



The City of Austin
Urban Forestry Board

Austin's

Urban Forest Plan

09-20-13 DRAFT





Our Vision...

Austin's urban forest is a healthy and sustainable mix of trees, vegetation, and other components that comprise a contiguous and thriving ecosystem valued, protected, and cared for by the City and all of its citizens as an essential environmental, economic, and community asset.



Credit: City of Austin, Urban Forestry Program

Downtown Austin through the trees at Auditorium Shores

Acknowledgements

We would like to thank the citizens of Austin, Texas who contributed 1,592 responses and provided helpful feedback to shape and guide this plan.

URBAN FORESTRY BOARD

Patrick Brewer
Chris Kite
Nicholas Classen
Ryan Fleming

Peggy Maceo
Len Newsom
Dan VanTreeck

CITY OF AUSTIN STAFF

Angela Hanson
Leah Haynie
Emily King

Walter Passmore
Alan Halter
Keith O'Herrin

OTHER CONTRIBUTING CITY OF AUSTIN STAFF

Cheyenne Krause
Keith Mars
Rob Grotty
Tonya Swartzendruber
Josh Portie
Lucia Athens
Mario Porras
John Robinson
Mike Personett
David Lambert
Mark Baker
Christopher Meyer
Kristin Carlton
Denise Delaney
Carl Wren
Matt Hollon
Bonny Holmes

Michael Embesi
Jessica Wilson
Humberto Rey
Jon Meade
Carol Haywood
Mitzi Cotton
Mark Cole
Jim Linardos
Ray Henning
Andy Halm
Michael Bogard
Pamela Abee-Taulli
Pharr Andrews
Margaret Valenti
Kathryn Murray
Justice Jones
Larry Schooler

OTHER AGENCY STAFF

...

09-20-13 DRAFT

Table of Contents

1 INTRODUCTION

Austin's Urban Forest Plan at a Glance
Introduction to the Urban Forest Plan
Benefits of the Urban Forest
The Goals of the Urban Forest Plan
The Process
The Vision for Austin's Urban Forest
Guiding Principles

15 STATE OF THE URBAN FOREST

Regional Context & History
Indicators of Sustainable Urban Forestry
- Vegetative Resource
- Community Framework
- Resource Management
Urban Forestry Challenges

57 IMPLEMENTATION

Implementation Goals
Policy Elements
Urban Forester Implementation Responsibilities

75 APPENDICES

- A. Austin Performance Indicators
- B. Public Engagement Process
- C. Public Comments
- D. Departmental Operational Plan Template
- E. Tree & Vegetation Regulations
- F. Tree & Vegetation Policies
- G. Professional Standards
- H. Standard Operating Procedures
- I. Organizational Structure
- J. Supporting Plans
- K. Models
- L. Glossary

79 BIBLIOGRAPHY

List of Figures

1.1 | City of Austin Owned Land & Parkland

1.2 | Tree Benefits

1.3 | Public Interest in Urban Forestry

1.4 | Citizen Participant Goals for the Urban Forest

2.1 | Austin Ecoregions

2.2 | Total Annual Precipitation in Austin (1943-2012)

2.3 | Austin Climate Graph (1943-2012)

2.4 | Average Annual Wind Prevalence in Austin (1984-1992)

2.5 | Historic Tree Canopy Cover

2.6 | Percent Tree Canopy Cover in Austin, 2010

2.7 | Top 10 Tree Species in Public Right-of-Way and Parks

2.8 | DBH Classes of Austin Trees by Small, Medium, and Large Growth

2.9 | Structural (Wood) Condition by Percentage

2.10 | Functional (foliage) Condition by Percentage

2.11 | Cost-Benefit of Public Street Trees

2.12 | Tree-Related Responsibilities by City of Austin Departments

3.1 | Citizen Prioritization of Urban Forestry Policy Elements

3.2 | What Urban Forest Management Items are Important to Fund?

EXECUTIVE SUMMARY

The goal of Austin's Urban Forest Plan is to establish a broad-scoped, long range vision for Austin's urban forest. It will provide a framework for City departments to use as a guide for managing their urban forest resources, in the form of Departmental Operational Plans, and will include a roadmap to implementation to reach that comprehensive vision. The end result will be a superior plan which identifies positive aspects, responsibilities, and innovations, but serves also as a model to the abutting neighbor, regional property owner, and the global community.

09-20-13 DRAFT

09-20-13 DRAFT


Community Voices



The Urban Forestry Board and City of Austin staff worked to engage the public at key intervals as a way to guide the development of the Plan. One method was through Leaf the Tree pop-up activities which were designed to capture a sample of public opinion concerning Austin's urban forest. Gathered on these two pages are a sample of some of the community comments the events received.

For a full list of public comments including all email and SpeakUp Forum discussions please visit austinurbanforestry.org.

We asked, “What should be done for trees and vegetation in our public spaces?”



Preserve older trees and protect their critical root zone.



Plant shade trees in public cemeteries, including large species.

09-20-13 DRAFT

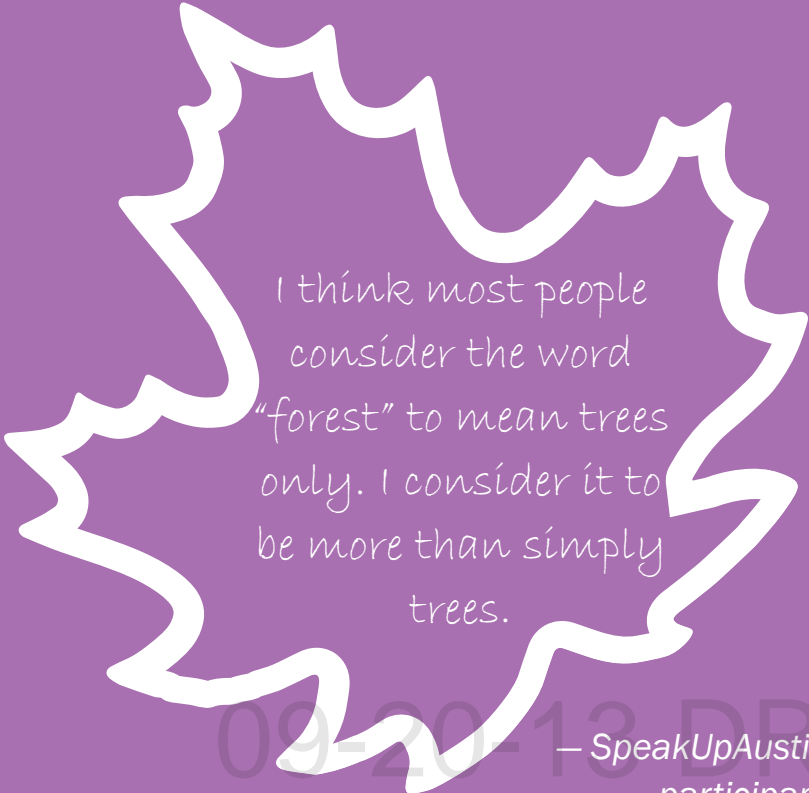


More native vegetation.



Establish standards for tree care that are based on scientific principles and applied uniformly.

Introduction




I think most people consider the word "forest" to mean trees only. I consider it to be more than simply trees.

09-20-13 DRAFT

— *SpeakUpAustin*
participant

1



The plan has to be specific and include goals with action plans with time lines.

Leaf the Tree —
participant

This chapter introduces Austin's Urban Forest Plan by providing information on why we care about our trees and vegetation and the benefits derived from them. In addition, this chapter lays out Austin's vision, goals, and guiding principles.

WHAT IS AN URBAN FOREST?

SCOPE OF THIS PLAN

BENEFITS OF THE URBAN FOREST

THE NEED FOR A PLAN

GOALS OF THE PLAN

PROCESS

A VISION FOR AUSTIN'S URBAN FOREST

GUIDING PRINCIPLES

COMMUNITY VOICES

Chapter 1: Introduction

Austin is an attractive and vibrant combination of its unique cultural and physical landscape. As the city has grown and changed, Austinites have voiced their love and concern for the impact that growth and a changing climate are having on trees and vegetation. As the city faces an unknown future, broad comprehensive planning becomes of paramount importance in the effort to support the health and long term vitality of our green infrastructure resource.

WHAT IS AN URBAN FOREST?

At first glance, the term “urban forest” seems like an oxymoron. A forest in a city...how could that be? To understand what we mean by urban forest, it is important to first understand the term “urban” which is a geographic area bound by a municipal jurisdiction and containing a large concentration of people—typically 50,000 or more people according to the United States Census Bureau (2013). The “forest” element consists of all trees and vegetation within an urban area regardless of public or private ownership. A city’s urban forest increases the quality of life for people residing there. The key to ensuring increased quality of life lies in maximizing the various benefits we derive from trees and vegetation located in our parks, along our streets, and in our yards.

Defining “Urban Forest”

“The aggregate of all community vegetation and green spaces that provide a myriad of environmental, health, and economic benefits for a community” (Sustainable Urban Forests Coalition, 2013).

“Urban Forest encompasses all the vegetation, both public and private, within the city.”



— SpeakUpAustin
participant



Credit: City of Austin, Urban Forestry Program

Kayakers on Barton Creek

What is the Public Right-of-Way?

The City of Austin's public right of way (ROW) is a land area owned and maintained by the City. It consists of the street surface, sidewalks, and grassy areas between the street pavement and a property boundary. In Austin, it is usually defined as the roadway plus 10 feet behind the curb. This definition of the City ROW may vary depending on the physical conditions at any given location. The public ROW covers approximately 47 square miles in Austin (City of Austin, 2013 right-of way & public parcels data).

SCOPE OF THIS PLAN

The urban forest does not stop at the edge of our local parks, natural areas, residential yards, and green spaces. It includes trees located within the public right-of-way (i.e. along streets, medians, and sidewalks), and along our waterways, among many more places.

Tree designation, between public and private, is greatly tied to land ownership. In the United States, urban foresters primarily focus on trees situated on public lands even though, in many cities, the majority urban forest is situated on private land and forest ecosystems exist beyond political boundaries. Sure enough, single family residences in Austin obtain the second highest acreage of tree canopy coverage after parkland and open space (City of Austin, 2006 tree canopy data). Despite this reality, this plan focuses on trees and vegetation located on public lands over which the City of Austin can exert the most direct influence.

The following list contains various land owned by the City. These are the most common areas in which the City manages and maintains the urban forest. See the map on the following page to view the distribution of these land components throughout Austin.

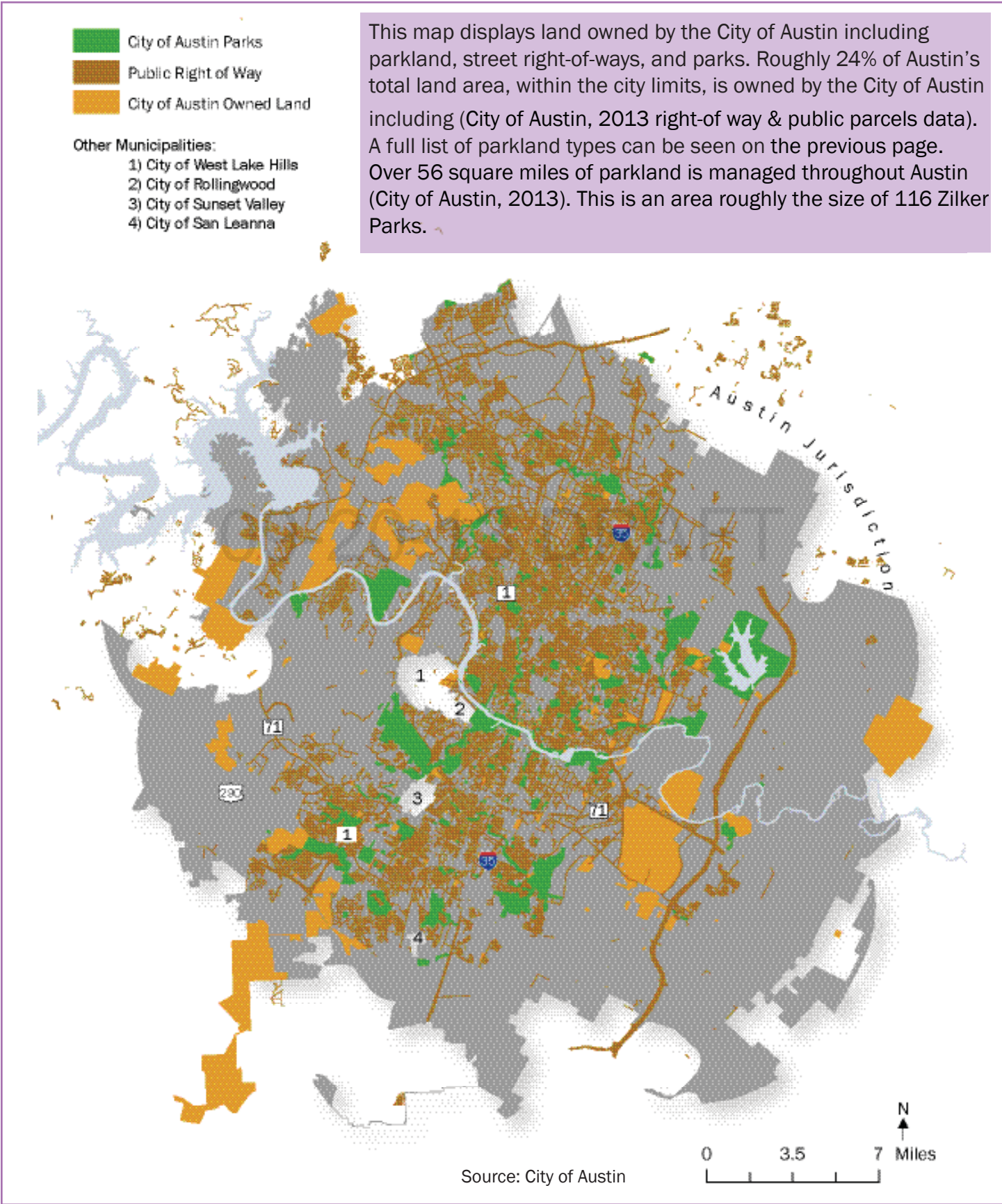
Parkland

- Neighborhood parks (Eastwoods)
- Pocket parks (Comal)
- District parks (Pease)
- Golf courses (Hancock)
- Greenbelts (Barton Creek Greenbelt)
- Metropolitan parks (Zilker)
- Nature preserves (Decker Tallgrass Prairie Preserve)
- School parks (Kealing)

Other

- Street right-of-way
- Medians
- Sidewalks
- Infrastructure easements
- Hike and bike rails
- Riparian areas (Waller Creek, Lady Bird Lake, Barton Springs Pool)
- Planting strips/triangles
- Cemeteries

Figure 1.1 | City of Austin Owned Land & Parkland



PLANNING FOR THE FUTURE



Wooldridge Park

BENEFITS OF THE URBAN FOREST

Today, urban forests are increasingly considered an element of a much larger green infrastructure (GI) network which provides benefits to humans (Benepe, 2013, ImagineAustin, 2012; Young, 2011; American Planning Association, 2009). Within this network, the urban forest plays an integral role in the health and vitality of Austin by providing social, ecological, and economic benefits to the community and by enhancing the quality of life for Austin residents. The following are a few benefits commonly provided by trees:

Figure 1.2 | Tree Benefits

Environmental	Frequently Cited Sources
<ul style="list-style-type: none">• Air pollution removal• Noise pollution reduction• Water quality enhancement• Carbon sequestration• Rainfall/stormwater interception• Flood mitigation• Urban heat island mitigation• Shading/reducing energy usage• Controlled stream channel erosion• Habitat provided for wildlife	<p>Nowak et al. 2006, Nowak 2002, Akbari et al. 2001 Nowak et al. 2006, Nowak 2002, Akbari et al. 2001 Cappiella et al. 2005 Nowak et al. 2002 Nowak et al. 2007, Raciti et al. 2006, Beattie et al. 2000 Cappiella et al. 2005 Streiling & Matzarakis 2003; Akbari et al. 2001; Rosenfeld et al. 1998 Donovan & Butry, 2009; Akbari et al. 2001 Raciti et al. 2006, Cappiella et al. 2005 Rudd et al. 2002, Fernandez-Juricic, 2000</p>
Social	
<ul style="list-style-type: none">• Crime reduction• Traffic calming• Increased public health• Education/school testing	<p>White et al. 2011, Donovan & Prestemon, 2010 Naderl, 2006; Wolf & Bratton, 2006 Bell et al. 2008; Mitchell & Popham, 2008; Lovasi et al. 2008; Ulrich 1984 ???</p>
Economic	
<ul style="list-style-type: none">• Increased property values• Improved retail business• Enhanced rental rates• Infrastructure cost savings	<p>Donovan & Butry, 2010, Crowner, 1991 Werner et al. 2001, Wolf, 2004 Donovan & Butry, 2011; Laverne & Winsor-Geideman, 2003 McPherson, 2006</p>

Aside from these benefits, Austin's urban forest faces many concerns. Accelerated land development, harsh environments brought on by climate change, recent periods of drought, increased public use, and public safety related to an aging tree population are but a few major tree-related concerns associated with our urban forest in Austin. In addition, the fact that trees do not naturally propagate themselves in a highly urbanized area, like they do in natural ecosystems, means the urban forest will not replenish itself as successfully without deliberate human intervention.

Case Study | Urban Heat Island Mitigation

Temperatures get hotter in the city than in rural areas, because highways, buildings, parking lots, etc. absorb and retain far more heat than materials in the natural environment. Shade trees that shelter homes and other structures are a great way to mitigate effects of urban heat. They help reduce energy use and utility costs as well as protect homes from sun damage and deterioration.

Top 5 Threats to the Urban Forest Through the Eyes of Citizen Participants

1. Development
2. Drought
3. Climate change
4. Soil compaction
5. Invasive species

Source: City of Austin, Urban Forestry Program, 2012

Imagine Austin | Priority Action CE A22

“Create an urban forest plan...that presents implementation measures...create a green infrastructure program to protect environmentally sensitive areas and integrate nature into the city” (ImagineAustin, 2012, p.247).

“AUFPP needs to have short and long term goals, with action items, with a plan (what, how, when).”



— Leaf the Tree
participant

THE NEED FOR A PLAN

Austin has experienced positive percent population change of over 30% for the last 4 decades (ImagineAustin, 2012). With increasingly more people living in Austin, the need to strategically approach the care and replenishment of the urban forest has reached a decisive point. Impacts from continuing growth and development, combined with long term drought conditions have created an imperative to move forward with the development of a broad-scoped, comprehensive urban forest plan.

The requirement for a comprehensive urban forest plan was initially established in Austin’s City Code in 1992 (§ 6-3-5). Later in 2012, with the adoption of Austin’s new comprehensive plan, ImagineAustin, priority was placed on protecting and expanding Austin’s green infrastructure elements through the creation of an urban forest plan. Austin’s Urban Forest Plan is the direct implementation of ImagineAustin’s call to action.

GOALS OF THE PLAN

- Establish a broad-scoped, long range vision for Austin’s urban forest.
- Provide a road map to implementation to reach the vision for the urban forest.
- Provide a framework for City departments to use as a guide for managing their urban forest resources.

With a plan in place to support Austin’s urban forest, the City will be able to 1) support the health and vitality of the community and its public spaces and 2) to manage the needs of a dynamic component of the City’s infrastructure. Of primary concern is the assurance of public well-being and safety, and enhancement of urban forest benefits through preservation, care and maintenance, and replenishment. A thriving, healthy urban forest is a reflection of the City’s ability to preserve individual trees and vegetation communities, restore and/or repair degraded lands, protect lands for environmental services, encourage the removal of non-native, invasive species, and replant trees and vegetation. A city that plans its urban forest is a city that truly and comprehensively plans for its future and the future livelihood of its citizens.

PROCESS

The Urban Forestry Board, established by Austin City Code § 2-1-183, was tasked with developing and subsequently revising a comprehensive urban forest plan with administrative assistance from the City of Austin Urban Forester (§ 6-3-5). The Urban Forestry Board is currently comprised of 7 City Council appointed members and acts in an advisory capacity to the City Council, the City Manager, and the director of the Parks and Recreation Department in all matters related to the urban forest. The duties of the Urban Forester (§ 6-3-4), include management of the public urban forest, oversight and supervision of City departments' work involving urban forest management, and ensuring preservation and replenishment of the public urban forest.

“With the assistance of the urban forester, the [urban forestry] board shall develop and revise the [comprehensive urban forest] plan.”

— Austin City Code
§ 6-3-5

Since 1992 attempts were made to develop the Code mandated plan but none resulted in a final product. Working collaboratively the Urban Forestry Board and Urban Forester took up the cause in February 2011 and kicked off the process to produce Austin's first Comprehensive Urban Forest Plan. With renewed support and energy, the Urban Forestry Board working group met often over the next 3 years.

Two public engagement initiatives were utilized to reach out into the community with the goal of engaging the public in a discussion on the topic of Austin's urban forest. In April 2012, a public meeting was held for comment on the urban forest plan vision statement, vision components and guiding principles. The Urban Forest Opinion Poll was also conducted through an online survey tool and received 876 responses. July 2013 featured pop-up Leaf the Tree Activities around town to gather a broad sampling of input from the community, and three surveys were initiated under the topics of policy, funding and performance indicators. A public education campaign was initiated to raise awareness and engage the public. In August 2013 a second public meeting was held as a community workshop and open house to prioritize resources and encourage face-to-face discussion. See Community Voices on page 11 and Appendix A for more information on the public engagement and education process.

A VISION FOR AUSTIN'S URBAN FOREST

Austin's urban forest is a healthy and sustainable mix of trees, vegetation, and other components that comprise a contiguous and thriving ecosystem valued, protected, and cared for by the City and all of its citizens as an essential environmental, economic, and community asset.

VISION COMPONENTS

Thriving

A thriving urban forest is one that is optimized according to site and ecosystem capacity.

Contiguous

A contiguous urban forest is composed of interconnected, forested corridors for transportation, community, recreation and wildlife throughout the city.

Healthy Ecosystem

A healthy urban forest is composed of a diverse, native and uneven aged palate of species adapted to the unique growing conditions of ecosystem types.

Valued

A valued urban forest is recognized as an asset that is essential to the well-being of the community and the ecosystem.

Protected

Trees are protected through sustainable site design and land management practices so that long-term ecosystem health is maintained.

Cared For

A well cared for urban forest is proactively managed for health, longevity and safety.

GUIDING PRINCIPLES

The guiding principles were established during the initial phase of the plan's development and apply to all areas and phases of the plan, its development, and its implementation.

- 1. Greatest Good Philosophy**
- 2. Wise Use of Resources**
- 3. Sustainable**
- 4. Science-Based Decision Making**
- 5. Public Safety**
- 6. Industry Recognized Best Management Practices**

COMMUNITY VOICES

Public engagement efforts produced over 1,500 total responses from online sources and multiple events that occurred throughout Austin. The list below details the major public engagement strategies undertaken for this plan. For more information on the public engagement process please see Appendix A. For a full list of comments please see Appendix B.

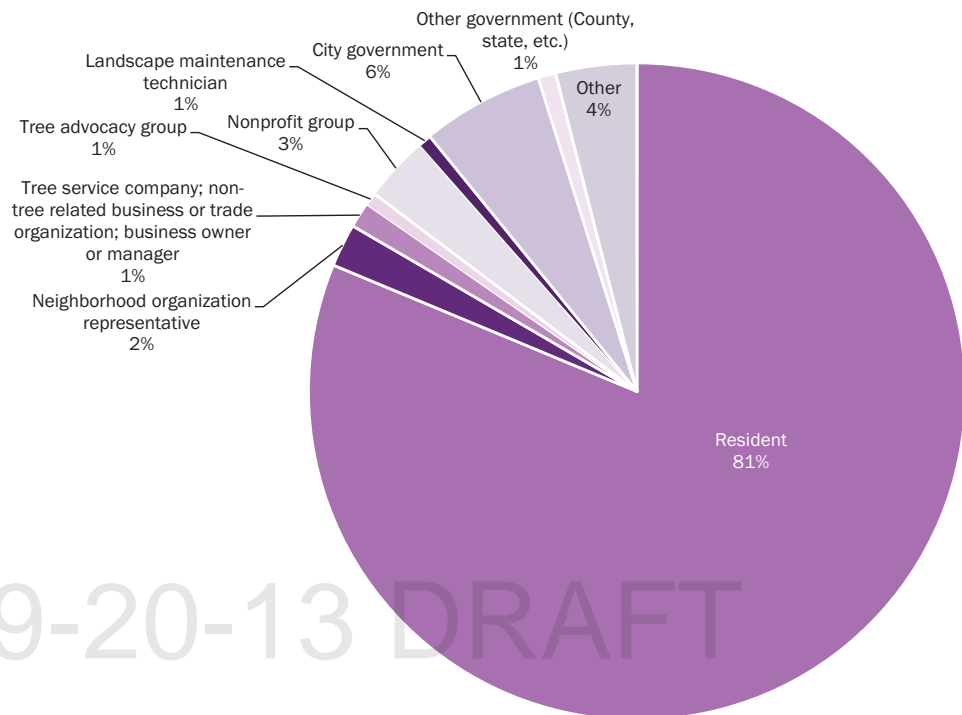
MAJOR PUBLIC ENGAGEMENT STRATEGIES

- Leaf-the-tree pop-up events
- Online and hardcopy surveys
- Community workshop & open house public meetings
- Radio and newspaper media outreach
- Social media and website outreach
- Email correspondence

The remainder of this chapter displays some major findings from the most recent surveys conducted in 2013. These results provide a snapshot into general public interest of the urban forest and citizen preferences as they relate to Austin's Urban Forest Plan.

Figure 1.3 | Public Interest in Urban Forestry

Which of the following best represents your interest in Austin's urban forest?




Source: City of Austin, Urban Forestry Program

Top 5 Citizen Participant Goals for the Urban Forest

- 1) Sustainability of the urban forest (can withstand drought, climate conditions).**
- 2) Quality of care of public trees**
- 3) Consistent funding and management across City departments**
- 4) Protecting wildlife and habitat**
- 5) Preservation of historic and important trees**

Source: City of Austin, Urban Forestry Program

State of Austin's Urban Forest



Austin does pretty well when it comes to the urban forest. But our urban forest is currently stressed by drought and under siege by new development.

09-20-13 DRAFT

2

*SpeakUpAustin —
participant*

The greenery in this city is one of the things that makes it so special.

*Tree Be-Leaf —
survey participant*

This chapter presents baseline information regarding Austin's urban forest resources as they stand today. Such information is the first step in future planning as it serves as a benchmark for monitoring present achievements against future goals.

REGIONAL CONTEXT

OUR URBAN FOREST'S HISTORY

INDICATORS OF SUSTAINABLE URBAN FORESTRY

VEGETATIVE RESOURCE

COMMUNITY FRAMEWORK

RESOURCE MANAGEMENT

URBAN FORESTRY CHALLENGES

REGIONAL CONTEXT

The Austin metropolitan region is nested within multiple ecosystems delineated by similarities and differences in biotic and abiotic traits such as geology, vegetation, climate, soils, land uses, wildlife, and hydrology. When a small area's local ecosystems exhibit enough similarities in these traits over a larger geographic region, the area is deemed an ecoregion. Austin lies at the confluence of three ecoregions as defined by the Environmental Protection Agency and the Texas Parks & Wildlife Department (Bryce, 1999). These regions include the Northern Blackland Prairie (including the Floodplains and Low Terraces of the Colorado River), the Edwards Plateau (including the Balcones Canyonlands and Live Oak-Mesquite Savanna subregions), and the Oak Woods and Prairies. A survey of Austin's local ecoregions serves as a base understanding of quality, quantity, and type of environmental resources existing within Central Texas. Such an understanding establishes and informs ecosystem management principles and policies. In an attempt to contextualize Austin's regional forest resource, the following surveys the physical and cultural landscape of Austin that has historically shaped the state of our urban forest.

Ecoregion

A region of ecosystems defined by a distinctive geography and ecological characteristics.

AUSTIN ECOREGIONS

Edwards Plateau | West of the Balcones Escarpment lies the Edwards Plateau. The plateau is an uplifted geological region and the largest of Austin's ecoregions. As one moves east in this region, the terrain becomes rugged with eroded limestone and granite rock forming what is known as the Texas Hill Country. Historically, the Edwards Plateau was a grassland savanna with intermittent forest patches. Originally, fire played a heavy role in determining vegetation types within the Edwards Plateau until wildfire suppression and overgrazing converted this area from grassland to brushland (Texas A&M Forest Service, 2008; Texas Parks & Wildlife, Edwards Plateau ecological region). As a result, Ashe juniper and mesquite dominate the landscape today as cattle avoid the juniper's bitter-tasting seed allowing for selective removal of other plant and tree species. Current land management practices have reintroduced controlled burns and employed "cedar choppers" to selectively

Chapter 2: State of Austin's Urban Forest

eradicate the invasive cedar attempting to achieve grassland regrowth.

Balcones Canyonlands & Live Oak Mesquite Savanna | The Balcones Canyonlands and Live Oak-Mesquite Savanna subregions provide variation on the plateau. The Live Oak-Mesquite Savanna dominates most of the western and northern portion of the Edwards Plateau although intermittent finger-like portions exist in the eastern portion of the Plateau. The Live Oak-Mesquite Savanna subregion is dominated, as its name suggests, by mesquite shrubland and live oak trees. On the other hand, limestone canyons cut by tributaries of the Colorado River, identify the Balcones Canyonlands. Karst topography further characterizes the terrain—the result of acidic rainfall reacting with limestone bedrock, which creates Swiss cheese-like formations in the ground. Water percolation through the porous limestone contributes to recharge of the Edwards Aquifer below. Slopes are particularly steep along stream courses with soil depth varying by topography slopes and hilltops usually have thin soils whereas flat areas and lowlands have thicker soils. Vegetative cover in the Canyonlands consists of evergreen woodlands and deciduous forests composed of Texas mountain laurel, Lacey oak, black cherry, bigtooth maple, Ashe juniper, sumac, acacia, and honey mesquite.

“...some parts of Austin are supposed to be prairie with limited trees.”



— Tree Be-Leaf
survey
participant

Blackland Prairie | The Blackland Prairie is a grassland ecoregion covering the eastern portion of Austin. Its boundaries form a thin strip spanning from the Red River in the north to San Antonio in the south. Its Cretaceous chalk, marl, and limestone formations created productive black clay soils suitable for farming. Initially the prairie consisted of tallgrasses however agricultural production converted much of the terrain into cropland and grazing pastures (Texas Parks & Wildlife, Blackland Prairie ecological region). The region is identified as the most altered ecoregion in Texas with 1% of the native Blackland Prairie remaining today (Ramos & Gonzalez, 2011; Clymer Meadow Preserve website, 2013). Like the Edwards Plateau, this region was historically influenced by natural fires however human settlement has introduced woody vegetation including pecan, cedar elm, hackberry, mesquite, and various oaks.

Chapter 2: State of Austin's Urban Forest

Ashe juniper, *Juniperus ashei*



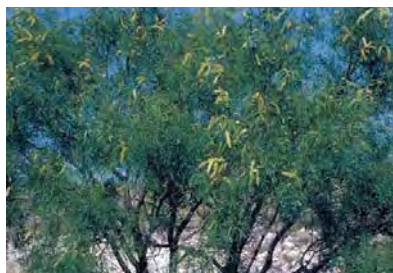
Native to Edwards Plateau. Provides habitat for the endangered Golden-cheeked Warbler. Major allergy irritant.

TX mountain laurel, *Sophora secundiflora*



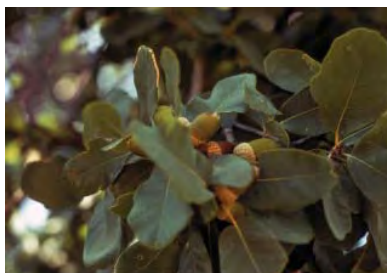
Native to Edwards Plateau. Ornamental flowers give off grape-scented fragrance.

Honey mesquite, *Prosopis glandulosa*



Aggressive spreader native to both Edwards Plateau and Blackland Prairie. Produces nectar and thorns.

Lacey oak, *Quercus laceyi*



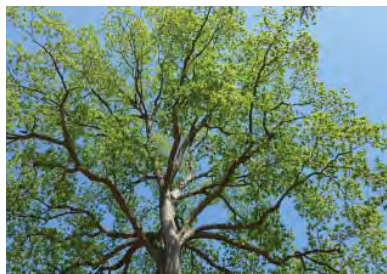
Native to Edwards Plateau. Resistant to oak wilt. Largest known specimen grows 50 miles west of Austin in Blanco, Texas.

Bigtooth maple, *Acer grandidentatum*



Native to Edwards Plateau. Leaves turn red and gold in fall.

Pecan, *Carya illinoensis*



Native to Blackland Prairie. Official Texas state tree. Nut producing.

Southern live oak, *Quercus virginiana*



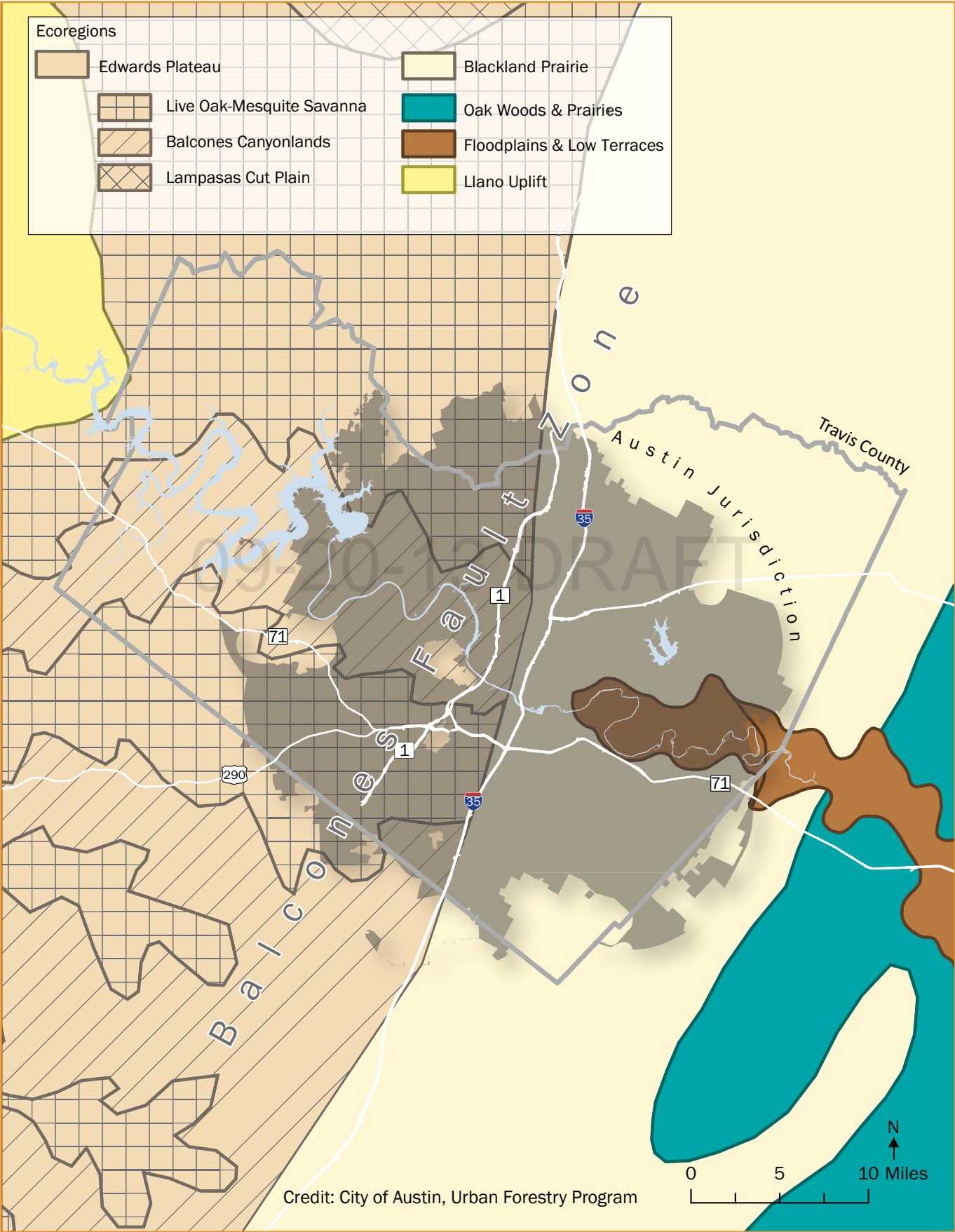
Native to Edwards Plateau and Blackland Prairie. Susceptible to oak wilt. Very popular shade tree.

Cedar elm, *Ulmus crassifolia*



Native to Edwards Plateau and Blackland Prairie. One of the most common species in Austin.

Figure 2.1 | Austin Ecoregions



Chapter 2: State of Austin's Urban Forest

Floodplains & Low Terraces | The Floodplains and Low Terraces subregion is part of the Blackland Prairie and includes the broad floodplains of the Colorado River. Historically, bottomland forests contained bur oak, Shumard oak, sugar hackberry, elm, ash, eastern cottonwood, and pecan although most forested land has been converted to agricultural land.

Oak Woods & Prairies | The Oak Woods and Prairies region is characteristic of savanna grasses, brushlands, and forest patches. Originally a diverse savanna of native grasses and patches of Post Oak trees, the region has given way to denser undergrowth due to fire suppression, farming, overgrazing, soil disturbance, and land parcelization beginning in the 1800s. Today, common species found in the region consist of blackjack oak, water oak, winged elm, hackberry, yaupon, and concentrations of loblolly pines near Bastrop.

09-20-13 DRAFT

Focus Point | Balcones Escarpment

Austin straddles a major geologic formation—the Balcones Fault—an inactive yet distinct fault zone stretching north to Waco. The surface expression of the fault is the Balcones Escarpment which impacts local climate patterns and greatly influences east-west spanning ecosystems creating unique variation in vegetation types, soils, topography, species biodiversity, and climate patterns throughout the region.

Culturally speaking, the Balcones Escarpment is the natural feature influencing human settlement throughout Central Texas' history (Palmer, 1986; City of Austin, Community Inventory Report, 2011). Early European economies in Central Texas were delineated by arable soils. In the west, shallow clay soils covering limestone bedrock discouraged farming yet promoted cattle grazing, while the fertile black soils to the east promoted agriculture (Johnson, 2013). As a result, most of Austin's agricultural lands exist today east of Austin.

09-20-



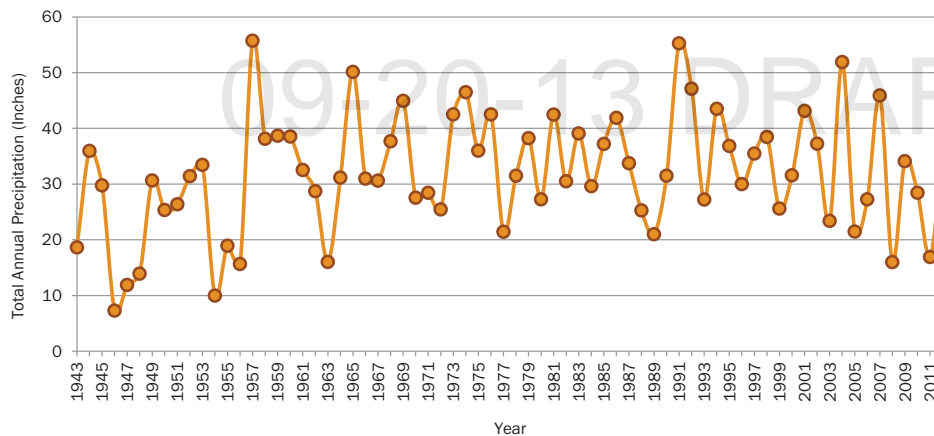
6th and Guadalupe

Chapter 2: State of Austin's Urban Forest

AUSTIN'S CLIMATE

Austin spans the climatic transition zone between the humid subtropics of east Texas and semiarid lands of west Texas. Summers are hot with temperatures exceeding 90°F most summer days, while winters are mild with daytime temperatures hovering around 50°F (NOAA, 2010). Weather patterns stem from Mexico's Atlantic and Pacific coasts. Occasional Arctic cold fronts intrude from the north. Austin experiences unreliable precipitation with peak rainfall typically occurring in May and September. Average yearly rainfall is near 30 inches, with periodic droughts and occasional flooding impacting normal precipitation levels. Because Austin sits between climatic regions, water levels are variable, which ultimately influences vegetative species growing throughout the Central Texas region.

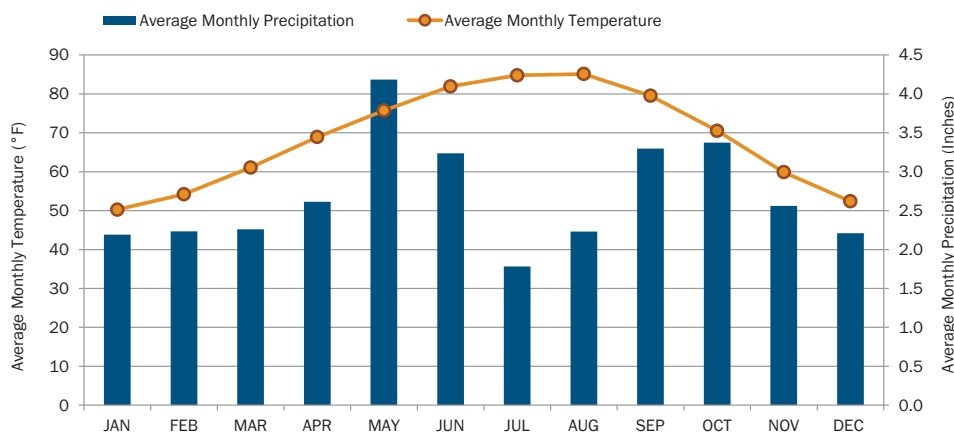
Figure 2.2 | Total Annual Precipitation in Austin (1943-2012)



*1946 precipitation total is inconclusive due to incomplete values.

Source: NOAA, 2013

Figure 2.3 | Austin Climate Graph (1943-2012)



*These values reflect monthly averages over a 69 year period.

Source: NOAA, 2013

“In this climate, you can’t have too much tree canopy with the urban heat island effect increasing each year.”

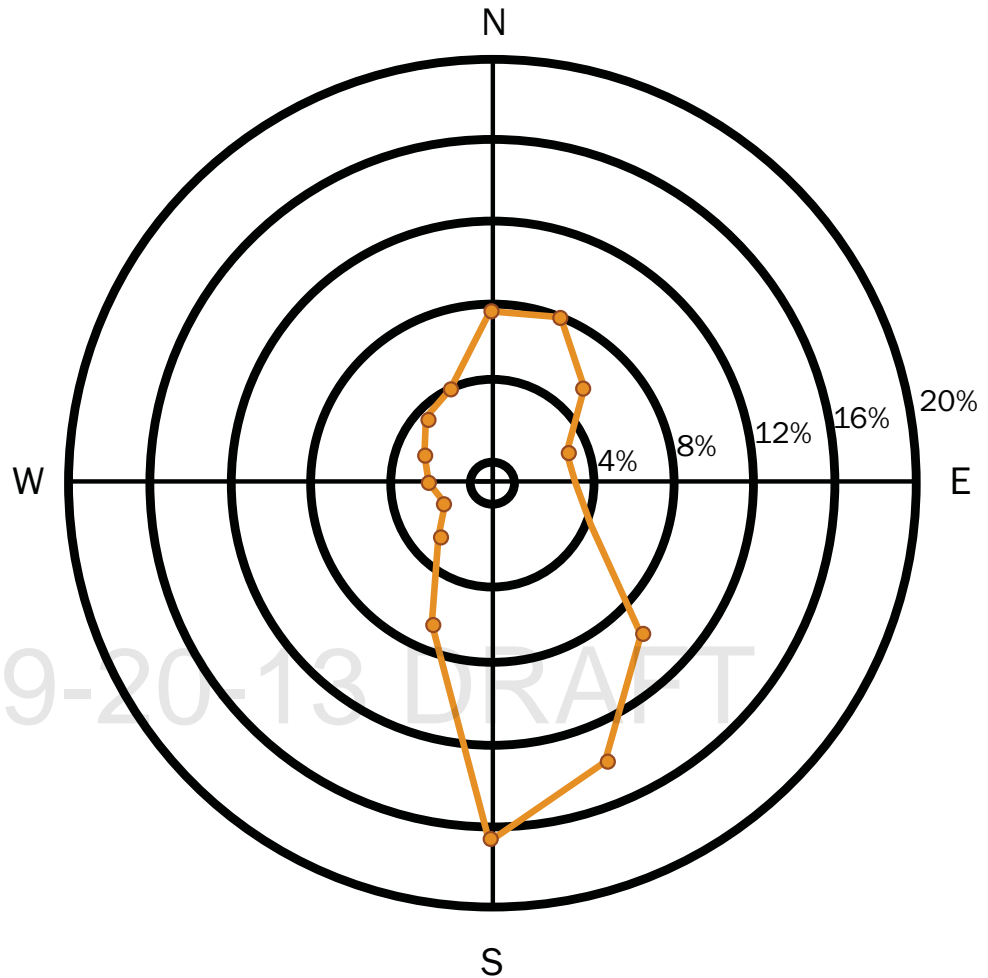


— Tree Be-Leaf survey participant

Wind Rose | A Graph of Austin's Wind Patterns

The graph at right displays the direction from which the wind blows (from the outer circle towards the center). The size of the orange area within each circle shows the amount of time that wind blows from a particular direction.

Figure 2.4 | Average Annual Wind Prevalence in Austin (1984-1992)



Source: Texas Commission on Environmental Quality

Figure 2.4 shows the most common wind patterns in Austin averaged over an 8 year period. This shows that Austin winds blow from the south and southeast 40% of the time and north or northeast 21% of the time typically at speeds from 4 to 18 mph. These are light to breezy style winds. Winds blow much less from the east and west directions. Wind patterns are important to consider since they can greatly impact the structure of trees and vegetation throughout their lifetime. Intense or extended winds may topple entire trees or limbs.

Chapter 2: State of Austin's Urban Forest

Drought: 2010-2011

Between October 2010 and September 2011, Texas experienced its worst drought in recorded history. Low precipitation resulted in devastating crop and vegetation loss throughout the state. For example, Texas lost an estimated 5.6 million urban trees—roughly 10% of Texas' urban forests—resulting in a projected \$560 million to remove said dead trees (Texas A&M Forest Service, 2012, February). On the other side, drought-related tree mortality in rural areas across Texas was estimated at 301 million trees with roughly 6.6% of tree loss occurring in Central Texas (Texas A&M Forest Service, 2012, September). These numbers are significant considering that Central Texas was estimated to have the largest count of live trees (1,540 million), out of any other Texas region, prior to the recent drought (Texas A&M Forest Service, 2012, September).



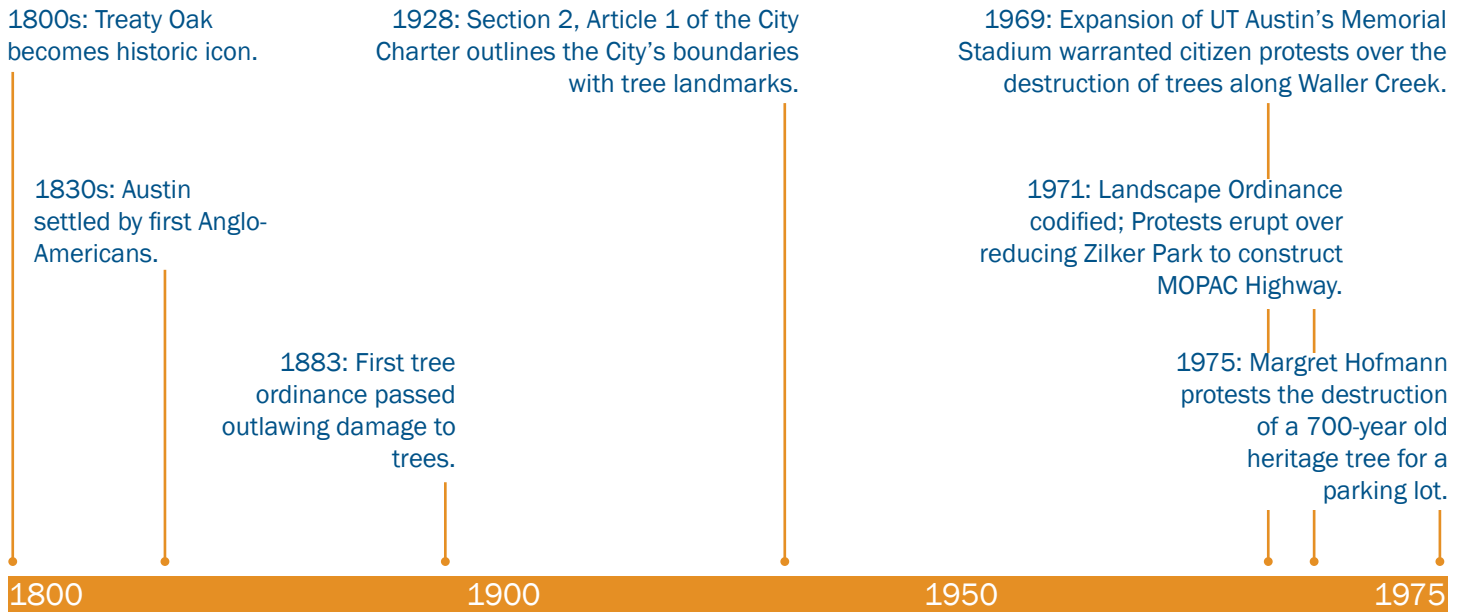
Focus Point | Bastrop Wildfire 2011

The 2011 Bastrop County Complex Fire burned from September through October across 16,200 acres of pine and mixed pine-deciduous forests just east of Austin. The fire most likely started from electrical power line sparks igniting dry vegetation. It was the most destructive wildfire in Texas history destroying over 1,000 homes and burning an estimated 1.5 million trees, of at least 5 inch diameter (Hanna, 2011; Texas A&M Forest Service, 2011). The fire's severity was exacerbated by the lengthy drought and by strong winds created by Tropical Storm Lee. Together these factors created prime conditions for a devastating wildfire.



This image was taken on September 11, 2011 from the Landsat 5 satellite. It shows burned vegetation in red compared to healthy vegetation in green. The burn mark shown here spanned 15 miles north-south in Bastrop County.

Chapter 2: State of Austin's Urban Forest



OUR URBAN FOREST'S HISTORY

Traveling to Austin in the 1850s, the legendary landscape architect Frederick Law Olmsted wrote, “the country around the town is rolling and picturesque, with many agreeable views of distant hills and a pleasant sprinkling of wood over prairie slopes” (Olmsted, 1978). Since then, Austin’s natural landscape has changed greatly from a “sprinkling of wood over prairie slopes” to a forested city. This forestation is a result of the human activities and level of support for our urban forest throughout history. The importance of trees to Austinites is

Chapter 2: State of Austin's Urban Forest

1983: Margaret Hofmann backs tree protection ordinance.

2013: Urban forest comprehensive plan created.

1988: Urban Forestry Board established.

2008: Clear-cutting of 100-year-old pecan grove in Oak Hill increases proponents of urban forest.

2010: Heritage Tree Ordinance passed.

2006: Appointment of the Tree Task Force.

2012: Imagine Austin Comprehensive Plan adopted.

1980

2000

2010

2013



largely solidified in historical events and City rules initiated by local residents. These human actions continue to impact local policies and goals in preserving a healthy urban forest citywide. The following timeline details important historical events impacting Austin's urban forest over the years. City rules initiated by local residents. These human actions continue to impact local policies and goals in preserving a healthy urban forest citywide. The following timeline details important historical events impacting Austin's urban forest over the years.

Chapter 2: State of Austin’s Urban Forest

Focus Point | Austin’s Tree Lady

Margret Hofmann was Austin’s most well-known tree advocate. Hofmann’s stardom as Austin’s “Tree Lady” began in 1973 when she challenged the removal of an ancient Live Oak on South First Street, establishing her “Think Trees” campaign. Soon after, Hofmann served a short-lived but influential City Council term from 1975 to 1977 in which she advocated protecting trees from destruction in the face of new development. Her efforts materialized in Austin’s first major heritage tree registry and the passage of Austin’s first modern tree protection ordinance in 1983. Hofmann’s tree-minded legacy persists today, influencing local environmental activism and City decisions. In 2010, the City passed its Heritage Tree Ordinance to further protect Austin’s aged urban forest; owing its formation to Hofmann. Her legacy is honored in the Margret Hofmann Oaks standing across from City Hall at the intersection of South 1st Street and Cesar Chavez Street.



Credit: Austin Chronicle

Margret Hofmann

“Trees are a part of the City’s story and history”



— Tree Be-Leaf
survey participant

Overview of Historical Code

Title 2. Administration
Chapter 2-1 City Boards

Article 2. Boards
§ 2-1-183 Urban Forestry Board
Source:
Ord. 20071129-011
Ord. 20101209-003

Title 6. Environmental Control and Conservation

Chapter 6-3 Trees and Vegetation

Article 1. General Provisions
§ 6-3-2 Urban Forester
Source:
1992 Code Section 15-10-4
Ord. 031023-10
Ord. 031211-11.

§ 6-3-5 Comprehensive Urban Forest Plan

Source: 1992 Code Sections 15-10-4(A) and (C)
Ord. 031023-10
Ord. 031211-11

§ 6-3-6 Standards of Care for a Tree or Plant on Public Property

Source: 1992 Code Section 15-10-4(D)
Ord. 031023-10
Ord. 031211-11

OVERVIEW OF KEY HISTORICAL TREE-RELATED ORDINANCES, REGULATIONS

1983

Ordinance | March 1983 [1983-0324-N] Establishes a new chapter 9-11 of the Austin city code of 1981 to be entitled "Trees"; providing for the protection of the largest and most valuable trees in the city of Austin. Also established the City Arborist position.

1996

Ordinance | March 1996 [19960328-B] Public Tree Care Ordinance. Regulating the planting, maintenance, and removal of trees on public property; establishing the office of Urban Forester; the issuance of written approvals for the maintenance, and removal of trees on public property; the removal of vegetation on private property which obstructs public travel; the protection of public trees; value recovery when public trees are damaged or removed; for trees as part of street improvements; prescribing penalties for violations of its provisions.

2010

Ordinance | February 2010 [20100204-038] Amendments to CH. 25-8, subchapter B, article 1 and section 6-3-48 relating to tree protection; protected tree provisions; and adding new division for heritage trees.

2012

Ordinance | June 2012 [20120614-058] Adoption of the Imagine Austin Comprehensive plan.

2013

Resolution | June 2013 [20130627-070] City Manager "to assess the value and benefits that public trees provide to the community and to various municipal functions... using existing city resources... quantify the value and benefits of...trees."

For a full list of historical Ordinances, Resolutions & Code please see the Appendix.



- | | | | |
|---------------------------------|---------------------------------|---------------------------------|---------------------------------|
| 1. New Wade Chapel. | 11. Methodist Episcopal Church. | 21. Methodist Episcopal Church. | 31. Methodist Episcopal Church. |
| 2. Temporary State House. | 12. Methodist Episcopal Church. | 22. Methodist Episcopal Church. | 32. Methodist Episcopal Church. |
| 3. Third United Baptist Church. | 13. Methodist Episcopal Church. | 23. Methodist Episcopal Church. | 33. Methodist Episcopal Church. |
| 4. County Prison. | 14. Methodist Episcopal Church. | 24. Methodist Episcopal Church. | 34. Methodist Episcopal Church. |
| 5. State University. | 15. Methodist Episcopal Church. | 25. Methodist Episcopal Church. | 35. Methodist Episcopal Church. |
| 6. Temple Avenue. | 16. Methodist Episcopal Church. | 26. Methodist Episcopal Church. | 36. Methodist Episcopal Church. |
| 7. Methodist Episcopal Church. | 17. Methodist Episcopal Church. | 27. Methodist Episcopal Church. | 37. Methodist Episcopal Church. |
| 8. Methodist Episcopal Church. | 18. Methodist Episcopal Church. | 28. Methodist Episcopal Church. | 38. Methodist Episcopal Church. |
| 9. Methodist Episcopal Church. | 19. Methodist Episcopal Church. | 29. Methodist Episcopal Church. | 39. Methodist Episcopal Church. |
| 10. Methodist Episcopal Church. | 20. Methodist Episcopal Church. | 30. Methodist Episcopal Church. | 40. Methodist Episcopal Church. |



AUSTIN, STATE CAPITAL OF TEXAS.

- 1. M. W. Moore Co. Paint Store and Carpet Room.
- 2. A. Hartman's Plumbing, Mill, Sash, Door and Blind Factory and Lumber Yard.
- 3. Hotel Dry.
- 4. Moore's Mill, formerly each proprietor of Bridge Station.
- 5. Calumet Lumber Yard.
- 6. W. W. Fennell & Co's Lumber Yard and Plumbing, Mill, Sash, Door and Blind Factory.
- 7. C. E. Mitchell Lumber Yard, Plumbing Mill, Sash, Door and Blind Factory.
- 8. Clifton Company.
- 9. Geo. B. Ruppelmann & Son's Ice Factory.
- 10. City National Bank.
- 11. First National Bank.
- 12. State National Bank.
- 13. Stewart & Hancock's Bank.
- 14. John H. Henshaw's Wholesale Store.
- 15. Austin Gas & Coal Co's Works.
- 16. A. Van Dusen's Lumber Yard.
- 17. Bragg's Lumber.
- 18. Joseph Natta's Lumber Yard and Plumbing Mill.
- 19. High School.
- 20. Ross & Sons' Hardware.
- 21. Smith & Sons' Hardware.
- 22. Central National Bank.
- 23. Austin & Sons' Hardware.
- 24. Western Electric Company.
- 25. Smith's Lumber.
- 26. A. C. Ruppelmann, Inc. Coal, Sash, Door and Blind Factory.
- 27. Turner Hall.

Augustus Koch's hand drawn map of Austin 1887

Credit: Amon Carter Museum

INDICATORS OF SUSTAINABLE URBAN FORESTRY

The remaining three sections present baseline information regarding Austin's urban forest resources. Such information helps in understanding our current situation and serves as a benchmark for monitoring present achievements against future goals.

This analysis follows a nationally-recognized framework for evaluating strategic urban forest planning and management through the implementation of urban forestry criteria and indicators proposed by Kenney et al. (2011). This framework was born out of The Montréal Process in 1994—an intergovernmental call for sustainable forest management worldwide—and later modified by Clark et al. (1997).

The following three sections mirror the Kenney et al. approaches to urban forestry sustainability: vegetative resource, community framework, and resource management. Each approach houses a set of criteria and performance indicators for measuring urban forestry management success. These off-the-shelf criteria were reviewed and modified when deemed appropriate.

In the case where issues were not addressed by these criteria, new criteria were created. There are 30 total criteria for Austin. The following sections provide a snapshot of Austin's urban forest in terms of the most comprehensive indicators available at this time. These indicators will be updated and reported on, when new data becomes available, culminating in a reoccurring "state of the urban forest" report.

The full list of Austin's performance indicators is shown on the following page. They are displayed in order of citizen prioritization as revealed through online polling and public engagement events. Citizen-guided prioritization will help set up the order in which urban forestry policies are implemented in the future.

Austin's Score: 73/120

Appendix A displays a performance indicator report card for Austin. Scoring of each indicator was confirmed by available datasets and City staff. Targets are provided when applicable. Performance rankings follow low, moderate, good, and optimal standards. To date, Austin urban forestry scores 73.5 out of a maximum 120 points towards an optimally-performing, sustainable urban forestry program.

Chapter 2: State of Austin's Urban Forest

What things are most important when we decide how healthy our urban forest is?	Vegetative Resource
	1) Native vegetation
	2) Species suitability
	3) Relative canopy cover
	4) Species distribution
	5) Condition of the urban forest
	6) Publicly-owned natural areas
	7) Urban forest pests
	8) Size-class distribution

What is the most important way that community members can get involved with taking care of the urban forest?	Community Framework
	1) Complete urban forest recognition
	2) General urban forest awareness
	3) Neighborhood action
	4) Public agency cooperation
	5) Involvement of State & Federal landholders
	6) Regional urban forest cooperation
	7) Green industry cooperation

What is more important for the City to spend money on to keep the urban forest healthy?	Resource Management - Coordination, Support, & Planning
	1) Urban forest establishment planning & implementation
	2) Municipality-wide funding
	3) City-wide urban forest funding
	4) City staffing
	5) Urban forest inventory
	6) Tree canopy cover inventory
	7) Urban forest risk management

“What is more important for the City to focus on in order to protect our urban forest and manage it sustainably?”	Resource Management - Protection & Practices
	1) Urban forest protection from development
	2) Water use & drought response
	3) Urban forest habitat suitability
	4) Wildlife & human habitat
	5) Sustainable practices
	6) Carbon sequestration & woody biomass

Chapter 2: State of Austin's Urban Forest

VEGETATIVE RESOURCE

The vegetative resource refers to the physical components of an urban forest related to vegetative growth. These components include but are not limited to trees, plants, grasses, soils, and water. Managing these physical resources by monitoring criteria such as tree canopy cover, age structure, and species diversity will help plan for a healthy and resilient urban forest well into the future. This section covers the following indicators:

- Tree canopy distribution
- Species composition
- Age structure
- Tree condition
- Tree values and benefits

Tree Canopy Distribution | Tree canopy is a simple measurement of an urban forest's spatial distribution. Canopy refers to a tree's aboveground layer of leaves, branches, and stems. When tree canopy density is high, we receive various benefits. These benefits include cleaning our air, cooling our homes through shading, and providing habitat for wildlife. Monitoring tree canopy distribution is one way to measure the health of our urban forest over time and to ensure we continue receiving benefits.

The percent of land covered by tree canopy provides a baseline indicator of an urban forest's extent, and is easily acquired with relatively little cost. Tree canopy covers an estimated 31% of Austin's land area (City of Austin's full purpose and 5 mile ETJ area) and has consistently decreased since the 1970's as shown in Figure 2.5 on the next page.

Canopy goals | A distraction?

Often cities set tree canopy cover targets to be achieved through tree planting programs. American Forests' (1996) recommends overall citywide canopy cover of 40% for humid cities and 30% for arid cities. Although new tree plantings are necessary in ensuring forest regeneration, tree planting programs attempting to achieve canopy cover goals often distract communities from other, equally-important management opportunities. Kenney et al. (2011) proclaim tree canopy cover does not paint a full picture of the urban forest. Species diversity, condition, age distribution, and mortality rates are equally important in forestry management.

Figure 2.5 | Historic Tree Canopy Cover

Canopy goals in other
U.S. cities

- Baltimore
40% by 2040
- Denver
18% by 2025
- Fairfax
45% by 2037
- Philadelphia
30 by 2025
- Phoenix
25% by 2030
- Seattle
30% by 2037

Year	% Tree Canopy Cover	Source
1977	39%	Rodgers & Harris, 1983
1982	37%	Crownover, 1991
1990	34%	Crownover, 1991
1996	34%	American Forests, 1996
2006	31%	City of Austin, 2006

Recent declines in canopy cover are most likely attributed to natural factors such as extended drought periods, as well as human impacts such as urban development. To put these numbers into perspective, American Forests recommends 30% tree canopy cover within arid cities and 40% cover within humid cities. Since Austin lies at a climatic transition zone between humid and dry, identifying appropriate canopy levels for Austin proves difficult. Furthermore, establishing percent canopy goals can defeat the purpose of truly sustainable urban forestry practice and can place unnecessary resources (i.e. time, money, labor) in well-intentioned but poorly planned endeavors. Nevertheless, measuring tree canopy distribution helps to identify forest loss over time and to inform tree planting programs in underserved communities.

At the neighborhood level, variations in tree canopy distribution are more complex. Many areas with high population density actually contain some of the highest tree canopy cover (e.g. Hyde Park). In fact, residences and open space areas contain the largest shares of tree canopy cover in Austin. The map on the following page shows a clear distinction between east and west Austin with greater tree canopy cover occurring in west Austin, and lower tree canopy cover occurring in east Austin. For instance, the Edwards Plateau region to the west contains the majority canopy coverage at 165,595 acres while the Blackland Prairie region to the east contains only 44,148 acres of tree canopy cover. This pattern is consistent with the natural and cultural histories of Central Texas, and reflects the domination of agricultural practices resulting in fewer trees, occurring in far east Austin. Additionally, the prevalence of high canopy

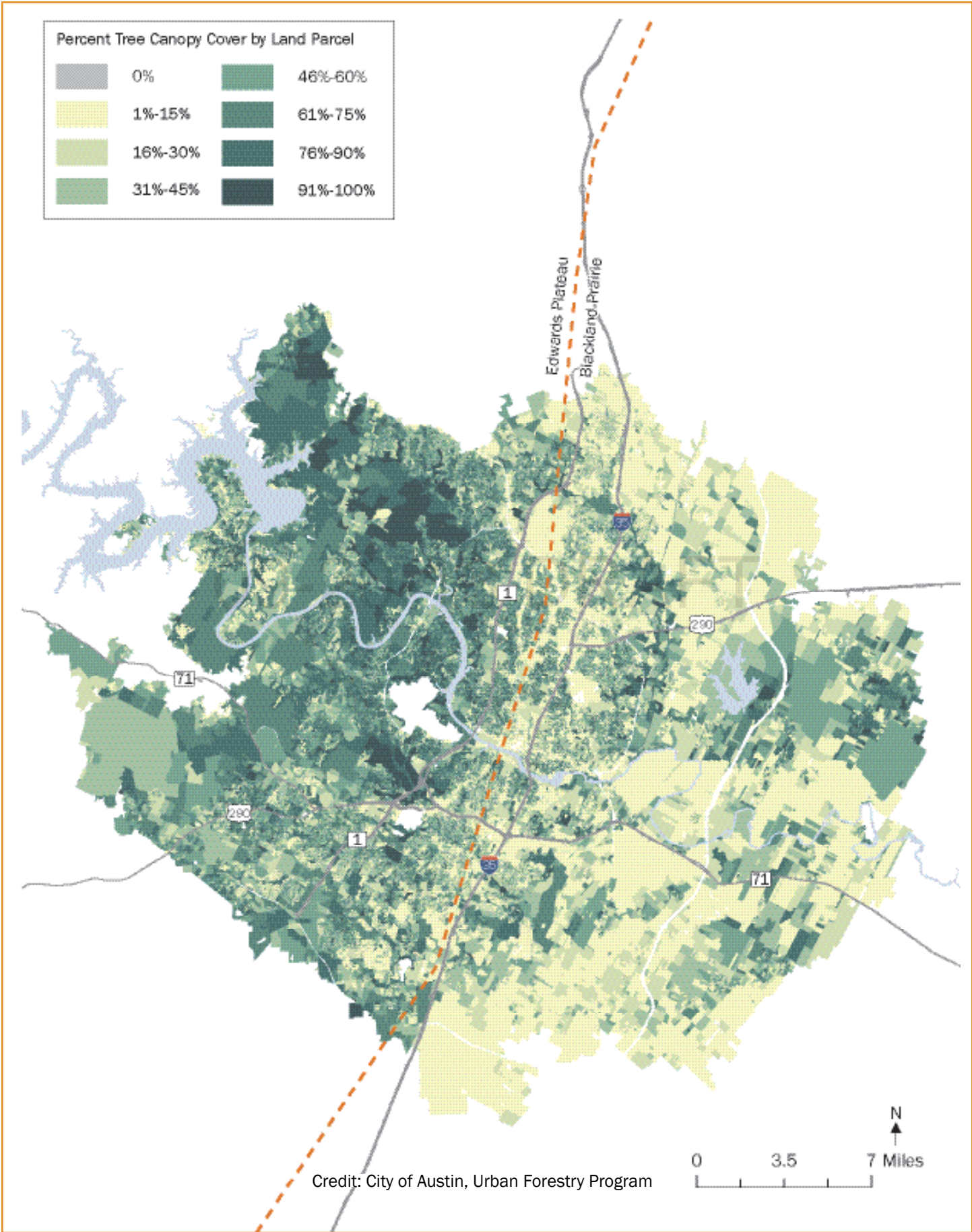
Chapter 2: State of Austin's Urban Forest

cover may reflect distributions of wealthier neighborhoods in west Austin while lower canopy cover percentages reflect distributions of less affluent neighborhoods in east Austin. Studies show a positive relationship between income and the demand for trees as rich communities have larger budgets and larger private lot sizes for trees to grow (Zhu & Zhang, 2008).

Austin Tree Canopy Map (Right) | Austin's tree canopy varies across the city. The map at right shows a clear distinction between east and west Austin with greater tree canopy cover occurring west of IH35 in the Edwards Plateau region, and lower tree canopy cover occurring east of IH35 in the Blackland Prairie region. Intuitively, many areas adjacent to or near water features show high tree canopy percentages.

Open space, single family, and undeveloped lands contain the highest distribution of tree canopy cover in the city (City of Austin, 2006 tree canopy data). In open space park areas, the amount of land covered by tree canopy (37,705 acres) is substantial—roughly 50 times the size of Central Park in NYC.

Figure 2.6 | Percent Tree Canopy Cover in Austin, 2010



Chapter 2: State of Austin's Urban Forest

Focus Point | Tree Inventory Assessment (2008)

Examining the characteristics of a city's tree population helps to understand the urban forest resource as it stands today and helps to prioritize future management focus. Species composition, age, condition, and tree values and benefits indicate the relative importance of individual tree species to Austin's urban forest.

A 2008 tree inventory sampled 14,925 park and right-of-way trees in Austin to gather information on tree attributes. The inventory estimates Austin's total public tree population at 155,762. This number was extrapolated based on the City's total parkland area and major street lengths to determine an overall 325,000 trees on public lands comprising approximately 200,000 trees growing on Austin's developed park lands, and 125,000 trees growing adjacent to major city streets. The inventory also indicated 190,940 planting spaces available in street right-of-ways. The 2008 inventory was limited by cost and time, so the sample size was small; the true number of Austin's public trees is likely much higher. In addition, the inventory omitted trees within natural areas, greenbelts, and preserves. Regardless, this is the most recent and largest sample of information for trees growing on public lands in Austin.

Species Composition | Within transit corridors and parks, Austin's public tree population consists of 166 different species mostly comprised of deciduous trees. Cedar Elm (*Ulmus crassifolia*) is the dominant species followed by Southern Live Oak (*Quercus virginiana*) and Crape Myrtle (*Lagerstroemia indica*).

Over-mature oaks and semi-mature non-native invasive trees thrive in many areas of Austin as well. Non-native invasive trees, such as Glossy Privet (*Ligustrum lucidum*), were not surveyed in 2008 and are therefore not discussed in this section although it is important to mention they pose a significant challenge in park management as they crowd out native plants. For more information, Austin's Invasive Species Management

What is a deciduous tree?

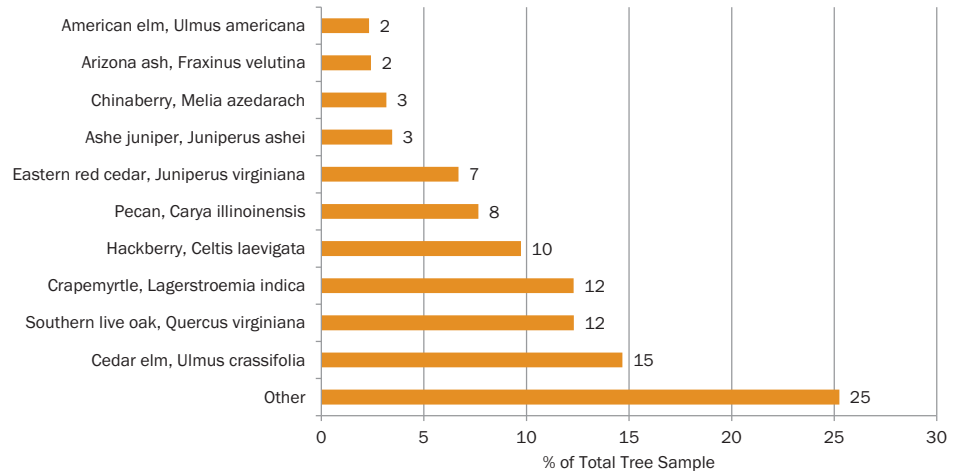
These trees shed their leaves annually during the cold season. They typically exhibit broadleaf leaves that are flat and thin as opposed to needle-like or scale-like leaves. Examples of deciduous trees include oak, ash, and pecan trees.

Invasive Species | Chinaberry

Chinaberry, *Melia azedarach* is a top 10 species in Austin's right-of-ways and parks. It comprises roughly 3% of the tree population in these areas. Chinaberry is invasive to Austin and is listed as one of Austin's top 24 invasive species (City of Austin, *Central Texas Invasive Plants Field Guide*, 2013). The tree is known to crowd out native plants as its leaves alter pH and nitrogen levels in the soil.



Figure 2.7 | Top 10 Tree Species in Public Right-of-Way and Parks



Source: City of Austin Urban Forestry Program, 2008

Species diversity ensures forest resiliency against arboreal diseases (i.e oak wilt) and devastating insect infestations (e.g. elm bark beetle) for which certain tree species are sensitive. Figure 2.7 shows the top 10 species represent 75% of the total tree population. According to a recommended rule of thumb, called the 10/20/30 rule, no single species should comprise more than 10% of the total tree population, no single genus should comprise more than 20%, and no single family should comprise more than 30% (Clark et al, 1997). As shown in Figure 2.7, the top 3 species each comprise over 10% of the total tree population, while no single genus represents greater than 20% of the population. The graph above shows its prevalence as Austin's eighth most common tree species within street right of ways and parks.

Chapter 2: State of Austin's Urban Forest

Age Structure | Age structure refers to the abundance of individual trees in a population according to their age. Documenting a tree population's age structure provides insight into the overall age of the urban forest, the value of individual tree species, and future maintenance costs. A diverse age structure of young to old trees ensures new generations replace older generations thus reducing the possibility of substantial tree mortality due to age.

There exist multiple avenues for determining tree age. Because a tree's trunk diameter and the age of a tree are closely related, tree diameter at breast height (DBH) is often used as a proxy for determining tree age. This is the most widely used and easiest technique. In Austin, DBH is measured at 4.5 feet above the ground.

A healthy urban forest consists of uneven age distributions where young trees comprise a larger share of the total tree population relative to larger diameter classes to compensate for tree mortality. Austin's street and park tree population follows closely to the Richards recommended DBH shares. Overall, Austin's public tree age structure consists of 45% young trees (less than 8 inches DBH), 47% established trees (8-23 inches DBH), and roughly 7% mature trees (24 inches DBH or greater). See Figure 2.8

Of the top 10 public tree species in Austin, Crape Myrtle, *Lagerstroemia indica*; Sugarberry, *Celtis laevigata*; and Chinaberry, *Melia azedarach* all have their largest share of trees in the small size class (<8 inches DBH). Considering large-stature trees, Pecan, *Carya illinoensis* and Southern Live Oak, *Quercus virginiana* represent the largest single shares in the large class size (24+ inches DBH).

The prevalence of Crape myrtles, a naturally small-growing species, may be affecting the overall age structure shown in Figure 2.8.

Suggested DBH Classes for a Healthy Street Tree Population

Richards (1982/1983) recommended the optimal distribution of relative age classes for stability in a street tree population. His suggestion breaks tree DBH into the following classes:

40% <8" DBH

30% at 8"-16" DBH

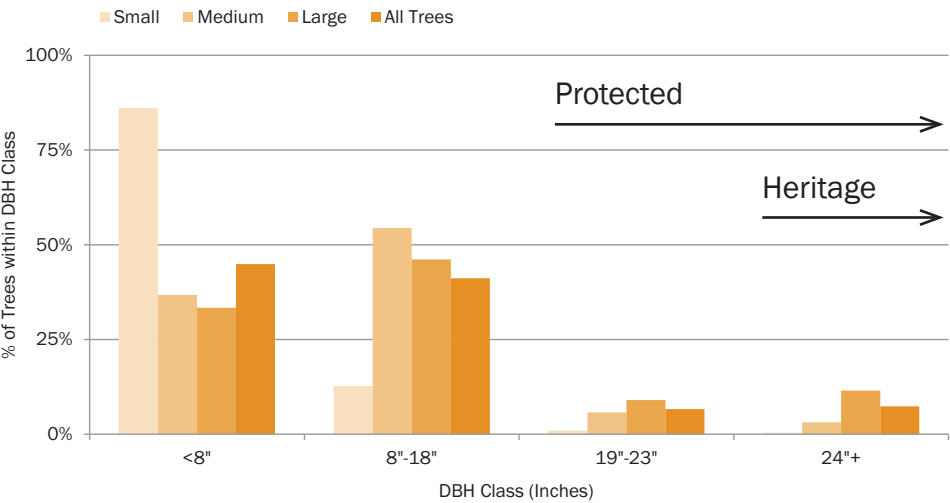
20% at 16"-24" DBH

10% >24" DBH

These classes have been modified to better reflect the City's "protected" and "heritage" tree sizes: 19" or greater DBH and 24" or greater DBH respectively.

Chapter 2: State of Austin’s Urban Forest

Figure 2.8 | DBH Classes of Austin Trees by Small, Medium, Large Growth



Source: City of Austin Urban Forestry Program, 2008

09-20-13 DRAFT

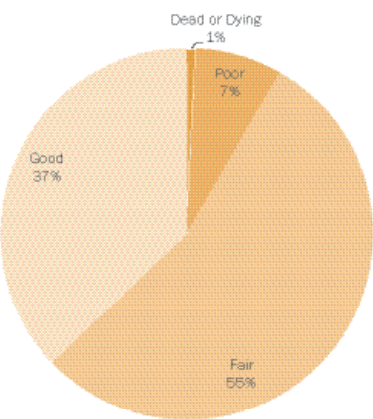
Tree Condition | Tree condition refers to the general health of a tree and provides insight into safety risks to the community and maintenance needs. By evaluating the condition of the urban forest we are then able to determine cost effective methods for improving and enhancing overall forest health and risk. Determining overall condition of tree structure (wood), functional (leaf) health, and assigning risk factor ratings can be accomplished by ground-level sight inspections. Austin trees are assessed and grouped into the following 4 categories of condition: good, fair, poor, and dead or dying. The following figures show the majority of structural (wood) health of trees is fair to poor whereas the majority of functional (leaf) health is good to fair.

Figure 2.9 | Structural (Wood) Condition by Percentage



Source: City of Austin Urban Forestry Program, 2008

Figure 2.10 | Functional (foliage) Condition by Percentage



Source: City of Austin Urban Forestry Program, 2008

Benefit-Cost of Austin's Public Trees

For every dollar spent on Austin's trees, the urban forest provides **\$9.87** in benefits back to the city. As a tree grows larger, it provides more benefits. This means, as a whole, the urban forest is one of the few components of public infrastructure that increases in value over time. This infrastructure, like all other more well known elements (e.g. water pipelines, roads, etc.), requires regular maintenance if it is expected to function at an acceptable level.

From this information, it was determined in 2008 that many trees, in poor health (Sugarberry, Chinaberry, Southern Live oak, Pecans, and Cedar elm), required priority removal in 2008. Southern Live Oaks and Cedar elms, in the street right-of-way, and Pecans, in parks, required high priority trimming. Though the trends initially point to Cedar elm and Southern Live oak being categorized as troublesome, these species also represent 15% and 12% of trees in the survey and therefore understandably exhibit these high numbers.

Tree Values and Benefits | Today, urban forests are increasingly considered an element of a much larger green infrastructure network providing benefits to people (Benepe, 2013, ImagineAustin, 2012; Young, 2011; American Planning Association [APA], 2009). Cities are increasingly suffering cut backs in state and federal funding coupled with lack of political leverage to raise taxes. Simultaneously, cities face increased demands for more and more projects (e.g. roadway repair, affordable housing, and expansion of public safety facilities) to meet the demands of population growth. Consequently, urban green infrastructure projects must compete for funding. Thus, the case for tree planting, care, and preservation campaigns, for example, must be made through quantitative arguments assigning dollar values to the benefits and costs associated with trees as green infrastructure elements. This translates to the economic language to which citizens and policy makers most immediately relate.

Focus Point | Calculating the Worth of Our Public Street Trees

Figure 2.11 displays the most recent cost-benefit analysis of Austin's public street trees. The financial values of these trees were calculated using i-Tree Street—a nationally-recognized software developed by the U.S. Forest Service. The software calculates costs and benefits of trees in dollar values according to species type, condition, size, and benefit prices (e.g. cost of electricity per kWh) according to local market conditions. Public park trees were omitted in this analysis because i-Tree Street only calculates cost-benefit statistics for street trees.

Chapter 2: State of Austin's Urban Forest

Figure 2.11 | Cost-Benefit of Public Street Trees

Benefits	Total \$ Value	\$ value/tree	\$ value/capita
Energy	1,318,664	8.47	1.78
CO2	308,729	1.98	0.42
Air Quality	147,872	0.95	0.20
Stormwater	2,948,331	18.93	3.99
Aesthetics	5,528,383	35.49	7.48
Total	10,251,979	65.82	13.87

Costs	Total \$ Value	\$ value/tree	\$ value/capita
Planting	25,314	0.16	0.03
Contract pruning	429,099	2.75	0.58
Pest mgmt.	0	0.00	0
Irrigation	125,816	0.81	0.17
Removal	183,899	1.18	0.25
Administration	69,634	0.45	0.09
Inspection/service	90,195	0.58	0.12
Infrastructure repair	0	0.00	0
litter clean up	114,916	0.74	0.16
liability/claims	0	0.00	0
Other costs	0	0.00	0
Total	1,038,873	6.67	1.40

Net Benefits	9,213,106	59.15	12.46
---------------------	------------------	--------------	--------------

Benefit-cost ratio

9.87

Source: City of Austin Urban Forestry Program, 2008

Green Infrastructure

ImagineAustin defines green infrastructure as “strategically planned and managed networks of natural lands, working landscapes and other open spaces that conserve ecosystem values and functions and provide associated benefits to human populations.”

Focus Point | Dead Wood

This refers to dead trees and limbs such as standing, yet no longer living, “snag” trees or downed logs. Although often regarded as an unattractive nuisance or threat to public health, dead wood serves an essential role in supporting wildlife and enhancing biologic processes. Birds, mammals, reptiles, amphibians, invertebrates, and various decomposers seek refuge in, on, or underneath dead wood. The presence of dead wood not only provides habitat but also facilitates the release of vital nutrients back into the urban forest ecosystem by increasing carbon in soils and capturing and retaining moisture. Dead wood is a prime example of an essential yet often overlooked benefit of the urban forest.



Log near Lady Bird Lake Trail

Chapter 2: State of Austin's Urban Forest

Green Infrastructure Elements

- Urban forest
- Urban trails
- Parks
- Greenways
- Greenbelts
- Preserves
- Natural areas
- Rivers
- Creeks
- Lakes
- Gardens
- Urban agricultural land
- Open spaces
- Wildlife habitats
- Stormwater features

Supporting Austin's Green Infrastructure

Snapshot of current planning efforts by the City of Austin to support green infrastructure.

ImagineAustin - Green Infrastructure Priority Program | To manage Austin's urban and natural ecosystems in a coordinated and sustainable manner.

Invasive Species Management Plan | A city-wide plan for the control and/or eradication of undesirable aquatic and terrestrial plant species.

Community Fire Mitigation Plan | This Plan will provide the framework for the County's efforts to become a Fire-Adapted Community, will aid regional communities in understanding wildfire risk, and will provide guidance for reducing that wildfire threat to avert potential catastrophic fires.

Climate Protection Plan | Established in 2007 it establishes five goals and associated objectives to achieve significant reductions in greenhouse gasses by 2020.

Green Roof Advisory Plan | A plan to support the growth of green roofs in Austin developed by the Council sponsored Green Roof Advisory Group.

Watershed Protection Management Plan | The Watershed Master Plan assesses erosion, flood and water quality problems in Austin. It also prioritizes and implements effective solutions that address all three problems. Solutions include projects, programs and regulations.

Travis County Colorado River Corridor Plan | The plan's goal is to provide orderly growth in the Corridor and help preserve and enhance the area's many valuable environmental, economic, recreational and cultural resources.

Chapter 2: State of Austin's Urban Forest

Major Urban Forest Pests

Fungal

Oak Wilt affects the red oak family rapidly, live oaks at intermediate speed, and white oaks less frequently and more slowly. Trees may contract oak wilt via nitidulid beetles or from another infected oak tree's subterranean roots if they graft together from close proximity. There is no treatment for oak wilt; it is a terminal condition.

Hypoxylon canker colonizes and decays sapwood in already-stressed trees. Oaks are usually targeted but other hardwoods are susceptible. This fungus usually presents a terminal situation for the trees that it infects.

Insect

Emerald Ash Borer (EAB) – This dime-sized insect is currently decimating ash tree populations across the United States. EAB will target stressed and weakened trees, laying eggs on the trunks. The hatched larvae will bore through the bark into the sapwood to feed until they reach adulthood and bore back through the bark and exit the tree. The larval feeding is what incurs the major damage and once a tree is infected it is usually too late to provide health care.

Nitidulid beetle – One of the major vectors (transporters) of the oak wilt fungus. The beetle will travel from tree to tree, spreading the lethal spores.

Vegetative

Chinaberry – Invasive tree from Asia. Dark green double-compound leaves. Grows more rapidly than most native trees, outcompeting them for sunlight and eventually shading native trees out altogether.

Glossy Japanese Privet (Ligustrum) – Invasive multi-stemmed evergreen tree/shrub native to southeast Asia. Leaves are glossy and waxy to the touch, 2-4 inches, and arranged in an opposite pattern. Grows more rapidly than most native trees and will outcompete them in most scenarios.

Chapter 2: State of Austin's Urban Forest

Mistletoe – Brittle evergreen plant that group colonizes on the exterior of tree bark. The plant will penetrate bark tissue and absorb water and nutrients in a parasitic fashion. Poisonous to humans.

Bacterial

Bacterial Leaf Scorch – *Xylella fastidiosa* is a bacterium known to cause scorch in tree leaf margins. Transmitted by insects that feed on sapwood fluids. Can cause tree stunting, the dying back of branches and death. Not to be mistaken for oak wilt, since the margin scorch can look similar in red oaks.

09-20-13 DRAFT

Chapter 2: State of Austin's Urban Forest

COMMUNITY FRAMEWORK

In a truly sustainable urban forest, all members of a community must cooperate to share the responsibility for natural resource management. Community framework is the fabric for which interested citizens as well as public, private, and nonprofit stakeholders work toward sustainable objectives.

This section covers the following indicators:

- General urban forest awareness
- Neighborhood action

General Urban Forest Awareness | Awareness is necessary and is the first step in community cooperation. Generally speaking, trees are seen as important to the Austin community and are acknowledged as beneficial providers of valuable services, but not without associated concerns. For instance, the 2012 Austin urban forest opinion poll, Tree Be-Leafs, found that participants valued trees most for their shade, environmental benefits, and aesthetics (City of Austin, Urban Forestry Program, 2012). On the other hand, citizens expressed power line interference and roots cracking sidewalks as the biggest tree-related concerns. Citizen concerns have and will continue to prioritize planning, implementation, and education efforts regarding our urban forest.

Neighborhood Action | Neighborhood action requires that citizens understand and participate in public urban forest management. Neighborhood organizations within and led by neighborhood initiatives should inform neighborhood plans that work in partnership with urban forestry standards. Although most Austin neighborhood plans include open space goals, they often lack explicit urban forestry goals. Nevertheless Austin has an active community involved in parks and natural areas throughout the city. The volunteer efforts of many community-based groups through tree planting initiatives and park cleanup or workdays show the community commitment to Austin's natural landscapes. Listed here are just a few examples of community-based tree-related organizations:

Chapter 2: State of Austin's Urban Forest

Community-Based Groups

- Barton Creek Greenbelt Guardians
- The Center for Environmental Research at Hornsby Bend
- American Youth Works - Texas Conservation Corps
- AmeriCorps
- Austin-Bastrop River Corridor Partnership
- Austin Parks Foundation
- The Trail Foundation
- TreeFolks
- Keep Austin Beautiful
- Hill Country Alliance
- Austin Tree Task Force
- Austin Heritage Tree Foundation
- Austin Chapter of the National Wildlife Federation Habitat Stewards
- Native Plant Society of Texas
- Capital Area Master Naturalists
- Travis County Master Gardeners
- Austin Neighborhoods Council
- Lady Bird Johnson Wildflower Center

Focus Point | TreeFolks

TreeFolks is a non-profit organization established in 1989 that grows the urban forest through tree planting, education, and community partnerships. They invite businesses, schools, government, citizen groups, and individuals to join them in creating a healthier environment and enhancing the quality of urban life. As a volunteer green planting organization, TreeFolks provides a valuable service to the Central Texas community. TreeFolks works closely with other groups to educate and involve citizens in tree planting and care. Since its inception, TreeFolks has planted 250,000 trees in the Austin and Central Texas area.

Chapter 2: State of Austin's Urban Forest

RESOURCE MANAGEMENT

This section describes the internal administrative and management resources available for sustainable management of Austin's urban forest. This not only pertains to physical resource management but also public and administrative perceptions of management itself. Resource management includes digital inventories, plans, funding, City staff, policies, etc.

This section covers the following indicators:

- Existing policies
- Urban forest establishment through tree planting programs
- Internal program resources

The creation and adoption of Austin's Urban Forest Plan seeks to guide overall citywide urban forest management such that policies and department operational plans conform to community visions. Ultimately, community visions inform local urban forestry policies that are embodied in our existing Imagine Austin comprehensive plan, City Code, and other policy documents.

Existing Policies | The following briefly details the major tree-related policies within the City of Austin in order to better understand how urban forestry resources are managed.

Several City policy documents guide tree protection, preservation, and care within Austin. These include the Land Development Code (e.g. § 6-3-6 Standards of Care for Trees or Plant on Public Property), and the Environmental Criteria Manual.

The City's Land Development Code serves to regulate land development by governing zoning, subdivision, and the site plan process within the City's planning and zoning jurisdiction—within the city limits and ETJ. Subchapter B of Chapter 25-8 (Heritage Tree Ordinance) in the Land Development Code outlines tree protection during the land development

Chapter 2: State of Austin's Urban Forest

process. Under this subchapter mature trees and heritage trees are protected from development destruction. Protected trees contain trunk diameters of at least 8 inches on commercial land and 19 inches on single family land when measured 4.5 feet above ground. Heritage trees contain trunk diameters of 24 inches or more when measured 4.5 feet above ground. Site plans must preserve protected trees on site in order to acquire building permits. Site plan approvals for development projects that require removal of protected trees require variances approved by the Land Use Commission or City Council.

The Environmental Criteria Manual is the City's guidebook for permitting. Section 3 (Tree and Natural Area Preservation) defines design criteria to achieve tree preservation goals derived from the Land Development Code. The section is extensive and, among other practices, outlines tree survey standards for developers to collect tree information in the site plan or permit approval application process. A ground survey of the proposed site requires collection of tree locations, trunk diameter measurements, and species type for protection.

Focus Point | Development and Tree Preservation

In 1983 the City Council adopted one of the most progressive Tree Ordinances in the country. The Tree and Natural Area Protection Code is based on the fundamental precepts of sound urban forest management; diversification, preservation, and replenishment. Proposed developments are reviewed to assure that a final product is achieved which results in a diversified and sustainable urban forest. City requirements are designed to achieve a balance of re-forestation and preservation, frequently emphasizing one of the two elements to achieve the best long-term benefit for the community. Trees 8 inches in diameter and larger are scrutinized for preservation potential, trees 19 inches and larger are classified as "protected sized trees" which receive enhanced evaluation for preservation. Austin-ites recognize that trees are valuable in economic, aesthetic, and environmental sustainability of the region.

Chapter 2: State of Austin's Urban Forest

Tree and Natural Area Preservation Ordinance | The Tree and Natural Area Preservation code is designed to assure that trees are an integral part of new development projects. Proposed development projects are evaluated on a case-by-case (and tree-by-tree) basis. The plan review process entails evaluating the existing tree resources on a site, understanding the dynamics of trees and development impacts, and negotiating a solution that results in a development with a balanced mixture young and mature trees, and a good diversity of species. Trees 8 inches in diameter and larger on a commercial sites (19 inches in diameter on a single family home sites) are evaluated for protection and replacement. The goal of each review is to assure that a final product is achieved which results in a diversified and sustainable urban forest. Existing trees are preserved when possible, additionally high quality native and adapted trees are required to be planted on development sites. Environmental Inspectors regulate the site during construction. More specifics on the City of Austin tree ordinance can be obtained within the Land Development Code (LDC) 25-8, Subchapter B.

Tree Planting Programs | Several tree planting groups, both public and nonprofit-based, guide new tree plantings in Austin. Austin Community Trees serves as a public partnership to plant trees with the ultimate goal of increasing canopy cover to cool Austin neighborhoods. In addition to ACT, PARD plants trees during the planting season (October-March) in parks, medians, and the ROW. Funding comes from Planting for the Future Fund and planting locations are chose based on neighborhood requests and a park planting prioritization analysis. Within PARD, the Urban Forestry Program plants approximately 500-1,000 trees annually. Areas that are planted are usually at the request of neighborhood associations with plantings conducted on Saturdays with the use of volunteers. The nonprofit TreeFolks promotes reforestation in Central Texas through a tree planting program called NeighborWoods delivering street trees on private residential land free of charge. The advantage of NeighborWoods lies in its partnership and reach across both public and private realms. The program works closely with PARD staff and is sponsored by the City's

Decker Indiangrass Management Plan

This management plan outlines a five year strategy to initiate the long term restoration of Blackland Prairie in Decker Tallgrass Prairie Preserve and Indiangrass Wildlife Sanctuary, located within Walter E. Long Metropolitan Park.

NeighborWoods

Through this program TreeFolks, a local non-profit organization, plants 3,600 trees a year along residential streets and sidewalks.

Climate Protection Program, Austin Energy, Apache, and Save Barton Creek Association. According to the TreeFolks website, they plant 10,000 trees annually totaling 250,000 trees in the Austin region to date.

Figure 2.12 shows (next page) the collaborative efforts of tree-related programs and responsibilities across City departments.

Parks and Recreation | The City's Parks and Recreation Department (PARD) primarily responds to tree issues in parks, preserves, and right-of-way (ROW) through the City's 311 call service. The department is responsible for over 2,000 miles of ROW and over 16,000 acres of park land according to the City's GIS datasets. The Urban Forestry Program exists within PARD as the primary entity for maintaining, preserving, removing, and planting trees growing on City parks and public property. Activities consist of removing low limbs over the ROW, clearing blind corners, removing and planting trees, and hauling woody debris from streets and parks. The Parks and Recreation Department also manages over __ acres of preserves, greenbelts, and natural areas.

Austin Energy | Austin Energy primarily responds to trees located in power line easements and near street lamps. Activities include pruning trees for electric utility line clearance and partnering with local nonprofits (e.g. TreeFolks) to plant new trees according to goals set in the City's Heat Island Initiative and Climate Protection Program. Austin Energy manages the vegetation under and around its 2,300 miles of overhead distribution and 500 miles of transmission lines. To accomplish this Austin Energy has instituted a program for the maintenance and management of the vegetation along the lines. Austin Energy's goal is to visit every mile of line once every four to five years to maintain the vegetation around the electric facilities.

Chapter 2: State of Austin's Urban Forest

Figure 2.12 | Tree-Related Responsibilities by City of Austin Departments

Planning & Development Review	Regulation	Planning	Planting	Maintenance	Education
1. Zoning	✓	✓			
2. Annexation	✓				
3. Environmental Inspection & Enforcement	✓	✓			
4. Landscape Inspection		✓	✓		
5. Comprehensive Planning		✓	✓		✓
6. GIS/Data Analysis	✓		✓		
7. City Arborist Program					
• Land Use & Environmental Review	✓	✓	✓	✓	✓
• Heritage Tree Ordinance	✓	✓		✓	
• General Permits	✓	✓		✓	
• Tree Ordinance	✓	✓	✓	✓	
• Hill Country Roadway Ordinance	✓	✓			
• Oak Wilt Program				✓	✓
• Urban forest Grant Program			✓	✓	✓
8. Urban Design					
• Great Streets	✓	✓	✓		
• TODs	✓	✓	✓		✓
• Small-Area Plans	✓	✓	✓		✓
9. Neighborhood Planning					
• Austin Community Trees		✓	✓		✓

Parks & Recreation	Regulation	Planning	Planting	Maintenance	Education
1. Memorial Dedication Tree Planting			✓		✓
2. Site Plan Review	✓	✓			
3. GIS/Data Analysis		✓	✓	✓	
4. Emergency response				✓	
5. Public Tree Care Permitting	✓			✓	
6. Tree City USA					✓
7. Adopt a Park Volunteer Agreements			✓	✓	
8. Community Gardens/Food Forests			✓		✓
9. Urban Forester					
• Preserves & Greenbelts		✓	✓	✓	✓
• Planting (Parks, ROW, and other public property)			✓		✓
• Maintenance (Parks, ROW, and other public property)				✓	
• Public & Private Partnerships		✓	✓	✓	✓
• Tree Inventory		✓	✓	✓	✓
• Park Planning		✓			
• Claims, Legal, & Appraisals	✓	✓			
• Urban Forestry Board Liaison	✓	✓			✓
10. Strategic & Operational Planning					
• Urban Forest Master Plan	✓	✓	✓		
• Site-specific Planning		✓	✓		
• Maintenance & Park And Trail Planning		✓	✓	✓	
11. Public Outreach & Education					
• Urban Forest Stewards					✓
• Leaf for a Leaf					✓
• Arbor Day					✓

Public Works	Regulation	Planning	Planting	Maintenance	Education
1. Capital Improvement Projects		✓			
2. ROW Maintenance	✓			✓	
3. Subdivision Infrastructure Construction		✓			
4. Road Improvements				✓	
5. Inspection				✓	
6. Sidewalk Easements	✓	✓			
7. Row & Alley: Debris Removal				✓	
8. Traffic Signs/Signals Clearance	✓			✓	
9. Neighborhood Partnering Program		✓	✓		✓

Watershed Protection	Regulation	Planning	Planting	Maintenance	Education
1. Stream Restoration					
2. Creek Maintenance (Field Operations)		✓	✓	✓	
3. Grow Green					✓
4. Flood Mitigation					
5. Watershed Protection Master Plan					
6. GIS/Data Analysis					
7. State of the Environment Report					
8. Riparian Zone Restoration Program					
9. Invasive Species Program		✓	✓	✓	
10. Integrated Pest Management (IPM)			✓	✓	

Key

- Regulation:** Program helps establish policies regulating some aspect of trees, e.g., protection, mitigation, placement, etc.
- Planning:** Program establishes strategic, long term, or comprehensive plans related to trees.
- Planting:** Program supports planting of trees, including organization & tree-distribution, watering for 2 years.

Chapter 2: State of Austin's Urban Forest

Austin Water	Regulation	Planning	Planting	Maintenance	Education
1. Dillo Dirt					
2. Wildland Conservation		✓		✓	✓
3. Water Conservation & Enforcement					
4. Water Quality Land Acquisition		✓			
5. Water Quality Protection Lands		✓	✓	✓	✓
6. Balcones Canyonland Preserve		✓	✓	✓	✓
7. Wildland Outreach			✓		✓
8. Fire Management Program		✓		✓	✓
9. Reclaimed Water					

Office of Sustainability	Regulation	Planning	Planting	Maintenance	Education
1. Sustainable Land Management					
2. Heat Island					
3. Neighborhoods					
4. Tree of the Year					
5. Green Alley (PW-CIP)					
6. Green Roofs Program					
7. Large Shade Tree Contract			✓		

Transportation	Regulation	Planning	Planting	Maintenance	Education
1. Long-Range Transportation Planning					
2. Parking					
3. Signs & Signals					
4. Traffic Engineers					
5. License Agreement	✓		✓	✓	

Austin Resource Recovery	Regulation	Planning	Planting	Maintenance	Education
1. Large Brush & Yard Trimmings Pick-Up					
2. Bulk Brush					
3. Christmas Tree Recycling					

Austin Energy	Regulation	Planning	Planting	Maintenance	Education
1. Green Building	✓	✓			✓
2. Power Line Clearance (AE)			✓	✓	✓

Fire	Regulation	Planning	Planting	Maintenance	Education
1. Wildland Fire Interface		✓		✓	✓
2. Development Review Support	✓	✓			

Corporate Purchasing	Regulation	Planning	Planting	Maintenance	Education
1. Tree-related Contracts & Services					

Office of Emergency Management	Regulation	Planning	Planting	Maintenance	Education
1. Ice Storms		✓			

Economic Growth & Redevelopment Services	Regulation	Planning	Planting	Maintenance	Education
· Downtown Redevelopment					

Law	Regulation	Planning	Planting	Maintenance	Education
1. Real Estate					

09-20-13 DRAFT

Maintenance: Program relates to City maintenance of trees, including inspection, pruning,, removal, long-term irrigation, etc.

Education: Program provides tree-related education and/or outreach to public.

Chapter 2: State of Austin's Urban Forest

Public Works | Responsibilities of the Public Works Department (Public Works) overlap PARD activities as most of their efforts relate to trees on ROW and transportation corridors. Public Works removes tree limbs causing obstructions of traffic signals, and removes debris from streets, alleys, and sidewalks.

Planning and Development Review | The Planning and Development Review Department (PDRD) integrates tree planting goals into the neighborhood planning process and by providing free trees through the Austin Community Tree (ACT) program. In addition, PDRD houses the City Arborist's Office responsible for issuing private tree permits on residential and commercial properties. The arborist's goals derive from the City's Land Development Code and Environmental Criteria Manual which guide tree protection, preservation, and design criteria.

Watershed Protection | The Watershed Protection Department (WPD) manages the urban forest in riparian areas with most efforts related to erosion problems on stream banks and trees growing on property overseen by the department. In conjunction with PDRD, the WPD works to improve riparian zones along creeks by establishing "no-mow/grow zones" along creek banks to improve erosion control, habitat, and water quality.

Austin Community Trees (ACT) serves to reduce the urban heat island effect by planting new trees on private property near streets and sidewalks. Eligible neighborhoods must have an adopted neighborhood plan, an established neighborhood contact team, and low tree canopy cover (below 40%) as defined by GIS analysis of the neighborhood. ACT program exists as a public partnership between the community who care for the trees, PDRD, PARD, and AE.

Image Placeholder

09-20-13 DRAFT

URBAN FORESTRY ONGOING CHALLENGES

In 2012, the Urban Forestry Board compiled the top three to four ongoing challenges that obstruct the City of Austin from achieving each vision component. Using the Urban Forestry Board's Retreat results as the ground work for this collaborative process, the working group crafted priority challenges for each of the six vision categories. The following lists these challenges.

1. CONTIGUOUS

- Lack of Integrated land classification and management of public lands
- Fragmented regional comprehensive planning/land classification
- Competing land use/urban development patterns

1. PROTECTED

- Insufficient resources to promote and enforce tree regulations
- Misperception of what a sustainable site is
- Insufficient mechanism to update standards and specifications for tree protection and sustainable site design.

2. HEALTHY ECOSYSTEM

- Lack of education and/or utilization of ecosystem-specific appropriate species
- Lack of comprehensive inventory
- Lack of coordinated effort to create a comprehensive locally and regional planting plan that supports diversity of age and species
- Lack of resources to accomplish the above things.

Chapter 2: State of Austin's Urban Forest

3. VALUED

- Lack of local government and public awareness and education of the benefits and value of the urban forest
- Inadequate methods for quantifying the ecosystem services and the financial benefits of the urban forest
- City government does not value trees as a public utility deserving of associated funds and regulations

4. THRIVING

- Biotic and abiotic stressors, i.e. invasive species, urban soil, and climate change
- Lack of financial resources for expanding the urban forest to optimal capacity
- Attrition of urban forest due to competing land uses and site design
- Lack of quantitative and qualitative information about the urban forest resource

5. CARED FOR

- Lack of resources prevents proactive urban forest maintenance
- Large size and complexity of City of Austin and ecosystem
- Lack of coordinated urban forest planning and management effort on a citywide scale
- Lack of education

Implementation



— Leaf the Tree
participant

09-20-13 DRAFT

3



SpeakUpAustin —
participant

Chapter 3 outlines implementation—the process of fulfilling goals and visions of the community. It involves policy measures to effect positive change within our urban forest. Our policies parallel the broad scope of this plan, as they are general and strategic, intending to change departmental urban forestry management.

IMPLEMENTATION GOALS

POLICY ELEMENTS

09-20-13 DRAFT

IMPLEMENTATION GOALS

Implementation is the first step in the transformation of public urban forest management. In order for a comprehensive plan to be effective and produce change implementation of the plan must spell out clear, measurable objectives. These objectives must be broad to accommodate the scope of the Plan, the strategic purpose (as opposed to a tactical purpose) of the plan. The success of the Plan will be measured in terms of the City's response to addressing the items laid out in the form of the Departmental Operational Plans and in making strides in advancing the Urban Forester functions. If implementation goals are met, there should be a marked change in the Performance Indicators, which, as a whole, can be considered a report card on the City's urban forest resource management.

GUIDELINES

Time Frame: The time frame for the Austin Urban Forest Plan (AUFPP) is 10 years. Ten years from when the Plan is adopted, a revised Comprehensive Urban Forest Plan will be created to reflect broad changes in the community that occur during that time.

Reporting: An annual State of the Urban Forest Report will be developed by the Urban Forester to report on the status and trend of the Performance Indicators as well as Departmental progress on developing Departmental Operational Plans to address the Policy Elements.

Public Input: Much of the public input received for Austin's Urban Forest Plan is tactical in nature. In many instances, specific geographic areas or management practices are mentioned. Because the AUFPP is a broad, strategic document that is not intended to spell out specific changes to operations performed by City Departments, much of the public input received for the AUFPP will be shared with City Departments and will be used to guide the development of Departmental Operational Plans.

Chapter 3: Implementation

IMPLEMENTATION STRATEGIES

Based on feedback from the community, Urban Forestry Board, and staff, these implementation strategies will be turned into goals for the Plan.

Overall strategies:

- City Departments to develop tactical Departmental Operational Plans based on the AUFP and addressing the Policy Elements
- Citywide follow-up items are implemented by the Urban Forester
- Improvement of Performance Indicators
- Mechanism established for interdepartmental coordination on urban forest decision-making
- City of Austin alignment with national standards or benchmarks for urban forest management, especially related to management structure and funding

GOALS

Austin Urban Forest Plan Implementation Goals

1) Performance Indicator

Overall, by 2023, the City of Austin improves its management of urban forest to a level of “Good” or higher based on Performance Indicators in the Comprehensive Urban Forest Plan.

2) Departmental Operational Plans

Every land-managing or land-regulating department has a draft Departmental Operational Plan based on the Comprehensive Urban Forest Plan and Action Matrix and is actively implementing within 18 months following adoption of the Comprehensive Urban Forest Plan

3) Austin Standard of Care

Austin-specific Standard of Care for Trees and Vegetation in place by 24 months following adoption of the Comprehensive Urban Forest Plan and provides common guidance and best management practices to all Departments.

4) Coordination

An interdepartmental tree work group coordinates on all operational and regulatory functions related to urban forest management and is overseen and coordinated by a single governing authority.

Chapter 3: Implementation

5) Benchmarks

City of Austin management structure and funding for urban forestry is well-documented and aligned with national standards and benchmarks.

Implementation Actions

1) Performance Indicator

1.1 By 18 months following adoption of the Comprehensive Urban Forest Plan, the urban forester will seek and utilize additional comprehensive public urban forest data collection and analysis, especially where known gaps exist, to improve data reliability and inform future updates to Performance Indicators. Data collection will include updated stakeholder input on urban forest topics.

1.2 The Urban Forester will report annually, starting 18 months following the adoption of the Comprehensive Urban Forest Plan, on the status of the Performance Indicators and will include additional information on trends or current urban forest issues. The information will be provided in the State of the Urban Forest Report.

1.3 The urban forester will recommend to departments urban forest data standards to improve citywide urban forest data management and analysis.

2) Departmental Operational Plans

2.1 The urban forester will oversee and provide staff support to Departments in their development of Departmental Operational Plans for urban forest management.

2.2 The urban forester will utilize the Departmental Operational Plan Action Matrix to facilitate the progress of Departmental implementation of the Comprehensive Urban Forest Plan

2.3 The urban forester will report once per year the Urban Forestry Board regarding Departmental progress toward implementing the Comprehensive Urban Forest Plan

Chapter 3: Implementation

3) Austin Standard of Care

3.1 By 12 months following adoption of the Comprehensive Urban Forest Plan, the urban forester will identify and compile all existing operational or regulatory items regarding urban forest management that guides or directs Departments. This information will identify areas for improvement as well as inconsistencies.

3.2 By 24 months following the adoption of the Comprehensive Urban Forest Plan, the urban forester will facilitate an interdepartmental working group to develop an Austin-specific Standard of Care for Trees and Plants on Public Property, adapted from the current SoC, to provide locally-relevant direction regarding public urban forest management.

3.3 The urban forester will brief the Urban Forestry Board regarding the updated SoC by 24 months following adoption of the Comprehensive Urban Forest Plan.

3.4 The urban forester will facilitate the incorporation of the SoC into City rules and ordinances utilizing City rule/ordinance change processes and rule/ordinance update projects.

3.5 The urban forester will educate citizens, developers, and community groups regarding the SoC to encourage its utilization on private property.

4) Coordination

4.1 Within 12 months after adoption of the Comprehensive Urban Forest Plan, the urban forester will facilitate an interdepartmental, multi-disciplinary work group comprised of City land management and land regulatory departments and establish a charter for the group. This group will coordinate urban forest policy changes and establish and update citywide Best Management Practices (BMP's) for urban forest management.

4.2 By 24 months following the adoption of the Comprehensive Urban Forest Plan and with information gathered by the urban forester and interdepartmental work teams, the City Manager will recommend changes based on recommendations from the interdepartmental group.

5) Benchmarks

5.1 By 18 months following the adoption of the Comprehensive Urban Forest Plan, the urban forester will compile detailed organizational structure and funding information from all City entities that manage the urban forest as well as from other municipalities comparable to Austin to establish and compare urban forest benchmarks. The urban forester will present this information to the Urban Forestry Board and the City Manager.

5.2 By 24 months following the adoption of the Comprehensive Urban Forest Plan The City Manager will review benchmark data regarding municipal urban forest management and recommend changes to organization structure and/or funding of urban forest management in Austin.

POLICY ELEMENTS

The Policy Elements are the guiding framework of Austin's Comprehensive Urban Forest Plan. Individual Policy Elements are seeds of change, which, collectively, provide an overall strategy for achieving the vision for Austin's urban forest. In conjunction with the other parts of this Plan they provide a comprehensive approach to urban forest planning and will ultimately guide the management of Austin's public urban forest resource. However, since the municipal functions that affect the urban forest, both directly and indirectly, are so varied and widespread across numerous City departments, each single Policy Element must be broad enough to encompass all of those functions. Accordingly, the tactical approach to addressing each Policy Element will be the responsibility of each City department, documented in a Departmental Operational Plan (DOP) developed in consideration of their mission(s), limitations and constraints, and opportunities.

Policy Element

categories were prioritized through the public participation process outlined in Appendix __. While the community felt that each category was important some issues needed a higher priority than others.

Chapter 3: Implementation

CITY STAFF INPUT

Interdepartmental staff provided feedback and edits to the Policy Elements prior to final editing by the Urban Forestry Board. The following departments provided feedback:

Parks and Recreation Department
Planning and Development Review Department
Austin Fire Department
Austin Water Utility
Watershed Protection Department
Austin Bergstrom International Airport
Office of Sustainability
Public Works Department
Austin Transportation Department

PUBLIC INPUT

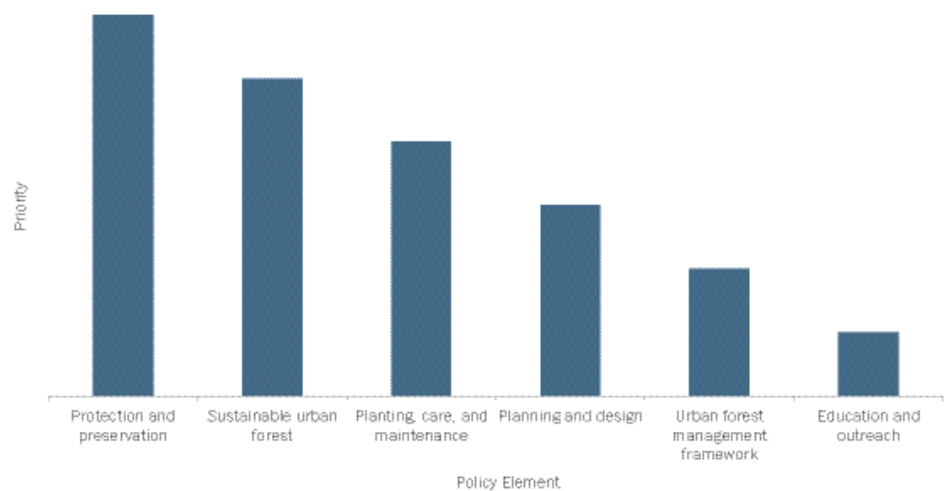
Public input was sought in determining which topical categories are most important for the Austin community. The order in which the Policy Element Categories will appear indicates the order of importance to the Austin community based on the input collected. City departments should note which Categories are most important to the community and prioritize those in the course of implementing the Departmental Operational Plans (DOP's). With guidance and support from the Urban Forester, each City department the interfaces with the urban forest will be required to report on their annual progress in addressing each Policy Element.

Community Voice

TBA

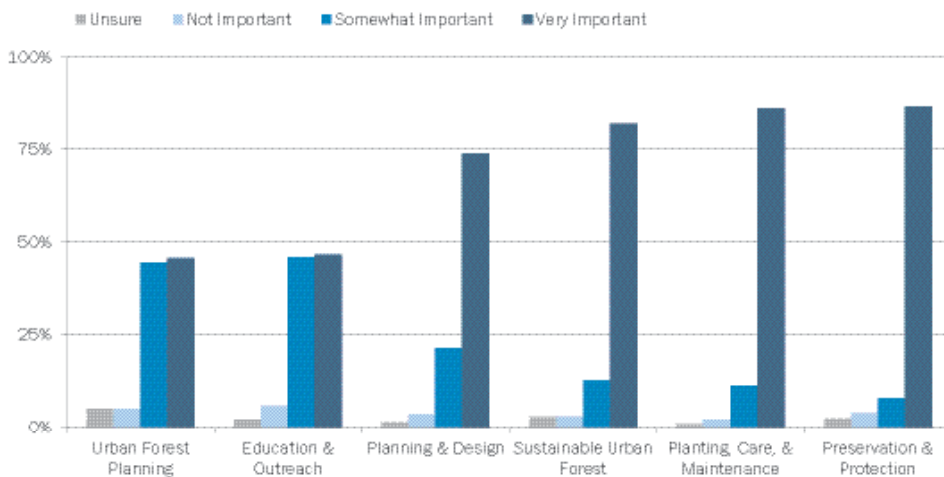


Figure 3.1 | Citizen Prioritization of Urban Forestry Policy Elements



Source: City of Austin, Urban Forestry Program

Figure 3.2 | What Urban Forest Management Items are Important to Fund?



Source: City of Austin, Urban Forestry Program

When it comes to urban forest management, citizen responses are mixed in regards to policy element prioritization versus funding as shown in the figures above. Preservation and protection is clearly a priority which should be given the most funding.

Chapter 3: Implementation

The Policy Element “Test” | Policy Elements are grouped into categories based on their urban forest topical category. The following questions were considered in determining the relevance and appropriateness of including each Policy Element:

- Does this policy element support the CUFPP vision?
- Does this policy element support the guiding principles?
- Is this policy element pertinent to public trees and vegetation?
- Is this policy element comprehensive?
- Does this policy element say “what” and not “how”?
- Is this policy element strategic and not tactical or operational?
- Will this policy element be relevant for the next 10-20 years?

THE POLICY ELEMENT CATEGORIES (Prioritized from public input)

PROTECTION AND PRESERVATION
SUSTAINABLE URBAN FOREST
PLANTING, CARE, AND MAINTENANCE
URBAN FOREST MANAGEMENT FRAMEWORK
PLANNING AND DESIGN
EDUCATION AND OUTREACH

“Preserve trees from development. Consider them green infrastructure.”



— *Leaf the Tree* participant

PROTECTION AND PRESERVATION

Policies related to preservation of public urban forest resources through regulation and other approaches that enhance preservation.

PR-1 Comprehensive Regulatory Approaches

In consideration of differing land uses and characteristics, develop and implement regulatory approaches in a manner that provides flexibility in the preservation of the urban forest. Examine regulations to identify and modify disincentives for urban forest preservation.

PR-2 Protection of Trees During and After Development

Evaluate and enhance current policies for public urban forest protection during and after development to promote the long-term health and

survival of trees and vegetation retained during development.

PR-3 Protect Steep Slopes

Increase retention of existing trees and vegetation that help stabilize steep slope areas in order to increase public safety, maintain slope stability, decrease soil erosion, and retain environmental function and natural character.

PR-4 Partnerships

Partner with federal, state, regional, and local governmental jurisdictions, community non-profit organizations, other City departments, the private sector and others to increase preservation and protection of the urban forest.

PR-5 View Obstructions

Establish incentives, regulations and education efforts to reduce conflicts between public and private interest and prioritize the urban forest in decisions regarding eliminating scenic or commercial view obstructions, except with regard to public safety or in established view corridors.

PR-6 Vegetation Valuation

Support and update tree valuation methods to closely reflect the complete functional value of vegetation for use when assessing fines, determining damages or estimating loss.

PR-7 Recovering Vegetation Value

When preservation of trees and vegetation is not feasible, require the complete replacement of the functional value of the resource and mitigate as close in proximity to the loss and as soon as possible.

PR-8 Prominent Rare Urban Forest Elements

Provide additional protection for prominent, sensitive, native, and/or rare urban forest elements during and after development. Protect trees based on species type/habitats.

Community Voices



“Save Our Big Trees.”

Community Voices



“Manage fire risk...
create a defensible
space.”

Plant adequate tree
species for areas
and obtain trees
from local nurseries.”

“Protect trees,
wildlife, vegetation
and creeks in
riparian areas.”

SUSTAINABLE URBAN FOREST

Sustainable Urban Forest policies are related to sustainability of the urban forest resource itself and the resources related to its management, such as water (and city assets).

S-1 Species, Age, and Geographic Diversity

Increase species diversity, a regionally-appropriate mix of vegetation, mixed-age populations and a varied distribution of species throughout the City to protect and improve the vigor and the resilience of our urban forest. Align urban forest composition with consideration of predicted climate patterns.

S-2 Urban Wood Utilization

Recycle green waste generated by urban forest maintenance and encourage the highest and best sustainable uses of removed trees and woody material, including reuse on site. Strive for 100% green waste recycling or reuse.

S-3 Integrated Pest Management

Incorporate Integrated Pest Management principles into land management practices.

S-4 Wildlife Habitat

Enhance wildlife habitat to the maximum extent based on site use through urban forestry policies, design and management practices.

S-5 Wildfire Risk

Achieve a balance between community desires for wildfire risk reduction and responsible vegetation management especially within the Wildland Urban Interface

S-6 Invasive Species Management

Identify and suppress non-native invasive species. Provide public education about the detriment of non-native invasive species to the urban forest particularly when related to other management policies.

Chapter 3: Implementation

S-7 Water Conservation

Minimize the need for supplemental irrigation of public trees and vegetation during design and maintenance planning. When utilizing water for supplemental irrigation of public trees and vegetation, maximize the use of non-potable sources (e.g., stormwater, reclaimed water) and adopt practices that conserve potable sources.

S-8 Urban Forest Pests

Using the principles and practices of Integrated Pest Management, identify, plan for, and respond to critical urban forest pests to reduce their impact on the community's urban forest.

S-9 Partnership

Partner with federal, state, regional, and local governmental jurisdictions, community non-profit organizations, the private sector and others to accomplish the sustainability goals of Austin's urban forest ecosystem.

PLANTING, CARE, AND MAINTENANCE

Planting, care and maintenance policies are related to the consideration of existing public urban forest resources and proactive planning for sustainable future urban forest resources, understanding inherent conflict between active site use and healthy forests.

PCM-1 Planting Priorities

Prioritize tree planting and landscaping on public property particularly in highly visible locations such as business districts and major corridors to maximize environmental, social and economic benefits. Avoid and/or minimize conflicts with existing public infrastructure.

PCM-2 Species Selection

Encourage the selection of appropriate native species based on project, location, site conditions, and potential future changes in climate patterns.

PCM-3 Urban Forest Planting and Maintenance Plan and Program

Establish and maintain a strategic planting and maintenance program based on national standards and best management practices. Prioritize the long-term survival of the urban forest through proactive maintenance to reduce resources expended on reactive or emergency response, to maximize urban forest benefits, and reduce urban forest mortality.

Community Voices



“Manage fire risk with a complete fire wise program that starts with education then hardens the home and finally, creates a defensible space - don't remove trees for fire risk.”

“Plant trees by bicycle paths.”

“Help preserve trees through oak wilt prevention.”

“Create a comprehensive watering and drought management plan to keep trees healthy.”

“Plant adequate tree species for areas.”

Community Voices



“Provide a canopy goal for different areas (residential, commercial, preserves) and a plan and timeline on how to obtain that.”

“Plant shade trees in public cemeteries, including large species and throughout the cemetery, not just crepe myrtles around the perimeter.”

“Preserve trees from development. Consider them green infrastructure - do not remove street trees so easily for developers to install a driveway.”

PCM-4 Planting Stock

Utilize high-quality planting stock originating from Central Texas region seed-sources and grown in nurseries that simulate Central Texas growing conditions.

PCM-5 Tree Canopy Cover

Identify canopy goals according to site and ecosystem capacity and develop a plan to achieve them.

PCM-6 Landscape Maintenance Management Plans

Ensure that trees and vegetation are properly cared for and survive, both during the plant establishment period and in perpetuity through such means as landscape management plans, maintenance agreements, and/or monitoring.

PCM-7 Partnerships

Partner with federal, state, regional, and local governmental jurisdictions, community non-profit organizations, City of Austin departments, the private sector and others to increase the replenishment, maintenance and care of Austin’s urban forest.

PCM-8 Public Safety

Take reasonable measures to reduce risk of urban forest elements that impact public health and safety.

URBAN FOREST MANAGEMENT FRAMEWORK

Policies related to City organizational structure and staffing levels, staff qualifications, involvement of City forestry staff in other City disciplines and functions, and funding for urban forest programs and efforts.

UF-1 Management Priorities

Evaluate and document the ecosystem services and benefits of the urban forest and consider the value of those services and benefits when seeking a balance between multiple and potentially competing needs of the environment, utilities and infrastructure, safety, the rights of property owners, budget priorities, and the desires of the public.

UF-2 Resource Needs

Ensure adequate resources are dedicated to the management of Austin’s urban forest and its ecosystem functions to support the City’s vision for its urban forest. Identify and quantify gaps in urban forest management

Chapter 3: Implementation

funding compared with national benchmarks and incorporate those needs in the Departmental budgeting process.

UF-3 Urban Forestry Funding Allocation

Allocate an appropriate proportion of funding for urban forest management.

UF-4 Funding Sources for Maintenance

Utilize existing or develop new funding sources such as assessment districts, user fees, fund raising, donations, grants, tax benefit financing, and/or an urban forest utility fee to fund urban forest management.

UF-5 Departmental Urban Forest Management Plan

Create a Departmental Operational Plan (DOP) for departmental urban forest management, consisting of an analysis of existing conditions and regulatory framework, desired future conditions, and a work plan based on the DOP Action Matrix. Update the DOP to reflect changing policies and regulations, standards of care, best management practices, and accomplishments.

UF-6 Standards of Care for Trees and Plants

Incorporate City of Austin Standards of Care for Trees and Plants into Departmental Operational Plans. Regularly contribute recommendations to City of Austin's Standards of Care for Trees and Plants revisions, coordinated by the Urban Forester, according to the best available science and current best management practices, accepted standards and guidelines to support the DOP.

UF-7 Coordination of Efforts and Partnerships

Develop partnerships between other City departments and coordinate with federal, state, regional and local governmental jurisdictions, local community non-profits and the private sector, to preserve, restore, manage, and design our urban forest.

UF-8 Staff Qualifications & Training

For all staff engaged in urban forest management, care and maintenance, employ qualified individuals and provide regular training to maintain qualifications up to and above -recognized standards and best practices and ensure that decisions are being made and maintenance is being performed according to City of Austin Standards of Care and industry best practices.

Community Voices



“Invest in maintenance of public trees.”

“Develop standards for snags.”

“Establish standards for tree care that are based on scientific principles and applied uniformly.”

“Develop standards for soil aeration.”

Chapter 3: Implementation

Community Voices



“Safety, reclaimed water, and planting.”

“Safety is most important, then keeping trees.”

UF-9 Contracts

When out-sourcing tree care and maintenance, retain contractors that have demonstrated qualifications to perform urban forest management according to City of Austin Standards of Care and industry best practices. Incorporate such standards and best practices into contract specifications.

UF-10 Urban Forester Support

Provide support to the Urban Forester and other departments to meet mandated directives assigned to the Urban Forester.

UF-11 Data Collection and Management

Collect data regarding Austin’s urban forest, such as quantity of canopy cover, forest condition and diversity of species, to support the creation of Departmental Operational Plans (DOP) and inform urban forest management decisions. Collaborate with federal, state, regional, and local governmental jurisdictions, community non-profits, and the private sector to collect and manage data.

UF-12 Urban Forest Risk Management

Consider and incorporate urban forest risk into city functions related to emergency management planning.

UF-13: Land Classification

Develop and adopt a common land classification system for properties owned/managed by the City. The classification system will provide the framework for development of class-specific Standards of Care for Trees and Vegetation.

UF-14: Regulatory Review

Identify and modify City regulations that are conflict with or otherwise hinder achievement of the vision for the urban forest. Where possible, work with intra and inter-departmental partners and external stakeholders to better align the City regulations with the City’s urban forest vision.

PLANNING AND DESIGN

Policies related to the consideration of existing public urban forest resources and planning for sustainable future urban forest resources on a site level scale.

Chapter 3: Implementation

PD-1 City Design Coordination

Establish coordination among City departments and utility providers when planning and designing public projects that include landscaping, urban forest protection, planting, supplemental irrigation, maintenance, and urban forest impacts.

PD-2 Infrastructure Design

Design streets, sidewalks, utilities and other infrastructure with a thorough consideration of existing and proposed vegetation, site use, and standards of care during the planning, design and construction processes.

PD-3 Soil Quality

Encourage retention and use of native soils for areas in new developments. Where native soils and growing conditions are not sufficient or optimal encourage use of soils engineered to be supportive of long-term urban forest health and provide a sustainable growing environment for the urban forest.

PD-4 Soil Volume

Increase the dedicated airspace and root volume available for urban forest elements to account for long-term desired growth and to assist with achieving the canopy coverage and maintenance goals.

PD-5 Reduce Soil Compaction

Avoid the compaction of soils and encourage soil protection and enhancement during and after development to increase or maintain infiltration of stormwater on-site and reduce run-off. Design for site uses that minimize soil compaction in critical areas.

PD-6 Landscaping and Stormwater Management

Align the City's landscape regulations and specifications with the integration of landscaping elements and low impact development stormwater management approaches. Incentivize use of techniques that can effectively achieve multiple urban forestry and stormwater management objectives. Some examples include native vegetation preservation, native soil retention and soil amendment, stormwater dispersion and bio-engineering.

PD-7 Partnerships

Partner with federal, state, regional and local governmental jurisdictions, community non-profit organizations, the private sector and others to

Community Voices



“Don’t allow cars, etc... to park under trees in parks, green belt entrances, etc...”

Community Voices



“Preserve trees
along right of ways.”

enhance the planning and design of public and private development and improvements in Austin.

PD-8 Planning Infrastructure Maintenance

Consider the needs and benefits of Austin’s urban forest in conjunction with other infrastructure systems when planning for the long-term maintenance of infrastructure and utilities.

PD-9 Tailored Incentives

Develop incentives, programs and/or regulations that are tailored to the needs and characteristics of differing land uses.

PD-10 Urban Forest and Transportation

Utilize or enhance urban forest elements in transportation designs to improve flow and safety of traffic and encourage alternative transportation.

PD-11 Designing for Human Health

Establish or retain urban forest elements during planning and design to maximize physical and mental human health as well as social health benefits

PD-12 Design with Maintenance in Mind

Incorporate pre-planning site assessments and design vegetation plans with consideration for long-term maintenance and resource use. Design for minimal long-term maintenance and resource use while still meeting site use goals.

EDUCATION AND OUTREACH

Policies related to public education, outreach, stewardship, and training of citizens, private entities, and non-profit organizations for urban forest promotion to achieve the vision for the urban forest.

EO-1 Education

Provide appropriate resources (e.g., staff, technical, and educational materials) to communicate with the public about the vision, goals, objectives, policies, incentives, standards, and regulations related to the management of Austin’s urban forest. Increase awareness of urban forest ecosystem issues and support citywide urban forest education efforts.

Chapter 3: Implementation

EO-2 Promote Stewardship

Develop capacity programming that leverages the commitment of citizen volunteers to engage in stewardship of Austin's urban forest.

EO-3 Incentives

Develop voluntary and incentive-based programs to build broader community support for the urban forest.

EO-4 Partnerships

Partner with federal, state, regional, and local governmental jurisdictions, community non-profit organizations, the private sector and others in education and outreach efforts to improve collaboration, leverage resources, and ensure consistent messaging.

EO-5 Records and Information

Collect and make available urban forestry information to the public.

EO-6 Education of Urban Forest Service Providers

Ensure that private urban forest service providers, individuals that wish to provide professional urban forest maintenance services and others whose work may impact the urban forest are educated about Austin's policies, regulations, and Standards of Care.

EO-7 Public Demonstration Projects

Develop and support publicly accessible pilot projects that demonstrate sound urban forest management. Document and implement effective strategies.

Community Voices



“Tree all non-profits
that are PARD
partners equally to
get more community
support.”

09-20-13 DRAFT

Glossary

Abiotic – nonliving (ISA, 2013)

Age structure - the abundance of individual trees in a population according to their age.

Biotic – “pertaining to living organisms” (ISA, 2013).

Community framework - Community framework is the fabric for which interested citizens as well as public, private, and nonprofit stakeholders work toward sustainable objectives.

Critical root zone (CRZ) – “area of soil around a tree where the minimum amount of roots considered critical to the structural stability or health of the tree are located” (ISA). “A CRZ is assigned to each tree, based on trunk diameter size. In Austin, a minimum of 50% of the CRZ is required to be left undisturbed by development to achieve minimal conformance with City Code regulations. The formula for calculating CRZ is Tree diameter in inches X 2, then convert to feet = CRZ diameter” (City of Austin, PDRD, 2013).

Dead or dying condition – “Majority of dead limbs and scaffold. Canopy nearly or completely dead. Restrictions to the site likely to cause failure or death of the tree. Tree may already be compromised” (ArborPro, Inc., 2008).

Dead wood – dead branches or other wood from a tree.

Deciduous - trees shed their leaves annually during the cold season. They typically exhibit broadleaf leaves that are flat and thin as opposed to needle-like or scale-like leaves. Examples of deciduous trees include oak, ash, and pecan trees.

Diameter at breast height (DBH) – The diameter of a tree measured at 4.5 feet above ground in the United States (ISA, 2013).

Glossary

Ecoregion - “areas of general similarity in ecosystems and in the type, quality, and quantity of environmental resources. They are designed to serve as a spatial framework for the research, assessment, management, and monitoring of ecosystems and ecosystem components. These general purpose regions are critical for structuring and implementing ecosystem management strategies across federal agencies, state agencies, and nongovernment organizations that are responsible for different types of resources within the same geographical areas” (EPA, 2010).

Escarpment - a steep slope or cliff resulting from a fault.

Fair condition – “Decent branch placement, less than ideal scaffold spacing, some co-dominance present, past pruning less than ideal but possibly correctable. Canopy relatively thin, foliage chlorotic, vigor and shoot elongation below norm for species, minor pests or possibility of infestation. Some restriction imposed by deficiencies such as proximity to competing species, proximity to sidewalks, grade changes, poor irrigation, overhanging adjacent trees” (ArborPro, Inc., 2008).

Fault zone – an area in which the earth fractures forming a geologic fault.

Genus - taxonomic group, composed of species having similar fundamental traits. Botanical classification under the family level and above the specific epithet (i.e., species) level (ISA, 2013).

Good condition – “Good to Excellent branch placement, lack of uncorrectable co-dominant leaders, good pruning history. Canopy generally full and balanced, good foliage color, vigor and shoot elongation typical of species, lack of visible or uncontrollable pests. Conditions ideal to favorable for full development to species potential, sufficient room for canopy and root growth, irrigation and soils exist to sustain development” (ArborPro, Inc., 2008).

Glossary

Green infrastructure - “strategically planned and managed networks of natural lands, working landscapes and other open spaces that conserve ecosystem values and functions and provide associated benefits to human populations” (ImagineAustin, 2012).

Greenbelt – a land use designation for a linear area that prevents urban development and ensures natural growth within its boundary.

Heritage tree – “a tree that has a diameter of 24 inches or more, measured 4.5 feet above natural grade, and is one of the following species: Texas ash, Bald cypress, American elm, Cedar elm, Texas madrone, Bigtooth maple, all Oaks, Pecan, Arizona walnut, or Eastern black walnut” (City of Austin Code, § 25-8-602).

Invasive species - non-native organisms likely to spread, disrupting the natural balance of an ecosystem (ISA, 2013).

i-Tree Eco – “i-Tree Eco is a software application designed to use field data from complete inventories or randomly located plots throughout a community along with local hourly air pollution and meteorological data to quantify urban forest structure, environmental effects, and value to communities” (USDA, U.S. Forest Service, 2013).

i-Tree Street – “an analysis tool for urban forest managers that uses tree inventory data to quantify the dollar value of annual environmental and aesthetic benefits: energy conservation, air quality improvement, CO2 reduction, stormwater control, and property value increase” (USDA, U.S. Forest Service, 2013).

Nature preserve – “Preserve land is a unique type of park land that is set aside because it provides essential endangered species habitat, includes a unique natural feature such as a cave or stream, or provides a prime example of a specific type of ecosystem” (City of Austin, PARD, 2013).

Glossary

Ordinance – a local law enacted by an authoritative municipality.

Performance indicator – a measurement of sustainable urban forestry management success as first explained by Kenney et al. (2011). Each indicator contains associated criteria and objective. Performance indicators rank levels of City performance: low (1), moderate (2), good (3), and optimal (4).

Poor condition – “Inferior branch placement, crowded scaffold, co-dominance likely, correction or mitigation necessary and likely extensive, restructuring needed to repair past pruning practices. Canopy sparse, dead twigs, stunted or absent new growth, declining number of growing points, pest presence visible or likely. One or more restrictions severe enough to hamper the ability of the tree to develop fully as listed above. Recent changes to the site may manifest themselves symptomatically in the future” (ArborPro, Inc., 2008).

Prairie – a type of grassland ecosystem containing grasses and shrubs as the main vegetation types and exhibiting a limited amount of annual rainfall.

Protected tree – “a tree with a diameter of 19 inches or more, measured 4.5 feet above natural grade” (City of Austin Code, § 25-8-602).

Public property – “means real property owned or controlled by the city with unrestricted public access, excluding a utility or drainage easement on private property” (City of Austin Ordinance 1983-0324-N).

Public right-of-way – an area of land owned and maintained by the City. It consists of the street surface, sidewalks, and grassy areas between the street pavement and a property boundary. In Austin, it is usually defined as the roadway plus 10 feet behind the curb (City of Austin, Transportation Department, 2013).

Glossary

Public tree – “a tree with at least two-thirds of its trunk diameter on public property” (City of Austin Code, § 6-3-1).

Resource management – internal administrative and management resources available for sustainable urban forestry management.

Savanna – a type of grassland ecosystem characterized by seasonal water availability and scattered trees.

Snag tree – a type of coarse woody debris that is standing, dead or dying.

Species – “taxonomic group of organisms composed of individuals of the same genus that can reproduce among themselves and have similar offspring” (ISA, 2013).

Sustainability - the ability to maintain ecological, social, and economic benefits over time (ISA, 2013).

Transit corridor – major streets with significant population density, mix of uses, and transit facilities, within close proximity, to encourage and support transit use. 16 arterial streets were selected for Austin’s 2008 tree inventory (ArborPro, Inc., 2008).

Tree canopy - collective branches and foliage of a tree or group of trees’ crowns. Aggregate or collective tree crowns (ISA, 2013).

Tree condition - the general health of a tree related to both foliage and structure.

Tree inventory - record of trees within a designated area that provides specified identification and condition information to be used for management decisions and actions (ISA, 2013).

Glossary

Urban forest - “The aggregate of all community vegetation and green spaces that provide a myriad of environmental, health, and economic benefits for a community” (Sustainable Urban Forests Coalition, 2013).

Urban forester – “an individual trained in or practicing urban forestry” (ISA, 2013).

Urban forestry – “management of naturally occurring and planted trees and associated plants in urban areas” (ISA, 2013).

Urban heat island – (built up areas that are hotter than nearby rural areas. The annual mean air temperature of a city with 1 million people or more can be 1.8–5.4 °F (1–3 °C) warmer than its surroundings. In the evening, the difference can be as high as 22 °F (12 °C)” (EPA, 2013).

Vegetative resource - The physical components of an urban forest related to vegetative growth.

Wind rose – “A wind rose gives a very succinct but information-laden view of how wind speed and direction are typically distributed at a particular location” (USDA, 2013).

Bibliography

09-20-13 DRAFT

Bibliography

Akbari, H. and S. Konopacki. (2005). Calculating energy-saving potentials of heat-island reduction strategies. *Energy Policy* 33(6):721-756.

Akbari, H., Pomerantz, M., & Taha, H. (2001). Cool surfaces and shade trees to reduce energy use and improve air quality in urban areas. *Solar Energy*, 70(3), 295-310.
DOI: 10.1016/S0038-092X(00)00089-X

American Planning Association. (2009). Planning the urban forest: Ecology, economy, and community development (Report No. 555) (J. Schwab, Editor). Chicago, IL.

American Forests. (1996). *Urban ecological analysis for Austin, Baltimore, Milwaukee*. Washington DC.

Anderson, L., & Cordell, H. (1988). Influence of trees on residential property values in Athens, Georgia: A survey based on actual sales prices. *Landscape and Urban Planning*, 15, 152-164.
DOI: 10.1016/0169-2046(88)90023-0

ArborPro, Inc. City of Austin, Urban Forestry Program. (2008). Urban forest inventory report for the transit corridors and parks City of Austin, Texas. Retrieved from City of Austin, Urban Forestry Program website: <http://austintexas.gov/sites/default/files/files/Parks/Forestry/austinufr2008.pdf>

Beattie, J., C. Kollin, & Moll, G. (2000). Trees tackle clean water regs. *American Forests*, 106(2), 18.

Bell, J. F., J.S. Wilson, and G.C. Liu. 2008. Neighborhood greenness and 2-Year changes in body mass index of children and youth. *American Journal of Preventive Medicine* 35(6):547-553.

Bibliography

Benepe, A. (2013, April 18). Green infrastructure as parks: How need, design, and technology can make cities better [Commentary Retrieved April 23, 2013, from Sustainable Cities Collective website: http://sustainablecitiescollective.com/nature-cities/143601/parks-green-infrastructure-green-infrastructure-parks-how-need-design-and-techn?utm_source=feedburner

Bryce, S.A., Omernik, J.M., and Larsen, D.P. (1999). Ecoregions - a geographic framework to guide risk characterization and ecosystem management: *Environmental Practice*, v. 1, no. 3, p. 141-155.

Cappiella, K., Schueler, T., & Wright, T. (2005). Urban watershed forestry manual: Methods for increasing forest cover in a watershed (Technical Report No. NA-TP-04-05). USDA Forest Service, Northeastern Area.

City of Austin. The Code of the City of Austin, Texas. Available from City of Austin, Office of the City Clerk website via American Legal Publishing Corporation: [http://www.amlegal.com/nxt/gateway.dll/Texas/austin/title25landdevelopment?f=t
emplates\\$fn=default.htm\\$3.0\\$vid=amlegal:austin_tx](http://www.amlegal.com/nxt/gateway.dll/Texas/austin/title25landdevelopment?f=templates$fn=default.htm$3.0$vid=amlegal:austin_tx)

City of Austin, Watershed Protection Department. (2013). *Central Texas invasive plants volunteer field guide*. Retrieved from City of Austin, Watershed Protection Department website: http://austintexas.gov/sites/default/files/files/Watershed/invasive/2013_Invasives_guide_small.pdf

City of Austin, Parks and Recreation Department. (2013). *Nature preserves*. Retrieved from City of Austin, PARD website: <http://austintexas.gov/department/nature-preserves-0>

Bibliography

City of Austin, Parks and Recreation Department. (2013). *Austin Parks and Recreation Department: Parkland inventory*. Retrieved from City of Austin, Parks and Recreation Department website: http://www.austintexas.gov/sites/default/files/files/Parks/GIS/Inventory/Austin_PARD_Has_2013.pdf

City of Austin, Planning and Development Review Department. (2013). Tree and natural area preservation: The critical root zone. Retrieved from City of Austin, PDRD website: <http://www.austintexas.gov/page/tree-natural-area-preservation-codes>

City of Austin, Transportation Department. (2013). Right of way management. Retrieved from City of Austin, Transportation Department website: <http://austintexas.gov/department/right-of-way-management>

City of Austin. (2012). *Imagine Austin comprehensive plan: Vibrant, livable, connected*. Retrieved from City of Austin, ImagineAustin Download Center website: ftp://ftp.ci.austin.tx.us/npzd/ustingo/web_IACP_full_reduced.pdf

City of Austin, Urban Forestry Program. (2012). Tree Be-Leafs: An urban forest opinion poll.

City of Austin. (2011). Community inventory report: Natural environment. *ImagineAustin*. (Draft). Retrieved from City of Austin, ImagineAustin Download Center website: <ftp://ftp.ci.austin.tx.us/npzd/compplan/inventory-naturalenvironment.htm>

Clymer Meadow Preserve website. (2013). Retrieved July 11, 2013, from: <http://www.nature.org/ourinitiatives/regions/northamerica/unitedstates/texas/placesweprotect/clymer-meadow-preserve.xml>

Bibliography

Crownover, J. (1991). Canopy cover analysis: City of Austin, Texas.

Donovan, G., & Butry, D. (2011). The effect of urban trees on the rental price of single-family homes in Portland, Oregon. *Urban Forestry and Urban Greening*, 10(3): 163-168. DOI: 10.1016/j.ufug.2011.05.007

Donovan, G., & Butry, D. (2010). Trees in the city: Valuing street trees in Portland, Oregon. *Landscape and Urban Planning*, 94: 77-83. DOI: 10.1016/j.landurbplan.2009.07.019

Donovan, G., & Prestemon, J. (2010). The effect of trees on crime in Portland, Oregon. *Environment and Behavior*, 44(1), 3-30. DOI: 10.1177/0013916510383238

Donovan, Geoffrey, H., & David Butry. (2009). The value of shade: Estimating the effect of urban trees on summertime electricity use. *Energy and Buildings*. 41(6): 662-668.

Environmental Protection Agency. (2013). Heat island effect. Retrieved from EPA website <http://www.epa.gov/hiri/>

Environmental Protection Agency. (2010). Level IV Ecoregions of Texas Metadata. Retrieved from EPA website: ftp://ftp.epa.gov/wed/ecoregions/tx/tx_eco.html

Fernandez-Juricic, E. (2000). Avifaunal use of wooded streets in an urban landscape. *Conservation Biology* 14(2): 513-521.

Griffith, G.E., Bryce, S.A., Omernik, J.M., Comstock, J.A., Rogers, A.C., Harrison, B., Hatch, S.L., and Bezanson, D. (2004). *Ecoregions of Texas* (color poster with map, descriptive text, and photographs): Reston, Virginia, U.S. Geological Survey (map scale 1:2,500,000).

Bibliography

Halley, S. (2011). *Background summary comprehensive urban forest management plan for the City of Austin*. (Unpublished draft).

Halter, A. (2013). *Determining existing, possible, and preferable urban tree canopy for Austin, Texas* (Graduate thesis). The University of Texas, Austin, TX.

Hanna, M. (2011). Bastrop wildfire losses rise. Retrieved from Insurance Council of Texas website: www.insurancecouncil.org/news/2011/Dec082011.pdf

International Society of Arboriculture. (2013). Online international dictionary. Retrieved from ISA website: <http://www.isa-arbor.com/education/onlineResources/multiLingualDictionary.aspx>

Jackson, L.E. 2003. The relationship of urban design to human health and condition. *Landscape and Urban Planning*, 64(4): 191-200.

Johnson, E. *Edwards Plateau*. (2013) Handbook of Texas Online. Published by the Texas State Historical Association. Retrieved from <http://www.tshaonline.org/handbook/online/articles/rxe01>

Kemp, S. (2008). *Mapping the history, iconography, and politics of the urban forest in Austin, Texas* (Graduate thesis). The University of Texas, Austin, TX.

Laverne, R., & Winson-Geideman, K. (2003). The influence of trees and landscaping on rental rates at office buildings. *Journal of Arboriculture*, 29(5), 281-290.

Locke, D., Grove, J., Lu, J., Troy, A., O'Neil-Dunne, J., & Beck, B. (2010). Prioritizing preferable locations for increasing urban tree canopy in New York City. *Cities and the Environment*, 3(1), 18.

Bibliography

- Lovasi, G.S., J.W. Quinn, K.M. Neckerman, M.S. Perzanowski, and A. Rundle. 2008. Children living in areas with more street trees have lower asthma prevalence. *Journal of Epidemiology and Community Health* 62, 647-649.
- McPherson, E. (2006). Trees are \$\$\$ – Realizing the Benefits of Trees. Davis, CA: Center for Urban Forest Research, Pacific Southwest Research Station, USDA Forest Service.
http://www.fs.fed.us/psw/programs/uesd/uep/products/powerpoint/psw_cufr631IndianaAA-1-11-06-3.swf
- Mitchell, R. and F. Popham. 2008. Effect of exposure to natural environment on health inequalities: An observational population study. *Lancet* 372:1655-60.
- Naderi, J. Kweon, B., & Maghelal, P. (2008). The street tree effect and driver safety. *Institute of Transportation Engineers Journal*, 78, 69-73. http://www.walkable.org/assets/downloads/StreetTreeEffectandDriverSafety_ITFeb08_.pdf
- Nowak, D., & Crane, D. (2002). Carbon storage and sequestration by urban trees in the USA. *Environmental Pollution*, 116, 381-389. DOI: 10.1016/S0269-7491(01)00214-7
- Nowak, D., Crane, D., & Dwyer, J. (2002). Compensatory value of urban trees in the United States. *Journal of Arboriculture*, 28(4), 194-199.
- Nowak, D., Crane, D., & Stevens, J. (2006). Air pollution removal by urban trees and shrubs in the United States. *Urban Forestry and Urban Greening*, 4(3-4), 115-123. DOI: 10.1016/j.ufug.2006.01.007

Bibliography

Nowak, D.J., R.E. Hoehn, D.E. Crane, J.C. Stevens, and J.T. Walton (2007). Assessing urban forest effects and values: New York City's urban forest. Resour. Bull. NRS-9. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 22 pp.
http://www.nrs.fs.fed.us/pubs/rb/rb_nrs009.pdf (accessed 01/26/2011).

National Oceanic and Atmospheric Administration. (2010). Austin climate summary [Fact sheet]. Retrieved March 14, 2013, from National Weather Service website: Retrieved from NOAA website: <http://www.srh.noaa.gov/ewx/?n=ausclidata.htm>

Olmsted, F. (1978). *A Journey through Texas or, a Saddle-Trip on the Southwestern Frontier*. Austin: University of Texas Press, p. 111.

Palmer, E. (1986). *The Balcones Escarpment: Land use and cultural change along the Balcones Escarpment 1718-1986*. In Abbot, P., & Woodruff, C., *The Balcones Escarpment, Central Texas*: Geological Society of America (pp. 153-162). Retrieved from http://www.lib.utexas.edu/geo/balcones_escarpment/pages153-162.html

Raciti, S. (2006). Urban tree canopy goal setting: A guide for Chesapeake Bay communities. USDA Forest Service, Northeastern Area.

Ramos, R., & Gonzalez, A. (2011). Decker Tallgrass Prairie Preserve & Indiangrass Wildlife Sanctuary management plan. Executive summary. Retrieved from <http://www.austintexas.gov/edims/document.cfm?id=157957>

Bibliography

- Richards, N.A. (1983). Diversity and stability in a street tree population. *Urban Ecology*, 7(2), 159-171. DOI: 10.1016/0304-4009(83)90034-7
- Rodgers, L., & Harris, M. (1983). Remote sensing survey of pecan trees in five Texas cities. *Journal of Arboriculture*, 9(8), 208-213. Retrieved April 24, 2013, from <http://joa.isa-arbor.com/request.asp?JournalID=1&ArticleID=1901&Type=2>
- Rosenfeld, A.H., H. Akbari, J.J. Romm, and M. Pomerantz. (1998). Cool communities: Strategies for heat island mitigation and smog reduction. *Energy and Buildings* 28(1): 51-62.
- Rudd, H., J. Vala, and V. Schaefer. (2002). Importance of backyard habitat in a comprehensive biodiversity conservation strategy: A connectivity analysis of urban green spaces. *Restoration Ecology* 10(2): 368-375.
- Streiling, S., and A. Matzarakis. (2003). Influence of single and small clusters of trees on the bioclimate of a city: A case study. *Journal of Arboriculture* 29(6): 309-316.
- Sustainable Urban Forests Coalition. (2013). How does the SUFC define urban forests? Retrieved from Sustainable Urban Forests Coalition website: <http://www.urbanforestcoalition.com/>
- Takano, T., K. Nakamura, and M. Watanabe. (2002). Urban residential environments and senior citizens' longevity in megacity areas: The importance of walkable green spaces. *Journal of Epidemiology and Community Health* 56(12): 913-918.
- Texas A&M Forest Service. (2008). Texas eco-regions: Edwards Plateau. Retrieved from <http://texastreeid.tamu.edu/content/texasEcoRegions/EdwardsPlateau/>

Bibliography

Texas Commission on Environmental Quality. (2013). Austin annual wind rose data 1984-1992. Retrieved from TCEQ website: <http://www.tceq.texas.gov/assets/public/compliance/monops/air/windroses/ausall.gif>

Texas Parks & Wildlife. Edwards Plateau ecological region. Retrieved from http://www.tpwd.state.tx.us/landwater/land/habitats/cross_timbers/ecoregions/edwards_plateau.phtml

Texas Parks & Wildlife. Blackland Prairie ecological region. Retrieved from http://www.tpwd.state.tx.us/landwater/land/habitats/cross_timbers/ecoregions/blackland.phtml

United States Census Bureau. (2013). *Rural and urban classification*. Retrieved September 9, 2013, from U.S. Census Bureau website: <http://www.census.gov/geo/reference/urban-rural.html>

Ulrich, R. (1984). View through a window may influence recovery from surgery. *Science*. 224: 420-421

United States Department of Agriculture, Natural Resources Conservation Service. (2013). Wind rose data. Retrieved from USDA, NRCS website: <http://www.wcc.nrcs.usda.gov/climate/windrose.html>

United States Department of Agriculture, U.S. Forest Service. (2013). i-Tree Eco/Street overview. Retrieved from USDA, U.S. Forest Service website: <http://www.itreetools.org>

Werner, B., Chandler, T., Raser, J., & O'Gorman, M. (2001). *Trees Mean*

Bibliography

Business: A study of the economic impacts of trees and forests in the commercial districts of New York City and New Jersey.

Retrieved from <http://www.urbanforestrysouth.org/resources/library/tresources/trees-mean-business>

White, Rachel E., Geoffrey H. Donovan, Jeffrey P. Prestemon. 2011
Trees thwart shady behavior. Nursery Management and Production. February: 30-33.

Wolf, K. & Bratton, N. (2006). Urban trees and traffic safety: Considering U.S. roadside policy and crash data. *Arboriculture & Urban Forestry*, 32(4), 170-179

Wolf, K. (2004). Trees and business district preferences: A case study of Athens, Georgia, U.S. *Journal of Arboriculture*, 30(6), 336-346.

Young, R. (2011). Planting the living city. *Journal of the American Planning Association*, 77(4), 368-381.
DOI: 10.1080/01944363.2011.616996

Geospatial Data Sources

Bibliography

The following data sources were used in this plan to analyze information and/or to create maps using Geographic Information Systems software. Geospatial data sources can be found on the City of Austin's GIS Data Sets website or through a public request for information. Geospatial data from other agencies may be acquired from their respective website or ftp portal.

City of Austin parks [feature class file]. (2013). Austin, Texas: City of Austin. Available: ftp://ftp.ci.austin.tx.us/GIS-Data/Regional/coa_gis.html

City of Austin parcel [feature class file]. (2010). Austin, Texas: City of Austin. Available: ftp://ftp.ci.austin.tx.us/GIS-Data/Regional/coa_gis.html

Jurisdictions [feature class file]. (2013). Austin, Texas: City of Austin. Available: ftp://ftp.ci.austin.tx.us/GIS-Data/Regional/coa_gis.html

PARC maintained unowned [feature class file]. (2013). Austin, Texas: City of Austin. Available: ftp://ftp.ci.austin.tx.us/GIS-Data/Regional/coa_gis.html

Tree canopy [feature class file]. (2010). Austin, Texas: City of Austin (unpublished). Available: ftp://ftp.ci.austin.tx.us/GIS-Data/Regional/coa_gis.html

Tree canopy [feature class file]. (2006). Austin, Texas: City of Austin. Available: ftp://ftp.ci.austin.tx.us/GIS-Data/Regional/coa_gis.html

Lakes [feature class file]. (2010). Austin, Texas: City of Austin. Available: ftp://ftp.ci.austin.tx.us/GIS-Data/Regional/coa_gis.html

Land use [feature class file]. (2010). Austin, Texas: City of Austin. Available: ftp://ftp.ci.austin.tx.us/GIS-Data/Regional/coa_gis.html

Right of way [feature class file]. (2013). Austin, Texas: City of Austin.

Bibliography

- Available: ftp://ftp.ci.austin.tx.us/GIS-Data/Regional/coa_gis.html
- Building footprints [feature class file]. (2006). Austin, Texas: City of Austin. Available: ftp://ftp.ci.austin.tx.us/GIS-Data/Regional/coa_gis.html
- Street centerline [feature class file]. (2006). Austin, Texas: City of Austin. Available: ftp://ftp.ci.austin.tx.us/GIS-Data/Regional/coa_gis.html
- Transportation planimetrics [feature class file]. (2003). Austin, Texas: City of Austin. Available: ftp://ftp.ci.austin.tx.us/GIS-Data/Regional/coa_gis.html
- Natural regions of Texas [shapefile]. (1994). Austin, Texas: Texas Parks and Wildlife Department. Available: http://www.tpwd.state.tx.us/landwater/land/maps/gis/data_downloads/
- Natural subregions of Texas [shapefile]. (1994). Austin, Texas: Texas Parks and Wildlife Department. Available: http://www.tpwd.state.tx.us/landwater/land/maps/gis/data_downloads/
- Level IV ecoregions of Texas [shapefile]. (2010). Corvallis, Oregon: Environmental Protection Agency. Available: <ftp://ftp.epa.gov/wed/ecoregions/tx/>

09-20-13 DRAFT

