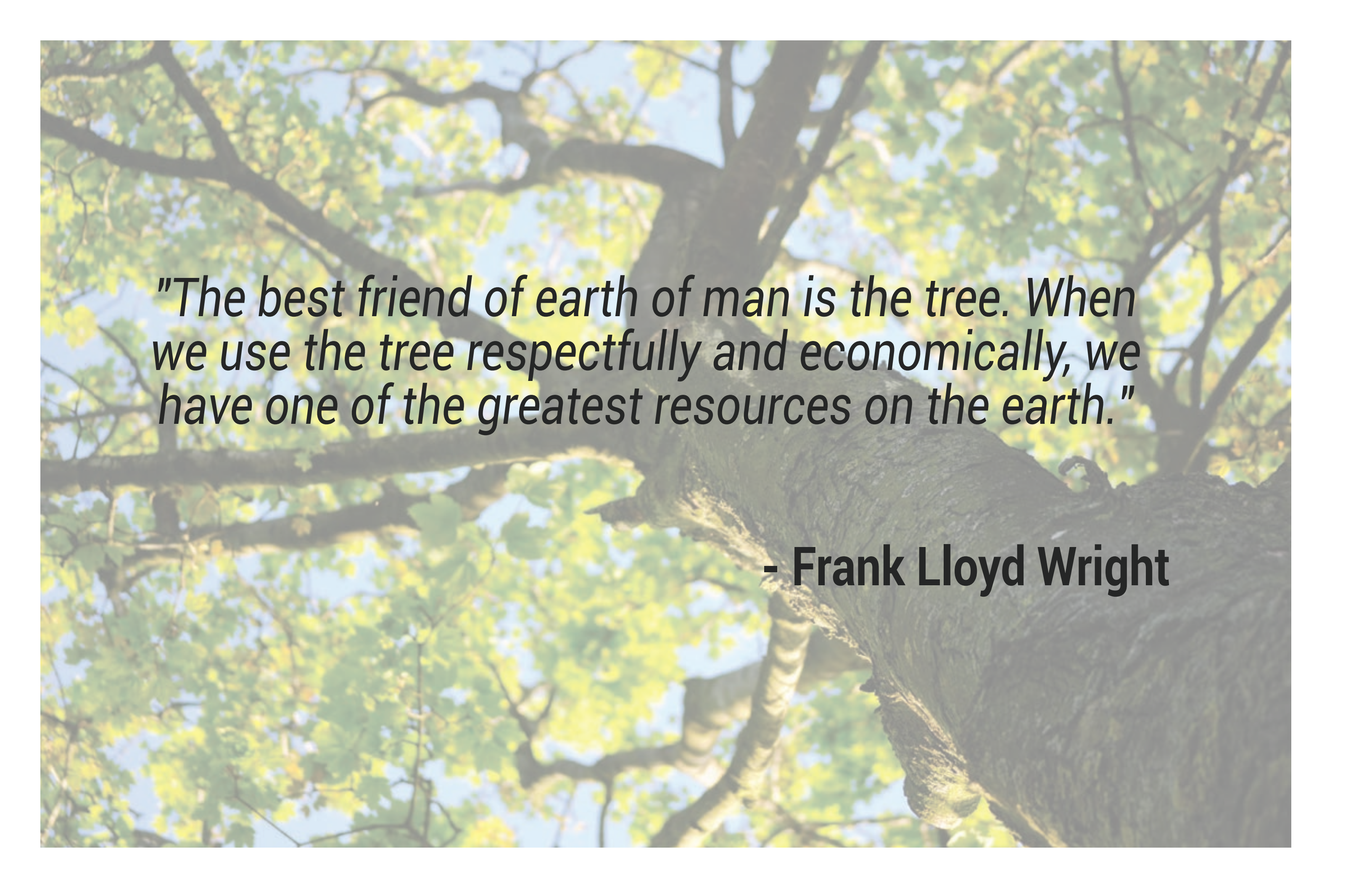# TULSA URBAN FOREST MASTER PLAN

*Growing Forward*

"The best friend of earth of man is the tree. When we use the tree respectfully and economically, we have one of the greatest resources on the earth."

- Frank Lloyd Wright

# TULSA URBAN FOREST MASTER PLAN

## *Growing Forward*

**2016**

# Acknowledgements

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Tulsa City Council

Tulsa County

Tulsa Public School District

Up With Trees

UP WITH TREES — PLANTING, PRESERVING & PROMOTING — TULSA'S URBAN FOREST ™

DAVEY RESOURCE GROUP — A Division of The Davey Tree Expert Company

CITY OF Tulsa — A New Kind of Energy™

# Table of Contents

# Executive Summary

The City of Tulsa's urban forest includes over 5.2 million public and private trees. These trees provide beauty and shade, as well as benefits to air quality, water quality, energy savings, wildlife, socioeconomics, and public health.

This Urban Forest Master Plan (UFMP) provides a guide for managing, enhancing, and growing the tree resource over the next 20 years along with long-range objectives for building an urban forest that is resilient, safe, and connected to the community.

The structure and organization of the UFMP is based on understanding what we have, what we want, how we achieve our goals, and evaluating how we are doing. This structure, referred to as adaptive management,
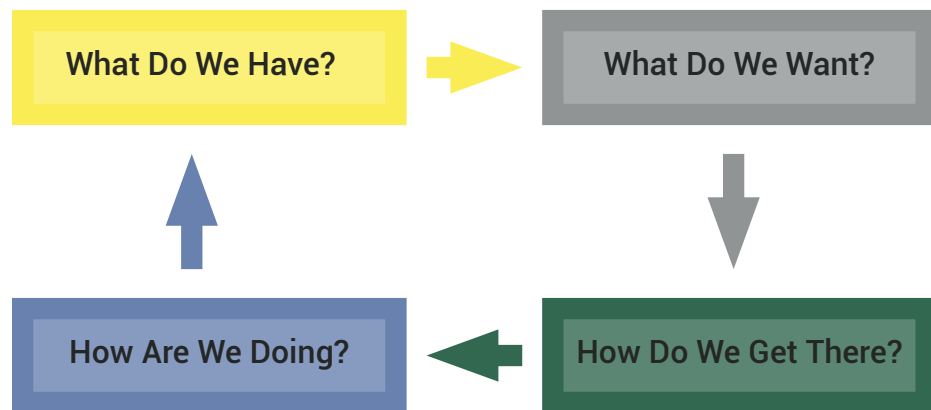


provides a good conceptual framework for managing urban forest resources and is commonly used for resource planning and management (Miller, R.W., 1988).

The plan development process involved a comprehensive review and assessment of the existing urban forest, including composition, value, and environmental benefits. The process explored community values, existing regulations, and policies that impact public and private trees. There are multiple stakeholders, internal and external, who play a role in the planning, design, care, and advocacy for the community forest. These stakeholders included park managers, elected officials, agency personnel, the local utility, regional nonprofits, and neighborhood groups, who contributed to the development of this Plan.

## What Do We Have?

Tulsa's Park and Recreation Department was established in 1906. Several parks host historic trees that have been preserved since pre-settlement days. Urban forestry in Tulsa was first formally recognized

in 1992. Since that time, park tree maintenance has steadily increased. For several years in the 1990s, street trees were pruned and maintained by the City on a regular cycle. However, in 2001, the responsibility for their care reverted to the adjacent homeowner.

Up With Trees, Tulsa's nonprofit urban forest advocate, was established in 1976 by Sid Patterson, the Tulsa Streets Comissioner. In 2015, recognizing a need to plan for additional tree planting and maintenance in the coming years, Up With Trees collaborated with the City of Tulsa and other urban forest management agencies to begin the process of developing an urban forest master plan.

Partial and sample inventories and aerial imagery was used to understand how Tulsa's urban forest looks today. These findings are summarized in the Tulsa's Urban Forest Benchmark Values table to the right.

The primary challenges and opportunities for the community forestry program are:

- Limited funding for tree care.
- Replacement of trees and canopy as they are lost through ongoing development.
- Optimizing health and resiliency in the urban forest to respond to drought, climate change, and emerging pests.
- Engaging the community in support of community trees and canopy goals.

With this foundation and an established urban forest, Tulsa is poised to realize increasing environmental benefits and value from its community trees.

## Tulsa's Urban Forest Benchmark Values

### Urban Forest

| | |
|---|---:|
| Number of All Trees | 5.2 Million |
| Replacement Value of All Trees | $5.3 Billion |
| Average Trees Per Acre | 41 |

### Most Common Trees

| | |
|---|---:|
| Celtis (Hackberry/Sugarberry) | 16% |
| Ulmus (Elm) | 15% |
| Carya (Hickory) | 8% |

### Tree Canopy Cover

| | |
|---|---:|
| Overall Canopy Cover | 26% |
| Impervious Surfaces | 29% |
| Maximum Urban Tree Canopy | 54% |

### Annual Benefits

| | |
|---|---:|
| Property Values | $102.8 Million |
| Avoided Stormwater Runoff | $18.4 Million |
| Carbon Dioxide Reduced | $6.6 Million |
| Energy Saved | $4.3 Million |
| Air Quality Benefits | $86,503 |
| **Total Annual Benefits** | $132.2 Million |

### Long-Term Benefits

| | |
|---|---:|
| Stored Carbon | $153 Million |

**City of Tulsa, Land Cover**



Legend:
- Tree Canopy
- Impervious Surfaces
- Low-Lying Vegetation
- Pervious Surfaces
- Open Water

N

0  1  2  3 Miles
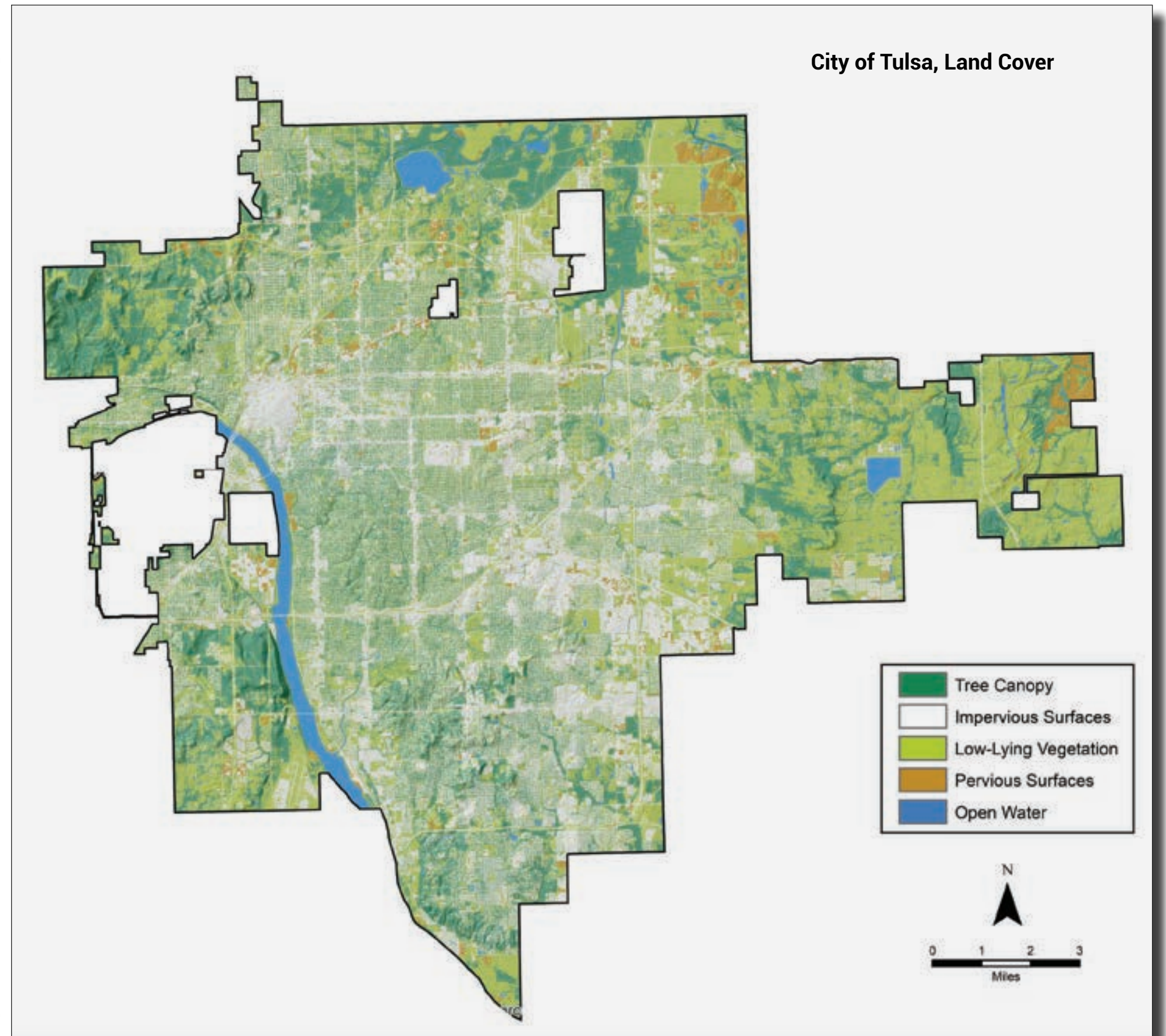
## How Do We Achieve Our Goals?

A few of the primary recommendations that support the goals include:

- Increase canopy cover, especially along roads and in areas with high environmental need.

- Revise standards for Landscaping Requirements to increase success in establishment, promote shade over impervious surfaces, and incentivise tree preservation.

- Promote design and construction standards that increase success in establishment of trees soil volume, planting space, and pervious surface.

- Develop a city-wide public tree inventory in partnership with multiple agencies to better understand the composition and condition of trees in parks, along roads, at schools, and in privately managed public open spaces to facilitate strategic management.

- Enhance outreach and education efforts to inform residents about tree benefits and proper tree care.

- Develop volunteer leadership and increase philanthropic opportunities.

A complete list of objectives is provided in the section "How Do We Achieve Our Goals?", along with strategies and tactics that will support the success of the UFMP.

## What Do We Want?

A primary emphasis for the UFMP is to identify appropriate collaborative strategies to ensure that critical tree care needs can be addressed in a timely, cost-effective, and efficient manner. This includes the proactive identification of risk and mitigation measures to promote public safety and reduce liability. Trees are living organisms, constantly changing and adapting to their environment and increasing in size over time.

Because of this, trees have specific needs at various life stages, including training for proper structure when they are young and increased monitoring and proactive risk management as they mature.

Deferring maintenance can have a significant effect on the overall health, structure, value, and lifespan of a tree. In addition, deferred maintenance often results in higher costs and less beneficial results, including increased risk potential. As a result, the UFMP identifies goals for optimizing urban forest programming and existing funding, along with personnel training.

**RESILIENT**

**SAFE**
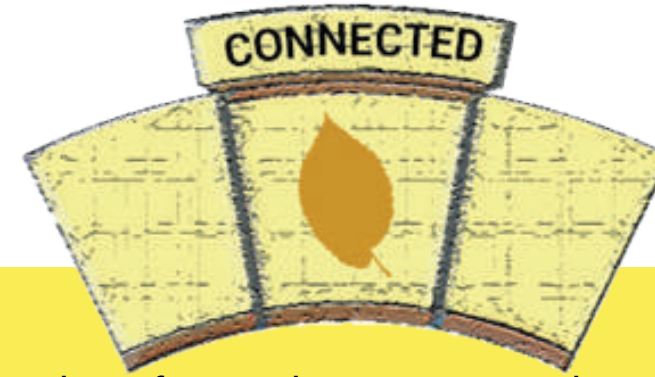
**CONNECTED**

**Goals**

A **resilient** urban forest that is diverse in species and age distribution, where new trees are planted strategically to optimize establishment, tree health, and benefits.

A **safe** urban forest that is regularly inventoried, to proactively identify structural defects and trees in poor condition, managed by well trained tree care personnel. Safety and health issues are addressed in a timely and efficient manner.

An urban forest that **connects** the whole community to nature, where tree canopy and tree benefits are distributed equitably, for all Tulsa residents to enjoy, and where information and resources about Tulsa's trees are easily accessed and shared.

**Recommendations**

- Ensure tree benefits for future generations through a sustainable planting program.
- Align policies with the community vision for canopy establishment.
- Explore additional funding sources to reach desired level of services.
- Achieve 30% urban tree canopy within 20 years.

- Maintain public trees proactively.
- Develop a tree risk management strategy.
- Monitor the resource for exotic and invasive pests and diseases.
- Develop training for tree care personnel based on industry best management practices.

- Implement a coordinated outreach and education campaign.
- Connect urban forestry partners through a single vision.
- Encourage public and private participation in urban forest management through volunteerism.
- Increase tree canopy coverage so that all people can enjoy the benefits of trees equitably.
- Focus on neighborhood-based initiatives and solutions to urban forestry issues.

# How Are We Doing?

The success of the UFMP will be measured through the realization of goals and demonstrated through increased value and environmental benefits in the urban tree resource.

The Plan identifies methods of measurement and timeframes for each of the strategies. These include annual plan review, periodic evaluation of tree canopy based on aerial imagery, and ongoing communication with key stakeholders.

Five components of tracking progress include:

- Annual Plan Review
- Resource Analysis
- Canopy Analysis
- State of the Urban Forest Report
- Community Satisfaction

Perhaps the greatest measurement of success for the UFMP will be its level of meeting community expectations for the planting, care and preservation of the community tree resource. With the continued engagement of Tulsa's many urban forest stakeholders, proactive managment, and strategic tree planting, Tulsa residents can expect to receive increasing benefits from the urban forest for years to come. This UFMP provides a roadmap, enabling Tulsa to realize a shared community vision of an urban forest that is resilient, safe, and connected.

# Introduction

## Mission

Multiple entities are responsible for the management of Tulsa's public tree resource. While these individual agencies' missions focus on specific management areas, the overall intent is to promote a high quality of life for Tulsans, recognizing that trees play an important role. In alignment with that sentiment, the mission of this UFMP is:

*To guide the management and growth of Tulsa's urban forest, to promote recognition and understanding of the contribution of trees to the health and well-being of our community, to nurture this vital resource for future generations, and to engage public and private stakeholders in collaborating to achieve our goals.*

## Vision

The project partners agreed upon the following vision for Tulsa's Urban Forest:

*An urban forest that is safe and resilient, providing a vital connection between residents and nature, and supported by an engaged community that recognizes the value and benefits trees provide.*

## Scope & Purpose

This Urban Forest Management Plan provides a guide for creating a resilient, safe, and connected urban forest in the City of Tulsa. In developing this Urban Forest Master Plan (UFMP), public and private stakeholders in Tulsa were engaged to develop a comprehensive vision of the current needs of Tulsa's urban forest, outlining potential challenges and opportunities, and ultimately, defining what Tulsa's urban forest will look like through the next 20 years.

The project scope includes all public and private trees managed and cared for by multiple agencies and property owners within the city limits of Tulsa, an estimated 5.2 million trees.

The Plan identifies keystones, goals, and recommendations for planting, maintaining, preserving, and protecting Tulsa's tree population. Wherever feasible a cost and a completion date or timeline for implementation is included.

Recognizing the significance of environmental and socioeconomic benefits provided by trees and their relationship with community values and expectations for a high quality of life, the Plan aims to:

- Promote shared vision and collaboration.
- Preserve and improve the health and sustainability of the community's tree resource and the vital benefits trees provide.
- Illustrate the value and benefit of community trees and promote engagement and appreciation for the urban forest.
- Support the preservation and enhancement of tree canopy throughout the community.
- Provide a basis and justification for establishing resources to support the care and management of Tulsa's urban forest.
- Communicate existing and foreseen challenges and opportunities.
- Establish benchmarks for measuring the long-term success of management strategies.
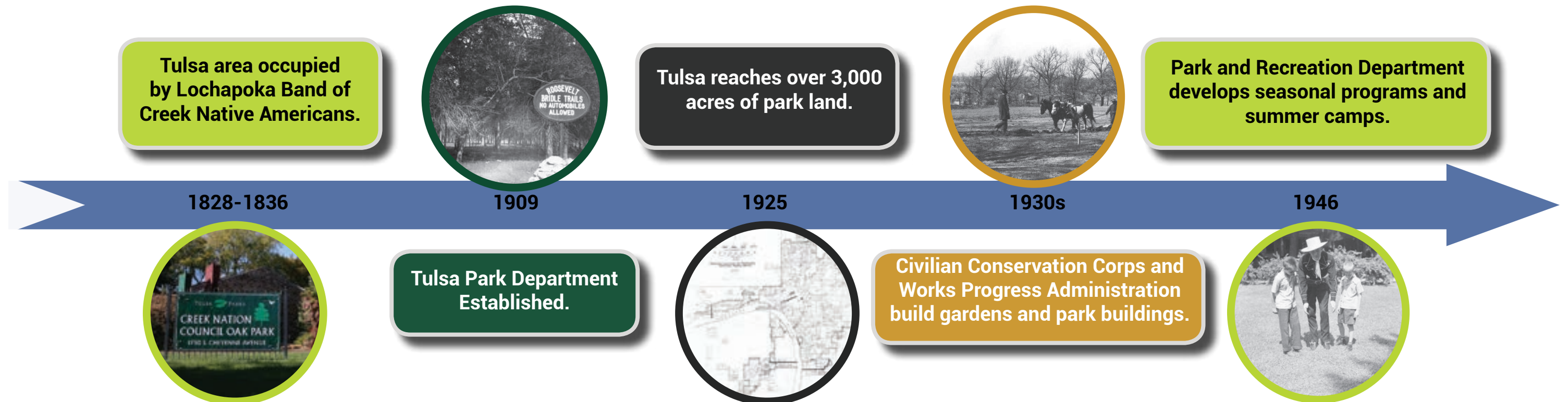
# What Do We Have?

## Community

Tulsa is located in the northeastern quadrant of Oklahoma on the Arkansas River, at the foothills of the Ozark Mountains. The average elevation in Tulsa is 700 feet above sea level. This region of the state is known as "Green Country", and the surrounding area includes prairies and rolling hills with native oaks and other hardwoods. The temperate climate is considered humid subtropical, with an average temperature of 60.8 degrees, and average annual precipitation of 41 inches. Seasonal snowfall averages 9.6 inches per year. Spring and early summer often include severe thunderstorms with large hail, damaging winds, and occasionally tornadoes.

Tulsa is considered the cultural and arts center of Oklahoma, with museums, opera, ballet, and one of the nation's largest concentrations of art deco architecture. The arts and culture are influenced by Southwest, Midwest, Southern, and Native American cultures, as expressed by the diversity of cultural centers, performing arts venues, ethnic festivals, and a growing collection of public sculptures, monuments, and artwork. The University of Tulsa and Oral Roberts University are two noteworthy colleges. The population is primarily white American (62.6%) with influential African American (15.6%), Hispanic (14%), and Native American (5.3%) populations. Tulsa is home to 398,121 residents in 163,906 households.

For most of the 20th century, the City held the nickname "Oil Capital of the World" and played a major role as one of the most important hubs for the American oil industry. Although the local economy began with development in the oil industry, recent diversification efforts have created a broader economic base in the energy, finance, aviation, telecommunications, and technology sectors. Also known as "America's Most

Tulsa area occupied by Lochapoka Band of Creek Native Americans.

Tulsa reaches over 3,000 acres of park land.

Park and Recreation Department develops seasonal programs and summer camps.

**1828-1836**   **1909**   **1925**   **1930s**   **1946**

Tulsa Park Department Established.

Civilian Conservation Corps and Works Progress Administration build gardens and park buildings.

Generous City", Tulsa is home to one of the largest community foundations in the nation, and is currently embarking on an extensive river park building project. This multi-year project to construct A Gathering Place for Tulsa spans over 100 acres along the Arkansas River waterfront. The donation to the River Parks Authority is the largest private gift to a public park in U.S. history.

# Urban Forestry History
## Early Park Development

Tulsa was settled between 1828 and 1836 by the Lochapoka Band of the Creek Native American tribe when they relocated from Alabama. A large bur oak tree was a central landmark in the native community and still stands today near present-day Cheyenne Ave. and 18th St. After multiple ownership changes, the site was purchased in 1960 by the Creek Nation and donated to the City of Tulsa. The area was preserved as the Creek Nation Council Oak Park. Today, the park is listed as a National Historic Place, within a Historic Preservation zone.

Parks, such as Council Oak, have long been important components of Tulsa's urban forest. The Tulsa Park Department was established on August 18, 1909, when the City of Tulsa bought the first parkland property, Owen Park, from Chauncey and Mary Owen for $13,500. Over the next several years, the Parks Commission was established to advise park management as well as developing a boulevard system to beautify the city with flowers, trees, and scenery. By 1925, Tulsa had over 3,000 acres of parkland.

Although Tulsa's economy was impacted during the Depression in the 1930s, the Park Department benefited from work programs. Civilian Conservation Corps (CCP) and Works Progress Administration (WPA) workers removed understory vegetation which preserved the larger trees.

The CCP and WPA workers also built the Rock Garden and Rose Garden at Woodward Park. The National Park Service facilitated building and structure development in Mohawk Park and WPA workers built bridges, roads, shelters, and restrooms with an eye toward blending them into the natural landscape. The City expanded the Park Department to become the Park and Recreation Department in 1946, and developed seasonal programs and summer camps for local children. Additional funding became available in 1960, when the Park and Recreation Department formed a partnership with Tulsa Public Schools to take advantage of federal funding programs. Today, the Park Department manages approximately 14,845 trees in 140 parks covering 8,200 acres.

The Tulsa River Parks Authority (TRPA) was established as a public-private partnership in 1974. Today, river parks include over 800 acres featuring 41 miles of trails, several playgrounds, picnic areas, fountains, and sculptures. TRPA administers hundreds of acres of land for wildlife habitat and preservation along the Arkansas River.



Sid Patterson unites civic groups and community members to form Up With Trees.

In response to heavy storm damage, Tulsa mayor commits to "ReGreen Tulsa" with ambitious tree planting plan.

**1974**    **1975**    **2001**    **2007**    **2016**

Tulsa River Parks Authority established.

City street tree pruning discontinues, and maintenance reverts to adjacent property owner.

Final "ReGreen Tulsa" tree is planted, reaching 10,000 trees.

## Street Trees in Tulsa

In 1990, the Federal Farm Bill included a Forestry Title that amended the Cooperative Forestry Assistance Act of 1978 and authorized a number of programs, including Urban and Community Forestry. This act allowed states to use federal funds to provide financial and technical assistance in urban and community forestry. For many communities, this spurred the establishment of urban forest departments, management plans, professional staff, and city ordinances.

While street trees were an important part of the urban forest for many years, they were not formally regulated until 1992 with Executive Order 92-06 (City of Tulsa). In February, 1992, the Mayor of Tulsa established a standardized tree program, and gave authority over management of public trees to the Urban Forester within the Park and Recreation Department. The Urban Forester was to recommend and supervise the planting, maintenance, protection, and removal of

trees on public and semi-public land in collaboration with other city departments.

At the same time, the Mayor appointed 9 citizens to be members of the Urban Forestry Advisory Committee. This committee also included the urban forester and other city staff as ex-officio, non-voting members of the committee. The advisory committee was responsible for advising the Mayor and all City Departments and Authorities on matters related to trees on public and semi-public property. Specifically, this included advice about maintenance standards, species selection, tree spacing, clearance, urban forest planning, tree care, public information, budget and policy review.

In addition to establishing the Urban Forester position and appointing the UF Advisory Committee, the order created definitions for trees, topping, standards, and other urban forestry terms, and outlined rules and standards for the urban forest, including tree planting and protection procedures, licensing and

training of personnel conducting tree planting and maintenance, and established the destruction of trees on public property to be a violation. For several years in the 1990s, City of Tulsa crews pruned and maintained street trees, eventually moving toward a 5-year pruning cycle. But street tree pruning was discontinued in 2001 and the responsibility for tree maintenance reverted to the private property owner. The Urban Forest Advisory Committee was inactive for several years until resuming in March 2006.

In 2007, residents became concerned when more than 50 trees in Woodward Park were identified for removal. In response, the Park and Recreation Department re-evaluated the trees in partnership with a local consulting arborist. It was determined that only one tree required removal while the others were pruned to mitigate hazards. To avoid similar issues in the future, Mayor Kathy Taylor issued Executive Order 2007-03, which established a new committee, the Tree Advisory Committee, and provided for the coordination and oversight for the maintenance of trees in Tulsa parks. Tree Advisory Committee goals were defined to include:

- Further beautification of the City of Tulsa
- Improve electric reliability
- Improve public safety
- Establish consumer complaint, resolution and feedback process
- Identify funding mechanisms
- Create a permanent Urban Forestry Initiative
- Increase citizen and community awareness of urban forestry issues

The Tree Advisory Committee was to receive quarterly Urban Forestry reports from the Tulsa Park Department. Tree trimming and removal was to be conducted in

accordance to submitted maintenance plans, except when special approval was granted by the Mayor due to imminent danger to persons or the spread of disease to other plantings.

Today, Up with Trees' organization grew slowly and steadily until 2007, when an unusually damaging ice storm severely impacted trees across the City. In response, Mayor Kathy Taylor jump-started a new initiative to plant public trees in Tulsa: Regreen Tulsa. The program aimed to plant 10,000 trees and included a substantial fundraising campaign that generated donations from businesses, foundations, and Tulsa Residents.

A direct mail campaign in partnership with the utility provider PSO reached out to the community to rebuild the urban forest, and over the next few years, Up With Trees' annual budget grew to over a million dollars. Today Up With Trees plants thousands of trees each year with over 600 volunteers doing 11,000 hours of service planting and maintaining trees.

Today, the Tree Advisory Committee is inactive, but there is a 4-member board that advises the Mayor on management of the park system. Street trees are primarily maintained by private property owners with the exception of clearance issues, which may be handled by the Streets Division. Trees in arterial medians are maintained by Up with Trees.

# Tree Canopy Benefits

Urban and natural forests work 24/7 to mitigate the effects of urbanization and development and to protect and enhance lives within the community in the following ways:

## AIR QUALITY

- Reducing particulate matter
- Absorbing gaseous pollutants
- Shade and transpiration
- Lowering power plant emissions
- Increasing oxygen levels

Trees protect and improve air quality by intercepting particulate matter ($PM_{10}$), including dust, ash, pollen, and smoke. The particulates are filtered and washed harmlessly to the ground. Trees and forests absorb harmful gaseous pollutants like ozone ($O_3$), nitrogen dioxide ($NO_2$), and sulfur dioxide ($SO_2$). Shade and transpiration reduces the formation of $O_3$, which is created during higher temperatures. By reducing energy needs, trees reduce emissions from the generation of power. And, through photosynthesis, trees and forests increase oxygen levels.
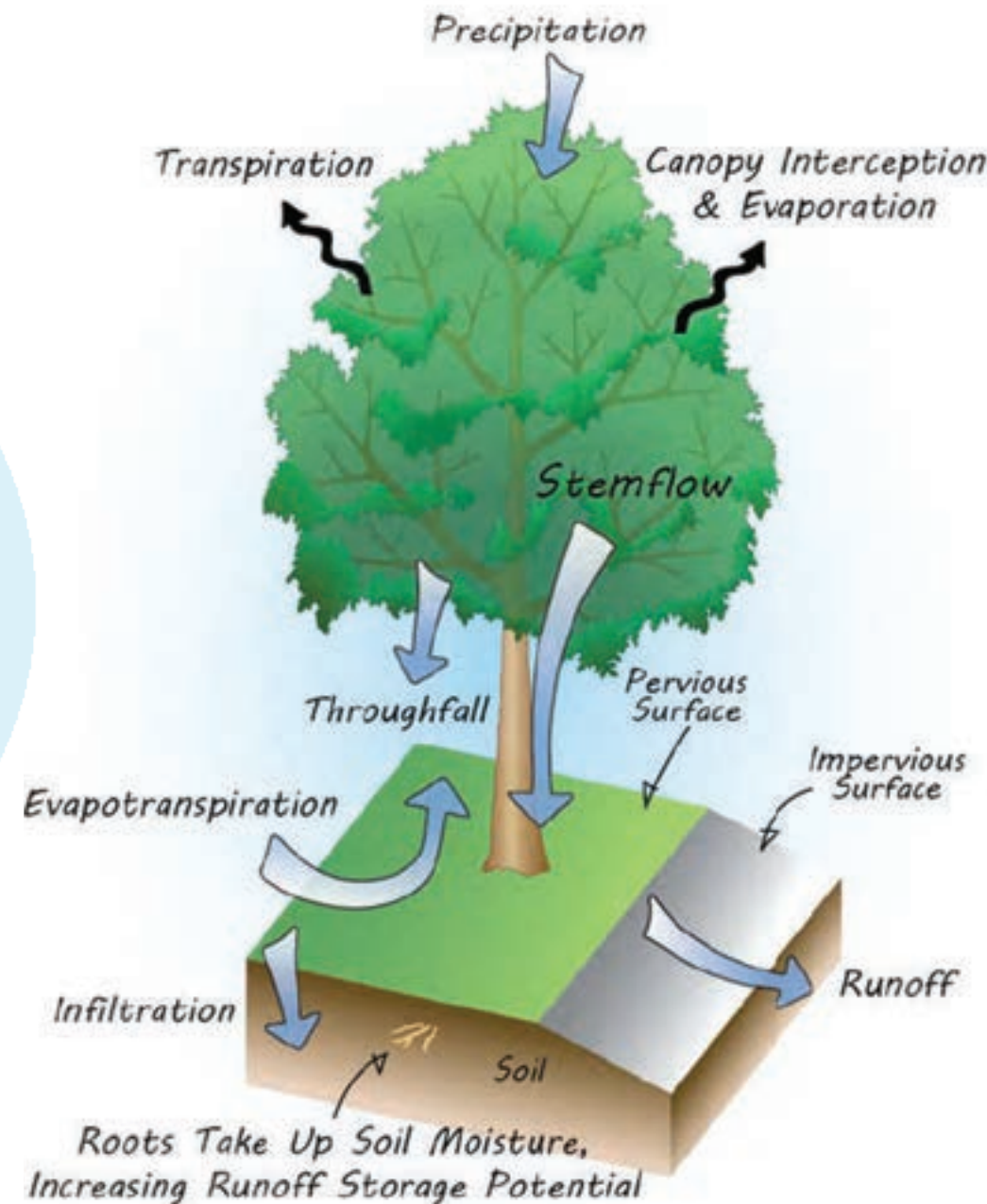


## ENERGY

- Transpiration
- Wind reduction
- Shading dwellings and hardscape

Shade from trees reduces the amount of solar heat absorbed and stored by impervious surfaces, thereby reducing the heat island effect, (an increase in urban temperatures in relation to surrounding locations). Through shade and transpiration, trees and other vegetation within an urban setting modify the environment and reduce heat island effects. Temperature differences of more than 9°F (5°C) have been observed between urban areas with and without adequate canopy cover (Akbari et al, 1992).

## WATER QUALITY

- Stormwater Interception
- Increasing soil capacity and rate of infiltration
- Reducing soil erosion

Trees intercept rainfall in their canopies, which act as mini-reservoirs. During rain events, this interception reduces and thus slows runoff. In addition to capturing stormwater, canopy interception lessens the impact of raindrops on bare soils. Tree roots can also increase the capacity and rate of soil infiltration. Through rainfall interception and increased soil infiltration, flow and volume of stormwater runoff is reduced. This aids in preventing sediments and other pollutants from entering the local waterways.

## CARBON

- Directly reducing atmospheric carbon dioxide through growth and carbon sequestration
- Indirectly reducing atmospheric carbon dioxide by lowering the demand for energy

Trees and forests directly reduce $CO_2$ in the atmosphere through growth and sequestration of $CO_2$ in woody and foliar biomass. Indirectly, trees and forests reduce $CO_2$ by lowering the demand for energy and reducing the $CO_2$ emissions from the consumption of natural gas and the generation of electric power.

Greenhouse gases (GHGs) absorb infrared radiation from the sun and trap this heat in the atmosphere, increasing the temperature of the Earth's surface. Thus, trees are crucial for moderating planet temperature through the absorbtion of GHGs.

## HUMAN HEALTH

- Increasing Walkability
- Providing access to healthy local produce
- Decreasing hospital patient recovery time

Trees provide opportunities for recreation, inviting community members to engage in regular physical activity. Oklahoma has the sixth highest adult obesity rate in the nation at 33%, up from 20% in 2000 and 10% in 1990 (TAH, 2015). This puts residents at increased risk of chronic diseases. In addition, many studies found that patients recovering from surgery showed reduced reliance on medication and quicker recovery when their recovery room had a view of trees rather than a brick wall (Ulrich, 1984).

## AESTHETIC

- Beautifying neighborhoods
- Providing shade and privacy
- Enhancing wildlife habitat
- Creating a sense of place
- Increasing property values

Commercial landscaping, that includes trees creates positive economic benefits for retailers and customers. There is documented evidence that trees promote better business by stimulating more frequent and extended shopping and a willingness to pay 11% more for goods and parking (Wolf, 2007). In Tulsa, the well-treed Utica Square Mall is a popular destination for shoppers, and many residents enjoy the summer evening music concert series under the shade of trees in the parking lot, and throughout landscaped areas of the commercial property.

# Benefit Values

Based on 2015 estimates, Tulsa's urban forest provides cumulative benefits valued at an average of $25.43 per tree, per year, for a total value of $132.2 million annually. Trees help conserve and reduce energy use, reduce local carbon dioxide levels, improve air quality, mitigate stormwater runoff, and provide other benefits associated with aesthetic value, property value, and quality of life.

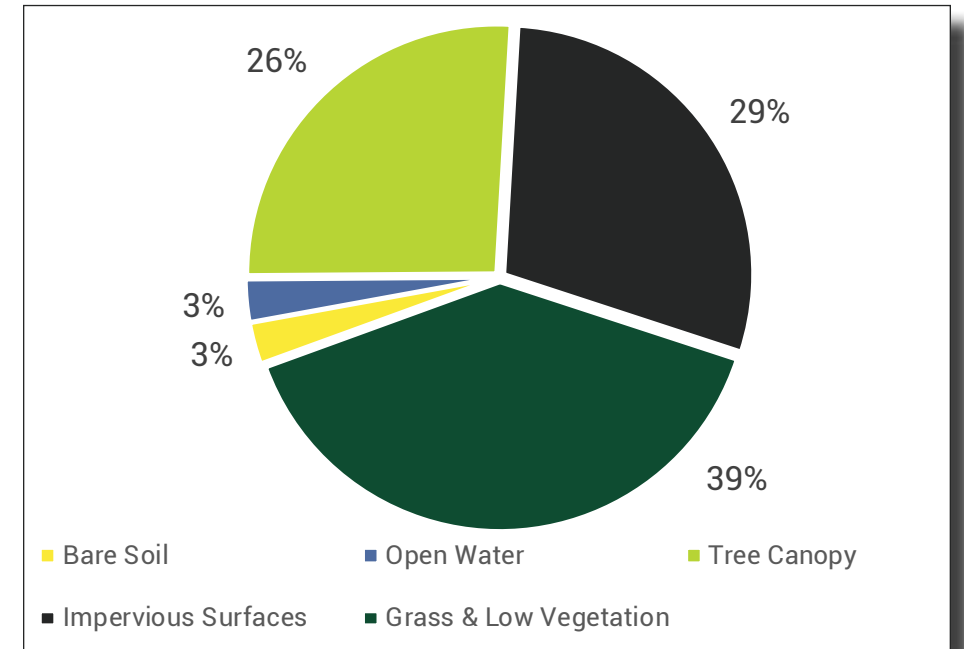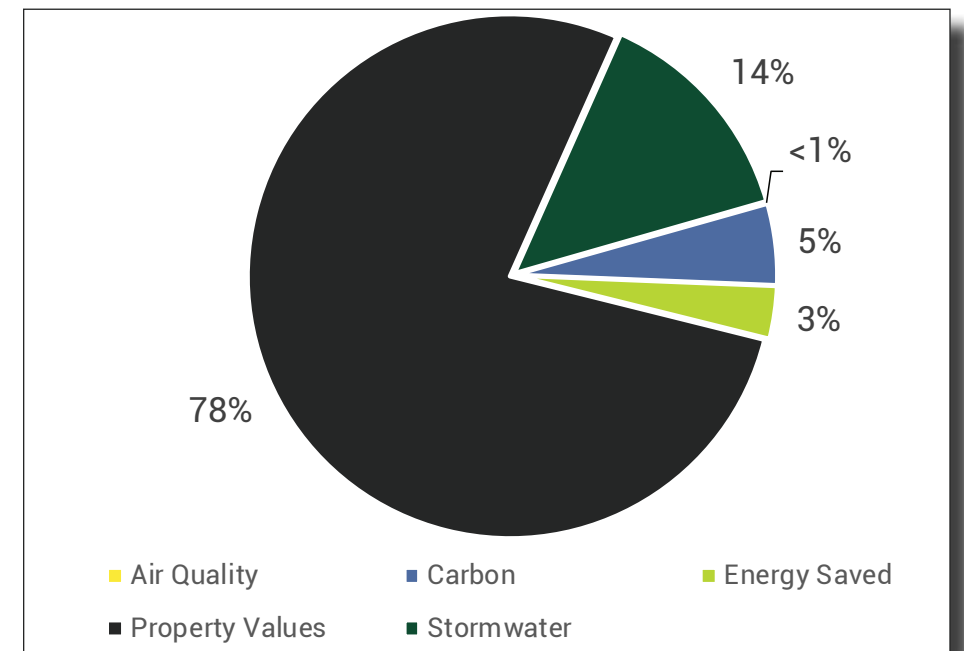| Annual Urban Forest Benefits | | |
|---|---|---|
| Item | $ | % of Total Benefits |
| Air Quality | 86,503 | <1% |
| Carbon | 6,634,259 | 5 |
| Energy Saved | 4,303,908 | 3 |
| Property Values | 102,838,496 | 78 |
| Stormwater | 18,374,720 | 14 |
| Total | $132,237,886 | 100% |

# Urban Forest Resource

Tulsa's urban forest resource varies, with trees of different species, size, and condition. Partial inventories from parks, schools, & Up With Trees, along with a ground-based sample inventory from 2015 (Resource Analysis), and aerial imagery from 1995 - 2015 (Urban Tree Canopy Assessment) were reviewed to establish a baseline understanding of the urban forest resource today. The value of the trees and their annual benefits was modeled based on local prices. This data revealed the following:

- Approximately 5.2 million trees are present with an average of 40.7 trees per acre.

- It would cost $5.3 billion to replace Tulsa's urban forest.

- Tulsa relies heavily on trees in the oak, hackberry, and pine genera to provide substantial tree benefits.

- Canopy covers 26% of Tulsa's land area.

- Tulsa has the potential to support up to 54% tree canopy.

- Tulsa's canopy provides quantifiable benefits to the community, valued at $102.8 million (increased property values) and $31.9 million (annual environmental benefits).

- 47% of trees are in good or better condition, and 35% are fair.

**Land Cover in Tulsa**

26% Tree Canopy
29% Impervious Surfaces
3% Open Water
3% Bare Soil
39% Grass & Low Vegetation

Legend:
- Bare Soil
- Open Water
- Tree Canopy
- Impervious Surfaces
- Grass & Low Vegetation

**Tulsa's Tree Benefits**

14% Stormwater
<1%
5% Carbon
3% Energy Saved
78% Property Values

Legend:
- Air Quality
- Carbon
- Energy Saved
- Property Values
- Stormwater

**City of Tulsa, Land Cover**



Legend:
- Tree Canopy
- Impervious Surfaces
- Low-Lying Vegetation
- Pervious Surfaces
- Open Water

N

0  1  2  3
Miles

# Urban Tree Canopy

An Urban Tree Canopy Assessment (UTC) provides a bird's-eye view of the entire urban forest, and identifies canopy, impervious, and other land cover classes. Canopy distribution was evaluated at several levels, including by council district, watershed, and census block. Specific land uses such as schools and parks were also mapped and canopy was quantified. Functional values, including canopy health and stormwater impact were evaluated.

## Overall City of Tulsa Land Cover

The City of Tulsa includes a total area of 128,571 acres with 33,455 acres (26%) of current tree cover. Excluding areas where tree cover is not feasible such as athletic fields and agricultural crop land, the city has an additional 36,603 acres (28%) with the potential to support tree canopy for a total possible canopy of 70,059 acres (54%). Almost half the existing canopy (47%) is estimated to be in very good or good condition, and 35% is fair. Tulsa's canopy provides quantifiable annual benefits to the community:

- Increases property values by $102.8 million

- Provides $31.9 million in environmental benefits

- Removes 1,214 tons of air pollutants, valued at $2.6 million

- Sequesters 92 tons of carbon, valued at $6.6 million

- Reduces 2 billion gallons of stormwater runoff, valued at $18 million

- Saves 53 million kWhs of energy, valued at $4.3 million
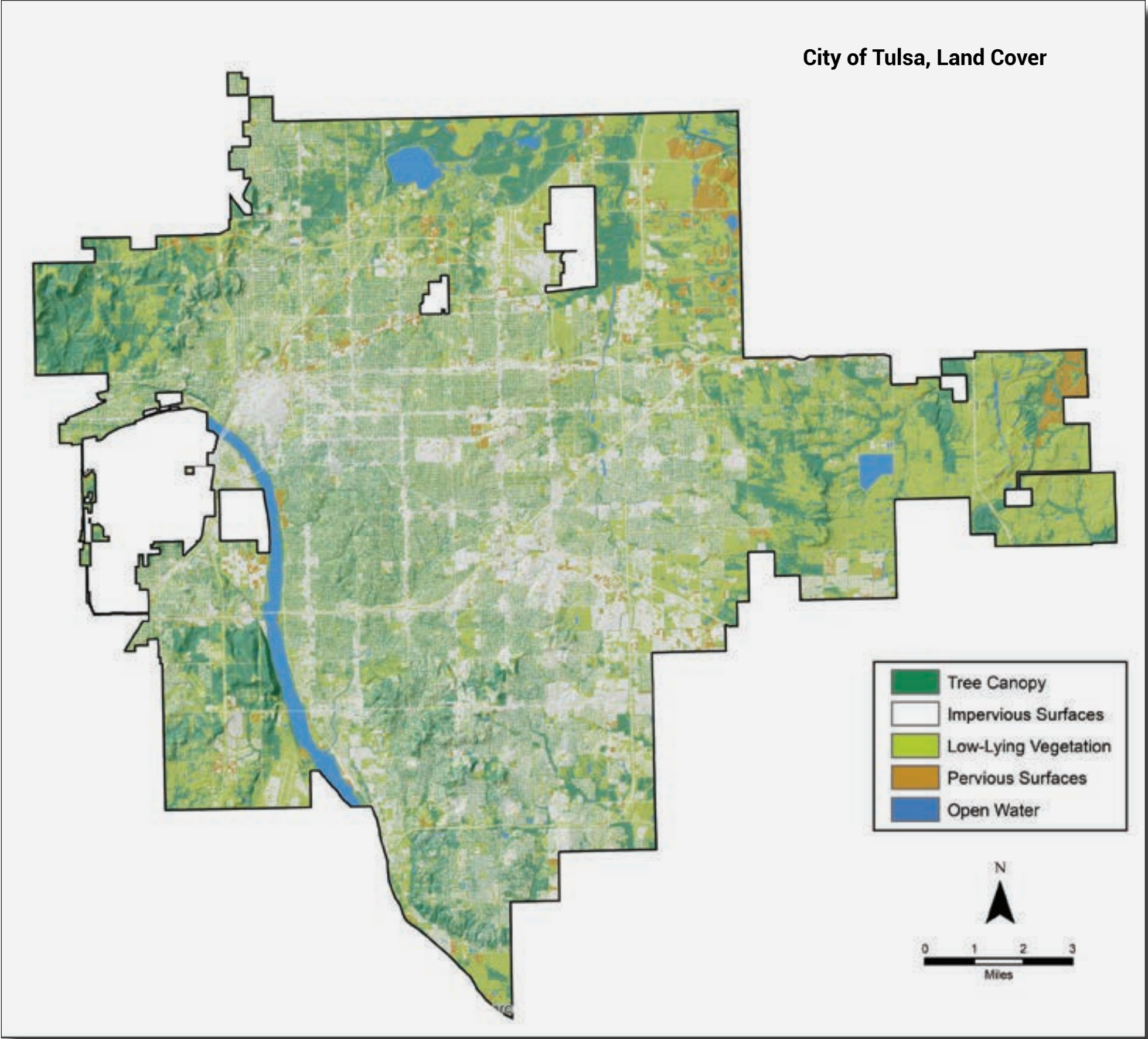
## Canopy Cover by Council District

City Council boundaries are one way to understand tree canopy, as they tend to reflect geographies that are well understood by community members and elected officials. Exploring canopy distribution and socio-economic indicators at this level can help facilitate outreach and education activities as well as develop a deeper understanding of tree canopy at a meaningful scale. Still it is important to recognize that land uses, such as residential, commercial, and open space can vary dramatically from one district to the next.

The City of Tulsa is divided into nine council districts. District 1 has 39% canopy cover (8,530 acres), due in part to significant undeveloped and agricultural land. District 5 has the fewest acres of tree canopy (1,261), and District 7 has the lowest canopy by percent (14.95%).

**City of Tulsa, Tree Canopy By Council District**



Legend:
- Less than 15%
- 15% - 19%
- 20% - 24%
- 25% - 29%
- Greater than 30%
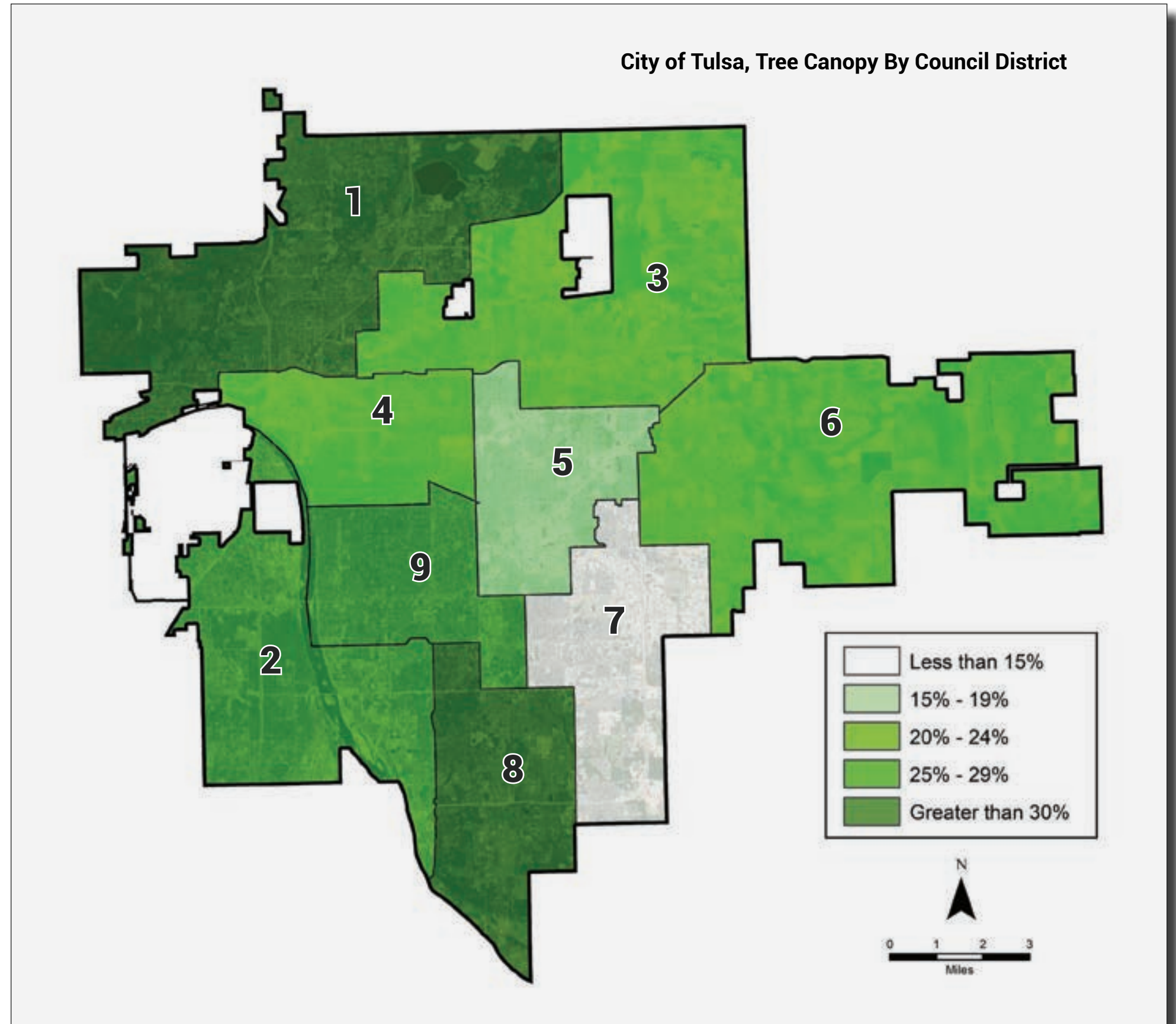
**Land Cover Class by Council District (Acres)**

| Council District | Tree Canopy Acres | Impervious Acres | Pervious Acres | Open Water Acres | Potential Plantable Acres |
|---|---|---|---|---|---|
| 1 | 8,530 | 3,950 | 8,860 | 738 | 6,610 |
| 6 | 5,790 | 3,517 | 14,319 | 570 | 5,011 |
| 3 | 4,440 | 5,204 | 10,967 | 328 | 7,645 |
| 2 | 4,116 | 4,292 | 5,992 | 1,245 | 4,568 |
| 8 | 3,511 | 3,700 | 2,946 | 83 | 2,637 |
| 9 | 2,467 | 3,091 | 2,608 | 230 | 2,414 |
| 4 | 1,742 | 4,164 | 2,003 | 187 | 1,912 |
| 7 | 1,606 | 5,176 | 3,867 | 98 | 3,291 |
| 5 | 1,261 | 4,381 | 2,554 | 62 | 2,518 |
| **Citywide** | 33,462 | 37,475 | 54,116 | 3,541 | 36,606 |

**Land Cover Class by Council District (Percent)**

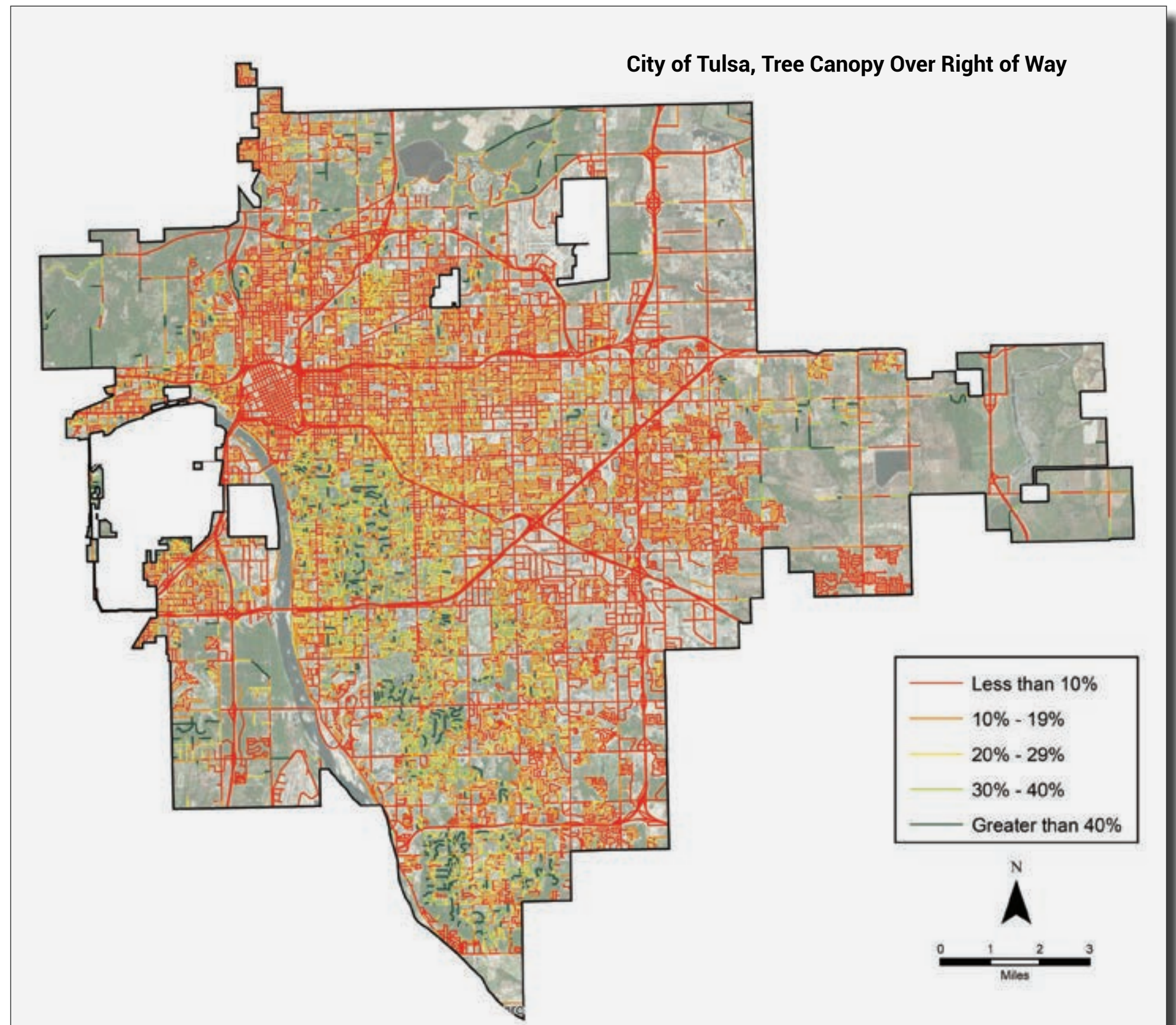| Council District | Tree Canopy % | Impervious % | Pervious % | Open Water % | Potential Canopy % |
|---|---|---|---|---|---|
| 1 | 38.64 | 17.89 | 40.13 | 3.34 | 68.57 |
| 8 | 34.29 | 36.13 | 28.77 | 0.81 | 60.03 |
| 9 | 29.38 | 36.81 | 31.06 | 2.74 | 58.13 |
| 2 | 26.31 | 27.43 | 38.30 | 7.96 | 55.51 |
| 6 | 23.93 | 14.54 | 59.18 | 2.35 | 44.64 |
| 4 | 21.51 | 51.44 | 24.74 | 2.31 | 45.13 |
| 3 | 21.21 | 24.85 | 52.38 | 1.57 | 57.72 |
| 5 | 15.27 | 53.06 | 30.93 | 0.75 | 45.76 |
| 7 | 14.94 | 48.16 | 35.98 | 0.92 | 45.56 |
| **Citywide** | 26.03 | 29.11 | 42.10 | 2.75 | 54.49 |

# Canopy Cover Over Roads

Street and roadside trees are an important part of the urban forest, and make up a large part of the public trees planted and maintained by Up With Trees. A 2016 survey of over 1,800 people in Tulsa County indicated that almost half of respondents would like to see more trees along main city streets (29%) and in neighborhoods (17%) when given eight alternative locations. This preference for tree-lined streets is understandable with Tulsa's hot, dry summers.

Indian Nations Council of Governments (INCOG) is a regional planning authority that works with communities across Tulsa County to develop complete street strategies which provide features for motorists, pedestrians and cyclists to share the road. Street trees are an important part of complete streets, as they calm traffic and shade the pavement. Canopy cover mapping over Tulsa's roads revealed 62% of roads have 10% canopy or less.

Right of way (ROW) asphalt concrete is a significant public investment, in both time and money. Research shows that the effects of street tree shade on asphalt increases performance and lengthens durability. One study found that streets shaded with trees required approximately one-third the number of slurry seals over a 30-year period, relative to streets without tree shade (McPherson, 2005).

Research shows drivers drive more slowly and carefully when on street lined trees, which suggests that trees may improve driving safety. A 2006 study in Texas discovered a 46% decrease in automobile crash rates across urban arterial and highway sites after landscape improvements featuring trees were installed (Mok, 2006).



**City of Tulsa, Tree Canopy Over Right of Way**

Legend:
- Less than 10%
- 10% - 19%
- 20% - 29%
- 30% - 40%
- Greater than 40%

N

0  1  2  3
Miles

City of Tulsa, Tree Canopy By Census Block

**Legend:**
- Less than 15%
- 15% - 19%
- 20% - 24%
- 25% - 29%
- Greater than 30%

N

0  1  2  3
Miles
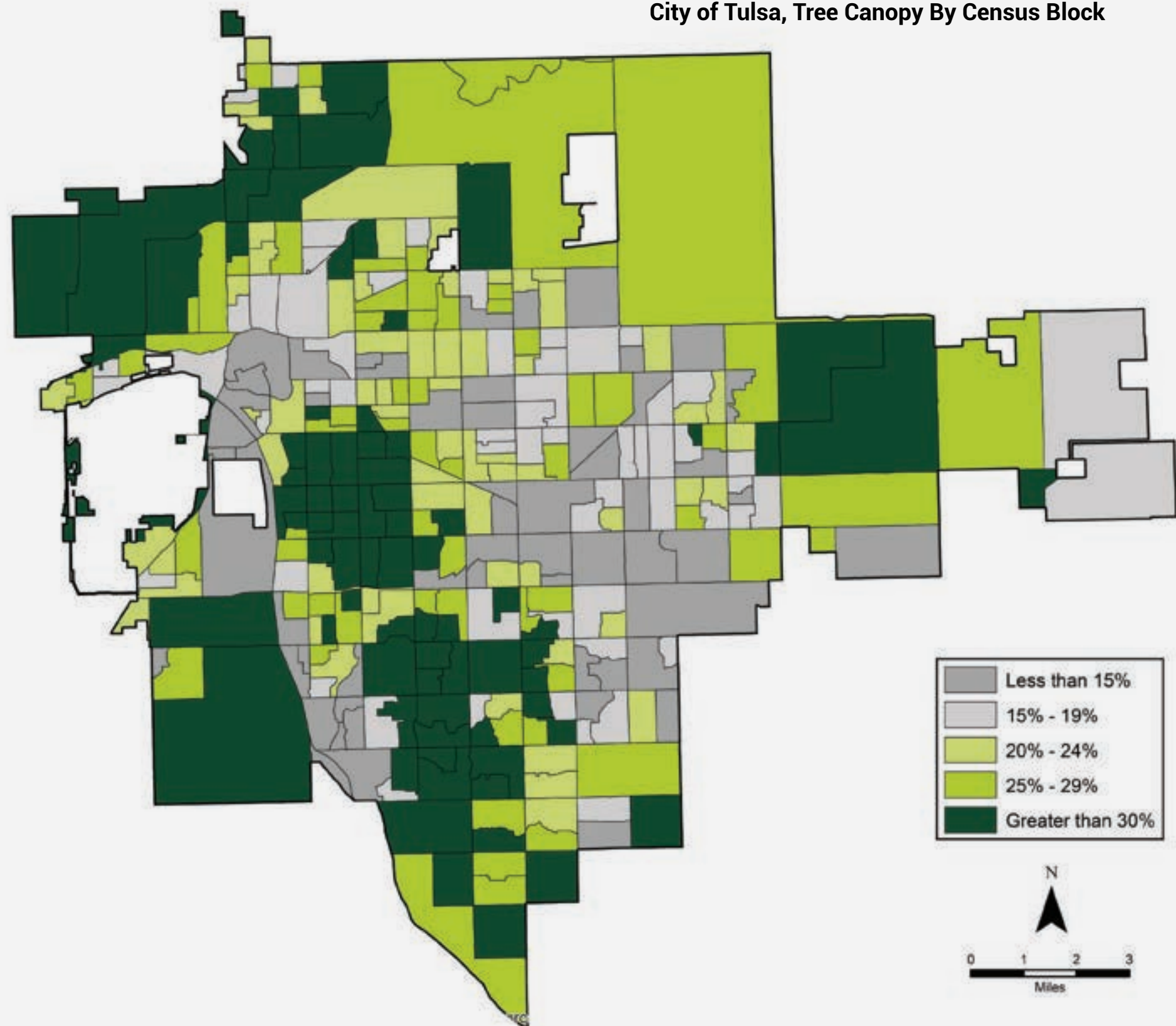
## Canopy Cover By Census Block

Mapping the canopy by census block provides a more detailed understanding of specific areas of Tulsa where canopy is established and where opportunities for tree planting exist. Among over 400 census block areas, 20% had 3-15% canopy, 54% had 15-30% canopy, and 26% of census block areas had over 30% tree canopy.

## Preferred Planting Sites

It could be assumed that all grass, low-lying vegetation, and bare soil are potential planting locations. However, realistically, not all of these areas are suitable planting sites due to intended site uses, including golf courses, cemeteries, sports fields, and other uses. Potential realistic plantable areas can be determined by excluding those pervious areas unsuitable for planting and including impervious areas where trees could realistically be added, such as in parking lot islands, along sidewalks and near road edges.

In addition, lists of low-canopy schools and parks have been generated to guide tree planting program development. In the City of Tulsa, both public and private schools and parks were considered because Tulsa has many privately owned open spaces. 80% of schools and 62% of parks have under 10% canopy.

*Overall tree canopy across the City of Tulsa averages twenty-six percent.*

# Priority Planting Areas

In Tulsa, tree planting at certain planting sites will produce a greater return on investment over other sites. For this analysis, planting site priority was determined based on identifying possible planting sites and then determining how a tree planted in the site would impact several factors related to stormwater interception and erosion control, urban heat islands, and environmental need. Based on community values, tree planting can be further prioritized by council district, neighborhood, and parcel to determine the most optimal planting priorities. These are sites where trees should be planted because they will provide the highest return on investment and generate the greatest community benefits.





City of Tulsa, Priority Planting

Very Low
Low
Moderate
High
Very High

N

0   1   2   3
Miles
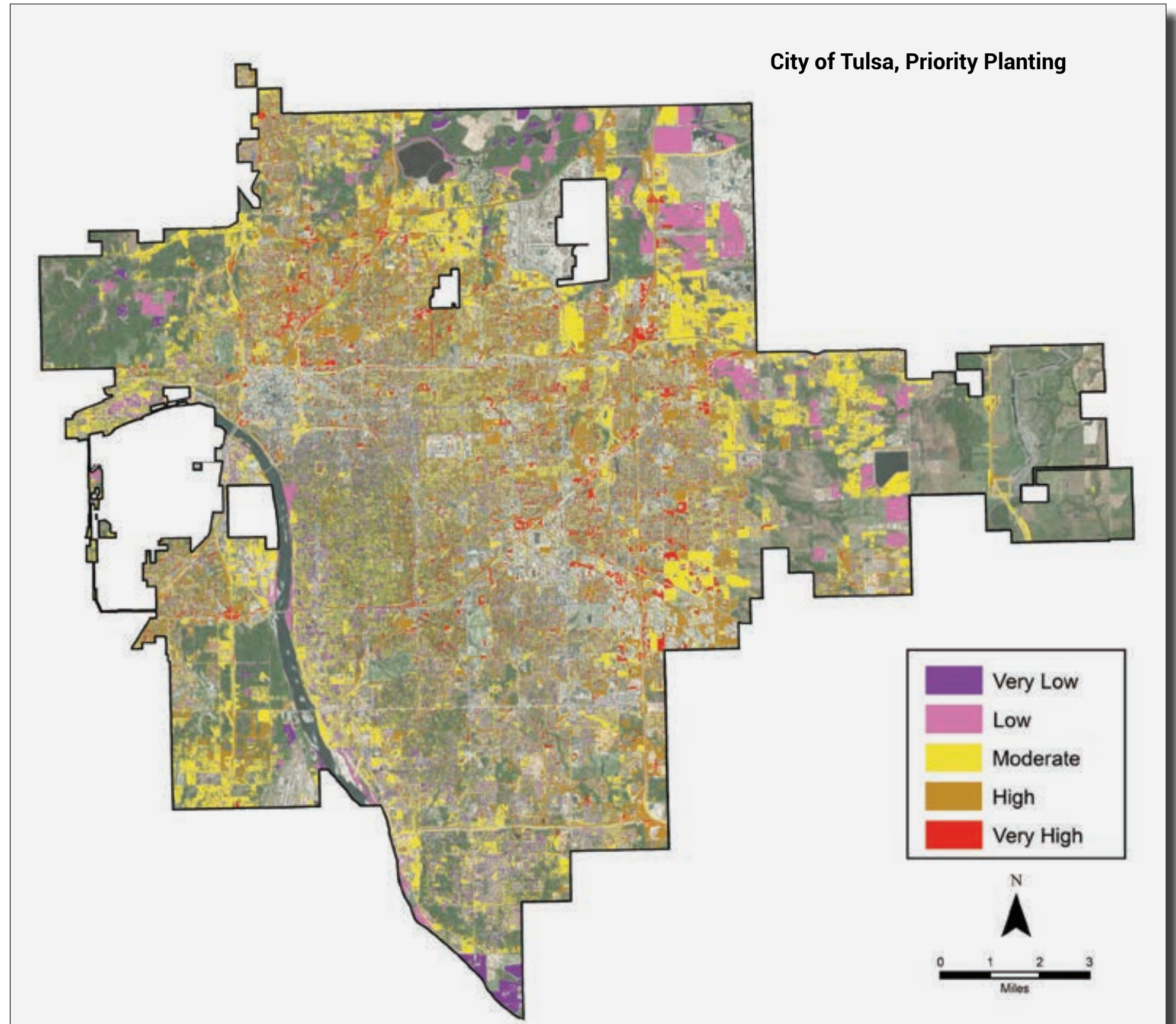
# Urban Forestry Partners

Tulsa's trees are managed by multiple agencies, departments, and private property owners. Annual dedicated funding for urban forestry varies, but recent estimates indicate an annual tree planting and management budget of $8.3 million across nine partners. There are approximately 30 full time employees providing urban forest management, and several agencies contract tree work with local arborists and tree care businesses.

## City of Tulsa

The City of Tulsa Park and Recreation Department (TP&R) strives to provide and preserve quality parks and recreation opportunities for all, and planting and maintaining trees is a vital part of this mission. The annual tree maintenance budget of the Tulsa Park and Recreation Department is $247,326, which serves 14,845 inventoried trees. The City of Tulsa Streets and Stormwater Department has a $1.08 million annual budget to manage trees along public streets, and within stormwater management facilities, including creeks, detention ponds, and drainage swales. For both City Departments, maintenance includes tree planting, watering, pruning, and removal when necessary. Maintenance is performed by city crews and contracted arboriculture professionals.

Tree management in the City of Tulsa is primarily conducted by the Park and Recreation Department, Urban Forestry Division. The Urban Forester is a Certified Arborist, assisted by 2 labor trade groundskeepers. Routine pruning is contracted out, and the pruning cycle is roughly 4 years. City personnel from the Park and Recreation Department, as well as Streets and Stormwater, conduct emergency response pruning when trees are an immediate danger to people, property, or road access.

Tree inspections are conducted when a citizen submits a request. Annually, 100-200 trees are planted in parks, and there is no scheduled street tree planting except in the downtown improvement area, and specific locations planted and maintained by the local nonprofit Up With Trees.

The Urban Forester primarily works within the Tulsa Park and Recreation Department, consulting with other departments, such as Streets and Stormwater, when tree preservation questions arise. The Urban Forester is authorized to collaborate with other departments and discuss tree-related issues with property owners and the general public. This typically takes place as one-on-one interactions.

## Tulsa Public Schools

Tulsa Public Schools manages trees at 91 campuses. A 2015 canopy study that reviewed the land cover of public and private schools in Tulsa found that 45% of the 4,543 acres of school grounds are potential tree planting sites, not including buildings, pavement, or ball fields.

## Tulsa River Parks Authority

Tulsa River Parks Authority (TRPA) strives to maintain, preserve, develop, and promote the Arkansas River and adjacent land areas under the Authority's jurisdiction within Tulsa County for the economic and cultural benefit of the community. TRPA's vision is for river parks to be the region's premier park, recreation, and entertainment destinations. The parks include 2,528 inventoried trees, and thousands more in natural areas. These areas include wildlife habitat, wetlands, riverbanks, and 26 miles of maintained trails.

| Urban Forest Manager | # of Planted and Inventoried Trees | Annual Tree Planting and Maintenance Budget | Acres Managed |
|---|---|---|---|
| City of Tulsa Park and Recreation Department, Urban Forestry Division | 14,845 | $ 247,326 | 8,200 |
| Tulsa County | | | 270 |
| Up With Trees | 22,000 | $ 250,000 | |
| Schools | 4,077 | $ 44,000 | 4,543 |
| City of Tulsa Streets & Stormwater Department | | $ 1,080,006 | |
| City of Tulsa Downtown Coordinating Council | 725 | $ 119,939 | |
| City of Tulsa Engineering Services | | $ 162,877 | |
| Public Service Company of Oklahoma | 1,950 line miles | $ 6,346,635 | |
| Tulsa River Parks Authority | 2,528 | $ 54,000 | 800 |

## Up With Trees

The mission of Up With Trees is to beautify greater Tulsa by planting trees and to create urban forestry awareness through education. Up With Trees has planted approximately 22,000 trees, at parks, schools, and along public roadsides planted over the past 40 years, and 14,000 of those are currently inventoried and actively maintained. UWT's tree planting program trains community volunteers to establish and maintain the trees, fostering awareness of the urban forest and the benefits trees provide.

Partnerships are essential to the success of Up With Trees' planting programs. Up With Trees partners with ODOT, the City of Tulsa, and the Downtown Coordinating Council (DCC) to secure planting locations and to provide maintenance for the trees throughout their lives.

Up With Trees is the primary organizer and educator about trees in the Tulsa community. This is accomplished through stakeholder engagement at events such as; the LAND Forum, the Green Leaf Gala, tree plantings, and trainings. The Up With Trees website (UpWithTrees.org) provides the general public with information about tree benefits, opportunities to attend classes, and upcoming training.

One popular training opportunity is the Citizen Forester Program which teaches participants the "Ps of Trees: Planning, Planting, Preserving, and Promoting". The website also hosts a calendar and provides information about upcoming events and volunteer opportunities. Residents can sign up to receive an e-newsletter. The website includes links to help address common local tree questions.

## Public Service Company of Oklahoma

Public Service Company of Oklahoma (PSO) provides electricity across the state, and is headquartered in Tulsa. Their mission is "We power Oklahoma: providing safe, reliable electric service." PSO manages any trees that are in proximity to electrical lines and ensure compliance with federal requirements for vegetation management in utility corridors (NERC, 2009).

In Tulsa, most of the electric utility easements are located behind properties, rather than along the roads, and there are many instances of fence-line trees (planted and volunteer) with the potential to grow toward utilities. PSO works diligently to inspect and provide line clearance for every tree along the utility easement on a four-year cycle. This program has been in effect since 2008.

PSO publishes one of the most popular tree booklets titled "Tree Tips: a Planning Guide", which features tree planting tips, including how to select the right tree for the right place, a matrix of tried-and-true species for the area, and tips on cultural practices. Information on common local soil issues such as pH balance and permeability, pruning tips, and even how to hire an arborist are covered by this resource.

## Tree Species Composition

While a 2007 tree inventory identified 14,845 trees in parks, subsequent plantings, and removals have not been well documented. In 2016, Up With Trees began inventorying trees in street medians to more fully understand species composition. The Tulsa school tree inventory should be considered an estimate. The chart below shows the species composition for these three partial inventories to help begin to understand Tulsa's tree species composition.

**Common Tree Species by Managing Agency**
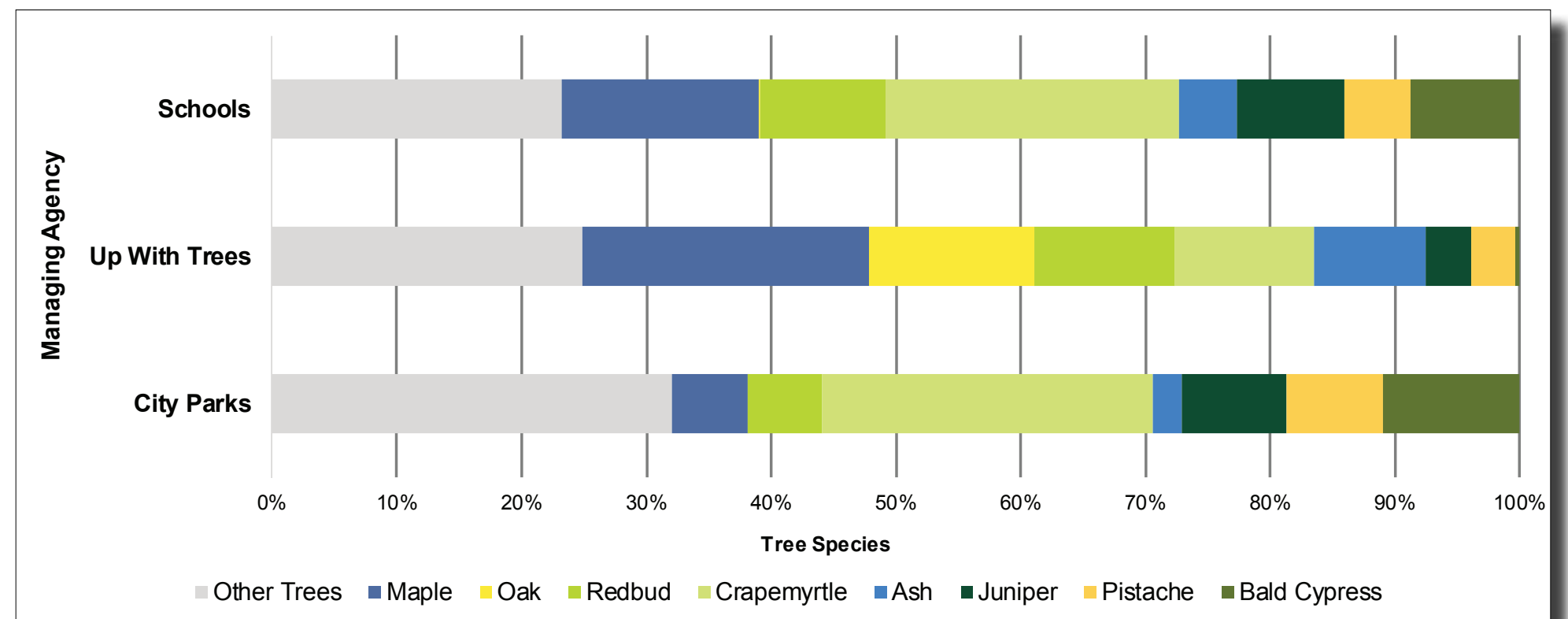
# Common Trees

Tulsa's urban forest features over 137 unique species. Appropriate species selection, or choosing the "right tree for the right place" is a key goal of this UFMP. Selecting appropriate tree species relies on an understanding of site conditions, as well as the palette of tree species that perform well in Tulsa.

Site considerations include:

- Soil volume, quality, compaction, and texture
- Irrigation or water availability
- Site access and maintenance opportunities
- Sun exposure
- Wind and air flow
- Human site uses
- Potential utility, line of sight, or clearance conflicts

Key considerations related to tree species include:

- Tree stature (height and width) at maturity
- Flower and fruit production
- Wildlife food and habitat attributes
- Wood strength

A revised Master Tree List was reviewed by multiple stakeholders and produced as a companion to this UFMP. Periodic updates to the Master Tree List are vital to introducing new promising tree species and cultivars, and retiring selections that no longer perform as desired.


Chinese Pistache (*Pistacia*)


Maple (*Acer*)


Cypress (*Taxodium*)


Oak (*Quercus*)

Redbud (*Cercis*)


Ash (*Fraxinus*)


Crapemyrtle (*Lagerstroemia*)


Juniper (*Juniperus*)

# Major and Emerging Pests

Invasive insects and diseases can cause citywide tree die offs, and create significant hazards when large numbers of trees die at once, outpacing the workload capacity of urban forest managers and tree care professionals. Early detection and planning for urban forest threats can help spread the burden of species-specific pests over several years, and anticipate fluctuating budgetary needs.

Asian Longhorned Beetle (ALB) is an insect that bores into and kills a wide range of hardwood species. ALB poses a threat to 23% of Tulsa City's urban forest (1.19 million trees), which represents a potential loss of $883 million in structural value (NASPF, 2005).

Emerald Ash Borer (EAB) has killed thousands of ash trees in parts of the United States. EAB has the potential to affect 4% of the population (214 thousand trees), which represents a potential loss of $94 million in structural value (NASPF, 2005).

Oak Wilt (OW), which is caused by a fungus, is a prominent disease among oak trees. OW poses a threat to 13% of Tulsa County's urban forest (700 thousand), which represents a potential loss of $2.3 billion in structural value (Rexrode and Brown, 1983).

# RESOURCES & OPPORTUNITIES

*The City of Tulsa includes a total area of 128,571 acres with 26% (33,455 acres) existing tree cover. Tulsa has the potential to support 54% tree canopy.*

*Tulsa has a rich history of parks and forestry which provides a strong foundation for expanding tree resource policies and creating new programs.*

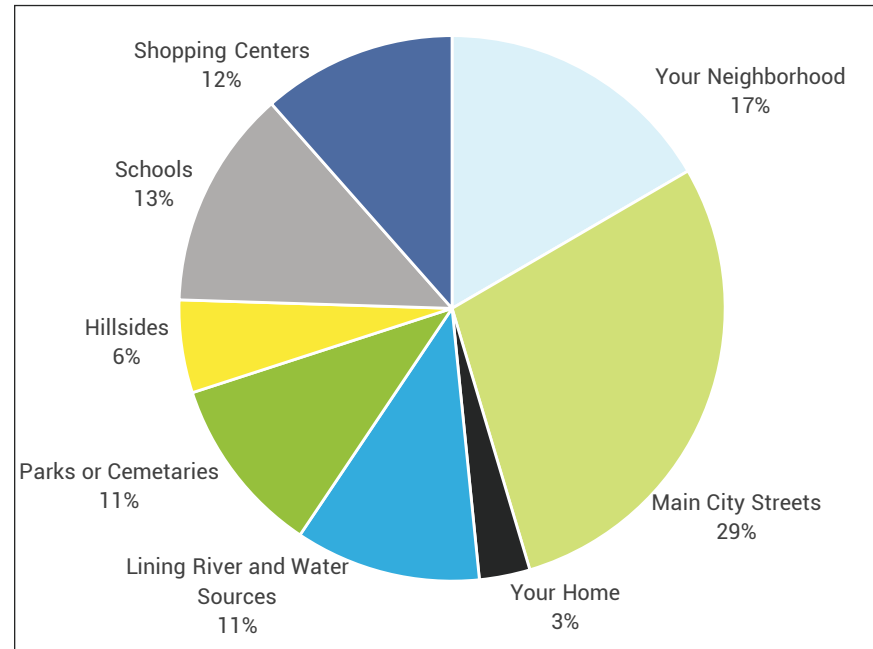*Combined, Tulsa and tree management partners have a planting and maintenance budget of $8.3 million. There are approximately 30 full time employees providing urban forest management, and additional contract work with local arborists and tree care businesses.*
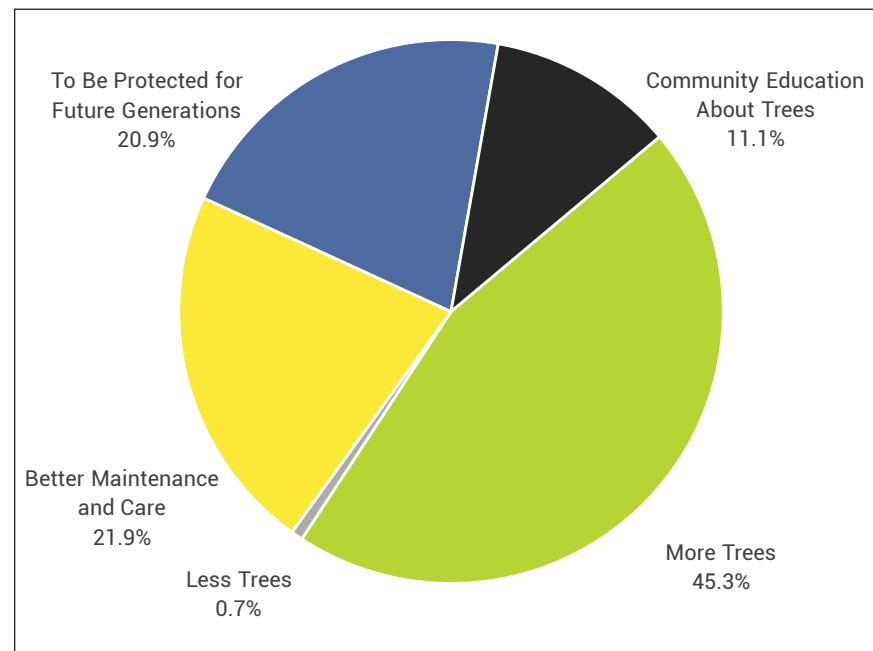
HEALING WALKWAY
"Lifting as we climb-The eternal verities shall prevail"
~ B.C. Franklin ~

ENTER                                                    EXIT

# What Do We Want?

## Community Input

Up With Trees and agency partners conducted substantial outreach to agency personnel, key regional stakeholders, and the Tulsa community.

### Master Plan Symposium

In June 2015, over 50 key stakeholders met to begin the discussion that would lead to the creation of this UFMP. This Master Plan Symposium began with an overview session to bring all attendees to the same awareness level about Urban Forest Planning, and the afternoon session allowed for discussion and brainstorming among participants. The questions discussed included:

- What are the top 5 issues facing our region?
- What is important to you regarding Tulsa County's tree canopy?
- What would you like to see from a forestation standpoint in 20 years?
- What happens next?

The symposium results were used to inform the development of this UFMP.

### Online Community Survey

In 2015, Up With Trees (UWT) developed a survey to understand community values about Tulsa's trees. Data was collected through online and with paper paper surveys. The online survey was available on the UWT website. The paper forms were distributed to local restaurants, churches, community groups, and other



local organizations. Over 1,800 people responded to the survey over six months. When asked how they feel about trees, the majority of participants (82%) placed a high value on trees, stating that they "Love" them.

Survey results also revealed which tree benefits were most valued. The top three benefits were air quality, shade, and increased property values. Residents were asked which challenges most affected their neighborhood trees, and maintaining trees and pruning trees were the top two. When asked what Tulsa's tree canopy needs most, survey participants valued tree planting and maintenance. Almost half (45%) of participants felt that more trees were necessary. Almost a quarter, (22%) wanted "Better Maintenance and Care" for Tulsa's trees.

When asked where more trees should be planted, main city streets and neighborhoods were the most popular responses. Among survey participants, tree planting activities were popular, which makes sense, given the popular opinion Tulsa needs more trees (45% of respondents to "What does Tulsa's canopy need most?").

The online survey included open ended questions, to give respondents the opportunity to provide feedback in their own words. The word map (above) was created using the open ended responses, with more common words shown in larger text. For example, "Tulsa" appeared the most frequently and thus is the largest.



TULSA URBAN FOREST
MASTER PLAN
*Growing Forward*

First Draft of Master Plan
Available for Public Input!

## "Where would you like more trees planted?"



- Shopping Centers 12%
- Your Neighborhood 17%
- Schools 13%
- Main City Streets 29%
- Hillsides 6%
- Your Home 3%
- Parks or Cemetaries 11%
- Lining River and Water Sources 11%

## "What does Tulsa's tree canopy need most?"



- To Be Protected for Future Generations 20.9%
- Community Education About Trees 11.1%
- Better Maintenance and Care 21.9%
- Less Trees 0.7%
- More Trees 45.3%

## Community Meeting

On June 8, 2016, Up With Trees hosted a community meeting at Oklahoma State University, which was attended by 41 community residents. The purpose was to share the results of the canopy study and gather input about proposed UFMP goals. The two hour meeting included a presentation about the tree resource, and provided ample time for dialogue and community input. Participants shared opinions and voted for their prefered approaches to solving key urban forest challenges.

Topics discussed included:

- Canopy goal setting
- Tree planting priorities
- Food forests
- Site design and groundcover near trees
- Tree protection

Considering the level of public input through community meetings, steering committee meetings, and through the survey, it is apparent that many Tulsa residents have thoughtfully considered the urban forest and it's needs. The dialogue started with these initial meetings and surveys should continue as more data is collected, and our understanding of the urban forest's challenges and opportunities evolves.

## LAND Forum

On October 23, 2015 a statewide forum was held to discuss the urban forestry challenges across Oklahoma. Participants included landscape architects, nursery representatives and developers. The intent of the forum was to open a dialogue about what challenges each industry faces, and to identify opportunities for improvement and collaboration. That dialogue informed the development of this UFMP.

## UFMP Advisory Council

Up With Trees convened an advisory council to steer the development of the Urban Forest Master Plan. The group of key stakeholders met monthly to review elements of the UFMP as it was developed. This review and feedback was vital to ensure that the UFMP reflects community values and addresses challenges to Tulsa's urban forest.

# Conclusion

Tulsa has an established urban forest managed by multiple agencies and property owners. Stakeholders share a vision for the urban forest that over time it will become more safe, resilient, and connected. Achieving this will require more monitoring, more tree planting, and more proactive regular maintenance than funding and agency resources currently allow.

Most partners agree that when trees cause conflict in Tulsa, it is often the result of a tree species that is incompatible with it's planting space, or a species that performed well in the past but is now impacted by emerging pests, changes in climate, or unusual weather events. This points to a directive to work to ensure that in the future, the right tree is planted in the right place. This includes consideration of species attributes and site factors, including soil volume and quality, water needs, light exposure, potential conflicts with utilities and pavement, emerging pests and pathogens, among other factors. In addition, managers anticipate the need for ongoing monitoring of species diversity, and the need to understand that some tree failure may occur for unforeseen reasons.

Currently Tulsa has 26% tree canopy cover. Many stakeholders support maintaining current levels or increasing canopy to 30%. With no current tree protection measures on private property - during development or for street trees - canopy growth will be challenging to achieve. Moreover, Tulsa's canopy distribution is variable, with limited canopy cover in some neighborhoods, and generous canopy in older, established areas. With newly-generated maps and canopy analysis, planting areas that strategically provide maximum impacts in terms of equity and environmental benefits can be prioritized.

While Tulsa's urban forest faces challenges, engaged residents and urban forest partners are a substantial asset. The community perception of Tulsa as "Green Country" and an appreciation for trees form a strong foundation for this UFMP. Ultimately, increasing the resiliency, safety, and equity of the urban forest will rely on collaborative partners communicating regularly and monitoring the tree and human resources of Tulsa's urban forest.

*While Tulsa's urban forest faces challenges, engaged residents and urban forest partners are a substantial asset. The community perception of Tulsa as "Green Country" and an appreciation for trees form a strong foundation for this UFMP.*

# COMMUNITY VISION

*Increase citywide canopy cover.*

*Plant the right species of trees based on site conditions.*

*Increase canopy cover over right of ways.*

*Plan and budget for proactive tree maintenance.*

# How Do We Achieve Our Goals?

The following section communicates the keystones for the UFMP and provides goals and recommendations for achieving these keystones.
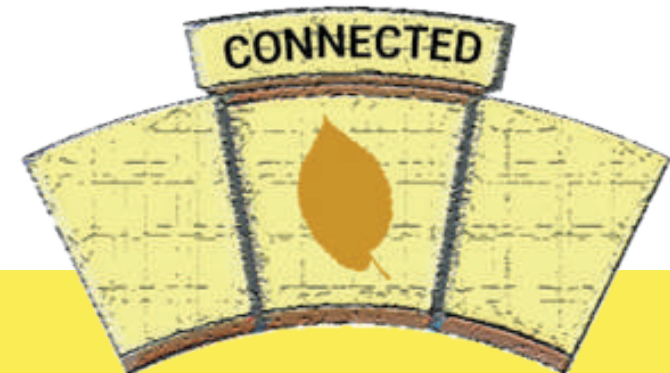
## Keystones

**RESILIENT**

**SAFE**

**CONNECTED**

## Goals

A **resilient** urban forest that is diverse in species and age distribution, where new trees are planted strategically to optimize establishment, tree health, and benefits.

A **safe** urban forest that is regularly inventoried, to proactively identify structural defects and trees in poor condition, managed by well trained tree care personnel. Safety and health issues are addressed in a timely and efficient manner.

An urban forest that **connects** the whole community to nature, where tree canopy and tree benefits are distributed equitably, for all Tulsa residents to enjoy, and where information and resources about Tulsa's trees are easily accessed and shared.

## Recommendations

- Ensure tree benefits for future generations through a sustainable planting program.
- Align policies with the community vision for canopy establishment.
- Explore additional funding sources to reach desired level of services.
- Achieve 30% urban tree canopy within 20 years.

- Maintain public trees proactively.
- Develop a tree risk management strategy.
- Monitor the resource for exotic and invasive pests and diseases
- Develop training for tree care personnel based on industry best management practices

- Implement a coordinated outreach and education campaign.
- Connect urban forestry partners through a single vision.
- Encourage public and private participation in urban forest management through volunteerism.
- Increase tree canopy coverage so that all people can enjoy the benefits of trees equitably.
- Focus on neighborhood-based initiatives and solutions to urban forestry issues.

## A resilient urban forest that is diverse in species and age distribution, where new trees are planted strategically to optimize establishment, tree health, and benefits.

### Goal 1: Ensure tree benefits for future generations through a sustainable planting program that encourages planting the right tree in the right place.

| Recommendations: | | Timeline | Costs | Partners |
|---|---|---|---|---|
| 1. Plant trees that mature to a size that fits the soil volume and site: | | 1-5 Years | $ | Up With Trees |
| 2. Plant Trees that are diverse and resilient to storms, pests, and anticipated climate changes: | Focus public outreach about tree planting on selecting trees that will not create future conflicts with infrastructure or utilities.<br><br>Where space allows, plant large-maturing shade trees whenever possible. | Ongoing | $$ | Up With Trees, PSO, City of Tulsa |
| | Update the City Master Tree List as an interactive attribute-based online resource.<br><br>Update print materials, such as the Public Service Company of Oklahoma's Tree Tips Booklet.<br><br>Work with local nurseries to promote availability of proven and innovative tree cultivars.<br><br>Promote xeric and drought-adapted species.<br><br>Promote species with structural characterstics that are resistant to storm damage. | | | |

### Goal 2: Align policies with the community vision for canopy establishment.

| Recommendations: | | Timeline | Costs | Partners |
|---|---|---|---|---|
| 1. Revise Landscape requirements for residential, commercial, and public buildings: | | 1-5 Years | $ | City of Tulsa |
| | Residential: Create policies that will result in sufficient shade trees to provide 50% canopy over neighborhood roads within 20 years.<br><br>Commercial: Plant for shade on east and west sides of buildings, and for windbreaks.<br><br>Public and Government Buildings: identify LEED certification goals for new facilities.<br><br>Parking Lots: Conduct baseline parking lot tree sample inventory to assess canopy % of randomly sampled parking lots (Use canopy study GIS layer.). Gradually implement tree requirements to produce 50% shaded surface within 20 years of planting.<br><br>All locations: Specify soil volume requirements based on mature tree stature.<br><br>Encourage proper street tree planting with any sidewalk construction or road repair work. | | | |
| 2. Incorporate urban forestry practices into the City's stormwater management efforts: | | 3-5 Years | $$ | City of Tulsa |
| | Collaborate with road-repair projects to integrate bioswales and street-side vegetated stormwater facilities | | | |

## Goal 3: Explore additional funding sources to reach desired level of services.

| Recommendations: | Timeline | Costs | Partners |
|---|---|---|---|
| 1. Establish one-time and ongoing funding needs. | 1 Year | $ | Up With Trees, City of Tulsa |
| 2. Identify and apply for grants. | 1 Year | $ | Up With Trees, City of Tulsa |

## Goal 4: Achieve 30% urban tree canopy cover within 20 years.

| Recommendations: | Timeline | Costs | Partners |
|---|---|---|---|
| 1. Explore policies that will facilitate tree replacement when removal is necessary. These measures could include: | 1-5 Years | $ | City of Tulsa |
| Replace street trees within one year of removal. Develop a tree removal permitting system to track removals of public ROW trees. Create public outreach materials to define when tree removal permits are required. Train local commercial arborists and landscaping companies to recognize when a tree removal permit is required. Develop a notification protocol for non-compliant properties and fee structure for failure to replace street trees. | | | |
| 2. Incentivise tree preservation on private property. | 5-10 Years | $ | City of Tulsa |
| 3. Evaluate park tree replacement policy to address canopy loss from storm damage: | 5-10 Years | $ | Up With Trees, City of Tulsa |
| The City of Tulsa plants around 200 park trees per year, but over 7,000 park trees were lost in the 2007 storm alone. Based on canopy study and community feedback, street and park tree planting will need to be increased to match community expectations. | | | |

## Goal 5: Measure and communicate progress in UFMP implementation.

| Recommendations: | Timeline | Costs | Partners |
|---|---|---|---|
| 1. Annual review plans and report progress: | Annually | $ | City of Tulsa |
| Review and Update the UFMP. Produce a State of the Urban Forest Report to benchmark achievements and identify areas of focus for the next year. | | | |
| 2. Maintain management practices and promote program growth: | Annually | $ | Up With Trees, City of Tulsa |
| Maintain Tree City USA status annually and apply for Growth Awards | | | |
| 3. Measure citywide land cover changes: | 10 Years | $$ | Up With Trees, City of Tulsa |
| The City of Tulsa plants around 200 park trees per year, but over 7,000 park trees were lost in the 2007 storm alone. Based on canopy study and community feedback, street and park tree planting will need to be increased to match community expectations. | | | |

**A safe urban forest that is regularly inventoried, to proactively identify structural defects and trees in poor condition, managed by well trained tree care personnel. Safety and health issues are addressed in a timely and efficient manner.**

## Goal 1: Maintain Public Trees Proactively.

| Recommendations: | Timeline | Costs | Partners |
|---|---|---|---|
| 1. Establish a city-wide tree inventory for Tulsa: | 1-5 Years | $$ | City of Tulsa |
| Update Up With Trees inventory continuously. | | | |
| Encourage other entities (ie Tulsa Public Schools, Tulsa County, City of Tulsa) to inventory all of their trees. | | | |
| 2. Optimize tree maintenance to follow industry standards and best management practices: | 10-20 Years | $$$ | Up With Trees, City of Tulsa |
| Explore partnerships to ensure all public trees receive maintenance on a 4 to 6-year pruning cycle. | | | |
| Train tree care personnel. | | | |
| Implement trials of tree site changes such as the addition of mulch and xeric groundcover to reduce mowing maintenance. | | | |
| Provide structural pruning for young trees to develop a single central leader and well-spaced scaffold branches. | | | |
| Develop a Street Tree Master Plan. | | | |
| 3. Formally establish the duties of the City Urban Forester to include overseeing all park tree management and providing oversight for street and stormwater facility trees: | 1-5 Years | $ | City of Tulsa |
| Include oversight of all park tree management and work review for street and stormwater facility tree pruning activities. | | | |

## Goal 2: Develop a Tree Risk Management Strategy.

| Recommendations: | Timeline | Costs | Partners |
|---|---|---|---|
| 1. Use Tree Risk Assessment (ISA TRAQ) when appropriate: | 1-5 Years | $ | City of Tulsa |
| TRAQ certified arborist conduct risk assessment for large trees where high value targets are present. | | | |
| 2. Establish a comprehensive tree emergency response and recovery plan: | 1-5 Years | $$ | City of Tulsa |
| Engage stakeholders to coordinate storm response among multiple departments. | | | |
| 3. Identify funding opportunities for disaster recovery: | Ongoing | $ | City of Tulsa |
| Explore using disaster mitigation plans and funds to address potential urban forest threats or hazards. | | | |

## Goal 3: Monitor the resource for exotic and invasive pests and diseases.

| Recommendations: | | Timeline | Costs | Partners |
|---|---|---|---|---|
| 1. Develop an EAB Management plan: | | 1-5 Years | $ | City of Tulsa |
| 2. Monitor for urban forest threats: | Using updated inventory, project ash treatment and removal strategies over 5-10 years. | 5-10 Years | $ | Up With Trees, City of Tulsa |
| 3. Develop public awareness of emerging urban forest pests and diseases: | Work with USDA to position traps in strategic locations. Facilitate commercial arborist pest ID training. | 1-5 Years | $$ | Up With Trees, Oklahoma Agricultural Experiment Station |
| | Use existing national communication and marketing tools to implement a local "Don't move firewood" campaign. | | | |

## Case Study: Look Before you Leaf

Poor tree structure, ice and wind storms, and unmonitored internal decay can all cause tree or limb failure, impacting public safety. To see a prime example of a model program focused on urban forest safety, Tulsa residents can look no further than their own backyards, where many fenceline trees are in Public Service Company's electric utility easement. When vegetation grows into close proximity or contacts a high-voltage utility line, service interruptions may occur, and electrocution or fire ignition is possible, so utility companies methodically inspect and maintain vegetation with the potential to cause a hazard.

In Tulsa, most of the electric utility easements are located behind properties, rather than along the roads, and there are many instances of fence-line trees (planted and volunteer) with the potential to grow toward utilities.

PSO's "Look Before You Leaf" tree planting philosophy provides guidance for tree planting within 40 feet from the lines. This includes recommending no trees at all within 15' on either side of utilities; small trees (under 30' tall at maturity) may be within 15-30' horizontally from the utility, medium trees (under 50') within 30-40', and large trees (51 feet and greater) should be planted no closer than 40' horizontally from the line.

PSO works diligently to inspect and provide line clearance for every tree along the utility easement on a four-year cycle. When trees are planted too close to utility lines, they can cause utility conflicts, and PSO proactively works with homeowners to conduct removals and provides vouchers for new replacement trees of appropriate stature. This program has been in effect since 2008 and, as a result, it is rare that trees require pruning more often than their 4-year cycle. Because of past successes, a new initiative was launched to conduct inspections outside the 80' wide utility impact area, to identify trees that are likely to fail in severe weather events.

**A resilient urban forest that is diverse in species and age distribution, where new trees are planted strategically to optimize establishment, tree health, and benefits.**

## Goal 1: Ensure tree benefits for future generations through a sustainable planting program that encourages planting the right tree in the right place

| Recommendations: | Timeline | Costs | Partners |
|---|---|---|---|
| 1. Communicate the energy saving benefits of trees: | 5-10 Years | $ | Up With Trees, PSO |
| Construct pilot projects to partner with PSO to plant trees strategically to reduce peak load by shading buildings, and provide signage to publicize the energy benefits of trees. Include user-friendly tree benefit information into newsletters and press releases. | | | |
| 2. Develop communication regarding various resources connected to trees available to the public: | 1-5 Years | $$ | Up With Trees |
| Develop an online interactive tree finder based on the reviesed Master Tree List. | | | |
| 3. Build on existing partnerships with schools: | 1-5 Years | $$ | Up With Trees |
| Explore partnership with all of the local schools to create an awareness campaign about trees and education about trees for the students. | | | |

## Goal 2: Connect urban forestry partners through a single vision.

| Recommendations: | Timeline | Costs | Partners |
|---|---|---|---|
| 1. Engage stakeholders in understanding and promoting the urban forest: | Ongoing | $ | Up With Trees, City of Tulsa |
| Maintain and cultivate relationships built during the UFMP development process. Convene meetings with elected officials to share the state of the urban forest update, annually. | | | |
| 2. Convene key stakeholders regularly: | Ongoing | $ | Up With Trees |
| Host community meetings such as 2015's Land Forum, or the 2016 Community Meeting to engage key urban forest stakeholders from business, agency, and community organizations, annually. | | | |

## Goal 3: Encourage public and private participation in urban forest management through volunteerism.

| Recommendations: | Timeline | Costs | Partners |
|---|---|---|---|
| 1. Expand and develop leadership in volunteer base: | Ongoing | $ | Up With Trees |
| Establish a monthly treemail update targeted specifically for volunteers. Provide opportunities for volunteers to take leadership roles in managing the urban forest. | | | |

## Goal 4: Increase tree canopy coverage so that all people can enjoy the benefits of trees equitably.

| Recommendations: | Timeline | Costs | Partners |
|---|---|---|---|
| **1. Strategically plant trees in high-priority planting areas:** | **Ongoing** | **$$$** | **Up With Trees, City of Tulsa** |
| Address council district canopy inequities by encouraging tree planting in low-canopy districts. Explore fruit tree planting partnerships with community gardens and schools. Target marketing outreach for tree give-aways to align with highest priority planting areas. Collect address of intended planting location from free tree recipients to track tree planting by neighborhood or census block. | | | |
| **2. Develop and implement forestry practices and policies that protect birds, pollinators and other wildlife:** | **1-5 Year** | **$$** | **Up With Trees, City of Tulsa** |
| Comply with all state and federal regulations that protect endangered and migratory species and nesting birds. Apply integrated pest management (IPM) strategies to determine appropriate responses to tree pests and pathogens. Promote important habitat plant species for cover, foraging, and nesting. Implement trials of tree site changes such as the addition of mulch and xeric groundcover to reduce mowing maintenance. Integrate wildflowers and monarch waystations into tree planting sites where appropriate. | | | |

## Goal 5: Focus on neighborhood-based initiatives and solutions to urban forestry issues.

| Recommendations: | Timeline | Costs | Partners |
|---|---|---|---|
| **1. Conduct public outreach to determine neighborhood challenges and opportunities related to trees:** | **1-5 Years** | **$** | **Up With Trees** |
| Solicit community feedback at neighborhood association meetings, and other existing public forums. Promote multiple modes of communication, soliciting feedback by mail, email, and in person at community events. | | | |
| **2. Explore opportunities for trained volunteers to serve neighborhoods through education, tree maintenance, tree planting, etc:** | **1-5 Years** | **$** | **Up With Trees** |
| Establish training programs for neighborhood tree coordinators or establish an internship program. | | | |
| **3. Facilitate community dialogue to establish a local vision for the care and growth of the urban forest:** | **1-5 Years** | **$** | **Up With Trees** |
| Engage with the neighborhood to approve species to be planted, and priority locations. | | | |

## Case Study: ReGreen Tulsa

ReGreen Tulsa was a successful public-private partnership to plant 10,000 trees, a prime example of urban forest resiliency in action. A December 2007 ice storm caused unprecedented damage to Tulsa's urban forest. Over 20,000 trees were lost throughout the community, including 7,000 trees in city parks. Kathy Taylor was Tulsa's mayor at the time. She worked with Up With Trees and leveraged city resources to kick off the project in 2008. Ultimately, through individual and corporate donations the community dedicated $1.5 million in private funding which was matched by the Tulsa Community Foundation to fund the $3 million project.

A diverse species palette, focusing on storm-resilient trees was selected. Over the last 9 years, trees were planted at schools, neighborhoods, parks, at city properties, and in 16 neighborhoods. The project had 15 collaborative partners to plant trees at 196 locations throughout Tulsa. Volunteer crews were trained to help plant the trees, recruiting many residents from nearby neighborhoods. This created a group of local, knowledgeable, engaged partners who could monitor the trees' establishment and growth.

## Case Study: Tisdale Food Forest

In the end we will conserve only what we love; we will love only what we understand; we will understand only what we are taught (Baba Dioum, 1968). This philosophy forms the basis of successful conservation marketing and communication strategies around the world. Stewards of Tulsa's urban forest may wonder how educational programs can go beyond the dissemination of information, to promote understanding - and ultimately love - of trees in Tulsa. One answer may lie in the adage: Give a man a fish, he'll eat for a day. Teach him to fish, he'll never go hungry again.

A food forest is a land management system which mimics a woodland ecosystem and provides edible fruits and nuts for human consumption. A relatively new public space design strategy, the concept of a food forest took root in 2009 with the development of the Beacon Hill Food Forest in Seattle, Washington. Tulsa's Tisdale Food Forest was established on April 24, 2016. It includes about 500 trees along the L.L.Tisdale Parkway. The Brady Heights Neighborhood Association partnered with Up With Trees to establish the trees, and local youth are being trained to maintain and harvest the nut trees. The program provides area teens with work experience, and growing self-confidence. Food forests also provide fresh, local food, and gardening experience for residents who may not have easy access to fresh fruits and locally harvested food.

# LESSONS LEARNED

*Disasters can act as catalysts, bringing the community together for the common good. The loss of 20,000 trees in a major ice storm became a key factor in ReGreen Tulsa's successful planting of 10,000 trees.*

*Tree risks and hazards can be successfully proactively managed. In a relatively short period of time, PSO has aligned most trees in proximity to utilities into a 4-year pruning cycle that effectively mitigates the risk of future utility conflicts.*

*People will become stewards for resources they perceive as creating value in the community. The Tisdale Food Forest provides fruits and nuts while building community skills and connections.*

# How Are We Doing?

## Monitoring and Measuring Results

It is vital that progress over time be monitored to ensure that the urban forest planning components are implemented in a timely manner, or that the plan is updated to reflect emerging challenges and opportunities.

### Annual Plan Review

The UFMP will guide management and planning decisions over the next 25 years. The goals, objectives, and actions will be reviewed yearly for progress and integration into an internal, annual work plan. The UFMP presents a long-range vision with target dates that are intended to be flexible. This will allow management to adapt in response to emerging opportunities, available resources, and changes in community expectations. Each year specific areas of focus should be identified, which will inform budget and time requirements.

## Resource Analysis

Tulsa urban forest managers can update the tree resource analysis as inventories are updated. The structure, benefits, replacement value, and tree benefits were quantified in 2015. Future studies can compare changes against these benchmarks. This allows for the evaluation of changes in tree condition, species diversity, benefits, and overall resource value. An objective of the UFMP is to complete this analysis every 10 years to illustrate progress and success towards UFMP goals.

## Canopy Analysis

Canopy changes can occur gradually or suddenly, as a result of emerging pests, significant storm events, development, and other factors. Using GIS analysis, managers can measure and illustrate changes in overall land cover. This information can be used to inform canopy goals and monitor attainment. A canopy study should be conducted every 10 years, or after major canopy-impacting events as needed.

## State of the Urban Forest Report

This report includes numbers of trees planted and removed, and other changes to the overall community urban forest (e.g., structure, benefits, and value). It will serve as a performance report to stakeholders, and as an opportunity for engagement. The data will be used to highlight the successful attainment of UFMP objectives as well as to inform stakeholders about any issues or stumbling blocks. This information can be reviewed every 5-10 years, and will be used to pursue additional project support and funding.

## Community Satisfaction

The results of the UFMP will include measurable improvements to efficiency and reductions in maintenance costs. Achievement of UFMP goals will affect several positive changes. These changes will:

- Support better tree health
- Produce greater longevity
- Reduce preventable tree failures

Meeting community expectations for the care and preservation of the urban forest resource is an important measurement of success. Community satisfaction can be measured through surveys, community meetings, and public support for the UFMP. Community satisfaction can also be gauged by the level of engagement and support for urban forest programs. An annual survey of urban forest stakeholders will help managers ensure activities continue to be aligned with the community's vision for the urban forest.

# TRACKING PROGRESS

*Review UFMP annually to identify areas of focus for budget priorities.*

*Update the tree resource analysis to observe changes in the structure, benefits, replacement value, and tree benefits which were quantified in 2015.*

*Monitor canopy progress with canopy analyses conducted every 10 years.*

*Produce annual State of the Urban Forest Reports.*

*Monitor community satisfaction and perception of the urban forest through surveys, and continued dialogue with key stakeholders.*

# Appendix

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# Tables

# Maps

# Figures

# Tree Policy & Regulation

## State Law

State law (2006 Oklahoma Code - Title 60 - Property) states that private property owners own trees whose trunks are located on their property. Since property owners must maintain their property in a way that does not create a public hazard or nuisance, private property owners are required to conduct street tree maintenance in Tulsa. The City of Tulsa further regulates trees that extend into the public right of way, requiring clearance for vehicles and sight lines.

## City of Tulsa Municipal Ordinance

### Street Trees

The regulation of street trees in the City of Tulsa is primarily located in Title 35 Chapter 6 section 606B. The code provides a species list for street trees, which are divided into three size categories (small, medium, and large). The list is adopted by the mayor and approved by the city council. Only species included on this official list of approved street trees may be planted as street trees without explicit permission given by the Director.

Private property owners along arterial streets and intersections are subject to design and maintenance regulations defined in section 606C. These design regulations center around safety and accessibility. Examples include; preserving sightlines to fire hydrants, preserving sightlines through intersections, and limb height minimums over streets and sidewalks.

Only trees listed in the "small trees" section of the official list of approved street trees may be planted under or within twenty feet of any overhead, to ensure public safety near electric utilities. Section 1210 states

that right-of-way occupants have the authority to trim trees which overhang streets, sidewalks, and arterial rights.

Section 606D details the city's approach to street tree maintenance. The City of Tulsa reserves the overriding right to prune, maintain, and regulate trees and shrubs within all right-of-way lines to ensure public safety, facilitate construction, enhance beauty, and/or protect public utilities. Abutting private property owners are allowed to plant and maintain street trees, as long as they conform to the street tree design regulations. This compromise allows private property owners a level of self-determination in adjacent street trees while ultimately preserving the City of Tulsa's ability to intervene when warranted.

### Zoning and Landscaping

In Chapter 10 of the Zoning Code, consideration is currently being given to revisions of this section (2016). The purpose of Landscaping Requirements is to; promote reasonable preservation of trees and vegetation; aid in ecological balance and environmental benefits, achieve a meaningful urban forest, and the beautification of the City of Tulsa. Section 1001 defines that these restrictions apply, generally, to new developments of at least more than 1 dwelling structure.

Section 1002C describes the tree requirements for these new developments. A minimum of one tree for each 1,500 square feet of street yard is mandatory. Surface parking areas located in the Central Business District Zone are required to contain trees along and parallel to the street boundary and within 10 feet of a public street right of way.

Parking lot trees provide many benefits; beautification, reduction of noise pollution, treatment of air pollution, and shade for increased walkability and reduced urban heat island effect. Section 1002D(2) requires

that landscaping must include irrigation systems.

### Tree Protection

Various protections for trees exist in the City of Tulsa. Section 1801 states that it is an offense to maliciously cut down or in any way injure trees, shrubs, or flowers in any public place. Section 2104 offers similar protection to vegetation which is the private property of another. Marking, painting, affixing objects to shade trees or tree-boxes is unlawful per section 1302. Nuisances affecting public peace and safety are liable to be removed by public staff, and are defined by section 103.

Section 1002C describes the tree requirements for new developments. A minimum of one tree for each 1,500 square feet of street yard is mandatory. Surface parking areas located in the Central Business District Zone are required to contain trees along and parallel to the street boundary and within 10 feet of a public street right of way. Parking lot trees provide many benefits; beautification, reduction of noise pollution, treatment of air pollution, and shade for increased walkability and reduced urban heat island effect. Section 1002D(2) requires that landscaping must include irrigation systems.

# Planit Tulsa:
# Tulsa's Comprehensive Plan

PlanIt Tulsa is the city's comprehensive plan. Several areas of the plan relate directly to urban forest management and have been used to guide this UFMP. The comprehensive plan includes priorities, goals, and policies:

**6.1** Develop an Urban Forestry Master Plan to guide overall management and preservation of the tree canopy throughout the city.

This plan will include a Street Tree Master Plan to guide planting trees during development and redevelopment and to designate appropriate trees for plantings along major roads and corridors.

The Street Tree Master Plan should include:

A methodology to implement the Street Tree Master Plan.

Standards for public streets, planting strip width and design.

Potential funding sources including utility bill surcharges for planting, initial maintenance, sidewalk repair and replacement by City crews.

Potential funding sources needed to replace damaged, dying or removed trees.

Evaluation of compliance with the Street Tree Master Plan.

Standards for the level of development or redevelopment that would trigger compliance with the plan.

**6.2** Determine Tulsa's baseline tree canopy coverage and establish a monitoring program to be updated regularly.

**6.3** Set annual targets for increasing the tree canopy coverage in concert with population and development density increases.

**6.4** Work to achieve a sustainable urban forest that contains a diverse mix of tree species and ages in order to use the forest's abilities to reduce stormwater runoff and pollution, absorb air pollutants, provide wildlife habitat, absorb carbon dioxide, provide shade, stabilize soil, and increase property values. Develop a list of preferred species to guide private property owners in choosing locally appropriate trees.

**6.5** Develop additional regulatory tools to preserve tree canopy based on an analysis of the existing tree canopy and identification of priority areas.

**6.6** Implement tree planting requirements for new developments, including parking lots and building setback areas.

**6.7** Develop a program to facilitate greening of streets and sidewalks by property owners in collaboration with organizations such as "Up With Trees," the local public and private school systems and private entities.

# Soil Volume and Tree Stature
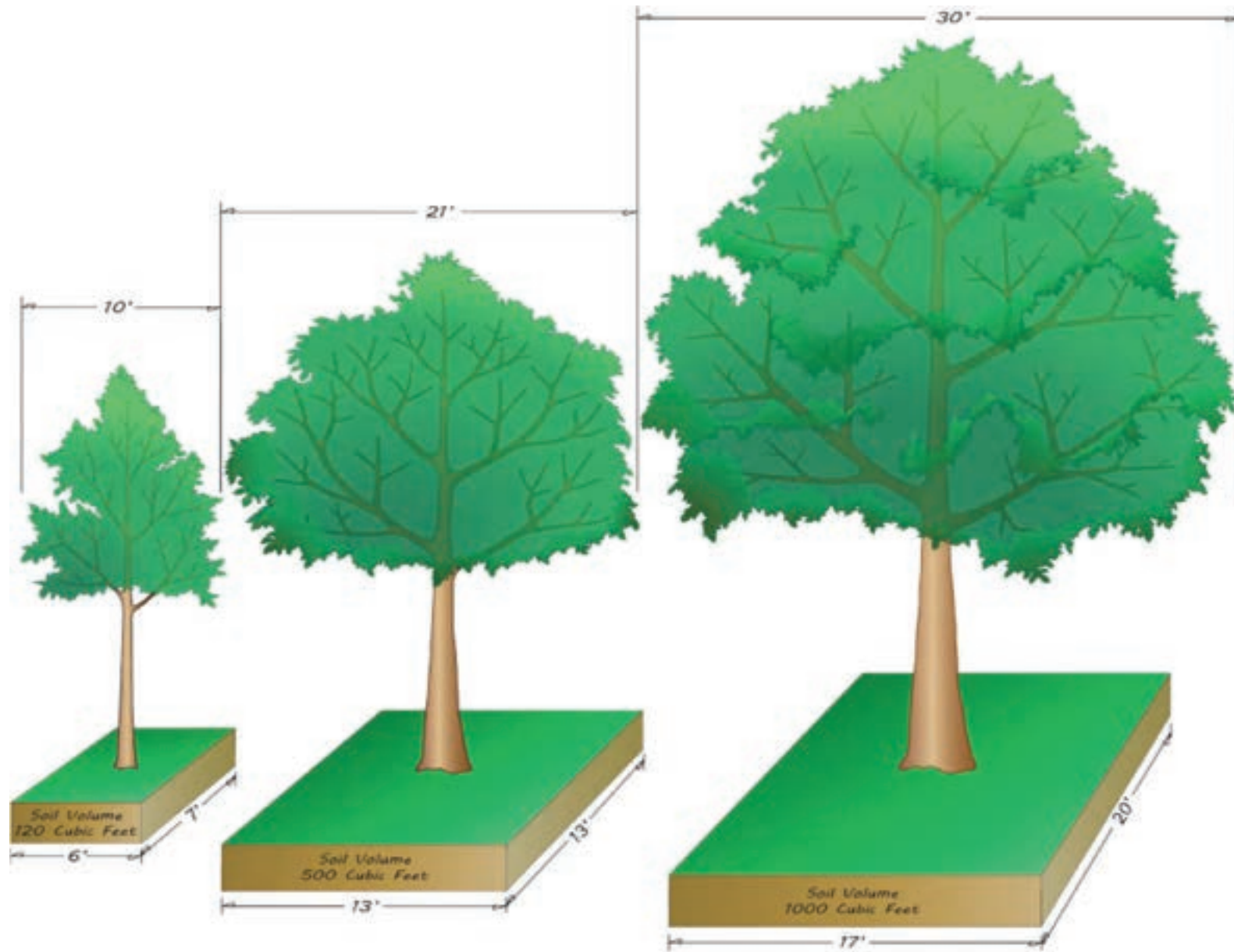




**Above:**

Tree growth is limited by soil volume. Larger stature trees require larger volumes of uncompacted soil to reach mature size and canopy spread (Casey Trees, 2008).
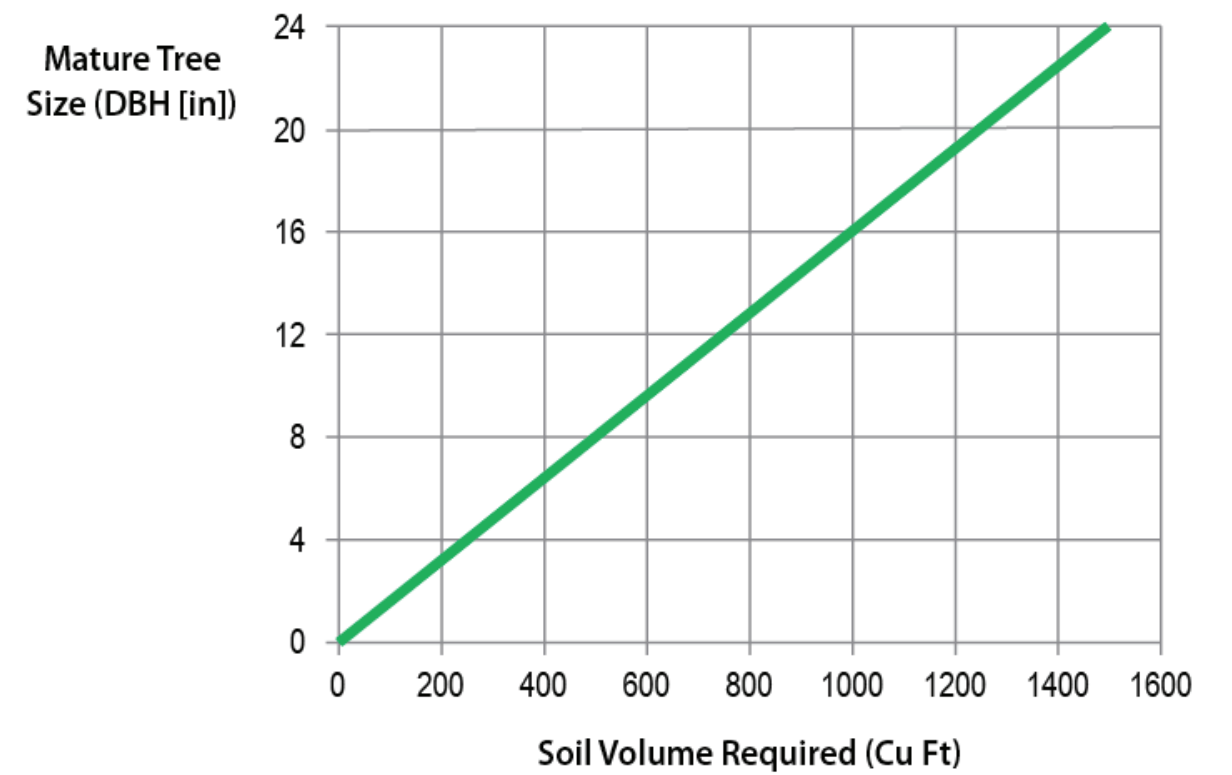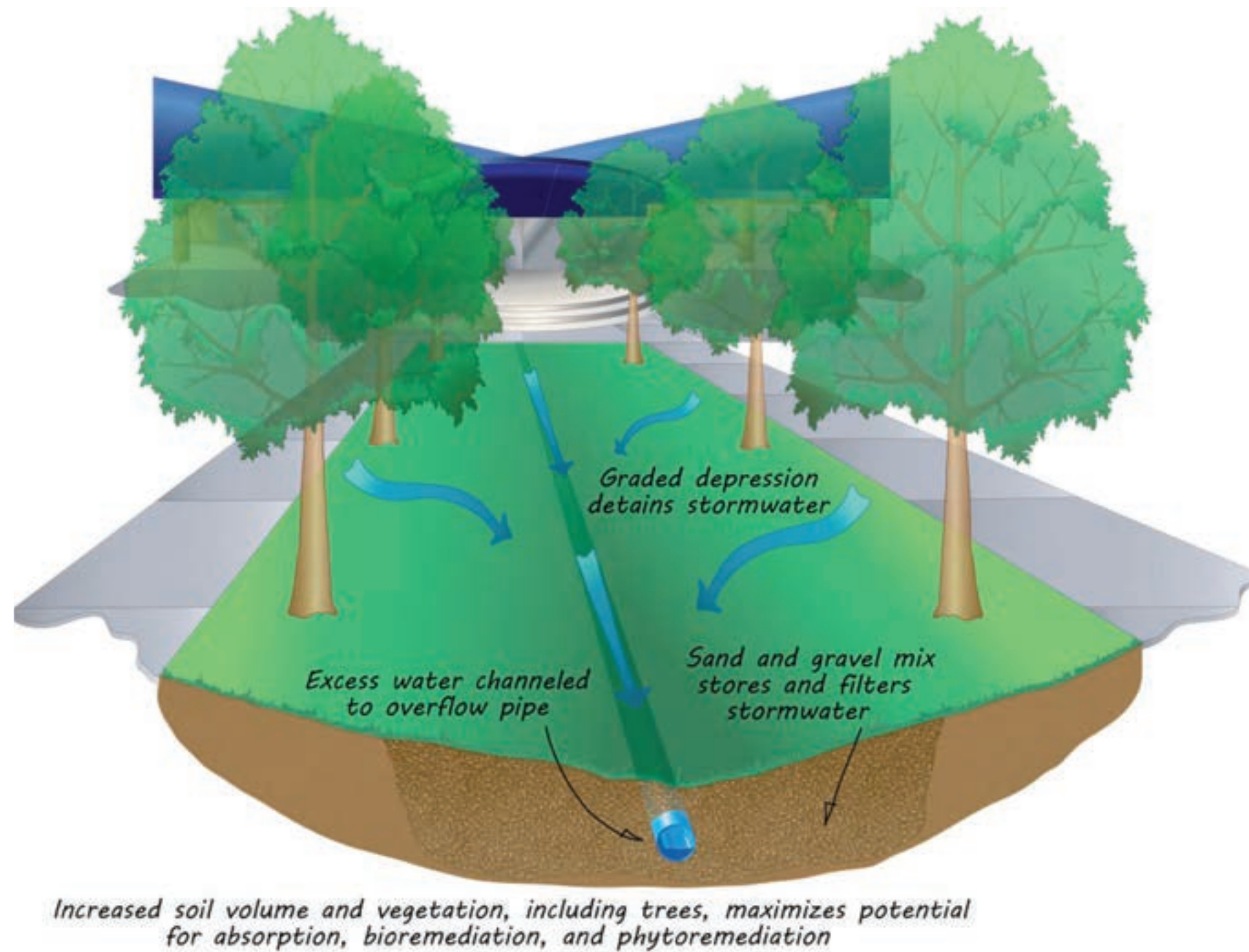
**Above:**

General relationship between soil volume requirements and mature tree size (James Urban, various sources, 1992).
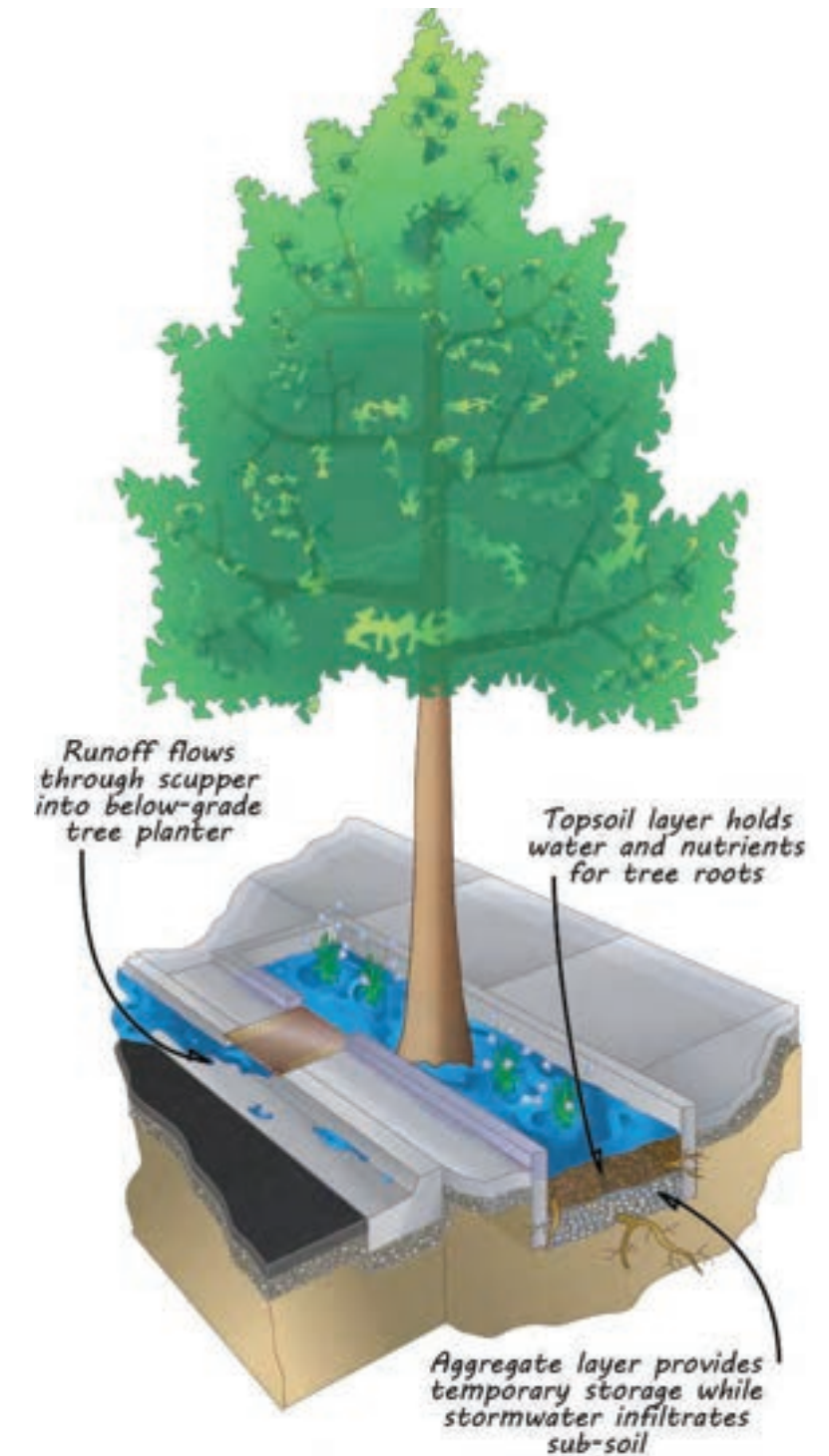
# Alternative Planter Designs



Graded depression detains stormwater

Excess water channeled to overflow pipe

Sand and gravel mix stores and filters stormwater

Increased soil volume and vegetation, including trees, maximizes potential for absorption, bioremediation, and phytoremediation
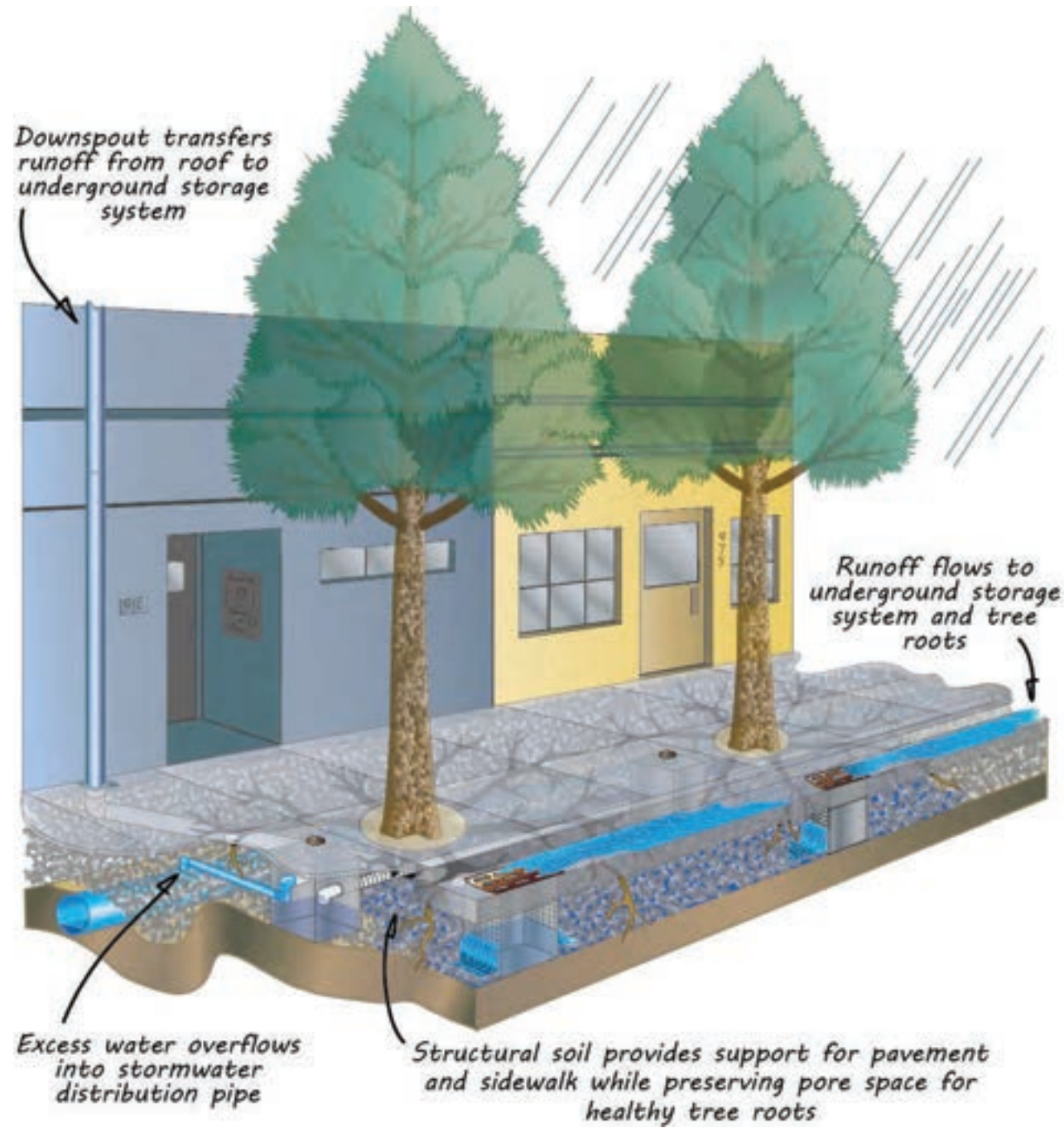
**Above:**

Bioswales are landscaped drainage areas with gently sloped sides designed to provide temporary storage while runoff infiltrates the soil. They reduce off-site runoff and trap pollutants and silt.



Runoff flows through scupper into below-grade tree planter

Topsoil layer holds water and nutrients for tree roots

Aggregate layer provides temporary storage while stormwater infiltrates sub-soil

**Above:**

Stormwater tree pits are designed to collect runoff from streets, parking lots, and other impervious areas. Stormwater is directed into scuppers that flow into below-grade planters that then allow stormwater to infiltrate soils to supplement irrigation.

# Alternative Planter Designs (II)



Downspout transfers runoff from roof to underground storage system

Runoff flows to underground storage system and tree roots

Excess water overflows into stormwater distribution pipe

Structural soil provides support for pavement and sidewalk while preserving pore space for healthy tree roots



Downspout transfers roof runoff to underground storage system

Runoff flows to underground storage system and tree roots

Reinforced concrete sidewalk

Undisturbed soil sub-base

Uncompacted soil supports a healthy root system and holds more stormwater

Excess water overflows into stormwater distribution pipe

Concrete pillars or prefabricated modules set on undisturbed sub-base provide support of sidewalk over uncompacted soil layer
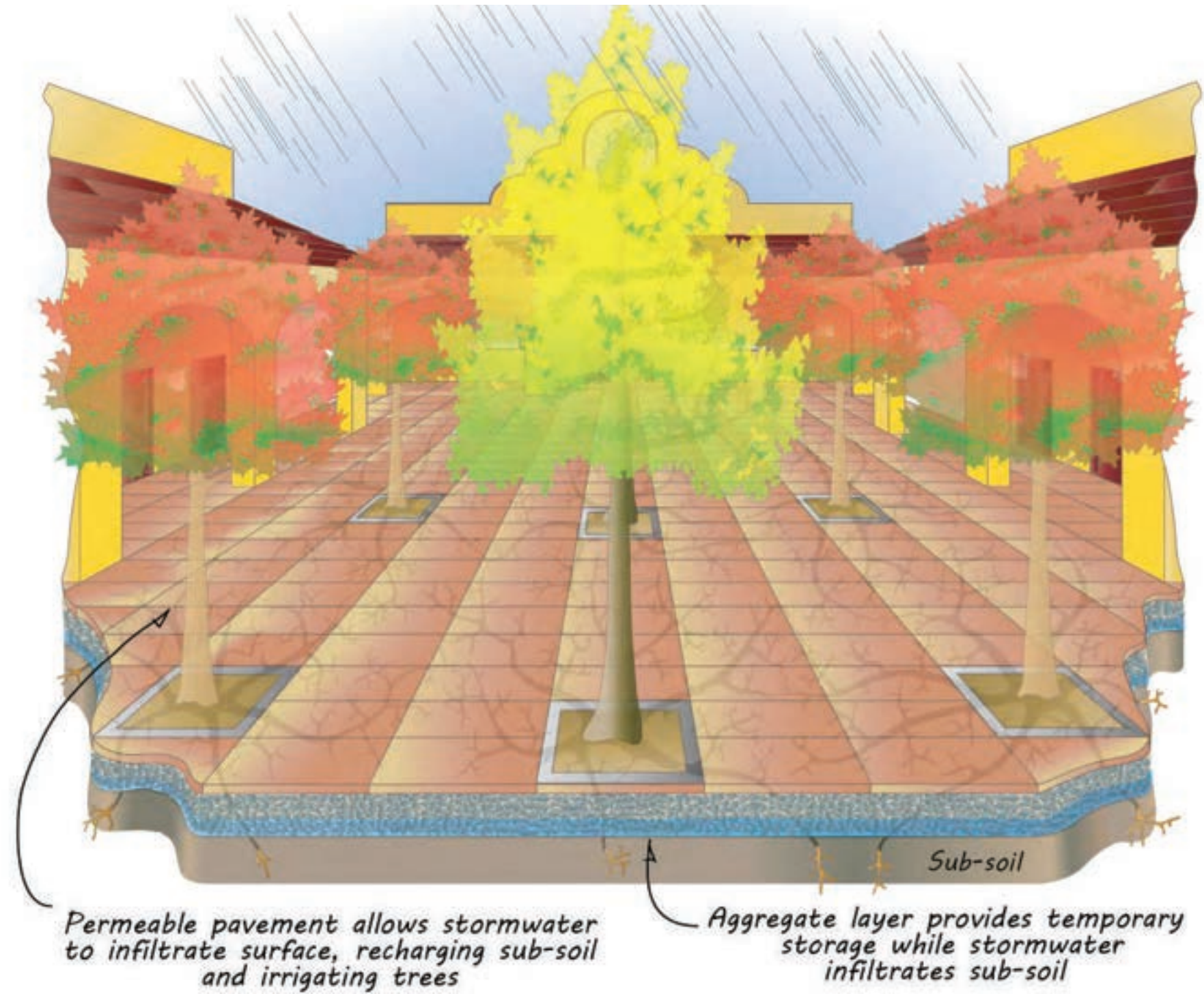
**Above:**

Structural soil is a highly porous, engineered aggregate mix, designed for use under asphalt and concrete as a load-bearing and leveling layer. The created spaces allow for water infiltration and storage, in addition to root growth.
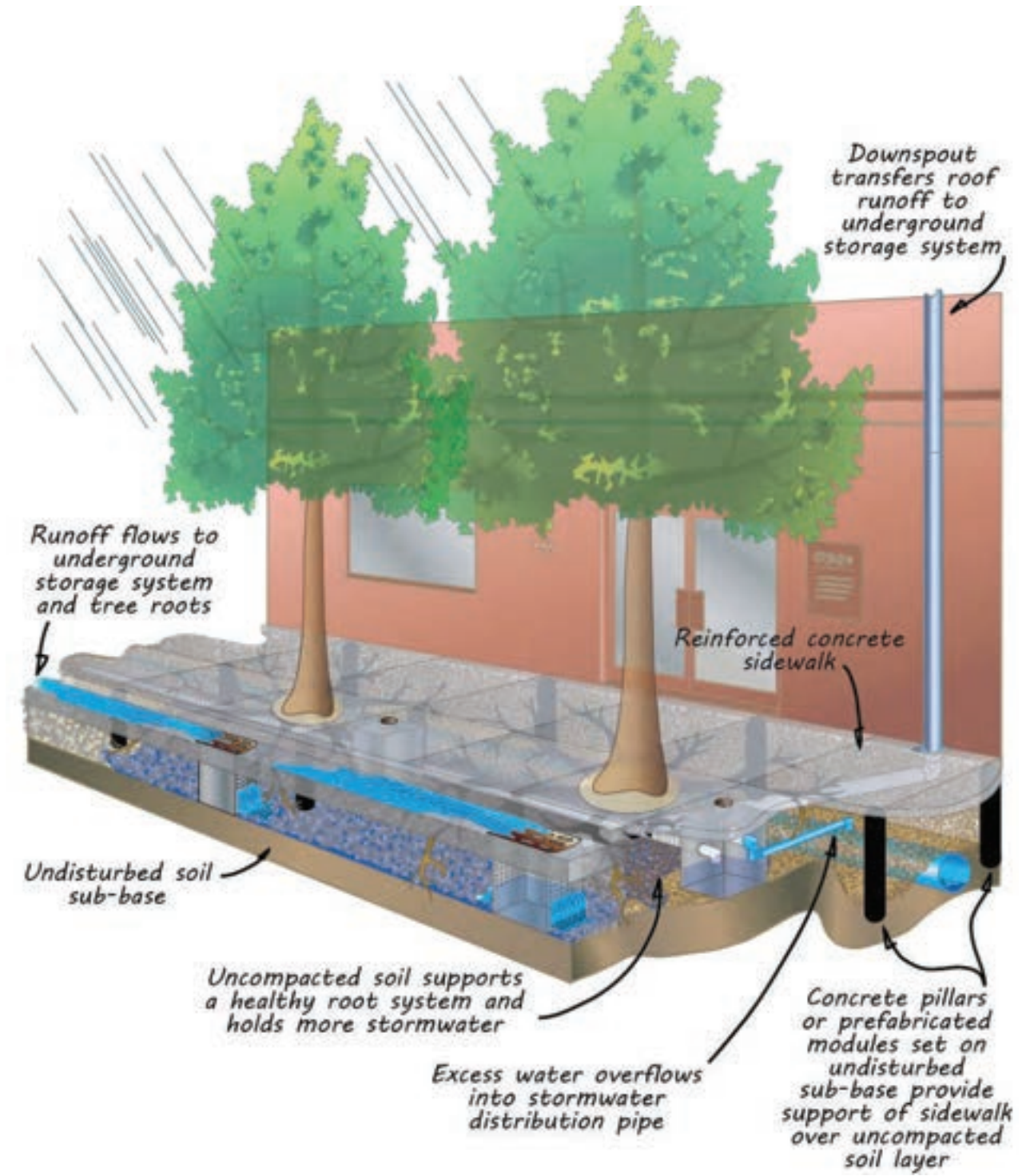
**Above:**

Suspended sidewalks use pillars or structured cell systems to support reinforced concrete, increasing the volume of uncompacted soil in subsurface planting areas and enhancing both root growth and stormwater storage.

Permeable pavement allows stormwater to infiltrate surface, recharging sub-soil and irrigating trees

Aggregate layer provides temporary storage while stormwater infiltrates sub-soil

Sub-soil

**Above:**

Permeable pavements allow stormwater and oxygen to infiltrate the surface, promoting tree health and groundwater recharge.

"It's the little things citizens do. That's what will make the difference. My little thing is planting trees."

- Wangari Maathai

# UP WITH TREES ™

**TREES**

| PLANTING,
PRESERVING &
PROMOTING

TULSA'S URBAN FOREST

Tulsa Urban Forest Master Plan - 2016