to forest health. Invasive plant species grow and spread rapidly, creating larger fuel loads that are much more difficult to manage. Non-native and invasive plant species also cause other significant environmental impacts include:

- Reduction of native biodiversity;
- Interference with ecosystem functions like fire, nutrient flow and flooding;
- Reduction of the value of streams, lakes and reservoirs, for recreation, wildlife and public water supply;
- Reduction of the recreational value of natural areas, parks and other areas.

For additional detailed information on the potential threats of non-native and invasive species visit the links below.

- www.austintexas.gov/department/austin%E2%80%99s-urban-forest-plan
- www.austintexas.gov/invasive

2.3.3.5 PESTS AND PEST MANAGEMENT

Non-native and invasive species are a growing threat to forests and overall ecosystem health. Many commonly used pesticides are harmful to people, pets, and the environment. The ultimate goal to protect sensitive environments is to reduce non-point source pollution and protect the region's groundwater. By utilizing an ecological approach to pest management, sensitive environments can be protected and the use of harmful chemicals can be minimized, therefore contributing to better environmental quality. Integrated Pest Management (IPM) is an approach to controlling pests (weeds, diseases, insects or others) that employs a progression of physical, mechanical, biological, and chemical tactics to keep pest problems low enough to prevent intolerable damage or annoyance.

The Grow Green program is a partnership of the City of Austin Watershed Protection Department and the Cooperative Extension Service of Travis County. This community-wide environmental education program promotes sustainable landscaping practices - aiming to preserve water quality, conserve water, encourage recycling, and advocate the IPM philosophy.

The Grow Green partnering agencies distribute educational materials to the Austin-area nurseries and home improvement stores that have elected to participate in the program.

2.3.3.6 DEVELOPMENT

Forests, particularly urban forests, are increasingly considered an element of a much larger green infrastructure network. Forests are an invaluable resource and play an integral role in health and vitality of communities by providing social, ecological, and economic benefits to the community and by enhancing the quality of life for residents. Forests can be impacted from development, primarily through declining the amount of canopy cover, stand fragmentation, encroachment onto the critical root zone, and competing land uses.

The *Austin Urban Forest Plan: A Master Plan for Public Property* (City of Austin 2013) identifies development as the number one threat to forests within the Austin area. This threat, combined with the impact of long-term drought, made it imperative to develop a plan to support the long-term health and vitality of the public urban forest within the Austin area. The *Austin Urban Forest Plan: A Master Plan for Public Property* establishes a broad scoped, long-range vision for Austin's public urban forest, and provides a framework for the City of Austin to use as a guide for managing the public urban forest over the next 20 years. Additional information on potential impacts from development and the Urban Forestry Plan can be found at http://www.austintexas.gov/department/austin%E2%80%99s-urban-forest-plan.

2.4 POPULATION AND LAND USE

According to the U.S. Census Bureau (2010), 1,024,266 people live Travis County, making it the fifth largest of Texas' 254 counties. The Austin-Travis County Plan Area encompasses a diverse array of communities. The City of Austin is by far the largest, with nearly 74 percent of the total county population. There are 22 incorporated cities, nine census-designated places (**Table 2**) and thousands of neighborhoods and subdivisions. Over 13 percent of the population lives within unincorporated areas of the county.

Within Travis County, the cities of Austin, Pflugerville, and Manor are estimated to have the greatest population growth by 2030 (Texas Water Development Board 2013). The majority of people and homes are located within municipal boundaries. Fueled by strong job growth and a high quality of life, Austin and Travis County are consistently among the fastest growing areas in the state.

Table 2. Community characteristics of the Austin-Travis County CWPP planning area.

Place	Population[1,2]	Land Area (square miles)[1,3]	Proportion of County Population (%)	Population Density/Square Mile	Estimated 2030 Population Change[2]
Travis County	1,024,266	990.2	100.0	1,034	404,159
Austin[4]					
Travis Co.	754,691	254.3	73.4	2,968	297,789
Williamson Co.	35,697	--	--	--	57,164
Hays Co.	2	--	--	--	8
Barton Creek*	3,077	5.0	0.3	619	--
Bee Cave	3,925	5.2	0.0	761	1,548
Briarcliff	1,438	1.7	0.1	866	567
Cedar Park	489	1.7	0.04	288	192
Creedmoor	202	2.3	0.0	89	--
Elgin	909	1.3	0.1	699	1,669
Garfield*	1,698	12.0	0.2	142	--
Hornsby Bend*	6,791	1.7	0.7	3,984	--
Hudson Bend*	2,981	4.0	0.3	748	--
Jonestown	1,834	6.1	0.2	299	291
Lago Vista	6,041	12.9	0.6	468	2,923
Lakeway	11,391	10.2	1.1	1,120	6,461
Leander	1,077	7.1	0.1	152	2,053
Lost Creek*	4,509	3.3	0.4	1,385	--
Manchaca*	1,133	1.9	0.1	586	--
Manor	5,037	7.4	0.5	685	7,306
Mustang Ridge	434	9.4	0.0	46	47
Pflugerville	46,936	22.3	4.6	2,103	57,549
Point Venture	800	0.9	0.1	941	724
Rollingwood	1,412	0.7	0.1	2,066	17

Place	Population[1,2]	Land Area (square miles)[1,3]	Proportion of County Population (%)	Population Density/Square Mile	Estimated 2030 Population Change[2]
Round Rock	1,362	0.7	0.1	1,946	545
San Leanna	497	0.4	0.0	1,121	--
Shady Hollow*	5,004	4.6	0.5	1,091	--
Sunset Valley	648	1.4	0.1	463	831
The Hills	2,472	1.1	0.2	2,284	528
Volente	520	2.1	0.1	247	298
Webberville	392	2.1	0.0	188	--
Wells Branch*	12,120	2.5	1.2	4,796	--
West Lake Hills	3,063	3.6	0.3	847	1,208
Windemere*	1,037	0.5	0.1	1,953	--
Unincorporated Areas	140,346	556.4	13.7	252	--

*Census Designated Place - the statistical counterpart of incorporated places and are delineated to provide data for settled concentrations of population that identifiable by name but are not legally incorporated under the laws of the state in which they are located (U.S. Census 2010).

1 – U.S. Census 2010

2 – Texas Water Development Board 2013; does not include CDPs or entities with less than 500 in total population across all counties.

3 – Land area in Travis County calculated for Cedar Park, Elgin, Leander, Mustang Ridge and Round Rock (City of Austin 2013a);

4 – Land area in Hays and Williamson Counties calculated for Austin (City of Austin 2013a)

For the Austin-Travis County project area, it is estimated that 463,641 people — 45 percent of the total project area population — live within the WUI (Texas A&M Forest Service 2014).

According to the Texas Land Trends study, more than 2.1 million acres of Texas farms, ranches, and forestlands were converted to other uses between 1997 and 2007 (Wilkins et al. 2009). Growth and development associated with population expansion in the state's 25 highest growth counties (including Travis County) were associated with over 40 percent of this land conversion, and 861,765 acres were lost from the agricultural land base in these counties. As a

function of population increase, roughly 149 acres of agricultural lands were consumed per 1,000 new residents (Wilkins et al. 2009).

Austin is the principal driver of population growth and associated expansion of the WUI in the planning area. The Imagine Austin Download Center provides a Community Inventory with extensive information on land use and zoning. The 2008 analysis of land use within all city jurisdictions (approximately 400,000 acres) comprised 38.4 percent undeveloped area, 21.1 percent residential, 20.2 percent institutional, 10.4 percent transportation, 7.3 percent commercial, and 2.6 percent water.

A February 14, 2014, article in *Forbes* Magazine titled "America's 20 Fastest Growing Cities," discussed their annual review of growth in the 100 largest Metropolitan Statistical Areas (MSAs) and stated that, "Austin takes the top spot on FORBES' annual list of America's Fastest-Growing Cities for the fourth year in a row. With a 2.5-percent population growth rate (estimated annual) for 2013—the highest of all the geographic regions—and an economy that expanded 5.88 percent last year, it's hard for other cities to compete these days." With Forbes' study placing Dallas at number four, Houston at number 10, and San Antonio at number 20, Austin and Travis County stand in the midst of one of the fastest growing regions in the United States.

The ongoing trends of agricultural lands converted to other uses, coupled with the availability of undeveloped land in the planning area, and the population growth in Austin and the surrounding regional MSAs, contribute to better understanding the expansion of the WUI throughout the planning area. An increasing number of Travis County residents live in the WUI and this increases the potential risk to life and property from a wildfire.

Numerous neighborhoods, organizations, and communities throughout the plan area are already making strides towards becoming fire adapted through the development of local CWPPs, achieving Firewise Communities recognition status, and/or participating in the Ready, Set, Go! Program (**Table 3**). The City of Sunset Valley developed and adopted their CWPP in 2012. Since 2004, 22 neighborhoods, organizations, and communities have achieved Firewise Communities recognition status (NFPA 2014). The Firewise Communities Program encourages neighbors to take responsibility in preparing their communities against the risk of wildfire (for more information, see www.firewise.org). Sixteen neighborhoods, organizations, and communities have implemented the Ready, Set, Go! Program within the plan area. The Ready, Set, Go! Program also works in a collaborative manner with the Firewise Communities Program. Ready, Set, Go! focuses on assisting individuals in making their home and property fire resistant

as well as preparing and, if necessary, implementing wildland fire evacuation plans. For more information, see **Appendix D**.

Table 3. Fire-adapted communities within the Austin-Travis County CWPP planning area.

Place	Community Size	CWPP	Year Achieved	Firewise	Year Achieved	Ready, Set, Go!
Austin-Travis County		X	2014*	X	2014*	X*
Austin Independent School District						X
Barton Creek Lakeside	500	-	-	X	2012	
Barton Hills Neighborhood Association				X		X
Canyon Mesa	261			X	2013	
Canyon Ridge Springs	52			X	2013	
CE-Bar Fire Department						X
City of Austin Wildland Conservation						X
City of Jonestown	1,834	-	-	X	2012	
City of Lago Vista	6,041	-	-	X	2011	
City of Lakeway	12,000	X	-	X	2013	
Estates of Shadowridge Homeowners Association						X
Jester Estates	2,700			X	2013	
Leander Fire Department						X
Long Canyon	1,000			X	2010	
Madrone Ranch				X	2013	
Meadow Mountain	88			X	2004	
Northwest Lake Travis Fire Rescue						X
Overlook Estates	133			X	2011	X
Pedernales FD						X
Point Venture				X	2013	

Place	Community Size	CWPP	Year Achieved	Firewise	Year Achieved	Ready, Set, Go!
Point Venture Office of Emergency Management						X
Point Venture Townhouses, Inc., Point Venture	191	-	-	X	2012	
River Place	34,432			X	2008	
Spanish Oaks**						
Steiner Ranch	12,000	-	-	X	2012	
Sunset Valley	648	X	2012	X	2012	
TC ESD #2						X
TC ESD #3 – Oak Hill FD						X
TC ESD #4						X
TC ESD #6 – Lake Travis Fire Rescue						X
The Estates at the Overlook	50			X	2011	
The Reserve at Lake Travis	10	-	-	X	2008	
Travis Country				X	2013	
Travis County Fire Marshal's Office						X
USFWS BCNWR						X
Vineyard Bay	300	-	-	X	2013	
Waterford				X	2012	
West Lake Hills	3,116			X	2008	

*currently under development

**currently inactive

This general overview of population and land use shows two important conditions. First, a number of communities, neighborhoods, and residents recognize the potential for wildfire and have taken the initiative to become more fire adapted through the implementation of wildfire preparedness programs like Firewise and Ready, Set, Go! Second, there is a great need for

expanding the use of local-level CWPPs and other programs advancing HIZ principles in the face of significant growth pressure.

2.5 FACILITIES OF CONCERN/INTEREST

Facilities of concern/interest also include those within Travis County with special-needs populations who require additional considerations in the event of a wildfire.

- Schools – There are 174 public, private, and charter schools for kindergarten through high school and 15 school districts in Travis County (Texas Education Agency 2012; Texas Private School Accreditation Commission 2012). Travis County is also home to six major universities and colleges including the University of Texas at Austin and Austin Community College, two of the largest in the U.S. (U.S. Department of Education 2012).

- Hospitals/Nursing Homes – According to the Texas Department of State Health Services (2012), there are 20 acute care and psychiatric hospitals in Travis County with 29 nursing homes (Texas Department of Aging and Disability Services 2012).

- Military Installations – Camp Mabry – the third-oldest active military installation in Texas, houses the headquarters of the Texas Military Forces (Texas Army National Guard, Texas Air National Guard, and Texas State Guard) on a 90-acre site that was added to the National Registry of Historic Places in 1996.

2.6 UTILITIES AND TRANSPORTATION

Utilities are generally defined as resources essential for the functioning of a society and economy. They commonly include roads, airports, bridges, power plants, water/wastewater treatment plants, utility lines (electric, water, phone, cable, gas, etc.), water supply (lakes, rivers, dams), and communications facilities.

The main transportation corridors include Interstate Highway 35, US 290, US 71, US 183, State Highway (SH) 130, SH 45, Loop 1 (MoPac Expressway), Loop 360, Ranch to Market Road (RM) 620, and RM 1431.

Austin-Bergstrom International Airport is the largest airport within the plan area. Several other municipal airports, privately operated airstrips, heliports, and landing strips are also located within Travis County (**Table 4**).

Table 4. Airports and Facilities within the Austin-Travis County CWPP planning area.

Facility Name	Facility Usage	Airport	Heliport
Austin Diagnostic Medical Center – 1XS5	Private		X
Austin Executive Airport – EDC	Public	X	
Austin-Bergstrom Intl Airport – AUS	Public	X	
Brackenridge Hospital – 18TS	Private		X
Capitol National Bank Building – 04TA	Private		X
Dell Children's Medical Center – 3XA6	Private		X
Dryden Airport – TX05	Private	X	
Falcons Nest – 7TX2	Private		X
Heart Hospital of Austin – XS41	Private		X
Kitching Ranch – XS65	Private		X
KVUE-TV- 19TS	Private		X
Lakeway Airpark Airport - 3R9	Public	X	
Mabry Ahp -Ng - TX26	Private		X
MGM – TS23	Private		X
Ossiport	Private		X
Seton Medical Center H-4 - 32TS	Private		X
South Austin Medical Center – 22TX	Private		X
Starflight Facility – TE94	Private		X
Tom Dye – XA24	Private		X
Crosswinds Airfield – TE96	Private	X	
Del Valle – TA55	Private	X	
Bakers Place – TX61	Private	X	
Skye Dance – 1XS2	Private	X	
Seidel Ranch – 02XS	Private	X	

Facility Name	Facility Usage	Airport	Heliport
Lz Phantom - 98XS	Private		X
Winns – TE14	Private		X
Lago Vista TX - Rusty Allen Airport – RYW	Public	X	
Shoreline Ranch – 1TX4	Private	X	
Johnny Voudouris - 6TS7	Private		X
Aero – 9TA0	Private		X

The Texas Commission on Environmental Quality (TCEQ) maintains a Water Utility Database (WUD) of information submitted from Texas Water Districts, Public Drinking Water Systems and Water and Sewer Utilities (https://www.tceq.texas.gov/utilities/iwud.html). The TCEQ WUD identified over 100 active water utilities and 36 active sewer utilities (**Table 5**) within Travis County (TCEQ WUD 2014).

Table 5. Water and Wastewater utilities within the Austin-Travis County CWPP planning area.*

Utilities with CCNs	Utility Ownership Type by Utility Type (Active Only)				
Ownership Type	Water	Sewer	Allocated	Submetered	Total
DISTRICT \ AUTHORITY	16	11	0	0	27
INVESTOR	21	10	0	0	31
MUNICIPALITY	10	10	0	0	20
WATER SUPPLY CORPORATION	21	4	0	0	25
Total by Utility Type	**68**	**35**	**0**	**0**	**103**

Utilities w/o CCNs	Utility Ownership Type by Utility Type (Active Only)				
Ownership Type	Water	Sewer	Allocated	Submetered	Total
DISTRICT \ AUTHORITY	27	0	0	0	27
INVESTOR	3	1	0	0	4
MUNICIPALITY	2	0	0	0	2
WATER SUPPLY CORPORATION	1	0	0	0	1
Total by Utility Type	**33**	**1**	**0**	**0**	**34**

Non-Utilities Service Types	Utility Ownership Type by Utility Type (Active Only)				
	Water	Sewer	Allocated	Submetered	Total
SUBMETER \ ALLOCATION	0	0	527	169	696
Total by Utility Type	**0**	**0**	**527**	**169**	**696**

*Source: http://www14.tceq.texas.gov/iwud/reports/index.cfm?RequestTimeout=1000 Accessed March 1, 2014

The City of Austin currently has two water treatment plants, Davis and Ullrich, which draw water from the Colorado River. Austin's first water treatment plant, the Green Water Treatment Plant, was decommissioned in October 2008. The city is building another facility, Water Treatment Plant 4.

Austin Water Utility operates two major wastewater treatment plants within the plan area -- Walnut Creek and South Austin Regional -- with total permitted capacity of 150 million gallons per day. The plants receive wastewater flow from Austin Water Utility's sanitary sewer collection system and fully treat the water before returning it to the Colorado River or reusing it through the city's Water Reclamation Program.

Austin Utility's Hornsby Bend Biosolids Management Plant receives millions of gallons of treated sludge each day from the two wastewater plants. After treating to kill pathogens in the sludge, it's combined with yard trimmings to make compost for land application and sales.

The Lower Colorado River Authority (LCRA) is the primary wholesale provider of electricity in central Texas and manages the region's water supplies. LCRA generates power from a number of sources, including six hydroelectric dams, three gas-fired plants, and a coal-fired facility. LCRA estimates that it generates about 46 percent of its power from coal, 50 percent from natural gas, and four percent from hydroelectricity, wind energy, and other renewable sources. LCRA uses the lakes and river as a system to conserve and convey water supplies and operates two hydroelectric power-generation and water-supply facilities within Travis County: Mansfield Dam on Lake Travis and Tom Miller Dam on Lake Austin.

Austin Energy oversees a diverse mix of more than 3,000 MW of total generation and operates three natural gas-powered plants in the Austin area. The Austin Energy electric system serves a 437 square-mile area, including Austin and portions of Travis and Williamson Counties. It operates more than 5,400 miles of overhead primary and secondary power lines,

almost 6,000 miles of underground primary and secondary lines, 620 miles of transmission lines, and 72 substations.

Pedernales Electric Cooperative (PEC) is a distribution and transmission cooperative that serves communities in western Travis County. PEC doesn't generate power and the LCRA is PEC's primary wholesale provider for electricity.

2.7 FIRE RESPONSE CAPABILITIES

The City of Austin Fire Department and 13 Emergency Service Districts (ESDs) primarily handle fire response within Travis County. The ESDs have 55 individual fire stations; the Austin Fire Department has 45 (**Figure 5**). **Table 6** includes the number of firefighters, number of stations and Public Protection Classification (PPC) rating by ESD and for the City of Austin. Under extreme wildfire conditions, the number of homes threatened can challenge even the best-equipped and staffed fire departments. This necessitates individual wildfire preparedness, planning, and mitigation.

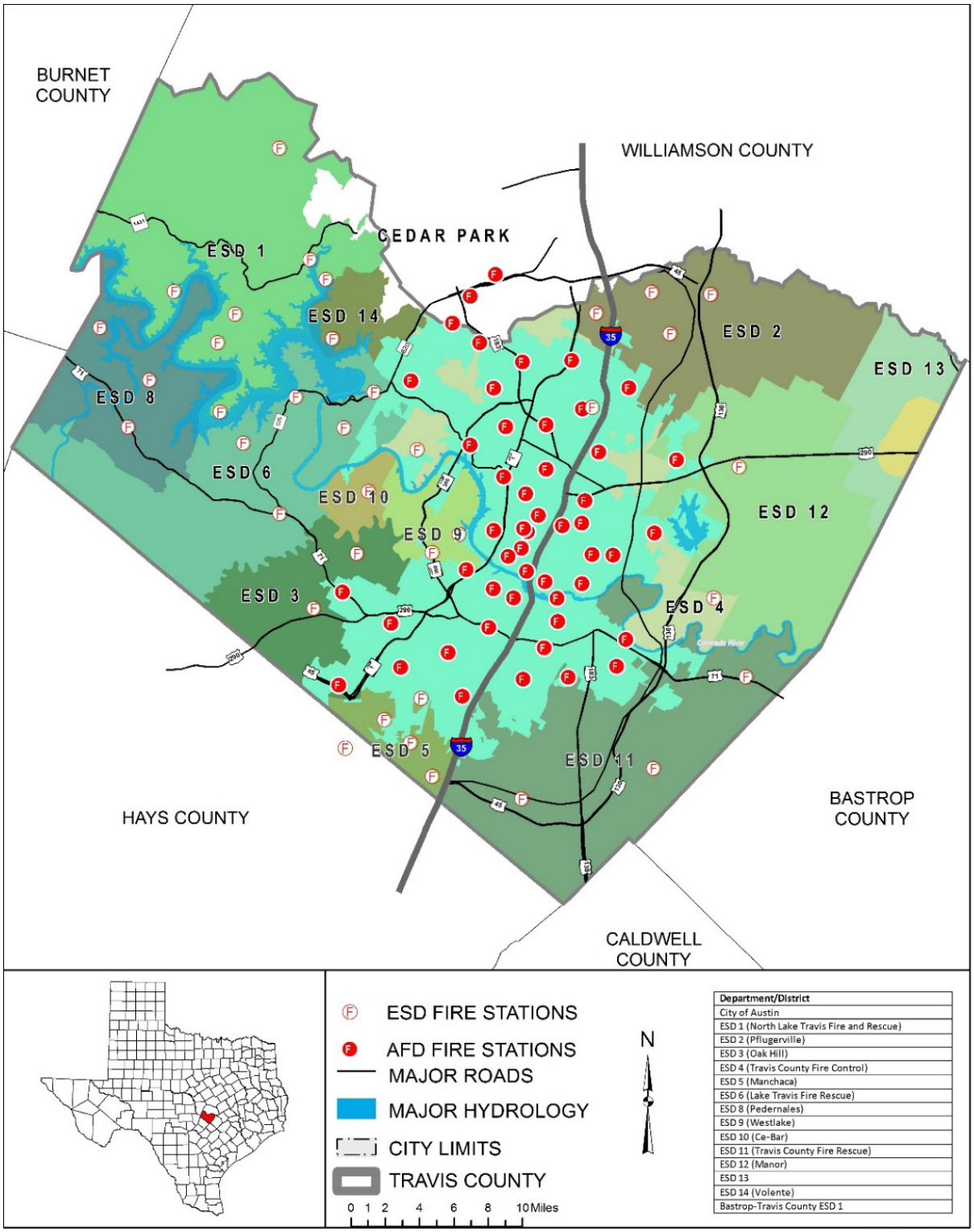

Figure 5. Fire stations in Travis County.

The PPC is a countrywide classification system used by the Insurance Services Office (ISO) to grade a community's local fire protection using ISO's Fire Suppression Rating Schedule (SFMO 2013b). ISO assigns communities a PPC rating from 1 (the best) to 10 (the worst) based on how well they score on such features as water distribution, fire department equipment and manpower, fire alarm facilities, fire safety education, building code enforcement, fire prevention code enforcement, and fire investigation capabilities. Some ESDs have a dual rating where the first number is the PPC for buildings within 1,000 feet of a fire hydrant and five road miles of a recognized fire station. The second number is for buildings more than 1,000 feet from a fire hydrant but within five road miles of a recognized fire station (SFMO 2013b).

Table 6. Travis County firefighting resources.

Department/District	Number of Firefighters	Number of Fire Stations	PPC Rating
City of Austin	1,129	45	2
ESD 1 (North Lake Travis Fire and Rescue)	26	7	4 – Point Venture 5 – Jonestown; Lago Vista 8b/9 – Rest of ESD 1
ESD 2 (Pflugerville)	77	4	3/8b
ESD 3 (Oak Hill)	27	2	2/8b
ESD 4 (Travis County Fire Control)	35	3	4/8b
ESD 5 (Manchaca)	25	2	3
ESD 6 (Lake Travis Fire Rescue)	80	5	2 – Bee Cave; The Hills; Lakeway 3 – River Place; Steiner Ranch; Comanche Trail; Marshall Ford; Mansfield Dam; Hudson Bend; Apache Shores; Cardinal Hills 8b – Rest of ESD 6 including Hamilton Pool
ESD 8 (Pedernales)	21	3	5/10
ESD 9 (Westlake)	34	3	3 – Rollingwood; West Lake Hills 3/8b – Rest of ESD 9
ESD 10 (Ce-Bar)	10	1	3/8b

Department/District	Number of Firefighters	Number of Fire Stations	PPC Rating
ESD 11 (Travis County Fire Rescue)	32	3	5/7
ESD 12 (Manor)	10	1	7/9
ESD 13 and Bastrop-Travis County ESD 1 (Elgin VFD)	39	1	3
ESD 14 (Volente)	20	1	8b

The PPC rating for an ESD is based on insurance measures and is not affected by the risk assessment performed for this CWPP. The parameters used in calculating the PPC do not include specific wildfire risk elements. Additionally, any measurement, classification, or identification of the existing wildfire risk does not alter the actual level of that risk, as it currently exists. Several of the ESDs have recently lowered their PPC ratings by investing in new equipment or training. ESD 12, which includes the City of Manor and the Village of Webberville, anticipates improving their rating with the construction of two new stations.

2.7.1 ADDITIONAL FIRE RESPONSE CAPABILITIES

2.7.1.1 USFWS BALCONES CANYONLANDS NATIONAL WILDLIFE REFUGE

The USFWS Balcones Canyonlands National Wildlife Refuge maintains a permanent, year-round crew of 10 wildland firefighters and three to five staff trained as wildland firefighters but whose primary responsibilities are not fire related. The refuge can also deploy approximately 25 firefighters from other federal agencies and outside sources, as needed. These are federal resources which may be allocated nationally. The refuge maintains mutual aid agreements with all neighboring fire districts, Texas A&M Forest Service, Austin Water Utility and the Nature Conservancy (Schwope 2013). A list of refuge firefighting resources is provided in **Table 7**.

The USFWS Balcones Fire Program is dedicated to protecting life, property, and natural resources from wildland fire. The fire program incorporates training, readiness, prevention, prescribed burning, and a strategy for the WUI to achieve a balance between protection from wildland fire and maintaining a healthy ecosystem. In support of that mission, the USFWS Balcones Fire Program is involved with numerous research activities relevant to both ecosystem

health and hazardous fuel reduction and was instrumental in assisting Lago Vista and Jonestown in establishing their Firewise Communities designations. It also conducts fuel treatment projects on properties adjacent to the refuge, and assists local entities in the area with mitigation treatments. It has also provided USFW mitigation BMPs and cost shares to land owners.

Figure 6. U.S. Fish and Wildlife Service fire crew at Balcones Canyonlands NWR (Abra Zobel, USFWS).

2.7.1.2 TEXAS A&M FOREST SERVICE

The Texas A&M Forest Service (TFS) is the lead state agency for wildfire response providing suppression resources and coordination. State response is activated as wildfires or conditions exceed the local firefighting resources ability to control. The TFS uses a unified command system to coordinate all cooperators including out-of-state resources (TFS 2009). TFS has more than 200 full-time, trained firefighters on staff and maintains qualification records for more than 745 firefighters and emergency responders (TFS 2009). Firefighting equipment is staged throughout the state. This represents about one firefighter for every 1,500 square miles, and under the extreme conditions of 2011 numerous wildfires were not manned by TFS or federal resources. Although no equipment is permanently staged in Travis County, nearby Bastrop, Bell, Fayette, and Gillespie Counties all have equipment (TFS 2013b). Additionally, federal and out-of-state resources and cooperators can share resources nationwide through the National Wildfire Coordinating Group.

2.7.1.3 OTHER MUNICIPALITIES (LEANDER, CEDAR PARK, ROUND ROCK)

While the cities of Cedar Park, Leander, and Round Rock are primarily situated within Williamson County, portions of their city limits extend into Travis County. A WUI committee has been created within the CAPCOG planning area to address this shared WUI. The Leander and Round Rock fire departments respond to fires within their respective jurisdictions in Travis County. The Cedar Park fire department responds to most areas of Cedar Park within Travis County except for the northwest corner of the city's extraterritorial jurisdiction, which is served by Travis County ESD No. 1 (City of Cedar Park 2013).

2.7.2 EMERGENCY FACILITIES

Travis County and the City of Austin have numerous facilities that have been identified and equipped to serve as shelters. These locations are not published in advance, as many factors will determine which shelter(s) would be opened. Some of these factors include the size and severity of the disaster, the location of the disaster area and the numbers of people requiring shelter. All pre-designated shelters are ADA accessible. When the determination is made which shelter(s) to open, the community will be informed via traditional media (television and radio), city and county websites, the Emergency Notification System, and the City of Austin's information lines (2-1-1 and 3-1-1) if located within the city's jurisdiction.

2.7.3 FIRE FIGHTING EQUIPMENT

Table 7 provides a list of firefighting resources for the City of Austin Fire Department and the Travis County ESDs.

Table 7. Travis County firefighting equipment.

	Battalion Vehicle	Brush	Engine	Ladder	Quint	Rescue	Command	Tender	Dozer	Other	Helicopter	Boat	Total
City of Austin	6	12	42	5	8	3			4			4	84
ESD 1 - North Lake Travis Fire & Rescue		6	6				2	4				2	20
ESD 2 – Pflugerville	1	5	6		1		4	1					18
ESD 3 - Oak Hill	1	3	2		1		1	1		2			11
ESD 4 - Travis County Fire Control	1	3	3				1			2			10
ESD 5 – Manchaca	1	2	3			2	1	2		1			12
ESD 6 - Lake Travis Fire Rescue	2	5	6		2		3		1			2	21
ESD 8 – Pedernales	1	4	3				1	2		2		1	14
ESD 9 – Westlake	2	3	3				1			2			11
ESD 10 - Ce-Bar	1	2	2				1	1		1			8
ESD 11 - Travis County Fire Rescue	1	4	6		1								12
ESD 12 – Manor		2	2				1						5
ESD 14 – Volente		2	2				1	1					6
Starflight											4		4

	Battalion Vehicle	Brush	Engine	Ladder	Quint	Rescue	Command	Tender	Dozer	Other	Helicopter	Boat	Total
USFWS Balcones Canyonlands NWR	1	3					1	1	1	2			9
TFS*		2						1	3				6
	18	58	86	5	13	5	18	14	9	12	4	9	251

*TFS equipment is not necessarily housed in Travis County but may be available for use. These are statewide resources that may be deployed elsewhere.

2.8 GOVERNMENT

Understanding the governmental environment in which wildfire mitigation efforts are to be implemented is as necessary as understanding the physical environment. While a particular set of physical conditions may be best addressed by a broad wildfire mitigation strategy, overlapping governmental jurisdictions with mission-specific regulations may dictate alternate treatments in order to both mitigate risk and comply with codes. This subsection provides a brief review of the various forms of governance in the planning area, their codes, regulations, and some constraints they can create on each other, and an overview of some existing inter-jurisdictional relationships.

2.8.1 GENERAL ORGANIZATION

Built upon the foundation of the U.S. Constitution and the sharing of federal and state powers, the Texas Constitution establishes the state's governmental framework and function. The state constitution gives units of local government (counties, municipalities, and special districts) varying degrees of regulatory authority. These authorities determine the extent a community can implement and enforce laws, ordinances, codes, and regulations. These include WUI codes and practices developed specifically to address life, environment, and property protection pertaining to the potential specific effects of wildfires. This section covers governmental organizational levels in a general context as they relate to this CWPP; however, more specific details about how they relate to wildfire mitigation and WUI Code and regulation development is in Section 2.8.2.

2.8.1.1 FEDERAL

As discussed earlier in Section 1.0, the Healthy Forests Restoration Act of 2003 (HFRA) provides federal legislation for implementing a number of provisions to reduce the risk of wildfire and restoring healthy forests and watersheds on federal, state, private, and tribal lands across the U.S. With this important piece of legislation, federal agencies, tribal, state, and local governments, and communities in at-risk areas of the country now have cohesive guidance and resources available to reduce the impacts of wildfire. It is important to remember that other federal environmental regulations, such as the Endangered Species Act and Clean Water Act, as well as any other state or local environmental regulations also need to be addressed when implementing specific wildfire mitigation strategies such as hazardous fuel reduction.

Travis County contains portions, or all, of the range extents for a number of federally protected species within its political boundaries. This makes regulations set out by the Endangered Species Act particularly important in developing comprehensive strategies, rules, and codes for wildfire mitigation. A large portion of western Travis County wildland is included within either the Balcones Canyonland Preserve (managed jointly by the City of Austin, Travis County, and other partners) or the Balcones Canyonlands National Wildlife Refuge, which is managed by the U. S. Fish and Wildlife Service (USFWS). The primary management concern for both of these wildland areas is to protect, maintain, and conserve the habitat these federally protected species require. Therefore, it is imperative that governmental entities and individual landowners and managers carefully consider any potential impacts to federally protected species and their habitat when developing WUI codes and executing wildfire mitigation.

Other federal environmental regulations that may need to be addressed during the development of WUI codes and implementation of wildfire mitigation strategies are the National Environmental Policy Act (NEPA), the Clean Water Act (CWA), and the Clean Air Act (CAA). The Environmental Protection Agency (EPA) and their designated federal entities and state counterparts regulate all.

2.8.1.2 STATE

The Texas Administrative Code (TAC) contains the compiled list of rules and regulations for state agencies and state agencies provide oversight and administration of those state rules and regulations. The Texas Commission on Environmental Quality (TCEQ) administers federal and state environmental regulations for air, water, and waste. The TCEQ is responsible for developing a State Implementation Plan (SIP), enforced and approved by the EPA, which

explains how Texas will meet National Ambient Air Quality Standards (NAAQS) based on Clean Air Act regulations. The EPA recognizes the importance of prescribed fire as a land management tool and encourages the development of smoke management plans to minimize the impacts of burning activities. TCEQ also administers regulations related to outdoor burning (Title 30 TAC Section 111) in order to advance protection of the environment, promote public health and safety, and avoid nuisance conditions. The Outdoor Burning Rule prohibits outdoor burning statewide with exceptions like firefighter training and prescribed burns. Under the guidance of the National Wildfire Coordinating Group's minimum qualifications for personnel involved in prescribed fires (PMS 310-1), the Texas Department of Agriculture Prescribed Burn Board adopts rules related to prescribed burning as authorized by the Texas Natural Resources Code and sets standards for prescribed burning by private landowners, develops training and certification requirements for prescribed burn managers, and minimum insurance requirements for certified burn managers.

TCEQ is also responsible for conducting Section 401 reviews of U. S. Army Corps of Engineers (USACE) Section 404 permit applications for projects that may impact U. S. waters and other special aquatic sites such as wetlands. TCEQ administers the Texas Pollutant Discharge Elimination System (TPDES), which has federal regulatory authority over discharges of pollutants to Texas surface water; however discharges associated with oil, gas, and geothermal exploration and development activities are regulated by the Railroad Commission of Texas. The TPDES requires a general permit to discharge storm water and Storm Water Pollution Prevention Plan (SWPPP) for projects disturbing more than one acre of soil. According to the TCEQ, soil disturbance activities, generally associated with construction activities, include clearing, grading, and excavating, but do not include activities such as routine clearing of existing right-of-way or similar maintenance activities. Also, a Water Pollution Abatement Plan (WPAP) is required for any regulated activity proposed in the Edwards Aquifer recharge zone. Regulated activities include any construction-related activity, such as clearing, excavation, or any activities that alter or disturb the topographic, geologic, or existing recharge characteristics of a site. Clarification will be needed from TCEQ to determine the regulatory oversight of certain wildfire mitigation strategies that might disturb soils or impact riparian areas within and outside of the Edwards Aquifer recharge zone.

Laws and regulations related to endangered and threatened species can be found in the TAC and the Texas Parks and Wildlife Code. The Texas Parks and Wildlife Department (TPWD) administers those regulations by prohibiting the taking, possession, transportation, or

sale of state-listed animal species and commerce in and collection of threatened and endangered plants without a permit issued by TPWD. TPWD regulations also provide additional protections for federally protected species.

2.8.1.3 COUNTY

Under state law, each county is governed by a commissioners' court of four elected commissioners and presided over by an elected county judge. Counties have limited legal authority compared to municipalities and can only pass regulations on those issues expressly authorized or implied by the Texas Constitution or statutes. This regulatory authority is generally restricted to unincorporated areas and includes, but is not limited to, subdivision review, floodplain management, road construction and maintenance, law enforcement, solid waste management, public works management (e.g., water and sewer delivery), and public health services. Based upon state law, Travis County and the unincorporated areas within it do not have the authority to implement a WUI code or ordinance.

Also included within the county government are 13 Emergency Service Districts (ESD) that provide fire protection and emergency medical services to unincorporated portions of the county. The ESDs, which are regulated by Chapter 775 of the Texas Health and Safety Code, are created through perceived need and public vote, and are supported by the Travis County Fire Marshal.

2.8.1.4 MUNICIPALITIES

Municipalities are incorporated by the state and include cities, villages, and towns. Municipalities have discretion in how they are organized with most choosing from a mayor-council or council-manager model (Blodgett [date unknown]; MacCorkle [date unknown]). Municipalities have fewer restrictions on their legal authority than counties. Some examples of expanded legal authority for municipalities include planning authorities, annexation of territories, passing ordinances (e.g., zoning, impervious cover, noise), enforcing and amending residential construction and electric codes, and expanded tax authority.

Based on regulations in Chapter 42 of the Local Government Code, an extraterritorial jurisdiction (ETJ) in Texas is a designated area that is adjacent to a municipality and where they can extend regulations to protect the municipality's quality of life by ensuring minimum standards. ETJ size is determined mainly by the municipality's size. Within Travis County, the City of Austin and county jointly regulate land subdivision, while the county or special districts

provide other services such as public safety, road maintenance, and parks. Unlike counties, municipalities can implement WUI codes and ordinances without specific state legislation.

2.8.1.5 NEIGHBORHOODS

At the neighborhood level, Covenants, Conditions and Restrictions (CCRs) are voluntary limitations and rules placed on a group of homes by a builder, developer, neighborhood association and/or homeowner association (HOA). CCRs are frequently associated with planned developments such as condominiums, townhomes, subdivisions, and housing cooperatives. Although many state and local ordinances protect citizens from unsafe or unhealthy conditions, CCRs more specifically regulate what residents can or cannot do to (or on) their home and property. For example, some CCRs regulate materials used for fencing or lawn maintenance. Local municipal ordinances and codes, legitimized by elected representatives for the purpose of protecting life, environment, and property, would normally take precedence over CCRs.

2.8.2 CODES AND REGULATIONS

The codes and regulations generated by each governmental entity are focused on using the authority granted to them to address their assigned mission. Depending on their level of authority, these government entities and their departments typically cooperate in promulgating codes and regulations within shared jurisdictions by first focusing on their own mission and then accommodating the missions of others. This can lead to constraints that have the potential to reduce the effectiveness of one or more missions involved. Wildfire can dramatically affect most of these missions and mitigation efforts must be considered across the full spectrum of codes and regulations in order to holistically address any one of the missions.

Wildfire mitigation, particularly in the WUI, is consistently challenged by the complex and interconnected nature of existing codes and regulations. The importance of this issue prompted the JWTF working group charged with developing this CWPP to form a Code Analysis/Regulatory Issues Task Group. These subject matter experts crafted the bulk of this portion of this CWPP that provides valuable guidelines for addressing code and regulations constraints with regard to WUI Code development and overall wildfire risk mitigation strategies.

2.8.2.1 CODES AND REGULATIONS IN THE WUI

A consistent, specifically tailored, community-based and developed code can be an effective tool in improving a community's wildfire resistance. Well-designed and consistently

implemented wildfire codes can support the development of fire-adapted communities across Travis County. Organizations and government service providers have certain responsibilities for public safety and an ability to provide a comprehensive, planned approach to community wildfire readiness and safety to augment wildfire risk reduction on personal property. In addition to best practices, technical guidance to the public, and emergency services, a public entity's approach may include regulatory frameworks and code development.

A cooperatively developed regional Wildland-Urban Interface (WUI) code framework, state and local codes, and complementary jurisdictions' policies could enhance the effectiveness of private and public voluntary measures, support existing local fire and building code implementation, align preventive measures across jurisdictions, reduce ignition and spread potential, and keep residents safer in the event of wildfire.

Any role in creating a WUI code or regulation should support these purposes: reduce wildfire encroachment and spread, mitigate intensity, reduce vulnerability and potential damage to property and life, and remain in compliance with all existing local, state and federal laws.

Currently in Travis County, most wildfire risk reduction is through voluntary measures, guidelines and recommendations implemented at various scales inconsistently across jurisdictions. No municipality or jurisdiction in the county, with the exception of the City of Leander, regulates or requires wildfire readiness for homeowners, developers, subdivisions, commercial properties, wildland managers, or fire professionals. Also, there is no state-level code to support development of such regulation in unincorporated areas. In western Travis County, a few neighborhood associations such as Steiner Ranch, River Place, Meadow Mountain, and The Reserve at Lake Travis have formed Firewise Community committees to explore options and disseminate information to their residents. However, at this scale, if one property owner prepares and next-door does not, both are still vulnerable to ignition, wildfire spread, and loss of life and/or property.

The following resources are widely promoted by county, municipalities, and neighborhood organizations, but these are general and voluntary, without connectivity across jurisdictions or to the fuel types and risk patterns in Travis County:

- *Ready, Set, Go!* Action Guide
- Spanish *Ready, Set, Go!* Action Guide
- Firewise Landscaping and Construction

These resources are useful if applied and interpreted for appropriate sites, but their effectiveness varies if not applied house-to-house and unsuitable as a step-by-step prescription for widespread application across variable sites. WUI Code(s) can guide jurisdictions' code development regionally, connecting preventive actions tailored by risk assessment. This is a community-based step but broader than Firewise Community committees and "best management practices," which are important but voluntary companion steps.

2.8.2.2 AUTHORITIES - OPPORTUNITIES AND CONSTRAINTS

Opportunities and constraints in WUI code development and implementation depend on the authorities granted to various jurisdictions: federal, state, and local (e.g. county, municipal, neighborhood associations, and some infrastructure providers). For instance, the state does not regulate building code specifics in communities, which is a constraint. But counties, municipalities, and even some neighborhood associations have the ability to enhance a community's flame and ember resistance through building codes and covenants that guide location and type of development in high-wildfire-risk zones and that address platting, development standards, and building materials including landscaping. Conceptually, code development and implementation will depend on jurisdictions' authorities; however, opportunities exist at various levels.

Similar to land development codes implemented for construction within floodplains, a WUI code can protect lives and properties by regulating development in high-risk areas and improve residents' access to more affordable insurance. For example, the following Austin Land Development Code (LDC) chapters guide location and development potential in certain flood-prone areas and similar code could be developed to address wildfire high-risk areas:

- Obstructions, adjacent property responsibilities, studies prior to construction, mapping, engineering, access requirements, and hazard zones are addressed in Drainage LDC 25-7;
- Flood-resistant construction is addressed in Building Code Appendix G LDC 25-12-3; and,
- Other technical building codes related to site plans, development, land clearing, vegetation removal, and the environment are covered in LDC 25-5 and LDC 25-8.

Technical manuals such as drainage and environmental criteria are directly related to these codes and have been developed through collaboration with public processes and other jurisdictions.

Codes and technical manuals define terms (e.g., 25-year floodplain, 100-year floodplain), risk categories/areas, avoidance zones, prohibited actions within certain defined-risk areas, planning studies and requirements for filing documents, and variances processes. All of this is aimed to improve personal safety and property protection from direct actions taken by a landowner or his/her neighbor.

Fundamentally, WUI code should change the location, design, and type of development in high-wildfire-risk zones at the site, neighborhood, and community levels. There are opportunities to shape our communities' wildfire resistance and preparedness all along the development spectrum: neighborhood associations, municipalities, county, and state. There are similar opportunities for implementation by neighborhoods, developers, planners, and reviewers.

Individual landowners of residential, commercial, rural and/or agricultural properties, subdivision and commercial developers, and advisory groups and committees are not regulatory bodies. However, they each have avenues to influence public policy, regulation, and safety decisions through stakeholder-driven processes as they develop guidelines, codes, and legislation.

Constraints to WUI code development include:

- Public perceptions such as risk associated with certain wildland types that do not mesh with specific, local fuel conditions;
- Trust in our governing bodies to have and apply expertise needed to protect community values;
- Individual values such as privacy, property values, and property rights;
- Limited experience with wildland fire behavior in our area's fuel types;
- Budget and capacity variability across jurisdictions to contribute to regularly updated, accurate mapping and risk assessment; and,
- Limited authority to develop and implement code.

ZONING/LAND USE

At the largest local scale, zoning is the division of land within a jurisdiction into separate districts within which uses are permitted, prohibited, or permitted with conditions. Zoning guides platting, building code and site regulations, such as building heights, bulk (density/floor-to-area ratio), setbacks, building coverage, and impervious cover. Zoning is a power granted to municipalities by the state in order to promote public health, safety, morals, or general welfare, and to protect and preserve places and areas of historical, cultural, or architectural importance and significance (City of Austin 2014).

Most people think of "zoning" as a map of particular development types across a jurisdiction: residential, commercial, multi-family, industrial, agricultural, and civic, to name a few. These are base zoning districts. Certain areas may have overlays or special districts on top of the base districts. These overlays more specifically guide development density and type to maintain certain community values such as waterfront, scenic corridors, historic districts, neighborhood character, or concentrated retail.

Zoning conditional overlay on specific properties could be applied to further restrict a zoning classification or land use in high-wildfire-risk areas as defined by the risk assessment. This tool could provide site development regulations tailored to individual properties/areas to do the following:

- Prohibit permitted, conditional, and/or accessory uses otherwise allowed in a base district;
- Make a permitted use a conditional use;
- Decrease the density that may be constructed;
- Decrease building heights;
- Increase minimum setback requirements;
- Decrease maximum impervious or building cover requirements,
- Restrict access to adjacent roads and require specific design features to minimize the effects of traffic.

In conjunction with platting, subdivision, and development code, the zoning overlay could define and identify high-wildfire-risk areas based on the risk assessment. The overlay also could limit or prohibit vulnerable hazardous materials and some commercial development. It could limit concentrated populations such as high-traffic retail, nursing homes, hospitals, and schools.

And the overlay could require certain development standards, and provide a mechanism for appeals.

Incorporated jurisdictions may author, approve, and implement a WUI code; however, unincorporated areas (counties) do not share that authority independently and must have sanction from the Texas Legislature. As of 2014, Texas is the only state in the U.S. that restricts large areas within its boundaries from being zoned or effectively planned (CAPCOG 2009). That said, several Travis County codes could mirror certain municipal codes.

PLATTING/SUBDIVISION

Platting and subdivision processes take zoning to the next-finer scale. They can identify permitted buffers, structures, and populations adjacent to potential wildfire interface and may improve or enhance responders' abilities to:

- Set standards for WUI easements, similar to drainage or other infrastructure easements, that require a fire-protection buffer zone on the development perimeter;
- Define structure density/concentration parameters to achieve setbacks from high-wildfire-risk areas and limit house-to-house fire transmission;
- Require survey and protection of natural features such as lakes, rivers, and wetlands; and manmade features as firebreaks that could enhance community wildfire resistance;
- Require roads to be adequate in width and grade to accommodate fire-suppression equipment and personnel and set standards for number and type of ingress/egress depending on wildfire risk, lot density, and structure density;
- Require identification of adequate water supply for fire suppression within the context of existing water budget and implemented practices that may affect the source;
- Require setbacks from WUI for certain development categories (e.g., high-traffic retail, nursing homes, hospitals, schools, manufactured home sites, and subdivisions) and community value sites that could be damaged by wildfire (e.g., sensitive habitat areas, historic structures/districts, infrastructure, scenic areas, recreational assets),
- Identify structure location standards within a lot to maximize defensible space.

BUILDING CODES

At a site-specific scale, building codes can be improved or modified to address specific construction materials or processes to reduce ignition potential and improve safety with:

- New or retrofitted/remodel construction materials such as masonry and metal roofing; construction practices such as soffit, foundation, deck, and fence materials;
- Greater protective measures at the individual lot scale for higher-risk developments, ingress/egress, driveways, buffers from adjacent areas, lighting, and fencing may differ from individual lot scale conditions for single family, commercial, and business. Such higher-risk developments could include vulnerable populations like hospitals or schools, multi-family, manufactured homes, and high-traffic commercial/retail.

2.8.2.3 POTENTIAL FOR A WUI CODE IN TRAVIS COUNTY

Jurisdictions within Travis County have various authorities to develop public health and safety codes. Regulatory hierarchy -- federal, state, local, neighborhood -- will influence how codes are developed and related to each other. WUI code could either be embedded in existing regulation or separate-but-compatible, stand-alone code within a jurisdiction's authority. Regardless of an entity's jurisdiction, any code development must be in compliance with existing local, state, and federal regulations.

FEDERAL

Fuel types, risk, and community values vary widely across the Unites States. While WUI regulation at this level would not entirely account for local risk assessment and reduction, the federal government takes an active interest in community wildfire readiness, safety, response, and natural resources' protection. Communities and regions implementing WUI code could find great support from federal agencies and resources under certain conditions.

Through the Wildland Fire Leadership Council (WFLC) and development of the National Cohesive Wildland Fire Management Strategy, programs within various participating agencies are dedicated to prevention, outreach, and emergency response (WFLC 2012). The Federal Emergency Management Agency (FEMA) participates in the WFLC and has a second avenue into wildfire preparedness and response through flood insurance programs.

Catastrophic wildfire leading to widespread vegetation loss can create favorable flooding conditions (less rainfall absorption and faster runoff) and mudslides. Properties directly affected by fires and those located below or downstream of burn areas are most at risk. In this way, FEMA links the National Flood Insurance Program (NFIP) to wildfire prevention and protection issues; therefore, communities with wildfire code implementation may eventually enhance their residents' flood insurance eligibility. FEMA also offers fuel and hazard mitigation grants under certain conditions. WUI code implementation locally could enable greater regional and local participation in that program.

Additionally, depending on community status federal regulations must be considered in any local code development and implementation policies to avoid conflicts with federal laws such as:

- Endangered species' protection -- Endangered Species Act, as implemented by U.S. Fish and Wildlife Service and other federal agencies;
- Water quality standards -- Clean Water Act, as implemented by U.S. Army Corps of Engineers and the EPA or the state or local designee for storm water pollution prevention, and
- Air quality standards -- Clean Air Act, as implemented by the EPA.

None of these federal laws prevents development or implementation of WUI code; however, policy development, platting and development review and construction practices directed by WUI code should not encourage activities in opposition to regulated resource protection.

STATE

According to Texas Agriculture Code Title 7, Soil and Water Conservation, Chapter 201:

"It is the policy of the legislature to provide for the conservation of soil and related resources of this state and for the control and prevention of soil erosion, and thereby to preserve natural resources, control floods, prevent impairment of dams and reservoirs, assist in maintaining the navigability of rivers and harbors, preserve wildlife, protect the tax base, protect public lands, and protect and promote the health, safety, and general welfare of the people of this state, and thus to carry out the mandate expressed in Article XVI, Section 59a, of the Texas Constitution."

At the state level, the legislature could enact WUI code either in pieces attached to related existing codes (e.g., Agricultural, Natural Resources, Water, Local Government, Public Safety, and Property codes) or coalesced into a stand-alone title under one of the existing codes. Similar code has been legislatively developed that guides resource- and property-protective measures, construction requirements, advisory boards, standards of practice and review, and related limits of liability. The best approach would be a stand-alone title, with the relationship clearly stated to other codes and titles for supporting reference so future changes to those regulations will be less complicated.

Similar to considerations under federal regulation, locally developed WUI code needs to consider opportunities and constraints imposed by Texas Local Government Code Title 7 Regulation of Land Use, Structures, Businesses, and Related Activities and Title 11 Public Safety (see County and Municipality sections below). WUI code also must consider resource protection and construction regulation programs run by TCEQ and TPWD; water issues as guided by Texas Water Code, Groundwater Districts, and other state-supported planning devices, and limits in process and actions on certain protected lands (Texas Parks and Wildlife Code Title 3 Chapter 26).

TRAVIS COUNTY AND MUNICIPAL EXTRATERRITORIAL JURISDICTION (ETJ)

Travis County, as a subdivision of the state, has limited authority as specified in the Texas Local Government Code Title 7 Regulation of Land Use, Structures, Businesses, and Related Activities Subtitle B County Regulatory Authority. Chapter 232 grants authority by which a county can regulate subdivision, platting, roadways, access, infrastructure, fire suppression, and other elements.

In addition to this limited land-use authority, Travis County has defined responsibilities under the Texas Local Government Code Chapter 573, federal Clean Water Act (CWA, or Federal Water Pollution Control Act, Section 402), and Texas Water Code to control pollutant discharges. This includes requirements to eliminate or reduce pollutant discharge from construction sites and industrial facilities and to ensure permanent best management practices (BMPs) are in place to capture and treat storm water in completed subdivisions or commercial sites. Travis County Code Chapter 82 defines development regulations, subdivision standards, platting, environmental protection during development, engineering standards, access and design standards, and other elements under which Travis County could have the authority to develop WUI code.

Travis County's WUI code development should not promote activities that would contradict the county's federal responsibilities under the Clean Water Act or the Balcones Canyonlands Conservation Plan (Endangered Species Act Section 10 permit jointly held and implemented with the City of Austin). Interlocal agreement amendments and permits may be required if portions of proposed WUI code run counter to these responsibilities.

Texas counties have limited land-use authority; however, land development regulations (LDRs, sometimes called Uniform Land Development Codes or ULDCs) are local regulations that implement the objectives and policies are often laid out in the local comprehensive plan. LDRs give the force of law to the vision set forth in a comprehensive plan and provide for orderly development and the protection of the health, safety, and general welfare of citizens. LDRs typically include provisions for subdivision and development review processes, and may also include zoning and other local development regulations. LDRs must be consistent with and function to implement the comprehensive plan. If a comprehensive plan includes provisions for wildfire risk reduction, then the LDRs for that area should include wildfire-risk reduction rules to implement the comprehensive plan.

The City of Austin and Travis County formed a single office for review and approval of residential subdivision proposals. They have approved a joint development code and executed an interlocal agreement to implement this joint regulatory function. City land-use authority can be achieved through limited-purpose annexation or development agreements (with property owners' consent but no service obligations) or full-purpose annexation (with service obligations but does not require property owners' consent). The best approach would be for the WUI code to complement Travis County Chapter 82, with the relationship clearly stated to related municipal codes.

The following provide examples of WUI codes complementing or supplementing existing codes or providing new regulations to address wildfire risk:

Santa Fe County, New Mexico – Urban Wildland Interface Code, Ordinance 2001-11

This ordinance deals with onsite fuel reduction/modification and fire-resistant building practices and materials in defined risk zones. The ordinance supplements the building and fire codes of Santa Fe County to mitigate the threat to life and property from the intrusion of wildland fire exposures, fire exposures from adjacent structures, and prevention of structure fires from spreading to wildland fuels. Vegetation management and defensible space regulations are voluntary, and the county works with individual communities toward education and compliance.

It addresses structural renovations and additions with threshold square footage that triggers compliance with the new code. New construction requires fire department review and approval, and new subdivisions are required to adopt the code, include it within the body of their covenants, and record it on each plat.

Central Yavapai Fire District, Arizona – Fuel Management Requirements for New Development

Central Yavapai's 2001 amendment to the Fire District Standards is designed to assist in controlling the accumulation of hazardous fuels around structures and along roadways in new developments. The rule addresses the clearance of brush and vegetative growth from structures and roads and requires developers to carry out fuel management and to establish subdivision covenants requiring the creation and maintenance of defensible space by property owners. The fire chief is responsible for enforcement and may issue citations for violations.

Eagle County, Colorado – Requirements for Vegetation Management and Defensible Space

Eagle County adopted wildfire regulations in 2003. New homes or remodels, and new subdivisions and planned unit developments (PUDs) in an area rated as moderate, high, or extreme wildfire risk in unincorporated Eagle County must have a vegetation management plan. The plans must be prepared by a natural resource professional with expertise in the field. They must include a site-specific wildfire analysis, a vegetation inventory, map of vegetation, and wildfire mitigation activities. All applications and plans are referred to the Colorado State Forest Service (CSFS) for review. The amended building code regulations establish minimum design and construction standards within the wildland-urban interface area. Defensible space is required when a site is determined to be at moderate, high, or extreme wildfire risk.

Ruidoso, New Mexico – Fuels Management Ordinances for Existing and New Development

The Village of Ruidoso adopted several ordinances to increase the responsibility of landowners to reduce hazardous fuels on their properties. The Fuels Management Ordinance requires vegetation abatement activities on private properties that are prioritized by degree of risk based on location in relation to the WUI and federal lands and based on a Fuels Hazard Rating. Fuels Management Standards were designed to minimize the risk of crown fires through the treatment of fuels in concentric rings around structures.

The most stringent requirements occur within zero to 30 feet of the structure and maximum density of vegetation standards by species are established from 30 to 60 or 120 feet (depending on the size of the property) beyond the structure. Forestry lot assessments

conducted by an urban forester include fuels hazard ratings for existing or undeveloped properties that consider and evaluate ingress/egress, road widths, accessibility, average lot size, street signs, fire protection, water supply, construction materials, vegetation density, existence of defensible space, flammability of vegetation surrounding structure, and topography.

Ruidoso also adopted an Urban-Wildland Interface Code for the "purpose of prescribing regulations mitigating the hazard to life and property from intrusion of fire from wildland fire exposures from adjacent structures and prevention of structure fires from spreading to wildland fuels." The Fuels Management Standards and Urban-Wildland Interface Code complement each other through a cohesive set of regulations that protect Ruidoso from hazardous fuel accumulation.

CITY OF AUSTIN

Within City of Austin jurisdiction, many titles and chapters would be compatible with WUI code development to guide development planning, development review, appeals and variances, environmental protection, construction, inspection, reporting, and operations. Titles and chapters listed below have the most logical connection with WUI code new insertions or revisions to reflect WUI principles (American Legal Publishing 2013):

- Title 6 Environmental Control and Conservation
    - 6-3 Trees and Vegetation – may be relevant to add coordination section to this chapter for any new development, redevelopment, and fuels or hazard mitigation project planning, review, and approval.
- Title 10 Public Health Services and Sanitation
    - 10-5-21 Duty to Maintain Property in Sanitary Condition - may be relevant to debris removal for fuels and hazard mitigation projects, as well as post-wildfire cleanup.
- Title 15 Utility Regulations
    - 15-3 Fire Hydrant Regulation – related to permits, restrictions, and equipment that could provide an opportunity for certain additional requirements or limitations based on location in or near assessment-driven high wildfire risk areas.

- 15-6 Solid Waste Services – may be relevant to debris removal for fuels and hazard mitigation projects, as well as post-wildfire cleanup (as with floods, perhaps under 15-6-12 Alternative Services).

- Title 25 Land Development
  - 25-2 Zoning – nearly every subchapter has potential to be modified to incorporate WUI code principles, including district definitions, overlay districts, district-specific requirements, compatibility standards, and lot-specific requirements.
  - 25-4 Subdivision – may provide an opportunity to apply standards for fire protection zones, setbacks in areas of high wildfire risk, egress and ingress standards to accommodate fire suppression equipment and multiple options for area evacuation.
  - 25-5 Site Plans – may benefit wildfire preparedness and protection to include review of current exempt provisions for items such as, but not limited to, type of fencing, wooden deck construction, and tree removal in high wildfire risk areas and supplement overall review process with additional attention to how site plans can be modified to address and mitigate for wildfire risk.
  - 25-6 Transportation – opportunities exist for WUI code development to contribute to planning, analysis, and siting of routes for safe wildfire response and emergency evacuations.
  - 25-7 Drainage – not directly related to wildfire safety, but is mentioned here as potential example to correlate type of regulation, floodplain development restrictions and requirements are similar overlays that could be mimicked for WUI code.
  - 25-8 Environment – similar to other environmental features, high-wildfire-risk zones could be included in this section. It would be a logical location for site assessment, review responsibilities and permitting, and reporting. Additionally, notification and specific project actions could be related to water quality, tree classes, critical environmental features, and endangered species protection (Subchapter A and Subchapter B Articles 1 and 2).

  - 25-9 Water Code – may have logical connection with water provisions for suppression in higher-risk areas and requirements for new construction to provide services for suppression.
  - 25-12 Building Code – Article 1, with few exceptions, applies to construction, alteration, addition, relocation, enlargement, replacement, repair, equipment, use and occupancy. It includes a change in occupancy, location, maintenance, removal, and demolition of every building or structure or any appurtenances connected or attached to such buildings or structures; and, Article 7. Fire Code.

- Title 30 Austin/Travis County Subdivision Regulations - This title applies to the subdivision of land in the City of Austin's extraterritorial jurisdiction within Travis County, including the areas the city has annexed for limited purposes. It guides city and county cooperation in platting, subdivision, and development review under single-office projects.
  - 30-2 Subdivision Requirements – addresses the need for additional access if located within an area with a high wildland protection rating according to the National Fire Protection Association Bulletin 299; additional provisions as listed above in 25-4 will advance wildfire safety.
  - 30-3 Transportation – Joint-use driveways must comply with road access requirements mandated in the Travis County Fire Code and be approved by the appropriate official; additional WUI code considerations similar to 25-6.
  - 30-4 Drainage – again, as with Title 25-7, not directly related to wildfire risk reduction, but is mentioned here as potential example to correlate type of regulation, floodplain development restrictions and requirements are similar overlays that could be mimicked for WUI code; see Article 2. 30-4-33 related to floodplain.
  - 30-5 Environment - same as suggestions in 25-8.

Other county municipalities have codes that can impact wildfire mitigation. **Table 8** includes a summary matrix of the typical types of codes and ordinances for local municipal jurisdictions other than Travis County and the City of Austin that can impact wildfire preparedness and protection efforts. The information included in **Table 8** is not meant to be exhaustive nor comprehensive, but it serves as an example of regulatory considerations that may benefit from WUI code principles to advance protection from ignition, wildfire spread, and loss of life and/or property.

Table 8. Regulatory considerations regarding wildfire mitigation activities for other municipalities within the Austin-Travis County CWPP planning area.

Jurisdiction	International Fire Code	Outdoor Burning	Landscaping	Protected Trees/Permit	Sensitive Environmental Features	Building Permits (retrofitting)
Bee Cave	X	X	X	X	X	X
Briarcliff		X				X
Cedar Park	X	X	X	X	X	X
Creedmoor						
Elgin			X		X	X
Jonestown	X	X	X	X	X	X
Lago Vista	X	X	X	X		X
Lakeway	X	X	X	X	X	X
Leander	X	X				X
Manor	X		X			X
Mustang Ridge						
Pflugerville	X	X	X	X		X
Point Venture	X			X		X
Rollingwood	X		X			X
Round Rock	X	X	X	X		X
San Leanna						X
Sunset Valley	X		X	X	X	X
The Hills	X			X		
Volente	X	X	X	X	X	X
Webberville	X		X	X	X	X
West Lake Hills	X	X	X	X		X

HOMEOWNER OR NEIGHBORHOOD ASSOCIATION COVENANTS

Typically, these covenants are policies or rules for individual neighborhoods, within the authority of such associations under Texas Property Code Title 11, which have limited enforcement. Property Associations' covenants may vary widely across the landscape; however, the utility of association covenants lies in defining local practices to enhance defensible space, reduce flammable vegetation types, and maintain home ignition zone

protection. Typically, this is through watering and maintenance requirements, approved landscaping plants to reduce volatile vegetation, and requirement for landscaping review if changed from the developer-installed landscape (presumably in compliance with the local building code). Additional covenants may include requirements for add-on or restoration of fencing, decking, pergola, arbor, or awning materials; neighbor lot line setbacks for repairs or improvements; construction materials, and timing of those construction activities. Restrictions and enforcement may be governed by the size of the county in which the association is active (Property Code Title 11 Chapters 201-203).

Within authorities granted by the Texas Property Code, associations may:

- Draft specific covenants in line with risk assessments and supportive of regional codes that define access, setbacks, landscaping, construction materials, and other requirements;
- Communicate potential changes to neighborhood covenants (e.g., landscaping materials and debris management, building construction setbacks and materials, renovation and new construction debris management) that would enhance community wildfire preparedness and safety, and **update covenants** within established processes; and,
- Establish Firewise Community committees to review recommendations and codes as often as needed to revise covenants based on risk assessment, which may change over time with implementation of mitigation strategies or changes to adjacent land uses.

JOINT WILDFIRE TASK FORCE AND STEERING COMMITTEE

After the 2011 fires, the Joint Wildfire Task Force (JWTF) was formed to address community needs for wildfire prevention, suppression, mitigation, and recovery and to identify steps to help Travis County become a fire-adapted community. The JWTF includes representatives from fire, law enforcement, emergency management, recreation, natural resource management, utilities, planning, and public works agencies within the City of Austin and Travis County. The JWTF also includes representatives from other local entities and municipalities (see a full list in **Table 1** of Appendix A).

While the JWTF and Steering Committee is comprised of local and regional experts with regulatory authority in their jurisdictions, the JWTF itself does not have regulatory authority. That said, the JWTF and subcommittees is a well-qualified vehicle for WUI code development and vetting across jurisdictions, along with sponsoring the public process.

The representatives in the JWTF have connections to work with external experts in fire planning, emergency services, WUI issues, transportation, infrastructure, natural resources management, legal issues, and policy development to:

- Refine local, regional, and state legislative processes related to probable WUI code adoption;
- Prioritize hazard areas, treatment locations and modalities; interpret recommendations to translate to particular code tied to process but not absolute findings. These may change as often as the risk is assessed and fuel mitigation projects are applied. And refine risk assessment with updated data;
- Identify specific recommendations regarding the development and application of infrastructure requirements to enhance fire suppression and response capabilities, such as access and egress requirements (transportation), water supplies (infrastructure), and fire protection planning (emergency services), including hydrant flow rates, pumper access and requirements, and fire protection plan fees;
- Platting review, Building Permit/Code and Structural Fire Professionals:
    - Identify a list of special building construction standards, suggested list of attributes for building design, location and construction proven to be most ignition-resistant to wildfire from roofing to foundation to openings and other penetrations vulnerable to ember entry;
    - Design oriented and prescriptive strategies, such as tree spacing and storage of combustible materials;
    - Definition of defensible space. Most building construction codes employed today, particularly in the city and county, incorporate the WUI requisites outlined in both of these model codes – review and modify if necessary.
- Define needed scientific support to update WUI map in Travis County, refine and direct data collection and analysis, determine reporting structures and frequencies;
- Create/update advisory groups either as separate new committees or as part of existing jurisdictions (e.g. City of Austin Environmental, Planning, Zoning),
- Interpret findings and translate recommendations into public services delivery for participating jurisdictions.

2.8.3 INTER-JURISDICTIONAL RELATIONSHIPS

The success of any planning effort depends on the depth and breadth of existing relationships and collaborations and the capacity to build new ones. With wildfire preparedness, the property owners within the WUI play a pivotal role in advancing the overarching goal of protecting life, property, and natural resources from wildfire. As discussed previously, communities, neighborhoods, and homeowners are taking the necessary steps to protect life and property through wildfire preparedness programs. However, assistance from federal, state, and local governmental agencies, fire departments and ESDs, environmental organizations, and wildfire suppression professionals is integral in complementing these localized efforts and to engage others, particularly in high-wildfire risk areas, in making the same commitment. Also, these same subject matter experts are dependent on knowledge and resource sharing among their colleagues and counterparts to provide effective support services. This section highlights existing emergency preparedness resources, inter-jurisdictional relationships and collaborations, and provides a recent example of a neighborhood collaborating with various governmental entities to successfully apply fire-adapted principles to their community.

2.8.3.1 EXISTING EMERGENCY MANAGEMENT AND HAZARD MITIGATION PLANS

Wildfire response may require more coordination and resources than those provided by the local fire department. A few examples of the activities that may be required during wildfire emergencies include community-wide emergency notifications, implementation of evacuation or in-place sheltering, traffic control for smoke hazards along roads, medical care, and coordination of multi-agency response (City of Austin 2012a). The City of Austin and Travis County have developed various documents to identify and plan for these and many other contingencies, including wildfire. These plans and programs include, but are not limited to, hazard mitigation plans and emergency operations plans. Several of these plans are briefly described below:

- **Travis County Emergency Operations Plan** – The Travis County Office of Emergency Management maintains this inter-jurisdictional plan, which provides guidance for emergency management operations for Travis County. This includes 17 cities with the County, but does not include the City of Austin. It provides an overview of methods of mitigation, preparedness, response and recovery, as well as organizational structure and responsibilities for various emergency tasks (Travis County 2010).

- **City of Austin Emergency Operations Plan** – This plan was developed to provide the general and conceptual framework for coordinated, multi-agency response and efficient use of resources during a major emergency or disaster. The Emergency Operations Plan is considered an all-hazards plan that establishes the framework for how the City of Austin responds to disasters, regardless of initial cause or hazard (City of Austin 2012a).
- **Travis County Hazard Mitigation Plan** – This plan identifies natural hazards that threaten the county, characterizes people and property at risk, outlines the planning process, and identifies priorities for mitigation action (Travis County 2004; 2011). This CWPP is included as an action item, and intended to serve as supplemental information in the hazard mitigation plan.
- **Austin Hazard Mitigation Plan** – The goal of this plan is to minimize long-term risks to human life and property from known hazards by identifying and implementing cost-effective mitigation actions (City of Austin 2010). This CWPP is included as an action item, and intended to serve as supplemental information in the hazard mitigation plan.
- **School District Hazard Plans** – The Texas Education Code §37.108 requires each school district to adopt and implement a multi-hazard emergency operations plan for use in the district's facilities. The plan must address mitigation, preparedness, response, and recovery. The plan must provide employee training, implementation of mandatory school drills, coordination with the Department of State Health Services and local emergency management agencies, law enforcement, health departments, and fire departments in the event of an emergency and implementation of a safety and security audit every three years.
- **Hospital/Nursing Home Hazard Preparedness and Response Plans** – Hospitals and nursing homes are required to adopt and implement hazard preparedness and response plans in accordance with Texas Administrative Code §133.45 and §19.1914, respectively. These plans include procedures for training personnel, coordinating with local emergency management agencies and evacuation procedures.

2.8.3.2 EXISTING INTER-JURISDICTIONAL RELATIONSHIPS

The JWTF, as discussed in previous sections, epitomizes the concept of an inter-jurisdictional relationship's ability to focus efforts and resources to tackle complex and important tasks for the benefit of their constituency. The JWTF includes subject matter experts from a broad array of disciplines serving to promote the main objective of creating a safer environment in a rapidly expanding WUI that has the potential for devastating wildfire.

The Texas A&M Forest Service (TFS) acts as the primary facilitator of wildfire protection, suppression, and education efforts across the state. TFS, a member of the Texas A&M University System, was formed in 1915 by the Texas Legislature to be responsible for the state's forests and all related matters including response coordination for major wildfires. The primary functions of the TFS include technical assistance, capacity building, facilitating cooperative collaborations, forestry-related research, wildfire protection, and promotion of forest resources economic development.

The TFS and other cooperative agencies (TPWD, U. S. Forest Service, National Park Service, USFWS, and Bureau of Indian Affairs), through the Texas Cooperative Wildland Fire Management and Stafford Act Response Agreement (TCWFM/SARA) have agreed to, "…improve efficiency by facilitating the exchange of personnel, equipment, supplies, services, and funds…[and] provide mutual support, cooperation, and assistance for prescribed fire management; fire prevention; fire preparedness; and for emergency management and assistance on incidents such as wildfire, floods, and hurricanes." The Texas Interagency Coordination Center advances the purpose of the TCWFM/SARA by coordinating mobilization, demobilization, and tracking of state and federal wildfire resources and personnel throughout the state.

TFS also facilitates and coordinates incident management for all types of disasters, which benefits and complements the Austin Fire Department (AFD), Travis County Emergency Service Districts (ESDs), and other emergency responders within the planning area. Other incident response resources include the Lone Star State Incident Management Team (LSSIMT), All Hazard Incident Management Team (AHIMT), and the Texas Intrastate Fire Mutual Aid System (TIFMAS). TIFMAS specifically provides grants, training, and qualifications and mobilization systems to utilize local resources for statewide use. By maintaining this program, TFS stretches limited local resources and bolsters the wildfire suppression capacity of local emergency responders like AFD and Travis County ESDs.

The USFWS, the only federal agency managing wildland within the planning area, maintains the Balcones Fire Program at the Balcones Canyonlands National Wildlife Refuge (BCNWR) to promote training, readiness, prevention, prescribed burning, and strategies to achieve balance between wildfire protection and restoring and maintaining healthy ecosystems within the WUI. The USFWS has mutual-aid agreements with all fire districts adjacent to the BCNWR as well as other USFWS lands in central Texas. The mutual aid agreements allow, with the exception of funding resources, cross-assistance for wildfire suppression, training, prescribed fire activities, and other wildfire-mitigation strategies.

The AFD–Wildfire Division promotes wildfire preparedness in the WUI through public education and hazardous fuel management. They also are an integral agency in any wildfire-suppression response in the planning area and adjacent jurisdictions. The AFD, Austin Water Utility Department – Wildlands Conservation Division, and TFS have an interlocal agreement to provide, "… mutual support, cooperation, and assistance for prescribed fire management, fire prevention, and fire preparedness." The interlocal agreement also facilitates capacity building, requests for equipment and personnel, and technical support. AFD also shares mutual aid with Travis County ESDs, which support each other during wildfire suppression, training, public education efforts, and wildfire mitigation activities.

The ESDs and associated fire departments in the unincorporated areas of Travis County provide crucial services and support for wildfire suppression by complementing regional responses to incidents. Firefighters within these districts are often the first line of defense for wildfires in the rural portions of the planning area, and they also provide mutual aid for all of the aforementioned agencies. A number of the ESDs and the Travis County Fire Marshal collaborated with AFD to develop education materials about Ready, Set, Go! for the general public. Also, the ESDs implement fuel mitigation programs and work with other County departments to further the goal of hazardous fuel reduction. They also support and encourage the establishment of local current and future Firewise Communities within their jurisdictions.

Within the planning area, a number of other land managers and local government departments collaborate with emergency responders and state and federal entities to implement wildfire mitigation strategies like prescribed fire and hazardous fuel reduction, assist in public education efforts, and provide technical support. They include The Nature Conservancy, Balcones Canyonlands Preserve staff, Austin Energy, COA Parks and Recreation Department, COA Watershed Protection Department, the Austin Water Utility Department – Wildlands

Conservation Division, and the University of Texas at Austin Lady Bird Johnson Wildflower Center. Their efforts and desire to collaborate will continue to contribute to the overall success of this planning effort.

Most of these agencies are advancing fire research that will clarify the role of fire in the planning area and central Texas by either conducting their own or assisting in research projects by providing support and resources during prescribe fire applications. Through supporting or implementing fire research efforts, these agencies will be able to more effectively apply prescribed fire as a wildfire mitigation strategy and contribute to developing alternate methods in places where prescribed fire is not practical or safe.

All of the collaborators mentioned in this section provide essential support to each entity's mission of protecting life, property, and natural resources from wildfire. In order to minimize the intensity and frequency of wildfire, collaboration with homeowners in the planning area is imperative to the success of this planning effort. Current federal, state, and local public education efforts and programs are important tools in engaging and garnering support for the goals and objectives of the JWTF and this planning effort. Further discussion of public education efforts can be found in Section 5.1.

The following example provides evidence that engaging residents within the planning area will have a positive effect mitigating the impact of wildfire in Travis County.

SUCCESSFUL INTER-JURISDICTIONAL AND COMMUNITY COLLABORATION: JESTER ESTATES PILOT PROGRAM

The City of Austin and Travis County are fortunate to have many communities engaged in fire-adapted principles. Programs such as Fire-Adapted Communities, Ready, Set, GO!, and Firewise encourage homeowners to take individual responsibility for preparing their home from the risk of wildfire. While fire adapted concepts begin with the homeowner, it often becomes a team effort. One example of this type of collaboration is the Jester Estates Pilot Program.

Jester Estates, a neighborhood of over 900 homes, is located northwest of downtown Austin and is nearly surrounded by Balcones Canyonlands Preserve wildland. Jester Estates wanted to become a Firewise recognized community, so they worked as team with the Austin Fire Department and Texas A&M Forest Service to reach their goal. This collaborative process included home assessments, Home Ignition Zone (HIZ) training, and education of fire adapted community principles.

The next step on the road to Firewise recognition was Jester Estate's "30 Foot Day," in which more than 125 homes participated in removing hazardous fuels within 30 feet of their homes. Jester Estates once again partnered with the Austin Fire Department as well as Austin Resource Recovery to remove over 79 tons of debris generated from fuel reduction activities. Jester Estates then completed the Firewise program and became recognized in 2013.

Fulfilling their goal of becoming a Firewise Community didn't stop Jester Estates from continuing to protect their community against the threat of wildfire. In January of 2014, homeowners partnered with the Austin Fire Department and the Water Quality Protection Division of the Austin Water Utility to create a shaded fuel break within critical areas of ingress and egress along the border of Jester Estates and the Balcones Canyonlands Preserve. Over 2,200 linear feet of wildland was treated and a demonstration plot created to raise awareness of the importance of fire-adapted principles.

Before shaded fuel break treatment

After shaded fuel break treatment

The table below is associated with the discussion found in Section 2.2.2, and is located here due to its length.

Table 1. Texas Ecological Systems Classifications (TPWD AND TNRIS 2009).

ECOLOGICAL SYSTEM	ECOLOGICAL DESCRIPTION (% OF COUNTY) & *CORRESPONDING VEGETATION MAPPING SYSTEMS*
Edwards Plateau Limestone Savanna and Woodland (22%)	

Landform: Rolling to level topography, often on plateau tops, but also on gentle slopes.

Soils: Generally loams, clay loams, or clays, often with limestone parent material apparent. Low Stony Hill, Adobe, Clay Loam, and Shallow Ecological Sites are commonly associated with this system.

Description: This upland system forms the matrix vegetation type of the Edwards Plateau, covering approximately 6,440,000 acres (2,606,000 ha.). It is typified by a mosaic of evergreen oak and juniper forests, woodlands and savannas over shallow soils of rolling uplands and adjacent upper slopes within the Edwards Plateau and some adjacent ecoregions where limestone is present. Significant open areas dominated by grasses may resemble prairies, and such open occurrences may grade into prairie types to the west (shortgrass prairie), northwest (Central mixedgrass), north (Southeastern Great Plains tallgrass), and east (Blackland).

Species such as *Quercus fusiformis* (plateau live oak) or *Juniperus ashei* (Ashe juniper) often dominate the canopy of this system. Other canopy species may include *Quercus buckleyi* (Texas oak), *Quercus laceyi* (Lacey oak, in the southwestern part of the Edwards Plateau), *Ulmus crassifolia* (cedar elm), *Fraxinus texensis* (Texas ash), *Quercus sinuata* var. *breviloba* (white shin oak), and *Quercus vaseyana* (Vasey shin oak) (especially in the western part of the region).

The shrub layer may be fairly well developed, containing overstory species, as well as species such as *Diospyros texana* (Texas persimmon), *Mahonia trifoliolata* (agarito), *Sophora secundiflora* (Texas mountain-laurel), *Opuntia engelmannii* (prickly pear), and *Opuntia leptocaulis* (tasajillo). Many uplands have mottes of *Quercus fusiformis* (plateau live oak) punctuating a generally grass dominated landscape, forming what has been referred to as a motte-savanna.

Understory species can contain various grass species, including *Schizachyrium scoparium* (little bluestem), *Bouteloua curtipendula* (sideoats grama), *Bothriochloa barbinodis* (cane bluestem), *Bothriochloa laguroides* ssp. *torreyana* (silver bluestem), *Nassella leucotricha* (Texas wintergrass), *Sorghastrum nutans* (Indiangrass), *Hilaria belangeri* (curlymesquite), *Buchloe dactyloides* (buffalograss), *Andropogon gerardii* (big bluestem), *Bouteloua hirsuta* (hairy grama), *Bouteloua rigidiseta* (Texas grama), *Muhlenbergia reverchonii* (seep muhly), *Muhlenbergia lindheimeri* (Lindheimer muhly), and/or *Carex planostachys* (cedar sedge). The composition of the grassland component is driven by grazing, fire, and climate. Shortgrass species such as *Buchloe dactyloides* (buffalograss) and *Hilaria belangeri* (curlymesquite) are favored under heavy continuous grazing and/or dry climate (to the west), while mid- and tallgrasses are favored under more mesic conditions, more well-developed soils, and well managed grazing.

The herbaceous stratum is often dominated by non-native grass species, especially *Bothriochloa ischaemum* var. *songarica* (King Ranch bluestem). Some disturbed areas on hard-bedded limestone of the western plateau are now dominated by mesquite woodland. Natural mesquite woodlands are believed to have occurred on the deeper soils of adjacent riparian systems.

- *Edwards Plateau: Ashe Juniper Motte and Woodland (9%)*
- *Edwards Plateau: Live Oak Motte and Woodland (2%)*
- *Edwards Plateau: Deciduous Oak / Evergreen Motte and Woodland (5%)*

Table 1. Texas Ecological Systems Classifications (TPWD AND TNRIS 2009).

ECOLOGICAL SYSTEM	ECOLOGICAL DESCRIPTION (% OF COUNTY) & *CORRESPONDING VEGETATION MAPPING SYSTEMS*
	□ *Edwards Plateau: Oak / Hardwood Motte and Woodland (1%)* □ *Edwards Plateau: Post Oak Motte and Woodland (<1%)* □ *Edwards Plateau: Savanna Grassland (5%)*
Edwards Plateau Dry-Mesic Slope Forest and Woodland (6%)	
Landform: Slopes generally greater than 20 percent. **Soils:** Stones and boulders are conspicuous on the soil surface. Soils are generally dark clay to clay-loam and shallow. Steep Rocky and Steep Adobe Ecological Sites may be associated with this system. **Description:** This system occurs on dry to mesic, middle slopes of the rolling uplands and escarpments of the Edwards Plateau and similar sites. The canopy is typically dominated or codominated by deciduous trees, including *Quercus buckleyi* (Texas oak), *Quercus laceyi* (Lacey oak), *Quercus sinuata* var. *breviloba* (white shin oak), *Fraxinus texensis* (Texas ash), *Ulmus crassifolia* (cedar elm), *Prunus serotina* ssp. *eximia* (escarpment black cherry), *Juglans major* (Arizona walnut), and/or *Celtis laevigata* var. *reticulata* (netleaf hackberry). *Quercus fusiformis* (plateau live oak) and *Juniperus ashei* (Ashe juniper) are often present and are sometimes codominant with deciduous species of this system. Canopy closure is variable, and this system can be expressed as forests or woodlands. The shrub layer may be well-represented, especially where the overstory canopy is discontinuous. Species such as *Aesculus pavia* var. *flavescens* (red buckeye), *Cercis canadensis* var. *texensis* (Texas redbud), *Forestiera pubescens* (elbowbush), *Ungnadia speciosa* (Mexican buckeye), *Ceanothus herbaceus* (Jersey tea), *Frangula caroliniana* (Carolina buckthorn), *Sophora secundiflora* (Texas mountain-laurel), *Viburnum rufidulum* (rusty blackhaw), *Rhus* spp. (sumac), *Vitis* spp. (grape), and *Garrya ovata* (silktassel) may be present in the shrub layer. With the large amount of exposed rock, frequent accumulation of leaf litter, and significant canopy closure, herbaceous cover is generally sparse, with *Carex planostachys* (cedar sedge) often present. Woodland forbs such as *Tinantia anomala* (widowstears), *Chaptalia texana* (silver-puff), *Nemophila phacelioides* (baby blue-eyes), *Salvia roemeriana* (cedar sage), *Lespedeza texana* (Texas lespedeza), and various ferns may also be present, if patchy.	
	□ *Edwards Plateau: Ashe Juniper Slope Forest (4%)* □ *Edwards Plateau: Live Oak Slope Forest (<1%)* □ *Edwards Plateau: Oak / Ashe Juniper Slope Forest (2%)* □ *Edwards Plateau: Oak / Hardwood Slope Forest (<1%)*
Crosstimbers Oak Forest and Woodland (<1%)	
Landform: Gently rolling, moderately dissected uplands, and irregular plains becoming more rugged in the western fringe of the distribution of this system. **Soils:** Sands or sandy loams, some with a claypan, are characteristic of this system. Ecological Sites typical of the eastern expressions include Sandy Loam, Tight Sandy Loam, Claypan Prairie, Sandstone Hill, and Sandy. Those more typical of the western expressions include Sandy Loam, Loamy Sand, Tight Sandy Loam, Sandy, and Clay Loam.	

Table 1. Texas Ecological Systems Classifications (TPWD AND TNRIS 2009).

ECOLOGICAL SYSTEM	ECOLOGICAL DESCRIPTION (% OF COUNTY) & *CORRESPONDING VEGETATION MAPPING SYSTEMS*

Description: This system is generally described as a savanna or woodland dominated by *Quercus stellata* (post oak) and/or *Quercus marilandica* (blackjack oak) and occurring in southwest-northeast trending bands separated by the Grand Prairie. Other species in the canopy may include *Ulmus crassifolia* (cedar elm), *Quercus fusiformis* (plateau live oak), *Celtis laevigata* (sugar hackberry), and *Juniperus virginiana* (eastern redcedar). The understory may have been historically dominated by *Schizachyrium scoparium* (little bluestem), but current understory composition may be largely determined by land use history and grazing pressure.

In the east, where precipitation is greater, tallgrass species such as *Andropogon gerardii* (big bluestem) and *Sorghastrum nutans* (Indiangrass) may be important components of the understory, or occupy prairie patches. In the drier west, shortgrass species such as *Buchloe dactyloides* (buffalograss) become more conspicuous. Other graminoid species that may be present include *Schizachyrium scoparium* (little bluestem), *Paspalum setaceum* (fringeleaf paspalum), *Sporobolus compositus* (tall dropseed), *Bouteloua curtipendula* (sideoats grama), *Bouteloua hirsuta* (hairy grama), *Bouteloua rigidiseta* (Texas grama), *Bothriochloa laguroides* ssp. *torreyana* (silver bluestem), *Nassella leucotricha* (Texas wintergrass), and *Aristida* spp. (threeawn). Non-native species such as *Cynodon dactylon* (Bermuda grass) and *Bothriochloa ischaemum* var. *songarica* (King Ranch bluestem) frequently dominate the herbaceous layer.

With the disruption of a natural fire cycle, branching of overstory species may be continuous to near ground level, reducing light penetration and leading to reduced herbaceous cover. The shrub layer may contain species such as *Smilax bona-nox* (greenbrier), *Rhus glabra* (smooth sumac), *Rhus trilobata* (skunkbush sumac), *Crataegus* spp. (hawthorn), and *Symphoricarpos orbiculatus* (coral-berry). Sites dominated by *Prosopis glandulosa* (mesquite), sometimes with *Ziziphus obtusifolia* (lotebush) as a common shrub component, are particularly common to the west.

Juniper (including *Juniperus virginiana* (eastern redcedar), *Juniperus ashei* (Ashe juniper), and *Juniperus pinchotii* (redberry juniper), depending on the site) dominated sites are also frequently encountered. Prairie openings and inclusions tend to occur on tighter soils.

- *Crosstimbers: Post Oak / Juniper Woodland (<1%)*
- *Crosstimbers: Post Oak Woodland (<1%)*

East-Central Texas Plains Post Oak Savanna and Woodland (2%)

Landform: This system occupies gently rolling to hilly topography. It is moderately dissected by drainages.

Soils: This system usually occurs on sandy to sandy loam soils, often with a marked clay subsurface horizon. Soils of this system are generally Alfisols, and are typically acidic to neutral. Typical Ecological Sites include Claypan Savanna, Claypan Prairie, Sandy Loam, Sandy, and Deep Sand.

Description: This system represents a transition from the woodlands and forests of East Texas to the prairies to the west, specifically the Blackland Prairie. Savannas and woodlands are typically dominated by *Quercus stellata* (post oak), *Quercus marilandica* (blackjack oak), and *Carya texana* (black hickory). Other species, such as *Quercus incana* (bluejack oak) (on more xeric sites), *Quercus fusiformis* (plateau live oak), *Ulmus alata* (winged elm), *Juniperus virginiana* (eastern redcedar), and *Prosopis glandulosa* (mesquite), can also be present in the overstory. In some sites, particularly in the south, *Quercus fusiformis* (plateau live

Table 1. Texas Ecological Systems Classifications (TPWD AND TNRIS 2009).

ECOLOGICAL SYSTEM	ECOLOGICAL DESCRIPTION (% OF COUNTY) & *CORRESPONDING VEGETATION MAPPING SYSTEMS*

oak) may codominate the woodlands.

Shrubs may attain significant cover in the understory, with species including *Ilex vomitoria* (yaupon) (often dominant), *Callicarpa americana* (American beautyberry), *Vaccinium arboreum* (farkleberry), *Sideroxylon lanuginosum* (gum bumelia), *Crataegus* spp. (hawthorn), *Ilex decidua* (possumhaw), *Toxicodendron radicans* (poison ivy), and *Symphoricarpos orbiculatus* (coral-berry).

Mid- and tallgrass species including *Schizachyrium scoparium* (little bluestem), *Sorghastrum nutans* (Indiangrass), and *Panicum virgatum* (switchgrass) are frequent in the understory where light penetration supports herbaceous cover, and also form prairie patches within the savanna, particularly on tighter soils. Other grasses present include *Andropogon gerardii* (big bluestem), *Bothriochloa laguroides* ssp. *torreyana* (silver bluestem), *Paspalum plicatulum* (brownseed paspalum) (to the south), *Nassella leucotricha* (Texas wintergrass), and *Sporobolus cryptandrus* (sand dropseed). Non-native grass species such as *Bothriochloa ischaemum* var. *songarica* (King Ranch bluestem), *Paspalum notatum* (bahiagrass), and *Cynodon dactylon* (Bermuda grass) may dominate some sites.

Post Oak Savanna (at least north of the Colorado River) contains species of more eastern affinities such as *Callicarpa americana* (American beautyberry), *Sassafras albidum* (sassafras), *Cornus florida* (flowering dogwood), *Vaccinium arboreum* (farkleberry), *Ulmus alata* (winged elm), and particularly *Ilex vomitoria* (yaupon), the latter species being absent from similar savannas of the Crosstimbers.

Drought, grazing, and fire are the primary natural processes that affect this system. Much of this system has been impacted by conversion to improved pasture or crop production. Overgrazing and fire suppression have led to increased woody cover on most extant occurrences and the invasion of some areas by problematic brush species such as *Juniperus virginiana* (eastern redcedar) (to the north) and *Prosopis glandulosa* (mesquite) (to the south).

- *Post Oak Savanna: Live Oak Motte and Woodland (<1%)*
- *Post Oak Savanna: Post Oak Motte and Woodland (<1%)*
- *Post Oak Savanna: Post Oak / Yaupon Motte and Woodland (<1%)*
- *Post Oak Savanna: Savanna Grassland (<1%)*
- *Post Oak Savanna: Redcedar Slope Forest (<1%)*
- *Post Oak Savanna: Oak / Redcedar Slope Forest (<1%)*
- *Post Oak Savanna: Oak / Hardwood Slope Forest (<1%)*

Edwards Plateau Floodplain Terrace (1%)

Landform: Valley floors of large rivers and perennial streams. This system tends to occupy broad valley bottoms with deep alluvial deposits of the Guadalupe, Lower Brazos, Colorado, Concho, and San Antonio River drainages where they occur within the Edwards Plateau (EPA Level III), Limestone Cut Plain, Limestone Plains, or Western Crosstimbers (EPA Level IV) ecoregions.

Soils: Bottomland soils of various types (Loamy, Clayey, and Sandy).

Description: These are forests and woodlands with a canopy dominated or co-dominated by *Carya illinoinensis* (pecan), *Ulmus crassifolia* (cedar elm), *Ulmus americana* (American elm), *Celtis laevigata* (sugar hackberry), *Celtis laevigata* var. *reticulata* (netleaf

Table 1. Texas Ecological Systems Classifications (TPWD AND TNRIS 2009).

ECOLOGICAL SYSTEM	ECOLOGICAL DESCRIPTION (% OF COUNTY) & *CORRESPONDING VEGETATION MAPPING SYSTEMS*

hackberry), and/or *Quercus fusiformis* (plateau live oak). *Carya illinoinensis* (pecan) may be more likely to occur in deeper and better-developed alluvial soils. Apparent dominance of *Carya illinoinensis* (pecan) may also be an artifact of preferential harvesting of other species, leaving this species in greater abundance. *Melia azedarach* (chinaberry) is a common non-native tree encountered on floodplains. Other species present may include *Fraxinus texensis* (Texas ash), *Fraxinus pennsylvanica* (green ash), *Juglans major* (Arizona walnut), *Quercus macrocarpa* (bur oak), *Quercus buckleyi* (Texas oak), *Acer negundo* (boxelder), *Sapindus saponaria* var. *drummondii* (western soapberry), *Ptelea trifoliata* (wafer-ash), *Juniperus ashei* (Ashe juniper), *Prosopis glandulosa* (mesquite), and *Platanus occidentalis* (American sycamore). *Quercus stellata* (post oak) may be dominant on sandy soils within the floodplain.

Woody species in the subcanopy may include *Sideroxylon lanuginosum* (gum bumelia), *Cornus drummondii* (roughleaf dogwood), *Morus rubra* (red mulberry), *Diospyros texana* (Texas persimmon), *Parthenocissus quinquefolia* (Virginia creeper), *Vitis* spp. (grape), *Smilax bona-nox* (greenbrier), *Baccharis neglecta* (roosevelt-weed), *Malvaviscus arboreus* var. *drummondii* (Turk's cap), *Juniperus ashei* (Ashe juniper), and *Ilex decidua* (possumhaw).

The herbaceous layer may be continuous, though relatively sparse, or patchy with species such as *Elymus virginicus* (Virginia wildrye), *Chasmanthium latifolium* (creekoats), *Nassella leucotricha* (Texas wintergrass), *Verbesina virginica* (frostweed), and *Carex* spp. (caric sedge). Some sites lack, or have very sparse, overstory canopies and represent shrublands or grasslands. Shrublands may be dominated by species in the shrub layer of the surrounding woodlands. Other components or dominants may include species such as *Prosopis glandulosa* (mesquite), *Acacia farnesiana* (huisache), *Sapindus saponaria* var. *drummondii* (western soapberry), *Juglans microcarpa* (little walnut), *Mahonia trifoliolata* (agarito), and *Cephalanthus occidentalis* (common buttonbush).

Grassland sites are frequently dominated by the non-native species *Cynodon dactylon* (Bermuda grass) and/or *Bothriochloa ischaemum* var. *songarica* (King Ranch bluestem). Native species that may also be present in (and sometimes dominate) these sites include *Panicum virgatum* (switchgrass), *Andropogon glomeratus* (bushy bluestem), *Elymus virginicus* (Virgina wildrye), *Nassella leucotricha* (Texas wintergrass), *Hordeum pusillum* (little barley), *Tripsacum dactyloides* (eastern gamagrass), *Muhlenbergia lindheimeri* (Lindheimer's muhly), *Carex* spp. (carices), and *Eleocharis* spp. (spikerushes). Floodplain occurrences often include portions that resemble Edwards Plateau Riparian vegetation, especially along stream margins, where *Platanus occidentalis* (sycamore), *Juglans microcarpa* (little walnut), *Taxodium distichum* (baldcypress), *Brickellia* spp. (brickellbush), *Cladium mariscus* ssp. *jamaicense* (saw-grass), and *Panicum virgatum* (switchgrass) are frequently encountered.

- *Edwards Plateau: Floodplain Ashe Juniper Forest (<1%)*
- *Edwards Plateau: Floodplain Live Oak Forest (<1%)*
- *Edwards Plateau: Floodplain Hardwood / Ashe Juniper Forest (<1%)*
- *Edwards Plateau: Floodplain Hardwood Forest (<1%)*
- *Edwards Plateau: Floodplain Ashe Juniper Shrubland <(1%)*
- *Edwards Plateau: Floodplain Deciduous Shrubland (<1%)*
- *Edwards Plateau: Floodplain Herbaceous Vegetation (<1%)*

Edwards Plateau Riparian (2%)

Landform: Riparian systems occur along intermittent streams. These sites tend to be in erosional situations, as opposed to broad alluvial depositional sites. This system occurs within the Guadalupe, Lower Brazos, Colorado, Concho, and San Antonio River drainages where they occur within the Edwards Plateau (EPA Level III), Limestone Cut Plain, Limestone Plains, or Western

Table 1. Texas Ecological Systems Classifications (TPWD AND TNRIS 2009).

ECOLOGICAL SYSTEM	ECOLOGICAL DESCRIPTION (% OF COUNTY) & *CORRESPONDING VEGETATION MAPPING SYSTEMS*

Crosstimbers (EPA Level IV) ecoregions.

Soils: By definition, this system is mapped in areas upstream of significant development of bottomland soils on soil types of the surrounding uplands.

Description: Riparian vegetation may be characterized as woodlands, shrublands, or herbaceous vegetation. These erosional sites may be gravelly, cobbly, or rocky, and generally occupy the upper reaches of streams. Woodlands may have *Quercus fusiformis* (plateau live oak), *Platanus occidentalis* (American sycamore), *Taxodium distichum* (baldcypress), *Fraxinus pennsylvanica* (green ash), *Fraxinus texensis* (Texas ash), *Ulmus crassifolia* (cedar elm), *Celtis laevigata* (sugar hackberry) (including var. *reticulata*), *Acer negundo* (boxelder), *Prosopis glandulosa* (mesquite), *Quercus buckleyi* (Texas oak), *Juniperus ashei* (Ashe juniper), *Salix nigra* (black willow), and/or *Sapindus saponaria* (western soapberry).

Shrub species that may be encountered in the understory of these woodlands (or, in some cases, may form shrublands lacking a significant overstory canopy) include *Juglans microcarpa* (little walnut), *Chilopsis linearis* (desert willow) in the western part of the Edwards Plateau, *Baccharis* spp. (false-willow), *Salix nigra* (black willow), *Juniperus ashei* (Ashe juniper), *Sapindus saponaria* (western soapberry), *Cornus drummondii* (roughleaf dogwood), *Sophora secundiflora* (Texas mountain-laurel), *Sideroxylon lanuginosum* (gum bumelia), *Diospyros texana* (Texas persimmon), *Ungnadia speciosa* (Mexican buckeye), *Prosopis glandulosa* (mesquite), *Cephalanthus occidentalis* (common buttonbush), and/or *Aloysia gratissima* (whitebrush).

Substantial patches of herbaceous cover may be present and often include species such as *Andropogon glomeratus* (bushy bluestem), *Panicum virgatum* (switchgrass), *Cladium mariscus* var. *jamaicense* (sawgrass), *Tripsacum dactyloides* (eastern gamagrass), *Setaria scheelei* (southwestern bristlegrass), *Nassella leucotricha* (Texas wintergrass), *Eleocharis* spp. (spikerush), *Brickellia* spp. (brickellbush), *Justicia americana* (American water-willow), *Hydrocotyle* spp. (water penny), and/or *Muhlenbergia lindheimeri* (Lindheimer muhly). Frequently, *Cynodon dactylon* (Bermuda grass) and/or *Bothriochloa ischaemum* var. *songarica* (King Ranch bluestem) dominate these grassland sites. *Sorghum halepense* (Johnson grass) is also a commonly encountered non-native grass. This system includes vegetation along very small streams, reaching upstream to spring heads and runs.

- *Edwards Plateau: Riparian Ashe Juniper Forest (<1%)*
- *Edwards Plateau: Riparian Live Oak Forest (<1%)*
- *Edwards Plateau: Riparian Hardwood / Ashe Juniper Forest (<1%)*
- *Edwards Plateau: Riparian Hardwood Forest (<1%)*
- *Edwards Plateau: Riparian Ashe Juniper Shrubland (<1%)*
- *Edwards Plateau: Riparian Deciduous Shrubland (<1%)*
- *Edwards Plateau: Riparian Herbaceous Vegetation (<1%)*

Southeast Great Plains Floodplain Forest (6%)

Landform: This floodplain forest occupies relatively broad flats at low topographic positions, along large streams where alluvial deposition dominates. Rivers such as the Sulphur, (and tributaries such as White Oak and Cuthand Creeks), Sabine (and Lake Fork), Trinity (and its major tributaries), Navasota, and portions of the Lower and Middle Brazos River (and its major tributaries) may support this system. Within Phase 1, the portions of the Guadalupe, Colorado, and San Antonio Rivers downstream of the Edwards Plateau ecoregion are also included in this system.

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ECOLOGICAL SYSTEM	ECOLOGICAL DESCRIPTION (% OF COUNTY) & *CORRESPONDING VEGETATION MAPPING SYSTEMS*

Soils: Bottomland Ecological Sites (including Loamy, Sandy, and Clayey) characterize this system.

Description: Dominant communities within this system range from floodplain forests to wet meadows to gravel/sand flats; however, they are linked by underlying soils and the flooding regime. Canopy dominants may include *Carya illinoinensis* (pecan), *Fraxinus americana* (white ash), *Quercus nigra* (water oak), *Ulmus crassifolia* (cedar elm), *Celtis laevigata* (sugar hackberry), *Ulmus americana* (American elm), *Quercus fusiformis* or *Q. virginiana* (plateau or coastal live oak), *Platanus occidentalis* (American sycamore), *Acer negundo* (boxelder), *Quercus macrocarpa* (bur oak), *Morus rubra* (red mulberry), *Fraxinus pennsylvanica* (green ash), and *Sapindus saponaria* var. *drummondii* (western soapberry).

Overgrazing and/or overbrowsing may influence recruitment of overstory species and composition of the understory and herbaceous layers. Shrub species may include *Callicarpa americana* (American beautyberry), *Ilex decidua* (possumhaw), *Ilex vomitoria* (yaupon), *Sideroxylon lanuginosum* (gum bumelia), *Diospyros virginiana* (eastern persimmon), *Vaccinium arboreum* (farkleberry), *Juniperus virginiana* (eastern redcedar), *Cornus drummondii* (roughleaf dogwood), and *Viburnum rufidulum* (rusty blackhaw), which may occur as dense patches following disturbance, but are otherwise generally fairly sparse. Vines such as *Berchemia scandens* (Alabama supplejack), *Campsis radicans* (common trumpetcreeper), *Vitis* spp. (grape), *Parthenocissus quinquefolia* (Virginia creeper), and *Ampelopsis arborea* (peppervine) may be conspicuous.

Herbaceous cover includes *Elymus virginicus* (Virginia wildrye), *Verbesina virginica* (frostweed), *Chasmanthium latifolium* (inland sea-oats), *Chasmanthium sessiliflorum* (narrowleaf woodoats), *Tripsacum dactyloides* (eastern gamagrass), *Symphyotrichum drummondii* var. *texanum* (Drummond's aster), *Geum canadense* (white avens), *Sanicula canadensis* (Canada snakeroot), *Panicum virgatum* (switchgrass), *Galium* spp. (bedstraw), and *Carex* spp. (caric sedge). Non-native grasses that may dominate these sites include *Cynodon dactylon* (Bermuda grass) and *Sorghum halepense* (Johnson grass). Herbaceous cover may be quite high, especially in situations where shrub cover is low.

- *Central Texas: Floodplain Juniper Forest (<1%)*
- *Central Texas: Floodplain Live Oak Forest (<1%)*
- *Central Texas: Floodplain Hardwood/Evergreen Forest (<1%)*
- *Central Texas: Floodplain Hardwood Forest (2%)*
- *Central Texas: Floodplain Evergreen Shrubland (<1%)*
- *Central Texas: Floodplain Deciduous Shrubland (<1%)*
- *Central Texas: Floodplain Herbaceous Vegetation (3%)*

Southeastern Great Plains Riparian Forest (1%)

Landform: Valleys and drainages along headwater streams of riparian systems within drainages of the Guadalupe, Colorado, and San Antonio Rivers downstream of the Edwards Plateau ecoregion.

Soils: By definition, this system is mapped along drainages upstream of the Bottomland Ecoclasses, so they will be mapped on soils of the surrounding uplands.

Description:

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ECOLOGICAL SYSTEM	ECOLOGICAL DESCRIPTION (% OF COUNTY) & *CORRESPONDING VEGETATION MAPPING SYSTEMS*
	Trees that may be present in stands of this system include *Celtis laevigata* (sugar hackberry), *Ulmus crassifolia* (cedar elm), *Platanus occidentalis* (American sycamore), *Populus deltoides* (eastern cottonwood), *Juglans major* (Arizona walnut), *Quercus fusiformis* (plateau live oak), *Quercus nigra* (water oak), *Quercus phellos* (willow oak), *Sapindus saponaria* var. *drummondii* (western soapberry), *Salix nigra* (black willow), *Fraxinus americana* (white ash), *Fraxinus pennsylvanica* (green ash), *Gleditsia triacanthos* (common honeylocust), and *Carya illinoinensis* (pecan). The shrub layer development is variable, sometimes with species such as *Amorpha fruticosa* (indigobush), *Forestiera acuminata* (swamp privet), *Ilex decidua* (possumhaw), *Ilex vomitoria* (yaupon), *Sideroxylon lanuginosum* (gum bumelia), *Juniperus virginiana* (eastern redcedar), *Diospyros virginiana* (eastern persimmon), *Cornus drummondii* (roughleaf dogwood), and/or *Viburnum rufidulum* (rusty blackhaw). Herbaceous cover is also variable, depending on overstory and shrub canopies and recent flooding history. Herbaceous species may include *Elymus virginicus* (Virginia wildrye), *Verbesina virginica* (frostweed), *Chasmanthium latifolium* (inland sea-oats), *Chasmanthium sessiliflorum* (narrowleaf woodoats), *Tripsacum dactyloides* (eastern gamagrass), *Symphyotrichum drummondii* var. *texanum* (Drummond's aster), *Geum canadense* (white avens), *Sanicula canadensis* (Canada snakeroot), *Panicum virgatum* (switchgrass), *Galium* spp. (bedstraw), and *Carex* spp. (caric sedge). Nonnative grass species that may be common to dominant on these sites include *Cynodon dactylon* (Bermuda grass) and *Sorghum halepense* (Johnson grass). The environment and characteristics of the vegetation of this system become drier from east to west, with moister representatives (such as communities containing *Quercus nigra* (water oak)) occurring in the eastern parts of the range. □ *Central Texas: Riparian Juniper Forest (<1%)* □ *Central Texas: Riparian Live Oak Forest (<1%)* □ *Central Texas: Riparian Hardwood / Evergreen Forest (<1%)* □ *Central Texas: Riparian Hardwood Forest (<1%)* □ *Central Texas: Riparian Evergreen Shrubland (<1%)* □ *Central Texas: Riparian Deciduous Shrubland (<1%)* □ *Central Texas: Riparian Herbaceous Vegetation (<1%)*
Edwards Plateau Limestone Shrubland (2%)	
	Landform: This system may occur on plateaus, or slopes, and may often form a discontinuous band around a plateau edge as it breaks into the adjacent slope. **Soils:** Soils are characterized by Shallow or Very Shallow Ecological Sites, but may also be found on Low Stony Hill Ecological Sites. **Description:** This system may be represented by extensive continuous shrub cover, or occur as a discontinuous shrubland, often with scattered emergent overstory trees. *Quercus sinuata* var. *breviloba* (white shin oak), *Quercus fusiformis* (plateau live oak), and/or *Juniperus ashei* (Ashe juniper) may be important components of the system. In the west, *Pinus remota* (paper-shell pinyon) may also contribute to a scattered emergent overstory.

Table 1. Texas Ecological Systems Classifications (TPWD AND TNRIS 2009).

ECOLOGICAL SYSTEM	ECOLOGICAL DESCRIPTION (% OF COUNTY) & *CORRESPONDING VEGETATION MAPPING SYSTEMS*

Shrub cover may be dominated by these species, or may be represented as an assemblage of a rather diverse array of species including *Rhus virens* (evergreen sumac), *Rhus lanceolata* (prairie sumac), *Cercis canadensis* var. *texensis* (Texas redbud), *Forestiera pubescens* (elbowbush), *Forestiera reticulata* (netleaf forestiera), *Ungnadia speciosa* (Mexican buckeye), *Sophora secundiflora* (Texas mountain- laurel), *Diospyros texana* (Texas persimmon), *Salvia ballotiflora* (mejorana), *Mimosa borealis* (fragrant mimosa), *Condalia hookeri* (brasil), *Rhus trilobata* (skunkbush sumac), *Opuntia engelmannii* (prickly pear), and *Mahonia trifoliolata* (agarito). This system also includes *Quercus mohriana* (Mohr's shin oak) or *Quercus vaseyana* (Vasey shin oak) dominated shrublands that are more common to the west.

Herbaceous cover may be patchy and is generally graminoid with species including *Schizachyrium scoparium* (little bluestem), *Bouteloua curtipendula* (sideoats grama), *Bouteloua rigidiseta* (Texas grama), *Bouteloua trifida* (red grama), *Hilaria belangeri* (curlymesquite), *Bothriochloa laguroides* ssp. *torreyana* (silver bluestem), *Nassella leucotricha* (Texas wintergrass), *Erioneuron pilosum* (hairy tridens), *Aristida* spp. (threeawn), and others. Disturbances such as fire may be important processes maintaining this system. However, it appears to persist on thin-soiled sites. In the western portions of the Edwards Plateau, more xeric conditions lead to the slow succession of sites to woodlands resulting in long-persisting shrublands.

- *Edwards Plateau: Ashe Juniper / Live Oak Shrubland (1%)*
- *Edwards Plateau: Shin Oak Shrubland (<1%)*
- *Edwards Plateau: Ashe Juniper / Live Oak Slope Shrubland (1%)*
- *Edwards Plateau: Shin Oak Slope Shrubland (<1%)*

Southern Blackland Tallgrass Prairie (13%)

Landform: Flat to gently rolling, with the most significant ridges associated with the harder Austin Chalk formation.

Soils: Typically Vertisols, but this system may occupy Mollisols or Alfisols in limited parts of its distribution. The system generally occurs on calcareous clays, but may also occur on loams, clay loams, or even sandy clay loams. Soils derived from certain Miocene formations may be slightly acid.

Description: Currently, only remnants of this system exist, with most of the historical distribution replaced by crop production or improved pasture. *Schizachyrium scoparium* (little bluestem) is the most ubiquitous component of occurrences of this system. *Andropogon gerardii* (big bluestem) and *Sorghastrum nutans* (Indiangrass) are also common dominants. Other species commonly encountered include *Bouteloua curtipendula* (sideoats grama), *Carex microdonta* (littletooth sedge), *Sporobolus compositus* (tall dropseed), *Nassella leucotricha* (Texas wintergrass), *Bothriochloa laguroides* spp. t*orreyana* (silver bluestem), *Eriochloa sericea* (Texas cupgrass), *Paspalum floridanum* (Florida paspalum), and *Tridens strictus* (longspike tridens).

Forbs commonly encountered in this system include *Symphyotrichum ericoides* (heath aster), *Stenaria nigricans* var. *nigricans* (praire bluets), *Helianthus maximiliani* (Maximilian sunflower), *Rudbeckia hirta* (blackeyed Susan), *Bifora americana* (prairie bishop), *Acacia angustissima* var. *hirta* (prairie acacia), *Desmanthus illinoensis* (Illinois bundleflower), and many more. Lowland sites and swales are often dominated by *Tripsacum dactyloides* (eastern gamagrass) and *Panicum virgatum* (switchgrass). A relatively unique type occurring on low Ph Alfisols is dominated by *Sporobolus silveanus* (Silveus' dropseed), *Carex meadii* (Mead's sedge), and *Fimbristylis puberula* (hairy fimbry).

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Several groups of communities are sufficiently unique to recommend including descriptions of them. Southern Blackland Alfisol Tallgrass Prairies occur on Alfisols at the northern and eastern edges of the Blackland Prairie region. These sites are typically more species-rich than other occurrences of the system. Multiple communities at the association level have been defined for this type including: *Schizachyrium scoparium* (little bluestem) – *Sorghastrum nutans* (yellow Indiangrass) prairies with various associated graminoids and forbs, varying with soil type and landscape position; *Tripsacum dactyloides* (eastern gamagrass) dominated prairies, often with a number of co-dominant forbs and grasses; and, *Sporobolus silveanus* (Silveus' dropseed) – *Carex meadii* (Mead's sedge) – *Tridens strictus* (longspike tridens) prairies associated with low pH Alfisols, known from Fannin, Lamar, and Grayson counties. The more typical communities of the system are Vertisol tallgrass prairies. There are also *Tripsacum dactyloides* (eastern gamagrass) – *Panicum virgatum* (switchgrass) dominated prairies on lowlands, like those that occur at Knight Prairie and Mill Creek Bottom.

- *Blackland Prairie: Disturbance or Tame Grassland (13%)*

Edwards Plateau Cliff (<1%)

Landform: Vertical or near vertical rock faces, sometimes alternating with slope forming limestone members.

Soils: Little to no soil development. Some soil accumulating on ledges and in crevices.

Description: Some of these sites may be mesic, accumulating moisture from nearby slopes in crevices within the limestone substrate, and seeps may be present. They often occur as long narrow bands. Composition and cover on these cliff faces is a function of aspect, canopy cover provided by surrounding systems, local climate, and moisture available from the underlying geologic formation. Seeps and mesic sites may have fairly dense cover of *Adiantum capillus- veneris* (maiden-hair fern) with patches of *Thelypteris ovata* var. *lindheimeri* (Lindheimer's maidenfern) present. More xeric sites often have significant shrub cover, with species such as *Buddleja racemosa* (Texas butterflybush), *Ungnadia speciosa* (Mexican buckeye), *Diospyros texana* (Texas persimmon), *Ageratina havanensis* (shrubby boneset), *Garrya ovata* ssp. *lindheimeri* (Lindheimer's silktassel), *Bernardia myricifolia* (southwest bernardia), *Philadelphus* spp. (mock-orange), *Styrax* spp. (snowbell), and *Toxicodendron radicans* ssp. *eximium* (poison ivy).

Herbaceous species that may be present include *Salvia roemeriana* (cedar sage), *Penstemon baccharifolius* (baccharisleaf beardtongue), *Schoenus nigricans* (black sedge), *Chaetopappa bellidifolia* (least daisy), *Perityle* spp. (rockdaisy), and ferns in the genera *Asplenium*, *Astrolepis*, *Cheilanthes,* and *Pellaea.* Sparse grasses including *Bouteloua hirsuta* (hairy grama), *Bouteloua rigidiseta* (Texas grama), and *Aristida oligantha* (oldfield threeawn) may be present. These cliffs often serve as refugia from herbivores

- Edwards Plateau: Wooded Cliff/Bluff *(<1%)*
- Edwards Plateau: Barren or Grassy Cliff/Bluff *(<1%)*

Agriculture and other Human-related, Azonal Subsystems (30%)

Azonal types are those types that are widespread and not particularly characteristic of any region or naturally occurring vegetation type. This may be due to disturbance, where wide ranging species adapted to disturbed conditions predominate. In other areas, land management may have resulted in invasion of widespread species such as juniper or mesquite. Azonal types may also be

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used to refer to general physiognomic types that are not ascribable to particular naturally occurring systems.

- ***Row Crops (6%)***
  This type includes all cropland where fields are fallow for some portion of the year. Some fields may rotate into and out of cultivation frequently, and year-round cover crops are generally mapped as grassland.
- ***Grass Farm (<1%)***
  Most areas mapped as this type in Phase 1 are dominated by *Cynodon dactylon* (Bermuda grass) and consist of golf course fairways and greens that are fertilized and irrigated. This type also includes a few areas of highly productive grassland on or near floodplains.
- ***Urban High Intensity (4%)***
  This type consists of built-up areas and wide transportation corridors that are dominated by impervious cover.
- ***Urban Low Intensity (20%)***
  This type includes areas that are built-up but not entirely covered by impervious cover, including most of the area within cities and towns.

Mainly Natural Azonal Subsystems (16%)

Azonal types are those types that are widespread and not particularly characteristic of any region or naturally occurring vegetation type. This may be due to disturbance, where wide ranging species adapted to disturbed conditions predominate. In other areas, land management may have resulted in invasion of widespread species such as juniper or mesquite. Azonal types may also be used to refer to general physiognomic types that are not ascribable to particular naturally occurring systems.

- ***Native Invasive: Deciduous Woodland (4%)***
  This broadly-defined type often has *Celtis laevigata* (sugar hackberry), *Ulmus crassifolia* (cedar elm), or *Prosopis glandulosa* (mesquite) among the dominants, and *Quercus stellata* (post oak) or *Quercus fusiformis* (plateau live oak) may be important. *Juniperus virginiana* (eastern redcedar) or *Juniperus ashei* (Ashe juniper) may also be present.
- ***Native Invasive: Juniper Woodland (<1%)***
  The majority of this mapped type is similar to Edwards Plateau: Ashe Juniper Motte and Woodland mapped vegetation type, with *Juniperus ashei* (Ashe juniper) and *Quercus fusiformis* (plateau live oak) the most common dominants. In the southern Post Oak Savanna, *Juniperus virginiana* (eastern redcedar) or sometimes *Pinus taeda* (loblolly pine) is the primary dominant, with *Quercus stellata* (post oak) and *Ulmus crassifolia* (cedar elm) common components. In the northern portion of the Blackland region, *Juniperus virginiana* (eastern redcedar) is the common dominant. In some of the western portions of Phase 1, *Juniperus pinchotii* (redberry juniper) may dominate.
- ***Native Invasive: Juniper Shrubland (4%)***
  Various species of *Juniperus* (juniper) dominate these shrublands. *Juniperus virginiana* (eastern redcedar) is the primary dominant of these shrublands or low woodlands in the Blackland Prairie, Post Oak Savanna, and far northern Crosstimbers ecoregions. To the west, on the Rolling Plains, *Juniperus pinchotii* (redberry juniper) may be the dominant. In other areas, *Juniperus ashei* (Ashe juniper) may dominate these shrublands.
- ***Native Invasive: Mesquite Shrubland (5%)***
  Prosopis glandulosa (mesquite) is often the dominant species of this broadly-defined type, but it may occur as a variety of open woodlands to dense shrublands with a variety of other species such as *Quercus fusiformis*

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ECOLOGICAL SYSTEM	ECOLOGICAL DESCRIPTION (% OF COUNTY) & *CORRESPONDING VEGETATION MAPPING SYSTEMS*
	(plateau live oak), *Juniperus ashei* (Ashe juniper), *Celtis* spp. (hackberries), *Ulmus crassifolia* (cedar elm), *Ziziphus obtusifolia* (lotebush), *Diospyros texana* (Texas persimmon), and *Mahonia trifoliolata* (agarito). Some areas of other deciduous shrubs, such as *Quercus sinuata* var. *breviloba* (white shin oak) and *Rhus lanceolata* (prairie sumac) may be mapped as this type. □ ***Open Water (3%)*** Most open water in Phase 1 consists of reservoirs or large ponds, although large rivers, including the Colorado and Brazos, are also mapped as open water. □ ***Marsh (<1%)*** Areas mapped as marsh are small, and consist of wet or alternately wet and dry soils with herbaceous vegetation. □ ***Swamp (<1%)*** Areas mapped as swamp in Phase 1 are typically forested wet or alternately wet and dry soils at the upper ends of reservoirs in the northern part of Phase 1. A variety of species, including *Taxodium distichum* (baldcypress), *Ulmus americana* (American elm), *Ulmus crassifolia* (cedar elm), *Salix nigra* (black willow), and *Quercus macrocarpa* (bur oak) may be present. □ ***Barren (<1%)*** This type includes areas where little or no vegetative cover existed at the time of image data collection. Large areas cleared for development are included, as well as rural roads and buildings and associated clearing in primarily rural areas. Streambeds with exposed gravel or bedrock, rock outcrops, and year-round fallow fields are also included.