

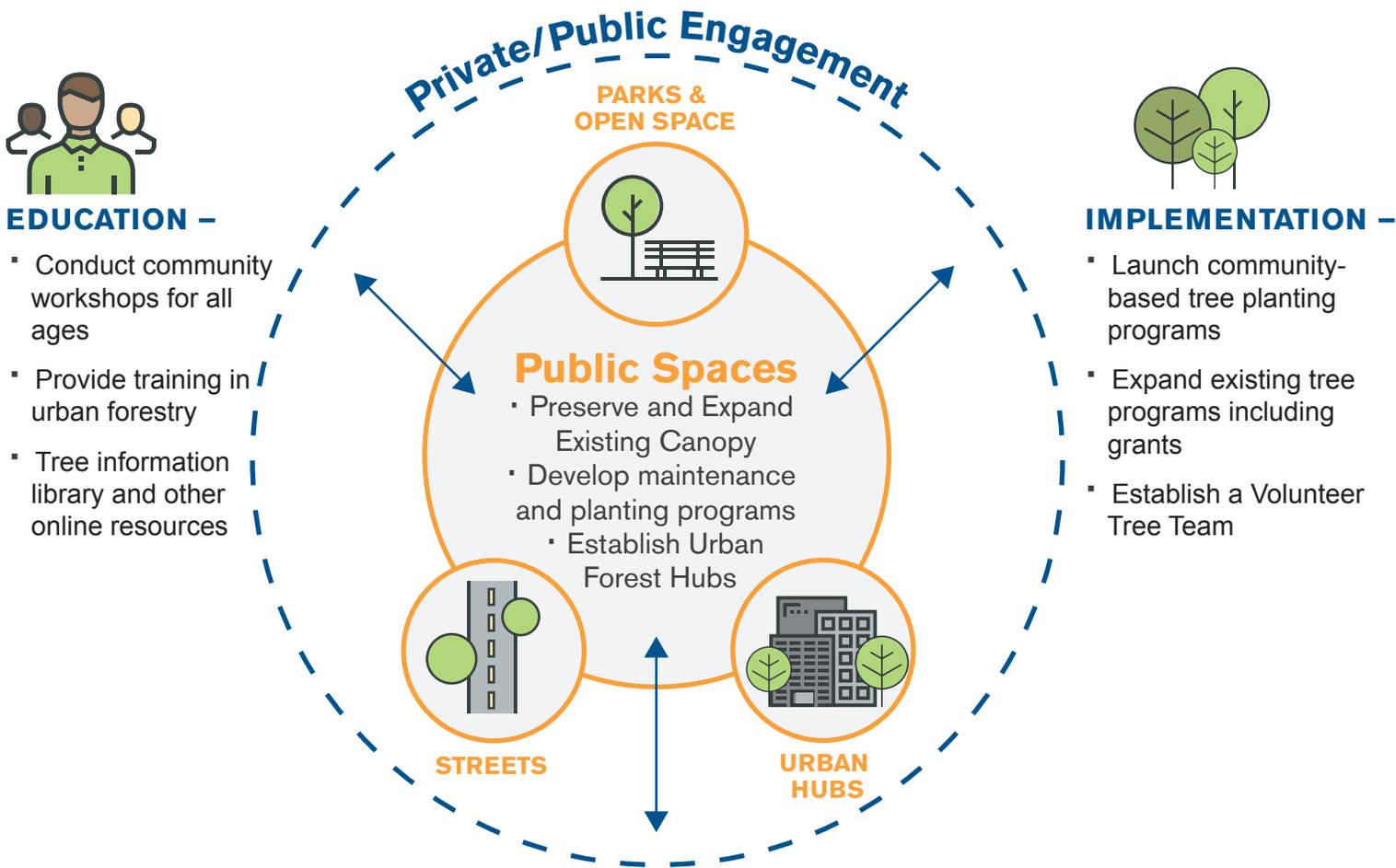


City of Tempe Urban Forestry Master Plan

September 2017

URBAN FOREST: OPPORTUNITIES FOR ACTION

The City of Tempe proposes a city-wide goal of 25% tree and shade canopy. In order to reach this aggressive goal, the City has identified three key public spaces on which to focus the planting and maintenance of new trees over this time: **parks and open spaces**, **streets** and **urban hubs** that are cores of commercial and civic activity that supports the 20-minute city. Targeting areas intended for pedestrian or civic activity as well as neighborhoods with low canopy cover, the City will also provide training and maintenance support through three principal private/public engagement strategies to ensure a sustainable urban forest.



Guiding Principles:

- Cultivate Collective Action
- Expand Shade to Maximize Urban Cooling
- Improve Walkability Equitably
- Support Biodiversity and Habitat
- Use Resources Wisely
- Enhance Property Values
- Enhance Community Beautification and Livability
- Promote a Healthy Community
- Right Tree, Right Place



COLLABORATION –

- Develop Public/Private partnerships
- Work with County, State and Federal Agencies
- Tap ASU research and collaborative programs like the Sustainable Cities Network

Research provided by

About this report

Urban forests are intentional human creations - they don't just happen - especially in the desert. Residents, city staff, businesses, and institutions must work to co-create healthy urban forests equitably distributed across the City of Tempe. The goal of this **Urban Forest Master Plan** (UFMP) is to expand Tempe's urban forest tree canopy and all the benefits trees provide for generations to come. Optimizing benefits and minimizing costs are central priorities. This Plan was developed with the consultation of arborists, city staff, community members, data analysts, and other experts in the urban forestry field.

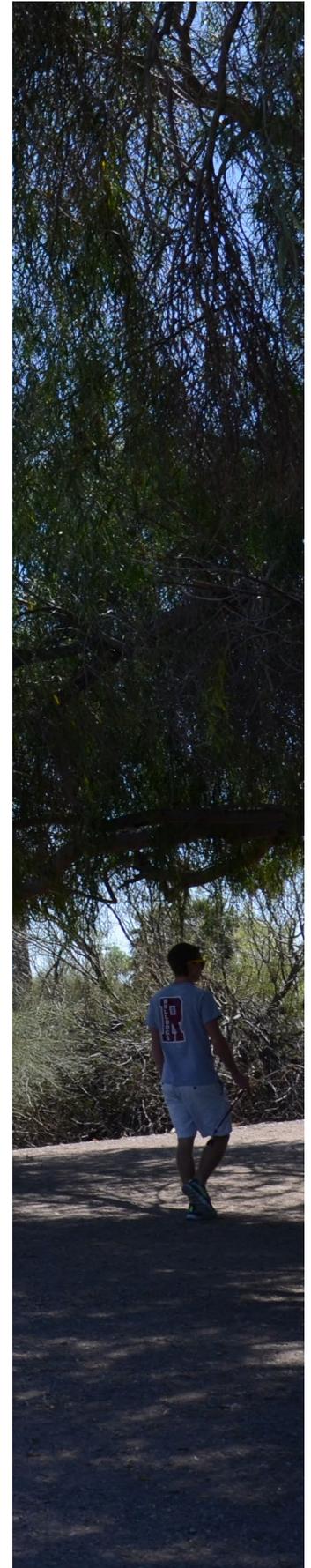
This UFMP includes a review of the current state of the existing urban forest, a vision for a healthy and sustainable future, and transition strategies to achieve a public health infrastructure that cools our streets, cleans our air, helps to mitigate the effects of global warming and beautifies our neighborhoods. The UFMP outlines the components of an integrated approach for engaging residents, community organizations, businesses and City departments to sustain an urban forest that supports the health and vitality of the community and its public spaces.

Current State:

The current state of the urban forest in the City of Tempe today is the result of the efforts and investments made by municipal and residential leaders from previous generations:

- **Tempe overall canopy cover**
3,412 acres (13.4% of total land area)
- **Tempe canopy cover in flood irrigated areas**
609 acres (21.5% of properties with flood irrigation, 2.4% of total land area)
- **Tempe canopy cover in non-flood-irrigated areas**
2,830 acres (12.4% of non-flood irrigated areas, 11% of total land area)
- **Tempe ROW canopy cover**
400 acres (1.6% of total land area)
- **Tempe canopy cover of publicly owned property**
200 acres (0.78% of total land area)

The city-managed urban forest includes trees in parks, street right-of-ways and municipally owned and managed facilities. There are approximately 19,450 city-managed trees in Tempe. Challenges to maintaining the existing canopy and expanding the urban forest include water use, infrastructure coordination, and funding. Maintenance of the urban forest is impacted by multiple plans and programs that exist across departments in the City. This UFMP highlights the necessity for coordination within these City departments and with utilities, landscapers, residents and businesses to ensure a healthy urban forest equitably distributed across the City.



Vision:

The City of Tempe’s General Plan 2040 includes the goal of becoming a 20-Minute City. This is defined as supporting development and land use where residents can comfortably walk or bike to urban hubs and major urban amenities, such as grocery stores, services and transit within 20 minutes of their homes. In support of this goal, the UFMP vision is to establish a green, cool and healthy Tempe that achieves a 25% urban forest tree canopy by 2040.

Public property solutions focus on parks and open space, streets, and urban hubs. However, the majority of the city consists of private properties (homes, businesses, retail, office) along with industrial, institutional and religious properties. Increasing the tree canopy on non-city properties will require solutions that engage, educate and empower the community. This includes developing community workshops to educate youth and adult community members about tree planting and care at local community centers and libraries, creating new and expanding existing programs for community engagement and empowerment and providing services to guide businesses and residents to plant the right tree in the right place.

Transition Strategy:

The UFMP outlines the components of an integrated approach for engaging residents, community organizations, businesses and City departments to sustain an urban forest that supports the health and vitality of the community and its public spaces. Improving city expenditure on tree planting and care while inspiring collaborative stakeholder action can create a 20-Minute City that benefits public wellbeing and economic development.

Guiding Principles:

The following guiding principles were established to support the vision of a green, cool and healthy Tempe and the overall UFMP:

- Cultivate Collective Action***
- Expand Shade to Maximize Urban Cooling***
- Improve Walkability Equitably***
- Support Biodiversity and Habitat***
- Use Resources Wisely***
- Enhance Property Values***
- Enhance Community Beautification and Livability***
- Promote a Healthy Community***
- Right Tree, Right Place***



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This report was prepared by:

ASU Rob and Melani Walton
Sustainability Solutions Initiatives
Arizona State University

Alex Slaymaker, Project Assistant, Global Sustainability Solutions Services
Bill Campbell, Project Manager, Global Sustainability Solutions Services
Dr. Ariane Middel, Data Analyst, Global Institute of Sustainability
Dr. Braden Kay, Project Manager, Global Sustainability Solutions Services
Andrea Levy, Project Assistant, Global Sustainability Solutions Services
Suzanne Jumper, Research Aide, Global Sustainability Solutions Services
Jessica Groeneveld, Project Coordinator, Global Sustainability Solutions Services
Jason Franz, Manager of Marketing and Communications, Walton Sustainability Solutions Initiatives
Abby Johnson, Photographer, Master Sustainable Solutions Student, School of Sustainability

with

Bonnie Richardson, Architect/ Principal Planner, City of Tempe

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The goal of becoming a 20-Minute City, as defined in the City of Tempe's General Plan 2040, supports development and land use where residents can comfortably walk or bike to urban hubs and major urban amenities, such as grocery stores, services and transit within 20 minutes of their homes.

Introduction

Because of its location in the heart of the Sonoran Desert, shade does not come naturally to many of the neighborhoods in the City of Tempe. Developing and maintaining a healthy urban forest provides many economic, social and environmental benefits including the reduction of energy use and utility costs, mitigation of the effects of the urban heat island, expansion of habitat for wildlife and reduction in stormwater runoff. To ensure that Tempe's mostly man-made urban forest remains healthy requires active management.

The intent of this Urban Forest Master Plan (UFMP) is to illustrate how urban trees are an important city asset and a crucial part of the City's public health infrastructure. The UFMP outlines the components of an integrated approach for engaging residents, community organizations, businesses and City departments to sustain an urban forest that supports the health and vitality of the community and its public spaces.

The urban forest includes all trees across the city from border to border, including those on private property (residential, commercial, institutional and industrial properties). The City-managed urban forest includes trees in parks, street right-of-ways and municipally owned and managed facilities. A healthy urban forest is critical to supporting the sustainable growth of a desert city such as Tempe. Expanding the urban forest will reduce heat retention and support the City's goal of becoming a 20-Minute City. This UFMP is a result of collaborative planning and

Urban hubs, also defined in the 2040 General Plan, are high density cores of commercial, residential, entertainment/recreational or civic activity that are infused with cultural amenities and are connected by parks, paths or transit.

research between staff from multiple municipal departments and the Walton Sustainability Solutions Initiatives at Arizona State University (ASU). In addition, at multiple community engagement events held during 2015-2016, a diverse range of residents expressed their desire for a healthy urban forest. In order to continue engagement with community stakeholders about urban forests, Tempe staff prepared a communication plan and began public outreach in 2016. Presentations and additional information are available at www.tempe.gov/urbanforest. Outreach will continue in 2017 inviting community review and comments.

The UFMP includes a review of the current state of the existing urban forest, a vision for a healthy and sustainable future and transition strategies, including a collection of potential activities and practices to achieve the vision. This plan also seeks to embrace the momentum of existing projects and initiatives and provides the tools necessary for city staff, residents and businesses to collaboratively create a thriving urban forest.

Specific goals and targets in this UFMP reflect the following key objectives:

- ***Empower residents, businesses, organizations and city staff to collaboratively create and care for an urban forest that provides a 25% tree canopy by 2040.***
- ***Improve mobility through the equitable distribution of shade trees to create a walkable, 20-Minute City that benefits public wellbeing and economic development.***
- ***Increase park, open space and public space use through the strategic and efficient utilization of natural, economic and human resources to expand and care for a healthy biodiverse urban forest canopy.***
- ***Increase tree canopy, replace missing/diseased trees and update sparse landscape in right-of-ways, parks and city properties.***



Current State

This section explains existing forestry programs, the distribution and characteristics of existing canopy cover, the economic value of trees and challenges to maintaining and expanding the canopy.

Tempe's estimated canopy coverage, including both City and privately managed trees, is currently 13.4% of the total land area. Tempe's canopy coverage by census tract ranges from 5% to 25.8% (Figure 1), and coverage by Character Area ranges from 8.5% to 20.5% (Figure 2). Using local landmarks such as canals, freeways, rail lines and city borders, the City has identified eight Character Areas, each representing distinct, historic and cultural identities within Tempe.

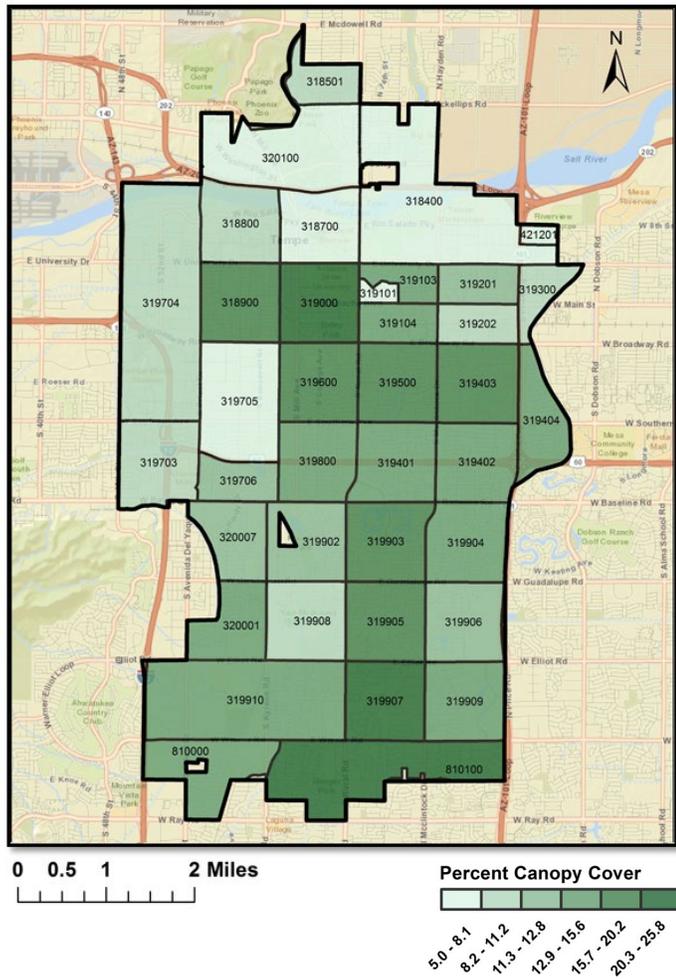


Figure 1: Tree Canopy Coverage by Census Tract

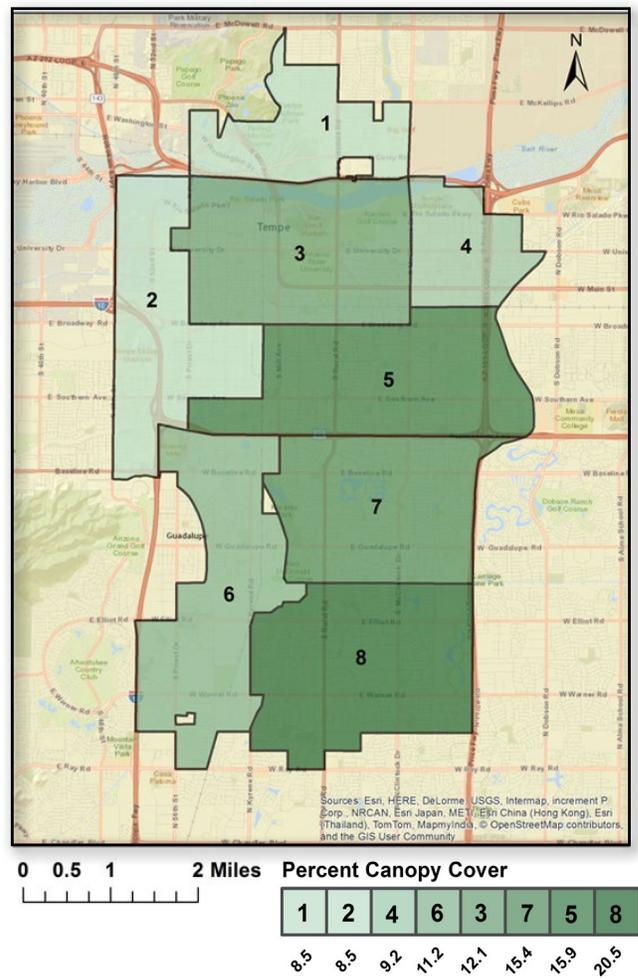


Figure 2: Tree Canopy Coverage by Character Area

City-wide tree canopy cover was calculated using the 4 Band NAIP Land Classification of Central Arizona: CAP LTER, by the Environmental Remote Sensing and Geoinformatics Lab, ASU, 2012. This project was primarily supported by the National Science Foundation under Grant No. BCS-1026865, Central Arizona–Phoenix Long-Term Ecological Research (CAP LTER) and undertaken through its affiliated Environmental Remote Sensing and Geoinformatics Lab (ERSG). Additional support was furnished by the Gilbert F. White Environment and Society endowment.

Census Tract No.	canopy cover [%]	canopy cover [acres]	Census Tract No.	canopy cover [%]	canopy cover [acres]
318400	6.8	125	319704	9	173
318501	10.7	33	319705	6.8	64
318700	5	30	319706	12.4	42
318800	10.3	65	319800	14.9	93
318900	17.1	109	319902	12.7	77
319000	21.5	137	319903	18.9	125
319101	7.8	6	319904	15	96
319103	13.8	33	319905	16.4	106
319104	14.6	46	319906	12.8	80
319201	11.9	39	319907	25.8	165
319202	9.5	31	319908	10.5	65
319300	11.2	30	319909	14.7	95
319401	14.8	98	319910	14.6	237
319402	15.6	101	320001	15	77
319403	16.3	107	320007	12.4	62
319404	13.9	68	320100	8.1	94
319500	16.3	104	421201	6.9	5
319600	20.2	128	810000	14.7	95
319703	10.8	73	810100	24.2	300

Character Areas	canopy cover [%]	canopy cover [acres]
1 Papago/North Tempe	8.5	176
2 Diablo/Double Butte	8.5	262
3 Rio Salado/Downtown/ASU	12.1	461
4 Escalante/Marketplace	9.2	137
5 Central City/Shalimar	15.9	611
6 AZ Mills/Emerald Center	11.2	413
7 Kiwanis/The Lakes	15.4	531
8 Corona/South Tempe	20.5	827

Table 2: Tree Canopy Cover in Tempe per Character Area

Table 1: Tree Canopy Cover in Tempe per Census Tract

There are approximately 19,450 City-managed trees in Tempe. The City owns and manages over 2% of the 13.4% canopy coverage city-wide. The inventory of City-managed trees includes over 80 species where 90% of the total count is comprised of 28 species, as listed in Table 3.

Top 30 City-Managed Trees in Tempe					
Species	Count	Percent	Species	Count	Percent
Palo Verde	1,885	12.33%	Gum	401	2.06%
White Carob Tree	1,708	6.34%	Velvet Mesquite	391	2.01%
Desert Willow	1,233	6.14%	Bottle Tree	357	1.84%
Chinese Elm	1,185	6.09%	California Palm	349	1.79%
India Rosewood	1,133	5.83%	Texas Ebony	332	1.71%
Live Oak	991	5.10%	Indian Laurel Fig	308	1.58%
Mexican Fan Palm	935	4.81%	Pine	276	1.42%
Shoestring Acacia	878	4.51%	Mulga	275	1.41%
Honey Mesquite	760	3.91%	Canary Island Pine	236	1.21%
Evergreen Ash	670	3.45%	Date Palm	226	1.16%
Olive	655	3.37%	Willow Acacia	205	1.05%
Chinese Pistache	539	2.77%	White Mulberry	202	1.04%
Afghan Pine	459	2.36%	Chinese Privet	189	0.97%
African Sumac	435	2.24%	Other	1805	9.28%
Velvet Ash	432	2.22%	Total	19,450	100.00%

Table 3: Top 30 City-Managed Trees in Tempe

Urban Forest Value

The urban forest provides value through increased physical and esthetic comfort as well as providing economic benefits through a variety of ecosystem services. In 2015, researchers from the Julie Ann Wrigley Global Institute of Sustainability and the Decision Center for a Desert City (DCDC), both research initiatives at Arizona State University, conducted a series of experiments to quantify the change in average temperatures resulting from the urban tree canopy at the neighborhood scale. Results from the study supported the idea that in a dry arid climate, shade is the most important factor in determining what temperature feels comfortable.

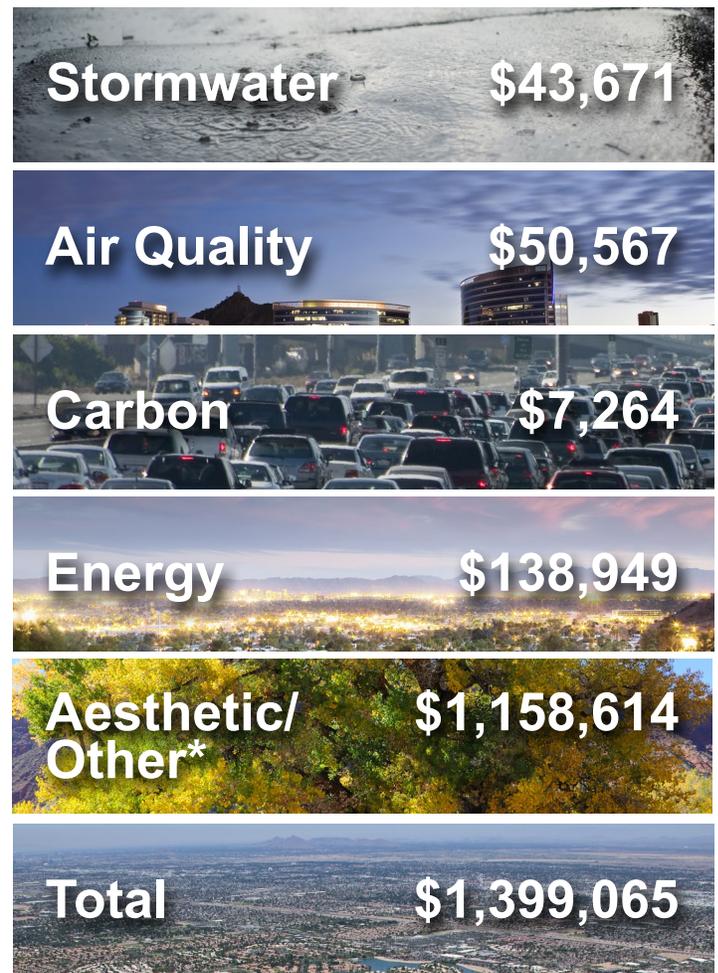
This study assessed the impact of an increase in tree canopy cover from 0% to 10% decreases average neighborhood temperatures by 3.6°F (2°C); increasing tree canopy cover to 25% leads to an additional temperature reduction of 4.3°F (2.4°C) – a total cooling benefit of 7.9°F (4.4°C) as compared to the bare neighborhood.

When tree planting efforts are equitably distributed and given proper maintenance, tree benefits can enrich the lives of everyone working in, living in or visiting Tempe. To analyze Tempe’s tree inventory and quantify the annual benefits that the city-managed urban canopy provides, researchers at ASU utilized i-Tree Streets, a component of the state-of-the-art, peer-reviewed software suite from the USDA Forest Service that provides urban and rural forestry analysis and benefits assessment tools. For more information about i-Tree assumptions refer to Appendix 2 (Resources).

The ecosystem services of a healthy canopy include stormwater runoff mitigation, improved air quality, carbon reduction, energy savings and enhanced property values.

Trees reduce energy usage and costs by shading buildings and streets, creating a cooler city. Air quality is improved as trees absorb contaminants and intercept dust while producing clean breathable air. In addition, trees absorb water during rain events and act as carbon sinks, resulting in a reduction of greenhouse gases. The 19,450 city-managed trees offer a total yearly benefit of \$1,399,065, as the following illustrates.

Yearly Economic Benefits of Existing Canopy



* Aesthetic / Other includes benefits such as:

- Beautification
- Increased use of parks & public spaces
- Enhanced property values
- Social and psychological benefits
- Human health benefits
- Stress reduction
- Wildlife support
- Preferred retail settings
- Improved longevity of asphalt

Tree Species Value

In collaboration with Tempe city staff, six drought tolerant species that represent a high prevalence in the existing stock were chosen for a more detailed i-Tree economic value analysis. This analysis illustrates the yearly economic benefits pertaining to energy, carbon reduction, stormwater management and aesthetic appeal at maturity. The six tree species detailed in the following graphic were chosen to give City of Tempe guidance when choosing species for expanding the urban forest. This list is not meant to be a recommendation, as the siting of individual trees is very location specific and should be based on a Right Tree, Right Place planting strategy.



Additional analysis was done to evaluate the annual economic value of a tree at initial planting vs. the economic value at maturity. The analysis, detailed below in Table 4, assumes the following:

1. Freshly planted trees have a diameter at breast height (DBH) of 0-6 inches
2. Mature trees have a DBH of 12-18 inches. DBH, is a standard method of expressing the diameter of the trunk of a standing tree.

Annual Economic Benefits by Diameter at Breast Height (DBH)												
Species	Energy		Carbon		Air Quality		Storm water		Aesthetic/ Other		Total Value	
	0-6" DBH	12-18" DBH	0-6" DBH	12-18" DBH	0-6" DBH	12-18" DBH	0-6" DBH	12-18" DBH	0-6" DBH	12-18" DBH	0-6" DBH	12-18" DBH
Chinese Elm	5.72	37.97	0.19	1.11	2.17	22.45	1.16	9.14	73.75	225.17	\$82.98	\$295.84
Desert Willow	2.00	15.88	0.08	0.45	0.15	4.15	0.31	2.34	17.79	61.59	\$20.33	\$84.40
Live Oak	2.90	17.52	0.33	2.54	-1.72	-8.95	0.96	6.12	35.84	162.94	\$38.30	\$180.16
Mesquite	3.80	20.33	0.21	0.82	1.24	9.92	1.09	6.38	64.45	133.87	\$70.79	\$171.32
Palo Verde	4.27	24.34	0.15	1.10	1.28	12.43	1.09	6.75	41.68	155.42	\$48.46	\$200.05
Chinese Pistache	2.66	22.26	0.11	0.45	-0.11	5.51	0.57	5.00	43.04	67.52	\$46.27	\$100.74

Table 4: Tree Species Annual Value at DBH (source: i-Tree)

Current Challenges

Trees in urban settings improve the quality of life of residents, employees and visitors. However, a set of complex challenges often interfere with the development of this shared desire to create a successfully managed healthy tree canopy across the entire City. Known barriers as described by city staff and residents are explained below and addressed in this report.

Water Use

Even though the State of Arizona passed the 1980 Groundwater Management Act mandating a 100-year water supply for communities, the future of water in Arizona is unclear. The current extended drought in California and the states in the Southwest serves as a reminder of the uncertainty of water resources in desert cities. Like all life, trees need water to survive. Some trees used in Tempe are not native to the region or desert-adapted and can be large consumers of water. Alternatively, some native and low water trees are often over-watered, which frequently results in inadequate root development and an early demise.

The development of a sustainable urban forest requires efficient use of water resources. Through the planting of low water and drought-tolerant tree species, along with high-efficiency irrigation systems and continued education, the City of Tempe can promote a sustainable urban forest and wise use of its water supply.

Viewsheds

A viewshed describes an area visible from a location. For example, businesses highly value the visibility of their signage from the street and sidewalk. If trees are planted and mature in a way that blocks property signs, business owners often become concerned and have been known to remove the tree. Conversely, shadeless sidewalks may also deter residents from walking and cycling to nearby businesses. Fortunately, these concerns can be alleviated through specific efforts to ensure visibility and shade.

Public vs. Private Property

The line between public and private property is commonly misconstrued. The City owns and manages roughly 2 percent of the land in Tempe, which includes parks, facilities, some right-of-way and street medians. However, Home Owners Associations or commercial centers typically own land between the sidewalk and their neighborhood fence or business parking area. Some private and public stakeholders do not clearly understand who is responsible for maintenance and upkeep of these spaces. This problem speaks to the need for education and engagement around tree maintenance responsibilities between residents, business owners and the City. In situations where trees straddle a property line, private and public stakeholders need to create an agreement outlining which party or parties will be responsible for providing consistent tree care.



Budgets

During the 2008 financial crisis, the City of Tempe made the difficult decision to reduce funding for park and streetscape improvements and maintenance. Thus, funds were not available to properly care for or improve existing tree infrastructure. Additionally, dead trees or trees uprooted from severe weather events were not immediately replaced. The recession not only reduced city funding needed to maintain the urban canopy, but also led many residents and businesses to reduce spending on the planting of new trees and the maintenance of existing trees. As the economy improved, Tempe has initiated the process of allocating additional funding to begin the re-vegetation process. Since walkability is valued by both the City and residents, increased investment in the urban forest is needed to provide necessary shade.

Maintenance

In the past, trees may not have been properly maintained for a multitude of reasons including poor pruning practices, over-watering, aging irrigation infrastructure and neglect. Some stakeholders have expressed concern that if more trees are added to the urban forest with the recent state of care, they will not mature into healthy trees capable of providing full benefits.

Residents are eager to learn how best to maintain their own trees and frequently ask if the City of Tempe would develop an educational resource to aid residents in becoming responsible tree keepers. A robust ongoing community forum

would support resident efforts to maintain and expand their neighborhood canopy

Lastly, some residents and business owners do not want trees on their property due to real or perceived increased commitments for water, clean-up and pruning. These challenges must be addressed in order to create a healthy urban tree canopy for generations of Tempe residents to enjoy.

Existing Plans and Programs

Multiple plans and programs exist across City departments that impact the urban forest. Successful implementation of the UFMP will require coordination with existing programs across departments including:

- ADA Accessibility Transition Plan
- Adopt-a-Path, a-Park, a-Street
- Character Area Plans
- Community Gardens
- Desert Parks Management Plan
- Downtown/Lake Street Tree Plan
- Energy Initiatives
- Living Tree Memorial Program
- Low Impact Development
- Storefront Improvement Program
- Tempe Rio Salado Park Master Plan
- Tempe Urban Open Space Plan
- Transportation Tree & Landscape Maintenance Plan
- Tree Planting/Neighborhood Grants Program
- Trees for Tempe
- Tempe City Code



Current Forestry Programs

This Urban Forestry Master Plan seeks to coordinate and enhance current forestry programs, including the following:

Trees for Tempe

This program replaces community trees damaged or lost due to storms. Residents can make monetary contributions and donations of time. There is no minimum dollar amount required to donate. Residents, organizations and local businesses can also donate their time to plant the trees. The annual Arbor Day 5 K race and walk event raises money to support this program.

Living Tree Memorial Program

This program provides the opportunity for participants to honor a loved one with the planting of a 24-inch box ash, oak, elm or similar species most suitable for the desired location chosen by the participant. Qualified donations result in the planting, care and maintenance of the tree, a certificate of recognition and an engraved brass leaf publicly displayed.

Adopt-a-Path, a-Park, an-Alley, a-Street

These programs offer neighborhood groups, community organizations and local businesses an opportunity to help enhance the appearance, safety and cleanliness of these important amenities.

Storefront Improvement Program

This program helps revitalize commercial buildings, support small businesses, reduce code violations and enhance the livability along Apache Boulevard by waiving fees, expediting city review of plans and providing matching funds in some cases.

Tempe Community ReLeaf Program

On December 3, 2015, the City Council approved and accepted a grant from American Forests, a non-profit dedicated to protecting and restoring healthy forest ecosystems. The City of Tempe was also designated as a Community ReLeaf City. The grant of approximately \$100,000 will initiate the City's Urban Forest Program.

Receiving a grant from American Forests is an opportunity to gain additional expertise in looking at the challenges specific to maintaining trees and shade in the urban desert. American Forests is dedicated to the assessment, restoration and monitoring of urban forests. Their process evaluates loss of trees due to storms, flash floods, etc., provides funding for replanting trees and addresses proper irrigation and stormwater management. American Forests also assists with community tree events and works with local partners and the City to address long-term management of the urban forest.

The Tempe Community ReLeaf Program will utilize the research and principles of this Plan, providing additional analysis with specific focus on trees lost to storms, invasive species, etc. This program also provides Tempe with a local partner, Bank of America, and assists in helping Tempe strategize funding for long term tree care. Tempe's intent is to focus the ReLeaf grant in the Rio Salado Park area; specifically replanting many of the trees lost in the severe 2015 storm near the Tempe Center for the Arts.

Vision for a Healthy Urban Forest

A healthy urban forest that supports the City of Tempe's goal of becoming a 20-Minute City by 2040 requires active management and participation by municipal staff and City residents. There are many potential future directions that Tempe's urban forest could take in the next several decades. Future scenarios depend on a complex web of interconnected factors including City and property owner actions, or inaction, in areas such as investment, maintenance, and infrastructure improvements. Other factors impacting future tree canopy include climate change, water availability, pests and disease.

Without definitive investments in the maintenance of existing trees and in the planting of new trees, Tempe's urban forest will decline.

Possible Futures

Tempe currently has approximately 13% canopy coverage and due to budget constraints has not made major investments to maintain the urban forest. Moving forward, City officials and residents can help shape a healthier, cooler future city through active management of the urban forest. For example, enhancing tree biodiversity could prevent the loss of a current tree population to disease.

However, developing and preserving a healthy urban forest is dependent on maintaining a generational continuum of municipal and residential collective action. The level to which this can be achieved will define the future of Tempe's urban forest.



Guiding Principles

The following principles support the vision of a green, cool and healthy Tempe and the overall Urban Forest Master Plan:

Cultivate Collective Action

Empower residents, businesses, city staff, non-profits and public-private partnerships to grow and maintain the urban forest. This principle will require coordination between diverse stakeholders and the development of a variety of programs to increase tree coverage city-wide. The benefits of increased canopy and cooling may enhance pride and inspire residents, volunteers and businesses to further support their community.

Expand Shade to Maximize Urban Cooling

Create a vibrant, walkable 20-Minute City that benefits public health and economic development by planting trees and building structured shade. Designers can augment this principle by planting trees and using construction materials that reduce the urban heat island (UHI) effect. To learn more about how trees reduce UHI, visit <https://www.asla.org/sustainablelandscapes/vid/urbanforests.html>.

Equitably Improve Walkability

Plant trees and design sustainable landscapes that improve walkability to retail and services in all neighborhoods. This is a priority that was expressed by residents at a community engagement event in 2016. In the UFMP, equity refers to providing a minimum level of tree canopy benefits to all neighborhoods. The City intentionally attempts to equitably distribute trees on their properties throughout all of Tempe. The greatest disparities in urban canopy coverage currently exist on private property.

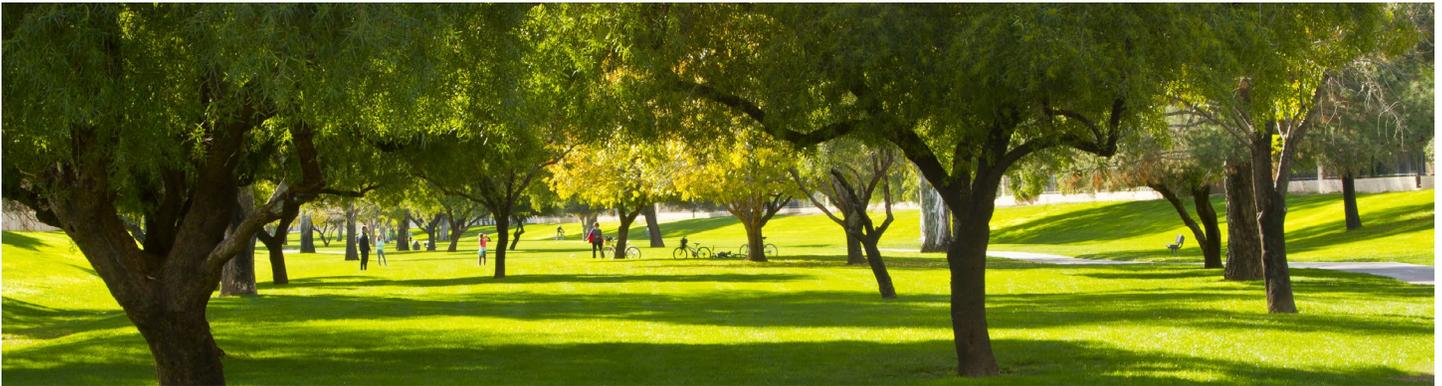
Support Biodiversity & Habitat

Plant diverse species of trees that absorb potential shocks, including extreme heat and species-specific disease. Develop a healthy urban forest that provides natural habitat for birds, animals and pollinators. Pollinators are often attracted to specific native species. For example, over 60 pollinators are attracted to the native mesquites, but only 12 come to the South American Mesquite. Additionally, migrating song birds that pass through Arizona prefer native trees and provide residents with pest control, beauty and song. Birds also enhance tourism in the Valley, attracting birders from across the world. This principle aligns with the City's habitat management plans to establish and manage natural wetlands and to provide habitat diverse species of plants, trees, animals and pollinators.

Use Resources Wisely

Select and care for trees and landscapes that reduce the use of water and when possible, fertilizers. When water is needed, consider supplementing potable water with condensate from HVACs systems, greywater and stormwater. Protect the plants, trees and soil by using Integrated Pest Management (IPM) to reduce or eliminate harmful chemicals. Use porous materials to assist in water filtration, and hardscape materials that reduce heat retention and reflection.





Enhance Property Values

Plant and maintain trees that enhance property values and attract businesses, retail customers and residents. Shopping centers with ample trees attract more shoppers who spend larger amounts of time at the establishment than those without trees. Increased property values benefit homeowners at resale. Livability in the desert demands shade during months of extreme heat.

Enhance Community Beautification and Livability

Plant trees to shade sidewalks, bike lanes and pathways in parks, along canals and in the right-of-way. Tree shade on pedestrian ways encourages walking and biking for short trips, reducing the number of auto trips. The natural beauty of a green, tree-lined street or park encourages outdoor activities, supporting stress reduction, regular exercise and a healthy lifestyle.

Right Tree in the Right Place

Select and maintain trees that are compatible with infrastructure such as street lighting, underground utilities and power lines. This requires City coordination with utilities, landscapers, residents and businesses. Education and information will assist owners and residents in selecting trees that will maximize shade, minimize water use, eliminate conflicts with overhead wires and support tree growth that preserves important viewsheds (i.e. mountain views, signage, etc.).

For a more detailed analysis of these Guiding Principles and how they relate to the goals and targets of the UFMP, see Appendix 1 – Principles, Goals and Targets. Creating a City of Tempe Urban Forester position will streamline tracking, evaluation and communication about goal progress to the City Council and the public and ensure that best management practices are implemented while expanding the urban forest.

Public Property Opportunities for Shade

Key design elements for improving tree coverage and health in parks and open space, streets and intersections were identified at workshops and meetings with city staff and management across several departments. Public property solutions will be implemented largely by the City, and will be identified in the Action Plan for the Urban Forest.

Tree planting and care efforts on public property illustrates the City of Tempe's commitment to a healthy urban forest. Installations that shade gathering areas, streets and sidewalks demonstrate to developers and private property owners that trees and shade structures can be used to create a more comfortable, walkable, livable city.

Parks and Open Space

In order to promote a healthy, walkable park, shaded perimeter and interior paths should be created and maintained. The design of public space must consider safety using lighting and proper path selection to discourage unlawful activity. Shade is needed along pathways to attract community use of the park. Tree selection and placement should coordinate with existing and future infrastructure.

Future budgets for tree infrastructure need to anticipate the costs for tree replacement due to age, storm damage and pest invasion, as well as the new trees planted to expand the canopy cover. Expanding tree canopy requires investment in staff and funding to maintain and purchase new trees.

The following design elements are intended to inform decision making around tree purchasing, planting and care in parks.

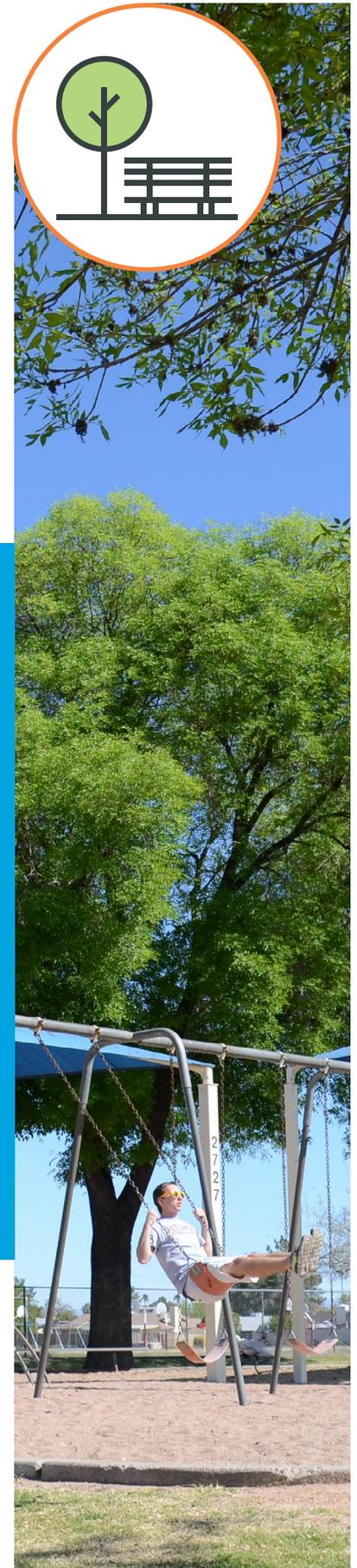
Key Design Elements

- Plant trees that do not obscure line of sight through a park to increase safety.
- Shade pathways and sidewalks.
- Create opportunities for exercise, play and gathering under the tree canopy.
- Plant tree clusters near activity zones and around amenities such as benches and grills to enhance park use.
- Coordinate tree shade with illumination along paths to enhance safety.
- Follow low impact design strategies, planting trees to utilize stormwater.
- Design parks to have view corridors; use tree clusters and variable tree heights to increase visibility and interest.
- Combine strategic trees with structural shade to optimize cooling.
- Ensure tree diversity to achieve maximum canopy health.
- Integrate color and texture variations to enhance beauty and diversity.

Opportunities

Parks and open space design can be used to highlight how trees shade play areas, pathways, sidewalks adjacent to streets and connector streets. Implementation of these design elements and city workforce collaboration and education will help Tempe parks and open space become a model of best practices for an urban forest in the desert.

City staff knowledge of urban forestry is important. Public Works will support skills development and encourage employees to become Certified Arborists.



Streets

Street and right of way trees provide an opportunity to calm traffic, extend the life of sidewalks and asphalt, and enhance shade. Increased shade along streets also helps to reduce the urban heat island effect and enhances pedestrian and bike accessibility. Land use and redevelopment projects are opportunities to select the right tree to mitigate the urban heat island effect while expanding shade and increasing walkability between businesses.

Street trees require significant coordination between city staff and local business to ensure that the urban forest is complementary to existing and planned infrastructure and signage. Maintenance requirements are a higher priority in these areas than parks and open space because clearance must be maintained for large vehicles and streets must be cleared promptly after storms.

The following design elements are intended to inform decision making around tree purchasing, planting and care in streets and right of ways.

Key Design Elements

- Continue to establish shaded bike lanes along streets.
- Plant curbside trees with ample space for roots to grow and collect stormwater from adjacent pavement.
- Consider potential conflicts with street edge canopies and large trucks.
- Prune trees carefully to reduce infrastructure conflicts (overhead utilities) and maximize healthy growth.
- Strategically place trees to provide continuous shade throughout the day.
- Phase street landscapes to coordinate with capital improvement and development projects.
- Provide trees or structural shade at bus stops.
- Ensure tree diversity to achieve maximum canopy health.
- Create shaded pedestrian walks and paths to encourage a healthy lifestyle.

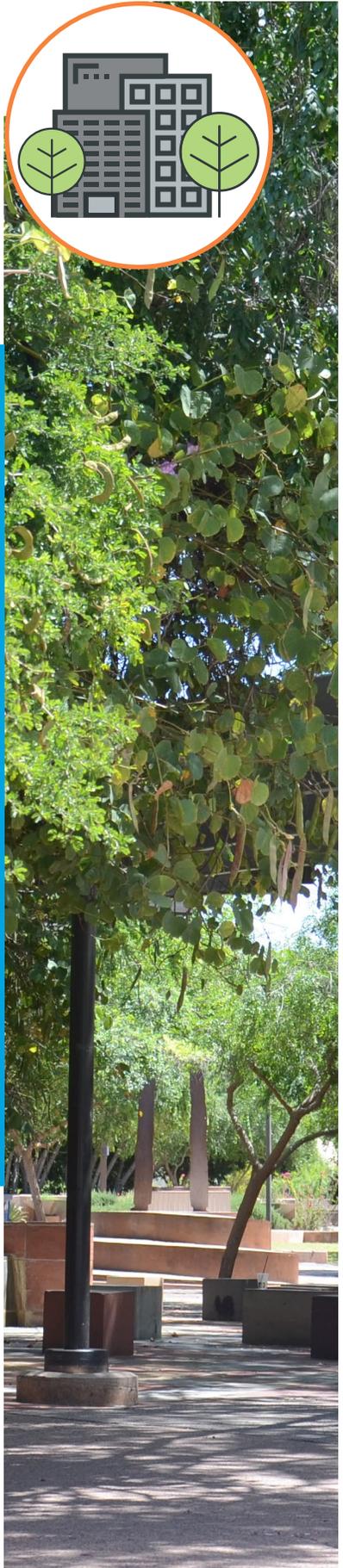
Opportunities

Street trees encourage increased pedestrian and cyclist activity and can decrease the exposure of vulnerable populations, including the young and elderly, to extreme heat when they are walking next to roads and parking surfaces that radiate heat. Increased walkability and access to public transportation, retail and services reduces road traffic and improves air quality.



Hubs

Tempe's retail and activity destinations that are shaded and comfortable promote outdoor activities and local spending. Mill Avenue in downtown Tempe, for example, provides a shaded corridor that successfully attracts pedestrians and cyclists to shops, restaurants, and activities. Strategic tree placement along streets and in parking lots can benefit businesses and pedestrians. Considering signage placement, providing sufficient space for proper root growth and careful pruning will improve property values and attract businesses.



Key Design Elements

- Educate businesses, landscapers and property owners on proper tree maintenance to ensure tree health.
- Increase canopy in parking lots and along walkways to increase customer comfort.
- Allow for shaded bike lanes and sidewalks.
- Shade intersection corners to improve waiting zones for pedestrians; select trees that do not obstruct driver visibility.
- Implement water-sensitive design and green infrastructure methods. Consider the use of curb cuts, swales and permeable pavement for better stormwater management.
- Provide educational outreach to inform business owners and tenants of the benefits of trees, particularly in increasing foot traffic, safety, local comfort and a healthy lifestyle.
- Select trees for street and parking areas that have these characteristics: low VOC emitter, single-trunk and an appropriately sized root ball.
- Ensure trees planted on commercial property are maintained properly and replaced when lost due to storms, disease, age or neglect.
- Work with businesses to identify key viewsheds, sign placement choices and structural shade or tree options during the design development phase.

Opportunities

Hubs require collaboration between the City and businesses to improve accessibility by bicyclists and pedestrians to social/business centers. Public-private partnerships are required for the City to include more hubs. Images throughout this report illustrate what pedestrians and cyclists already know - a journey under shade is more enjoyable physically and aesthetically than traveling under the intense rays of the sun. Adding trees, maintaining irrigation systems and providing proper care at hubs and on the streets which connect hubs will benefit residents and the businesses which depend on them.

Opportunities for Change

There is no silver bullet that creates shaded hubs, streets, parks or open space. In order to achieve increased canopy on public property, a variety of efforts are required. The program concepts outlined below provide a sampling of the opportunities present for innovative stakeholder engagement.

Library Pilot Gardens

The city will soon have a new Landscape and Management Plan for the Tempe Library and Community Complex at Southern Avenue and Rural Road. This provides an ideal opportunity to develop interactive teaching programs at the library where residents and the business community can learn (and teach) proper methods of tree planting, watering and pruning. Understanding attributes of the diverse selection of trees on the campus will assist property owners in selecting the right tree for the right place as they add to the tree canopy across the City. With programming and demonstration options, this area can serve as an example of an urban forestry hub of activity.

Another pilot project could be a Children's Reading & Activities Garden, where teaching can take place under the shade of the trees. An interpretive signage program allows parents and children to learn about the landscape. Activities can be scheduled by the library or enjoyed independently.

Tall Pots Pilot Program

Tempe is exploring the feasibility of obtaining trees from Maricopa County Flood Control District's Tall Pots Program, designed to expand the tree canopy on properties without access to water. This program grows young trees in tall cylinders raised above the ground, so they establish a long, healthy tap root. Implementing a Tall Pots Pilot Program will allow Tempe to evaluate a new approach to planting native or adapted desert trees that can thrive without a dedicated water source. After one year of minimal watering, the County has seen a successful survival rate of 85% without irrigation.

Private Property Champion for Hub Walkability

Encourage urban tree planting at retail, business and corporate locations by pursuing collaborative demonstration projects to showcase benefits of trees. For example, the new Mountain Park Health Center (MPHC) project on the northeast corner of McClintock Road and Broadway Road is a potential partner with the City's Urban Forest program. While planning the renovation of the property, Mountain Park's staff and patients have identified shade trees as an important element to the campus. This demonstration installation is funded by grants; the Health Center will provide ongoing maintenance and care.

This project will exhibit how trees support a healthy lifestyle, reducing stress by providing serene areas where patients can wait for services or watch their children play. By opening their campus to surrounding residents for walking or jogging along tree-shaded exercise paths, they become a valued neighbor in the community. They have also proposed community education sessions for establishing a healthy lifestyle.



Private Property Opportunities for Shade

The City of Tempe has many passionate, active residents who are already working to create a healthy tree canopy. Private property solutions for expanding and maintaining a healthy urban forest provide opportunities for residents and businesses to partner with the City to expand shade on private property. For example, multiple neighborhood groups have worked to plant over 200 trees in their community utilizing grants offered through the Maryanne Corder Neighborhood Grant Program.

The following options suggest building on current momentum and addressing specific opportunities on private property through collaborative partnerships and creative education. Each program focuses on one or multiple facets of capacity development while strengthening skills and knowledge required for residents to help accomplish mutual goals set forth in the UFMP.

Tree Bank

In many cities, corporations, groups, and individuals fund the donation of trees for planting by residents and organizations, such as community services groups, volunteer teams, clubs and youth groups. Some cities partner with a local nursery to provide trees. This strategy is currently used in Los Angeles, Chicago and Houston.

Online Tree Community

Many creative options for community forestry can be found in cities in the US and around the world. For example, some cities provide residents the ability to order trees from their website and to input information about new and existing trees to form a community tree management inventory. Additionally, the residents can sign up to take care of certain new trees planted in their community. This provides a platform for residents to share stories and memories about certain trees. In a similar program in New York City, residents

sign up to maintain trees and in Melbourne, Australia the storytelling component is used. Additional functions of an online portal might focus on business stakeholders.

The City is also in the process of developing an online brochure to help residents properly plant and maintain their trees. This type of information was requested by many residents during community engagement events in 2016.

Citizen Forester

A community engagement and empowerment program could be established in order to build community participation and help spread change without relying on additional city personnel.

A definition for community-engaged learning developed by the Stanford University Haas Center for Public Service states:

“...engagement with a community that addresses societal needs not currently being met by governments, markets, or the independent sector; intentional integration of learning objectives and experience with/in the community; student preparation, ongoing reflection, and critical analysis; reciprocal benefits for students, community, and campus partners; opportunities to critically examine public issues or explore one’s civic identity.”

A citizen forester program is a concept designed to foster knowledge, skills, experiences and connections focused on helping citizens maintain and expand tree and shade coverage. After completing the program, citizen foresters will mobilize efforts within their own neighborhoods to promote the beautification, increased walkability and improved comfort provided by trees. Through an offering of activities, training, tours, lectures, volunteer opportunities and discussions, community members engaged in such a program would be prepared to make long-lasting positive change in their community.

Edible Forest Initiative

This concept could promote the planting and harvesting of trees which bear edible fruits, seeds and nuts. If the City identifies trees that produce food on public property, they could encourage residents to harvest. This program could reduce maintenance costs while promoting a sense of place tied to the local history and culture of the Valley.

A community organization in Tucson, Desert Harvesters, recently created a co-op for milling flour from mesquite pods with a portable hammer mill. The Phoenix non-profit Trees Matter (previously the Valley Permaculture Alliance), holds an annual mesquite milling event in the fall, complete with a mesquite pancake breakfast. This flour is highly nutritious and has the potential to support a healthy lifestyle, and possibly cultivate new local business opportunities.

Pollinator and/or Bird Demonstration Garden

This is an opportunity to create landscapes that use plants and trees beneficial to pollinators and birds. With interpretive signage, it could inspire residents to plant these beneficial gardens across the City. In some cities, residents who register the beneficial plants in their front yard receive a sign to place along the sidewalk to educate others on what services their vegetation provides. Austin, Texas has a program encouraging residents to plant pollinator-friendly native plants. These programs support a nation-wide commitment established by the White House in 2015 to providing habitat for pollinators.

Neighborhood and Homeowner Association (HOA) Opportunities

Associations could receive educational materials on the benefits of trees pertaining to real estate values, cooling costs and aesthetic appeal. Additional information could include proper tree selection, planting tips, incentives and maintenance. This could result in better understanding of tree pruning maintenance.

Community Workshops for All Ages

The goal of these workshops is to teach youth and adult community members about tree planting and care at local community centers and libraries. Simultaneously, children might attend tree-related events including trivia, reading circles, crafts and games. A number of these types of programs (Tree Care Training, Workshops) exist in New York City.



Transition Strategy

Increasing tree canopy across the entire City to 25% by 2040 will require a net increase of approximately 94,000 additional trees. This count does not include additional new plantings that will be required for replacing trees damaged by storms, pests or old age.

Champions and Partnerships

Champions and strategic partnerships are critical for boosting Tempe's urban forests. In order to keep stakeholders engaged, it's important to celebrate successes and acknowledge even small steps toward the 2040 vision.

- **City Urban Forester:** A municipal Urban Forester would serve as tree champion within the City and help the community realize and maximize the benefits of the urban forest. Urban Foresters engage with city staff and residents by offering planting support and providing educational and technical information and public workshops. They also maintain an inventory with data on the species and status of trees, develop current cost/benefit analysis, and identify benchmarks met and goals achieved. Additionally, an Urban Forester can ensure that coordination occurs between departments and that best practices are implemented to increase canopy.
- **Local Nurseries:** Nurseries need to supply high-quality, biodiverse, drought-tolerant, healthy trees for the City and its residents to plant.
- **City Staff:** Staff can use the various ideas outlined in this UFMP to engage business and residents to find opportunities and resources to grow and maintain a healthy urban forest.
- **Landscapers and Landscape Architects:** These professionals can work with the businesses and residents they serve and encourage their clients to increase canopies and also help property owners select the right tree for the right place.
- **Community Members:** Residents may plant trees on private property and advocate for more trees. It would be encouraging to others if an inventory of residential trees planted was available on the City website. Residents could post a photo of their tree, date planted, GIS marker and DBH (diameter) to the site. This could be done without city staff assistance.
- **Birders:** Birders can share their knowledge and work to enhance diverse shade-providing bird habitat.
- **Citizen Foresters:** Tempe residents who obtain training from an established program will be equipped with the knowledge and skills to lead planting and maintenance efforts in their neighborhoods.
- **Gardeners:** Home and professional gardeners can collaborate with community garden and edible forest movements to enhance the urban forest.
- **Tempe Neighborhoods Together (TNT):** The mission of Tempe Neighborhoods Together is to create an independent group dedicated to enhancing/developing our neighborhoods through two way discussions with the Tempe City Council and their staff.

Additional Resources

Tempe's vision for a healthy urban forest will not be achieved unless additional resources are secured to plant and maintain trees. Critical organizational resources and processes that need to be considered in the implementation of the UFMP are:

- **Neighborhood Associations:** Residents and their neighborhood associations can help safeguard trees and shade as a priority in the City. Neighborhood associations can organize tree planting days and tree counts.
- **Character Areas:** Tempe residents have expressed the importance of an urban forest through the character areas planning process.

- **Businesses:** Businesses can sponsor tree-planting events and ensure their own properties demonstrate proper tree maintenance practices; sets an example of the potential for a robust urban forest.
- **Utility Companies:** Utilities around the country supply trees to residents to reduce energy demands. Additionally, utility companies may help ensure the right trees are planted in the right places; thereby mitigating conflict. For example, Salt River Project (SRP) has a Forestry Division with dedicated personnel available to check for lines at a potential tree planting site.
- **National Forestry Organizations:** The Arbor Day Foundation and Alliance for Community Trees have resources and grants that may be beneficial to building an urban forestry program.
- **Arizona Department of Forestry and Fire Management:** The State of Arizona provides grants and resources that can support Tempe’s ongoing efforts to reach tree planting and biodiversity goals. They provided grant funding for the preparation of this Urban Forestry Master Plan.
- **Capital Improvement Projects (CIP):** CIP projects could help fund streetscape improvements with the intention of increasing Tempe’s urban forest. Prioritizing tree shade can be used in parks to improve the canopy coverage along pathways, sidewalks and playgrounds.

Policy

Policies that fully support urban forestry goals offer the most direct path to success. Potential policy opportunities include:

- **Tree Palette:** City staff identified an opportunity to redefine the City’s tree palette to support biodiversity, low water-use, and context-specific planting. The palette would be used for parks, property renovations, streetscape retrofits and more. Although monoculture street trees have historically been used in Tempe to create a sense of identity along major arterial streets, continued use should be monitored due to increased vulnerability resulting from using only one species.
- **Streetscapes:** By implementing Low Impact Development (LID) standards and adopting best practices, the City would expand its living assets to realize increased environmental and social benefits. Low Impact Development (LID) is a sustainable approach to stormwater management that utilizes the landscape to absorb storm runoff, reducing offsite flows that can contribute to flooding and infrastructure costs.
- **Biodiversity:** Policy can influence the quantity, type and the percentage of one or more species planted during a specified time frame. Some North American cities have created similar policies to support biodiversity. For example, Vancouver does not plant more than 5 percent of annual tree plantings with any one species.
- **Shopping Centers and Parking:** The City of Tempe can partner with the development community to create more expansive tree canopy for shopping centers and surface level parking lots, increasing benefits and balancing project needs and significantly cooling the expanse of asphalt.
- **Thermal Comfort:** Some staff recommended that Tempe collaborate on further research at ASU to develop best practices on how trees can support thermal comfort in a desert environment (species selection, distance planted from sidewalk, and irrigation strategies).

Creative Engagement

Engagement across a variety of programs, educational efforts and social capacity building initiatives can expand support for the goals of the 2040 vision:

- **Annual Tour des Trees:** Establish city Tour des Trees weekend in Tempe in collaboration with the annual Tour des Trees Event held on ASU campus and sponsored by the Arizona Department of Forestry and Fire Management, the Sustainable Cities Network, the Arizona Community Tree Council, Trees Matter and other groups. This event brings residents, arborists and city staff together on a walk/bicycle ride around a specific area of the City. During this journey, residents can stop at identified locations to talk with arborists and learn about the benefits of trees, proper

care practices, what types of trees to plant and more. Partnering with the sponsors to expand this event could increase awareness of the event and open opportunities for viewing the on-campus arboretum as part of the tour. Tour may also highlight older neighborhoods and unique trees identified by residents through an online competition prior to the event.

- **Pop-Up Forest:** Create a pop-up forest in a highly visible location, for example, during an ASU football weekend or festival event to increase foot traffic and open unique branding opportunities (i.e. tailgate in the forest).
- **Art Classes with Salvaged and Living Trees:** Utilize local knowledge to help educate residents about how to use wood salvaged after storms or removal to build beautiful artwork and functional pieces through workshops. Damon McIntyre is an ASU Woodshop Instructor and Tempe resident with a passion for trees. He has volunteered to lead tree-focused art-inspired workshops with the community. This is one example of how residents are eager to contribute their skills to boost urban forestry in the community.
- **“Grow Your Network” Volunteer Days:** Create volunteer opportunities for specific sectors in partnership with ASU, industry organizations and local businesses which are branded as opportunities to network with professionals while planting trees.



Opportunities for Action

The UFMP defines a series of items designed to facilitate the management of public and private property solutions in support of a healthy urban forest. The UFMP anticipates the addition of a full-time City of Tempe Urban Forester. This position will be dedicated to advancing the objectives of the UFMP through stakeholder engagement programs, urban forest management and improving communication and coordination within the City.



Public Property

- Prepare a 10 year Action Plan.
- Hire City of Tempe Urban Forester to manage the UFMP and support city staff by providing educational and technical information to the many departments that impact the urban forest and providing cross-departmental coordination to ensure best practices are implemented to support a healthy urban forest.
- Budget for proper care, replacement and planting of trees.
- Create an internal City of Tempe cross-departmental Urban Forest Committee to coordinate actions to advance the goals outlined in the UFMP.
- Identify maintenance schedules for each major tree species and develop a reference manual on care.
- Conduct tree inventory every five years, gathering accurate data on the number of trees and the condition of the urban forest to support management decisions and planning.
- Identify what aspects of mechanized tree and landscape maintenance can be done without fossil fuel powered machines in order to reduce operation emissions and operating cost.

Private Property

- Maintain City website with information for residents, businesses and landscaping companies. Provide guidelines and suggestions for tree care, pruning and neighborhood grants. Market updated webpage in 2017.
- Expand neighborhood grant program and streamline an option for tree planting and care.
- Identify business opportunities for shade. Another concept used in other cities that may help businesses transition is the subsidization of tree watering for the first year after planting. In order to encourage more businesses to plant trees on their property, the City may donate water bags enabling trees to grow healthy without additional costs to the business owner. Guidelines for participation to decrease program abuse could include a minimum requirement for the number and diversity of trees planted. Demonstrations and pilot programs can be used to gauge effectiveness and interest. A guide for landscape maintenance might improve the lifespan and appearance of trees in parking lots.

Opportunities for Action - City of Tempe Public Property Solutions

**PW: Public Works - ED: Economic Development - CS: Community Services - CD: Community Development
IT: Information Technology - TR: Transportation - NS: Neighborhood Services - SPM: Sustainability Program Manager
PIO: Public Information Officer - CM: City Manager - ENG: Engineering - CoT – City of Tempe**

Principles:

Cultivate Collective Action

Expand Shade to Maximize Urban Cooling

Improve Walkability Equitably

Support Biodiversity and Habitat

Use Resources Wisely

Enhance Property Values

Enhance Community Beautification and Livability

Promote a Healthy Community

Right Tree, Right Place

Parks and Open Space

Opportunities	Depts. Involved	Participation	Funding
1. Expand canopy			
Plant trees in parks through community events and City efforts*	PW-Parks, CS, CD-NS, CM-PIO, CM-SPM	Parks Manager, Parks Supervisors, PIOs, Neighborhood Associations, ASU, Adopt a Park, Arbor Day 5K	Grants
Encourage and highlight community pilot projects (i.e. Community ReLeaf Program)	PW-Parks, CS, CD-NS, CM-PIO, CM-SPM	Parks Manager, Parks Supervisors, PIOs, Neighborhood Services, Neighborhood Associations	N/A
Plant trees along walkways for shade and stormwater retention	PW-Parks, PW-Water, PW-TR, PW-ENG, CD, CM-SPM	Parks Manager, Parks Supervisor, Department Directors, Deputies, Transportation Planners	
2. Preserve and properly care for existing trees			CIP
Develop and implement maintenance plan for existing urban forest and irrigation infrastructure**	PW-Parks, PW-Water, PW-TR, CD	Parks Manager, Parks Supervisors, CoT Urban Forester, ASU, Utilities	N/A
Replace harmful invasive species and storm damaged trees with native and drought-tolerant species	PW- Parks, PW-Water, CD-NS, CM-SPM, CM-PIO	Parks Manager, Parks Supervisors, Volunteers, Neighborhood Associations	CIP, Grants
3. Ensure appropriate care for each type of park and open space			
Implement Standard Operating Procedures (SOPs) for tree selection, planting and maintenance (including irrigation) specific for desert open space, urban parks and more	PW-Parks, PW-Water, PW-TR	Parks Manager, Parks Supervisors, CoT Urban Forester, AZ Dept. of Forestry and Fire	CIP

Parks and Open Space – cont.

Opportunities	Depts. Involved	Participation	Funding
4. Develop and implement Living Asset Management System			
Create Living Asset Management System***	PW- Parks, PW-TR, CM-SPM, IT	Parks Manager, Parks Supervisors, CoT Urban Forester, IT Personnel, Department Directors	CIP
Provide training and education for city staff on system inventory and management	PW- Parks, PW-TR, CM-SPM, IT	Parks Manager, Parks Supervisors, CoT Urban Forester, IT Personnel, Department Directors	CIP
Integrate and use Living Asset Management System to track health, maintenance and inventory	PW- Parks, PW-TR, CM-SPM, IT	Parks Manager, Parks Supervisors, CoT Urban Forester, IT Personnel, Department Directors	CIP

Notes:
 *Coordinate tree planting with City infrastructure (security cameras, line of sight, benches) and anticipated events.
 **Clearing storm damage and replacing trees should be included as a separate budget item so weather events do not inhibit canopy expansion.
 ***The Living Asset Management System recognizes the increase in value as trees mature.

Streets

Opportunities	Depts. Involved	Participation	Funding
1. Plant more trees to shade streets, right of ways and medians			
Develop and implement guidelines for tree selection, planting and maintenance in certain contexts (ROW, under power lines, etc.)	PW-Parks, PW-Water, PW-TR, ED, CM-SPM	Parks Manager; Parks Supervisors, CoT Urban Forester, CM-SPM Water Utilities, Transportation Manager, Local Nurseries*, APS, SRP	N/A
Fully utilize existing volunteers for tree planting	PW-Parks, PW-TR, ED, CD-NS, CM-PIO	Adopt-a-Park, Adopt-a-Street, Adopt-an-Alley, Civic Groups, Bicycle Groups, Tempe Neighborhoods Together (TNT) Non-profits	N/A

Streets – cont.			
Opportunities	Depts. Involved	Participation	Funding
Plant trees and/ or install shade structures at bus stops	PW-Parks, PW-TR, CD-NS	Transportation Planners, Streets Manager, Landscape Supervisor	
Plant trees in neighborhoods with low canopy cover	PW-Parks, PW-TR, CD, CD-NS, CM-SPM	Community Development Director, Sustainability Programs, Neighborhood Associations, Habitat for Humanity, Civic Groups	Grants
As street improvements are scheduled, retrofit street edge to support more trees and increase shade	PW-Parks, PW-TR, PW-ENG, ED, CD, CM-SPM	Community Development Director, Engineering Deputy	CIP
2. Educate on care			
Ensure that contracts with landscapers include requirements to properly and efficiently care for trees	PW-Parks, PW-Water, PW-TR, PW-ENG, CM-SPM	Parks Manager, Parks Supervisors, CoT Urban Forester, Engineering, Transit/Streets Landscape Supervisor	CIP
Engage with local business owners and residents to ensure maintenance responsibilities on new and existing trees are clear*	PW-TR, CS, CD-NS, CM-PIO	CoT Urban Forester, Neighborhood Services, PIOs, Community Development, Habitat for Humanity	
Notes ED only applies to streets with businesses. *Educate businesses and residents to trim trees in or near the right-of-way, especially if these trees may interfere with green or grey infrastructure or utilities.			



Hubs			
Opportunities	Depts. Involved	Participation	Funding
1. Pilot urban canopy projects at hubs (i.e. Mountain Park Health Center and Tempe Library)			
Host events at sites that focus on improving tree canopy to highlight pilot projects	PW-Parks, PW-TR, ED, CS, CD-NS, CM-SPM, CM-PIO	CoT Urban Forester, PIOs, Sustainability Programs, Neighborhood Services, Local First Arizona, Non-profits	Grants, Business
Recruit neighboring businesses and organizations to enhance tree canopy	PW-Parks, ED, CS, CD-NS, CM-SPM, CM-PIO	CoT Urban Forester, PIOs, Neighborhood Services, Local First Arizona, Apache Boulevard Association, Downtown Tempe Authority, Kiwanis, Non-profits	Grants
Provide acknowledgement and messaging for participating companies	PW-Parks, ED, CD-NS, CM-SPM, CM-PIO	CoT Urban Forester, PIOs, Local First Arizona, Tempe Chamber of Commerce	City, Business
2. Provide outreach to focus on the role of urban forest in hubs			
Develop guidelines to help businesses plant and effectively care for trees in hubs	PW-Parks, PW-TR, PW-ENG, ED, CD-NS, CM-SPM, CM-PIO	CoT Urban Forester, PIOs, Planning, Engineering, Local First Arizona, Businesses	N/A
Develop guidelines for parking lots in hubs	PW-Parks, PW-ENG, ED, CD	CoT Urban Forester, Planning, Engineering, Landscape Architect	N/A
Create incentive program to ensure businesses water newly planted trees	PW-Parks, PW-Water, ED, CD	Local First Arizona, Local nurseries, Utilities	PW-Water, Grants
3. Establish Urban Forest hubs			
Celebrate businesses and organizations helping to expand healthy canopy	PW-Parks, PW-TR, ED, CD-NS, CM-PIO	PIOs, Planning, Local First Arizona Neighborhoods, Non-profits, Businesses	

Hubs – cont.			
Opportunities	Depts. Involved	Participation	Funding
Assist in the expansion of urban forest hubs	PW-Parks, PW-TR, ED, CD, CD-NS, CM-SPM, CM-PIO	Tempe Chamber of Commerce, Neighborhood Economic Development Corporation (NEDCO), Non-profits	N/A

Opportunities for Action - City of Tempe Private Property Solutions

PW: Public Works - ED: Economic Development - CS: Community Services - CD: Community Development - IT: Information Technology - TR: Transportation

Citizen Forester			
Opportunities	Depts. Involved	Participation	Funding
1. Develop Citizen Foresters			
Educational and technical programs and workshops for groups and members of the community to support a healthy urban forest.	PW-Parks, ED, CD-NS, CM-SPM, CM-PIO	CoT Urban Forester, Sustainability Program Manager	Grants
2. Create pilot projects			
Design and develop pilot program(s) to engage businesses and residents to expand and maintain the urban canopy on private property.	PW-Parks, PW-TR, CD-NS	CoT Urban Forester, Forestry non-profits, Volunteers	Unknown
Recruit residents and businesses active in tree planting to participate in pilot program(s)	PW-Parks, CD-NS, CM-PIO	CoT Urban Forester, Non-profits, ASU, Flood Control District of Maricopa County	Grants
Develop programs that provide on-going tree planting and maintenance education and guidelines that encourage residents and businesses to support and grow a healthy urban forest on privately-owned property.	PW-Parks CD-NS	CoT Urban Forester, Sustainability Programs, Non-profits	Grants
Recruit non-profit or local group to manage educational programs	PW-Parks, CM-SPM	Sustainability Programs, Non-profits, ASU Public/Private Partnerships	Unknown
Utilize social media, neighborhood association meetings, and partnership organizations to explain programs and pilots.	PW-Parks, CD-NS, CM-SPM	CoT Urban Forester, Non-profits, ASU, Flood Control District of Maricopa County, Neighborhood Organizations	Grants
Conduct interviews and engage with pilot participants to gather feedback to support continuous program improvement.	PW-Parks, CM-SPM, CM-PIO	CoT Urban Forester	Grants

Tree Bank Opportunities			
Opportunities	Depts. Involved	Participation	Funding
1. Strategize how to enhance current tree donation programs			
Discuss collaboration opportunities with SRP, APS, and Arbor Day's Energy Saving Trees program	PW-Parks, ED, CD-NS, CM-SPM, CM-PIO	SRP, APS, Arbor Day Foundation	N/A
Form partnership with local nursery(s) for potential tree donation program	PW-Parks, CD-NS	Local nurseries, SCN, City of Phoenix	N/A
Recruit corporate partners to fund donation of trees	PW-Parks, ED, CD-NS, CM-SPM	Corporate partners, SRP, APS, Non-profits	N/A
2. Investigate other funding opportunities and consider new programs			



Conclusion

A 20-Minute City with a healthy urban forest is achievable for the City of Tempe, but it will require additional resources, institutional commitment and resident and community support. Based on staff focus groups and workshops, infrastructure and viewshed requirements historically take priority over shade, walkability and urban cooling. This will require a shift in the perceived importance of the urban forest such that green infrastructure can assume an important investment value within the City and positively coexist with new and existing buildings and infrastructure.

Taking into consideration the current state of Tempe's urban forest, potential future scenarios, solution options and the proposed Opportunities for Action, Tempe residents and city staff can now implement more innovative shade and cooling strategies.

This Urban Forestry Master Plan provides the framework by which the City of Tempe can begin the process of developing a sustainable urban forest through collaborative engagement with City departments, residents, community groups and private businesses. The metrics for success lie in developing a deeper understanding of the benefits provided by urban trees and a public and private commitment to allocating the necessary resources to achieving a healthy and sustainable urban forest.



Appendices

Appendix 1 – Principles, Goals and Targets

City of Tempe Tree and Shade Goals and Targets

Related Principles	Potential Goals	Proposed Targets	Notes	
Equitably Improve Walkability¹ Expand Shade to Maximize Urban Cooling	#1: Create shade to help support a walkable 20-Minute City that benefits public health and economic development while reducing urban heat island	#1: Increase city-wide canopy cover to 25% by 2040 ² (measure with satellite images or i-Tree) ³ .	¹ Equitably improving walkability is defined in the Master Plan as ensuring every neighborhood, no matter the socio-economic status, can benefit from tree canopy ² Current canopy cover is 13.4% on average with a range of 5-34.8% in different census tracts. ³ Special training required for i-Tree software	
		#2: Plant trees along major sidewalks and bike paths to increase shade and walkability to retail and other desirable areas		
		#3: Communicate with business owners, rental owners, apartment complexes, and HOAs to promote care of current trees, timely replacement of dead trees and planting of new trees.		
		#4: Use cool/ low heat absorbing materials in capital improvement projects.		Examples of cool materials are adding permeable light colored pavements to new projects and planting trees as shading mechanisms for existing dark infrastructure.
	#2: Ensure trees and shade benefit all residents	#5: Assist neighborhoods with lowest canopy coverage in attaining a minimum of 10% coverage by 2025.		
		#6: Increase research of hottest areas in the City to inform tree planting.	Consider partnering with ASU to continue urban heat island research: http://cesa.asu.edu/urban-systems/100-cities-project/history	
	#3: Decrease air pollution throughout the City.	#7: Prioritize tree planting in neighborhoods with low canopy coverage (5-10% coverage) to help increase air quality and improve health outcomes.	After education about the benefits of trees, it is possible that some neighborhoods may not want trees due to real or perceived higher water bills, maintenance concerns, and more. Continue to strategize alternative methods to achieve this target.	
Use Resources Wisely	#1: Plant and maintain trees and landscapes that use water efficiently.	#1: Plant native and drought-tolerant species to reduce potable water use for landscaping.	Drought Tolerant Species Examples: Mesquite, Palo Verde	
		#2: Increase the number of landscape design solutions utilizing curb-cuts, condensate/ grey water, etc.	Low Impact Development (LID)	
		#3: Plant trees to serve as stormwater runoff collectors and treatment alternatives.	LID	
		#4: Create guidelines for green landscaping for public/private properties that increase permeability and create alternative to stormwater management solutions.		

Related Principles	Potential Goals	Proposed Targets	Notes
Right Tree Right Place	#1: Plant and maintain trees that are compatible with infrastructure (i.e. street lighting, underground utilities and power lines).	#1: Establish a protocol to coordinate infrastructure and demonstrate it in projects to support canopy goal.	
	#2: Identify the best method for residents and business owners to select the best species of trees and the proper planting considerations.	Identify best references and link to site.	Create a simple reference sheet that directs people to the best choice (ITTT process).
Support Biodiversity & Habitat	#1: Develop a healthy urban forest to withstand shocks and provide natural habitat for birds, animals and pollinators.	#1: Diversify tree species selection on City projects in order to boost resilience and attract more diverse wildlife.	Use City projects to set an example of good stewardship.
		#2: Encourage strategic planting of certain trees which may require external inputs (water, pesticides) and/or pruning.	Use Integrated Pest Management to reduce toxicity for humans and animals and damage to trees, landscape and soil.
		#3: Encourage edible landscapes for those willing to provide care.	Follow best practices for urban Sonoran Desert environments.
		#4: Remove invasive species (i.e. Salt Cedar).	Inventory species and area of impact to determine cost/benefit and budget impacts.
Cultivate Collective Action Enhance Property Values Enhance Community Beautification and Livability	#3: Empower residents to get more involved in tree planting and maintenance.	#1: Substantially expand partnerships with community organizations, institutions and groups.	Tempe Neighbors Together, Habitat for Humanity, etc.
		#2: Create Urban Forester position at City of Tempe to manage community programs and educational outreach.	
		#3: Provide trees at a reduced cost to residents (through City of Tempe, collaborators or non-profits).	
		#4: Increase the number of trees planted by residents and community/ civic groups.	Through education, workshops, tree giveaways, community tree planting events, etc.
Preserve Viewsheds Enhance Property Values Enhance Community Beautification and Livability	#1: Support tree planting that avoids blocking commercial signage.	#1: Require developers to consider signage conflict when making tree planting decisions.	Provide 25% tree canopy coverage; encourage site plans that provide tree shade where it is most needed; consider grouping trees to accommodate view corridors for signage.
		#2: Revise signage policy and practices to support tree planting.	Develop signage model that can be read by pedestrians and bicyclists as well as auto passengers.
	#2: Develop pilot projects on commercial and residential properties that showcase the benefits of trees in this setting to promote best practices.	#1: Work with developers in conceptual design phase of projects	
		#2: Work with businesses that have an existing sustainability platform.	
		#3: Present ideas to architects, landscape architects and developers in professional settings (conferences, workshops, meetings)	

Appendix 2 – Resources

i-Tree

i-Tree uses analyses of how trees impact property values to put a price tag on the aesthetic benefits of the trees. Information on how aesthetic value is calculated in i-Tree: https://www.itreetools.org/streets/resources/Influence_of_Trees_on_Residential_Properties_Anderson_Cordell.pdf

i-Tree software cannot determine the actual age of trees, height is used as a proxy measure. Forty percent of City-managed trees in Tempe are 1-15 feet tall and 46.8% are 16-30 feet tall.

For more detail on i-Tree assumptions view the following documents:

https://www.itreetools.org/streets/resources/Streets_Reference_Cities_Science_Update_Nov2011.pdf

<https://www.itreetools.org/streets/resources/A%20Practical%20Approach%20to%20Assessing%20Street%20Trees.pdf>

<https://www.itreetools.org/streets/resources/Selecting%20Ref%20Cities%20for%20iTree%20Streets%20McPherson%20AUF.pdf>

https://www.itreetools.org/streets/resources/Influence_of_Trees_on_Residential_Properties_Anderson_Cordell.pdf

All data analysis was conducted by Dr. Ariane Middel during 2015 and 2016.

Low Impact Development Tool Kit

<http://www.mesaaz.gov/home/showdocument?id=14999>

Datasets Used

- 4 Band NAIP Land Classification of Central Arizona*: CAP LTER, by the Environmental Remote Sensing and Geoinformatics Lab, ASU, 2012
- Right-of-Way (ROW) Shapefile (buffered streets)
- Provided by Arlene Palisoc, City of Tempe
- City boundary and Census Tract boundary Shapefile
- U.S. Census Bureau, 2010
- Character area Shapefile
- Digitized from aerial image
- SRP flood irrigation Shapefile
- SRP, February 2010

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ASU Rob and Melani Walton
Sustainability Solutions Initiatives

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