OKLAHOMA CITY
COMMUNITY FOUNDATION
Helping you help the community

Oklahoma City Parks Tree Inventory

The Oklahoma City Community Foundation, together with the City of Oklahoma City Parks & Recreation Department and Oklahoma Forestry Services, is pleased to present the final report from an inventory of trees in Oklahoma City's public parks. Conducted by Davey Resource Group, the inventory provides data on 19,632 trees located in 2,069 acres of 134 Oklahoma City parks. Funding for the project was provided by the Oklahoma City Community Foundation and Oklahoma Forestry Services.

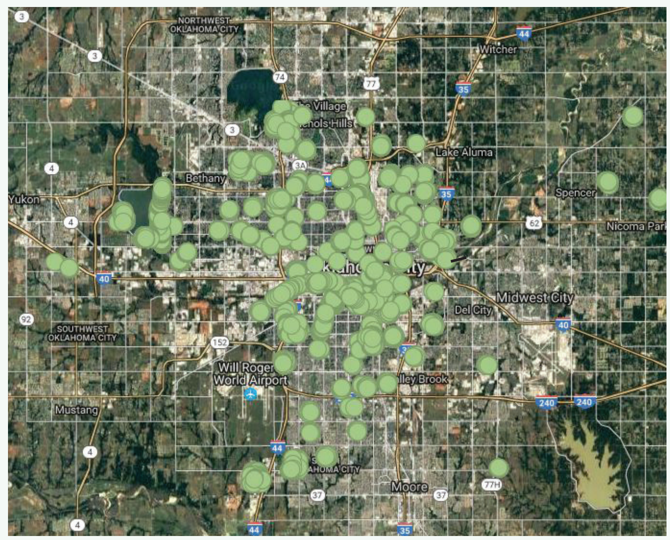
Background

Oklahoma City Community Foundation's Margaret Annis Boys Trust/Parks & Public Space Initiative

The Margaret Annis Boys Trust is a permanent endowment at the Oklahoma City Community Foundation that supports beautification projects in public parks, schools and neighborhoods throughout Oklahoma County. Through our work with the Margaret Annis Boys Trust, we recognized a community need to also support the development of Oklahoma City's parks and other public lands, which led to the creation of our Parks & Public Space Initiative. Through the initiative, we fund grants to support our community's parks, trails, school campuses and other public spaces through programming, stewardship and other improvements.

Oklahoma City Parks Master Plan

In 2012, together with the City of Oklahoma City, we hired the national consulting firm Wallace Roberts Todd to develop a long-term plan for the funding, maintenance and improvement of the community's public parks. The consultant team conducted a community survey to help understand current park usage and identify park and recreation priorities. The survey indicated that the city should prioritize making improvements to existing parks, including planting more trees. The Oklahoma City Parks Master Plan identified six strategic directions of growth for the Oklahoma City parks system, as well as specific action steps to move the parks system forward. Recommended actions included developing a comprehensive asset management system and implementing a tree planting and replacement program in Oklahoma City parks. The tree inventory project is one of the first steps toward achieving these goals. Read more about the Oklahoma City Parks Master Plan at occf.org/okcparksplan.



Project overview

The Oklahoma City tree inventory project connects tree planting with Geographic Information Systems (GIS) technology to efficiently plan why and where trees are planted in our public parks system. The project mapped and identified 19,632 trees in the developed areas of 134 Oklahoma City public parks, providing data sets on each tree including variety, height, canopy cover and health condition. The project also assessed the environmental benefits throughout Oklahoma City parks related to air and water quality and storm water management. The data is available to the public through an online mapping application at **oklahomacityok.mytreekeeper.com**. A complete report is also available at **occf.org/treeinventory**.

What we learned

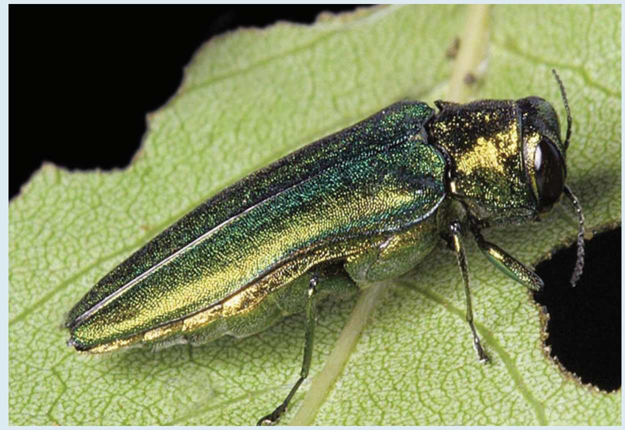
- Within the 2,084 acres of Oklahoma City's developed public park areas, more than 19,632 trees provide 310.8 acres (13.5 percent) of canopy cover.
- The estimated value of the inventoried trees is $42.1 million, or an average of $2,146 per tree.
- The majority of trees in our parks are in good or fair condition: Good = 44 percent; Fair = 50 percent; Poor = 4 percent; Dead = 1 percent
- The tree population in Oklahoma City parks meets diversity standards and includes 185 different species, with 60 percent being native to Oklahoma. The most common species is the eastern redcedar, accounting for 7 percent of the total population. Experts recommend no single species represent 10 percent or more of the total tree population to protect against potential threats of disease, pests and other stressors that naturally gravitate toward specific varieties.
- The estimated distribution of tree ages, based on trunk diameter, is nearly ideal for our city parks. An ideally aged population allows park managers to uniformly allocate maintenance costs and ensure continuity of canopy coverage:
    - 8 inches or less (relatively young) = 35.3 percent
    - 7-24 inches (established) = 64 percent
    - >24 inches (mature) = 9 percent
- Trees growing in our public parks provide $163,603 in annual environmental benefits to the city, including:
    - $43,053 = 324 tons of carbon sequestered
    - $88,774 = 8.81 tons of air pollutants removed
    - $31,776 = 3.5 million gallons of stormwater intercepted
- In addition to the environmental benefits highlighted in the report, the trees throughout Oklahoma City's parks also provide unquantified aesthetic, human health, socioeconomic, property value and wildlife sustainability benefits.

Outcomes and benefits

- Establishes a baseline of data to more efficiently plan for tree maintenance, planting and replacement in Oklahoma City parks.
- Provides interactive data and technology to help parks staff improve efficiency of daily operations and workflow.
- Enhances tree management decisions regarding species selection, distribution and maintenance policies.
- Supports city budget planning with accurate data on trees that require maintenance and number of trees that need to be planted in the future to maintain tree canopy.
- Enables proactive planning to protect tree canopy against potential threats like insects, disease, drought, ice and other severe weather.
- Projects potential outcomes through forecasting technology to estimate future tree population.
- Quantifies environmental value of trees in our community parks.
- Assists community partners in long-term, proactive planning for park and trail improvement projects, public activation initiatives and tree canopy sustainability.
- Informs city residents about importance of our community's urban forest and provides usable information about tree species performance and selection in central Oklahoma.

How we can use the data

Protecting Against Pests



The Emerald Ash Borer is a wood-boring beetle that has killed hundreds of millions of ash trees in North America. Spread through infested logs or firewood, the pest was discovered in Grove, Okla., in October 2016, and is predicted to infiltrate all of the ash trees throughout Oklahoma.

Ash trees in Will Rogers Park

Using the tree inventory data, we know that 492 ash trees are currently growing in Oklahoma City parks. These trees account for 3 percent of our parks' trees and 18 percent of total leaf area. By identifying the exact location, size and condition of every ash tree in city parks, staff can proactively plan to control the pest. Knowing the size and condition of each ash tree will help determine which trees to inoculate and which to remove prior to infestation. Parks staff can also begin replacing at-risk trees and interplanting more sustainable tree varieties to protect against canopy cover loss.

Mitigating Effects of Storm Damage

Unfortunately, central Oklahoma experiences a variety of severe weather including drought, wind, tornadoes and ice storms. Ice storms cause millions of dollars in damage to trees and property annually. The tree inventory data will help identify and locate which trees in our city parks are at greater risk for significant damage.

Weak-wooded tree varieties such as maple and elm are more susceptible to storm and ice damage, while stronger varieties including oak and cypress can better withstand the effects of severe weather. Parks staff can use the data to identify which parks have greater populations of at-risk trees, as well as the proximity to overhead power lines.

This information will assist grounds crews in responding to the highest risk areas in the parks to efficiently remove hazards following the storm. The interactive database will allow grounds crews to flag potential hazards requiring follow-up maintenance such as torn branches, exposed stumps or split trunks. By continually updating the inventory data, staff can analyze the tree population on an ongoing basis and plan for replacement of damaged trees.

Enriching Neighborhood Parks

Neighborhoods, civic groups and other organizations can use the tree inventory data to assist with planning of park improvement projects. For each of the 134 parks inventoried, tree variety, size and condition can easily be viewed on a map, as well as the presence of overhead utilities or other special conditions that should be considered. The data can help determine the most successful variety of tree to plant in a given location to achieve optimum shade coverage, especially along trails, picnic and play areas. The software can also forecast growth of trees over a specified time period given the proposed variety and size of trees to be planted. This virtual data will be extremely beneficial in planning for park improvement projects to evaluate the future potential of tree benefits and ensure efficient use of funding.

View of Glen Ellyn Park

Improving Environmental Quality

- **Air Quality**
  Oklahoma City is one of the largest cities in the nation in compliance with the Clean Air Act. The trees in our city parks help improve air quality by removing 8.1 tons of pollutants annually. By revealing which species are providing the greatest pollution removal benefits, the tree inventory data can assist city planners in air quality management strategies.
- **Carbon Storage and Sequestration**
  Trees help mitigate climate change by storing atmospheric carbon. As a tree grows, it stores more carbon in its wood and foliage. When trees are allowed to die and decay, stored carbon is released back into the atmosphere. Maintaining healthy trees helps to ensure that carbon remains out of our atmosphere. The data estimates that trees in our city parks currently store 7,150 tons of carbon, which is equivalent to the carbon released each year by 5,060 automobiles or 2,070 single family homes. These trees capture an additional 324 tons of carbon from the atmosphere each year, valued at $43,053.
- **Stormwater Runoff**
  During rainfall, trees intercept precipitation, while their root systems promote infiltration and moisture storage in the soil. The water that reaches the ground and does not infiltrate the soil becomes stormwater runoff, which can contribute pollution to streams, rivers and other bodies of water. In Oklahoma City, the trees in our city parks help to reduce an estimated 3.5 million gallons of runoff each year, resulting in reduced stormwater management costs for municipalities. Tree inventory data indicating which species are the most efficient at reducing runoff can be used by city planners for future management strategies.

Informing the Public

The Oklahoma City Parks Tree Inventory can help educate our community about the vital importance of the trees in our city parks. In addition to quantifying the economic and environmental benefits, the data can also be practically applied by Oklahoma City residents in their personal landscaping projects. Information about tree species performance and diversity, tree value, hazard potential, planting priority, canopy cover and susceptibility to pests and pathogens can assist citizens with planting the most suitable and beneficial trees for their geographic location.

Next Steps

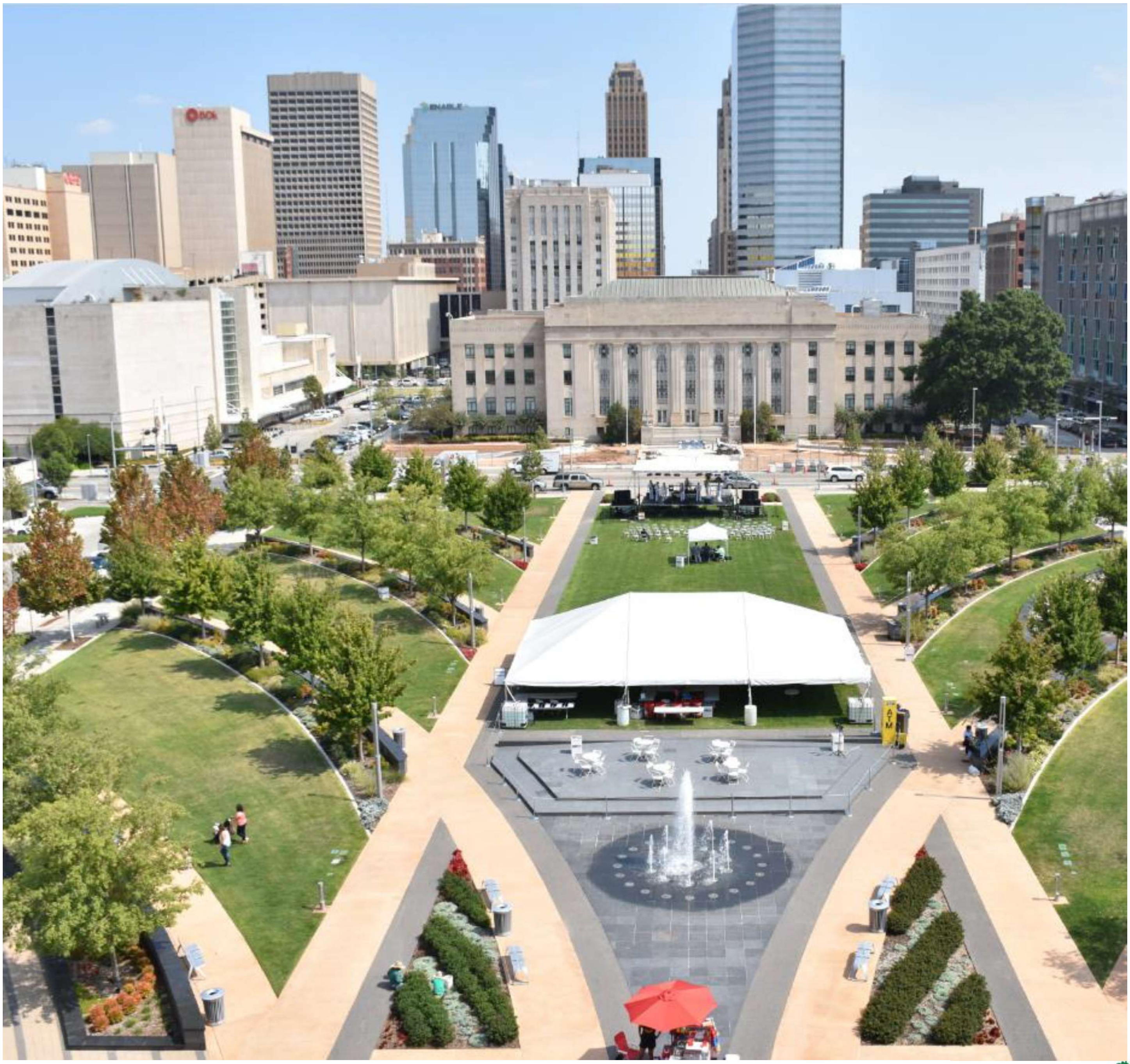
The Oklahoma City Parks Tree Inventory is designed to be a fluid, tree management system. The interactive software will allow city staff to update the data with new tree plantings, removals, tree growth and condition on an ongoing basis.

This data and technology will allow us to follow the recommendation of the Oklahoma City Parks Master Plan to evaluate and implement a tree planting and replacement program for our city parks. In addition, continued collaboration with stakeholders will allow us to further utilize this data.

To review the complete Oklahoma City Parks Tree Inventory Report, visit **occf.org/treeinventory**.

Oklahoma City
Community Forest Assessment

2016



DAVEY
RESOURCE GROUP
A Division of The Davey Tree Expert Company

Oklahoma City, Oklahoma
Community Forest Assessment

2016

Prepared for:

City of Oklahoma City Parks and Recreation Department

Oklahoma City Community Foundation

Oklahoma Forestry Services

Prepared by:

Davey Resource Group
A Division of the Davey Tree Expert Company

Funding provided by:

Oklahoma City Community Foundation

Oklahoma Forestry Services

This report is adapted from the standard i-Tree Ecosystem Analysis report that is generated upon submission of i-Tree Eco data. i-Tree Eco (formerly Urban Forest Effects model) was cooperatively developed by USDA Forest Service Northeastern Research Station (NRS), the USDA State and Private Forestry's Urban and Community Forestry Program and Northeastern Area, the Davey Tree Expert Company, and SUNY College of Environmental Science and Forestry.

Table of Contents

Tables

Figures

Executive Summary

Structure

Community trees play a critical role in Oklahoma City, where the 2,084 acres of parks are home to over 19,632 trees in the developed and usable areas of parks. This tree population provides numerous benefits both tangible and intangible to residents, visitors, and businesses (Table 1).

Table 1. Benchmark Values

Physical Traits	Amount	Value ($)
Total Number of Trees	19,632	
Stumps	134	
Leaf Surface Area (acres)	1,273	
Carbon Stored (tons)	7,154	$951,845
Replacement Value		$42,127,177
Annual Environmental Benefits	**Amount**	**Value ($)**
Carbon Sequestered (tons)	324	$43,053
Stormwater Intercepted (gallons)	3,555,938	$31,776
Air Pollutants Removed (tons)	8.81	$88,774
Total Annual Environmental Benefits		**$163,603**

In 2016, to support the preservation and management of community trees, the Oklahoma City Community Foundation and the Oklahoma Department of Forestry commissioned an inventory of public trees in parks. The inventory produced a GIS layer that includes vital information about each tree including species, size, condition, and geographic location. Davey Resource Group (DRG) used this data in conjunction with i-Tree Eco benefit-cost modeling software to develop a detailed and quantified analysis of the current structure, function, and value of the community urban forest. This report details the results of that analysis.

The tree population is characterized by the following:

- 185 tree species (See Appendix III)
- 60% species native to Oklahoma
- Eastern redcedar (7%) is the most common species, followed by Chinese pistache (6.5%), and post oak (6.2%)
- 35.3% of the population measures 8" DBH or smaller; 9% is larger than 24" DBH
- 44% good condition, 50% fair, 4% poor, and 1% dead
- 13.5% (310.8 acres) tree canopy cover in the developed and usable area of parks

Benefits

Annually, Oklahoma City's community trees provide cumulative environmental benefits to the community at an average value of $8.33 per tree, for a total value of $163,603. These annual environmental benefits include:

- 324 tons of carbon sequestered, valued at $43,053
- 8.8 tons of air pollutants removed, valued at $88,774
- 3.6 million gallons of stormwater intercepted, valued at $31,776

When the annual investment of $436,430 ($22.23/tree) for the management of Oklahoma City's park trees is considered, the annual net cost to the community is $272,826, an average of $13.90 per tree.

These benefits were calculated without factoring in the unquantified aesthetic, human health, socio-economic, and property value, and wildlife sustainability benefits that these parks and trees also provide.

Management

Oklahoma City's park tree resource is a dynamic resource that requires continued investment to maintain and realize its full benefit potential. **Trees are one of the few community assets that have the potential to increase in value with time and proper management.** Appropriate and timely tree care can substantially increase lifespan. When trees live longer, they provide greater benefits. As individual trees continue to mature and aging trees are replaced, the overall value of the community forest and the amount of benefits provided grow as well. This vital, living resource is, however, vulnerable to a host of stressors and requires ecologically sound and sustainable best management practices to ensure a continued flow of benefits for future generations.

The urban forest in Oklahoma City parks is an establishing resource in overall fair to good condition. With continued new tree planting, proactive management, and planning, the benefits from this resource will continue to increase as young trees mature. Young tree training, a regular pruning cycle, and regular inspection to identify structural and age-related defects is recommended to manage risk and reduce the likelihood of tree and branch failure. Based on this resource analysis, DRG recommends the following:

- Maintain species diversity by ensuring that new tree plantings include a variety of suitable species and don't unduly increase reliance on prevalent species.
- Identify additional available planting sites to maintain diversity and increase benefits. Install large-stature species wherever space allows.
- Provide structural pruning for young trees and a regular pruning cycle for all trees.
- Protect existing trees, especially mature native species, and manage risk with regular inspection to identify and mitigate structural and age-related defects.
- Continue to maintain and update the inventory database, tracking tree growth and condition during regular pruning cycles.

With adequate protection and planning, the value of the community urban forest resource in Oklahoma City will increase over time. Proactive management and an ongoing tree replacement plan are critical to ensuring that residents continue to receive a high return on their investment. Along with new tree installation and replacement planting, funding for tree maintenance and inspection is vital to preserving benefits, prolonging tree life, and managing risk. Existing mature trees should be maintained and protected whenever possible since the greatest benefits accrue from the continued growth and longevity of existing canopy. Managers can take pride in knowing that Oklahoma City's community trees support the quality of life for residents and neighboring communities.

Introduction

Community

Oklahoma City is the capitol as well as the largest city in Oklahoma with a population of 610,613. The primary watershed is the North Canadian River, and the northeastern portion of the community is considered part of the Cross Timbers ecological region, known for blackjack and post oak woodlands. The climate is consistent with the semi-arid western plains, including periods of prolonged drought and heat in summer months, tempered by winds from the southwest. Oklahoma City is one of the largest cities in the nation in compliance with the Clean Air Act. The city receives average annual precipitation of 34 inches, of which 5-10 inches is typically snow. Very heavy rainfall, leading to flash flooding, occurs regularly, and winter ice and snow storms are not uncommon. The city has an active severe weather season from March through June, although tornadoes have occurred in every month. Since 1980, 150 tornadoes have touched down within the city limits.

Oklahoma City has had multiple growth spurts since its incorporation in 1889. In the 1920s, the city developed major stockyards, attracting residents and livestock business from Omaha and Chicago. The working stockyards remain an attraction today. In 1928, oil was discovered within the city limits, and the area became a major US oil producer over the following decades. The community is home to several colleges and universities, including Oklahoma City University, and medical campuses of University of Oklahoma (OU Medicine). Significant population increases in the 1990s followed the community's transition from primarily a center for government and oil business, to a diversified economy with thriving information technology, health, and service industries. In 2008, Forbes magazine named Oklahoma City the most recession-proof city in America.

Museums and regional parks include the Oklahoma Museum of Art, the Science Museum of Oklahoma, the Oklahoma City Zoo, the American Banjo Museum and the Myriad Botanical Gardens. Oklahoma City features a regional cornerstone park in each quadrant which were once connected by the Grand Boulevard Loop, some sections of which still exist today.

Scope & Purpose

The urban forest contributes to a healthier, more livable, and prosperous Oklahoma City. This Community Forest Assessment provides benchmarks for the current amount of canopy, leaf surface area, and structure of 19,632 trees in the developed and usable areas of city parks (Figure 1). It also provides an overview of the ecosystem services of these trees. The community's 134 parks encompass 2,069 acres. Parks vary in size and shape with an average area of 16 acres. The largest park, Route 66 Park, includes 149 acres, about 7% of the park system. A full inventory of trees in city parks was conducted by ISA Certified Arborists from June 1, through October 8, 2016. This GIS-based tree inventory will allow Oklahoma City Forestry Staff to better understand, prioritize, and manage the public tree population.

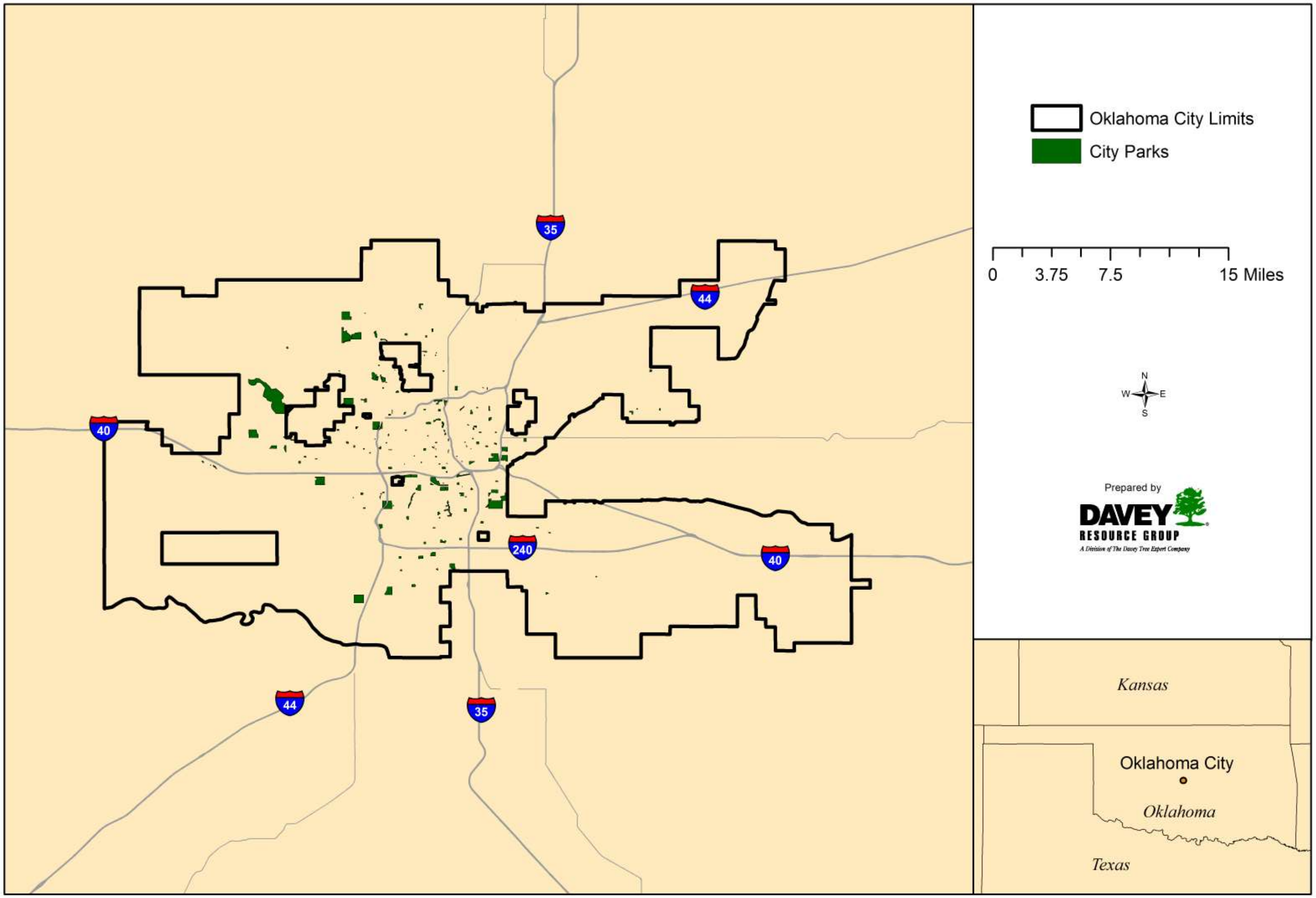


Figure 1. Map of Inventoried Parks

Methods

Data were collected by ISA Certified Arborists who receive extensive training to ensure efficiency, consistency, accuracy and replicability. Data were checked for accuracy at multiple points in the collection process, and data inconsistencies were identified and corrected at the time they occurred. This results in data with an accuracy level of 95% or greater for the tree population.

Tree inventory data were exported from TreeKeeper7 and coded and converted to an i-tree v.6.1.15 Eco V6.0.3 project file. I-tree Eco is a software application designed to use inventory data collected in the field along with local hourly air pollution and meteorological data to quantify urban forest structure, environmental effects, and value to communities. The program is a central computing engine that makes scientifically sound estimates of the effects of urban forest based on peer-reviewed scientific equations to predict environmental and economic benefits. **Aesthetic, human health, socio-economic, property value, and wildlife sustainability benefits are not calculated as part of this study although they are certainly an important benefit of Oklahoma City's park tree resource.** The baseline data can be used to make effective resource management decisions, develop policy, and set priorities.

Urban Forest Structure

Species Composition

Oklahoma City parks include a wide variety of more than 185 tree species (Appendix III). The top 10 most common species represent 49% of the population (Figure 2). The most predominant species are eastern redcedar (*Juniperus virginiana*, 1,365 trees, 7%), Chinese pistache (*Pistacia chinensis*, 1,279 trees, 7%), and post oak (*Quercus stellata*, 1,211 trees, 6%). A majority of trees (60%) are native to Oklahoma, and 62% are from North America. The next most common area of origin is Asia (27%).

There is a widely accepted rule that no single species should represent greater than 10% of the total population, and no single genus more than 20% (Clark Et al, 1997). In Oklahoma City, no tree population exceeds these diversity guidelines. Maintaining diversity in an urban forest is important. Dominance of any single species or genus can have detrimental consequences in the event of storms, drought, disease, pests, or other stressors that can severely affect an urban forest and the flow of benefits and costs over time. Catastrophic pathogens, such as Dutch Elm Disease (*Ophiostoma ulmi*), Emerald Ash Borer (*Agrilus planipennis*), Asian Longhorned Beetle (*Anoplophora glabripennis*), and Sudden Oak Death (SOD) (*Phytophthora ramorum et al.*) are some examples of unexpected, devastating, and costly pests and pathogens that highlight the importance of diversity and the balanced distribution of species and genera. Pests and pathogens are discussed further in the section Urban Forest Threats.

Figure 2. Species Distribution

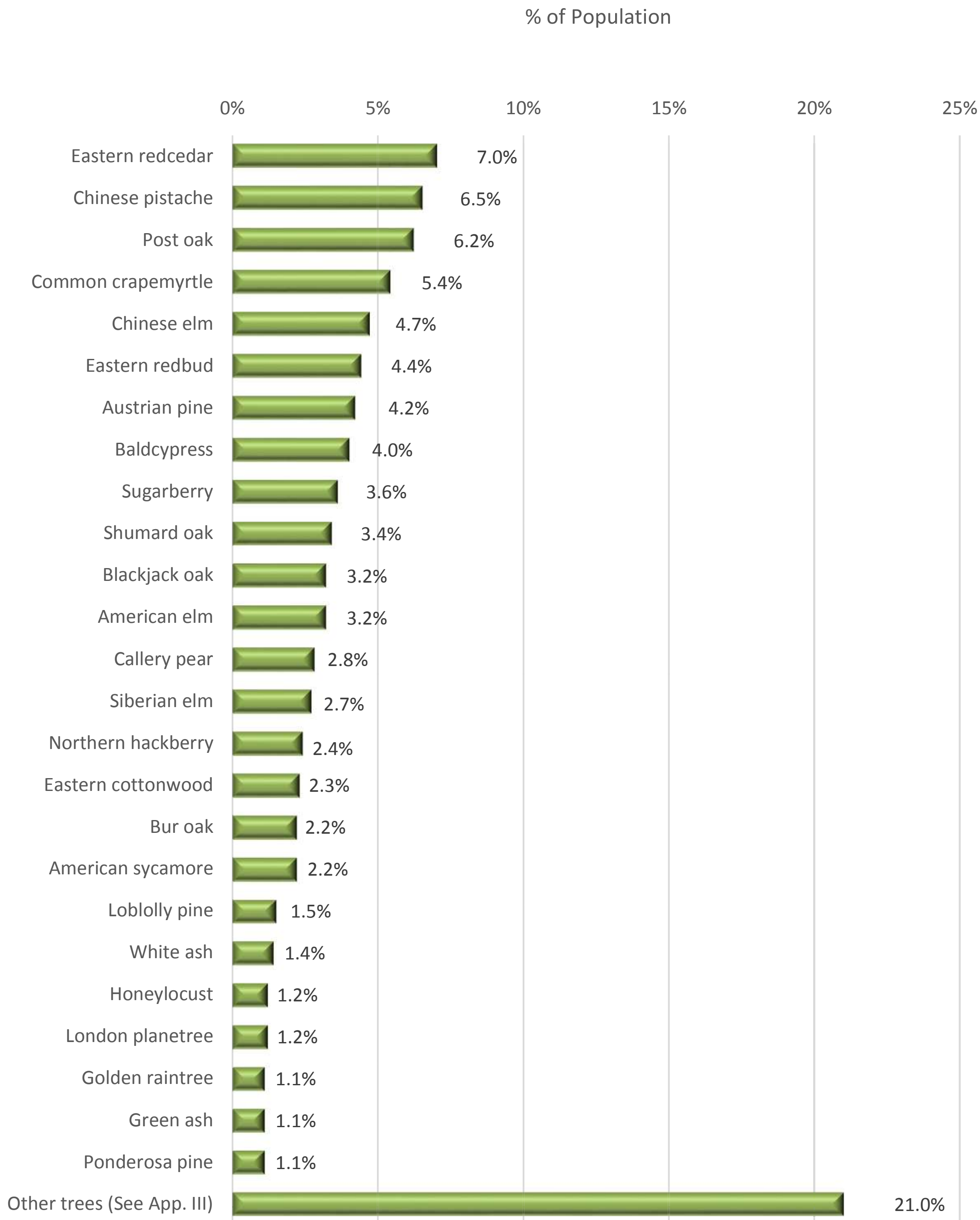


Table 2. Species Distribution

Common Name	Species	Number of Trees	% of Pop.
Eastern redcedar	*Juniperus virginiana*	1,365	6.95%
Chinese pistache	*Pistacia chinensis*	1,279	6.51%
Post oak	*Quercus stellata*	1,211	6.17%
Common crapemyrtle	*Lagerstroemia indica*	1,069	5.45%
Chinese elm	*Ulmus parvifolia*	932	4.75%
Eastern redbud	*Cercis canadensis*	864	4.40%
Austrian pine	*Pinus nigra*	817	4.16%
Baldcypress	*Taxodium distichum*	794	4.04%
Sugarberry	*Celtis laevigata*	707	3.60%
Shumard oak	*Quercus shumardii*	669	3.41%
Blackjack oak	*Quercus marilandica*	630	3.21%
American elm	*Ulmus americana*	619	3.15%
Callery pear	*Pyrus calleryana*	542	2.76%
Siberian elm	*Ulmus pumila*	535	2.73%
Northern hackberry	*Celtis occidentalis*	472	2.40%
Eastern cottonwood	*Populus deltoides*	448	2.28%
Bur oak	*Quercus macrocarpa*	437	2.23%
American sycamore	*Platanus occidentalis*	425	2.16%
Loblolly pine	*Pinus taeda*	294	1.50%
White ash	*Fraxinus americana*	279	1.42%
Honeylocust	*Gleditsia triacanthos*	243	1.24%
London planetree	*Platanus x acerifolia*	228	1.16%
Golden raintree	*Koelreuteria paniculata*	218	1.11%
Green ash	*Fraxinus pennsylvanica*	211	1.07%
Ponderosa pine	*Pinus ponderosa*	208	1.06%
Other trees (See App. III)		4,136	21.07%
Total		**19,632**	**100%**

DBH Distribution

For most woody plants, trunk diameter (DBH) increases incrementally on an annual basis. Therefore, DBH may be used to estimate the age of the population. Oklahoma City urban forest managers recognize that in order to maintain a healthy and vibrant urban forest, it is important to have a diversity of tree species and ages. Based on the relative relationship between age and diameter, the distribution of the sampled trees indicates an establishing population, with 27% of all trees less than 6 inches DBH.

The distribution of individual tree ages within a tree population influences present and future costs as well as the flow of benefits. An ideally-aged population allows managers to allocate annual maintenance costs uniformly over many years and assures continuity in overall tree canopy coverage and associated benefits. A desirable distribution has a high proportion of young trees to offset establishment and age-related mortality as the percentage of older trees declines over time (Richards, 1982/83). This ideal, albeit uneven, distribution suggests a large fraction of trees (40%) should be young, with diameters (DBH) less than eight inches, while only 10% should be in the large diameter classes (greater than 24 inches DBH).

The DBH distribution of Oklahoma City's park tree resource is nearly ideal, with 35.3% of trees 8 inches DBH or less and 9% of trees larger than 24 inches DBH (Figure 3 and Table 3). With ongoing proactive management, this resource will continue to produce a stable benefit stream, supporting the quality of life and health of the community and the environment. The City has a fairly large population of established trees (64% are 7-24" DBH). With regular inspection and proactive management, these trees have the potential to continue providing benefits for years to come.

Figure 3. DBH Distribution

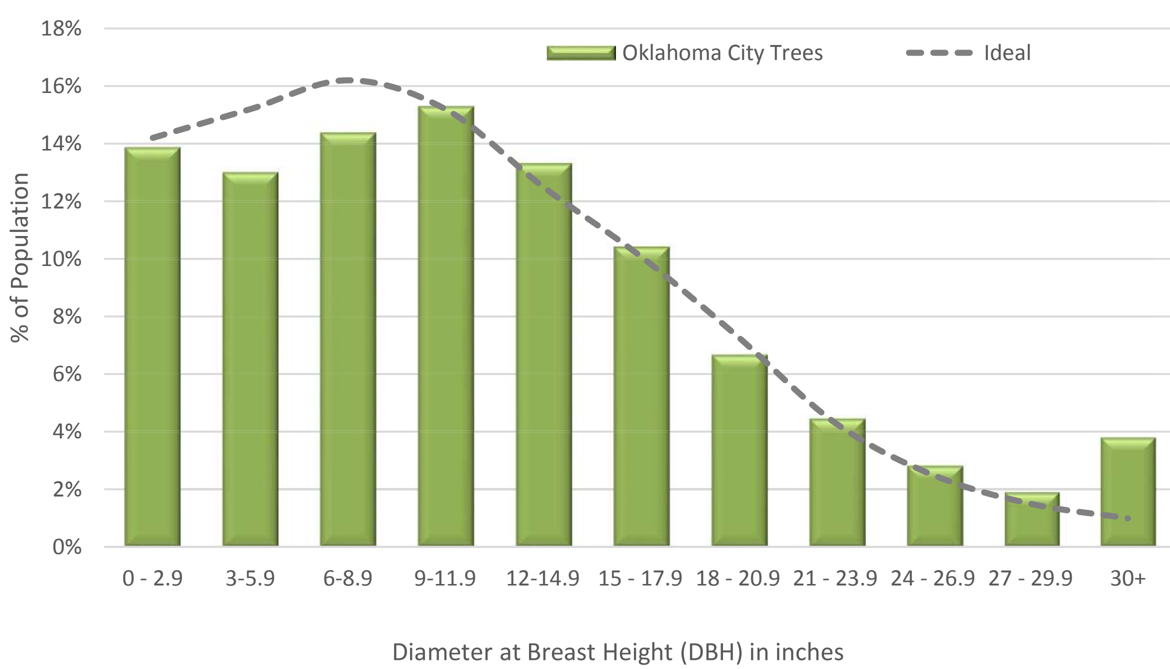


Table 3. DBH of Most Common Species

Species	# of Trees	Diameter at Breast Height (DBH)											% of Pop.
		0 - 2.9	3-5.9	6-8.9	9-11.9	12-14.9	15 - 17.9	18 - 20.9	21 - 23.9	24 - 26.9	27 - 29.9	30+	
Eastern redcedar	1,365	56	216	265	257	231	188	91	38	16	1	5	6.95%
Chinese pistache	1,279	77	239	331	311	175	83	38	19	3	3	0	6.51%
Post oak	1,211	0	7	87	246	253	280	157	94	31	30	24	6.17%
Common crapemyrtle	1,069	982	86	2	0	0	0	0	0	0	0	0	5.45%
Chinese elm	932	34	106	223	198	162	85	51	34	26	8	6	4.75%
Eastern redbud	864	208	352	215	72	10	6	1	0	0	0	0	4.40%
Austrian pine	817	11	81	213	231	135	87	35	13	5	3	3	4.16%
Baldcypress	794	110	125	86	98	122	84	54	41	28	16	30	4.04%
Sugarberry	707	26	76	123	126	80	75	56	56	41	21	28	3.60%
Shumard oak	669	74	92	75	82	99	106	62	40	18	8	12	3.41%
Blackjack oak	630	0	4	20	106	167	144	96	50	22	13	8	3.21%
American elm	619	0	14	37	59	78	77	68	67	70	45	104	3.15%
Callery pear	542	9	46	119	144	103	72	36	10	3	0	0	2.76%
Siberian elm	535	9	32	55	65	81	60	55	32	33	29	84	2.73%
Northern hackberry	472	6	29	65	88	93	50	42	32	21	16	30	2.40%
Eastern cottonwood	448	1	6	4	16	34	56	70	54	51	33	123	2.28%
Bur oak	437	7	35	53	50	29	40	34	49	36	33	71	2.23%
American sycamore	425	3	23	34	61	72	49	48	28	25	32	50	2.16%
Loblolly pine	294	70	51	51	26	32	39	14	9	1	1	0	1.50%
White ash	279	12	81	90	41	24	9	6	8	2	2	4	1.42%
Honeylocust	243	1	12	29	54	50	43	26	18	9	0	1	1.24%
London planetree	228	22	47	25	19	29	24	15	13	11	6	17	1.16%
Golden raintree	218	11	65	56	39	25	10	7	4	1	0	0	1.11%
Green ash	211	3	17	53	51	26	17	11	8	9	3	13	1.07%
Ponderosa pine	208	0	4	14	37	54	59	27	12	1	0	0	1.06%
Other trees (See App. III)	4,136	992	710	499	529	451	305	212	146	91	70	132	21.07%
Citywide	**19,632**	**2,724**	**2,554**	**2,825**	**3,004**	**2,615**	**2,048**	**1,314**	**876**	**554**	**374**	**747**	**100%**

Carbon Storage

Oklahoma City's park trees are storing 7,154 tons of carbon valued at $951,844. That is equivalent to the carbon released per year by 5,060 automobiles or 2,070 single family homes. Carbon storage is the volume of carbon stored (wood and foliar mass) in all the inventoried trees to date. As trees grow they store more carbon as new wood, and in starch reserves. When trees die and decay, they release much of the stored carbon back to the atmosphere. In urban environments, most trees that die are removed and chipped or disposed of as firewood, releasing stored carbon. Thus, carbon storage is an indication of the amount of carbon that can be lost if trees are allowed to die and decompose.

Tree Condition

Tree condition can be related to species fitness, age, environmental stressors, and maintenance, or a combination of these factors. The inventory found 94% of trees in fair or better condition, with 44% good (8,563 trees) and 50% fair (9,890 trees) (Figure 4).

In some cases, corrective pruning and maintenance can improve tree health and condition, since condition ratings evaluate deadwood and structural defects. When deadwood and defects are removed, tree condition improves. Trees in poor condition and stumps often represent opportunities for tree planting where site use supports new trees in these locations.

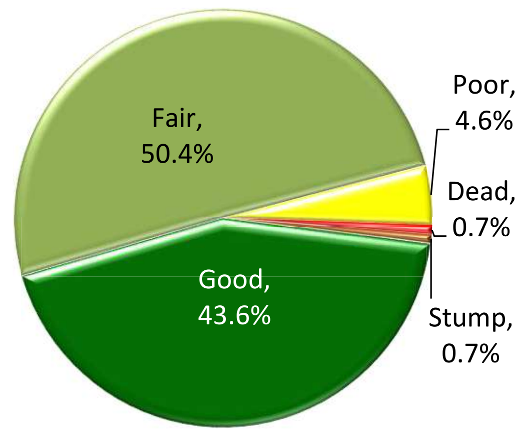


Figure 4. Tree Condition

Relative Performance Index

The *relative performance index* (RPI) is one way to further analyze the condition and suitability of specific tree species. The RPI provides an urban forest manager with a detailed perspective on how different species perform compared to each other. The index compares the condition ratings of each tree species with the condition ratings of every other tree species within the population. An RPI of 1.0 or better indicates that the species is performing as well or better than average. An RPI value below 1.0 indicates that the species is not performing as well in comparison to the rest of the population. Among the 25 most common species, each representing at least 1% of the inventory, 13 have an RPI of 1.0 or greater (Table 4). Crapemyrtle (*Lagerstroemia indica*, RPI=1.05), Austrian pine (*Pinus nigra*, RPI=1.03), and baldcypress (*Taxodium distichum*, RPI=1.03) have the highest RPI among the top 25 trees.

The RPI can be a useful tool for urban forest managers. For example, if a community has been planting two or more new species, the RPI can be used to compare their relative performance. If the RPI indicates that one is performing relatively poorly, managers may decide to reduce or even stop planting that species and subsequently save money on both planting stock and replacement costs. The RPI enables managers to look at the performance of long-standing species as well. Established species with an RPI of 1.00 or greater have performed well over time. These top performers should be retained, and planted, as a healthy proportion of the overall population. It is important to keep in mind that, because RPI is based on condition at the time of the inventory, it may not reflect cosmetic or nuisance issues, especially seasonal issues that are not threatening the health or structure of the trees. Urban forest managers must filter the RPI values through the lens of tree removals and emerging pests. A species with a high RPI and an emerging pest threat may not be ideal for future plantings. For example, Austrian pine is susceptible to a nematode, and ash are susceptible to the Emerald Ash Borer, recently found in Grove, Oklahoma. Certain varieties and cultivars may have a higher RPI than a population as a whole, eg. disease-resistant cultivars.

An RPI value less than 1.00 may be indicative of a species that is not well adapted to local conditions, and therefore more likely to present increased safety and maintenance issues. Species with an RPI less than 1.00 should receive careful consideration before being selected for future planting. However, prior to selecting or deselecting trees based on RPI alone, managers should consider the age distribution of the species, among other factors. A species that has a below average RPI, and a lot of trees in larger DBH classes, may simply be exhibiting signs of population senescence.

Table 4. Relative Performance Index of Most Common Species

Species	Dead	Poor	Fair	Good	RPI	# of Trees	% of Pop.
Common crapemyrtle	0.00	0.90	21.60	77.50	**1.05**	1,069	5.45
Austrian pine	0.00	0.70	40.40	58.90	**1.03**	817	4.16
Baldcypress	0.30	2.10	28.20	69.40	**1.03**	794	4.04
Eastern redcedar	0.40	2.10	38.50	59.10	**1.02**	1,365	6.95
Chinese pistache	0.00	2.20	46.80	51.00	**1.02**	1,279	6.51
White ash	0.40	3.60	36.60	59.50	**1.02**	279	1.42
Shumard oak	0.00	3.30	50.70	46.00	**1.01**	669	3.41
Bur oak	0.00	2.30	54.50	43.20	**1.01**	437	2.23
Post oak	0.10	2.10	57.00	40.80	**1.00**	1,211	6.17
Chinese elm	0.00	2.10	60.20	37.70	**1.00**	932	4.75
American sycamore	0.00	1.60	62.40	36.00	**1.00**	425	2.16
Loblolly pine	0.00	4.40	50.30	45.20	**1.00**	294	1.50
Golden raintree	0.00	4.10	55.50	40.40	**1.00**	218	1.11
London planetree	0.00	7.90	52.20	39.90	**0.99**	228	1.16
Ponderosa pine	0.00	3.40	61.10	35.60	**0.99**	208	1.06
Eastern redbud	0.50	5.00	60.80	33.80	**0.98**	864	4.40
Sugarberry	0.00	7.40	59.10	33.50	**0.98**	707	3.60
Blackjack oak	0.20	3.80	74.60	21.40	**0.98**	630	3.21
Northern hackberry	0.20	6.60	66.30	26.90	**0.98**	472	2.40
American elm	0.00	8.90	66.70	24.40	**0.97**	619	3.15
Callery pear	0.40	8.70	64.20	26.80	**0.97**	542	2.76
Honeylocust	0.80	7.00	65.00	27.20	**0.97**	243	1.24
Green ash	0.00	10.40	62.10	27.50	**0.97**	211	1.07
Eastern cottonwood	0.20	6.50	83.30	10.00	**0.96**	448	2.28
Siberian elm	0.70	20.00	76.10	3.20	**0.91**	535	2.73
Other trees (See App.III)	0.00	0.01	0.09	0.10	**1.00**	4,136	0.21
Total/ Average	**0.20**	**4.60**	**51.00**	**44.20**	**1.00**	**19,632**	**100%**

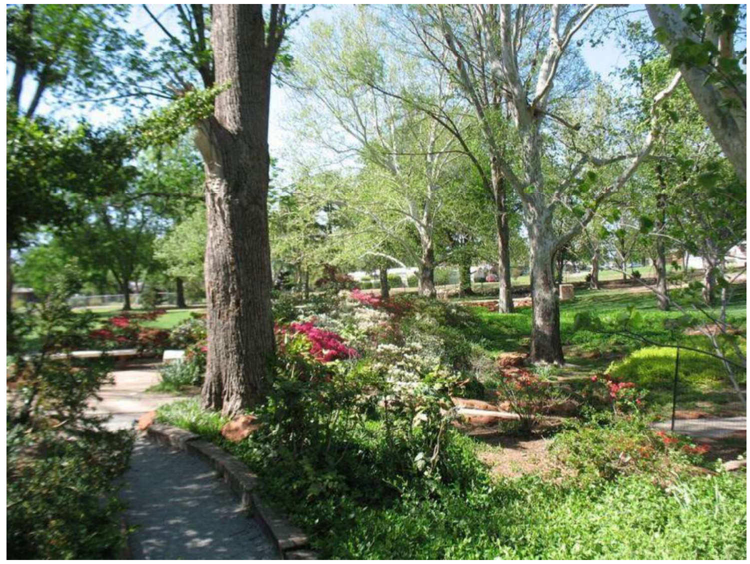
The RPI value can also help to identify underused species that are demonstrating good performance. Trees with an RPI value greater than 1.00 and an established DBH distribution may be indicating their suitability in the local environment and may receive consideration for additional planting. When considering new species based on RPI, it is important to base the decision on established populations. The greater number of trees of a particular species, the more relevant the RPI becomes.

Oklahoma City's park inventory data identified 17 species that may be underutilized (Table 5). This list should be reviewed by local experts to verify suitability. Several species, such as chaste tree (*Vitex agnus-castus*), Rocky Mountain juniper (*Juniperus scopulorum*), and Shantung maple (*Acer truncatum*) should be evaluated with care. These populations include many small individuals and it is not clear from examining the data alone if the population is simply young, or if these are established populations of trees that have a small stature and small DBH at maturity. The Scotch pine is susceptible to nematodes that may influence future performance.

Table 5. Underutilized High-Performing Species

Species	RPI	# of Trees	% of Pop.
Chaste tree	1.07	71	0.36
Yaupon	1.06	108	0.55
Oriental arborvitae	1.05	42	0.21
Pondcypress	1.05	23	0.12
American holly	1.04	155	0.79
Amur maple	1.04	42	0.21
Southern magnolia	1.04	43	0.22
Arizona cypress	1.03	62	0.32
Cedar elm	1.03	111	0.57
Live oak *(Q. fusiformis*)	1.03	84	0.43
Shantung maple	1.02	91	0.46
Scotch pine	1.02	55	0.28
Chinkapin oak	1.01	90	0.46
Sawtooth oak	1.01	192	0.98

Species Importance & Leaf Area



To quantify the significance of any one particular species in Oklahoma City's park tree inventory, an importance value is derived for each of the most common species. Importance values (IV) are particularly meaningful to urban forest managers because they indicate a reliance on the functional capacity of a particular species. **i-Tree Eco calculates importance value based on the sum of percentages of leaf area and population.** Importance value suggests reliance on specific species based on their population and leaf area. The importance value can range from zero (which implies no reliance) to 200 (suggesting total reliance).

Ideally, no single species should dominate the composition of an urban forest population. Since the importance value goes beyond population numbers alone, it can help managers to better comprehend the impact of a complete loss of any one species. When importance values are comparatively equal among the 10 most abundant species, the risk of major reductions to benefits is significantly reduced. Of course, suitability of the dominant species is another important consideration. Planting short-lived or poorly adapted species can result in shorter lifespans and increased long-term management investments.

The 25 most abundant species (>1% of the population) represent 79% of the overall population, and 84% of the total leaf area, for a combined importance value of 162 (in a scale of 200) (Table 6). Of these, Oklahoma City's parks rely most on eastern redcedar (*Juniperus virginiana*, Importance Value =14.4). Due to their large stature and high leaf surface area, some species provide more impact than their population numbers alone would suggest. Chinese pistache (*Pistachia chinensis*), post oak (*Quercus stellata*), Chinese elm (*Ulmus parvifolia*), baldcypress (*Taxodium distichum*), and American elm (*Ulmus americana*) have importance values over 10, indicating Oklahoma City parks rely heavily on these species for tree benefits. These 6 species with high importance values represent 32% of the tree population and provide 38% of the leaf area.

The low importance value of some species is a function of tree type. Immature and small-stature populations tend to have lower importance values than their percentage in the overall population might suggest. This is due to their relatively small leaf area and canopy coverage. For instance, crapemyrtle (*Lagerstroemia indica*) represents 5% of the population with leaf surface area of 0.7%, a contribution gap that is unlikely to diminish over time. In contrast, Austrian pine (*Pinus nigra*) is a large-stature species at maturity, which represents 4% of the population but 2% of the leaf surface area. Today, 65% of that population is under 12" DBH. As these trees mature, the importance value of this species is likely to increase, barring unforeseen events, such as emerging pests or pathogens such as pine wilt and nematodes that could impact this species.

Table 6. Species Importance of Most Common Species

Species	% of Pop.	Acres of Leaf Area	% of Leaf Area	Importance Value
Eastern redcedar	6.95	94.31	7.41	**14.36**
Chinese pistache	6.51	68.49	5.38	**11.89**
Post oak	6.17	67.55	5.31	**11.47**
Chinese elm	4.75	81.04	6.37	**11.11**
Baldcypress	4.04	79.32	6.23	**10.27**
American elm	3.15	88.19	6.93	**10.08**
Sugarberry	3.60	65.92	5.18	**8.78**
American sycamore	2.16	83.73	6.58	**8.74**
Eastern cottonwood	2.28	77.16	6.06	**8.34**
Austrian pine	4.16	31.17	2.45	**6.61**
Shumard oak	3.41	39.39	3.09	**6.50**
Common crapemyrtle	5.45	9.04	0.71	**6.16**
Siberian elm	2.73	38.14	3.00	**5.72**
Blackjack oak	3.21	31.94	2.51	**5.72**
Northern hackberry	2.40	40.86	3.21	**5.61**
Eastern redbud	4.40	15.82	1.24	**5.64**
Bur oak	2.23	37.02	2.91	**5.13**
Callery pear	2.76	25.55	2.01	**4.77**
London planetree	1.16	29.35	2.31	**3.47**
Loblolly pine	1.50	9.81	0.77	**2.27**
White ash	1.42	9.57	0.75	**2.17**
Green ash	1.07	13.37	1.05	**2.12**
Ponderosa pine	1.06	11.80	0.93	**1.99**
Honeylocust	1.24	7.67	0.60	**1.84**
Golden raintree	1.11	6.76	0.53	**1.64**
Other trees (See App. III)	21.07	210.14	16.51	**37.58**
	100%	**1,273**	**100%**	**200**

Replacement Value

The current replacement value of Oklahoma City's park tree inventory is $42.1 million (Table 7). The replacement value accounts for the historical investment in trees over their lifetime. It is also a way of describing the value of a tree population (and/or average value per tree) at a given time. The replacement value reflects current population numbers, stature, placement, and condition. There are several methods available for obtaining a fair and reasonable perception of a tree's value (CTLA, 1992; Watson, 2002). The cost approach, trunk formula method used in this analysis assumes the value of a tree is equal to the cost of replacing the tree in its current state (Cullen, 2002).

The average replacement value per tree is $2,146, and among the 25 most common trees, the highest average per-tree replacement value is $5,682 for bur oak (*Quercus macrocarpa*). The population of 1,211 post oak (*Quercus stellata*) would cost $4.4 million ($3,631/tree) to replace, while the population of 1,069 crapemyrtle (*Lagerstroemia indica*) would cost just 81,534 ($76/tree). With an overall value of over $42.1 million, Oklahoma City's park trees represent a vital component of city infrastructure and a valuable public asset. Park trees are an asset that, with proper care and maintenance, will continue to increase in value over time.

The relatively low replacement values of eastern redbud (*Cercis canadensis,* $500/tree) and crapemyrtle (*Lagerstroemia indica*, $76/tree) is tied to their small stature at maturity. These species provide value in the landscape by creating accents and seasonal color.

Table 7. Replacement Value of Most Common Species

Species	# of Trees	% of Pop.	Replacement Value ($)	% of Value	Average Value per Tree ($)
Post oak	1,211	6.17	**4,397,720**	10.44	3,631
Eastern redcedar	1,365	6.95	**2,631,888**	6.25	1,928
Bur oak	437	2.23	**2,483,051**	5.89	5,682
Baldcypress	794	4.04	**2,317,630**	5.50	2,919
Sugarberry	707	3.60	**2,281,448**	5.42	3,227
Blackjack oak	630	3.21	**2,229,463**	5.29	3,539
Chinese elm	932	4.75	**2,032,647**	4.83	2,181
American elm	619	3.15	**1,960,975**	4.65	3,168
Shumard oak	669	3.41	**1,858,564**	4.41	2,778
Northern hackberry	472	2.40	**1,698,310**	4.03	3,598
Austrian pine	817	4.16	**1,597,537**	3.79	1,955
Chinese pistache	1,279	6.51	**1,549,974**	3.68	1,212
American sycamore	425	2.16	**1,523,036**	3.62	3,584
Eastern cottonwood	448	2.28	**1,059,506**	2.52	2,365
Callery pear	542	2.76	**810,176**	1.92	1,495
Siberian elm	535	2.73	**775,359**	1.84	1,449
Green ash	211	1.07	**617,320**	1.47	2,926
Ponderosa pine	208	1.06	**597,794**	1.42	2,874
London planetree	228	1.16	**555,460**	1.32	2,436
Honeylocust	243	1.24	**539,706**	1.28	2,221
Loblolly pine	294	1.50	**466,119**	1.11	1,585
White ash	279	1.42	**447,303**	1.06	1,603
Eastern redbud	864	4.40	**432,386**	1.03	500
Golden raintree	218	1.11	**238,762**	0.57	1,095
Common crapemyrtle	1,069	5.45	**81,534**	0.19	76
Other trees (See App. III)	4,136	21.07	**6,943,511**	16.48	1,627
Total/ Average	**19,632**	**100%**	**$4,2127,177**	**100%**	**$2,146**

Because the replacement values are per tree averages for the entire population, some individual trees will be valued much higher and some much lower within each species. Distinguishing the replacement value from the value of annual benefits produced by this urban forest resource is very important. Annual benefits are discussed in the following section.

Urban Forest Benefits

Annual Environmental Benefits

Urban forests have functional values (either positive or negative) based on the environmental functions trees perform. For example, trees remove pollutants from the air, a positive benefit value, but they also release volatile organic compounds (VOCs) which contribute negatively to air quality. The air quality impacts calculated for this tree resource are the net benefits. In addition to air quality benefits, trees slow down stormwater and remove pollutants, resulting in reduced stormwater management costs for municipalities. Tree growth sequesters carbon in woody stems and roots. The value of these ecosystem functions is calculated in terms of both volume and cost savings.

Table 8. Annual Environmental Benefits

Annual Benefit	Volume	Value
Carbon Sequestered	323.59 tons	$43,053
Air Quality Improved	8.81 tons	$88,774
Runoff Avoided	3,555,938 gal.	$31,776
Total		**$163,603**

Annual environmental functional values tend to increase with increased number and size of healthy trees (Nowak, Crane, & Dwyer, 2002). Through proper management, urban forest values can be increased over time as trees mature and with improved longevity. Climate, pest, and weather events can cause values to decrease as the amount of healthy tree cover declines. Today, Oklahoma City's park trees are providing annual environmental benefits valued at $163,603 (Table 8 and Figure 5).

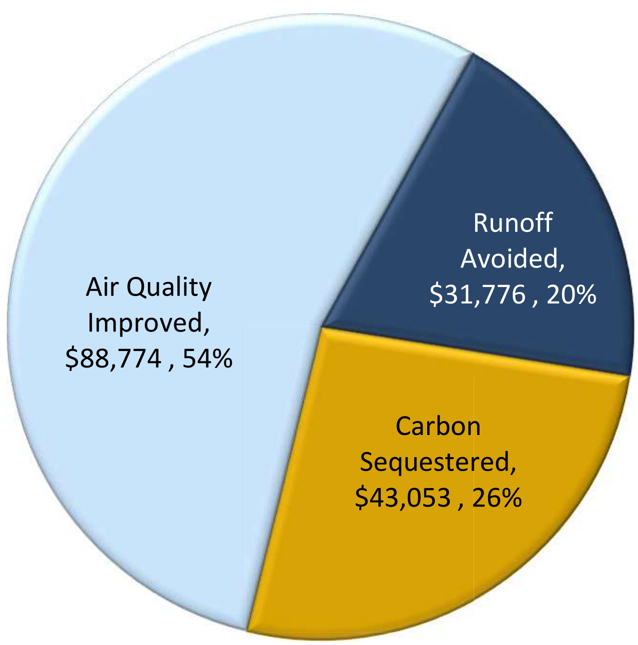


Figure 5. Annual Environmental Benefits

Air Quality

Urban vegetation can directly and indirectly affect local and regional air quality by altering the urban atmospheric environment (Nowak, 1995). In Oklahoma City, park trees are improving air quality by removing 8.81 tons of pollutants valued at $88,774 (Table 10 and Figure 6).

Four ways that urban trees affect air quality include:

- Temperature reduction and other microclimate effects
- Removal of air pollutants
- Energy effects on buildings
- Emission of volatile organic compounds (VOCs) and equipment emissions during tree maintenance

Oklahoma City is one of the largest cities in the nation in compliance with the Clean Air Act (OKC Modern Transit Project). The community's urban forest is a contributor to this distinction, and its continued expansion can help continue this legacy. Air pollution can lead to decreased human health, damage to trees and shrubs and ecosystem processes, and reduced visibility.

The urban forest helps improve air quality, and recent integrative studies show an increase in tree cover is associated with reduced ozone formation (Nowak & Dwyer, 2007). However, trees also emit volatile organic compounds that can contribute to ozone formation. Thus, the air quality impacts of trees are complex, and the i-tree Eco software models these interactions to help urban forest managers evaluate the true impact of urban trees on Oklahoma City's air quality. The cumulative and interactive effects of trees on climate, pollution removal, VOCs, and power plant emissions determine the net impact of trees on air pollution. Local urban forest management decisions also can help improve air quality (Table 9).

Table 9. Urban Forest Management Strategies to Improve Air Quality

Strategy	Result
Increase the number of healthy trees	Increase pollution removal
Sustain existing tree cover	Maintain pollution removal levels
Sustain large, healthy trees	Large trees have greatest per-tree effects
Plant long-lived trees	Reduce long-term pollutant emissions from planting and removal
Favor low maintenance trees	Reduce pollutants emissions from maintenance activities
Reduce fossil fuel use in maintaining vegetation	Reduce pollutant emissions
Plant trees in energy conserving locations	Reduce pollutant emissions from power plants
Plant trees to shade parked cars	Reduce vehicular VOC emissions
Supply sufficient water to vegetation	Enhance pollution removal and temperature reduction
Plant trees in polluted or heavily populated areas	Maximizes tree air quality benefits
Avoid pollutant-sensitive species	Improves tree health
Utilize evergreen trees for particulate matter	Year-round removal of particulates

Table 10. Air Pollution Removal by Most Common Species

Species	Pollution Removal (tons)	Pollution Removal (pounds)	Pollution Removal Value ($)	% of Pollution Removal
Eastern redcedar	**0.65**	1,300	6,576	7.38
American elm	**0.61**	1,220	6,150	6.92
American sycamore	**0.58**	1,160	5,839	6.58
Chinese elm	**0.56**	1,120	5,651	6.36
Baldcypress	**0.55**	1,100	5,531	6.24
Eastern cottonwood	**0.53**	1,060	5,380	6.02
Chinese pistache	**0.47**	940	4,776	5.33
Post oak	**0.47**	940	4,711	5.33
Sugarberry	**0.46**	920	4,597	5.22
Northern hackberry	**0.28**	560	2,849	3.18
Shumard oak	**0.27**	540	2,747	3.06
Siberian elm	**0.26**	520	2,659	2.95
Bur oak	**0.26**	520	2,581	2.95
Blackjack oak	**0.22**	440	2,227	2.50
Austrian pine	**0.22**	440	2,173	2.50
London planetree	**0.20**	400	2,046	2.27
Callery pear	**0.18**	360	1,782	2.04
Eastern redbud	**0.11**	220	1,103	1.25
Green ash	**0.09**	180	933	1.02
Ponderosa pine	**0.08**	160	823	0.91
Loblolly pine	**0.07**	140	684	0.79
White ash	**0.07**	140	667	0.79
Common crapemyrtle	**0.06**	120	630	0.68
Honeylocust	**0.05**	100	535	0.57
Golden raintree	**0.05**	100	471	0.57
Other trees (See App. III)	**1.34**	2,680	14,653	15.21
Total	**8.81**	**17,620**	**$88,774**	**100%**

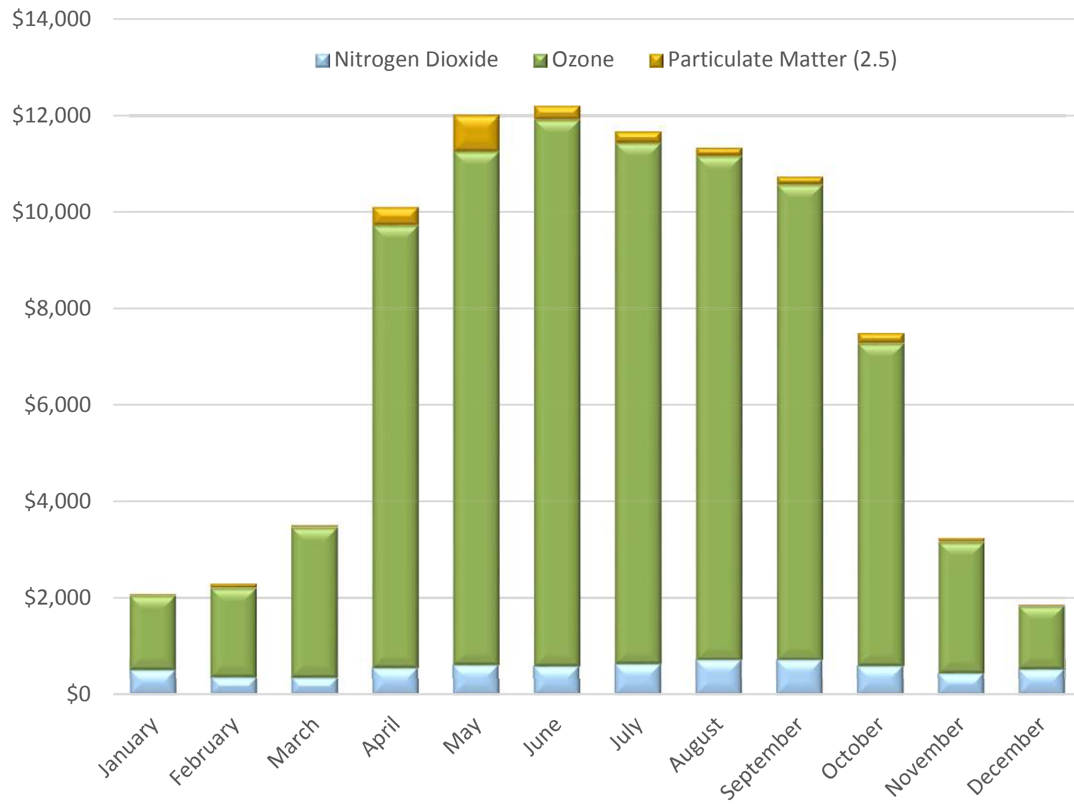


Figure 6. Tons of Most Abundant Three Air Pollutants Removed Annually

Volatile Organic Compounds

In 2016, trees in Oklahoma City parks emitted almost 11 tons of volatile organic compounds (VOCs) (8.7 tons of isoprene and 2.2 tons of monoterpenes). Emissions vary based on species characteristics (e.g. some genera such as oaks are high isoprene emitters) and amount of leaf biomass. Twenty-nine percent (29%) of the urban forest's VOC emissions were from post oak and eastern cottonwood.

Carbon Sequestration

Climate change is an issue of global concern. Urban trees can help mitigate climate change by sequestering atmospheric carbon (from carbon dioxide) in wood and foliar tissue and by altering energy use in buildings, and consequently altering **carbon dioxide emissions** from fossil-fuel based power plants (Nowak & Dwyer, 2007). Trees reduce the amount of carbon in the atmosphere by sequestering carbon in new growth every year. The amount of carbon annually sequestered is relative to the size, age, and vigor of the trees. Annually, Oklahoma City's park trees sequester an estimated 324 tons of carbon per year with an associated value of $43,053 (Table 12). Carbon storage and **carbon sequestration** values are calculated based on approximately $133 per ton (EPA, 2015).

Table 11. Annual Carbon Sequestration by Most Common Species

Species	Gross Carbon Sequestration (ton)	CO_2 Equivalent (ton)	% Gross Carbon Sequestration
Post oak	29.87	109.53	**9.23**
American elm	19.04	69.83	**5.88**
Blackjack oak	18.73	68.70	**5.79**
Chinese pistache	17.54	64.30	**5.42**
Eastern cottonwood	16.23	59.52	**5.02**
Shumard oak	16.11	59.09	**4.98**
Sugarberry	15.44	56.63	**4.77**
Bur oak	15.06	55.22	**4.65**
Siberian elm	14.75	54.09	**4.56**
American sycamore	13.87	50.87	**4.29**
Chinese elm	13.66	50.10	**4.22**
Northern hackberry	11.66	42.74	**3.60**
Eastern redcedar	9.17	33.62	**2.83**
Callery pear	9.16	33.60	**2.83**
Baldcypress	7.46	27.36	**2.31**
Honeylocust	5.90	21.64	**1.82**
London planetree	5.52	20.24	**1.71**
Austrian pine	4.83	17.73	**1.49**
Eastern redbud	4.73	17.34	**1.46**
White ash	4.22	15.47	**1.30**
Golden raintree	2.61	9.55	**0.81**
Ponderosa pine	1.93	7.07	**0.60**
Green ash	1.82	6.67	**0.56**
Loblolly pine	1.60	5.88	**0.49**
Common crapemyrtle	1.23	4.51	**0.38**
Other trees (See App. III)	61.43	225.33	**18.98**
Total	**323.59**	**1,186.62**	**100%**

Avoided Stormwater Runoff

Rainfall interception by trees reduces the amount of stormwater that enters collection and treatment facilities during large storm events (Figure 7). Trees intercept rainfall in their canopy, acting as mini-reservoirs, controlling runoff at the source. Healthy urban trees reduce the amount of runoff and pollutant loading in receiving waters in three primary ways:

- Leaves and branch surfaces intercept and store rainfall, thereby reducing runoff volumes and delaying the onset of peak flows.
- Root growth and decomposition increase the capacity and rate of soil infiltration by rainfall and reduce overland flow.
- Tree canopies reduce soil erosion and surface flows by diminishing the impact of raindrops on bare soil.

Stormwater runoff is a cause for concern in many urban areas as it contributes pollution to streams, wetlands, rivers, lakes, and oceans. Federal Clean Water Act regulations require municipalities to obtain a permit for managing their stormwater discharges into water bodies. Each city's program must identify the best management practices (BMPs) it will implement to reduce its pollutant discharge. Nationwide, non-point source pollution is one of the biggest contributors to poor water quality. Non-point source pollution occurs when stormwater carries surface contaminants into surface or ground water. Preventing non-point source pollution and reducing stormwater runoff is a serious environmental concern for many communities.

Trees are a natural, cost-efficient, and highly effective part of a stormwater management program Many communities are turning to trees to help solve their stormwater issues in a holistic manner. Engineered and natural stormwater systems that incorporate the natural benefits provided by trees are proving to be more cost-effective and sustainable than traditional detention and treatment methods. There are many methods and construction designs available for integrating urban trees into stormwater management infrastructure, including pervious pavement systems, suspended sidewalks, structural soils, bioswales, and stormwater tree pits, but some of these designs can be costly to implement. Preserving natural or engineered forest stands and existing

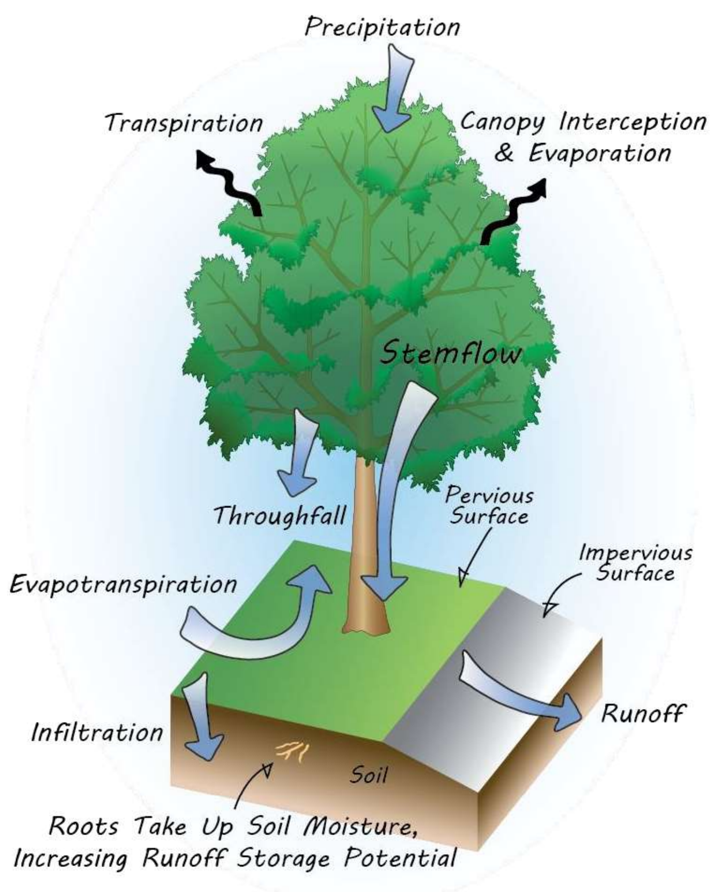


Figure 7. How Trees Impact Stormwater

trees in park areas effectively solves the park's potential stormwater issues before they occur.

Although tree leaves, branches, and bark may intercept precipitation and thus mitigate surface runoff, only the precipitation intercepted by leaves is accounted for in this analysis. The model estimates the trees in Oklahoma City parks help to reduce runoff by an estimated 3,555,938 gallons per year with an associated value of $31,776 (Table 13).

Table 12. Stormwater Runoff Avoided by Most Common Species

Species	Potential Evapotranspiration (gallons)	Evaporation (gallons)	Transpiration (gallons)	Water Intercepted (gallons)	Avoided Runoff (gallons)	Avoided Runoff Value ($)
Eastern redcedar	12,376,143	1,200,281	6,159,486	1,201,775	**263,407**	2,354
American elm	11,573,653	1,122,452	5,760,095	1,123,850	**246,327**	2,201
American sycamore	10,988,742	1,065,726	5,468,990	1,067,053	**233,878**	2,090
Chinese elm	10,634,855	1,031,405	5,292,864	1,032,689	**226,346**	2,023
Baldcypress	10,409,779	1,009,576	5,180,846	1,010,833	**221,556**	1,980
Eastern cottonwood	10,125,390	981,995	5,039,308	983,218	**215,503**	1,926
Chinese pistache	8,988,379	871,724	4,473,429	872,809	**191,304**	1,709
Post oak	8,865,308	859,788	4,412,178	860,858	**188,684**	1,686
Sugarberry	8,651,488	839,051	4,305,762	840,096	**184,133**	1,645
Northern hackberry	5,362,434	520,067	2,668,832	520,715	**114,131**	1,020
Shumard oak	5,169,035	501,311	2,572,579	501,935	**110,015**	983
Siberian elm	5,005,149	485,416	2,491,014	486,021	**106,527**	952
Bur oak	4,858,226	471,167	2,417,892	471,754	**103,400**	924
Blackjack oak	4,191,973	406,552	2,086,304	407,058	**89,220**	797
Austrian pine	4,089,894	396,652	2,035,501	397,146	**87,047**	778
London planetree	3,851,152	373,498	1,916,681	373,963	**81,966**	732
Callery pear	3,353,203	325,205	1,668,857	325,610	**71,368**	638
Eastern redbud	2,076,093	201,347	1,033,251	201,597	**44,186**	395
Green ash	1,755,195	170,225	873,544	170,437	**37,357**	334
Ponderosa pine	1,548,749	150,203	770,797	150,390	**32,963**	295
Loblolly pine	1,287,612	124,877	640,832	125,032	**27,405**	245
White ash	1,255,296	121,743	624,748	121,894	**26,717**	239
Common crapemyrtle	1,185,842	115,007	590,182	115,150	**25,239**	226
Honeylocust	1,007,149	97,677	501,248	97,798	**21,436**	192
Golden raintree	887,331	86,056	441,616	86,164	**18,885**	169
Other trees (See App. III)	27,577,338	2,674,536	13,724,977	2,677,875	**586,941**	5,245
Total	167,075,411	16,203,543	83,151,810	16,223,718	3,555,938	$31,776

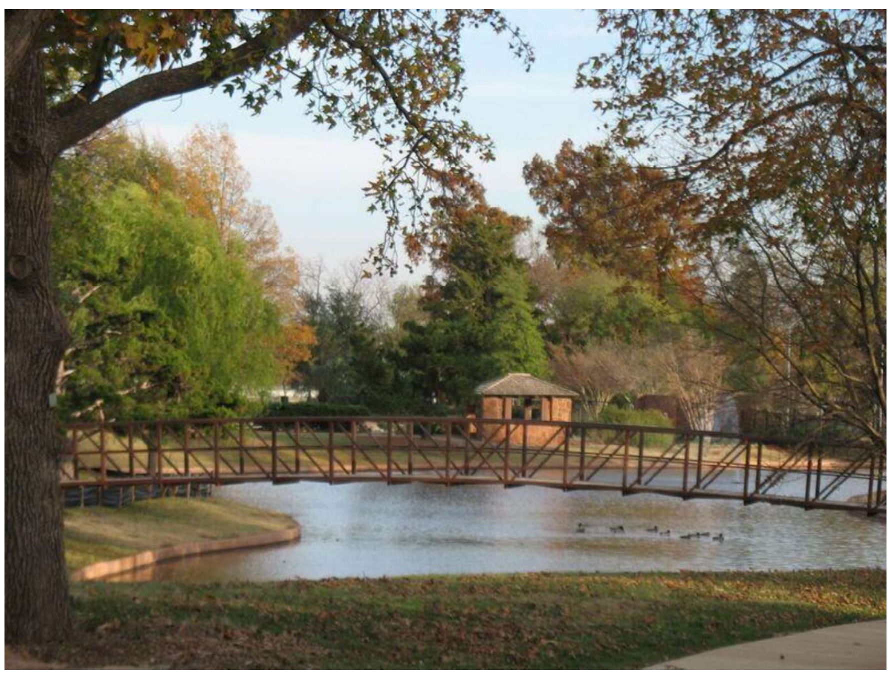
Energy Savings

Trees modify climate and conserve energy in three principal ways:

- Shading reduces the amount of radiant energy absorbed and stored by hardscape surfaces, thereby reducing the heat island effect.
- Transpiration converts moisture to water vapor, thereby cooling the air by using solar energy that would otherwise result in heating of the air.
- Reduction of wind speed and the movement of outside air into interior spaces and conductive heat loss where thermal conductivity is relatively high (e.g., glass windows) (Simpson, 1998).

The *heat island effect* describes the increase in urban temperatures in relation to surrounding suburban and rural areas. Heat islands are associated with an increase in hardscape and impervious surfaces. Trees and other vegetation within an urbanized environment help reduce the heat island effect by lowering air temperatures 5°F (3°C) compared with outside the green space (Chandler, 1965). On a larger citywide scale, temperature differences of more than 9°F (5°C) have been observed between city centers without adequate canopy coverage and more vegetated suburban areas (Akbari and others, 1992). The relative importance of these effects depends upon the size and configuration of trees and other landscape elements (McPherson, 1993). Tree spacing, crown spread, and vertical distribution of leaf area each influence the transport of warm air and pollutants along streets and out of urban canyons. Trees reduce conductive heat loss from buildings by reducing air movement into buildings and against conductive surfaces (e.g., glass, metal siding). Trees can reduce wind speed and the resulting air infiltration by up to 50%, translating into potential annual heating savings of 25% (Heisler, 1986).

Aesthetic, Property Value, & Socioeconomic Benefits



Trees provide beauty in the urban landscape, privacy and screening, improved human health, a sense of comfort and place, and habitat for urban wildlife. Research shows that trees promote better business by stimulating more frequent and extended shopping and a willingness to pay more for goods and parking (Wolf, 1999). In residential areas, the value of these benefits are captured as a percentage of the value of the property on which a tree stands. **While tree value can be monetized in commercial and residential areas, there is no current model for calculating the aesthetic benefits of park trees.**

Environmental Benefit to Investment Ratio

Table 13. Environmental Benefits and Investment

Environmental Benefits	Value ($)	$ per Tree	$ per Capita
Gross carbon Sequestration	43,053	2.19	0.07
Pollution Removal	88,774	4.52	0.15
Avoided Runoff	31,776	1.62	0.05
Total Benefits	**$163,603**	**$8.33**	**$0.27**
Investment			
Purchasing Trees and Planting	25,000	1.27	0.04
Contract Pruning	88,250	4.50	0.14
Removal	49,823	2.54	0.08
Administration	107,302	5.47	0.18
Clean Up/ Disaster Recovery	166,055	8.46	0.27
Total Investment	**$436,430**	**$22.23**	**$0.71**
Environmental Benefit-Investment Ratio			**0.37**

Oklahoma City receives substantial environmental benefits from their community urban forest; however, the City must also consider their investments in maintaining this resource. Applying a *benefit-investment ratio* (BIR) is a useful way to evaluate the public investment in a community tree resource. A BIR is an indicator used to summarize the overall value compared to the investments of a given resource. Specifically, in this analysis, BIR is the ratio of the total value of benefits provided by all the park trees in 130 parks, compared to the cost (investment) associated with their management.

Annually, the total estimated environmental benefits provided by Oklahoma City's park trees is $163,603, which equates to an average of $8.33 per tree or $0.27 per person (Table 13). These benefits are realized on an annual basis.

It is important to acknowledge that this is not a full accounting of the benefits provided by this resource because this study did not calculate increased property values related to trees and because some benefits are intangible and/or difficult to quantify, such as:

- Impacts on psychological and physical health and wellness
- Reduction in crime and violence
- Increases in tourism revenue
- Quality of life
- Wildlife habitat
- Aesthetic benefits
- Socio-economic impacts
- Increases in property values
- Placemaking

Empirical evidence of these benefits does exist (Wolf, 2007; Kaplan, 1989; Ulrich, 1986), but there is limited knowledge about the physical processes at work and the complex nature of interactions make quantification imprecise. Tree growth and mortality rates are highly variable. A true and full accounting of benefits and investments must consider variability among sites (e.g., tree species, growing conditions, maintenance practices) throughout the City, as well as variability in tree growth.

Urban Forest Threats

Pests & Pathogens

In Oklahoma City, the entire park tree resource, 19,632 trees, valued at over $42 million may be impacted by emerging and existing pests and pathogens. In 2016, Emerald Ash Borer (EAB) was discovered less than 200 miles away in Grove, Oklahoma. This lethal urban forest pest is commonly spread through the movement of infected wood outside established quarantine areas. Monitoring for this pest should begin soon to help inform ash tree population management. The 493 ash (*Fraxinus*) represent 2.5% of the park tree resource. EAB is just one of many emerging pests and pathogens threatening Oklahoma City's Urban forest (Table 15). Anticipating and monitoring for these threats is an important part of urban forest management.

Table 14. Pest & Pathogen Proximity to Oklahoma City

Pest Name	Susceptible Tree Species	# of Trees	% of Pop.	Structural Value ($)	Leaf Area (%)	Leaf Area (acres)	Proximity
Southern Pine Beetle	Pines	1,401	7%	2,857,742	5%	57	TX, AR, 250 miles
Fusiform Rust	Loblolly/Slash Pines	295	2%	2,878,301	1%	10	Oklahoma, 250 miles
Gypsy Moth	Oaks/Others	5,759	29%	17,230,371	28%	358	Oklahoma, 250 miles
Oak Wilt	Oaks	3,787	19%	13,695,266	18%	226	Oklahoma, 250 miles
Emerald Ash Borer	Ashes	493	3%	1,073,498	18%	23	Grove, OK 196 miles
Bacterial Leaf Scorch	All Tree Species	19,632	100%	42,127,177	100%	1,273	Oklahoma City
Botrysphaeria Canker	Hardwoods	15,594	79%	33,992,637	74%	944	Oklahoma City
Biscogniauxia	Oaks	3,787	19%	13,695,266	18%	226	Oklahoma City
Oak Leaf Itch Mite	Oaks	3,787	19%	13,695,266	18%	226	Oklahoma City
Pine Shoot Beetle	Pines	1,401	7%	2,857,742	5%	57	Oklahoma City
Dutch Elm Disease	American Elm	1,352	7%	3,011,526	11%	139	Oklahoma City
Pine Wilt Complex	Non-native Pines	1,189	6%	2,740,409	3%	44	Oklahoma City
Crapemyrtle Scale	Common Crapemyrtles	1,069	5%	81,534	71%	9	Oklahoma City
Asian Pear Rust	Pears	549	3%	815,143	2%	26	Oklahoma City
Seridium Canker	Cypresses/Thujas	175	1%	122,987	6%	82	Oklahoma City

Forecasting Urban Forest Threats & Opportunities

While it is impossible to predict the future, climate, mortality trends, and emerging pests, can inform projections of what the park tree population will look like in years to come. I-tree Eco allows the creation of multiple predictive scenarios including pest threats, storm impacts, tree planting programs, and expected annual mortality. To demonstrate this predictive tool, a scenario was generated for the next 30 years.

- EAB is discovered in 2019.
- Plant 100, 500, or 1,000 trees per year.
- Plant a species palette similar to the diversity of the current tree resource, but exclude ash (*Fraxinus*).

Projected Outcome

In the scenario above, the following attributes characterize the tree population in the year 2046:

Table 15. Forecast Urban Forest Structure

Benchmark	Present (2016)	2046 Forecast with Annual Tree Planting		
		100/year	500/year	1,000/year
Number of Living Trees	19,632	8,944	16,331	25,960
Canopy (acres)	311	244	287	343
Leaf Area (acres)	1,273	849	1,182	1,619
Carbon Storage (tons)	7,154	8,539	9,165	10,069

In addition to structural changes, the tree population will provide different benefits depending on the number of trees planted annually. Those annual environmental benefits can be calculated for the year 2046.

Table 16. Forecast Urban Forest Annual Environmental Benefits in 2046

Benchmark	Present (2016)	2046 Forecast with Annual Tree Planting		
		100/year	500/year	1,000/year
Carbon Sequestered (tons)	324	328	392	480
Air Pollutants Removed (tons)	8.8	6.4	8.1	10.3

Forecasting Other Scenarios

Additional scenarios can be projected including storms, hurricanes, altered mortality rates based on tree condition, and additional pest outbreaks among the listed pest species. Alternative tree planting rates can be input to determine the threshold for tree planting that will deliver the desired benefit stream from the tree resource. This forecasting tool can be used to create budgets and determine priorities for years to come.

Conclusion

This analysis describes the current structural characteristics of Oklahoma City's park tree resource, using established tree sampling, numerical modeling, and statistical methods to provide a general accounting of the benefits. The analysis provides a "snapshot" of this resource at its current population, structure, and condition. Rather than examining each individual tree, as an inventory does, the resource analysis examines trends and performance measures over the entire urban forest and each of the major species populations within.

In this report, community trees are providing quantifiable impacts on air quality, reduction in atmospheric CO_2, and stormwater runoff. The City's 19,632 trees in developed park areas are providing over $163,603 in annual environmental benefits, an average of $8.33 per tree or $0.27 per person. The resource has a replacement value of $42.1 million.

Oklahoma City's park trees have a nearly ideal DBH distribution of young to established trees in fair to good condition. The resource has a healthy diversity with more than 185 different species providing 311 acres of tree canopy. The City can increase the benefits from this resource by planting new trees as trees decline and are removed. Park managers should continue to focus resources on preserving existing and mature trees to promote health, strong structure, tree longevity, and manage risk. Structural and training pruning for young trees will maximize the value of this resource, reduce long-term maintenance costs, and ensure that as trees mature they provide the greatest possible benefits over time. Davey Resource Group recommends the following:

- Maintain species diversity by ensuring that new tree plantings include a variety of suitable species and don't unduly increase reliance on prevalent species.
- Use appropriate planting sites to maintain diversity and increase benefits. Install large-stature species wherever space allows.
- Provide structural pruning for young trees and a regular pruning cycle for all trees.
- Protect existing trees and manage risk with regular inspection to identify and mitigate structural and age-related defects.
- Continue to maintain and update the inventory database, including tracking tree growth and condition during regular pruning cycles.

Urban forest managers can better anticipate future trends with an understanding of the current status of the City's tree population. Managers can also anticipate challenges and devise plans to increase the current level of benefits. Performance data from the analysis can be used to make determinations regarding species selection, distribution, and maintenance policies. Documenting current structure is necessary for establishing goals and performance objectives and can serve as a benchmark for measuring future success. Information from the urban forest resource analysis can be referenced in development of an urban forest management or master plan. An urban forest master plan is a critical tool for successful urban forest management, inspiring commitment, and providing vision for communication with key decision-makers both inside and outside the organization.

Appendix I. References

Abdollahi, K.K.; Z.H. Ning; and A. Appeaning (eds). 2000. Global climate change and the urban forest. Baton Rouge, LA: GCRCC and Franklin Press. 77p.

Abraxas Energy Consulting, http://www.abraxasenergy.com/emissions/

Baldocchi, D. 1988. A multi-layer model for estimating sulfur dioxide deposition to a deciduous oak forest canopy. Atmospheric Environment. 22: 869-884.

Baldocchi, D.D.; Hicks, B.B.; Camara, P. 1987. A canopy stomatal resistance model for gaseous deposition to vegetated surfaces. Atmospheric Environment. 21: 91-101.

Energy Information Administration, 2003, Emissions of Greenhouse Gases in the United States 2003. http://www.eia.doe.gov/oiaf/1605/ggrpt/

Energy Information Administration. 1994 Energy Use and Carbon Emissions: Non-OECD Countries DOE/EIA-0579.

Energy Information Administration. 2001. Total Energy Consumption in U.S. Households by Type of Housing Unit. http://www.eia.doe.gov/emeu/recs/contents.html.

Environmental Protection Agency (EPA), 2015; Interagency Working Group on Social Cost of Carbon. www3.epa.gov/climatechange/Downloads/EPAactivities/social-cost-carbon.pdf

Graham, R.L., Wright, L.L., and Turhollow, A.F. 1992. The potential for short-rotation woody crops to reduce U.S. CO2 Emissions. Climatic Change 22:223-238.

Heating with Wood I. Species characteristics and volumes. http://ianrpubs.unl.edu/forestry/g881.htm

Insect/disease proximity to study area was completed using the U.S. Forest Service's Forest Health Technology Enterprise Team (FHTET) database. Data includes distribution of pest by county FIPs code for 2004-2009. FHTET range maps are available at www.foresthealth.info for 2006-2010.

Layton, M. 2004. 2005 Electricity Environmental Performance Report: Electricity Generation and Air Emissions. California Energy Commission. http://www.energy.ca.gov/2005_energypolicy/documents/2004-11-15_workshop/2004-11-15_03-A_LAYTON.PDF

McPherson, E.G. and J. R. Simpson 1999. Carbon dioxide reduction through urban forestry: guidelines for professional and volunteer tree planters. Gen. Tech. Rep. PSW-171. Albany, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Research station 237 p. http://wcufre.ucdavis.edu/products/cufr_43.pdf

National Emission Trends http://www.epa.gov/ttn/chief/trends/index.html

National Transportation Statistics http://www.bts.gov/publications/national_transportation_statistics/2004/.

Nowak, D.J. 1994. Atmospheric carbon dioxide reduction by Chicago's urban forest. In: McPherson, E.G.; Nowak, D.J.; Rowntree, R.A., eds. Chicago's urban forest ecosystem: results of the Chicago

Urban Forest Climate Project. Gen. Tech. Rep. NE-186. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station: 83-94.

Nowak, D.J. 1995. Trees pollute? A "TREE" explains it all. In: Proceedings of the 7th National Urban Forestry Conference. Washington, DC: American Forests. Pp. 28-30

Nowak, D.J. 2000. The interactions between urban forests and global climate change. In: Abdollahi, K.K., Z.H. Ning, and A. Appeaning (Eds). Global Climate Change and the Urban Forest. Baton Rouge: GCRCC and Franklin Press. Pp. 31-44.

Nowak, D.J. and J.F. Dwyer. 2007. Understanding the benefits and costs of urban forest ecosystems. In: Kuser, J. (ed.) Urban and Community Forestry in the Northeast. New York: Springer. Pp. 25-46.

Nowak, D.J., and D.E. Crane. 2000. The Urban Forest Effects (UFORE) Model: quantifying urban forest structure and functions. In: Hansen, M. and T. Burk (Eds.) Integrated Tools for Natural Resources Inventories in the 21st Century. Proc. Of the IUFRO Conference. USDA Forest Service General Technical Report NC-212. North Central Research Station, St. Paul, MN. pp. 714-720. See also http://www.ufore.org.

Nowak, D.J., R.E. Hoehn, D.E. Crane, J.C. Stevens, J.T. Walton, and J. Bond. 2008. A ground-based method of assessing urban forest structure and ecosystem services. Arboriculture and Urban Forestry 34(6): 347-358.

Nowak, D.J.; Crane, D.E.; Dwyer, J.F. 2002. Compensatory value of urban trees in the United States. Journal of Arboriculture. 28(4): 194 - 199.

Nowak, D.J.; Crane, D.E.; Stevens, J.C.; Hoehn, R.E. 2005. The urban forest effects (UFORE) model: field data collection manual. V1b. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeastern Research Station, 34 p. http://www.fs.fed.us/ne/syracuse/Tools/downloads/UFORE_Manual.pdf

Nowak, D.J.; Crane, D.E.; Stevens, J.C.; Ibarra, M. 2002. Brooklyn's Urban Forest. Gen. Tech. Rep. NE-290. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeastern Research Station. 107 p. Council of Tree and Landscape Appraisers guidelines. For more information, see Nowak, D.J., D.E. Crane, and J.F. Dwyer. 2002. Compensatory value of urban trees in the United States. J. Arboric. 28(4): 194-199.

Nowak, David J., Hoehn, R., and Crane, D. 2007. Oxygen production by urban trees in the United

Oklahoma City Modern Transit Project, http://www.mtpokc.com/about.html

Residential Wood Burning Emissions in British Columbia, 2005. http://www.env.bc.ca/air/airquality/pdfs/wood_emissions.pdf.

U.S. Environmental Protection Agency. U.S. Power Plant Emissions Total by Year www.epa.gov/cleanenergy/egrid/samples.htm.

U.S. Forest Service. Tree Guides. http://www.fs.fed.us/psw/programs/uesd/uep/tree_guides.php.

Zinke, P.J. 1967. Forest interception studies in the United States. In: Sopper, W.E.; Lull, H.W., eds. Forest Hydrology. Oxford, UK: Pergamon Press: 137-161.

Appendix II. Methods

Tree Inventory

Data was collected from June – October, 2016 by ISA Certified Arborists trained to record accurate, replicable data. This information represents tree attributes at the time of collection, subject to change as time passes because an urban forest is a dynamic system. Additional details about field measurements taken and field protocols are described in the Arborist Handbook for Oklahoma City (2016). The following attributes were collected for Oklahoma City's park tree population:

Tree Data and Attributes

Address: The street name and number of the property where the tree trunk is located

Geolocation: The lat/long coordinates of the trunk, recorded on a GIS basemap

Land Use: Park – public land for recreation or in a natural state

Sub Zone: The park or city facility name

Planter Type: Type of planting space

- B - Back of Walkway
- M - Median/Island
- O - Open/Unrestricted
- PS - Park Strip
- R - Raised Planter
- T - Tree Lawn
- W - Tree Well
- U - Unmaintained Area

Planter Size: the planter size in feet from 1x1 up to 10x10, or 10'+. If planter size is not square, the narrower width was recorded.

Irrigation: Irrigation hardware is visible.

- Overhead Utilities: Presence of overhead high-voltage power lines
- Present - No Conflict - Trees with Overhead utilities less than 10ft from the tree are listed as having OH present.
- Present - Conflict - Trees have been making contact with the wires.
- N/A - No overhead utilities present.

Infrastructure: Conflict: Trees in conflict with street signs, traffic devices, and/or other City infrastructure, paths, or roads

Species: The botanical name of the tree, stumps are recorded as stump, regardless of species.

DBH (Diameter at Breast Height): Trunk diameter to the nearest 0.1 inch at 4.5 feet above grade, Multi-stem trees are recorded as the average of all stems. The Arborist Handbook for Oklahoma City includes additional specifications for the measurement of irregular DBHs.

Tree Health

- Good: no apparent problems
- Fair: Minor problems such as small branch failures or dieback, minor cavities, or decay, mild pest problems
- Poor: Major problems such as major dieback, large areas of decay with cavities or conks, major branch failures or significant pest infestation
- Dead: Dead or extreme decline, non-restorable

Height: Total tree height measured with a laser range finder

Height to Live Crown: Height from the tree base at ground level to the top of the live foliage crown. The top of the live crown is determined by the live foliage and not by the point where a branch intersects with the main bole.

Height to Crown Base: Height from the tree base at ground level to the bottom of the live foliage crown. Does not count non-continuous branches not continuous with the main crown (eg epicormic shoots). The live crown base is the point on the main trunk perpendicular to the lowest live foliage on the last branch that is included in the live crown. The live crown base is determined by the live foliage and not by the point where a branch connects to the trunk. Therefore, if the crown base touches the ground, zero is an acceptable value. Record dead trees as -1.

Crown Width: Crown width (to nearest foot) measured in two directions: north-south and east-west or as safety considerations or physical obstructions allow. If tree is downed or leaning, take width measurements perpendicular to the tree bole.

Percent Crown Missing: The percent of the crown volume that is not occupied by branches and leaves. Missing canopy is measured by standing at two perpendicular angles to the tree and recorded as 0%, 100% or in intervals of 10%.

Crown Light Exposure: Number of sides of the tree receiving sunlight from above (maximum of five). Top of tree is counted as one side. Divide the crown vertically into four equal sides. Count the number of sides that would receive direct light if the sun were directly above the tree- Figure 11. One-third of the live crown must be receiving full light in order for a side to qualify.

Percent of Dieback: The percent dieback in crown area. This dieback does not include normal, natural branch dieback, i.e., self-pruning due to crown competition or shading in the lower portion of the crown. However, branch dieback on side(s) and top of crown area due to shading from a building or another tree is included.

Maintenance Data

Immediate Maintenance: Record of immediate needed maintenance includes recommendations (e.g. none, stake, train, raise, remove, treat pest, treat disease). Trees assigned an immediate maintenance need have issues that could impact the health of the tree or public safety if not resolved in a timely manner.

Future maintenance: Recommendations for future action include one of the following recommended maintenance categories which have been adapted from the Best Management Practices for Tree Inventories and ANSI - A300 Part 7:

- *Structural Prune:* This category is used to identify young trees that would benefit from pruning to improve structure and health.
- *Clean:* This category focuses on identifying the need to remove dead, dying, broken, or diseased wood.
- *Raise:* This category requires pruning to remove low branches that may interfere or cause obstructions with sight or traffic.
- *Thin:* This category includes the selective removal of live branches to reduce density, or for managing sprouts and suckers.
- *Reduce:* This category includes trees that require selective pruning to decrease the height and/or the spread of the crown.
- *Inspect:* This category is used to identify trees that warrant a secondary inspection beyond the scope of this inventory. Record any observed structural defects and incorporate the observations into recommendations for future action
- *Remove:* This category is reserved for trees that are dead, in severe decline, or those that present serious structural defects that cannot be remedied.
    - *Priority 1 Removal:* These trees have defects that cannot be cost-effectively or practically treated, have a high amount of deadwood, and pose an immediate hazard to a property or person. Davey recommends that these trees be removed immediately
    - *Priority 2 Removal:* These trees are not as great of a liability as Priority 1 Removals, being smaller and/or less hazardous, although they are also recommended for removal. Davey recommends that they be removed as soon as possible
    - *Priority 3 Removal:* Trees designated for Priority 3 Removal do not pose a public hazard and are small, dead, or poorly formed. Smaller dead trees and failed transplants are in this category. Large trees in this category are generally poorly sited, of inferior quality, and pose little to no threat to the community.

Observations: General observations referring to a tree’s health, structure and location are recorded. These observations are intended to provide additional information that may be of value to the forest manager. Observations are added at the arborist's discretion and are not considered guaranteed tree attributes. Trees that are identified for removal should have comments pertaining to the reason for recommended removal.

i-Tree Eco Model and Field Measurements

All field data was collected during the leaf-on season to properly assess tree canopies. The i-Tree Eco model uses inventory data, local hourly air pollution, and meteorological data to quantify the urban forest and its structure and benefits (Nowak & Crane, 2000), including:

- Urban forest structure (e.g., genus composition, tree health, leaf area, etc.).
- Amount of pollution removed hourly by the urban forest, and its associated percent air quality improvement throughout a year. Pollution removal is calculated for ozone, sulfur dioxide, nitrogen dioxide, carbon monoxide and particulate matter (<2.5 microns and <10 microns).
- Total carbon stored and net carbon annually sequestered by the urban forest.
- Structural value of the forest as a replacement cost.
- Potential impact of infestations by pests or pathogen

Definitions and Calculations

Avoided surface water runoff value is calculated based on rainfall interception by vegetation, specifically the difference between annual runoff with and without vegetation. Although tree leaves, branches, and bark may intercept precipitation and thus mitigate surface runoff, only the precipitation intercepted by leaves is accounted for in this analysis. The U.S. value of avoided runoff, $0.0089 per gallon, is based on the U.S. Forest Service's Community Tree Guide Series (McPherson et al., 1999; 2000; 2001; 2002; 2003; 2004; 2006a; 2006b; 2006c; 2007; 2010; Peper et al 2009; 2010; Vargas et al 2007a; 2007b; 2008).

Carbon dioxide emissions from automobile assumed six pounds of carbon per gallon of gasoline if energy costs of refinement and transportation are included (Graham, Wright, & Turhollow, 1992).

Carbon emissions were calculated based on the total city carbon emissions from the 2010 US per capita carbon emissions (Carbon Dioxide Information Analysis Center, 2010) This value was multiplied by the population of Oklahoma City (610,613) to estimate total city carbon emissions.

Carbon sequestration is removal of carbon from the air by plants. Carbon storage and carbon sequestration values are calculated based on $133.04 per short ton (EPA, 2015; Interagency Working Group on Social Cost of Carbon, 2015).

Carbon storage is the amount of carbon bound up in the above-ground and below-ground parts of woody vegetation. Carbon storage and carbon sequestration values are calculated based on $133.04 per ton (EPA, 2015; Interagency Working Group on Social Cost of Carbon, 2015).

Diameter at Breast Height (DBH) is the diameter of the tree measured 4’6” above grade.

Energy savings are calculated based on the prices of $85.00 per MWH and $48.19 per MBTU.

Household emissions average is based on average electricity kWh usage, natural gas Btu usage, fuel oil Btu usage, kerosene Btu usage, LPG Btu usage, and wood Btu usage per household in 2009 (EIA, 2013; EIA, 2014), CO2, SO2, and NOx power plant emission per KWh (Leonardo Academy, 2011), CO emission per kWh assumes 1/3 of one percent of C emissions is CO (EIA, 2014), PM10 emission per kWh (Layton 2004), CO2, NOx, SO2, and CO emission per Btu for natural gas, propane and butane (average used to represent LPG), Fuel #4 and #6 (average used to represent fuel oil and kerosene) (Leonardo Academy, 2011), CO2 emissions per Btu of wood (EIA, 2014), CO, NOx and SOx emission per Btu based on total emissions and wood burning (tons) from (British Columbia Ministry 2005; Georgia Forestry Commission 2009).

Leaf Area was estimated using measurements of crown dimensions and percentage of crown canopy missing.

Monetary values ($) are reported in US dollars throughout the report.

Passenger automobile emissions assumed 0.72 pounds of carbon per driven mile (U.S. Environmental Protection Agency, 2010) multiplied by the average miles driven per vehicle in 2011 (Federal Highway Administration, 2013).

Pollution removal is calculated based on the prices of $1,469 per ton (carbon monoxide), $10,339 per ton (ozone), $10,339 per ton (nitrogen dioxide), $2,531 per ton (sulfur dioxide), $6,903 per ton (particulate matter less than 2.5 microns) (Nowak et al., 2014).

Potential pest impacts were estimated based on advice from local experts in Oklahoma City, combined with i-tree Eco pest range maps. In the model, potential pest risk is based on pest range maps and the known pest host species that are likely to experience mortality. Pest range maps for 2012 from the Forest Health Technology Enterprise Team (FHTET) (Forest Health Technology Enterprise Team 2014) were used to determine the proximity of each pest to Canadian County. For the county, it was established whether the insect/disease occurs within the county, is within 250 miles of the county edge, is between 250 and 750 miles away, or is greater than 750 miles away. FHTET did not have pest range maps for Dutch elm disease and chestnut blight. The range of these pests was based on known occurrence and the host range, respectively (Eastern Forest Environmental Threat Assessment Center; Worrall 2007). Due to the dates of some of these resources, pests may have encroached closer to the tree resource in recent years.

Structural value is based on the physical resource itself (e.g., the cost of having to replace a tree with a similar tree). Structural values were based on valuation procedures of the Council of Tree and Landscape Appraisers, which uses tree species, diameter, condition, and location information (Nowak et al 2002a; 2002b).

Ton is equivalent to a U.S. short ton, or 2000 pounds.

Table 17. Benefit Prices

Benefit	Price ($)	Per Unit	Notes
Electricity	$0.0850	KWh	McPherson and Simpson 1999
Natural Gas	$0.4820	Therm	Oklahoma Natural Gas, Average: November 2013 - October 2016
Carbon	$133.0400	Short Ton	Interagency Working Group on Social Cost of Carbon, 2015
Stormwater	$0.0089	Gallon	Interagency Working Group on Social Cost of Carbon, 2015
Ozone	$1,469.0000	Ton	Nowak et al., 2014
Carbon Monoxide	$10,339.0000	Ton	Nowak et al., 2014
Nitrogen Dioxide	$10,339.0000	Ton	Nowak et al., 2014
Sulfur Dioxide	$2,531.0000	Ton	Nowak et al., 2014
PM2.5	$6,903.0000	Ton	Nowak et al., 2014

Appendix III. Tables

Common and botanical names of trees in study population, # of trees in population. Alphabetical by common name

Table 18. Botanical and Common Names of Tree Species

Species	Common Name	# of Trees	Leaf Area (acres)	Average Condition (%)
Pinus eldarica	Afghan pine	6	0.15	90.50
Alnus	Alder spp	1	0.00	82.50
Rhamnus alnifolia	Alderleaf buckthorn	3	0.14	90.50
Tilia americana	American basswood	3	0.48	90.50
Ulmus americana	American elm	619	88.19	83.65
Ilex opaca	American holly	155	1.58	90.78
Prunus americana	American plum	1	0.04	82.50
Platanus occidentalis	American sycamore	425	83.73	86.49
Phellodendron amurense	Amur corktree	1	0.04	94.50
Maackia amurensis	Amur maackia	1	0.09	82.50
Acer ginnala	Amur maple	42	1.22	90.21
Malus	Apple spp	139	2.31	88.88
Prunus armeniaca	Apricot	2	0.03	88.50
Cupressus arizonica	Arizona cypress	62	1.47	89.47
Betula platyphylla	Asian white birch	5	0.12	94.50
Tamarix aphylla	Athel tamarisk	2	0.07	94.50
Cedrus atlantica	Atlas cedar	19	0.48	85.95
Pinus nigra	Austrian pine	817	31.17	89.42
Salix babylonica	Babylon weeping willow	5	0.47	82.50
Taxodium distichum	Baldcypress	794	79.32	90.19
Tilia	Basswood spp	1	0.00	0.00
Tilia platyphyllos	Bigleaf linden	1	0.11	94.50
Populus grandidentata	Bigtooth aspen	1	0.12	94.50
Carya cordiformis	Bitternut hickory	1	0.01	62.50
Robinia pseudoacacia	Black locust	48	1.35	74.36
Quercus velutina	Black oak	2	0.13	82.50
Nyssa sylvatica	Black tupelo	21	0.14	64.98
Juglans nigra	Black walnut	82	16.45	80.70
Salix nigra	Black willow	2	0.17	88.50
Quercus marilandica	Blackjack oak	630	31.94	84.18
Acer negundo	Boxelder	6	0.71	81.17
Bumelia	Bumelia spp	1	0.01	94.50
Quercus macrocarpa	Bur oak	437	37.02	87.23
Washingtonia filifera	California palm	1	0.00	94.50

Species	Common Name	# of Trees	Leaf Area (acres)	Average Condition (%)
Pyrus calleryana	Callery pear	542	25.55	83.67
Prunus caroliniana	Carolina laurelcherry	6	0.04	94.50
Ulmus crassifolia	Cedar elm	111	4.81	89.67
Vitex agnus-castus	Chaste tree	71	2.10	93.49
Prunus cerasifera	Cherry plum	12	0.08	85.50
Quercus pagoda	Cherrybark oak	3	0.19	86.50
Melia azedarach	Chinaberry	2	0.32	82.50
Castanea mollissima	Chinese chestnut	1	0.03	82.50
Quercus variabilis	Chinese cork oak	1	0.06	62.50
Ulmus parvifolia	Chinese elm	932	81.04	86.59
Koelreuteria bipinnata	Chinese flame tree	12	1.51	85.83
Chionanthus retusus	Chinese fringe tree	13	0.09	94.50
Firmiana simplex	Chinese parasoltree	2	0.08	94.50
Pistacia chinensis	Chinese pistache	1,279	68.49	88.18
Cercis chinensis	Chinese redbud	1	0.03	82.50
Liquidambar formosana	Chinese sweet gum	2	0.11	82.50
Zelkova sinica	Chinese zelkova	1	0.05	82.50
Quercus muehlenbergii	Chinkapin oak	90	4.81	87.21
Bumelia lanuginosum	Chittamwood	52	3.10	84.50
Crataegus crus-galli	Cockspur hawthorn	1	0.02	94.50
Prunus virginiana	Common chokecherry	2	0.01	94.50
Lagerstroemia indica	Common crapemyrtle	1,069	9.04	91.61
Ptelea trifoliata	Common hoptree	1	0.01	94.50
Tilia x europaea	Common lime	2	0.16	88.50
Pyrus communis	Common pear	7	0.15	91.07
Diospyros virginiana	Common persimmon	64	3.26	85.27
Ilex verticillata	Common winterberry	2	0.01	88.50
Salix matsudana	Corkscrew willow	3	0.12	75.83
Tilia euchlora	Crimean linden	1	0.09	94.50
Magnolia acuminata	Cucumber tree	1	0.00	94.50
Cupressus	Cypress spp	4	0.48	91.50
Cedrus deodara	Deodar cedar	24	0.44	89.50
Chilopsis linearis	Desertwillow	22	0.17	83.05
Populus deltoides	Eastern cottonwood	448	77.16	82.23
Cercis canadensis	Eastern redbud	864	15.82	85.18
Juniperus virginiana	Eastern redcedar	1,365	94.31	88.88
Ulmus	Elm spp	29	2.16	89.26
Quercus robur	English oak	75	5.17	86.77
Acer barbatum	Florida maple	17	1.09	87.68
Cornus florida	Flowering dogwood	7	0.01	85.93
Acer x freemanii	Freeman maple	167	10.12	83.87

Species	Common Name	# of Trees	Leaf Area (acres)	Average Condition (%)
Ginkgo biloba	Ginkgo	10	0.05	91.30
Koelreuteria paniculata	Golden raintree	218	6.76	86.52
Laburnum x watereri	Golden-chain tree	1	0.01	94.50
Fraxinus pennsylvanica	Green ash	211	13.37	83.71
Euonymus hamiltoniana	Hamilton's spindletree	1	0.01	94.50
Eucommia ulmoides	Hardy rubber tree	2	0.14	88.50
Acer campestre	Hedge maple	4	0.37	91.50
Pinus heldreichii	Heldrich pine	1	0.00	94.50
Prunus subhirtella	Higan cherry	6	0.01	94.50
Ilex	Holly spp	6	0.06	92.50
Gleditsia triacanthos	Honeylocust	243	7.67	83.68
Lonicera	Honeysuckle spp	2	0.03	78.50
Aesculus hippocastanum	Horse chestnut	2	0.15	94.50
Juniperus	Taylor juniper	52	0.13	94.50
Acer palmatum	Japanese maple	14	0.03	91.07
Sophora japonica	Japanese pagoda tree	29	1.25	83.60
Pinus densiflora	Japanese red pine	2	0.02	82.50
Pinus parviflora	Japanese white pine	2	0.21	78.50
Zelkova serrata	Japanese zelkova	20	1.89	83.10
Ziziphus	Jujube spp	2	0.10	62.50
Juniperus	Juniper spp	70	0.45	93.64
Gymnocladus dioicus	Kentucky coffeetree	88	4.09	84.95
Cornus kousa	Kousa dogwood	3	0.01	86.50
Prunus serrulata	Kwanzan cherry	2	0.01	94.50
Libocedrus	Libocedrus spp	8	0.71	84.50
Celtis lindheimeri	Lindheimer's hackberry	2	0.21	88.50
Tilia cordata	Littleleaf linden	5	0.48	88.10
Quercus Quercus/live virginiana	Live oak	84	2.70	89.64
Pinus taeda	Loblolly pine	294	9.81	87.04
Platanus x acerifolia	London planetree	228	29.35	85.71
Albizia julibrissin	Mimosa	5	0.21	89.70
Fraxinus angustifolia	Narrow-leafed ash	1	0.19	94.50
Quercus rugosa	Netleaf oak	1	0.01	82.50
Catalpa speciosa	Northern catalpa	29	1.85	82.91
Celtis occidentalis	Northern hackberry	472	40.86	84.24
Quercus rubra	Northern red oak	118	8.88	85.48
Thuja occidentalis	Northern white cedar	52	2.53	82.62
Acer platanoides	Norway maple	2	0.10	88.50
Quercus	Oak spp	4	0.26	91.50
Aesculus glabra	Ohio buckeye	4	0.03	78.50

Species	Common Name	# of Trees	Leaf Area (acres)	Average Condition (%)
Platycladus orientalis	Oriental arborvitae	42	2.08	91.64
Liquidambar orientalis	Oriental sweetgum	1	0.10	82.50
Maclura pomifera	Osage orange	10	0.35	89.70
Quercus lyrata	Overcup oak	2	0.06	88.50
Broussonetia papyrifera	Paper mulberry	1	0.04	82.50
Malus pumila	Paradise apple	2	0.02	88.50
Prunus persica	Peach	3	0.04	90.50
Carya illinoinensis	Pecan	141	13.57	84.94
Parrotia persica	Persian ironwood	2	0.07	94.50
Quercus palustris	Pin oak	77	6.25	86.71
Pinus	Pine spp	1	0.03	82.50
Pinus thunbergii	Black pine	11	0.41	91.23
Prunus	Plum spp	3	0.01	94.50
Taxodium ascendens	Pondcypress	23	1.73	91.89
Pinus ponderosa	Ponderosa pine	208	11.80	86.10
Ilex decidua	Possum haw	9	0.05	93.17
Quercus stellata	Post oak	1,211	67.55	86.90
Ligustrum	Privet spp	1	0.02	82.50
Acer truncatum	Shantung maple	91	1.52	88.21
Salix discolor	Pussy willow	1	0.00	94.50
Thuja	Redcedar spp	5	0.15	89.70
Acer rubrum	Red maple	27	0.75	82.41
Betula nigra	River birch	43	1.87	84.36
Juniperus	Juniper	101	1.14	92.44
Paulownia tomentosa	Royal paulownia	1	0.02	82.50
Elaeagnus angustifolia	Russian olive	10	0.31	66.25
Viburnum rufidulum	Rusty blackhaw	1	0.01	94.50
Magnolia x soulangiana	Saucer magnolia	17	0.20	92.38
Quercus acutissima	Sawtooth oak	192	12.46	87.79
Pinus sylvestris	Scotch pine	55	2.64	88.83
Carya laciniosa	Shellbark hickory	1	0.29	82.50
Quercus imbricaria	Shingle oak	2	0.17	94.50
Pinus echinata	Shortleaf pine	15	0.82	89.70
Quercus shumardii	Shumard oak	669	39.39	87.37
Ulmus pumila	Siberian elm	535	38.14	78.26
Tilia tomentosa	Silver linden	3	0.29	94.50
Acer saccharinum	Silver maple	52	6.11	87.19
Pinus elliottii	Slash pine	1	0.10	94.50
Ulmus rubra	Slippery elm	52	5.14	80.19
Cotinus coggygria	Smoke tree	10	0.14	92.10

Species	Common Name	# of Trees	Leaf Area (acres)	Average Condition (%)
Ulmus carpinifolia 'Hollandica'	Smoothleaf elm	3	0.27	90.50
Ulmus minor	Smooth-leaf elm	1	0.14	94.50
Sapindus	Soapberry spp	129	4.47	86.98
Catalpa bignonioides	Southern catalpa	12	0.62	83.83
Magnolia grandiflora	Southern magnolia	43	0.58	90.59
Quercus falcata	Southern red oak	5	0.36	92.10
Euonymus	Spindletree spp	4	0.13	91.50
Magnolia stellata	Star magnolia	3	0.06	94.50
Acer saccharum	Sugar maple	57	2.66	86.04
Celtis laevigata	Sugarberry	707	65.92	85.05
Quercus michauxii	Swamp chestnut oak	1	0.13	82.50
Quercus bicolor	Swamp white oak	100	1.82	85.46
Liquidambar styraciflua	Sweetgum	137	9.65	87.59
Fraxinus texensis	Texas ash	2	0.08	94.50
Sophora affinis	Texas sophora	2	0.05	82.50
Ailanthus altissima	Tree of heaven	21	1.51	84.40
Acer buergerianum	Trident maple	10	0.31	92.10
Sciadopitys verticillata	Umbrella pine	3	0.01	90.50
Crataegus phaenopyrum	Washington hawthorn	1	0.00	94.50
Quercus nigra	Water oak	62	5.53	87.08
Nyssa aquatica	Water tupelo	1	0.00	94.50
Fraxinus americana	White ash	279	9.57	88.63
Morus alba	White mulberry	196	14.79	82.51
Quercus alba	White oak	11	0.75	93.41
Populus alba	White poplar	2	0.07	88.50
Quercus phellos	Willow oak	10	0.78	82.10
Salix	Willow spp	141	8.70	81.05
Ulmus alata	Winged elm	3	0.31	90.50
Ilex vomitoria	Yaupon	108	1.51	92.76
Cladrastis kentukea	Yellowwood	2	0.06	94.50
Total/ Average		**19,632**	**1,273**	**86.71**

Table 19. Park Areas Inventoried (2016)

Park	Address	Acres
Route 66 Park	9901 NW 23RD ST	149
South Lakes Park	4302 SW 119TH ST	128
Dolese Youth Park	4701 NW 50TH ST	126
Overholser Park	2402 E OVERHOLSER DR	99
Earlywine Park	3033 SW 119TH ST	98
Woodson Park	3401 S MAY AVE	88
Douglass Park	900 FREDERICK DOUGLASS AVE	77
Wheeler Park	1120 S WESTERN AVE	69
Will Rogers Arboretum	3400 NW 36TH ST	48
Will Rogers Park	3301 NW 32ND ST	42
Stars & Stripes Park	3701 S LAKE HEFNER DR	39
Wiley Post - West	2018 S ROBINSON AVE	37
Woodson Park/Wisenhunt Soccer Complex	3200 S INDEPENDENCE AVE	37
Lightning Creek Park	8100 S WESTERN AVE	35
Rotary Park (PAL)	1604 SW 15TH ST	35
Draper Park (Capitol Hill Lions Center)	3816 S ROBINSON AVE	33
Kids Lake Park	3200 W WILSHIRE BLVD	32
Edwards Park	1515 N BRYANT AVE	32
Hefner Park	3301 NW GRAND BLVD	31
Brock Park	1601 SW 25TH ST	30
Syl Goldman Park	5333 S INDEPENDENCE AVE	28
Regatta Park	701 S LINCOLN BLVD	25
Schilling Park	601 SE 25TH ST	23
Trosper Park	2300 SE 29TH ST	23
North Rotary Park	5708 N TULSA AVE	21
Southern Oaks Park	6818 S WALKER AVE	20
Bluff Creek Park- West	10941 N MERIDIAN AVE	20
Oliver Park	65 SW GRAND BLVD	18
Washington Park/Shelter	400 N HIGH AVE	18
Edgemere Park	3421 N HARVEY PKWY	18
Minnis Lakeview Park	12520 NE 36TH ST	17
Memorial Park	1152 NW 36TH ST	17
Merrel Medley Park	11100 S PENNSYLVANIA AVE	17
Bricktown Canal		16
Wiley Post - East	2018 S ROBINSON AVE	15
Diggs Park	2201 N COLTRANE RD	14
Hathaway Park	3730 S LINDSAY AVE	14
Ted Reynolds Park	3005 W RENO AVE	13
Crown Heights Park East	3721 N SHARTEL AVE	13
Pat Murphy Park	4551 W HEFNER RD	12

Park	Address	Acres
Progressive Community Park	4401 LENOX AVE	12
OK River Trails	Meridian- Eastern (south side of river)	12
Pitts Park	1920 N KATE AVE	12
Lincoln Park - South	3900 N MLK AVE	11
Shallowbrook Park	4901 S SHALLOW BROOK DR	11
Dolphin Wharton Park	301 NE 63RD ST	11
Woodland Park	730 NE 50TH ST	11
Quail Creek Park	11130 QUAIL CREEK RD	10
Hiram Park	8200 HAPPY LN	10
McKinley Park	1300 N MCKINLEY AVE	10
Macklanburg Park	2234 NW 117TH ST	10
Douglas Park	500 NW 47TH ST	9
Ross Park	2701 NW 62ND ST	9
Tulsa Park	2409 S TULSA AVE	9
L.D. Lacy Park	1114 NE 43RD ST	9
Sellers Park	8301 S VILLA AVE	9
Melrose Park	7800 MELROSE LN	9
McCracken Park	425 SE 64TH ST	8
Lincoln Park - North	4712 N MLK AVE	8
Rotary Playground Park	416 SE 15TH ST	8
Girvin Park	3400 NW 14TH ST	8
Mackleman Park	5501 MACKLEMAN DR	8
Pied Piper Park	1303 NW 100TH ST	8
Harlow Park	4800 NW 19TH ST	7
Taylor Park	1115 SW 70TH ST	7
Lela Park	1801 N LELA AVE	7
Hosea Vinyard Park	4201 S WALKER AVE	7
Northeast Center Park North	1300 NE 33RD ST	7
Geraldine Park	3203 N GERALDINE AVE	6
Luther Dulaney Park	2931 NW 41ST ST	6
Crown Heights Park West	3721 N SHARTEL AVE	6
Youngs Park	4610 S YOUNGS BLVD	6
Redlands Park	1423 NW 141ST ST	5
John F. Kennedy Park	1824 NE 16TH ST	5
Jack W. Cornett Park	3001 N GROVE AVE	5
E.B. Jeffrey Park	1600 N MERIDIAN AVE	5
Bob Akers Park	2408 SE 11TH ST	5
Kitchen Lake Park	5501 SE 119TH ST	5
Goodholm Park	2701 N ROBINSON AVE	5
Top O' Town Park	2102 S EVEREST AVE	5
Harvest Hills Park	8235 NW 104TH ST	5

Park	Address	Acres
May Park	2817 SW 34TH ST	5
Smitty Park	4500 N BILLEN AVE	5
Zachary Taylor	633 NW 52ND ST	4
Lytle Park	801 GREENVALE RD	4
Flower Garden Park	4711 N CLASSEN BLVD	4
Siler Park	9600 S FAIRVIEW DR	4
Creston Hills Park	2240 NE 18TH ST	4
Phillips Park	2808 N PROSPECT AVE	4
Lippert Park	5501 S SHARTEL AVE	4
Lorraine Thomas Park	2350 S INDEPENDENCE AVE	4
Perle Mesta Park	1900 N SHARTEL AVE	4
Brookwood Park	9600 S SHARTEL AVE	4
Denniston Park	2609 DENNISTON DR	4
Sparrow Park	300 NW 30TH ST	3
Swatek Park	2301 NW 29TH ST	3
Reed Park	1217 N MAY AVE	3
J.B. Black Park	2121 N COUNCIL RD	3
Grant Corbin Park	4032 NW 13TH ST	3
Tinsley Park	3300 NW 65TH ST	3
North Highland Park	8200 N HARVEY AVE	3
Harden Park	2801 CRESTON DR	3
E.W Perry Park	1329 NE 48TH ST	2
Alice Harn Park	926 NW 15TH ST	2
Winans Park	2100 N BROADWAY AVE	2
Glen Ellyn Park	2300 GLEN ELLYN ST	2
Meadowbrook Park	3809 NW 10TH ST	2
Wayman's Park	1900 N DREXEL BLVD	2
Lake Hefner Lions Children’s Playground	9050 LAKE HEFNER PKWY	2
Mayfair Park	4510 N MAYFAIR DR	2
Britton Park	1301 NW 96TH ST	2
Zurline Park	2800 S WOODWARD AVE	2
McNabb Park	901 NE 33RD ST	2
Red Andrews Park	720 NW 8TH ST	2
Draper Memorial Park	100 SW 3RD ST	1
McMechan Park	1601 MCMECHAN PKWY	1
Mayview Park	3135 NW 73RD ST	1
Manuel Perez Park	301 SW 14TH ST	1
Mike Dover Park	4601 S WALKER AVE	1
Nichols Court Park	1901 CULBERTSON DR	1
Highley Park	1934 NW 8TH ST	1
Burton/Britton Park - South	9701 N SHARTEL AVE	1
Woodrun Park - East	4 N WILLOWOOD DR	1

Park	Address	Acres
Stiles Circle Park	379 N STILES	1
Saint Clair Park	2212 N ST CLAIR AVE	1
Green's Tot-Lot Park	13044 BURLINGAME AVE	1
Guilchester Park	2716 DORCHESTER DR	1
Culbertson Park	1101 NE 13TH ST	1
O'Neil Park	725 NW 13TH ST	1
Rhode Island Park	6623 N RHODE ISLAND AVE	0.5
Mark Twain Park	2402 NW 1ST ST	0.4
Woodrun Park (POND) - West	309 AZALEA HILL DR	0.2
Pilot Center Park	1435 NW 2ND ST	0.1
Total Acres		**2,069**