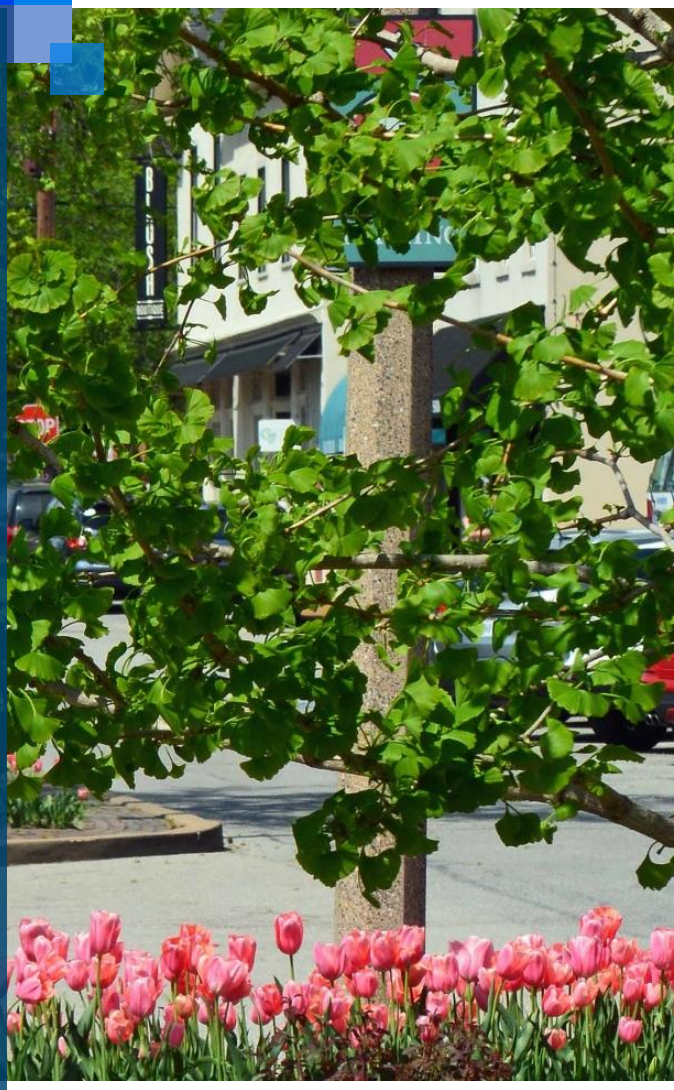
URBAN FOREST

MASTER PLAN

THE “GREEN TREE CITY”



CITY OF KIRKWOOD,
MISSOURI

AUGUST | 2022

PLANIT GEO™
mapping a greener future

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URBAN FOREST

MASTER PLAN

CITY OF KIRKWOOD, MISSOURI

A PLAN FOR THE "GREEN TREE CITY"

AUGUST 2022

ACKNOWLEDGMENTS

Funding for this effort supported by the City of Kirkwood

- The City of Kirkwood, MO Contributors –

Public Services Department- Division of Engineering

Public Services Department-Division of Forestry

City of Kirkwood Supporting Departments and Offices

City Council

Keep Kirkwood Green

Community members of Kirkwood

All other photos unless noted are from the City of Kirkwood, Missouri

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Mission Statement

Kirkwood's Urban Forest Master Plan provides the framework to maintain, protect, and enhance the City's urban forest. Kirkwood is dedicated to achieving the goals set forth in this Plan through shared commitments with its partners and residents. This shared commitment will lead to a city where the benefits of the urban forest are utilized for environmental, economic, and local success for present and future generations.

Vision Statement

Kirkwood will prioritize the health of its current and future urban forest to support a healthy, sustainable, and resilient community.

A Letter from Kirkwood's Urban Forester

Kirkwood, Missouri is a place where we value our trees for the benefits they provide and see them as necessary assets to the community. The City will continue to enhance our urban forest through proper management and industry leading practices that will aid in the health and vitality of our trees. In turn, we strive to be a leader in urban forest management as well as to inspire other programs in the region.

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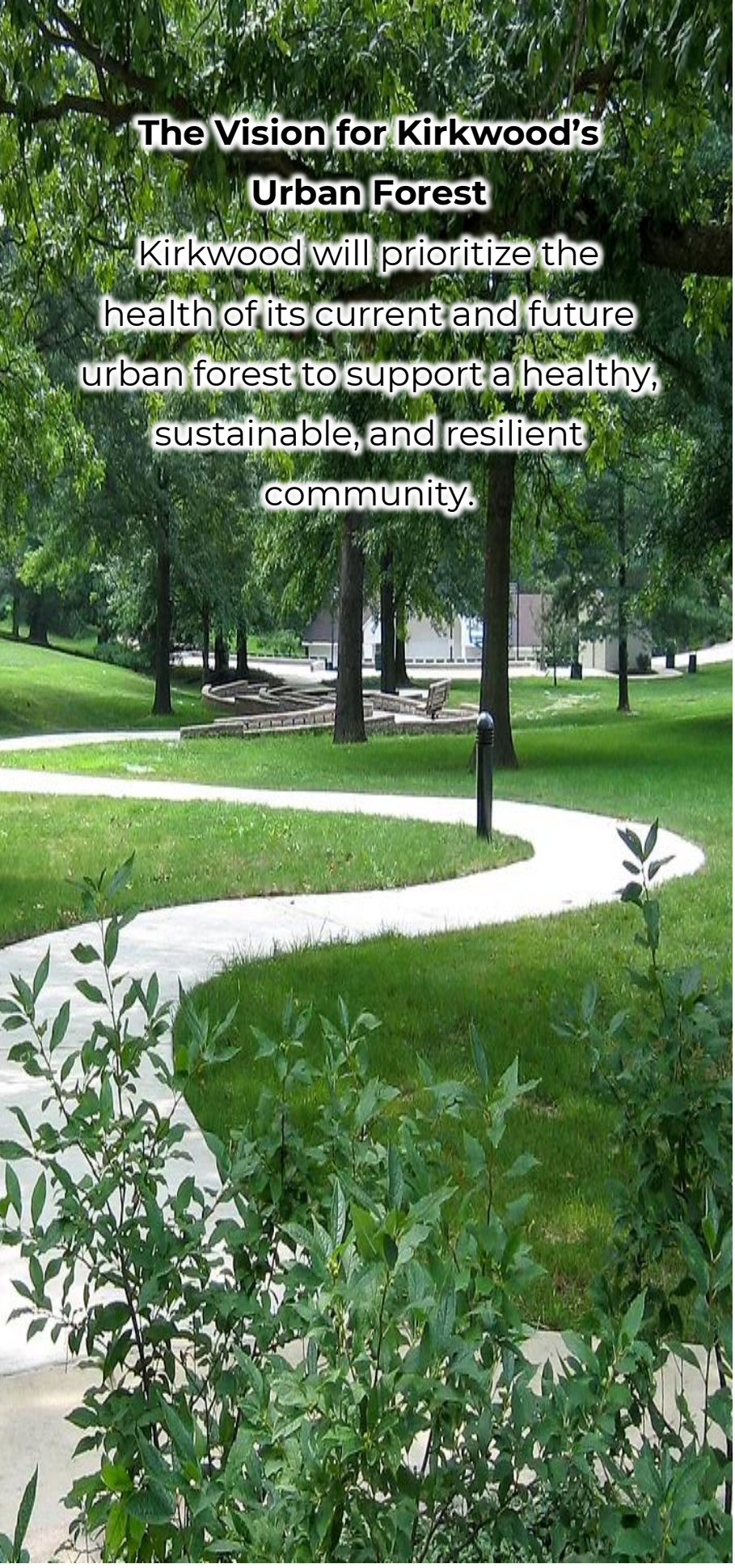


The Vision for Kirkwood's Urban Forest

Kirkwood will prioritize the health of its current and future urban forest to support a healthy, sustainable, and resilient community.

Planning Process

Prior to the development of the City of Kirkwood, Missouri's Urban Forest Master Plan ("Plan", "UFMP"), the City's Urban Forester within the Forestry Division of the Public Services Department and supporting staff worked with City departments, partners, and the community to identify the needs of the urban forest.

To inform the Plan, consultations and engagement with key City staff were conducted. Feedback received through these efforts was used to produce a draft Plan with a shared vision for the urban forest. The team then shared draft goals, actions, and targets or key performance indicators with members of the Public Services Department and key stakeholders to ensure initial input was captured accurately.

Input received informed action priorities and the context in the Plan to provide technical guidance for the City Forestry Division while being relevant, accessible, and tangible to the community.

The overarching goal of the Urban Forest Master Plan is to provide the framework for current and future City tree managers to sustain, protect, and enhance the urban forest to maximize the many benefits city trees provide to the residents and future generations.

Kirkwood's Urban Forest Today

The residents of the City of Kirkwood ("the City", "Kirkwood") care about the place where they live, work, and recreate. Among the many things that make the City special is its physical environment—the urban forest—consisting of tree-lined streets, abundant parks, natural areas, trees in parking lots and framing buildings, flowering trees in spring, fall color, trees with swings in backyards, and trees edging streams and ponds cooling the waters for aquatic life. One of the most important responsibilities is to protect these resources and ensure that Kirkwood will always be a beautiful, healthy, and livable city, long into the future.

The City of Kirkwood, known as the "Green Tree City", has a vibrant urban forest that continues to be created, modified, and removed primarily by people, and sustaining it will require ongoing human intervention. The goal of this intervention is a sustainable urban forest— an urban forest that optimizes the benefits of trees while meeting established safety and economic goals. Achieving this requires robust management, diverse funding, adequate staffing, effective policies, and maintenance actions consistent with best practices.

The urban forest offers many benefits, some of which are directly identifiable and quantifiable, and others that are experienced. Recognition of the role urban forests play in improving human health and well-being in addition to being critical climate change mitigators continues to increase. A 2022 study of Kirkwood's trees determined the ecosystem services and benefits of the nearly 9,000 public trees (streets and parks) totaled over half a million dollars annually. Most notably, the inventoried public tree population prevents nearly 8 million gallons of stormwater runoff by intercepting rainfall, reduces the amount of energy used by over 1.3 million kilowatts, and sequesters over 1.1 million pounds of carbon annually. Taking into account the structural value, it is estimated that the total public tree population is valued at nearly $27.5 million. The City's legacy of trees continues to grow and caring for this asset is an important part of maintaining a sustainable, and vibrant city.

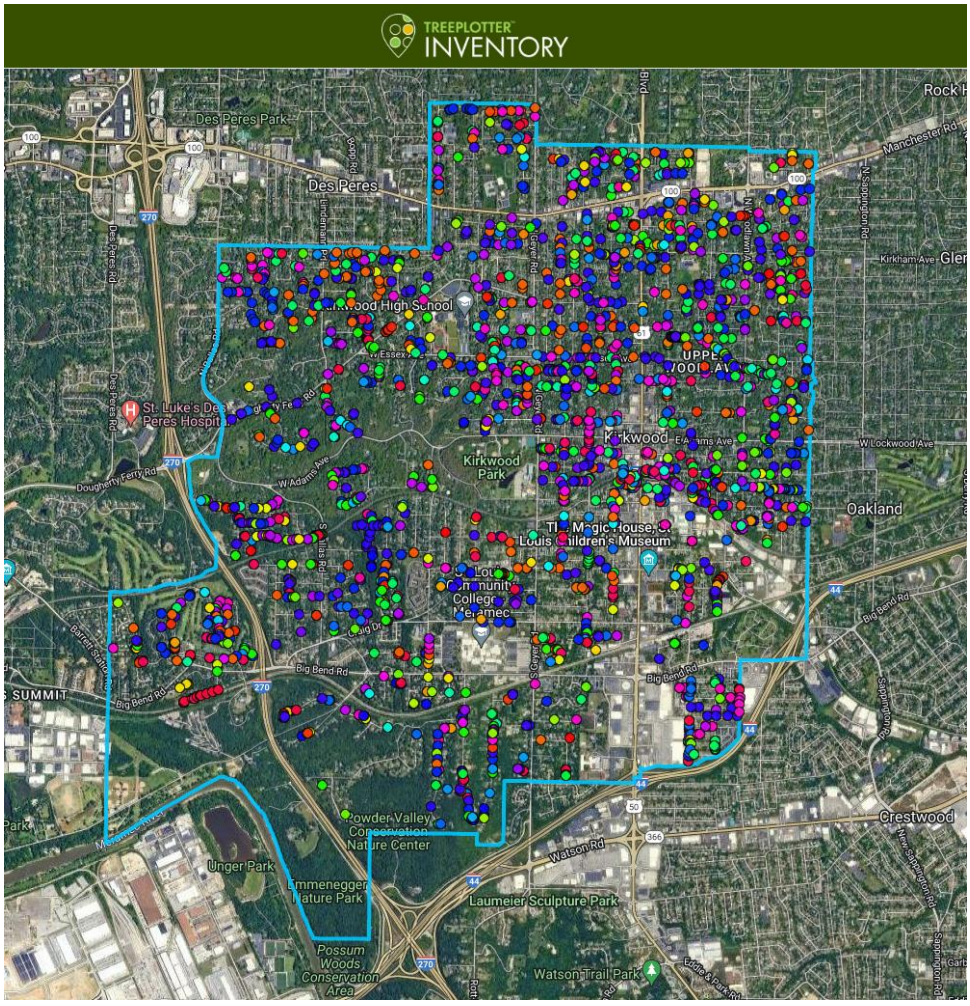
The presence of trees in an urban environment must be balanced with other citywide goals such as property rights, growth management, transportation, economic development, urban design, and the goals of property owners. A significant challenge faced by Kirkwood's urban forest is climate change. Trees both mitigate climate change and are affected by climate change. They absorb carbon dioxide and produce oxygen, but the changing weather (increased temperatures, frequent flooding, shortened lake freeze-thaw periods, and severe storms) has negative impacts on tree health, making them more susceptible to disease and pests.

Trees also face issues as the City grows and changes. The world is undergoing an enormous surge of urban population growth, with more than half of all people now living in towns and cities (United Nations Population Fund). While nature may seem far from the urban environment, research increasingly shows that it plays a critical role in the lives of city residents. The urban forest supports the health and well-being of the people, offering benefits like stress reduction and opportunities for social connection. A growing body of scientific evidence suggests contact with nature provides a multitude of health benefits and may be an important factor in disease prevention and health promotion for people who live in urban areas. A healthy and thriving urban forest supports these benefits. Achieving the goals of City planning efforts and urban forest management requires cohesive planning and coordination that will benefit the community as a whole.

MANAGING THE URBAN FOREST

The City of Kirkwood has a diversity of existing policies, programs, regulations, and incentives that are used to manage the City's urban forest. City departments engaged in Kirkwood's urban forest planning effort each bring important expertise, perspective, and resources to this commitment—to the tune of nearly $1.2 million (average from 2019-2022, includes utility tree management budget) to manage nearly 9,000 public trees. The City's Urban Forestry Program within the Forestry Division of Public Services is overseen by the City's Urban Forester and in June 2022, a new supporting position was fulfilled to review plans, enforce the ordinance, among other tasks. The Urban Forester is responsible for the management of City trees within the public rights-of-way and planning for the overall health of the urban forest. The Urban Forester also provides staff support to the Kirkwood Urban Forestry Commission and provides administration and enforcement of forestry regulations. The Urban Forestry Program engages in long-range planning and management, oversees tree removal and maintenance contracts, provides technical support to City residents, manages public property trees on over 300 acres, oversees development design, regulates the removal of trees, and promotes stewardship of the urban forest. Interdepartmental coordination is essential for effective management and consistent delivery of urban forestry programs.

Kirkwood's urban forest is a diverse ecosystem consisting of young and mature trees of varying species, function, and associated benefits.



0.31 public trees per capita

Nearly 9,000 public trees inventoried

174 unique public tree species

67% of public trees in good condition

28% of public trees are 1 to 6 inches in diameter

The Citywide Urban Forest

The City's project team consisting of Kirkwood's Public Service's Forestry staff and urban forestry consultants developed a set of diverse, comprehensive goals to guide urban forestry work. These goals were informed by an inclusive engagement process with the community and stakeholders undertaken throughout the planning process. The results of these efforts are a series of urban forestry goals to address the resource, the programs, and the people.

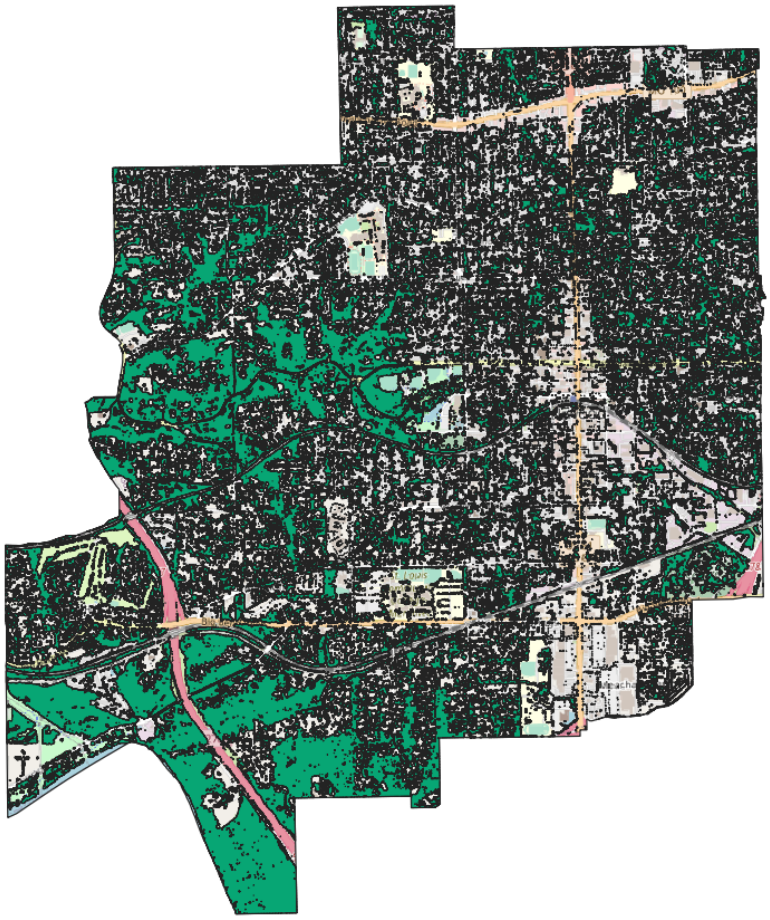
Urban Forest Master Plan Vision

Healthy Trees, Healthy City: *Kirkwood will prioritize the health of its current and future urban forest to support a healthy, sustainable, and resilient community.*

Supporting the Vision: Kirkwood's Tree Canopy and Equity Goal

Tree canopy is a valuable component of Kirkwood's urban ecosystem and expanding the urban forest is part of the solution to the City's social, environmental, and economic concerns. To achieve the vision for the urban forest, the City has established a goal to increase its tree canopy coverage by 7 percent— up from 43 percent currently— over a 24-year timespan or "50 percent by 2045".

To reach this goal, approximately 13,300 new trees need to be planted over the 24-year timeframe while preserving the City's existing urban tree canopy cover. The goal of 50 percent canopy and 13,300 new trees is based on a variety of factors including species diversity, urban forest benefits, maintenance responsibility, and an equitable distribution of tree canopy. In turn, the 13,300 trees will add annual benefits of over $303,000 and improve tree equity across the City, bringing all Census Block Groups to a Tree Equity Score of at least 75 (out of 100) according to the American Forests' Tree Equity Score Tool (TES, TreeEquityScore.org). In addition, the canopy goals will address stormwater, energy conservation, population density, human health, and underserved communities.



Challenges Facing Kirkwood's Urban Forest

Urban trees can play a significant role in making cities resilient to weather and climate extremes, and in protecting human and ecosystem health and safety. To do so, trees must be consciously selected, planted, and managed as the central component of an urban forest where individual trees are maintained as part of a greater system with the purpose of improving the urban environment and enhancing the benefits of that ecosystem.

Sustainable Management – Addressing Street Tree Maintenance

The public street trees throughout Kirkwood are primarily the responsibility of the City to maintain. One measure of sustainable management is the number of years it takes to prune all public trees, also referred to as the pruning cycle. Currently, the City maintains street trees on a programmed 8-year cycle requiring approximately 1,100 trees to be pruned per year. A pruning cycle of five years is recommended for communities in the region. This would require the City to collectively prune approximately 1,700 trees annually— up 600 trees per year from the current average.

Routine maintenance, often referred to as grid pruning or programmed pruning, is the most cost effective near- and long-term pruning management strategy for city tree maintenance since every tree within a given grid, priority area, or zone is pruned each pruning cycle. When each tree is inspected and pruned on a regular cycle, both short- and long-term maintenance costs are reduced due to efficiencies in mobilization, scheduling, and service tracking; both preventative and reactive maintenance are performed in one operation and the need for future priority pruning is minimized. Conversely, street trees that are not pruned on a regular cycle, or their maintenance is deferred, results in the opposite effect— as the interval between pruning increases the tree health declines and the maintenance costs increase.

The City should utilize this Plan to secure a sustained and dedicated funding stream for the maintenance and management of the public tree population for the next 20 years. If the program becomes underfunded, street tree maintenance and health will suffer. The impact of deferred maintenance would be felt by the City, the public, and the urban forest itself. Prolonged maintenance deferral would reduce the overall health of the urban forest, reduce the associated benefits and services provided by trees, and increase public safety risks.

In addition to programmed pruning, the City should continue to monitor the urban forest for current and potential tree pests and diseases. Emerald ash borer is still a concern in the City and there is a rising concern with the woody oak gall targeting Kirkwood's most abundant public tree, the pin oak.

Risk Tree Management

One of the unique challenges of managing Kirkwood's urban forest stems in part from the nature of trees in the St. Louis region— certain trees can grow exceptionally tall. These larger species of trees can be more prone to branch failures than other tree species. In addition to large tree size, the prevalence of particular species in the urban forest population presents more instances for possible damages and consequences as a result of the failure of a tree or tree part. Certain species require more frequent pruning when they exist in public spaces. Other species of trees are known to be prone to decay. The combination of large and maintenance-demanding public trees requires thoughtful management that is consistent and transparent and adheres to industry standards and best practices.

The 2022 tree inventory provides the data and guidance to effectively manage risk and this Plan provides the framework for increasing funding and resources to address the concerns.

Tree Related Policies and Regulations

Trees can be found mentioned in several City codes, regulations, and plans. Regulations to guide tree planting and maintenance are improving but the protection of significant trees on private property should be addressed. Though significant improvements have been made, there still exist some inconsistencies or gaps in the policies and regulations for Kirkwood's trees. It is recommended the City explore a tree protection ordinance for significant and heritage trees greater than 30 inches in diameter on private lots greater than one acre in size. These recommendations are addressed in the Plan's strategies and actions.

Tree Protection during Construction

Currently, Best Management Practices (BMPs) for protecting trees on construction sites are inconsistently applied and the monitoring of tree protection zones (TPZ) is insufficient. The new position within the Forestry Division, fulfilled in June 2022, supports tree protection as the City continues to grow and change. Prior to this position, the Urban Forester had over 100 new home plans to review on average, emphasizing the need for the position and the challenges facing the urban forest.

Alternative Solutions to Tree and Sidewalk Conflicts

The City habitually applies linear streetscape design which limits retrofits and alternative solutions to tree and sidewalk conflicts. Kirkwood has made some use of flexible design, however, these types of designs could be considered more often. Flexible design would allow more sidewalks to meander around trees, parcels could be developed around healthy existing trees, and additional right-of-way easements/frontages could be obtained rather than blindly applying the 'safe streets' or ADA retrofit designs. Through the planning effort to develop this Plan, recommendations for updating City Code and regulations were provided along with the guidance for applying alternative solutions.

Limited Resources to Address Climate Change Impacts

Cities around the world, and specifically in the St. Louis region, face dramatically intensifying extreme weather and climate impacts including drought, long-term water shortages, flooding, more frequent heavy storm events, and extreme heat. In many instances, these impacts are already exceeding the designed capacity of city infrastructure to protect the health and safety of residents, businesses, and neighborhoods, which in turn threatens the fiscal viability of the City. Urban trees play a significant role in making Kirkwood resilient to weather and climate extremes, and in protecting human and ecosystem health and safety. To do so, trees must be consciously selected, planted, and managed as the central component of an urban forest where individual trees are managed as part of a greater system with the purpose of improving the urban environment and enhancing benefits.

Strategic Tree Planting

The ability of Kirkwood's urban trees and urban forests to achieve desired benefits is drastically limited if the funding for maintenance and management does not grow with the expanding and threatened urban forest. Innovative and inclusive programs, training of tree care professionals, and enforcement of tree-management best practices will support long-term tree health. If tree health is compromised, the beneficial functions of trees become limited, leaving trees more susceptible to pests and disease, and leading to premature tree death. Urban trees face multiple challenges to surviving and thriving. Trees that die years

prematurely will not create the root systems and canopies needed to reach their benefit potential and maximize their return on investment.

Kirkwood's recent urban forestry projects such as the inventory and Plan are crucial efforts for building a more sustainable community and working toward carbon neutrality. Tree planting is one of the few tangible actions the City can directly take to address non-source specific pollution in Kirkwood and the inventory and master plan will support strategic planning for continued plantings resulting in long-lasting benefits.

Planting trees in Kirkwood should be strategically planned to address environmental justice, equity, access, and levels of service for all neighborhoods. Tree plantings can address canopy cover inequities, intensive tree management can reduce risks and prolong the associated benefits of trees, and diverse outreach approaches and unique programs can enhance urban forest stewardship in the community. Planting and maintaining an urban forest that exists in concert with other green infrastructure must include management by trained individuals, the use of tree inventory data, an understanding of baseline conditions and forecasted environmental changes, collaboration among departments to mainstream urban forest management, a community with a shared vision for the urban forest, tree canopy goals and priority planting areas, and a roadmap for management provided in the Plan.

Addressing the Challenges

These issues and challenges listed above and as recognized in Kirkwood are exacerbated in disadvantaged areas of communities with limited resources. The City needs this comprehensive plan to preserve and expand the urban forest which will result in an equitable distribution of tree canopy, associated benefits, and urban forestry opportunities. The City, its partners, and the community support a plan for the urban forest that sustains the resource and provides benefits to all who live, work, and recreate in the City.

To address these challenges, the Urban Forest Master Plan offers Kirkwood an opportunity to study, evaluate, and plan for improving urban forest management toward the goal of supporting human and ecosystem health and well-being. The urgency of protecting the urban forest has risen sharply as drought, pests, disease, climate impacts and budget cuts lead to rapidly rising tree mortality. To address and reverse tree die-off and the loss of ecosystem benefits, Kirkwood needs a robust system of professional management of public trees and improved support of resident engagement in the care and expansion of the urban forest, both public and private.

When making improvements to the urban forest, efforts should be prioritized to improve environmental justice, equity, access, and levels of service for underserved and vulnerable areas. These considerations may include additional tree plantings for more equitable distribution of urban forest cover and benefits, intensive tree management, diverse outreach approaches, and unique stewardship programs.

Kirkwood's Urban Forest Master Plan is a crucial planning effort to build a more sustainable resource and a healthy community, among other core urban forest management elements. This strategic plan for Kirkwood's urban forest aims to help guide how the City might think about strengthening City Code, policies, ordinances, standards, practices, and procedures; analyzes staffing structures and authority; identifies opportunities for sustained and diversified funding; provides guidance for routine and systematic inventories and assessments; identifies tree maintenance efficiencies and planting/canopy goals and

priorities; addresses storm, disaster, and risk management needs; and strengthens community outreach, education, and engagement.

Kirkwood needs a robust system of professional management and public access to support resident engagement in care and expansion of the urban forest.

Planning Process

This Urban Forest Master Plan is the City's first of its kind. This Plan will set the stage for future actions and efforts that will ensure the long-term health, management, and success of the trees that comprise the urban forest.

Planning Approach

The purpose of the 20-year Urban Forest Master Plan is to answer the fundamental components of adaptive management: what do we have, what do we want, how do we get what we want, and how are we doing. Developing the Plan required input from City staff, stakeholders, residents, data sources, thoughtful analysis, a coordinated vision, and time.

What do we have?

The first step of the process is to complete a baseline assessment of the urban forest, the resources that manage it, and the people that influence and benefit from it. The elements completed in the planning process provide the foundation for setting goals and measuring progress.

What do we want?

The Plan is shaped by knowing what the urban forest needs, the resources required to manage it, and what the community wants. This was informed by public engagement through messaging, public surveys, presentations, staff interviews, and development of the urban forest vision and supporting goals.

How are we doing?

The City needs to continually monitor progress towards the vision and goals. The Urban Forest Master Plan includes guidance for implementing actions. The planning approach for this Plan provides the framework for continual monitoring and evaluation of efforts using the U.S. Forest Service's Urban Forest Audit System. Updates to this audit will inform any necessary changes to strategies in an adaptive management approach.

How to get what we want?

The goal, strategy, and action framework lay out the roadmap to achieve a shared vision that supports the needs of all members of the community. Recommended actions and the associated targets are strategic, measurable, attainable, realistic, and time-bound (SMART) and have been developed through extensive research, data analyses, stakeholder consultations, community engagement, benchmarking research, and gap analyses during the planning process.

Public Participation

The public engagement sessions consisted of an online survey (nearly 500 responses, 1.6 percent of the population), virtual meetings with the Urban Forestry Commission, news articles, social media posts, City website content, email updates through the City's listservs, postcards, and the project website— KirkwoodUrbanForest.com.

Feedback received through these efforts was used to produce a draft Plan with a shared vision for the urban forest. The team then shared draft vision, goals, and actions with City staff, key stakeholders, and the members of Kirkwood's community to ensure initial input was accurately captured.

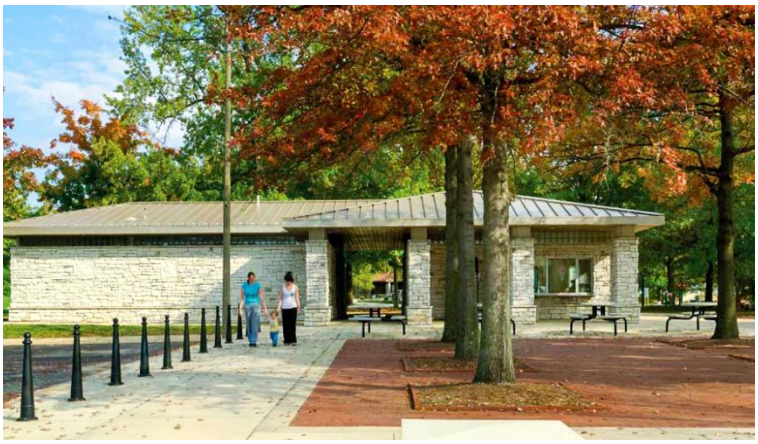
Within the final Plan, action priorities were developed to provide technical guidance for City departments that are relevant, accessible, and tangible to the community.

Staff and Stakeholder Participation

When stakeholder engagement is done effectively, it improves communication channels between parties, creates and maintains support for the Plan, gathers information for the urban forestry programs, reduces the potential for conflict or other issues, and enhances the reputation of the program and ultimately, the Plan. Effective communication with stakeholders not only ensures they are aware of the objectives and finer points of a plan, it also serves to help the program understand those who will be affected by the plan, how they will access and interpret information from the program, allows the program to anticipate how stakeholders will respond, and builds a support system within city departments to collectively implement the plan.

Prior to the development of Kirkwood's Urban Forest Master Plan, the City's Urban Forester within the Forestry Division along with supporting staff worked with City departments, partners, and the community to identify the needs of the urban forest. To inform the Plan, a total of 27 City staff or commission/board members were invited to a series of consultations. Staff participants represented the Electric Department, Building Commissioner's Office, Public Services Department, and the Parks and Recreation Department. In addition, members from the Urban Forestry Commission and Park Board participated. Also, traditional and non-conventional stakeholder engagement occurred throughout the planning process. This process enabled the development of strategies that are in alignment with existing workflows and operations as well as the strategies to improve efficiencies and achieve common goals.

Planning the Urban Forest



The planning process consisted of two phases; the needs assessment completed through extensive research, staff consultations, data analyses, benchmarking, and systematic audits to inform the second phase— the primary framework of the goals and actions in the Urban Forest Master Plan. The first phase establishes a baseline from which short- and long-term strategies can be developed and monitored over time. The needs of the urban forest and the programs that manage it were evaluated through an audit of existing conditions and operations to establish a baseline from which progress can be measured. This diligent approach to Kirkwood's urban forest management gauges the City's readiness and available resources to achieve optimal levels of urban forest management and sustainability. Through this phased approach, a comprehensive understanding was gathered of the urban forest, the programs that manage it, and the community that benefits from and shapes it to inform long-term goals and strategic actions.

The main tenets of this Plan focus on increasing, maintaining, and protecting a diverse tree canopy; analyzing the urban forest; analyzing management methods and structure; evaluating City ordinances and policies, evaluating financial challenges; expanding community outreach regarding urban forests; and addressing environmental changes for increased sustainability.

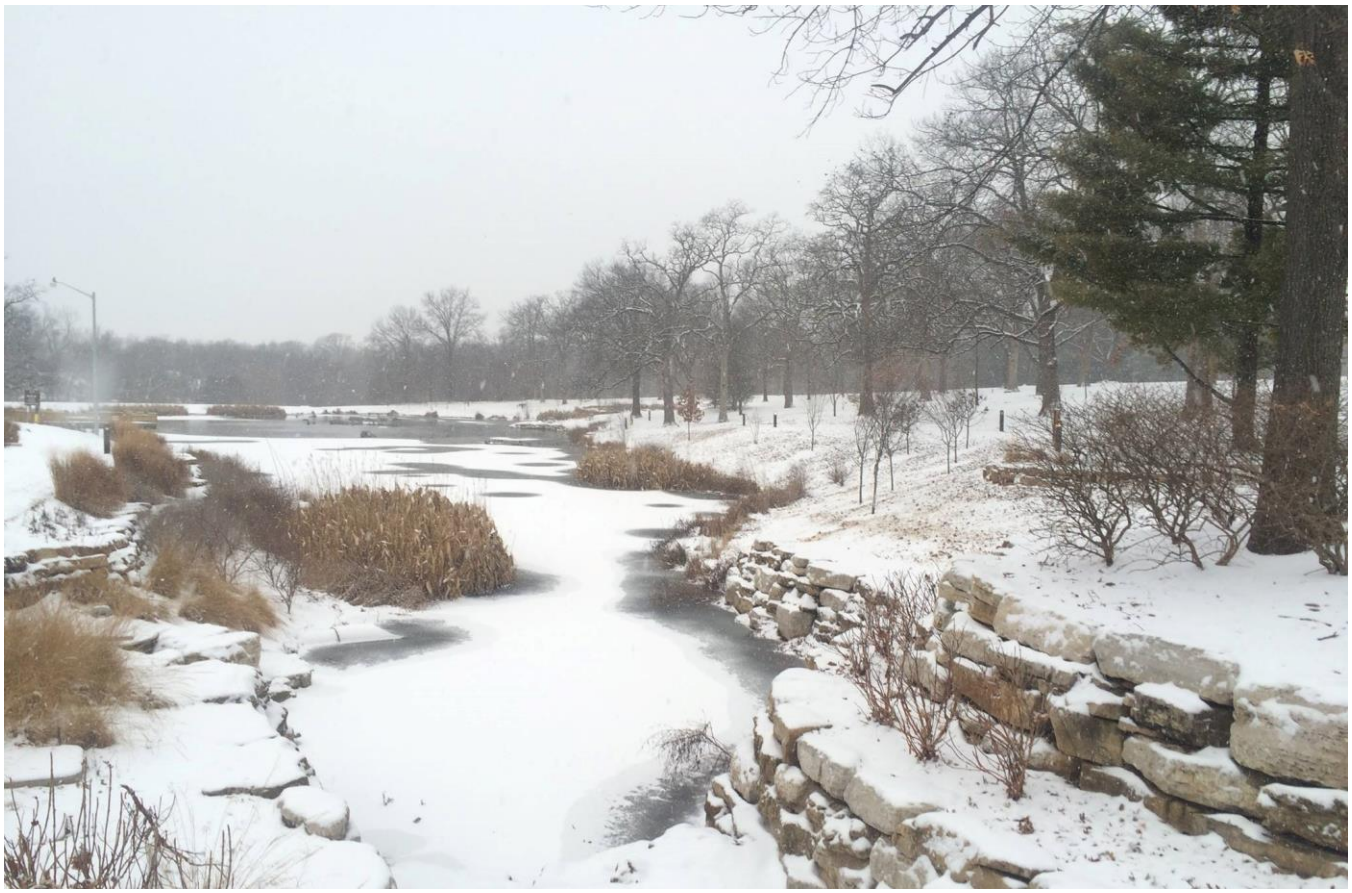
The Urban Forest Master Plan adheres to the following guiding principles:

- Recognize trees comprising the urban forest are more than aesthetic enhancements.
- Recognize trees as the backbone of the urban ecosystem and an essential part of the community's green infrastructure.
- Promote the health and growth of the urban forest by following scientifically established best management practices for tree selection, planting, watering, and pruning.
- Promote a robust urban forest through policies and practices that reduce its vulnerability to known diseases or pest infestations, and future threats, including the anticipated effects of climate change.
- Engage in a continuous process of long-range planning for the growth and maintenance of the urban forest.
- Promote public appreciation of the urban forest through educational outreach programs.
- Support local businesses, institutions, organizations, and individuals in their efforts to grow and maintain the urban forest through community education.
- Strengthen and expand conventional and non-conventional partnerships to leverage resources and increase capacity that achieve shared goals.
- Proceed in a manner that is inclusive and transparent.

KEY FINDINGS

State of the Urban Forest

- 8,614 public trees within 11,109 total public sites resulting in a 78 percent stocking rate.
- 43 percent urban tree canopy cover Citywide in 2020 and a Tree Equity Score of 87 out of 100.
- 174 unique public tree species with pin oak as the most common (17 percent).
- The top ten most common public tree species comprise 48 percent of the population.
- Of the ten most common public trees, red maple, pin oak, eastern red cedar, and eastern white pine are healthier than the overall average for the population.
- A total of 2,485 possible planting sites in public areas (rights-of-way) were inventoried in 2022. 66 percent of these sites are either medium (44 percent) or large (22 percent).
- The Citywide urban forest provides an annual estimated benefit of $1,766,187 by improving air quality, providing carbon storage and sequestration, and reducing stormwater volumes (excludes property values, energy savings, health savings, among others).
- Public trees provide $518,964 benefits and services annually equating to an annual average of $60 per tree, and $19 per capita.
- For every $1 spent on public trees, there is a $4.47 return on investment.



The Urban Forestry Program

- The urban forest is managed by the City's Forestry Division within the Public Services Department.
- City staff managing the urban forest amount to 2.00 full-time employee equivalents (FTEs) for the Urban Forestry Program though multiple divisions and sections are involved with public and private trees in the City (i.e., Park Operation, Streets Division, Planning Division, Engineering Division, and Kirkwood Electric).
- 51 percent of public trees are 12 inches in diameter or less.
- The majority (67 percent) of public trees are in good condition and 24 percent are in fair condition (2022).
- The most common maintenance need for public trees is routine pruning of large trees (67 percent) and structural pruning of young and small trees (28 percent).
- The 2022 budget compared to the public tree population is $35 per tree and there is one public tree for every three residents of Kirkwood (2022).
- Kirkwood's Urban Forest Audit Score based on U.S. Forest Service criteria is 68 percent (2022).
- Challenges and shared priorities among City staff and commission members include sustainable urban forest management, program efficiencies and resources, risk tree management, community outreach and engagement, and tree policies, regulation, and enforcement.
- The recommended long-term tree canopy cover goal is 50 percent by the year 2045 (24 years) requiring 565 trees to be planted per year on average (13,300 total trees) of which 50 percent should be City-led (283 trees per year on average). Achieving the canopy goal will add 383 acres of new canopy.
- Incremental short-term canopy goals include 44 percent by 2025 (1,978 new trees), 46 percent by 2030 (2,825 new trees), 47 percent by 2035 (2,825 new trees), 48 percent by 2040 (2,825 new trees), and 50 percent by 2045 (2,825 new trees)
- Future benefits and services forecasted for an urban forest that comprises 50 percent of the City in 24 years amounts to $303,300 annually or $12,900 added per year.
- On average a budget of $571,300 is needed annually to perform the public tree maintenance, removals, and plantings recommended in the Plan.

Community Viewpoints and Priorities

View the Community Engagement Findings section for additional information and background.

- Most respondents live in Kirkwood (94 percent).
- Primarily, respondents are older than 65 (37 percent) and own a home (91 percent) in Kirkwood.
- Most responses indicated they have maintained their own tree (87 percent), watered a tree (85 percent), or planted a tree (80 percent) at some point in their life.

- Most feel canopy cover is good but should be increased (62 percent).
- Respondents feel the number of public and private trees has decreased (65 percent) and the overall health and quality of public trees has decreased (44 percent) in the last 10 years.
- Tree plantings to increase canopy cover should be targeted or emphasized in commercial and industrial areas (17 percent), rights-of-way (17 percent), and private property (16 percent).

- New trees planted should consider placement in relation to above (59 percent) and below (45 percent) ground utilities, and reducing hardscape damage (45 percent).
- To increase tree canopy, the majority support the City exploring a tree protection ordinance for significant and heritage trees greater than 30 inches in diameter on private lots greater than one acre in size (71 percent).
- Most respondents feel the greatest benefit provided by trees includes adding natural beauty (23 percent), reducing air pollution (20 percent), and improving the quality of life and mental health (20 percent).

URBAN FOREST MASTER PLAN GOALS

The City's project team consisting of Public Services Department staff and urban forestry consultants developed a set of diverse, comprehensive goals to guide urban forestry over the next 20 years. These goals were informed by an inclusive engagement process with the staff and stakeholders undertaken throughout the planning process.

1 **TREE MANAGEMENT POLICY (MP):**
Urban forest policies are the foundation for preserving the environmental benefits, management, and the character of Kirkwood's urban forest.

2 **CAPACITY, TRAINING, AND AUTHORITY (CT):**
Kirkwood has the capacity and expertise to provide optimal levels of service for sound urban forest management.

3 **BUDGET AND FUNDING (BF):**
City resources enable comprehensive urban forest management for the preservation and enhancement of tree benefits.

4 **ASSESSMENTS AND PLANS (AP):**
A thorough understanding of the urban forest ensures data-driven decisions, sustainable and comprehensive planning, and amplified tree benefits.

5 **COMMUNITY ENGAGEMENT (CE):**
Sustainable urban forest management and equity is achieved through a partnership with the City and its residents resulting in improved well-being, human health, and local economies.

6 **GREEN ASSET MANAGEMENT (GA):**
Kirkwood proactively manages the public trees, continues to grow and expand a healthy canopy, effectively mitigates storm damage, maintains public safety, and optimizes urban forest benefits.

Goals listed above are not listed by any particular order or priority

Strategic Actions

1 **TREE MANAGEMENT POLICY (MP):**
Strategic actions for collaboration, strengthening of policies, sustaining canopy, achieving planting targets, and stewardship of the resource.

2 **CAPACITY, TRAINING, AND AUTHORITY (CT):**
Strategic actions for collaboration, planning, training, certification, and optimal service levels.

3 **BUDGET AND FUNDING (BF):**
Strategic actions for sustained funding to manage the urban forest, strengthen programs that manage it, and adjust to reflect changes.

4 **ASSESSMENTS AND PLANS (AP):**
Strategic actions to assess and effectively plan the current and future urban forest.

5 **COMMUNITY ENGAGEMENT (CE):**
Strategic actions for community outreach, engagement, partnerships, and recognition.

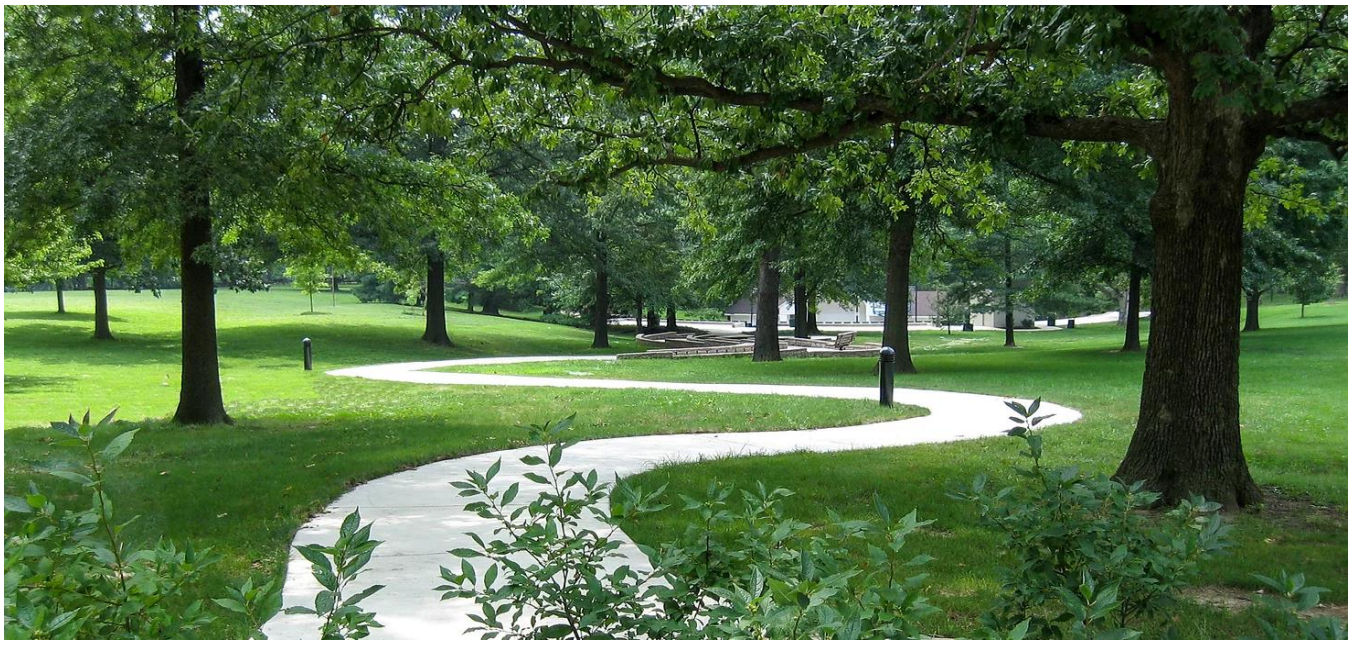
6 **GREEN ASSET MANAGEMENT (GA):**
Strategic actions for urban forest maintenance, removals, achieving canopy goals, managing risk, and growing a sustainable urban forest.

Call to Action

Urban forests are an important green infrastructure asset for communities across Missouri. However, the capacity of urban forests to support healthy and resilient cities is constrained and challenged by stressors such as climate change impacts including extreme weather events, urban development pressures, altered soils, exotic tree pests and diseases, and invasive species. Now more than ever there is a critical need to sustain large, healthy, genetically appropriate trees on public and private land through long-term planning and budgeting, inclusive decision-making, and strategic policy development that supports adaptive management. Thus, comprehensive urban forest support must extend well beyond tree planting initiatives.

Management of urban forests is often considered the sole responsibility of municipal governments. In reality, responsibility should also be shared by private residents, community groups, and other partners. All of these groups have important roles to play. Successful management frameworks must recognize that the urban forest is part of a complex system that includes the built environment and is influenced by human activities and policies and practices that shape Kirkwood's urban areas. Furthermore, decision-making must be made in the context of future uncertainty associated with climate change. Kirkwood's Urban Forest Master Plan provides the framework and road map for efficient, sustainable, and equitable urban forestry practices.

This coordinated planning effort— led by the City's Public Services Department, stakeholders, and consultants— included an updated inventory of public trees to inform management, tree maintenance and removal priorities, tree replacement strategies, and policies and procedures for tree preservation. This Plan leverages existing strengths to address current and future challenges and opportunities. A primary strength identified in the planning process is the collaboration and cooperation among City departments and partners. Implementing the Urban Forest Master Plan will require a shared commitment— a difficult requirement the City has already achieved through cooperative plan designs, project monitoring, utility tree management, outreach, tree care, planting, among other vital services.



The action agenda within this Plan outlines the steps over the next 20 years the City of Kirkwood and community partners will take to grow and care for a sustainable and equitable urban forest. The actions were informed by the inclusive engagement process involving key staff and stakeholders. Departmental workplans will provide additional details on those aspects of the urban forest that each department can manage. For example, the Public Services Department manages trees along the streets in the rights-of-way while Kirkwood Electric has primary responsibility for the maintenance of trees within proximity to service lines.

City departments will continue to support urban forestry efforts with available funding. Even though some of the action items below could help expedite the recovery of the most vulnerable communities, the urban forestry planning team is aware of the challenging times ahead. As economic recovery takes place and additional funding becomes available, the urban forestry team recommends that new funding be prioritized toward the following efforts:

1. Strategically planting trees throughout Kirkwood and complying with the City's tree-related policies.
2. Ongoing funding for tree and natural area crews to maintain the urban forest.
3. Continuing to perform urban forest assessments to inform management.
4. Developing plans and strategies to manage the urban forest on City of Kirkwood natural landscapes and properties.
5. Leverage existing planning efforts to achieve common goals.
6. Removing invasive plants from Kirkwood's forested areas.
7. Coordinating departmental work and collaborating on citywide urban forestry efforts.
8. Creating a citywide urban forestry communication strategy that will identify better ways to share information with all neighborhoods and demographics about volunteer opportunities, tree care information, regulations, incentives, and managing risks.
9. Updating initiatives and regulations in support of Kirkwood's urban forest.

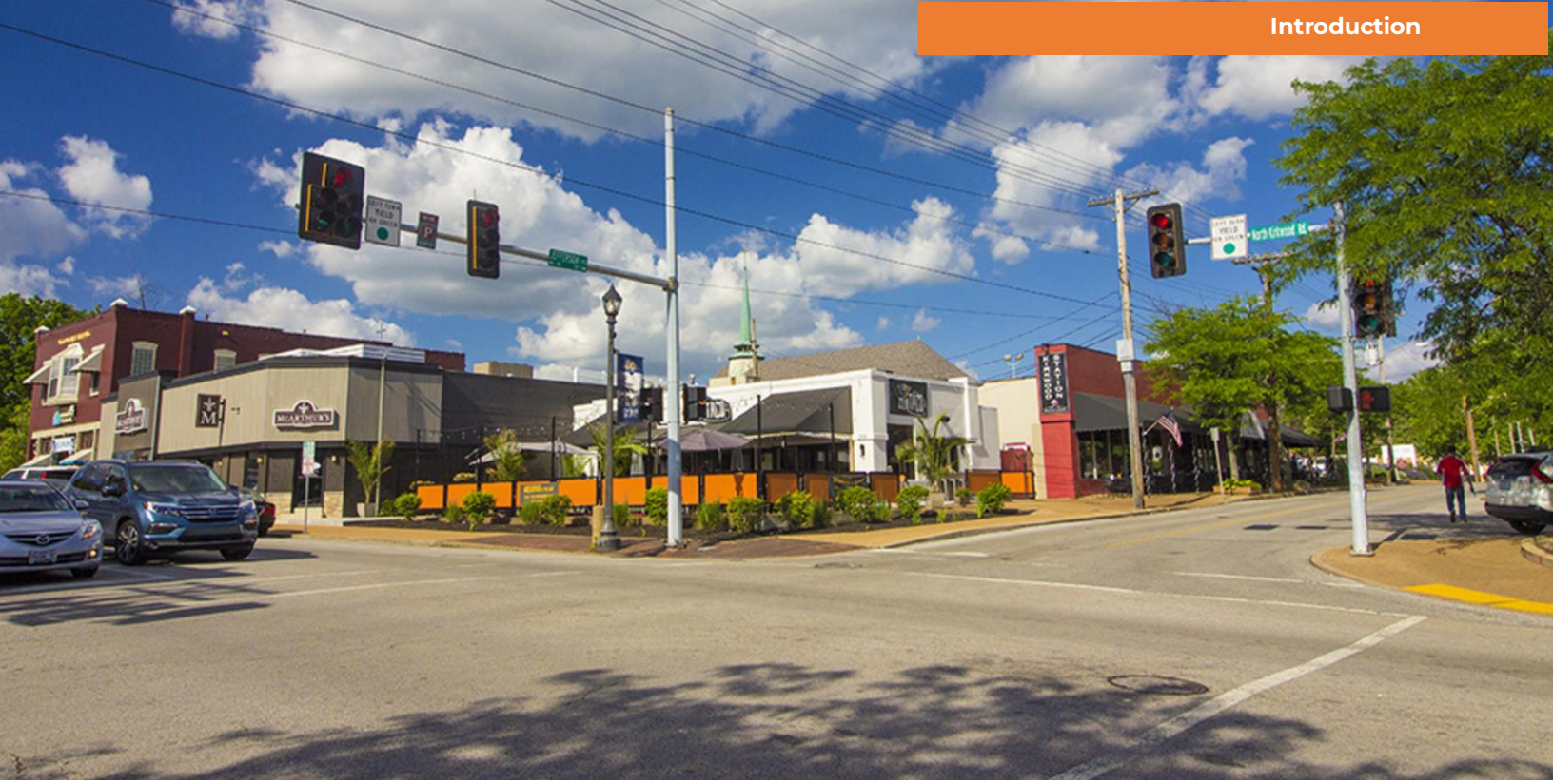
> "Urban trees and forests are considered integral to the sustainability of cities as a whole. Yet, sustainable urban forests are not born, they are made. They do not arise at random, but result from a community wide commitment to their creation and management."
>
> CLARK et al., 1997, *A Model of Urban Forest Sustainability*

From this shared commitment between the City and its residents, the vision and goals for Kirkwood's urban forest can be achieved. Reaching and sustaining the urban forest vision will require ongoing monitoring, analysis, and reporting of this Plan to keep urban forest partners involved and focused on accomplishing the actions. The Urban Forest Master Plan should be a living document that is updated as changes occur to the resource and other planning efforts. As the Plan is updated, it should continue to serve as a road map with strategic priorities and recommended actions to assist the City and stakeholders in their efforts to grow, protect, and sustain a healthy urban forest for all residents and future generations.

2022 Urban Forest Master Plan

AUGUST 2022

EXECUTIVE SUMMARY



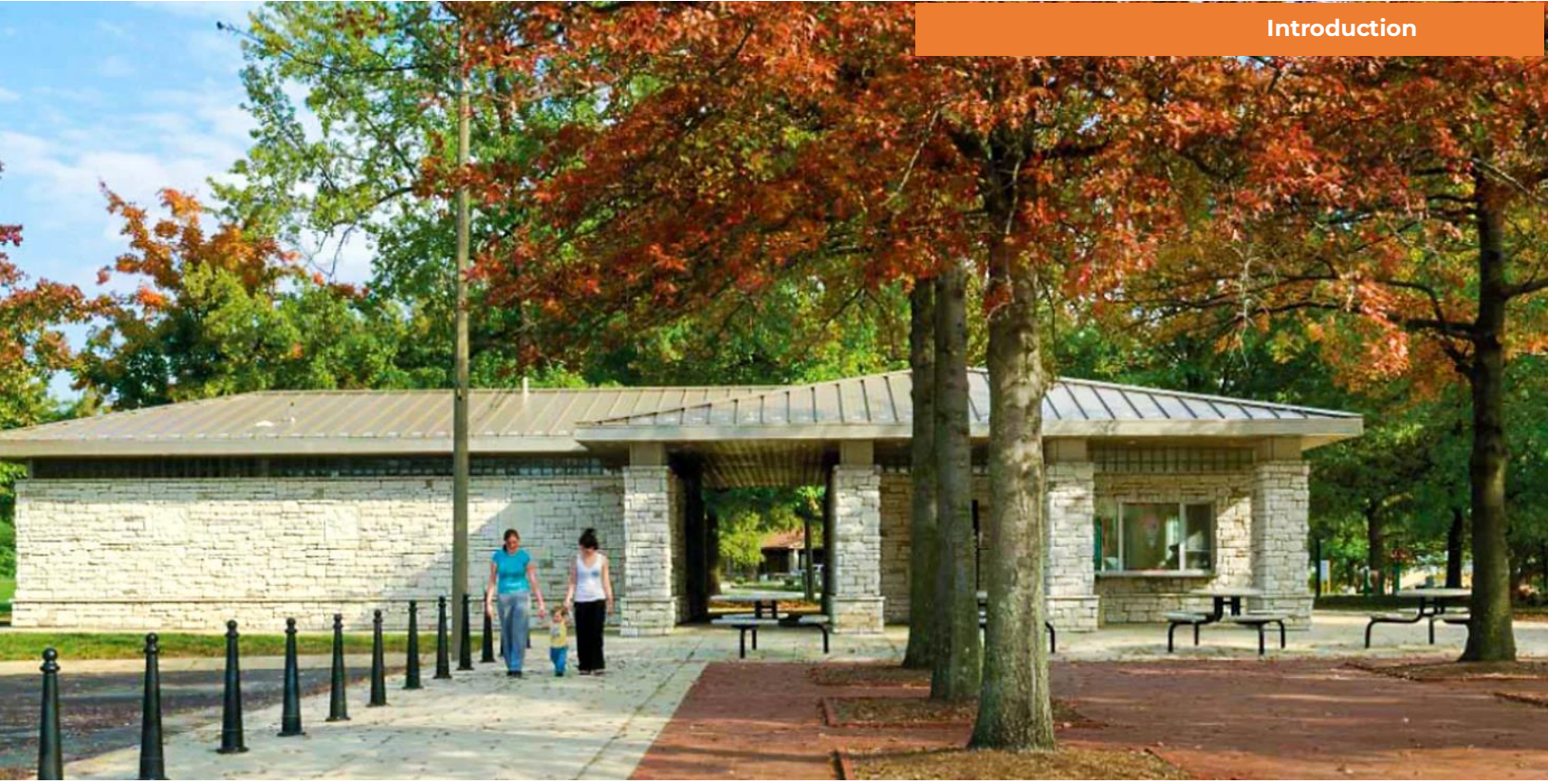
INTRODUCTION

Plan Purpose

Many city planning and management actions, especially those that occur during redevelopment, have a large impact on the character and condition of the urban forest. A thriving and well-maintained public tree population provides a wide variety of benefits to the community. A healthy urban forest contributes to the economic vitality of Kirkwood, provides environmental stability, and provides a better quality of life. Care for the natural environment by the City, contractors, residents, and volunteers is necessary to maintain and enhance the quality and benefits of the urban forest to which all residents are entitled.

To help ensure the urban forest will continue to prosper, the City has developed this long-term Urban Forest Master Plan ("Plan", "UFMP") to account for the needs of trees in the urban environment. In order to develop and maintain desired urban forest resource and program conditions, necessary management actions need to be executed in a timely manner. This Plan provides actions for management to maximize the benefits of the urban forest within the confines of available resources. This approach is implemented to successfully:

- Establish a baseline assessment of the urban forest resource, resources for management, and the community engagement framework.
- Provide analyses of urban forest management criteria to assist the Forestry Division in achieving greater levels of service.
- Provide the criteria for achieving goals of sustainable urban forest management in a phased approach based on available resources.
- Provide data-driven strategies and solutions to address shared priorities in the community.
- Provide the framework and guidance for regulating tree maintenance, protection, and tree planting that will support the City's tree ordinance.
- Be a living document by providing the framework and guidance for adaptive management.

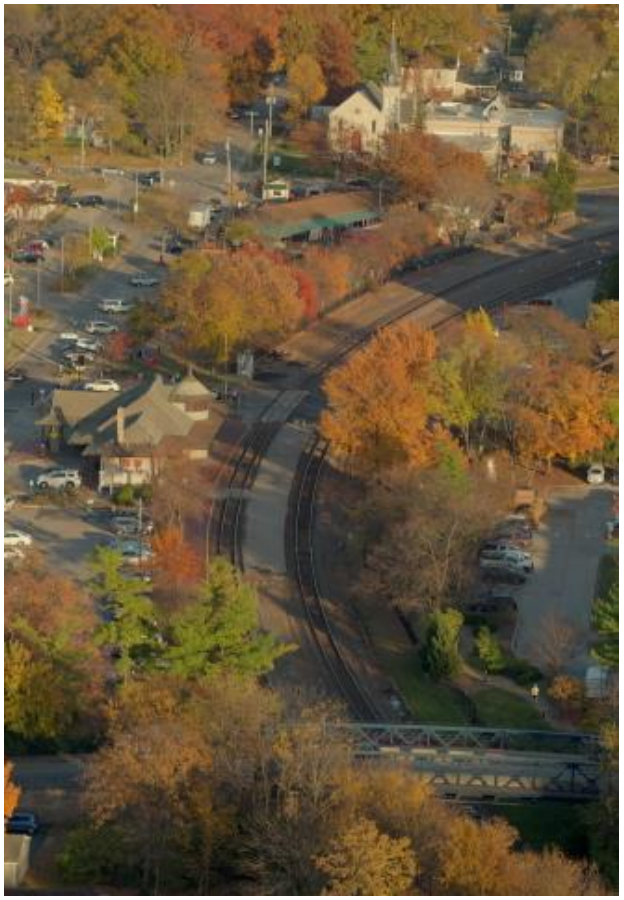


The Guiding Principles of the Urban Forest Master Plan

The Urban Forest Master Plan will adhere to the following guiding principles:

- Recognize that the trees of the urban forest are more than aesthetic enhancements.
- Recognize trees as the backbone of the urban ecosystem and an essential part of the community's green infrastructure.
- Promote urban forest health and growth by following scientifically established best management practices for tree selection, planting, watering, and pruning.
- Promote a robust urban forest through policies and practices that reduce its vulnerability to known diseases or pest infestations, and future threats, including the anticipated effects of climate change.
- Engage in a continuous process of long-range planning for the growth and maintenance of the urban forest.
- Promote appreciation of the urban forest through educational outreach programs.
- Support local businesses, institutions, organizations, and individuals in their efforts to grow and maintain the urban forest through community education.
- Proceed in a manner that is inclusive and transparent.

Background



Kirkwood is located in St. Louis County, approximately 14 miles west of the City of St. Louis. The City covers approximately nine square miles and is bounded by interstate highways that provide excellent access to all parts of the St. Louis metropolitan area. Kirkwood was the first planned suburban residential area west of the Mississippi River. The City was established in 1853, incorporated in 1865, re-incorporated as a fourth class city in 1899, and as a third class city in 1930. In 1984, the City became a home rule city as permitted under a 1971 amendment to the Missouri Constitution. Known as "The Green Tree City," the City is an attractive suburban residential community with tree-lined streets, a vibrant downtown shopping district, and a highly rated public school system. The City has a diverse economic base, which includes several large retailers, limited industries, and many small specialty shops.

The trees throughout Kirkwood are an asset that bring value and benefits to the community. The City, with the implementation of this Urban Forest Master Plan, recognizes this asset and is working to ensure it continues bringing value and benefits to its residents for generations to come. The urban forest provides environmental benefits, adds to property values, and contributes to an enhanced quality of life for all of Kirkwood's residents, and implementation of this Urban Forest Master Plan is a tremendous opportunity to reinforce the City's dedication to preserving this important asset.

As is the case in cities around the world, the trees that make up Kirkwood's urban forest suffer from the difficulty of growing in harsh urban environments. Stressors such as pests and diseases, the current changing climate, air and water pollution, compacted soils, limited growing spaces, development, and limited resources are all factors to consider when planning for the healthy growth of an urban forest. To overcome such rigorous conditions for the City's trees and reap the benefits of these valuable assets, the care of the urban forest must be strategically and efficiently planned and cared for.

This Urban Forest Master Plan aims to obtain adequate tree management levels and garner support through staffing, funding, the community, and policy. Adequate tree management includes efficient and effective tree care, bolstered tree plantings to maintain age and species diversity in the public tree population, the equitable preservation and enhancement of canopy coverage citywide to enhance the character and aesthetics of neighborhoods, and exemplary stewardship of the forest from all who live and work in Kirkwood. The Urban Forest Master Plan must be regarded as both a long-range policy guide and a living document that will respond to changing conditions over its life. It requires a close partnership between policy makers, staff, and the community. Adoption of this Urban Forest Master Plan enables the City to accomplish these objectives.

Defining the Urban Forest

> "Urban forestry can be defined as the art, science, and technology of managing trees and forest resources in and around community ecosystems for the physiological, sociological, economic, and aesthetic benefits trees provide to society."
>
> Helms, 1998

Any inhabited area that has trees and vegetation is considered a community forest, though more urbanized communities often refer to this resource as an urban forest. Based on Kirkwood's population density, tree population, and the public interaction with and received benefits from trees, Kirkwood's resource is referred interchangeably as an urban and community forest in this Plan. The Urban Forest Master Plan focuses on the City-owned trees in public rights-of-way and parks and the structure of contracted tree maintenance and removals. The Plan also has implications for the trees on private property and attention to these are addressed through ordinance updates and community outreach and education strategies.

The concept of urban and community forest management developed in the 1960s out of the death and devastation of the elm tree population throughout the United States due to Dutch Elm disease. The discipline of urban forestry strongly advocates for species and age diversity in a city's tree population so that the elm tree devastation of the 1960s does not happen again. Unfortunately, native and invasive pests and diseases continue to spread.

During the last four decades, urban forestry has evolved as researchers and practitioners learn more about the structure and function of trees and their unique role in providing environmental, economic, and social benefits to urban areas. Urban forestry provides each of these benefits in differing circumstances—as infrastructure, as part of design and development, and as efficient and productive providers of economic development.

Residents traditionally have indicated that they consider the trees in the community a priority. In urban environments, street and park trees are sometimes the only day-to-day interaction with nature that many residents may enjoy. As Kirkwood continues to grow and change, the urban forest needs a strong advocate. This will happen with the education and support of the City's constituency, staff, and elected officials via an approved urban forest master plan. The urban forest is unique in the array of benefits it provides to the community, and a plan will effectively collect and showcase these values.

While a plan is useful in helping educate and ensure future viability, it also will set up useful parameters for the daily operations and care of the urban forest. A fresh look at all urban forestry-related policies currently in place brings into focus what is necessary for day-to-day activities to ensure long-term viability and safety of the urban forest.

Benefits of the Urban Forest

The quality of life of the members in any community depends on the urban forest, as trees make a vital and affordable contribution to the sense of community, pedestrian-friendly neighborhoods, energy savings, and air quality. Kirkwood's Public Services Department is critical to meeting the City's commitment to climate change mitigation and adaptation, carbon sequestration, stormwater reduction, wildlife habitat enhancement, and water conservation. Trees are one of the few infrastructure investments that, if properly maintained, will grow in value over time.

BENEFITS AND SERVICES PROVIDED BY KIRKWOOD'S URBAN FOREST

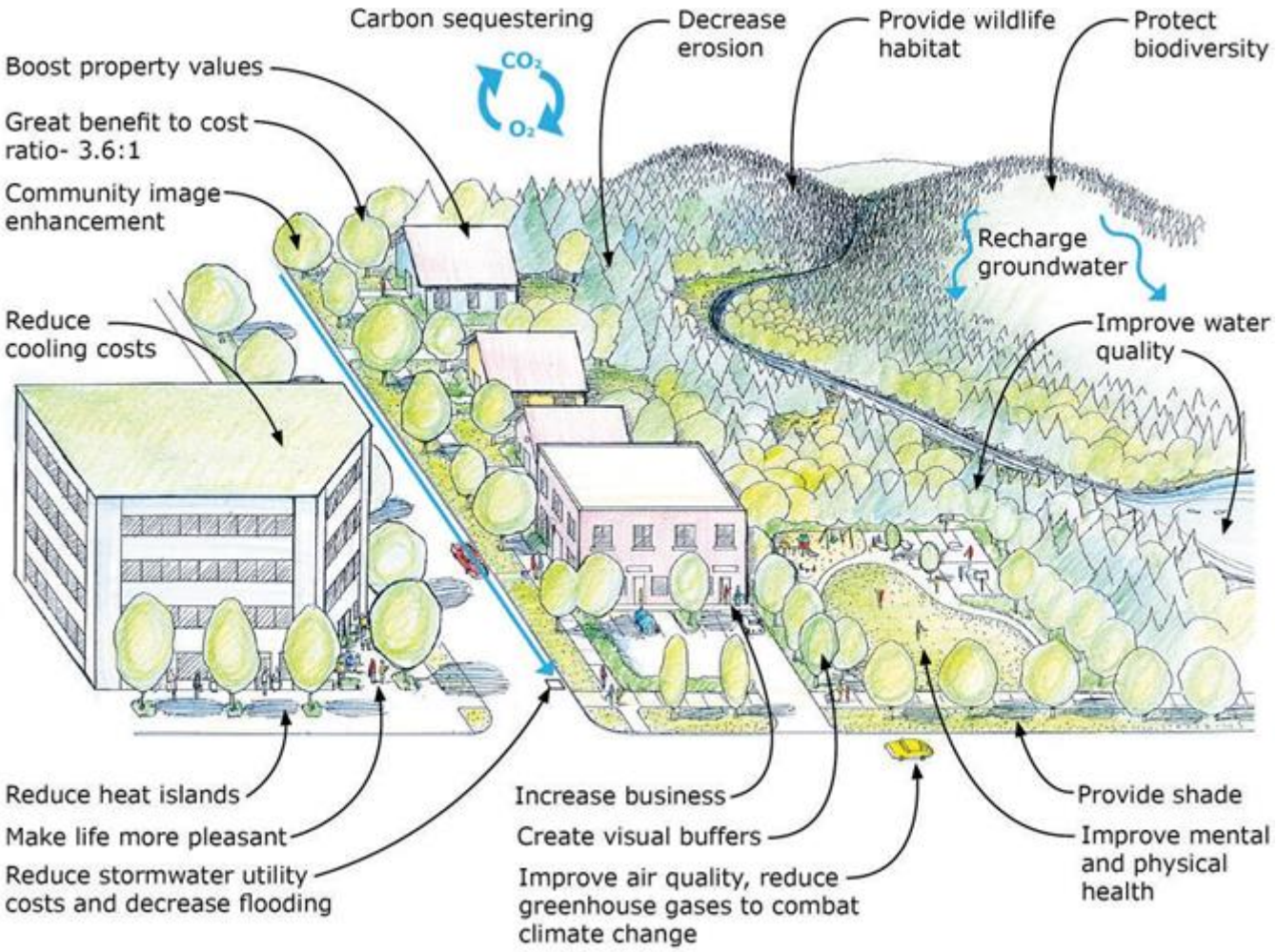


Figure 1. Overview of the ecosystem benefits and services provided by trees in communities

Note: The following data was derived from the Alliance for Community Trees.

Reduce Stress and Improve the Quality of Life

Neighborhoods with generous canopies of trees are good for public health. Greater contact with natural environments correlates with lower levels of stress, improving performance. Students' concentration levels go up when they are able to look out onto a green landscape. Studies show that children with attention deficit disorder function better after activities in green settings. A green environment impacts worker productivity. Workers without views of nature from their desks claimed 23 percent more sick days than workers with views of nature. Residents of areas with the highest levels of greenery were 3 times as likely to be physically active and 40 percent less likely to be overweight than residents living in the least green settings.

Clean the Air and Breathe Easier

Shade trees reduce pollution and return oxygen to the atmosphere. In addition to carbon dioxide, trees' leaves or needles absorb pollutants, such as ozone, nitrogen dioxide, sulfur dioxide, and some particulate matter.

Save Energy and Lower Energy Costs for Buildings

As natural screens, trees can insulate homes and businesses from extreme temperatures, keep properties cool, and reduce air conditioning utility bills. A 20 percent canopy of deciduous trees over a house results in annual cooling savings of 8 to 18 percent and annual heating savings of 2 to 8 percent. By planting shade trees on sunny exposures, residents and businesses can save up to 50 percent on hot-day energy bills.

Positively Influence Climate to Ensure Sustainability

Trees absorb carbon dioxide and store carbon in wood, which helps to reduce greenhouse gases. Carbon emissions from vehicles, industries, and power plants are a primary contributor to increased air temperatures in metropolitan areas. Trees in the United States store 700 million tons of carbon valued at $14 billion with an annual carbon sequestration rate of 22.8 million tons per year valued at $460 million annually.

Reduce the Need for Street Maintenance

Shaded streets last longer and require far less pavement maintenance, reducing long- term costs. Canopy diminishes pavement fatigue, cracking, rutting, and other damage. A study from University of California at Davis found that 20 percent shade cover on a street improves pavement condition by 11 percent, which is a 60 percent savings for resurfacing over 30 years.

Raise Property Values

Trees are sound investments, for businesses and residents alike, and their value increases as they grow. Sustainable landscapes can increase property values up to 37 percent. The value of trees appreciates over time, because the benefits grow as they do. For businesses, trees have added value, including higher revenues. Shoppers seek out leafy promenades that frame storefronts. Research shows that shoppers spend more—between 9 and 12 percent more—on products in tree-lined business districts.

Conserve Water and Soil

A tree's fibrous roots, extending into the soil, are premier pollution filtration and soil erosion prevention systems. Intensely urbanized areas are covered with a large number of impermeable surfaces. In contrast to an impervious hardscape, a healthy urban forest can reduce annual stormwater runoff up to 7 percent. Highly efficient trees also utilize or absorb toxic substances such as lead, zinc, copper, and biological contaminants. One study estimated that eliminating the need for additional local stormwater filtration systems would result in savings exceeding $2 billion.

Cooler Pavement Diminishes Urban Heat Islands

Broad canopy trees lower temperatures by shading buildings, asphalt, and concrete. They deflect radiation from the sun and release moisture into the air. The urban heat island effect is the resulting higher temperature of areas dominated by buildings, roads, and sidewalks. Cities are often 5° to 10°F hotter than undeveloped areas, because hot pavement and buildings have replaced cool vegetated land. In addition, high temperatures increase the volatility of automobile oil and oil within the asphalt itself, releasing the fumes into the atmosphere. Shade trees can reduce asphalt temperatures by as much as 36°F, which diminishes the fumes and improves air quality.

Protect Wildlife and Restore Ecosystems

Planting and protecting trees can provide habitat for hundreds of birds and small animals. Urbanization and the destruction of valuable ecosystems have led to the decline of many of species. Adding trees, particularly native trees, provides valuable habitat for wildlife.

Build Safe Communities and Decrease Crime

Police and crime prevention experts agree that trees and landscaping cut the incidence of theft, vandalism, and violence by enhancing campus neighborhoods. Thriving trees on well-maintained streets indicate pride of ownership. Public housing residents with nearby trees and natural landscapes reported 25 percent fewer acts of domestic aggression and violence. Apartment buildings with high levels of greenery had 52 percent fewer crimes than those without any trees. Buildings with medium amounts of greenery had 42 percent fewer crimes.

Calm Traffic and Make Neighborhoods Safer and Quieter

People drive more slowly and carefully through tree-lined streets, because trees create the illusion of narrower streets. One study found a 46 percent decrease in crash rates across urban arterial and highway sites after landscape improvements were installed. The presence of trees in a suburban landscape reduced the cruising speed of drivers by an average of 3 miles per hour. Faster drivers and slower drivers both drove at decreased speeds in the presence of trees. Trees reduce noise pollution, buffering as much as half of urban noise. By absorbing sounds, a belt of trees 100 feet wide and 50 feet tall can reduce highway noise by 6 to 10 decibels. Buffers composed of trees and shrubs can reduce 50 percent of noise.

Key Issues Facing Urban Forests

The City of Kirkwood has a unique urban form and character. Its size, layout, and development density influence the landscape and has created a charming and livable city. Kirkwood's community members show pride in their city, and their neighborhoods are well cared for. The City's climate is ideal for a wide range of plants and street trees and many of the City's streets and landscapes exhibit a unique and rich planting character. Some of the City's historic neighborhoods and its newest developments have a rich urban forest that illustrates Kirkwood's potential to be an even greater tree-filled city guided by a strategic plan.

Image Description 1. Downed trees resulting from a storm in July 2021 (Source: Fox 2 Now)

Cities around the world, and specifically in the St. Louis region face dramatically intensifying extreme weather and climate impacts including drought, frequent storms, flooding, and an increase in sustained high temperatures. In many instances, these impacts are already exceeding the designed capacity of city infrastructure to protect the health and safety of residents, businesses, and neighborhoods, which in turn threatens the fiscal viability of cities and regions. Urban trees can play a significant role in making cities resilient to weather and climate extremes, and in protecting human and ecosystem health and safety. To do so, trees must be consciously selected, planted and managed as the central component of an urban forest where individual trees are managed as part of a greater system with the purpose of improving the urban environment and enhancing benefits.

Yet the ability of urban trees and urban forests to achieve desired benefits is often drastically limited due to poor maintenance and management stemming from insufficient municipal budgets, lacking urban forest management systems and programs, limited training of tree care professionals, and a lack of enforcement of tree-management best practices to support tree health. Consequently, long-term tree health is compromised in many cities, resulting in limiting the beneficial functions of trees, leaving trees more susceptible to pests and disease, and leading to premature tree death. The impact of this is compounded for disadvantaged communities. As stated by Jad Daley, president and CEO of American Forests, "The single greatest threat from climate change to people in cities is extreme heat."

In turn, urban trees face multiple challenges to surviving and thriving. Trees that die years prematurely will not create the root systems and canopies needed to reach their benefit potential and maximize their return on investment. These challenges are exacerbated in disadvantaged areas of communities with limited resources. Planting and maintaining an urban forest that exists in concert with other green infrastructure must include management by trained individuals, the use of tree inventory data, an understanding of baseline conditions and forecasted environmental changes, collaboration among

departments to mainstream urban forest management, a community with a shared vision for the urban forest, and a roadmap for management provided in a plan.

The City of Kirkwood needs a comprehensive plan to preserve and expand the urban forest which results in an equitable distribution of tree canopy, associated benefits, and urban forestry opportunities. The City, its partners, and the community support a plan for the urban forest that sustains the resource and provides benefits to all who live, work, and recreate in the City.

Kirkwood's Urban Forest Master Plan offers the City an opportunity to study, evaluate, and plan for improving urban forest management toward the goal of supporting human and ecosystem health and well-being. The urgency of protecting the urban forest has risen sharply as drought, pests, disease, climate impacts and budget cuts lead to rapidly rising tree mortality. To address and reverse tree die-off and the loss of ecosystem benefits, Kirkwood needs a robust system of professional management and public access to support resident engagement in care and expansion of the urban forest.

When making improvements to the urban forest, efforts should be prioritized to improve environmental justice, equity, access, and levels of service for underserved and vulnerable areas. These considerations may include additional tree plantings for an equitable distribution of urban forest cover and benefits, intensive tree management, diverse outreach approaches, and unique stewardship programs.

Kirkwood's Urban Forest Master Plan is a crucial planning effort to build a more sustainable resource, a healthy community, and progression towards carbon neutrality. Tree planting is one of the few tangible actions the City can directly take to address non-source specific pollution in Kirkwood and this master plan supports strategic planning for continued plantings resulting in long-lasting benefits.

This strategic plan for Kirkwood's urban forest strengthens City code, policies, ordinances, standards, practices, and procedures; analyzes staffing structures and authority; identifies opportunities for sustained and diversified funding; provides guidance for routine and systematic inventories and assessments; identifies tree maintenance efficiencies and planting priorities; addresses risk management needs; strengthens community outreach, education, and engagement; among other core urban forest management elements.

Image Description 2. Keep Kirkwood Green's 50 Trees Program (left) and tree planting (right)

Kirkwood's Urban Forestry Background

Established in 1853, Kirkwood was one of four early commuter railroad suburbs in the St. Louis region. The story of trains is intertwined with the history of Kirkwood. Kirkwood owes its very existence to the railroad. The City was named for James Pugh Kirkwood, the engineer in charge of locating, surveying, and building the railroad. In the heart of the City, the beautiful and historic Kirkwood Train Station was built in 1893 and is now on the National Register of Historic Places.

Image Description 3. Mudd's Grove circa 1930's (Source: Library of Congress)

Image Description 4. Kirkwood City Hall (Source: About St. Louis)

Kirkwood is now home to 27,540 people and boasts high property values, quality public and private schools, safe neighborhoods, and exceptional City services. The City has an extensive parks system comprising more than 300 acres of park land. It is the responsibility of the City's Public Services Department to manage nearly 9,000 trees within these parks as well as trees along street and other public properties within the City. Kirkwood's Public Services Department, Division of Forestry, also oversees tree ordinance enforcement, tree preservation and planting on development projects, contracted street tree maintenance and removals, and permitting relating to new tree planting and street tree maintenance.

Kirkwood has been recognized as a Tree City USA community for 31 years (2021). Kirkwood has shown a dedication to maintaining and caring for their urban forest through their planting efforts and the care of their trees.

Image Description 5. Tree City USA tree planting in 2019 at City Hall (Source: City of Kirkwood)

In 2018 the City became proactive in tree maintenance operations and designed a plan to have all city trees pruned for health, safety, and integrity on an eight-year cycle to reduce public tree issues during inclement weather events as well as improve the health of thousands of trees. Also, Kirkwood is the only municipality in the Greater St. Louis area that owns and operates its own electric utility. One core responsibility of this department is utility vegetation management.

Management Planning Process

Planning Approach

The purpose of the Urban Forest Master Plan is to answer the fundamental components of adaptive management: what do we have, what do we want, how do we get what we want, and how are we doing. Developing the Plan required input from City staff, stakeholders, data sources, thoughtful analysis, a coordinated vision, and time.

What do we have? The first step of the process is to complete a baseline assessment of the urban forest, the resources to manage it, and the people that influence and benefit from it. The six planning elements completed as part of the needs assessment provide the foundation for setting goals and measuring progress.

What do we want? The Plan is shaped by knowing what the urban forest needs, what the staff require to manage it, and what the community wants. This was informed by City staff interviews, a public survey, and the development of the goal and action framework.

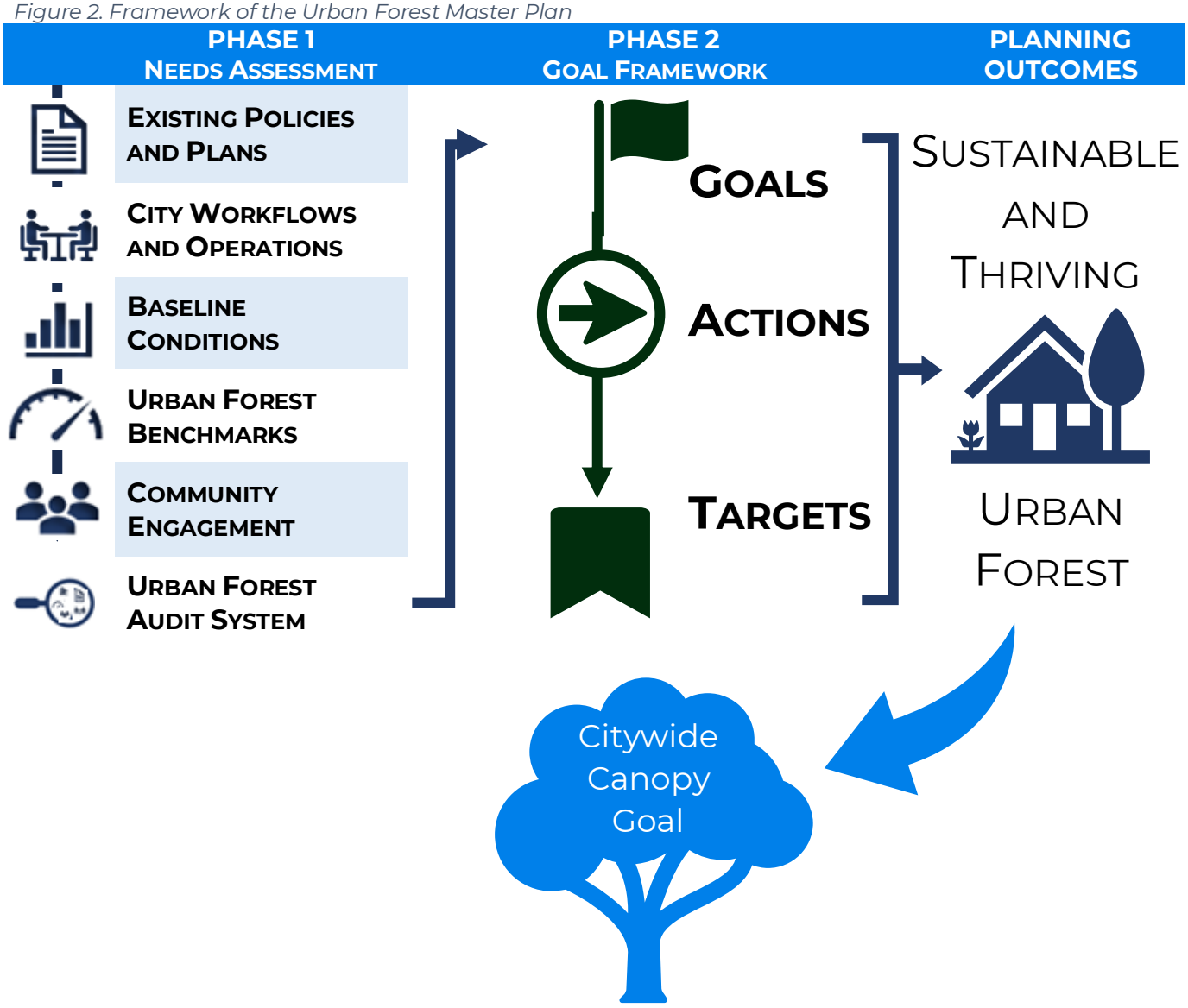
How do we get what we want? The goal, action, and target framework lay out the road map to achieve a shared vision that supports the needs of all members of the community.

How are we doing? The City needs to continually monitor progress towards the vision and goals. The Urban Forest Master Plan includes guidance for implementing actions and the responsible department(s) or stakeholder(s) to lead the effort. The planning approach for this Plan provides the framework for continual monitoring and evaluation of efforts using the U.S. Forest Service's Urban Forest Audit System. Updates to this audit will inform any necessary changes to strategies and actions in an adaptive management approach.

Understanding the Urban Forest Challenges and Opportunities

The iterative planning process built on work accomplished during previous meetings and planning elements and was augmented by extensive research. This systematic evaluation of the City of Kirkwood's urban forest management processes, resources, staffing, structure, and policies was conducted by completing the six planning elements as part of the needs assessment: 1) Existing Policies and Plans, 2) City Workflows and Operations, 3) Baseline Conditions, 4) Urban Forest Benchmarks, 5) Community Engagement, and 6) Urban Forest Audit System. The City's project team evaluated the outcomes and findings of these planning elements and the urban forestry consultants revised these based on feedback to provide a comprehensive analysis that informs the baseline assessment and recommendations for the Urban Forest Master Plan. The following diagram summarizes the process, and the findings are detailed in the "What Do We Have and What Do We Want?" section.

Figure 2. Framework of the Urban Forest Master Plan



Primary Framework of the Urban Forest Master Plan

Understanding the benefits and functions of the urban forest, the City has developed this Urban Forest Master Plan.

> "Without a plan, the governments and individuals responsible for taking care of an urban forest will not be effective in meeting the true needs of the trees and the community. A plan establishes a clear set of priorities and objectives related to the goal of maintaining a productive and beneficial community forest."
>
> American Public Works Association, 2007

The optimal approach to managing an urban forest is to develop an organized, proactive program using information to set goals and measure progress. This information can be utilized to establish priorities, plan strategically, draft cost-effective budgets, and ultimately minimize the need for costly, reactive solutions to crises or urgent risk mitigation. Based on the results of the needs assessment, incremental steps to achieve these improvements were developed that can be applied as the City continues to progress.

The goals of the Urban Forest Master Plan focus on preserving, maintaining, and enhancing the urban forest to ultimately benefit the residents of Kirkwood. The framework for this Plan supports the urban forestry vision:

Vision

Kirkwood will prioritize the health of its current and future urban forest to support a healthy, sustainable, and resilient community.

Goals

Goals supporting the urban forest vision are provided based on strengths and opportunities identified during the needs assessment. Each goal is supported by actions and targets the City and partners will use to attain the goal. An overarching goal to increase canopy for long-term benefits, equity, and sustainability was developed to guide management goals.

Actions

Actions are Specific, Measurable, Achievable, Relevant, and Time-bound to be implemented to acquire the goals of each planning theme. These actions include recommended timeframes or "target year(s)" beginning upon plan adoption and the lead department or partner(s) for implementation. Each action is rated based on the priority, level of effort and/or resources required, and the efficacy of the action.

Targets

Targets are performance standards and measurable values of specific indicators that enable monitoring of the actions to determine attainment of the actions and goals.

Figure 3. Goal and action framework for Kirkwood's Urban Forest Master Plan

Evaluation

Using the Urban Forest Audit System— described in the needs assessment— and the Plan targets, implementation progress and success can be evaluated and annually reported. The evaluation using the audit provides the information necessary for adaptive management.

Co-benefits of Plan Implementation

Each action is accompanied by a graphic depiction of co-benefits, illustrating added value that comes with achieving that action and respective goal. For example, a neighborhood with dense tree canopied streets and landscape may have cooler summer temperatures that lead to fewer heat illnesses reported. Each action impacts four different co-benefits at various levels; the greatest relative level of impact is indicated by the presence of one or more of the following symbols or abbreviations in the Plan's action tables:

- ***Community ("C")*** – actions that engage the public.
- ***Equity ("E")*** – opportunities to satisfy essential needs and achieve full potential.
- ***Human Health ("H")*** – provides physical benefits to local residents.
- ***Natural Environment ("N")*** – benefits of air quality, water quality, and habitat.

What Do We Have and What Do We Want?

Existing Policies and Plans Findings

The purpose of this element is to gauge the City's commitment and readiness for urban forest sustainability. Measuring alignment of existing policies and plans ensures a strong connection among the programs that manage the urban forest and the projects and initiatives that support them. Proper alignment of urban forestry program recommendations reduces the risk of wasting resources and enables success of key projects that support urban forestry goals. Plans cannot live in isolation, therefore, cross-examining various plans and documents brings to light any projects or initiatives that are a misplacement of resources and time.

Several documents and resources were reviewed and indexed as part of the information discovery process. These documents included:

Primary Documents and Resources

- **EnVision Kirkwood 2035 – City of Kirkwood Comprehensive Plan (2017):** This plan represents the collective vision for the future of Kirkwood that was provided through engagement efforts during the EnVision Kirkwood 2035 planning process and is designed to be used as a guide in decision making with respect to not only the future growth and development of Kirkwood, but the everyday decisions that preserve Kirkwood's unique sense of place.

- **City of Kirkwood Tree Manual:** Provides the technical information necessary to perform work on trees regulated in the Tree Code of the City of Kirkwood, Missouri. The manual contains sections for tree pruning, tree protection, tree planting, and prohibited plant species. Sections in the manual can be modified by the Urban Forester as the urban forest changes, industry standards are updated, and/or invasive pests or species pose a threat to the established management practices.

- **Tree Inventory Summary Report (2017):** A multi-phase comprehensive GPS tree inventory of street trees within Kirkwood's city limits spanning multiple years began in 2014. The 2017 report summarized 9,982 trees by ranking size, condition, and species frequency. A separate analysis was completed for Kirkwood's ash tree population to help understand what the effects of the invasive Emerald Ash Borer (EAB) will entail.

- **2021 – 2022 Fiscal Year Operating Budget:** The City of Kirkwood Charter stipulates that the Chief Administrative Officer develop a description of the significant changes and highlights of the budget and program priorities and submit them to City Council with the proposed fiscal year budget. The City's budget, a carefully constructed plan for the operation of the City, is developed by the City's department heads and the finance and administration management team. It is a balanced and workable outline for the expenditure of funds to continue the services that provide for the public safety, welfare, and quality of life of all the community members of Kirkwood.

- **Park and Recreation Master Plan (2005):** Provides the City of Kirkwood a valuable aid in continuing efforts to meet recreation needs and exceed the goals set by the Parks and Recreation Department and the community members of Kirkwood. The Master Plan addresses data collection, plan analysis, master plan, and implementation strategies. The plan illustrates several design concepts for mini, neighborhood, district, and metropolitan parks and open space/greenway linkages throughout the community. These illustrations present the vision of the plan and the quality of planning and design that will be required to meet the expectations of the community.

- **City of Kirkwood Strategic Plan (2017):** A five-year strategic plan based around the goals of enhancing the quality of life of citizens, improving governance and strengthening relations between citizens and their government, strategically growing economic activity to support quality of life., nurturing downtown Kirkwood as the heart of the community, and investing for the future through public infrastructure.
- **Kirkwood Street Tree Guide (2012):** The intention of this guide is to provide urban planners, architects, landscape architects, public works managers, utility managers, and Kirkwood residents with a list of trees appropriate for street tree application, tailored to the Kirkwood environment. In turn Kirkwood citizens and staff are equipped with state-of-the-art tree recommendations as the community continues to enhance Kirkwood's urban forest.
- **Chapter 24 Trees (Street Tree Ordinance):** The purpose of this section within Kirkwood Municipal Code is to promote and protect the preservation, safety, and general welfare of the City's interests by providing for the regulation of the planting, protection, maintenance, survival, and removal of the trees within the City of Kirkwood. All City parks and park-maintained spaces are exempt from this chapter.
- **Chapter 25 Zoning and Subdivision Code, Article VIII Landscaping and Buffering Standards:** The purpose of this section is to promote and protect the public health, safety, convenience, and general welfare of the people of Kirkwood through the establishment of minimum regulations governing the subdivision, development, and use of land, buildings, and structures. Article VIII contains requirements for the landscaping plan, tree preservation plan, planting, landscaping standards, among others applicable to urban forest management.

A total of 15 unique resources were reviewed during the research deep dive to inform the Plan. From these resources, a total of 145 references to urban forestry-related material were identified using a discovery matrix developed by the U.S. Forest Service.

Table 1. Count of document references to urban forestry

U.S. Forest Service Category	Count of Document References to Category
Management Policy and Ordinances	32
Capacity and Training	5
Funding and Accounting	5
Decision and Management Authority	17
Inventories	10
Plans	5
Risk Management	8
Disaster Planning	0
Standards and Best Practices	51
Community	12
Total	**145**

Envision Kirkwood's Goals and the Urban Forest Master Plan

Table 2. Summary of the City's Comprehensive Plan supporting this Urban Forest Master Plan

Active Living & The Environment Goals and Objectives	Actions Supporting Goals and Objectives (paraphrased for summary)
Goal 2: Maintain open space and natural areas	
Objective 2.A: Coordinate with outside organizations to help with continued support and stewardship of Kirkwood Natural Amenities.	2.A.1: Work with organizations to identify types of maintenance and stewardship needs. 2.A.2: Identify potential partners… 2.A.3: Work with partners to develop maintenance and stewardship plans… 2.A.4: Continually review programs and measure impacts.
Objective 2.B: Continue to grow and promote volunteer programs.	2.B.4: Identify other volunteer or civic groups to partner together.
Objective 2.C: Integrate native plantings into city projects and private development that are low maintenance and require minimal care.	2.C.1: Review existing native landscape programs and initiatives in nearby communities. 2.C.2: Decide the proper method to promote native plantings. 2.C.3: Enact a program to educate developers and residents about native options including trees, for new and infill developments.
Goal 3: Promote a thriving and healthy urban forest	
Objective 3.A: Develop a master plan for addressing the preservation and expansion of the urban forest.	3.A.1: Identify issues and objectives to address. 3.A.2: Outreach to the community for feedback. 3.A.3: Establish an implementation plan between City and affiliated partners.
Objective 3.B: Create a tree preservation ordinance to protect old growth trees and promote new plantings.	3.B.1: Determine a clear direction from the community. 3.B.2: Finalize the tree ordinance based on community input and submit to City Council for adoption. 3.B.3: Create an outreach campaign for Community residents and builders to ensure understanding of the ordinance and the long-term benefits. Include this information in any property maintenance and permitting materials.
Objective 3.C: Inventory, inspect, and maintain all public trees on a continual basis.	3.C.1: Analyze the tree inventory data to create a full understanding and necessary steps to maintain and enhance it. 3.C.2: Apply for grants to fund inventory recommendations.

2016 Kirkwood Community Survey and Envision Kirkwood 2035 Survey

2016 Community Survey

A community survey was shared in 2016 to gather feedback on the City exploring changes to tree-related ordinances and policies:

Would you support the development of City regulations to govern if and when property owners may remove trees on commercial and residential properties?

The majority (46 percent) responded "no" to the question and 26 percent responded "yes". The remaining respondents answered "don't know" so perhaps education and more participation from the community would create a majority support for tree regulations on commercial and residential properties.

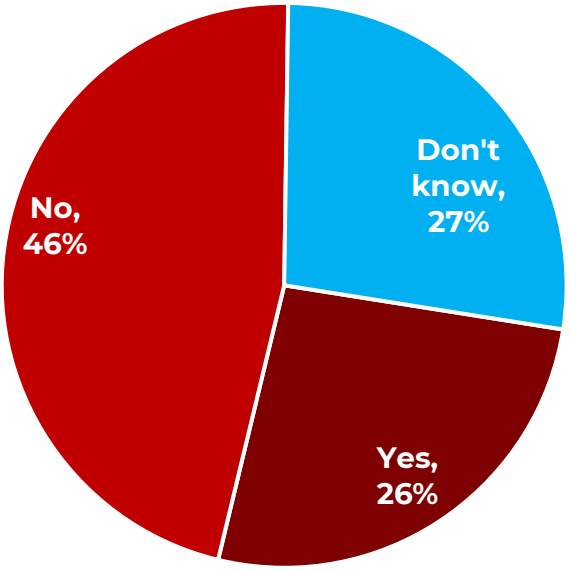


Figure 4. 2016 community survey results

2017 Envision Kirkwood 2035 Planning

To develop the City's Comprehensive Plan, a community survey was shared to gather additional input on updates to the City's tree-related ordinance. The survey was shared with open house attendees and the majority were in favor of requiring permits for tree removal (73 percent) and a tree ordinance (84 percent).

The outcomes of this effort resulted in the City recently updating its tree-related ordinances.

Image Description 6. Source: Envision Kirkwood 2035

KIRKWOOD'S 2017 STRATEGIC PLAN

Mission Statement:

The mission of the City of Kirkwood is to enhance the quality of life for current and future generations of Kirkwood residents through strong leadership, effective stewardship, and exceptional service.

Vision Statement:

Kirkwood will be the most livable community; a place recognized for its beauty, historic charm, strong neighborhoods, vibrant businesses and involved citizenry.

CORE VALUES

Responsiveness: We provide services that address our citizens' wishes and needs.
Stewardship: We prudently and efficiently manage financial and human resources while promoting a sustainable environment.
Community: We deliver services and provide facilities that support the development of strong bonds with one another.
Tradition: We honor our community's historic past and build upon it for the future.
Involvement: We involve our citizens in local government activities.
Inclusiveness: We respect and value the diversity and contributions of all members of our community.
Integrity: We foster the highest ethical standards.

STRATEGIC GOALS

(i) Enhance the quality of life of citizens.
(ii) Improve governance and strengthen relations between citizens and government.
(iii) Strategically grow economic activity to support quality of life.
(iv) Nurture downtown Kirkwood as the heart of our community.
(v) Invest for the future through public infrastructure.

Goal 1) Enhance the quality of life of citizens. Keep the small town feel, historic charm, amenities, affordability, good schools, safety/security, strong neighborhoods, attractiveness, accessibility, and stability of Kirkwood. Prudently and efficiently manage financial and human resources while promoting a sustainable environment.

Objective A: Promote environmental conservation and sustainability.

Initiatives/Projects/Actions:

(1) Implement comprehensive citywide plan for protecting/planting and sustaining trees.
  (a) Who is responsible: Director of Public Services (primary) City [Urban] Forester and Urban Forestry Commission (assisting).
  (b) How will it be accomplished: Develop a comprehensive Urban Forest Master Plan to regulate tree maintenance, protection and tree planting that will support the City's tree ordinance.
  (c) Why it should be accomplished: Implementing a comprehensive Master Plan is needed to protect and manage the green landscape for which Kirkwood is known. Without the implementation of a plan to protect and maintain City trees, the landscape of Kirkwood may change with the continued redevelopment of properties in conjunction with the aging urban forest.

City Workflows and Operations Findings

In April 2022, members of the community were interviewed to identify workflows, measures of success, concerns, priorities, and shared goals and outcomes as it relates to trees in the City. A total of 27 staff or commission members were invited to participate in a six-question survey and participate in follow-up interviews if desired. A total of 16 survey responses (59 percent) were received from staff representing the Electric Department, Building Commissioner's Office, Public Services Department, and the Parks and Recreation Department. In addition, members from the Urban Forestry Commission and Park Board participated. The figure below provides the summary of responses.

Figure 5. Illustration of the responses from the staff and commission/board member survey

From the survey, most respondents serve as advocates for public trees and park improvements, over 50 percent support community recreation and engagement, and half are involved with City ordinances and Code enforcement. Over half of the respondents noted the staffing levels as a challenge, along with needed improvements as it relates to the environment and ordinances (38 percent). 31 percent feel the current budget is a challenge and 25 percent are challenged with existing protocols and best management practices. The respondents noted their top priorities to address in the Plan as Tree Code related, development requirements, planting strategies, maintenance, safety, levels of service, and education. Respondents would like to see this Plan address resources and staffing (56 percent), community engagement (44 percent), and information, equipment, and technology (38 percent). Also, 63 percent support the City exploring a protection ordinance for significant trees greater than 30 inches in diameter on one acre or larger private lots.

The City staff and community member input, benchmarking research, inventory and canopy analysis, public engagement, and the Urban Forest Audit informed the Plan's goals and strategic actions to address shared concerns and priorities.

Baseline Conditions Findings

To identify the existing conditions of the urban forest from which goals and actions can be measured, an analysis of existing tree-related datasets was completed as part of the evaluation process. These datasets included the updated public tree inventory database and the 2022 urban tree canopy assessment.

Public Tree Inventory

In 2022, an updated public tree inventory was completed for nearly 9,000 trees located along streets and in medians within the public right-of-way. This data was used to assess tree abundance, distribution, composition, size classes, and functional benefit. Prior to the 2021 Urban Forest Master Plan project, the City had a public tree inventory completed in 2014 and a report in 2017 summarized the tree population. The combined summary of this inventory database informed recommendations in the Plan and key findings are highlighted below. An overview of ecosystem services and benefits associated with this public tree population is summarized in the following section.

Table 3. Overview of the 2022 public tree inventory analysis

8,614	Public street trees in 2022	9,982	Public street trees in 2014-2017
174	Unique public tree species	75	Unique public tree genera
67%	Good condition	6%	Poor condition
8%	Pin oak (*Quercus palustris*)	17%	Oak (*Quercus*) trees
47	Trees to remove	13”	Average tree diameter of all trees
23%	Trees in the 6-12-inch class	28%	Trees in the 0-6-inch class

Ecosystem Services and Benefits of the Inventoried Public Trees

Table 4. Annual ecosystem benefits and services of public trees inventoried (8,614 trees)

Overall	Energy Savings	Air Quality	Property Value	Carbon Services	Stormwater
$518,964	$82,657	$6,756	$298,556	$5,441	$53,415
Annually	1.3M kWh	7,072 lbs	Added value	1.1M lbs C seq.	9M gallons

Additional summaries and analyses of the public tree population from the 2022 inventory are provided in Appendix A and Appendix B.

Citywide Urban Tree Canopy

Additional summaries, analyses, and guidance from the 2022 Urban Tree Canopy Assessment are provided in the Goals for Urban Forest Equity and Sustainability section.

Overview

An assessment of tree canopy cover citywide provides the data and information to develop goals and strategies relating to tree planting, preservation, tree equity, and risk management along with the data to support community outreach and education. These urban tree canopy assessments, referred to as "UTC Assessments" or "Tree Canopy Assessments" and "TCA's" provide the information for long-term planning and serves as a measurement of change and progress over time.

This information can be utilized with other city planning efforts for sustainability, equity, human health, climate resiliency, stormwater management, water quality, wildlife preservation and enhancement, air quality improvements, and development guidelines among many others.

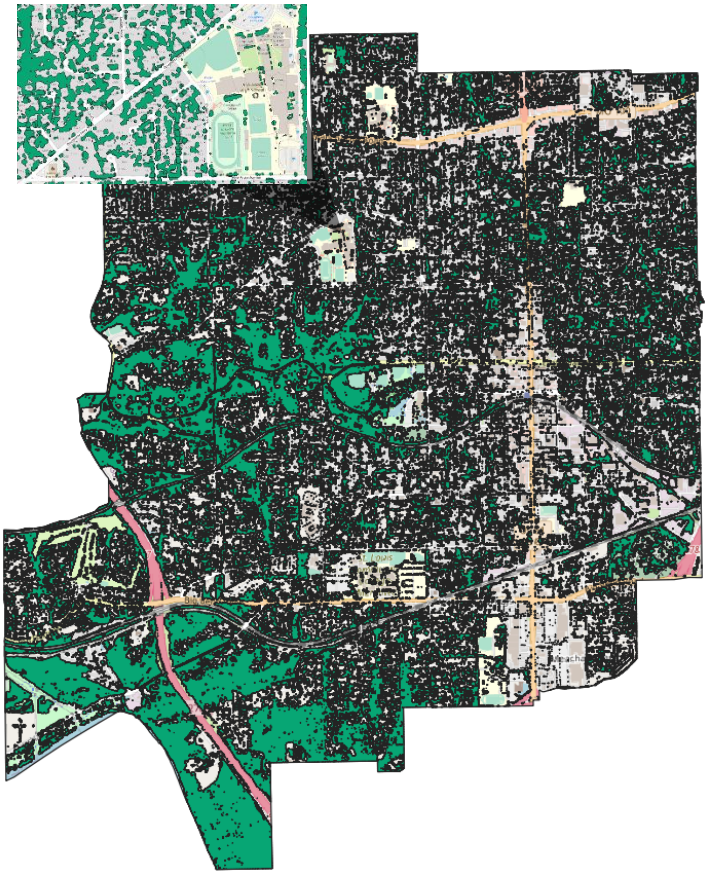


Figure 6. Map of Kirkwood's tree canopy cover (2022 assessment using USDA NAIP 2020 imagery)

UTC assessments provide a baseline understanding of existing canopy cover across the entire city. In addition, these assessments provide an analysis of possible planting areas citywide and by various planning boundaries. This assessment for Kirkwood represents an important step in better understanding current conditions of the urban forest, its tree canopy distribution and value, and the importance of urban forestry during planning processes. This baseline assessment should be utilized in measuring progress resulting from implementing this Plan.

Urban Tree Canopy (UTC) Findings - Overview

For Kirkwood, the existing tree canopy and possible planting areas were assessed citywide, by right-of-way (ROW), Forestry Maintenance District (FMD), within the ROW of each FMD, Zoning Class, and Census Block Group. The assessment is based on 2020 imagery provided by the USDA's National Agriculture Imagery Program (NAIP). In addition to the GIS files, Excel spreadsheet, and maps, a fact sheet was provided as part of the assessment project. The summaries below provide an overview of the baseline conditions relating to urban tree canopy cover and possible planting area in the City.

UTC Findings – Citywide

The 2022 UTC assessment first classified land cover by various types. Tree canopy, water, and possible vegetative area were calculated along with unsuitable areas including unsuitable vegetation, unsuitable impervious, and unsuitable soil.

Of the 5,880 total acres (including water) across the City, 43 percent is tree canopy, 23 percent non-canopy vegetation, 33 percent impervious, 1 percent soil and dry vegetation, and 0.2 percent water.

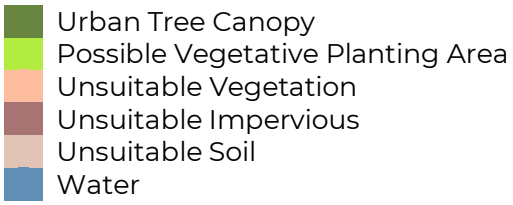
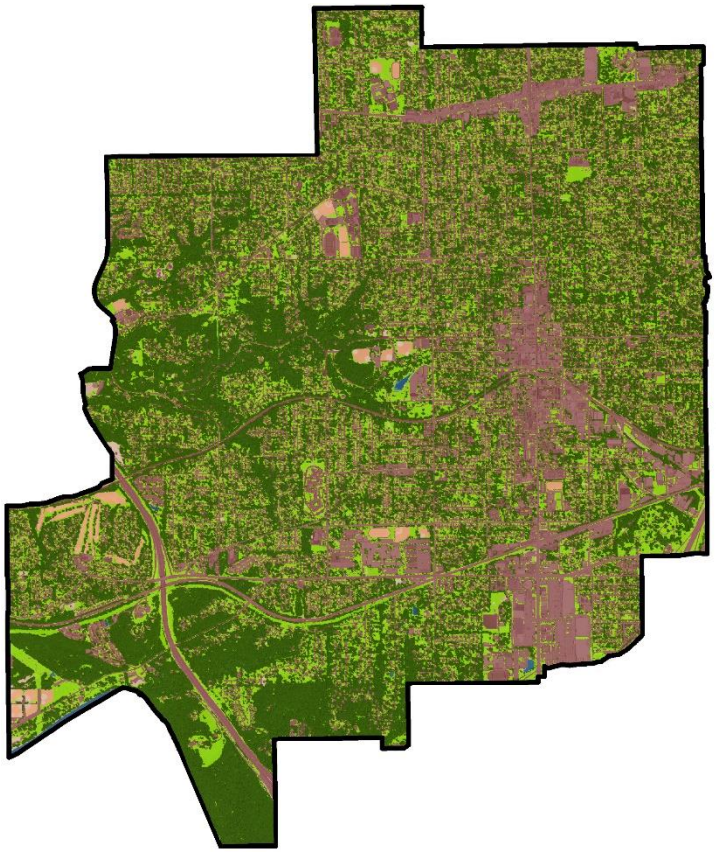


Figure 7. Land cover across the City of Kirkwood

Citywide Land Cover



Based on the 2020 imagery, the Citywide tree canopy cover is 43 percent or 2,548 total acres. Meaning, when viewed from above, nearly half of Kirkwood is shaded by the canopy of trees. To understand exactly what 2,548 acres of canopy looks like, a real-world equivalent would be the surface area of over 1,900 professional football fields.

Of the 5,866 total land acres of Kirkwood, 34 percent is classified as "unsuitable" meaning it is land cover class that is not available for new tree canopy. These areas may include buildings, roadways, agricultural land, or recreational areas such as a baseball field.

The remaining 22 percent of Kirkwood's land area is classified as "possible planting area". These areas consist of grass, turf, low-lying shrub areas, and impervious areas such as parking lots and sidewalks. These hardscapes may be more difficult to plant trees, but the benefits of the trees once established may be far greater due to the reduction of impervious surfaces that contribute to stormwater runoff and urban heat islands.

Citywide Tree Canopy Metrics

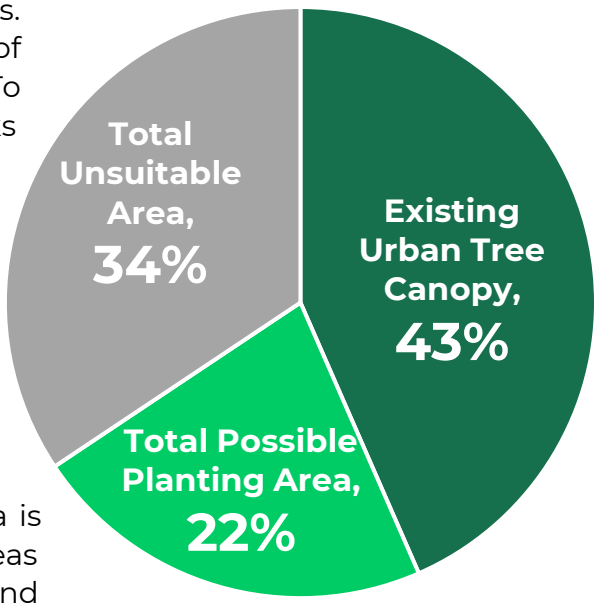


Figure 8. Citywide tree canopy results

UTC Findings – Forestry Maintenance Districts (FMDs)

The tree canopy metrics were also summarized by Forestry Maintenance Districts to provide effective data for planning, preserving, and growing tree canopy cover in Kirkwood. A total of eight FMDs exist in the City, each with their own unique land cover, opportunities, and constraints.

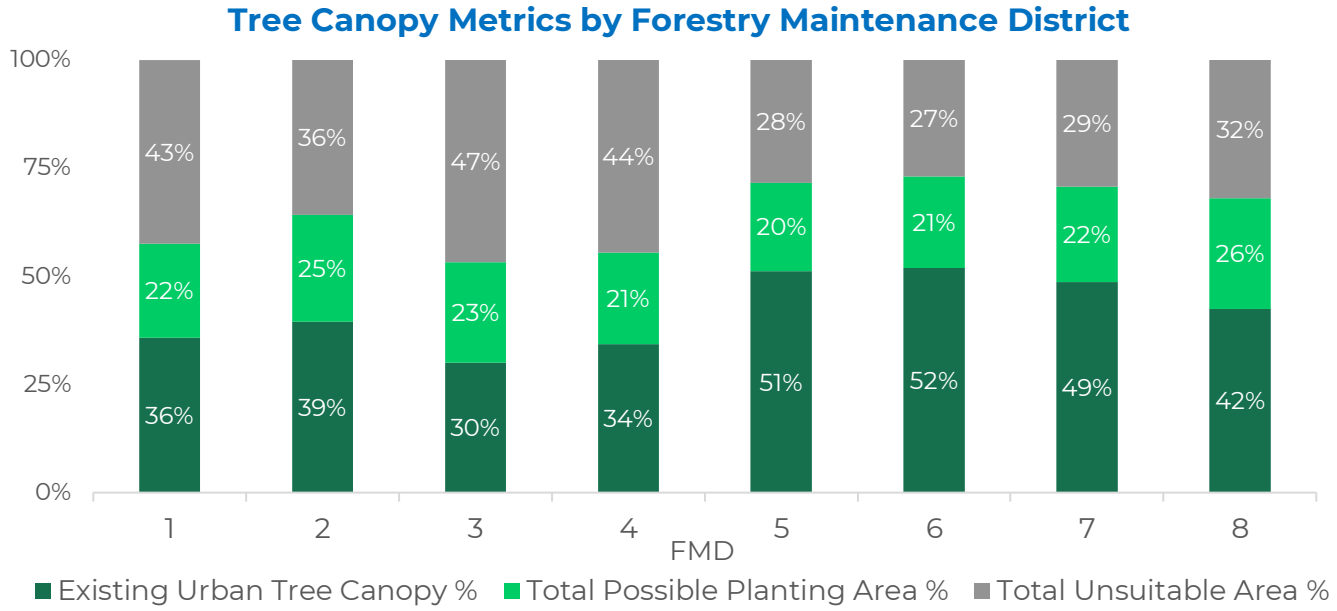


Figure 9. Tree canopy metrics by Forestry Maintenance Districts

Existing Tree Canopy by FMD

FMD 6 has the greatest percentage of existing tree canopy (52 percent) but has the second lowest amount of total land area (565 acres). FMD 5 has the greatest amount of total land area (1,633 acres) and the greatest amount of tree canopy cover (836 acres, 51 percent). Regarding possible planting area (PPA) for future tree canopy, each of the eight FMDs have relatively the same proportion of space— an average of 23 percent. FMD 8 has the highest percentage of PPA (26 percent) and FMD5 has the greatest amount of PPA acres (334). FMD 5 has the greatest amount of unsuitable acres (463) but FMD 3 has the greatest percentage of unsuitable area with 43 percent.

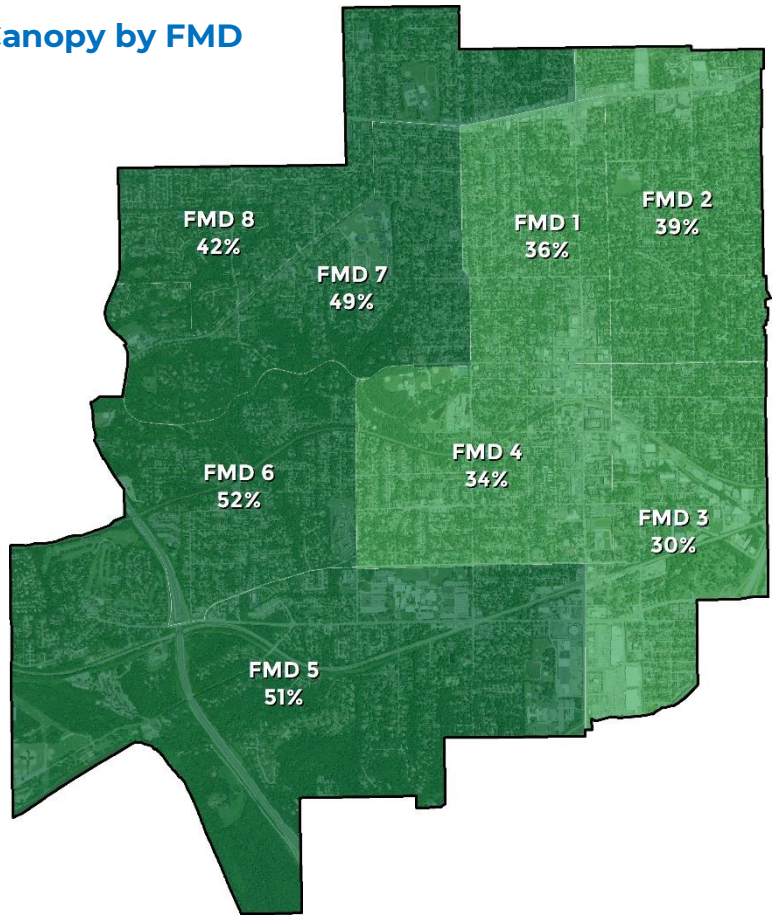


Figure 10. Existing tree canopy cover (%) by Forestry Maintenance District

UTC Findings – Zoning Classes

Existing tree canopy cover and possible planting areas were summarized by Zoning Class. There are a total of 13 classes in Kirkwood consisting of business, commercial, flood plain, industrial, single family, multiple family, and special multiple family zoned areas. These classes were consolidated into business zones, flood plain, light industrial, and residential for reporting and planning purposes. The available resources, opportunities, and constraints vary by zoning classes, therefore each consolidated class is summarized below to inform the Plan's goals and strategies.

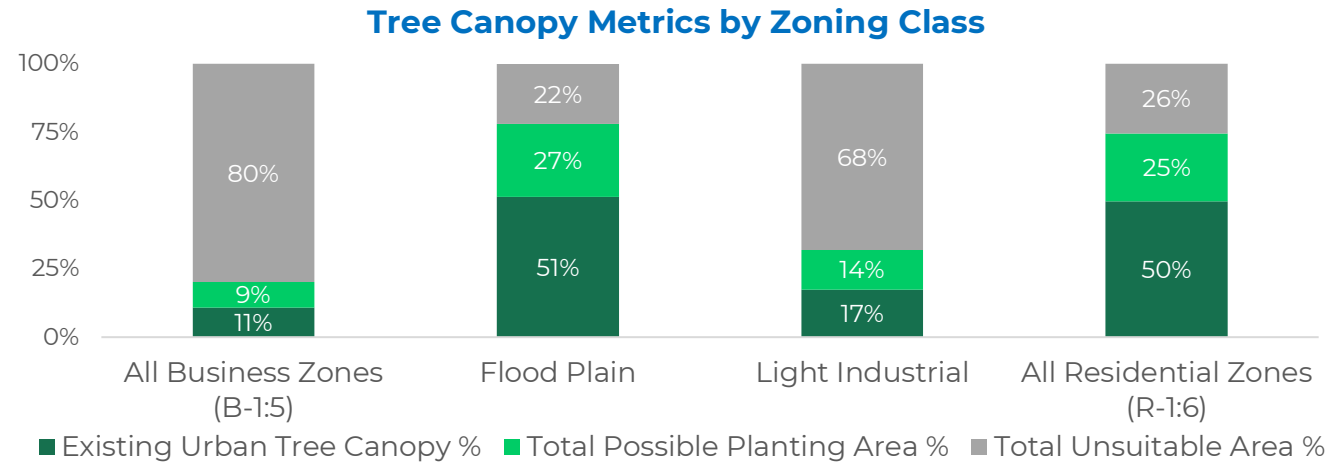


Figure 11. Tree canopy metrics by Zoning Class

Residentially-zoned areas have the greatest amount of existing tree canopy cover (2,141 acres) whereas, business zones have the lowest proportion (11 percent), and industrial zones have the lowest amount (18 acres).

The greatest amount of possible planting area for new canopy exists in the residential zone with 1,061 acres and the least amount of possible planting area is on industrial-zoned land with 15 acres.

Existing Tree Canopy by Zoning Class (consolidated)

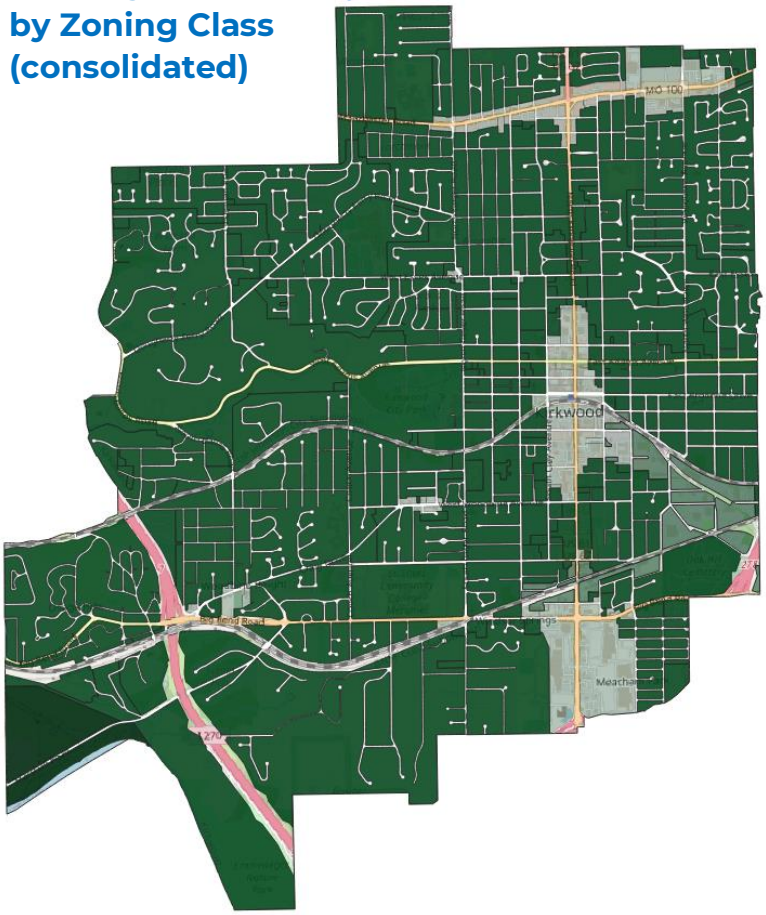


Figure 12. Existing tree canopy cover (%) by Zoning Class

UTC Findings – Census Block Groups

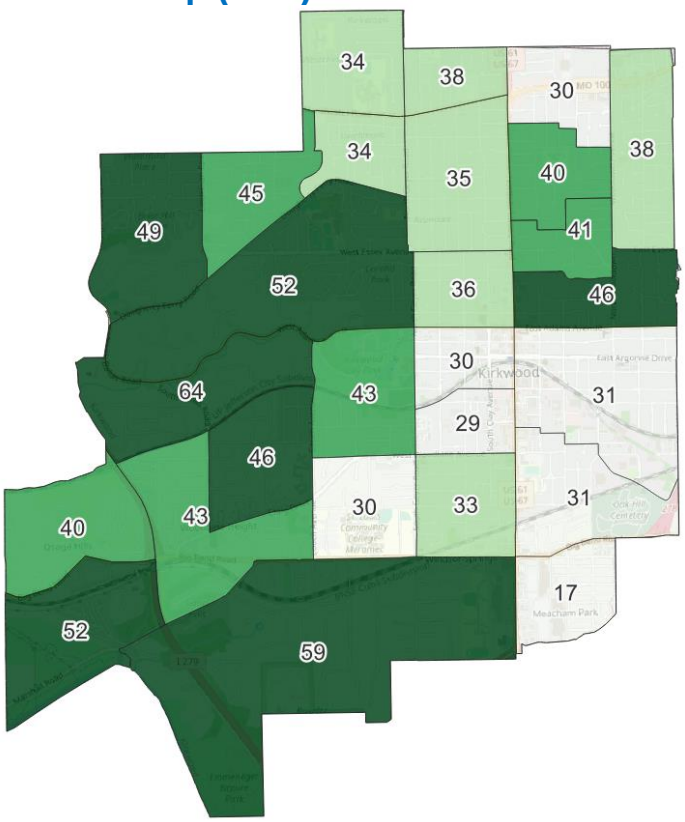
The UTC assessment metrics were summarized by U.S. Census Block Group (CBG) within the City of Kirkwood. This planning boundary enabled the development of prioritized planting areas discussed in the next section.

The average size of CBGs in Kirkwood is 217 acres. Of the 27 CBGs within the City, eight have an existing tree canopy cover percent greater than the Citywide average of 43 percent. Canopy cover ranges from 17 percent to 64 percent.

Nine CBGs have more than 50 acres of possible planting area and five CBGs have more than 25 percent of their land area classified as possible planting area. PPA ranges from 17 percent to 31 percent.

Figure 13. Existing tree canopy (%) by Census Block Group (right)

Existing Tree Canopy (%) by Census Block Group (CBG)



Tree Canopy Metrics by Census Block Group (CBG)

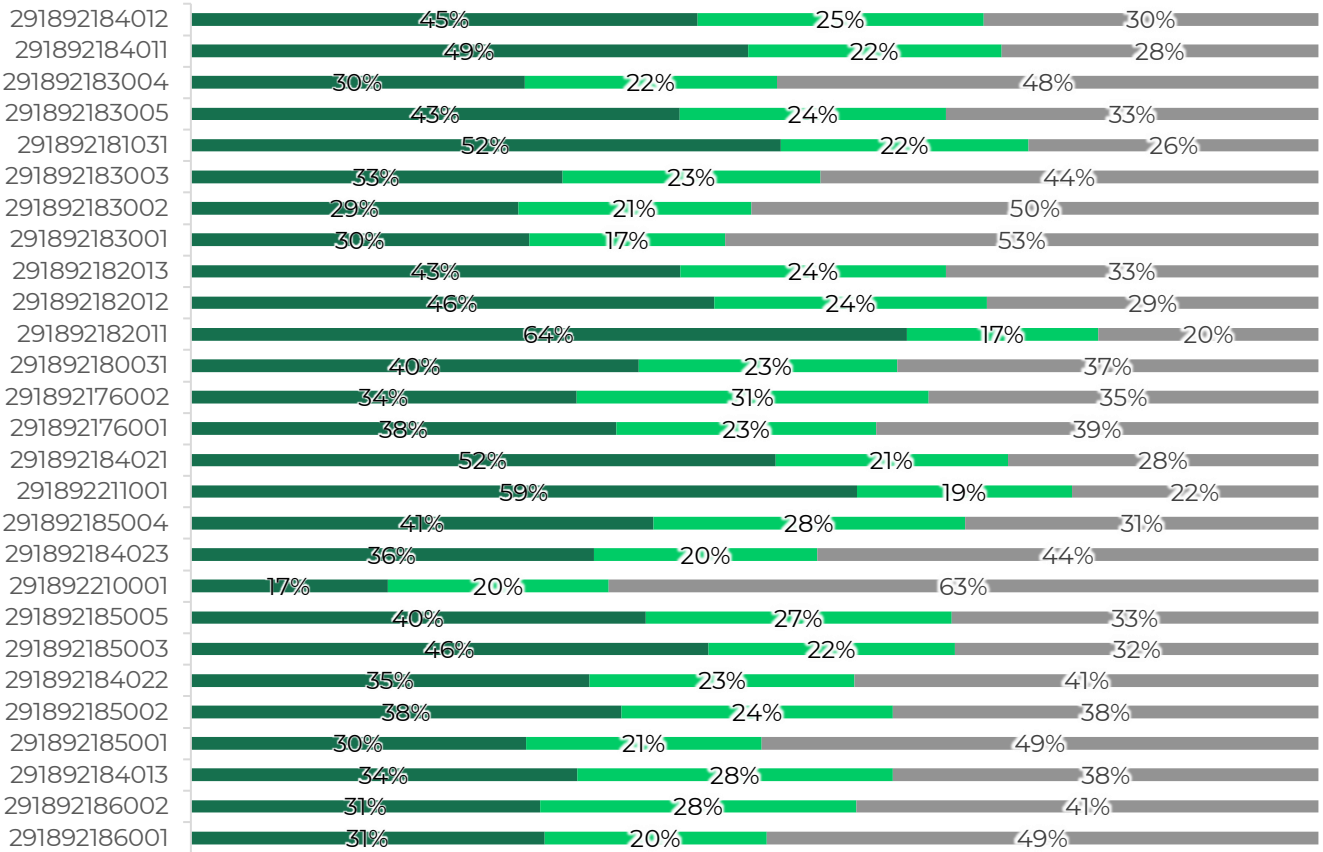


Figure 14. Tree canopy metrics by Census Block Group

Priority Planting Areas

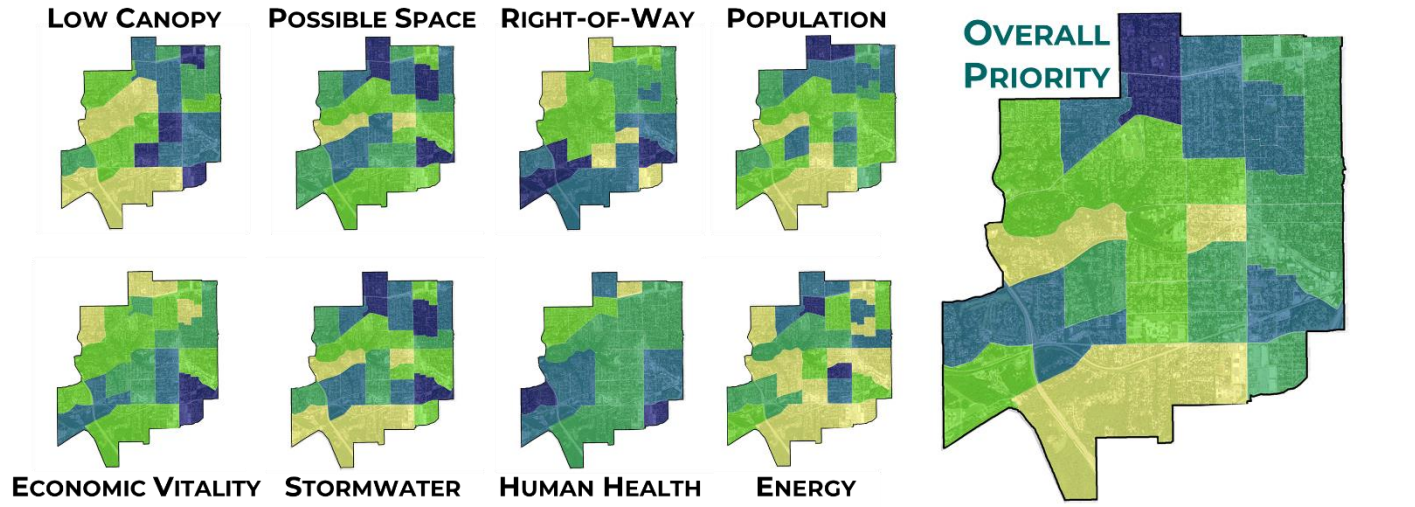


Figure 15. Priority planting areas by Census Block Group and scenario

Using the U.S. Census Block Group sociodemographic data and the results of the 2022 Urban Tree Canopy Assessment, a series of priority planting scenarios were developed. The priorities are derived from the UTC data such as the low canopy CBGs, CBGs with the greatest amount of possible space, and CBGs with the most available space in the public right-of-way. From the sociodemographic data, CBGs are prioritized where trees can address population density, low median household income, stormwater runoff, human health, and energy savings. Incorporating each of these priorities results in an overall composite priority map as shown above where planting trees may have a multitude of benefits for the community. The priority scenarios were utilized to draft the canopy goals in this Plan. The criteria for each of these priorities is provided below:

(1) **Low Canopy:** It is important to understand the existing distribution of existing tree canopy across the City. This scenario shows CBGs that are low in canopy cover.
(2) **Possible Space:** This scenario shows the CBGs with the greatest percent of total area available for possible planting.
(3) **Right-of-Way (ROW):** Trees planted within a ROW help reduce stormwater runoff, decrease urban heat island, and improve air quality. This scenario identifies CBGs with the most possible planting area within the ROW.
(4) **Population Density:** This scenario shows CBGs with the highest population density. Larger numbers of people will benefit from the ecosystem services that increased tree canopy coverage can provide.
(5) **Economic Vitality:** The presence of trees aligns with increased economic vitality and quality of life. This scenario prioritizes CBGs with a lower-than-average median household income, as reported by the U.S. Census American Community Survey 5-year summaries.
(6) **Stormwater:** Trees can be integrated to help manage stormwater, specifically when targeting impervious surfaces. This scenario shows CBGs with the greatest amount of planting area on impervious surfaces that are within 100 feet of all surface water bodies.
(7) **Human Health:** Trees and green spaces have been proven to lower stress levels, in turn, improving public health.
(8) **Energy Conservation:** Trees provide a reduction in energy use in the summer by providing shade and in the winter by reducing wind. This scenario identifies CBGs with the greatest amount of residentially-zoned areas having low tree cover and high total possible planting area.

KIRKWOOD'S TREE CANOPY AND EQUITY

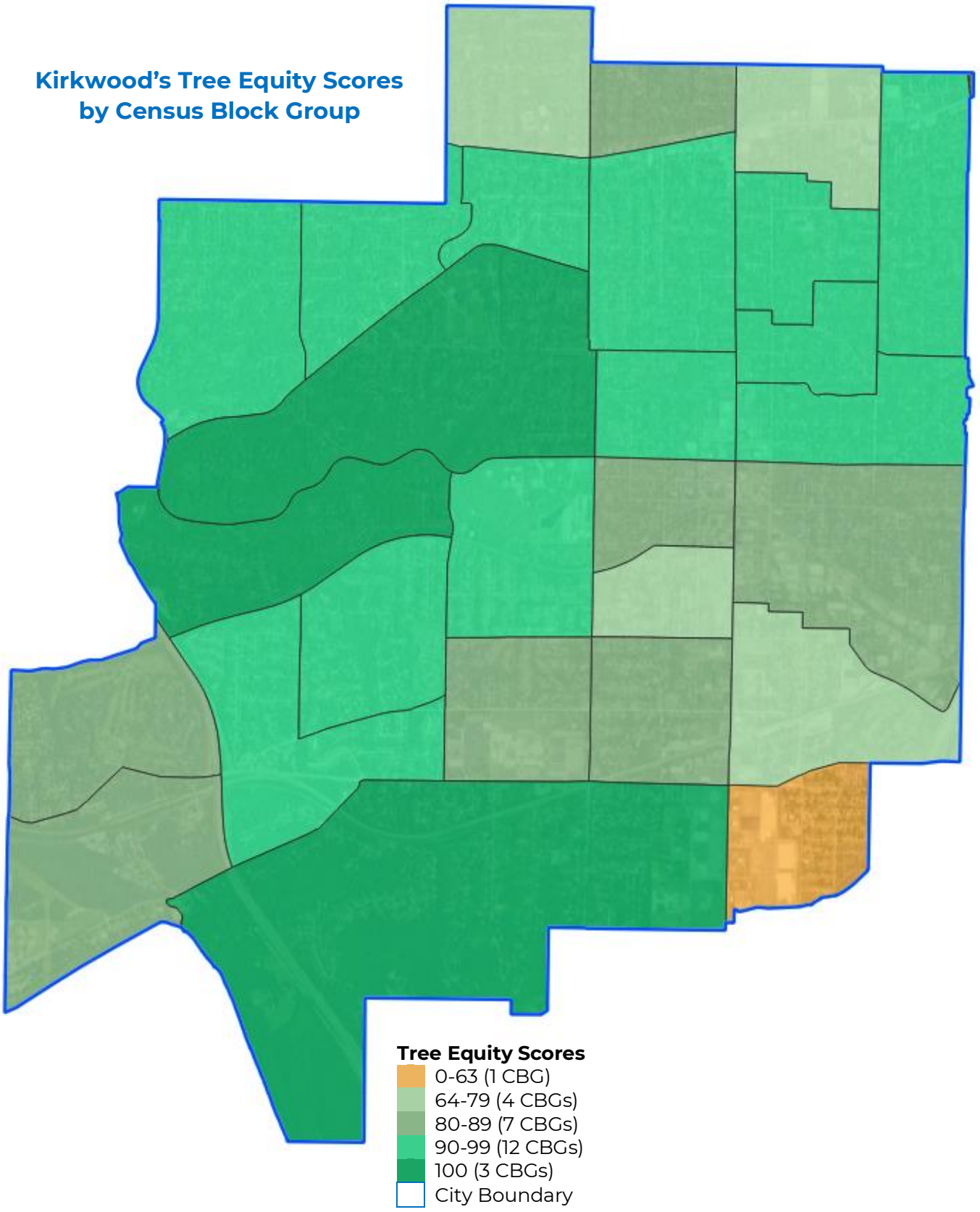


Figure 16. Map showing Tree Equity Scores (TreeEquityScore.org) for Kirkwood's Census Block Groups

Regarding tree canopy equity, trees are generally sparse in socioeconomically disadvantaged neighborhoods and more prominent in wealthier neighborhoods. Focused on addressing this inequity, the American Forests organization created the Tree Equity Score (TES, TreeEquityScore.org) tool that measures tree equity across 150,000 U.S. neighborhoods and 486 municipalities in urban areas. Each community's TES indicates whether there are enough trees for everyone to experience the health, economic, and climate benefits that trees provide. The scores are based on how much tree canopy and surface temperature align with income, employment, race, age, and health factors. A 0- to-100-point system makes it easy to understand how a community is doing. With the knowledge the score provides, Kirkwood's community leaders, tree advocates, and residents alike can address climate change and public health through the lens of social equity, attract new resources, factor the scores into technical decisions, guide implementation of the Urban Forest Master Plan, and track progress toward achieving tree equity. A score of 100 represents tree equity.

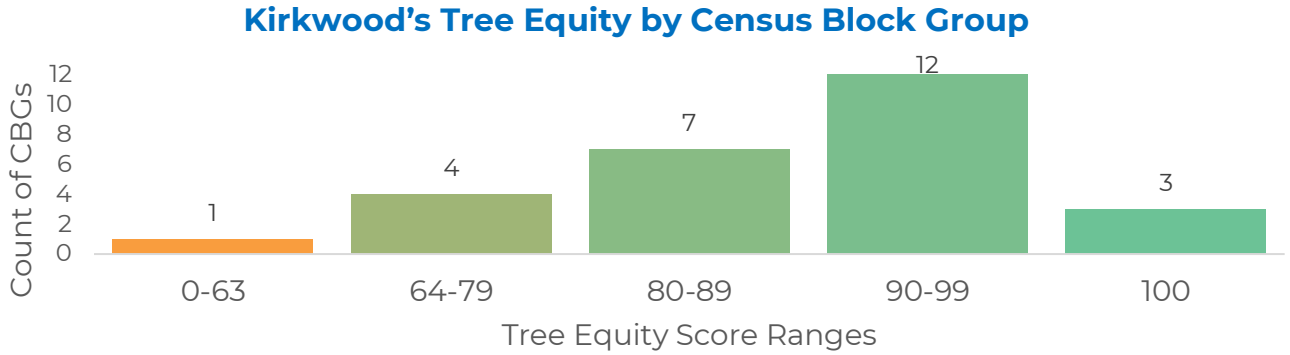


Figure 17. Distribution of Tree Equity Scores among Kirkwood's Census Block Groups

The Tree Equity Score for the City of Kirkwood is currently at a score of 87 out of 100. This score is based on a combination of metrics for 27 Census Block Groups (CBG) comprising the City and averaged for a combined total score. As shown in the figure above, only three of the CBGs are attaining tree equity with a score of 100 though 12 (44 percent) are in the 90-99 range. Only one CBG is in the 0-63 range. Note, the TES tool and datasets do not perfectly align with the City's boundary and the CBGs extend beyond the City boundary affecting some of the scores.

In the past few years, regional partners are increasingly acknowledging and confronting the past practices, current perceptions, and accelerating progress to ensure that communities, landscapes, and policies are more intentional about enhancing historically disinvested areas. Driven in part by the City's Urban Forest Master Plan and other City/regional initiatives, ambitious goals to increase tree canopy in areas of greatest need are taking hold. These goals will grow a more equitable urban forest that provides long-lasting benefits. In addition, the City must commit to plant and maintain trees, update and align policies and procedures to grow and protect public and private trees, and engage the community members of Kirkwood to become advocates and stewards of the City's urban forest. Although the City will oversee and monitor these canopy goals, the effort will inevitably require extensive support from all City departments, community-based organizations, and others aiming to prepare for a hotter and drier climate. As a first step, the City's 2022 Urban Forest Master Plan provides guidance to prioritize resilient, climate-appropriate trees, preserve and conserve mature trees, and properly manage resources to ensure that trees thrive in the urban environment. The cooperation of the City, partners, organizations, property owners, and others is instrumental to meeting these goals, and this Plan provides the approach to formally establish a tree canopy goal that will guide this shared commitment.

Urban Forest Benchmarks Findings

The following summary provides an overview of the urban forest benchmarking results based on the analysis of two datasets; Arbor Day Foundation's 2019 Tree City USA database (method 1) and the *Municipal Tree Care and Management in the United States – a 2014 Urban and Community Forestry Census of Tree Activities* by R. Hauer and W. Peterson (method 2). The complete analysis and summary is detailed in the worksheets and reports provided by the Urban Forest Master Plan project.

The benchmarking research and comparison of analogous communities was completed to establish baseline metrics from which progress can be measured. Comparing the benchmark values to other communities enables the development of realistic urban forestry goals and recommendations. The benchmarking research provides a comparative analysis and a means to monitor improvements though there are variations in the data and methods of reporting by communities. Therefore, the comparisons should be considered as an initial assessment where further study may be needed.

Communities Included in the Benchmark Comparison Study

Table 5. List of communities for the benchmarking research (ordered by population difference)

City	County, State	Population	Proximity (miles)
Kirkwood	**St. Louis County, MO**	**27,708**	**0.0**
Edwardsville	Madison County, IL	26,631	33.7
Alton	Madison County, IL	26,528	24.4
Maryland Heights	St. Louis County, MO	25,756	10.0
Ballwin	St. Louis County, MO	30,404	8.5
Webster Groves	St. Louis County, MO	22,995	2.7
University City	St. Louis County, MO	35,500	7.3
Ferguson	St. Louis County, MO	21,203	12.4
Wentzville	St. Charles County, MO	41,000	28.0
Creve Coeur	St. Louis County, MO	18,702	5.4
Manchester	St. Louis County, MO	18,146	5.6
Belleville	St. Clair County, IL	44,478	24.8
Lake Saint Louis	St. Charles County, MO	16,230	24.5
Chesterfield	St. Louis County, MO	47,800	13.7
Florissant	St. Louis County, MO	52,158	15.7
St Peters	St. Charles County, MO	54,842	19.0
Washington	Franklin County, MO	13,982	33.6
Dardenne Prairie	St. Charles County, MO	13,009	25.6
Crestwood	St. Louis County, MO	11,870	2.3
Eureka	St. Louis County, MO	11,009	13.1
Saint Charles	St. Charles County, MO	70,329	19.2

Benchmarking Key Findings and Comparisons

Table 6. Summary of method 1 benchmarking research results

2019 Tree City USA - Kirkwood		2019 Tree City USA - Regional	
$300k	Forestry budget (without Kirkwood Electric budget for utility vegetation management)	$189k	Average forestry budget
$10.82	Per capita forestry budget	$5.99	Average per capita budget
$99k	Tree maintenance budget	$27k	Average maintenance budget
$16k	Tree planting/care budget	$54k	Average planting/care budget
1,144	Trees pruned	333	Average trees pruned
145	Trees removed	139	Average trees removed
78	Trees planted	972	Average trees planted

Table 7. Summary of method 2 benchmarking research results

2014 Census Kirkwood		2014 Census – Population Group (25k-50k)	
$300k	Forestry budget (2019)	$344k	Average forestry budget
0.33%	Of total budget for forestry	0.63%	Of total budget for forestry
9k	Public trees inventoried	26k	Average count of public trees
$34.81	Budget per tree	$37.35	Average budget per tree
0.31	Public trees per capita	0.83	Average public trees per capita
9k	Public trees per staff	6k	Average public trees per staff
40	Acres of parks and open space	388	Average acres of parks and open space

Community Engagement Findings

Project Website

To support the development of the urban forest vision, goals, and recommended actions, the urban forestry consultants met with the City's Communications Manager to develop an outreach strategy that gathers input and feedback from all members of the community. A primary strategy for continuous education and engagement was the development of a project-specific website containing background information, project timelines, draft outcomes, additional resources, and the platform for launching the public survey. The website can be found at www.KirkwoodUrbanForest.com.

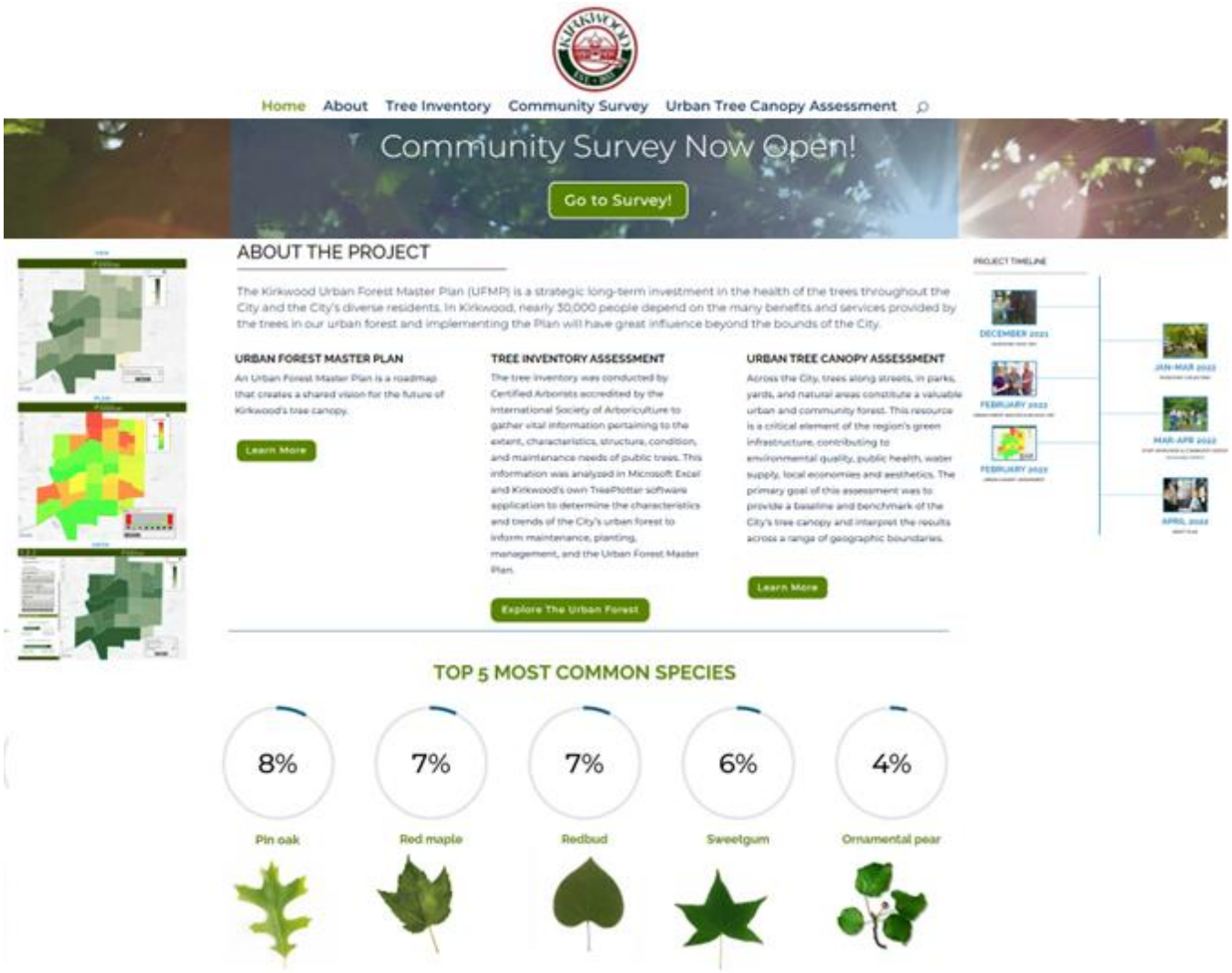


Figure 18. The project website for Kirkwood's Urban Forest Master Plan

A total of 827 users visited the website from April to July 2022 for a total of 1,776 webpage views. Of the total users or website visitors, 10 percent returned to the website more than once. The City has the option to host the website six months after the adoption of the Urban Forest Master Plan or utilize the content and/or website analytics to support future public outreach, engagement, and messaging.

Public Survey

In April 2022, a 14-question online survey was launched to learn how trees impact the lives of Kirkwood's community members, to gather perceptions on the amount and health of the urban tree canopy cover, gather input on priority areas for expanding tree canopy, identify shared concerns relating to trees, gauge support for enhanced tree protection, and recognize the benefits and services provided by trees that the community values most.

The survey was available on the project website (KirkwoodUrbanForest.com) throughout the entire month of April. Within one week of launching the survey, 86 responses were received, by mid-April a total of 323 responses, and by May 1st a total 453 responses were received. The following provides an overview of the engagement garnered from the effort followed by a summary infographic (Figure 20).

Figure 19. Postcard created to announce the public survey

The majority of respondents live (94 percent) and own a home (91 percent) in Kirkwood and are 65 years old or older (37 percent). Respondents are engaged with their urban forest in that they have maintained their own tree (87 percent), watered a tree (85 percent), or planted a tree (80 percent) at some point in their life. Most respondents feel the canopy cover is good but should be expanded (62 percent) because they feel the number of public and private trees in the City has decreased (65 percent) and the health and quality of public trees has decreased (44 percent) in the last 10 years. Tree plantings to increase canopy should be targeted or emphasized in commercial / industrial areas (17 percent), rights-of-way (17 percent), and private property (16 percent). Considerations for new and existing trees should include their location to utility lines (59 percent), impact on underground utilities (45 percent), and hardscape damage (45 percent). To support an increase in tree canopy cover, the majority support the City exploring a tree protection ordinance for significant/heritage trees greater than 30 inches in diameter on private lots greater than one acre in size (71 percent). Most survey responses were in support of enhancing the urban forest because of the benefits trees provide such as added natural beauty (23 percent), reducing air pollution (20 percent), and improving the quality of life and mental health (20 percent). Others included the urban forest's role in climate change.

Success of this engagement effort is largely attributed to the City's commitment to share the survey and conduct outreach. The survey was announced on the City's website, the Trash Talk newsletter, social media posts, website spotlights, resident e-newsletter, and shared throughout relevant partner networks. In addition, a postcard with a QR code was prepared for the Youth Advisory Commission to hand out at the downtown Kirkwood voter registration drive.

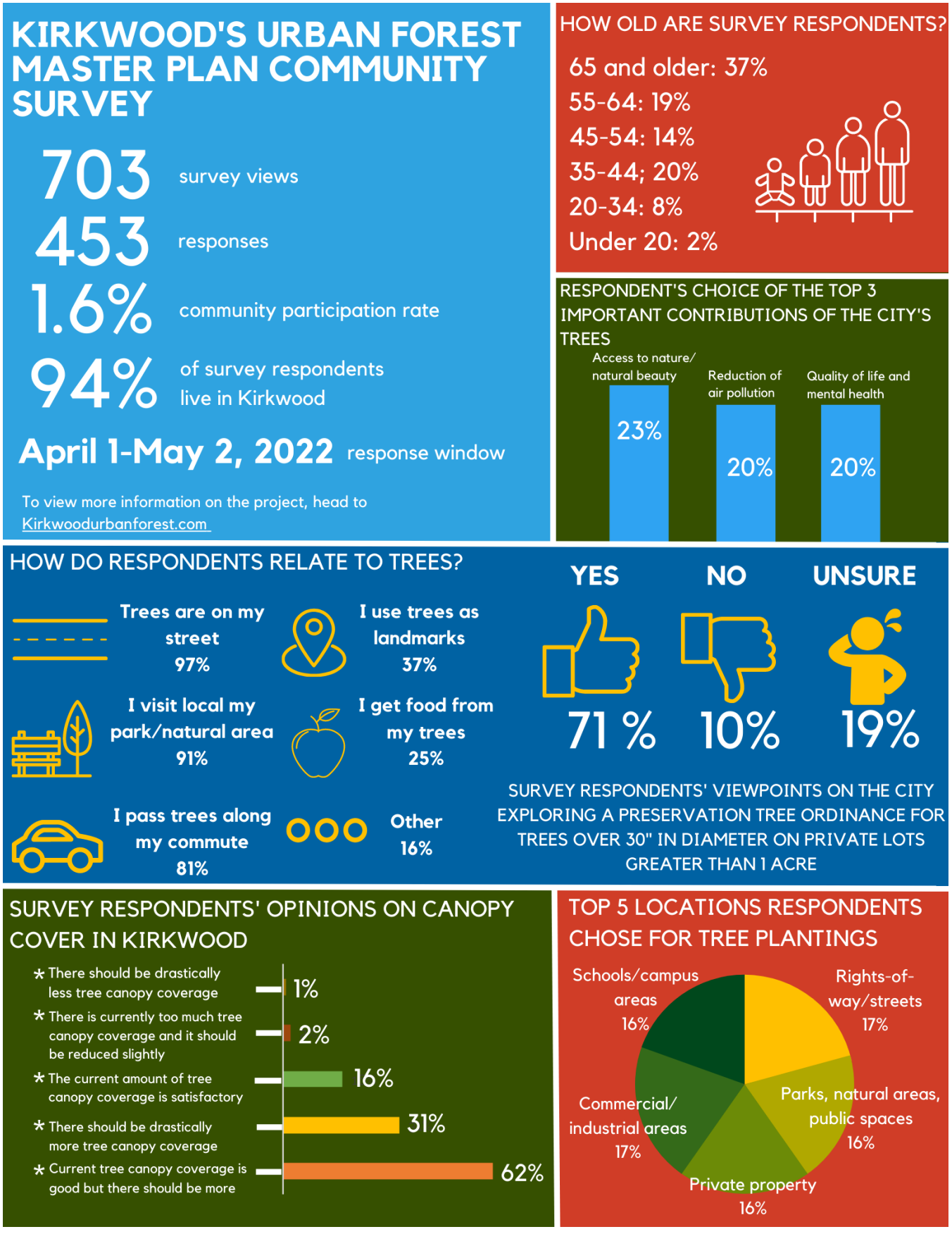


Figure 20. Summary results of the public survey

Urban Forest Audit System

To develop this Plan, 15 documents, plans, and resources were gathered and reviewed by applying the U.S. Forest Service's Urban Forest Sustainability and Management Audit's Discovery Matrix. This matrix includes a total of 11 urban forest categories, each containing a multitude of supporting elements. All resources were reviewed to identify references regarding each of the categories and supporting elements. There are a total 145 instances where the 15 resources reference the 11 categories and supporting elements. The number of resources referencing elements of urban forest sustainability and management demonstrates Kirkwood's readiness for changes driven by this Plan. Recommendations in this Plan align with components of these supporting resources. A detailed worksheet and summary report were provided as part of the UFMP project.

Based on the analysis of findings from the needs assessment, **Kirkwood scored a 68 percent** in terms of urban forest sustainability and management as defined by the U.S. Forest Service, partners, and planning consultants. The City of Kirkwood scored relatively high when compared to other urban forestry audits completed by the consultants for other communities of similar size. Overall, the City scored highest in the Decision and Management Authority, Community, Inventories, and Green Asset Evaluation categories—all of which are at or above 75 percent out of 100. The Urban Forest Master Plan provides the guidance to maintain these strengths and to address shortcomings as opportunities.

Based on the audit of 129 subcategories (11 primary categories), Kirkwood is achieving "Adopted Common Practice" for 51 (40 percent) of these. 71 subcategories (28 percent) are "In Development". Applying the multipliers of 2 for Adopted Practice and 1 for In Development results in a total score of 173 out of 254 possible points, or 68 percent (detailed in the following table).

Table 8. Outcomes of the urban forest auditing process for Kirkwood (2022)

#	Description	SOC* (% Achieved)	Base** (% Achieved)	Overall Rating	Overall (% Achieved)
1	Management Policy, Ordinances	50%	67%	15	54%
2	Professional Capacity and Training	83%	NA	11	69%
3	Funding and Accounting	75%	NA	7	58%
4	Decision, Management Authority	100%	100%	8	100%
5	Inventories	NA	75%	22	85%
6	Urban Forest Management Plans	NA	50%	14	58%
7	Risk Management	58%	50%	10	56%
8	Disaster Planning	NA	50%	6	43%
9	Standards and BMPs***	75%	63%	41	68%
10	Community	100%	NA	24	86%
11	Green Asset Evaluation	NA	NA	15	75%
Total		**77%**	**65%**	**173**	**68%**

*Standard of Care (SOC) elements represent the minimum group of urban forestry management "best practices" that a municipality should consider for implementation. SOC refers to the degree of prudence and caution required of an individual who is under a duty of care (i.e., legal obligation of the controlling authority, owner, or manager) to minimize risk. Neither state, regional, nor national minimum management components have been established for SOC but these are interim recommendations for consideration. (NA = not applicable)

**Base Practices (BP) elements represent additional urban forest management activities or components that may effectively expand a program beyond the SOC group (see footnote above). These elements are typically precursors to other "non-core" elements in the category. (NA = not applicable)

***Best Management Practices (BMPs)

Urban Forest Audit Summary Discussion

The main purpose of the urban forest audit is to apply the research and findings gathered throughout the planning effort to inform the Plan's goals, strategic actions, and targets. This audit or "gap analysis" enables the urban forestry program within the Forestry Division to control different aspects of its program with data. This gap analysis identified the shortcomings that the program should overcome and by quantifying them, the program can make improvements. It also enables effective monitoring of Plan goals in that the audit categories and elements can be revisited at key intervals in the implementation process to measure progress and adapt strategies accordingly. For the comprehensive evaluation of all subcategories within the Urban Forest Audit, see Appendix C.

The information provided in the table above describes the current conditions of Kirkwood's urban forest, the programs that manage it, and the community framework. As recommended in the Plan's monitoring methods, the City should use this framework to evaluate implementation progress, report successes, and inform changes to Plan actions. Many of the urban forest audit elements were given a rating of "In Development" as they previously did not exist but are addressed in this Urban Forest Master Plan. This means that the City is already well underway in advancing its program and its Urban Forest Audit score.

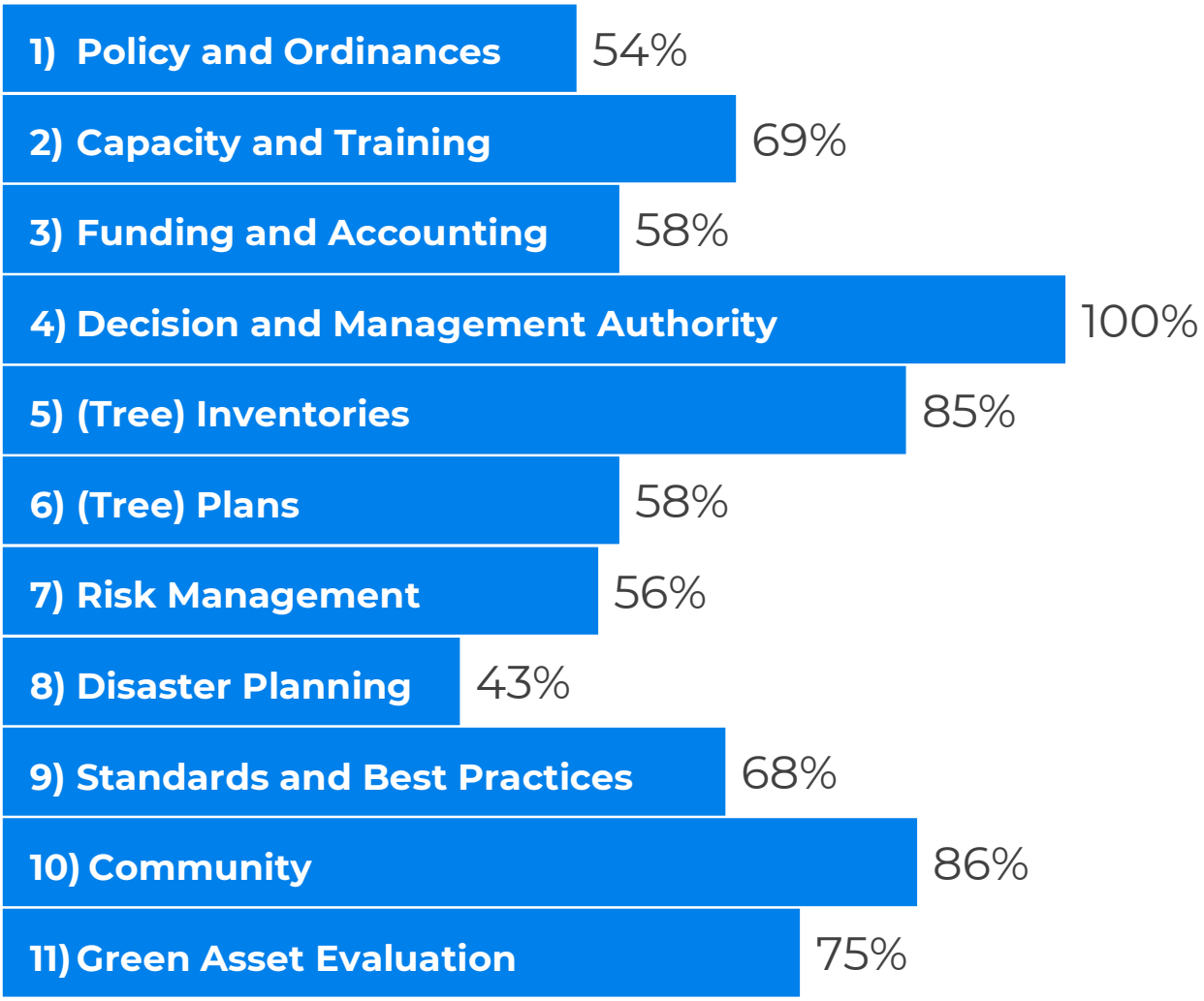


Figure 21. Summary of the 2022 Urban Forest Audit for Kirkwood's Plan

Interpreting the Urban Forest Audit Scores

The Urban Forest Audit System should serve as a baseline assessment from which progress can be measured and strategies can be adjusted using an adaptive management approach. Overall, Kirkwood scored a 68 out of 100 based on the consultants' evaluation. The scores resulting from the evaluation are informative but should not be considered a definitive assessment or a reason for excessive action due to a currently low score or inaction due to a high score. The following provides an interpretation of the scores for the City to consider when implementing the Plan's corresponding actions.

Management Policy and Ordinances

Table 9. Interpretation of the 2022 Urban Forest Audit scores

Category	Implications
Management Policy and Ordinances **Rating of 54%**	**STRENGTHS**: The City scored relatively average in this category due to the existing and recently updated tree ordinances and development standards. As part of the UFMP, a canopy assessment was completed and canopy goals were drafted to support a "no net loss" approach to urban forest canopy management. **OPPORTUNITIES**: Enhanced tree protection and enforcement in the right-of-way and on private property will support a "no net loss" strategy for retaining the benefits of urban forests. Appropriate levels of public and private tree ordinances as well as a strengthened Heritage Tree Program would advance Kirkwood in this category. Also, the City should explore planning options for climate mitigation and adaptation aligned with sustainability efforts and goals and formally adopt canopy goals.
Professional Capacity and Training **Rating of 69%**	**STRENGTHS**: Staff have industry certifications, qualifications, and training. **OPPORTUNITIES**: Kirkwood scored average in this category since the urban forestry program is understaffed compared to industry standards and similar cities. Additional staff involved in tree activities such as permitting, ordinance enforcement, development planning, and community engagement should be certified arborists accredited by the International Society of Arboriculture.
Funding and Accounting **Rating of 58%**	**STRENGTHS**: Urban forestry is budgeted annually, and the Forestry Division is acquiring oversight of the utility vegetation management budget from Kirkwood Electric. **OPPORTUNITIES**: Based on benchmarking research, when excluding the utility vegetation management budget, Kirkwood is below regional averages in terms of budget per public tree ($34.81 compared to $37.35 for cities with similar population size). A diversified, sustainable, and dedicated funding source is needed. Kirkwood has a strong network of engaged community residents who are in support of reallocating resources for urban forestry and provide tree stewardship support (i.e., young tree training).
Decision and Management Authority **Rating of 100%**	**STRENGTHS**: Kirkwood has an Urban Forestry Commission and the Urban Forestry Program has authority over day-to-day activity. The staff closely engage with other City divisions and sections. The City scored high in this category since the audit only contains four subcategories but can be expanded as described in the opportunities below. **OPPORTUNITIES**: Continue to coordinate with other City staff, partners, and contractors. Identify workflow efficiencies and maintain standard operating procedures and contractor specifications.

Category	Implications
Inventories **Rating of 85%**	**STRENGTHS**: Kirkwood has a comprehensive public tree inventory (2022) and a previous inventory from 2014-2017. In 2022, the City completed an assessment of Citywide urban tree canopy cover. The data is used to inform management and prioritize tree planting and preservation for environmental justice and equity. **OPPORTUNITIES**: The City should support in a technical capacity the inventory of private property trees including campuses and corporations. In addition, a sample survey of trees in public open space and natural areas would provide data to support sustainable urban forest management. The City should maintain these inventories and conduct reassessments of tree canopy cover every 5 to 10 years to monitor change, track canopy goals, and adapt strategies.
Urban Forest Management Plans **Rating of 58%**	**STRENGTHS**: Tracking and reporting of urban forest management activities, this Plan, and urban forestry referenced in the Comprehensive Plan resulted in higher than average scores for certain elements within this category. **OPPORTUNITIES**: Plans for other landscapes comprising the urban forest such as open space, grounds on public facilities, campus/university trees, and green stormwater management, is an opportunity for Kirkwood. The Park and Recreation Master Plan of 2005 should be updated and reflect goals in this Plan to a degree. Implementation of this Plan will increase the rating as will plans for private trees and enhanced street tree strategic planning such as a street tree planting plan.
Risk Management **Rating of 56%**	**STRENGTHS**: Staff and contractors trained in tree risk assessments and standard of care adopted. The City completed a comprehensive public tree inventory in 2022 to inform management strategies. **OPPORTUNITIES**: Additional internal technical support for assessing trees questioned for removal would improve the efficiency, effectiveness, resourcefulness, and appeal of City operations. A maintained inventory of trees in public rights-of-way is necessary to identify, monitor, plan, prioritize, and mitigate risk. The inventories detail Kirkwood's vulnerabilities to tree pests and diseases, climate change impacts, storm events, invasive species, and the natural or premature senescence of trees. The Plan provides recommendations for implementing risk management standards and best practices.
Disaster Planning **Rating of 43%**	**STRENGTHS**: The City's maintenance staff and contractors address downed trees and limbs and collaborate when extensive response is needed. **OPPORTUNITIES**: Primarily, a multi-faceted disaster plan for public trees is needed along with coordination between the county and neighboring cities.

Category	Implications
Standards, and Best Practices **Rating of 68%**	**STRENGTHS**: Kirkwood has an average rating for this category due to the tree ordinances, Tree Manual, Zoning Ordinance, Comprehensive Plan, and informational fliers such as Kirkwood Electric's Vegetation Management Tree Trimming Policy and Standards. **OPPORTUNITIES**: The City should specifically mention American National Standards Institute's (ANSI) standards, ISA best practices, and other related references in City Code. The Tree Manual could be expanded to include more detail on regulations along with any updates recommended in this Plan. Updates to tree ordinances may include canopy goal policies as recommended in this Plan. Overall, implementing the Plan will raise Kirkwood's score in this category.
Community **Rating of 86%**	**STRENGTHS**: Kirkwood is a Tree City USA city, demonstrating the value placed on urban forests. This Plan included a public survey and has engaged and informed the public through an interactive and current project website— KirkwoodUrbanForest.com. The City conducts Arbor Day events, has an Urban Forestry Commission, supports Keep Kirkwood Green and the Junior Treekeepers program, engages the public through social media, website, and other platforms, addresses service requests, and works closely with other community partners. **OPPORTUNITIES**: Continue to utilize the project website and the City's website, address the concerns and questions posed in the survey, conduct outreach to the public based on survey feedback, establish a recognition program by sector for exemplary urban forest considerations, address underserved areas as identified in the canopy and tree equity assessments, and facilitate more trainings both internally and for the public. Align efforts with ongoing initiatives relating to climate change and sustainability and garner community partnerships that represent the diverse population in the City. Continue to engage with the Urban Forestry Commission and Keep Kirkwood Green to increase capacity, provide support for urban forest advocacy, and support community engagement.
Green Asset Evaluation **Rating of 75%**	**STRENGTHS**: The public tree population is diverse with 174 unique tree species, relatively young (28% in the 0-6-inch size class), and mostly in good condition (67%). **OPPORTUNITIES**: This category is for documenting observed outcomes and improvements which will occur as this Plan is implemented and the comprehensive public tree inventory is maintained. The updates to tree-related ordinances and design standards will likely contribute to urban forest health, preservation, and growth. Currently, no public tree species exceed the recommended 10% distribution nor do any of the tree genera exceed the threshold of 20%. Pin oaks are at 7% and *Quercus* trees are at 17%, respectively. The City should develop a strategic tree planting plan to maintain diversity, meet canopy goals, plant for a changing climate, optimized planting sites, increase the stocking levels, and provide post-planting care. One concern is the top ten most prevalent species comprise nearly half (48%) of the entire public tree population. This example of current vulnerabilities should continue to be monitored and addressed by implementing the Plan.

Summary of Findings

Table 10. Conclusions from the planning elements integrated into the Urban Forest Master Plan

Element	Conclusion
1) Existing Policies and Plans	The City has a strong framework of policies and plans that allude to or reference urban forestry, but a strategic Urban Forest Master Plan is needed to connect these elements. Envision Kirkwood 2035 has a goal specific to the development of this Plan to support tree ordinances. The City should implement actions in this Plan to update policies and inform existing and ongoing City plans.
2) City Workflows and Operations	Multiple City divisions and departments interact or influence the public tree population. The Forestry Division has established strong communications and support among these agencies to review development plans, utility tree pruning, tree ordinance enforcement, and other activities. Standard Operating Procedures (SOPs) may be developed to solidify the cooperation and support changes to urban forestry program staffing. Continued cohesive planning and management will maintain efficiencies and improve the levels of service provided to City residents.
3) Baseline Conditions	The City has a public tree inventory and Citywide tree canopy assessment and should consider regular updates. Additional inventories of parks and open space and private tree sampling should be considered. The City public tree population would benefit from a strategic planting plan by neighborhood that supports an adopted long-term Citywide canopy goal.
4) Urban Forest Benchmarks	The City should evaluate its staffing levels, contractor arrangements, and responsibilities to better manage the public tree population at levels consistent with industry standards and cities of similar population size, especially given the challenges posed by climate change and development. The budget for urban forest management should align with the recommended actions in this Plan. Kirkwood should also consider adopting a Citywide canopy goal, a common urban forestry benchmark, from which progress can be measured.
5) Community Engagement	Outreach and engagement should be supported by the Urban Forestry Commission and community partners to maintain a healthy and resilient urban forest supported and cared for by community stewards. A community outreach strategy would align efforts and resources.
6) Urban Forest Audit System	Overall, the City scored 68 percent based on the U.S. Forest Service's Urban Forest Audit system that evaluates 11 categories of urban forest management and sustainability. A relatively high scoring was anticipated since the City is taking purposeful steps in elevating its urban forest management program. Implementation of actions in this Plan will maintain strengths and improve shortcomings. Frequent auditing exercises should be conducted to measure progress and adjust strategies in an adaptive management approach. The auditing outcomes will provide the Urban Forester and future staff with crucial data for daily and long-term priorities.

How Do We Get What We Want?

Goal, Action, and Target Framework

Results from five planning elements were used to complete the Urban Forest Audit of Kirkwood's urban forest and the programs that manage it. With this process, the City's strengths and opportunities were systematically evaluated to inform the Plan's urban forestry goals, actions, targets, and evaluation criteria for adaptive management. The goals in the Plan are a result of this evaluation and are consistent with the categories in the Urban Forest Audit system. These goals systematically identify how the City will achieve desired outcomes.

Applying Planning Outcomes to the Goal Framework

Table 11. Goals for Kirkwood's urban forest

Goal Theme	Audit Score*	Goal Description
Tree Management Policy (MP)	61% avg	Urban forest policies are the foundation for preserving the environmental benefits, management, and the character of Kirkwood's urban forest.
Capacity, Training, and Authority (CT)	84% avg	Kirkwood has the capacity and expertise to provide optimal levels of service for sound urban forest management.
Budget and Funding (BF)	58%	City resources enable comprehensive urban forest management for the preservation and enhancement of tree benefits.
Assessments and Plans (AP)	71% avg	A thorough understanding of the urban forest ensures data-driven decisions, sustainable and comprehensive planning, and amplified tree benefits.
Community Engagement (CE)	86%	Sustainable urban forest management and equity is achieved through a partnership with the City and its residents resulting in improved well-being, human health, and local economies.
Green Asset Management (GA)	58% avg	Kirkwood proactively manages the public trees, continues to grow and expand a healthy canopy, effectively mitigates storm damage, maintains public safety, and optimizes urban forest benefits.

*Based on the 2022 evaluation of Kirkwood's urban forestry asset, programs, and community framework. Tree Management Policy rating includes Management Policy and Ordinances (54%) and Standards and Best Management Practices (68%); Capacity, Training, and Authority rating includes Capacity and Training (69%) and Decision and Management Authority (100%); Assessments and Plans rating includes Inventories (85%) and Urban Forest Management Plans (58%); Green Asset Management rating includes Risk Management (56%), Disaster Planning (43%), and Green Asset Evaluation (75%).

City of Kirkwood's Urban Forestry Goals

1

TREE MANAGEMENT POLICY (MP):
Urban forest policies are the foundation for preserving the environmental benefits, management, and the character of Kirkwood's urban forest.

2

CAPACITY, TRAINING, AND AUTHORITY (CT):
Kirkwood has the capacity and expertise to provide optimal levels of service for sound urban forest management.

3

BUDGET AND FUNDING (BF):
City resources enable comprehensive urban forest management for the preservation and enhancement of tree benefits.

4

ASSESSMENTS AND PLANS (AP):
A thorough understanding of the urban forest ensures data-driven decisions, sustainable and comprehensive planning, and amplified tree benefits.

5

COMMUNITY ENGAGEMENT (CE):
Sustainable urban forest management and equity is achieved through a partnership with the City and its residents resulting in improved well-being, human health, and local economies.

6

GREEN ASSET MANAGEMENT (GA):
Kirkwood proactively manages the public trees, continues to grow and expand a healthy canopy, effectively mitigates storm damage, maintains public safety, and optimizes urban forest benefits.

Action Framework

Table 12. Framework and description of urban forestry actions

Priority	Effort	Action # & Order	Action Description	Co-Benefits**	Lead* & Target Year
1-3 ranking of action importance indicated by cell color (3 cells = highest priority)	1-3 ranking of resources required indicated by cell color (3 cells = highest level of effort)	Action number with a reference to the Urban Forest Audit categories. Number to indicate overall order of implementation	Description of the action for the respective goal	Additional benefits to Kirkwood. Up to 3 dots ("●") possible. More dots, greater impact. C=Community, H=Human Health, E=Equity, N=Natural Environment	Implementer lead and collaborator. Calendar year(s) to implement

*Lead: FD = Public Services Department's Forestry Division; SD = Public Services Department's Street Division; PD = Public Services Department's Planning Division; ED = Public Services Department's Engineering Division; PRD = Parks & Recreation Department's Park Operations; KW = Kirkwood Electric; UFC = Urban Forestry Commission. **Bold** indicates lead agency followed by supporting agencies.

**Co-benefits: C = Community; H = Human Health; E = Equity; N = Natural Environment

Table 13. Example framework of the urban forestry actions

Priority	Effort	Action # Order	Tree Management Policy (MP) Actions	Co-Benefits**	Lead* & Target Year
		MP.01 ##	Align resources and planning efforts across City departments and partners to meet common goals and improve efficiencies.	C H E N	**FD**, SD, PD, ED, PRD, KW, UFC, KKG 2023, Annually

Table 14. Example framework of the urban forestry action targets

ACTION TARGET 1	ACTION TARGET 2	ACTION TARGET 3
Supporting target leading to final target aligned with action "target year" and desired outcome	Supporting target leading to final target aligned with action "target year" and desired outcome	**Targets in bold font and colored by goal color are the primary target to measure success of implementing the corresponding action**

Appendices and Supporting Studies

To guide implementation of the actions in this Urban Forest Master Plan a series of appendices and supporting studies were completed. The need for these resources was uncovered during the planning stages. The research, City staff meetings, tree assessments, and benchmarking informed the comprehensive audit system that identified Kirkwood's strengths and opportunities as it relates to the urban forest. It is recommended the City departments utilize these resources to implement actions and integrate them into daily operations and workflows where applicable. These resources include:

Appendix A. Public Tree Inventory Analysis and Summary

Summarizes the public tree inventory completed in 2022 by extent, location, structure, condition, and maintenance priority to support implementation of this Plan.

Appendix B. Management Schedule and Budget Worksheet

Based on the analysis of the 2022 public tree inventory, this worksheet details the schedule and estimated costs to complete the maintenance and removal priorities.

Appendix C. 2022 Urban Forest Audit Results: Provides the status for each element within the 11 categories of urban forest management, sustainability, and equity as defined by the U.S. Forest Service and urban forestry consultants for the UFMP. The interactive worksheet provided as part of the project should be utilized to monitor and adapt UFMP implementation.

Appendix D. Funding Mechanisms: To support the implementation of actions in this Plan, a matrix of funding mechanisms is provided that describe the funding option, requirements, considerations, and limitations. The City should have a diverse portfolio of funding sources to be sustainable and achieve the urban forest vision.

Appendix E. Trees and Hardscape Conflicts Solutions Workbook: Existing trees in the landscape share limited space with other City infrastructure. As such, the assets are competing for space which may result in conflicts between trees and hardscape. This workbook provides the decision matrix to assess the tree(s), the site(s), and the conflict(s) in a transparent and consistent manner. In addition, alternative solutions for tree and hardscape conflicts are provided.

Appendix F. Urban Forest Best Practices: To support implementation of this Plan, a series of best practices for maintenance and planting is provided. This information should be utilized internally and shared with partners and the community to maintain and grow a healthy and sustainable urban forest.

Appendix G. Storm and Disaster Management Guidance: One area where the Urban Forest Audit identified a shortcoming is in the City's protocols and strategies for storm and disaster preparation, response, and recovery. This resource provides guidance from the U.S. Forest Service and regional examples for the City of Kirkwood to integrate into its existing storm and disaster management program.

GOAL 1

TREE MANAGEMENT POLICY (MP)

Urban forest policies are the foundation for preserving the environmental benefits, management, and the character of Kirkwood's urban forest.

URBAN FOREST AUDIT:
Management Policy and Ordinances at 54% Attainment (2022)
Standards and Best Management Practices at 68% Attainment (2022)

STRENGTHS: Chapter 24 of Kirkwood Municipal Code entitled, "Trees" describes the City authority to manage street and other public trees along with the preservation and protection regulations (Article II). This Chapter describes the City and abutting property owner's responsibilities, restrictions, and permitting requirements. The Forestry Division and supporting divisions actively monitor development designs and plans and provides guidance for City projects in regard to tree planting, preservation, protection, mitigation, and maintenance. The City has a strong framework of standards and best practices in place including a Tree Manual containing pruning, protection, and planting specifications and prohibited tree species.

OPPORTUNITIES: As part of the Urban Forest Master Plan, tree canopy goals were developed that may be integrated into City Code and policy. The Citywide tree canopy goals and planting priorities should be reviewed, refined, and adopted. Canopy targets at a finer scale such as neighborhoods should be considered. Align these goals with planning efforts such as stormwater and sustainability. Continue to engage in City policy, guidelines, procedures, and plan updates. All efforts should support a "no-net-loss" strategy through proper tree preservation. To support canopy goals, the City should explore a tree protection ordinance for Centennial/Significant/Heritage trees greater than 30" in diameter on private lots greater than 1 acre in size. The public survey for the UFMP should be used during consideration.

It is recommended the Forestry Division compile all tree-related standards and best practices into an update to the Tree Manual. This manual should be a guide for City staff, contractors, property owners, and developers. The City would advance in this audit category by including existing resources as well as statements of necessary industry standards (e.g., ANSI and ISA), proper tree selection to support species and age diversity, and tree risk assessment protocols in the manual.

PURPOSE:

- Support: An urban forestry program implementing actions without the appropriate support from policy and ordinances is at risk of using resources and time inefficiently and may lack the enforcement necessary for permanent improvements. A weak or outdated framework of policy and ordinances for urban forest management jeopardizes the success of key projects that support this Plan.
- Connections: Alignment of policy and ordinances ensures a strong connection among the urban forestry program's high-level strategic goals, and the projects and initiatives that support these goals.
- Holistic: Programs cannot live in isolation. Therefore, cross-examining and aligning various plans, policies, and ordinances brings to light any projects or initiatives that are a misplacement of resources.

Tree Management Policy (MP) Actions

Table 15. Goal 1, Tree Management Policy Actions

Priority	Effort	Action # Order	Tree Management Policy (MP) Actions	Co-Benefits**	Lead* & Target Year
		MP.01 28	Align resources and planning efforts across City departments and partners to meet common goals and improve efficiencies.	C H E N	**FD**, SD, PD, ED, PRD, KW, UFC, KKG 2023, Annually
		MP.02 29	Tree managing staff should engage in City department planning such as updates to the City's Comprehensive Plan, Park and Recreation Master Plan, Stormwater Management Guidance (tree credits), Kirkwood Electric's Utility Line Vegetation Management Program, and other City planning efforts.	C H E N	**FD**, SD, PD, ED, PRD, KW, UFC 2023, Annually
		MP.03 65	As tree-related policies, guidelines, best practices, and standards are refined, update the Tree Manual and consider separate manuals for planners, developers, homeowners, contractors, and private tree care companies.	C H E N	**FD**, SD, PD, ED, KW, UFC, KKG 2032

*Lead: FD = Public Services Department's Forestry Division; SD = Public Services Department's Street Division; PD = Public Services Department's Planning Division; ED = Public Services Department's Engineering Division; PRD = Parks & Recreation Department's Park Operations; KW = Kirkwood Electric; UFC = Urban Forestry Commission; KKG = Keep Kirkwood Green. **Bold** indicates lead agency followed by supporting agencies.

**Co-benefits: C = Community; H = Human Health; E = Equity; N = Natural Environment

Tree Management Policy (MP) Targets

Table 16. Goal 1, Tree Management Policy Action Targets

Action Target 1	Action Target 2	Action Target 3
MP.01: All entities, resources, and planning efforts identified (Year 2)	MP.01: Regular meetings between departments and partners improves outcomes and efficiencies (Year 5)	MP.01: Goals of participating partners are achieved (Year 20)
MP.02: Tree management staff represented at relevant planning meetings (Year 2)	MP.02: Tree management staff represented at relevant planning meetings (Year 5)	MP.02: Urban forestry is integrated into all relevant City and partner planning efforts (Year 10)
MP.03: Code, manuals, standards, and policies are updated (Year 5)	MP.03: The Tree Manual is updated (Year 8)	**MP.03: Manuals are prepared and distributed specific to all sectors (Year 10)**

GOAL 2

CAPACITY, TRAINING, AUTHORITY (CT)

Kirkwood has the capacity and expertise to provide optimal levels of service for sound urban forest management.

URBAN FOREST AUDIT:
Capacity and Training at 69% Attainment (2022)
Authority at 100% Attainment (2022)

STRENGTHS: The Forestry Division is staffed with certified, qualified, and trained personnel for the management of the urban forest. Supporting this team is the framework established to utilize certified consultants and contractors for public tree removals and maintenance. City staff maintain certifications and continue to expand skillsets and offer trainings and presentations relating to the City's urban forest.

The staffing structure in place allows for clear communications and authority with coordinated efforts between the Forestry Division and other City agencies.

OPPORTUNITIES: Continue to support in-house and outsourced training for staff and contractors as it relates to tree maintenance, safety, risk, and other needs. Currently, the Forestry Division is staffed with two individuals. It is recommended the City evaluate the staff involved in tree permitting, ordinance enforcement, development planning, natural and open space management, and community engagement. As changes occur to programs, policies, and procedures, the Forestry Division should update Standard Operating Procedures (SOPs).

PURPOSE:

1. Quality: The complexity of urban forests requires adept personnel for its appropriate care, growth, and resiliency. A city with quality staff reduces the variance of quality in service.
2. Efficiency: A city with adequate staffing levels who are appropriately trained can meet the needs of the community timely and effectively. Staff with an understanding and training in processes affecting the urban forest can align efforts to achieve common goals.
3. Safety: Safe practice of arboriculture and urban forestry is critical for city staff, contractors, and the public to reduce the potential risk of public hazards.
4. Service: This Plan provides recommendations to enhance service levels as it relates to public tree maintenance to achieve improved urban forest health through proper and routine tree maintenance.

Capacity, Training, Authority (CT) Actions

Table 17. Goal 2, Capacity, Training, Authority Actions

Priority	Effort	Action # Order	Capacity, Training, Authority (CT) Actions	Co-Benefits**	Lead* & Target Year
■		**CT.01** 1	Establish an urban forestry working group with regular meetings to monitor progress of implementing actions. Finalize lead implementers.	● ● ● ● C H E N	**FD**, SD, PD, ED, PRD, KW, UFC, KKG 2022
■		**CT.02** 11	Utilize a continuous improvement framework (Commitment, Strategy, Process, Performance) to improve operational workflows and coordination among departments impacting or influencing the urban forest.	● ● ● ● C H E N	**FD**, SD, PD, ED, PRD, KW, UFC, KKG 2022, Annually
■	■	**CT.03** 27	Appropriately staff the review of plans for commercial development projects and enforcement of the Tree Ordinance.	● ● ● ● C H E N	**FD**, SD, PD, ED, KW, UFC 2023, Annually
■	■	**CT.04** 41	Ensure tree-related operations are represented by staff with industry credentials such as International Society of Arboriculture (ISA) Certified Arborist and Tree Risk Assessment Qualification (TRAQ) either directly through the department or supporting department.	● ● ● ● C H E N	**FD**, SD, PD, ED, PRD, KW, UFC 2024, Annually
■	■	**CT.05** 42	Provide or support training to departments involved in the tree permitting processes, plan reviews, tree inspections, project design, and construction. ISA Certified Arborists within the department or supporting department should be involved with these processes.	● ● ● ● C H E N	**FD** 2025, Annually

*Lead: FD = Public Services Department's Forestry Division; SD = Public Services Department's Street Division; PD = Public Services Department's Planning Division; ED = Public Services Department's Engineering Division; PRD = Parks & Recreation Department's Park Operations; KW = Kirkwood Electric; UFC = Urban Forestry Commission; KKG = Keep Kirkwood Green. **Bold** indicates lead agency followed by supporting agencies.

**Co-benefits: C = Community; H = Human Health; E = Equity; N = Natural Environment

Capacity, Training, Authority (CT) Targets

Table 18. Goal 2, Capacity, Training, Authority Action Targets

Action Target 1	Action Target 2	Action Target 3
CT.01: Potential departments, partners, and sectors necessary for implementation of the UFMP identified (Year 1)	CT.01: All necessary members join the workgroup (Year 1)	**CT.01: Meeting framework and responsibilities established (Year 1)**
CT.02: UFMP actions to improve efficiencies begin to be implemented (Year 1)	**CT.02: Regular meetings between departments and partners identify changes in workflows and resource needs (Year 2)**	CT.02: The framework shows improvements in workflows, efficiency, efficacy, and communications (Year 5)
CT.03: SOPs established for the Forestry Division and supporting staff to engage in plan reviews (Year 2)	CT.03: The Forestry Division is involved in more pertinent plan reviews (Year 3)	**CT.03: The Forestry Division is involved in all pertinent plan reviews (Year 4-20)**
CT.04: Required certifications and qualifications for tree management staff and contractors identified (Year 2)	CT.04: Staff and contractors maintain certifications, qualifications, and licenses (Year 3-20)	**CT.04: Staff and contractors maintain certifications, qualifications, and licenses (Year 3-20)**
CT.05: Training needs are identified (Year 3)	CT.05: Annual training meets the needs of City staff (Year 3-20)	**CT.05: Annual training meets the needs of City staff (Year 3-20)**

Capacity, Training, Authority (CT) Actions Continued

Table 17. Goal 2, Capacity, Training, Authority Actions continued

Priority	Effort	Action # Order	Capacity, Training, Authority (CT) Actions	Co-Benefits**	Lead* & Target Year
		CT.06 21	Stay current with industry research, science, and technology through various platforms. An example includes management of current and potential exotic tree pest and disease threats.	C H E N	**FD**, SD, PD, ED, PRD, KW, UFC, KKG 2022, Annually
		CT.07 43	Strengthen or establish written urban forestry protocols, specifications, and standards for capital projects, construction administration, maintenance, contracts, and performance monitoring.	C H E N	**FD**, SD, PD, ED, PRD, KW, UFC, KKG 2025
		CT.08 44	Evaluate staffing and contractor resources required to effectively plant trees aligned with canopy goals and provide post-planting care.	C H E N	**FD**, UFC, KKG 2025, 2030
		CT.09 64	Evaluate the feasibility of a Citywide Volunteer Coordinator dedicated to urban forestry along with the roles and shared goals of the Urban Forestry Commission and local non-profits.	C H E N	**FD**, SD, PD, ED, PRD, KW, UFC, KKG 2032

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**Co-benefits: C = Community; H = Human Health; E = Equity; N = Natural Environment

Capacity, Training, Authority (CT) Targets Continued

Table 18. Goal 2, Capacity, Training, Authority Action Targets continued

Action Target 1	Action Target 2	Action Target 3
CT.06: A framework for acquiring necessary information is established (Year 2)	CT.06: Tree management staff attend relevant conferences, webinars, and trainings (Year 3-20)	**CT.06: Tree management staff attend relevant conferences, webinars, and trainings (Year 3-20)**
CT.07: Existing protocols and other guidance documents are gathered and reviewed (Year 3)	CT.07: Areas for improvements to protocols and guidance documents is listed (Year 4)	**CT.07: All relevant protocols and guidance documents are updated and maintained (Year 5)**
CT.08: Canopy goals and planting targets are finalized (Year 2)	CT.08: An analysis of the required staff necessary to plant and maintain new trees to meet canopy goals is prepared (Year 4)	**CT.08: A budget proposal is prepared detailing the necessary staff (Year 9)**
CT.09: A needs assessment is prepared detailing the role of an urban forestry-specific Volunteer Coordinator (Year 6)	CT.09: A budget proposal is prepared detailing the necessary staff (Year 9)	**CT.09: A Volunteer Coordinator supports Citywide community outreach and engagement needs (Year 11)**

GOAL 3

BUDGET AND FUNDING (BF)

City resources enable comprehensive urban forest management for the preservation and enhancement of tree benefits.

URBAN FOREST AUDIT:
Funding and Accounting at 58% Attainment of Urban Forest Audit Category (2022)

STRENGTHS: The City annually budgets for urban forest management and the Forestry Division utilizes partners to leverage resources and continues to seek funding opportunities to maintain and enhance the urban forest.

OPPORTUNITIES: The 2014 census of urban forestry programs across the U.S. determined the average budget per public tree (streets, parks, maintained natural areas) to be $37.50. Specifically, for Kirkwood's population group (25,000 – 50,000 people), the average is $37.35 budget per public tree annually (Hauer et al. 2014). Based on Kirkwood's 2019 budget for urban forestry (excluding Kirkwood Electric's budget for utility vegetation management, ~$750,000), the Forestry Division has $34.81 budgeted per public tree (~9,000 trees). Compared to the 2014 census, Kirkwood has a deficit of $2.54 per public tree, annually, equating to an approximate annual shortage of $22,000 compared to the average.

The Forestry Division understands the importance of an adequate pruning rotation of public trees and has adopted an 8-year cycle utilizing contractors. The City should anticipate cost increases for maintaining the public trees as well as the associated costs of planting trees to reach canopy goals and the post-planting care required. The budget per public tree metric is an initial analysis that can be utilized to garner this support. Therefore, continual inventories of public trees and analysis of urban forest structure, condition, maintenance needs, and other attributes is necessary to inform budget proposals.

PURPOSE:

- Effectiveness: Appropriate funding levels for urban forestry allow better implementation of this Plan and daily operations resulting in a higher level of service to the community.
- Equity: More resources equate to additional levels of service, particularly to historically underserved and lower-income areas.
- Accountability: Appropriate accounting of management activities and accounting of the urban forest itself enable adequate funding that is performance- and attribute-based.

Budget and Funding (BF) Actions

Table 19. Goal 3, Budget and Funding Actions

Priority	Effort	Action # Order	Budget and Funding (BF) Actions	Co-Benefits**	Lead* & Target Year
		BF.01 12	Continue to budget for annual public tree inventory collection and data management equipment needs for the upcoming budget planning sessions. See Appendix D for further guidance.	C H E N	**FD**, UFC 2022, Annually
		BF.02 13	Continue to seek and acquire funding and technical assistance from organizations such as the Missouri Department of Conservation in cooperation with the MO Community Forestry Council's Tree Resource Improvement and Maintenance (TRIM) cost-share grants, U.S. Forest Service, MU Extension, and others. See Appendix D for further guidance.	C H E N	**FD**, UFC 2022, Annually
		BF.03 30	Develop an annual education and training budget for tree management staff that supports attending CEU accrediting seminars, workshops, and conferences each year. Consider the Tree Care Industry Association's Certified Treecare Safety Professional accreditation.	C H E N	**FD**, UFC 2023, Annually
		BF.04 40	Utilize Appendix D to secure funding for urban forest management activities (e.g., Urban Tree Canopy Assessment and Inventory updates, neighborhood-level strategic tree planting plans, resources to maintain a growing urban forest, policy and ordinance enforcement).	C H E N	**FD**, UFC 2024, Annually

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Budget and Funding (BF) Targets

Table 20. Goal 3, Budget and Funding Action Targets

Action Target 1	Action Target 2	Action Target 3
BF.01: All street and park trees are reinventoried in at least one City Forestry Maintenance District per year, data managed in system (Year 2)	BF.01: All street and park trees are reinventoried in at least one Forestry Maintenance District per year, data managed in system (Year 3-20)	BF.01: All street and park trees are reinventoried in at least one Forestry Maintenance District per year, data managed in system (Year 3-20)
BF.02: Resources of partners are utilized (Year 1)	**BF.02: Grant application submitted and approved for a project such as tree planting, planning, inventory (Year 2)**	BF.02: Grant application submitted and approved for a project such as tree planting, planning, inventory (Year 3-20)
BF.03: An assessment of training needs supports budget planning (Year 1)	BF.03: All tree management staff retain certifications, licenses, and qualifications (Year 2)	**BF.03: All staff associated with urban forest management are certified and/or appropriately trained (Year 10)**
BF.04: Funding mechanisms provided in the UFMP are explored for funding strategies (Year 1)	BF.04: Priority activities and projects identified, funding mechanism strategy(s) implemented (Year 2)	**BF.04: Funding secured for priority activities and/or projects (Year 3)**

Budget and Funding (BF) Actions Continued

Table 19. Goal 3, Budget and Funding Actions continued

Priority	Effort	Action # Order	Budget and Funding (BF) Actions	Co-Benefits**	Lead* & Target Year
		BF.05 22	Continue to secure short-term funding within to manage emergency response for tree damage after storm events, including debris management.	C H E N	**FD**, UFC 2022, 2026, Annually
		BF.06 31	Use the data from the Assessments and Plans actions (i.e., tree maintenance needs, tree planting needs, ecosystem services) to support budget and funding increases aligned with resource needs and actions in the UFMP.	C H E N	**FD**, UFC 2023, 2027, Annually
		BF.07 56	Use inventory data, the UFMP, and other resources to secure the necessary budget to implement pest/disease treatment and control measures.	C H E N	**FD**, UFC 2028
		BF.08 67	Establish a dedicated, sustained funding source beyond the current departmental budget for urban forestry operations to increase the level of service to meet the community's high standards. Use Appendix D as guidance.	C H E N	**FD**, UFC, KKG 2041

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**Co-benefits: C = Community; H = Human Health; E = Equity; N = Natural Environment

Budget and Funding (BF) Targets Continued

Table 20. Goal 3, Budget and Funding Action Targets continued

Action Target 1	Action Target 2	Action Target 3
BF.05: The urban forest is analyzed to identify priorities, at-risk areas, and concentrations of concern (Year 1)	BF.05: The feasibility of funding mechanisms provided in the UFMP are further refined and strategies are developed (Year 3)	**BF.05: Mechanisms for dedicated emergency funding and contracts for storm response are secured (Year 5)**
BF.06: Tree inventory data and supporting information is utilized to establish annual budget (Year 2)	BF.06: Tree inventory data and supporting information is utilized to establish annual budget (Year 4)	**BF.06: The program budget reflects the needs identified in the tree inventory, canopy assessment, and other resources (Year 6)**
BF.07: Funding mechanisms provided in the UFMP and in the sustained funding report are explored for pest and disease management (Year 4)	BF.07: A tree pest and disease plan is completed and a budget proposal is prepared (Year 6)	**BF.07: The budget is secured to implement the tree pest and disease plan in its entirety (Year 7)**
BF.08: Tree inventory and canopy data along with supporting information is utilized to identify any budget shortfalls (Year 10)	BF.08: Strategies in the sustained funding report are fully implemented (Year 15)	**BF.08: A dedicated, sustained funding source is established that represents the needs of the urban forest, service levels, and community (Year 20)**

GOAL 4

ASSESSMENT AND PLANS (AP)

A thorough understanding of the urban forest ensures data-driven decisions, sustainable and comprehensive planning, and amplified tree benefits.

URBAN FOREST AUDIT:
Inventories at 85% Attainment (2022)
Urban Forest Management Plans at 58% Attainment (2022)

STRENGTHS: The Forestry Division utilizes resources to conduct routine inventories (2014-2017 and 2022) and the data is maintained in the City's tree inventory management software. The data is managed to prioritize tree maintenance and removals and to report the associated ecosystem services and benefits of the inventoried trees. In addition, maintenance records are tracked in the inventory software. Trees are incorporated into stormwater management and appropriately tracked. The City has completed a high-resolution Urban Tree Canopy (UTC) Assessment which also identified prioritized planting areas.

The City has multiple plans influencing the urban forest from Envision Kirkwood 2035, the Park and Recreation Master Plan, Stormwater Management Guidance, Tree Manual, and other planning resources. This Urban Forest Master Plan aligns efforts to increase future rankings of this audit category.

OPPORTUNITIES: Implementation of this Urban Forest Master Plan will strengthen Kirkwood in terms of the assessment and plans audit category. The Forestry Division should consider providing technical support to partners such as campuses, corporations, and other entities in establishing and maintaining tree inventories supported by a management and planting plan. This will provide a holistic approach to Citywide urban forest management, sustainability, equity, and resiliency.

PURPOSE:

- Informed Management: An inventory of the City's valuable assets—public trees—provides the data for informed management and resource decisions.
- Measured: An understanding of the population of trees provides baseline information from which progress and change resulting from this Plan and an urban forestry program can be measured for adaptive management.
- Value: The inventory of public trees provides information that can be used to quantify the ecosystem services and benefits provided to community residents, environment, and economy.
- Inclusivity: The urban forest is comprised of public and private trees spanning a multitude of ecosystems and land uses. Plans for tree across these landscapes ensures all aspects of urban forestry are included in a cohesive, strategic manner.

Assessments and Plans (AP) Actions

Table 21. Goal 4, Assessments and Plans Actions

Priority	Effort	Action # Order	Assessments and Plans (AP) Actions	Co-Benefits**	Lead* & Target Year
		AP.01 6	Continue to conduct "windshield surveys" for quick visual assessments of public trees. Utilize the information gathered, service requests, and inventory data to prioritize tree maintenance and removals.	C H E N	**FD**, PRD, KW, KKG 2022, Annually
		AP.02 10	Maintain the inventory of public street and park trees. Update as maintenance and new plantings occur. Encourage partners to manage a current inventory of utility trees.	C H E N	**FD**, PRD, KW 2022, Annually
		AP.03 17	Track all city-led tree plantings and tree plantings conducted by partners. Utilize the tree inventory software and consider integrating with the city asset management program.	C H E N	**FD**, KKG, SD, ED, PRD, UFC 2022, Annually
		AP.04 25	Use the ISA protocols established in Action GA.10 when conducting risk tree assessments deemed a priority or imminent need.	C H E N	**FD** 2023, Annually
		AP.05 26	Create an annual activity calendar for urban forest management aligned with actions in this UFMP.	C H E N	**FD** 2023, Annually
		AP.06 39	Complete an urban forest audit using similar criteria as the 2021 audit completed for the UFMP to evaluate improvements in urban forest management and adapt strategies.	C H E N	**FD** 2024, Bi-annually
		AP.07 46	Support academic institutions, corporations, healthcare facilities, and Homeowners' Associations (HOAs) or planned communities in a technical and educational capacity to develop urban forest inventories.	C H E N	**FD**, UFC, KKG 2025, Annually
		AP.08 47	Support academic institutions, corporations, healthcare facilities, and Homeowners' Associations (HOAs) or planned communities in a technical and educational capacity to develop urban forest management plans.	C H E N	**FD**, UFC, KKG 2025, Annually

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**Co-benefits: C = Community; H = Human Health; E = Equity; N = Natural Environment

Assessments and Plans (AP) Targets

Table 22. Goal 4, Assessments and Plans Action Targets

Action Target 1	Action Target 2	Action Target 3
AP.01: Priority areas or planning areas established for surveys. Annual survey completed and data is prioritized (Year 1)	AP.01: Annual survey completed and data is prioritized (Year 2-20)	**AP.01: Annual survey completed and data is prioritized (Year 2-20)**
AP.02: Database updated to reflect changes to the public tree population (Year 1)	AP.02: All street trees are inventoried in at least one Forestry Maintenance District per year (Year 2)	AP.02: All Forestry Maintenance Districts are inventoried and data is up-to-date (Year 10)
AP.03: A system is established to methodically and routinely gather tree planting and removal data (Year 1)	AP.03: Tree planting and removal data from all partners is integrated into the City's tree inventory system (Year 2)	**AP.03: All tree planting and removal data from the City and partners is accurately maintained (Year 5)**
AP.04: Risk assessment thresholds and protocols are established (Year 2)	**AP.04: A routine risk assessment process is implemented (Year 2)**	AP.04: A reduction in service requests relating to tree risks and hazards is observed (Year 10)
AP.06: UFMP action worksheet is utilized (Year 1)	AP.06: List of activities drafted (Year 2)	**AP.06: Annual calendar created (Year 2)**
AP.05: A team to complete the updated audit is established (Year 1)	**AP.05: The first City-led urban forest audit is completed (Year 3)**	AP.05: An urban forest audit is routinely conducted (Year 4-20)
AP.07: Key entities identified for strategic outreach (Year 1)	**AP.07: One subarea urban forest inventory is completed by partners (Year 4)**	AP.07: At least one new subarea urban forest inventory is completed annually by partners (Year 10)
AP.08: Key entities identified for strategic outreach (Year 1)	**AP.08: One subarea urban forest management plan is completed by partners (Year 4)**	AP.08: At least one new subarea urban forest management plan is completed annually by partners (Year 10)

Assessments and Plans Actions (AP) Continued

Table 21. Goal 4, Assessments and Plans Actions continued

Priority	Effort	Action # Order	Assessments and Plans (AP) Actions	Co-Benefits**	Lead* & Target Year
		AP.09 50	Routinely update the comprehensive public tree inventory in a phased approach by Forestry Maintenance District. At minimum, reinventory the entire public tree population 5 years after the 2022 inventory.	● ● ● ● C H E N	**FD**, PRD 2027
		AP.10 51	Complete an update to the comprehensive high-resolution Urban Tree Canopy (UTC) Assessment using industry recommended protocols.	● ● ● ● C H E N	**FD**, PD, ED 2027
		AP.11 53	Strengthen storm and disaster preparations, mitigations, and recovery strategies, protocols, and mechanisms.	● ● ● C H E N	**FD**, SD, KW, PRD 2027
		AP.12 54	Complete a sample inventory of trees in public natural areas and open space.	● ● ● ● C H E N	**PRD**, FD 2028
		AP.13 55	Quantify the ecosystem benefits and appropriate appraisal values of public trees to conduct a cost-benefit analyses of public trees. This informs maintenance recommendations, program structure, and raises public awareness of the urban forest benefits.	● ● ● C H E N	**FD**, UFC 2028, Bi-annually
		AP.14 57	Review, update, and document the tree species appropriate for planting in the public right-of-way and in parks. Encourage appropriate trees for private property in a Recommended Tree Planting List.	● ● ● C H E N	**FD**, SD, ED, PD, KW, PRD, KKG 2028
		AP.15 49	Based on the outcomes of the bi-annual urban forest audit, available resources, industry technology and research, and data, modify existing actions and develop new actions to continue to achieve goals of the 2022 UFMP. Update at least every 5 years.	● ● ● ● C H E N	**FD**, UFC 2026, 2031

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**Co-benefits: C = Community; H = Human Health; E = Equity; N = Natural Environment

Assessments and Plans (AP) Targets Continued

Table 22. Goal 4, Assessments and Plans Action Targets continued

Action Target 1	Action Target 2	Action Target 3
AP.09: Forestry Maintenance Districts and roadway corridors prioritized (Year 2)	AP.09: Funding is secured for inventory and equipment needs (Year 5)	**AP.09: The updated inventory of all public trees is completed (Year 6)**
AP.10: A budget is prepared and approved for the UTC update (Year 4)	AP.10: An RFP is prepared and consultant selected to complete the UTC update (Year 5)	**AP.10: An updated UTC is completed (Year 6)**
AP.11: Resources to support storm and disaster management are gathered (Year 4)	AP.11: Changes to storm and disaster procedures are drafted (Year 5)	**AP.11: Procedures for urban forest and storm/disaster management is formalized in a written document (Year 6)**
AP.12: Protocols are established for the sample inventory (Year 5)	AP.12: Funding is secured for the sample inventory (Year 6)	**AP.12: The sample inventory is completed (Year 7)**
AP.13: The public tree inventory is current to the extent possible (Year 1-6)	**AP.13: The ecosystem services and benefits of the public tree population is updated (Year 7)**	AP.13: Ecosystem services and benefits of the public tree population are routinely updated based on inventory data and industry research (Year 8-20)
AP.14: Existing tree species lists are reviewed (Year 5)	AP.14: Inventory data informs tree species list (Year 6)	**AP.14: An updated recommended tree species list is created (Year 7)**
AP.15: An assessment of UFMP actions and targets achieved is completed (Year 3)	AP.15: Updated actions for the UFMP are drafted (Year 4)	**AP.15: The UFMP has updated actions and targets (Year 5)**

GOAL 5

COMMUNITY ENGAGEMENT (CE)

Sustainable urban forest management and equity is achieved through a partnership with the City and its residents resulting in improved well-being, human health, and local economies.

URBAN FOREST AUDIT:
Community at 86% Attainment (2022)

STRENGTHS: The Forestry Division utilizes partners to achieve shared goals for the urban forest and to engage the community. Partners include the Urban Forestry Commission, Keep Kirkwood Green, among others. The City website contains ample information about the benefits of the urban forest and the importance of proper care and tree selection. It also includes the Tree Manual. The City utilizes a multitude of mediums for outreach and education and maintains communications through social media. The City has achieved 31 accreditations as a Tree City USA community from the Arbor Day Foundation.

OPPORTUNITIES: The Forestry Division could benefit from a designated volunteer coordinator to oversee urban forestry outreach and community education and engagement. In addition, the Forestry Division and partners should share the outcomes of this Plan with the community through multiple platforms and continue to engage the community members by conducting routine surveys and sharing updates on Plan implementation progress. It is important to continue to remove barriers to encourage participation in activities and feedback opportunities for all City demographics, cultures, and neighborhoods. Existing and potential partnerships should represent all neighborhoods and the Forestry Division and partners should continue to track volunteer metrics. To encourage additional support, the City should consider a public platform for displaying the location, character, and benefits of the public trees inventoried. This public-facing tool could be the platform for expanding on a Significant Tree Program that provides the location and attributes of the City's distinguished trees.

PURPOSE:

- Inclusivity: Residential property contains a large portion of the City's total tree canopy cover. Sustaining the City's urban forest requires residential collaboration and feedback and fostering long-term relationships to improve outcomes.
- Transparency: Program and funding transparency are essential in building resilient community partnerships.
- Resourcefulness: Public participation and insight provide resourceful and impactful urban forest program growth.
- Community: Active participation in nature-related efforts foster community pride and ownership, and breaks down walls, helping bring communities closer together as they become closer to nature.

Community Engagement (CE) Actions

Table 23. Goal 5, Community Engagement Actions

Priority	Effort	Action # Order	Community Engagement (CE) Actions	Co-Benefits**	Lead* & Target Year
		CE.01 2	Coordinate the outreach strategy as a Citywide initiative rather than a departmental effort.	C ● H ● E ● N ●	**FD**, UFC, KKG, KW, PRD, SD, ED, PD 2022
		CE.02 3	Formalize clear and consistent design and language for urban forestry outreach materials.	C ● H ● E ● N ●	**FD**, UFC, KKG, KW, PD, PRD, SD, ED 2022
		CE.03 4	Update the City's website and materials based on information from the UFMP.	C ● H ● E ● N ●	**FD** 2022
		CE.04 5	At minimum, share quarterly informative urban forestry and tree-related content to a social media, City website, and other communication platforms.	C ● H ● E ● N ●	**FD**, UFC, KKG Quarterly
		CE.05 16	Continue to provide information regarding the Tree Ordinance, unauthorized tree plantings, invasives, identifying pests and diseases, planting and young tree care best practices, utility pruning roles and procedures, public tree permitting requirements, and tree maintenance responsibility.	C ● H ● E ● N ●	**FD**, UFC, SD, ED, PD, PRD, KW, KKG 2022, Annually
		CE.06 18	Support volunteer training opportunities as feasible.	C ● H ● E ● N ●	**FD**, UFC, KKG, PRD 2022, Annually
		CE.07 19	Continue to strengthen partnerships with civic groups, Homeowners' Associations, volunteers, institutions, internal, City Council, neighborhoods, improvement districts, regional organizations, and non-conventional organizations.	C ● H ● E ● N ●	**FD**, UFC, KKG, PRD 2022, Annually
		CE.08 20	Continue to track and annually report urban forestry activities of all partners and continue to maintain Arbor Day Tree City USA designation. Strive to achieve Arbor Day Foundation Growth Awards and Sterling Tree City status.	C ● H ● E ● N ●	**FD**, UFC, KKG, KW 2022, Annually

*Lead: FD = Public Services Department's Forestry Division; SD = Public Services Department's Street Division; PD = Public Services Department's Planning Division; ED = Public Services Department's Engineering Division; PRD = Parks & Recreation Department's Park Operations; KW = Kirkwood Electric; UFC = Urban Forestry Commission; KKG = Keep Kirkwood Green **Bold** indicates lead agency followed by supporting agencies.

**Co-benefits: C = Community; H = Human Health; E = Equity; N = Natural Environment

Community Engagement (CE) Targets

Table 24. Goal 5, Community Engagement Action Targets

Action Target 1	Action Target 2	Action Target 3
CE.01: Meet with City departments and partners to develop the community outreach plan (Year 1)	**CE.01: Urban forest outreach and education aligns with other City and partner initiatives, messaging, and events (Year 1)**	CE.01: Urban forest outreach and education integrated into all applicable initiatives, messaging, and events (Year 10)
CE.02: Information from the UFMP is compiled and outreach strategies are drafted (Year 1)	CE.02: UFMP outreach strategies are coordinated with other City departments and efforts (Year 1)	**CE.02: A community outreach plan clearly defines the messaging and approaches (Year 1)**
CE.03: Information in the UFMP is compiled and aligned with the community outreach plan (Year 1)	CE.03: Information is provided to City communications staff and partners for launching and distributing content (Year 1)	**CE.03: The City's and partners' websites and materials contain information consistent with outreach strategy (Year 1)**
CE.04: Urban forestry information relevant to the season and events is shared on various platforms (Q1)	CE.04: Urban forestry information relevant to the season and events is shared on various platforms (Q2)	**CE.04: The City or partner(s)'s website is the go-to source for all urban forestry communications and information (Year 10)**
CE.05: Information is gathered and aligned with the community outreach strategy (Year 1)	**CE.05: Information and resources are shared annually (Year 2)**	CE.05: Data shows a decline in invasive species, tree maintenance malpractice, pests and diseases, and other concerns (Year 20)
CE.06: Training needs are identified with City partners (Year 1)	**CE.06: At least one City or partner-led volunteer training activity is implemented (Year 2)**	CE.06: Partners in all City neighborhoods complete at least one volunteer training annually (Year 10)
CE.07: A network of existing and potential partners is identified using the UFMP and community outreach plan (Year 1)	**CE.07: A diverse network of partners existing with clear communications and roles defined (Year 4)**	CE.07: A diverse network of partners exists representing all City neighborhoods and demographics (Year 10)
CE.08: Receive Tree City USA recognition (Year 1)	CE.08: Receive Tree City USA annually, receive an ADF Growth Award (Year 10)	CE.08: Receive Tree City USA recognition and Sterling status (Year 20)

Community Engagement (CE) Actions Continued

Table 23. Goal 5, Community Engagement Actions continued

Priority	Effort	Action # Order	Community Engagement (CE) Actions	Co-Benefits**	Lead* & Target Year
		CE.09 32	Align the roles and responsibilities of the Urban Forestry Commission with the UFMP.	C H E N	**FD**, UFC 2023
		CE.10 33	Support in a technical capacity the strengthening of a local non-profit organization for the stewardship, outreach, and advocacy of Kirkwood's urban forest.	C H E N	**FD**, UFC, KKG 2023
		CE.11 34	Prioritize community service requests and update the City website with frequently asked questions and resources.	C H E N	**FD** 2023, Annually
		CE.12 37	Utilizing the local non-profit organization and/or the Urban Forestry Commission, engage neighborhoods with volunteer tree planting events. Prioritize areas with lower urban tree canopy and other considerations such as underserved communities using a Tree Canopy Assessment (TCA) and other datasets. Develop a Master Tree Planting Plan to support this action.	C H E N	**FD**, UFC, KKG 2024, 2031, Annually
		CE.13 38	Conduct bi-annual community surveys to gauge public viewpoints and receive feedback on implementation of the UFMP, and program success. Survey responses should inform future urban forest decision making.	C H E N	**FD**, UFC, KKG 2024, Bi-annually
		CE.14 58	Track community service requests and responses and link these to the respective tree(s) in the tree inventory software.	C H E N	**FD** 2028, Annually
		CE.15 63	Utilizing the local non-profit organization and/or the Urban Forestry Commission, develop a program that recognizes exemplary urban forest stewards and volunteers representing youth, residents, organizations, and business owners.	C H E N	**FD**, UFC, KKG 2030

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**Co-benefits: C = Community; H = Human Health; E = Equity; N = Natural Environment

Community Engagement (CE) Targets Continued

Table 24. Goal 5, Community Engagement Action Targets continued

Action Target 1	Action Target 2	Action Target 3
CE.09: Existing roles and responsibilities are documented and reviewed (Year 1)	CE.09: UFMP actions are listed and aligned with UFC roles (Year 2)	**CE.09: The UFC supports implementation of the UFMP (Year 2)**
CE.10: The framework and strategies for supporting a NPO are reviewed (Year 1)	CE.10: An existing or new organization commits to the role of community tree stewardship and outreach (Year 2)	**CE.10: SOPs are created between the organization and the City and the NPO supports UFMP actions (Year 2)**
CE.11: Street and park tree related service requests are analyzed to identify trends and hot spots (Year 1)	**CE.11: The Forestry Division continues to prioritize service requests and adds FAQs to the City website (Year 2)**	CE.11: FAQs on City website continue to be updated based on analyses of service requests received (Year 3-20)
CE.12: Annual tree planting events are well attended and support UFMP goals and actions (Year 2)	**CE.12: Utilize the Urban Tree Canopy Assessment or other data to identify priority planting neighborhoods and areas (Year 3)**	CE.12: A Master Tree Planting Plan informs priority areas and tree species and all neighborhoods engaged (Year 10)
CE.13: Survey responses from the UFMP project are examined and addressed (Year 1)	**CE.13: An online survey is launched to gather input and feedback (Year 3)**	CE.13: An online survey is launched and feedback is received from all neighborhoods and demographics (Year 10)
CE.14: Existing service request data is analyzed (Year 5)	CE.14: Service request system integrated into the tree inventory software (Year 6)	**CE.14: Service requests are maintained and tracked in the tree inventory software (Year 7)**
CE.15: Criteria and sectors of exemplary urban forest stewardship is established (Year 6)	CE.15: Announcement of recognition program is shared with City partners and the public with a request for nominations (Year 8)	**CE.15: Exemplary urban forest stewardship recognition awarded to multiple sectors (Year 9)**

GOAL 6

GREEN ASSET MANAGEMENT (GA)

Kirkwood proactively manages the public trees, continues to grow and expand a healthy canopy, effectively mitigates storm damage, maintains public safety, and optimizes urban forest benefits.

URBAN FOREST AUDIT:
Green Asset Management at 75% Attainment (2022)
Risk Management at 56% Attainment (2022)
Disaster Planning at 43% Attainment (2022)

STRENGTHS: The Forestry Division manages the public tree population for public safety, tree health, and urban forest resiliency through contracted tree maintenance that adheres to industry standards and best practices. In 2018, the City adopted an 8-year programmed pruning cycle. Through these efforts, the public tree population inventoried is in healthy condition overall (67 percent), planted in the appropriate locations, and is relatively diverse. No tree genus exceeds the 20 percent threshold nor do any species exceed the 10 percent threshold. The public tree population contains 174 unique species, contributing to the diversity.

Tree management staff are qualified to conduct tree risk assessments, complete windshield surveys and manage service requests to prioritize maintenance, administer maintenance contracts, oversee development design, and manage maintenance records. The City actively discourages the planting of inappropriate or undesirable tree species.

OPPORTUNITIES: Research indicates a pruning rotation of approximately five to seven years results in reduced long-term costs and improves public safety and tree health. Tree planting should align with other programs, canopy goals, planting targets, and goals of diversity and resiliency. The City should consider developing a strategic planting plan as well as a plan to manage risk by addressing tree pests and diseases, climate change, storm response, and disaster planning on the City and county level.

PURPOSE:

- Efficiency: Alignment of operations improves workflows, encourages resourcefulness, and reduces conflicts. Routine systematic tree maintenance reduces surges of maintenance and removal demands, identifies issues before they become more expensive, and optimizes available time and resources.
- Safety: Appropriate management of green assets reduces the risk of tree failures as well as person and property damage. Utilizing industry standards and best practices reduces on-the-job incidents to the extent possible.
- Sustainability: Managing urban forests as City assets will support stormwater management, climate resiliency, and human health goals. Appropriate maintenance and planting will support a healthy, long-lived urban tree canopy equitably distributed across a city.
- Proactive: Routine maintenance reduces future costs. Planting the urban forest with the appropriate species also reduces future costs, conflicts, and climate change impacts.

Green Asset Management (GA) Actions

Table 25. Goal 6, Green Asset Management Actions

Priority	Effort	Action # Order	Green Asset Management (GA) Actions	Co-Benefits**	Lead* & Target Year
		GA.01 7	Prioritize young and large tree maintenance based on updated inventory data and resources.	C H E N	**FD** 2022, Annually
		GA.02 8	Continue to prioritize and complete necessary public tree removals utilizing contractor protocols.	C H E N	**FD** 2022, Annually
		GA.03 9	Maintain the current maintenance regimen (8-year cycle) by contracting large tree pruning, young tree training, and other tree maintenance activities based on available resources. Adjust as changes occur as a result of GA.01.	C H E N	**FD** 2022, Annually
		GA.04 14	Educate and train City staff and contractors to adhere to Best Management Practices for the maintenance of all diseased/infested City trees.	C H E N	**FD** 2022, Annually
		GA.05 15	Manage invasives in public parks, rights-of-way, and on public properties as feasible with available funding.	C H E N	**FD**, PRD, SD, KW 2022, Annually
		GA.06 23	Annually revisit contract specifications and in-house policies and directives to ensure that tree care operations adhere to current industry standards, including ANSI A300 Standards for Tree Care Operations, ANSI Z133.1-2012 for Arboricultural Operations Safety Requirements, and ISA Series Best Management Practices (BMPs). Include Kirkwood Electric and other relevant organizations.	C H E N	**FD**, KW, SD, ED, PD, PRD 2023, Annually
		GA.07 24	Continue to implement the tree work order system in the City's tree management software.	C H E N	**FD** 2023, Annually
		GA.08 45	Coordinate with other City departments to maximize the number of trees planted through Capital Improvement Programs and stormwater management projects. Establish procedures for replacing damaged trees during infrastructure replacement projects.	C H E N	**FD**, PD, ED, SD, KW, PRD, KKG 2025, Annually

*Lead: FD = Public Services Department's Forestry Division; SD = Public Services Department's Street Division; PD = Public Services Department's Planning Division; ED = Public Services Department's Engineering Division; PRD = Parks & Recreation Department's Park Operations; KW = Kirkwood Electric; UFC = Urban Forestry Commission. **Bold** indicates lead agency followed by supporting agencies.

**Co-benefits: C = Community; H = Human Health; E = Equity; N = Natural Environment

Green Asset Management (GA) Targets

Table 26. Goal 6, Green Asset Management Action Targets

Action Target 1	Action Target 2	Action Target 3
GA.01: Service requests and maintenance continue to be prioritized by the Forestry Division (Year 1)	GA.01: Service requests and routine maintenance continue to be prioritized by the Forestry Division (Year 2)	GA.01: All public young trees receive proper training and established trees are maintained on a recommended rotation (Year 20)
GA.02: Service requests and tree removals continue to be prioritized by the Forestry Division (Year 1)	GA.02: Service requests and tree removals continue to be prioritized by the Forestry Division (Year 2)	GA.02: A reduction in necessary removals overall is observed (Year 20)
GA.03: Priority public trees are pruned (Year 1)	GA.03: Priority public trees are pruned (Year 2-19)	GA.03: All public young trees receive proper training and established trees are maintained on a recommended rotation (Year 20)
GA.04: Annual training or resources shared with pertinent staff (Year 1)	GA.04: Annual training or resources shared with pertinent staff (Year 5)	GA.04: The spread of disease or pests caused by removals and pruning is negligible (Year 20)
GA.05: A comprehensive public tree inventory is completed (Year 6)	**GA.05: Priority areas and strategies established for invasive species management (Year 8)**	GA.05: The urban forest is healthy, diverse, and sustainable (Year 20)
GA.06: Contractor specifications meet ANSI, ISA, and OSHA standards (Year 1)	GA.06: Contractor specifications meet ANSI, ISA, and OSHA standards (Year 5)	GA.06: Observations show a decrease in tree malpractices on public and private property (Year 10)
GA.09: SOPs for work orders are established (Year 2)	GA.09: The City effectively manages tree maintenance and removals in the system (Year 3)	**GA.09: The City fully implements the work order system within the tree inventory software for all public trees (Year 4)**
GA.08: Regular meetings to identify opportunities to collaborate (Year 2)	GA.08: Trees effectively integrated into all City projects where feasible (Year 5)	GA.08: A shared commitment achieves local and Citywide tree canopy goals (Year 20)

Green Asset Management (GA) Actions Continued

Table 25. Goal 6, Green Asset Management Actions continued

Priority	Effort	Action # Order	Green Asset Management (GA) Actions	Co-Benefits**	Lead* & Target Year
		GA.09 35	Use Citywide tree inventory data and best available science for long-term planning and management of existing and future tree pests and diseases impacting the City's urban forest. Consider a tree pest and disease plan.	C H E N	**FD**, UFC, PD 2024, Annually
		GA.10 36	Strengthen protocols and threshold criteria for routine and impromptu public tree risk assessments. Consider ANSI A300 Tree Risk Standards, SOPs, communication protocols, and decision checklist for transparency and consistency.	C H E N	**FD** 2024
		GA.11 48	Develop a framework and approach to utilize biomass following future storm events. Consider using biomass for (natural) playgrounds, a wood chip program, and pulp wood to paper mills.	C H E N	**FD** 2025
		GA.12 52	Use the results of an updated high-resolution Urban Tree Canopy (UTC) Assessment to prioritize tree plantings based on low existing tree cover and enhancing benefits provided by trees.	C H E N	**FD** 2027
		GA.13 59	Update the suitable tree list based on the tree inventory, climate change projections, site suitability, drought tolerance, ecosystem services, tree canopy goals, among other factors.	C H E N	**FD** 2030
		GA.14 60	Develop a more strategic approach to tree species and site selection to ensure the resilience and optimize ecosystem service provision of Kirkwood's urban forest.	C H E N	**FD** 2030
		GA.15 61	Consider a tree planting program for removed trees and new planting sites that is informed by a comprehensive inventory and Urban Tree Canopy (UTC).	C H E N	**FD**, KKG 2030
		GA.16 62	Evaluate the feasibility of incrementally implementing programmed pruning of public trees on the recommended 5-year rotation— reduced from the current 8-year rotation.	C H E N	**FD** 2030
		GA.17 66	Update maintenance regimen (number of park and street trees pruned annually) by evaluating inventory data, program structure, available resources, and demands.	C H E N	**FD**, PRD 2035

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**Co-benefits: C = Community; H = Human Health; E = Equity; N = Natural Environment

Green Asset Management (GA) Targets Continued

Table 26. Goal 6, Green Asset Management Action Targets continued

Action Target 1	Action Target 2	Action Target 3
GA.09: Tree inventory data is analyzed and cross-examined with industry research (Year 3)	GA.09: A tree pest and disease plan is implemented and a strategy for managing other susceptible tree species is established (Year 6)	GA.09: The public tree population is resilient to existing and potential tree pests and diseases (Year 20)
GA.10: Existing protocols and industry recommendations are compiled (Year 1)	**GA.10: Protocols and risk assessment criteria updated, documented, and distributed (Year 3)**	GA.10: Inventories show a reduction in tree risk, less service requests, and improved public perception (Year 20)
GA.11: Annual and forecasted debris amounts and costs of disposal are identified, risks identified (Year 2)	GA.11: Craftsmen and processing partners identified and agreements obtained (Year 3)	**GA.11: Installation of first nature playground accessory and increased use of biomass following storm events (Year 4)**
GA.12: Scope of Work established (Year 4)	GA.12: RFP released and consultant selected (Year 5)	**GA.12: UTC completed, canopy goals are updated, and tree plantings are prioritized (Year 6)**
GA.13: An analysis of the tree inventory and UFMP informs changes to the tree species planting palette (Year 6)	GA.13: Updated draft of the tree species list is completed (Year 8)	**GA.13: The updated tree species list is integrated into City projects, partner projects, policies, and manuals (Year 9)**
GA.14: An analysis of the tree inventory and UFMP informs changes to the tree species planting palette (Year 6)	GA.14: Tree planting aligns with canopy, resiliency, and ecosystem services goals (Year 8)	**GA.14: Tree planting aligns with canopy, resiliency, and ecosystem services goals (Year 10)**
GA.15: An updated Urban Tree Canopy Assessment is completed (Year 6)	GA.15: A comprehensive public tree reinventory is completed (Year 6)	**GA.15: A tree planting program is established guided by a plan (Year 9)**
GA.16: A comprehensive street and park tree inventory is completed (Year 6)	GA.16: A case study is prepared detailing the costs for a rotational pruning program (Year 8)	**GA.16: Funding is secured for incrementally implementing a rotational programmed pruning cycle of street trees (Year 9)**
GA.17: An analysis of the tree inventory and UFMP provides the recommended staffing levels (Year 8)	GA.17: A budget proposal is prepared detailing the necessary staff (Year 12)	**GA.17: The City has the staff and resources to manage the public tree population on a recommended rotation (Year 14)**

Goals for Urban Forest Equity and Sustainability

Overview

Urbanization creates significant changes in land use and land cover, affecting the structure, pattern, and function of ecosystems. The public is increasingly concerned about how these changes influence daily life and affect the sustainability of "quality of life" for future generations. Improving air quality, cooling urban heat islands, building resiliency against storms, and reducing stormwater runoff are challenges facing the City of Kirkwood. Rapid growth in Kirkwood (at a rate of 0.30 percent annually, City source), is accelerating these problems. The problems need solutions as the City tries to protect and restore environmental quality while enhancing economic opportunity. Tree canopy is a valuable component of Kirkwood's urban ecosystem. Thus, expanding the urban forest is part of the solution to the City's social, environmental, and economic problems.

To guide efforts towards the urban forest vision, communities with tree canopy assessment data often set tree canopy cover goals based on the existing tree canopy cover amount and the aim to provide an equitable distribution of canopy cover and associated benefits. For Kirkwood, the planning consultants conducted an analysis of tree canopy cover data and Tree Equity Scores (TreeEquityScore.org) to develop draft canopy goals that would increase canopy cover and address tree equity. This section provides the guidance to refine the draft goals, establish incremental targets, and adopt a Citywide canopy goal that is shared by the City, its partners, and all property owners within Kirkwood. Progress towards these canopy goals should be tracked, measured, and shared to guide urban forest management and maintain community interest and support.

Tree Canopy Goals

With this understanding, the City evaluated the feasibility of creating a canopy goal. Currently, 43 percent of Kirkwood's land area is covered by tree canopy when viewed from above. This value provides a baseline metric that forms the foundation of the strategies in the Plan. To achieve the vision for the urban forest, the City has established a goal to increase its tree canopy coverage by 7 percent over a 24-year timespan (50 percent). To reach this goal, approximately 13,300 new trees need to be planted over the 24-year timeframe while preserving the City's existing urban tree canopy cover. The goal of 50 percent canopy and 13,300 new trees is based on a variety of factors including species diversity, urban forest benefits, and an equitable distribution of tree canopy.

Canopy Goals – Purpose and Approach

Across the U.S., cities are setting goals— some based on careful study of current canopy, community needs, and availability of planting space, others base their goals on the principle that more trees are better than fewer, set ambitious campaign goals, then work to mobilize efforts to meet it. Generally, the U.S. Forest Service recommends canopy cover of 40-60% in northwestern communities and in 1997, the American Forests organization established a benchmark of 40% after analyzing the tree canopy in dozens of cities from 1992 to 1997 and working closely with the research community. While incredibly valuable and groundbreaking at the time, technology and research have significantly evolved over the past 20 years, leading to a consensus that more nuanced approaches to canopy goal setting are necessary. Supporting this statement, U.S. Forest Service Research Forester Greg McPherson of the Pacific Southwest Research Station adds, "Tree canopy cover targets are difficult to specify broadly because the opportunities to create canopy are highly variable among cities, even within a climatic region or land use class."

Tree canopy targets are best developed for specific cities and should consider constraints to creating canopy such as:

- Development densities (i.e., dense development patterns with more impervious surfaces have less opportunity for cover);
- Land use patterns (i.e., residential areas may have more opportunity for canopy than commercial areas, but canopy cover tends to be less in residential areas of disadvantaged communities versus wealthy ones);
- Ordinances (i.e., parking lot shade ordinances promote cover over some impervious areas); and
- Climate (i.e., canopy cover in desert cities is often less than tropical cities).

Within those parameters, quantifiable data can be used so a tree canopy goal achieves specific objectives, such as reaching the canopy percentage necessary to reduce urban heat island temperatures to a specific range, or to reduce stormwater runoff by a projected amount. According to a national analysis by U.S. Forest Service researchers, a 40-60% urban tree canopy is attainable under ideal conditions in forested states. 20% in grassland cities and 15% in desert cities are realistic baseline targets, with higher percentages possible through greater investment and prioritization.

It is important to note, however, that urban tree canopy percentage is just one of many criteria to consider. A robust tree canopy comprised of largely invasive species, for example, is not a healthy urban forest. Age and species diversity, condition of trees and equitable distribution across income levels, to name a few, should also be considered (Leahy, American Forests, 2017).

Citywide and Forestry Maintenance District Tree Canopy Goals

The following presents the proposed canopy goals though the City and partners should evaluate and refine these for approval by staff and City Council.

For the City of Kirkwood, the development of canopy goals was driven by tree canopy cover data, benchmarking research, Tree Equity Scores, analysis of existing and potential resources, City input, and community feedback.

Using this integrated approach, the City of Kirkwood's ambitious and achievable goal is **50 percent tree canopy cover in 24 years (2045)**, with intermediate goals every five years. To achieve this, the City must preserve the existing canopy and increase its coverage by seven percent, **up from 43 percent**, and plant approximately 565 trees annually or a total of 13,300 trees. These new trees would collectively grow the canopy throughout the City to an area equivalent to nearly 290 football fields and would provide additional ecosystem services and benefits in the amount of approximately $303,000 annually. These calculations and estimates are based on industry research and practices though there are some assumptions including;

- A no-net-loss strategy, meaning the number of public trees removed along with removals on private property or through development are replaced.
- Trees that mature into large canopy-bearing trees are planted wherever feasible. Calculations use an average tree canopy diameter of 40 feet equating to a surface area of 1,257 square feet.
- Includes City-led, partner, volunteer, and private tree plantings. In this study and canopy goal scenario, it is recommended the **City plant 50 percent of the necessary trees** or **approximately 283 trees per year**.
- The City only has approximately 2,485 public street planting sites available as of the 2022 inventory so new planting sites will need to be created by converting impervious surfaces to planting sites and/or planting in parks and natural areas.
- Assumes a potential for young tree mortality post-planting.

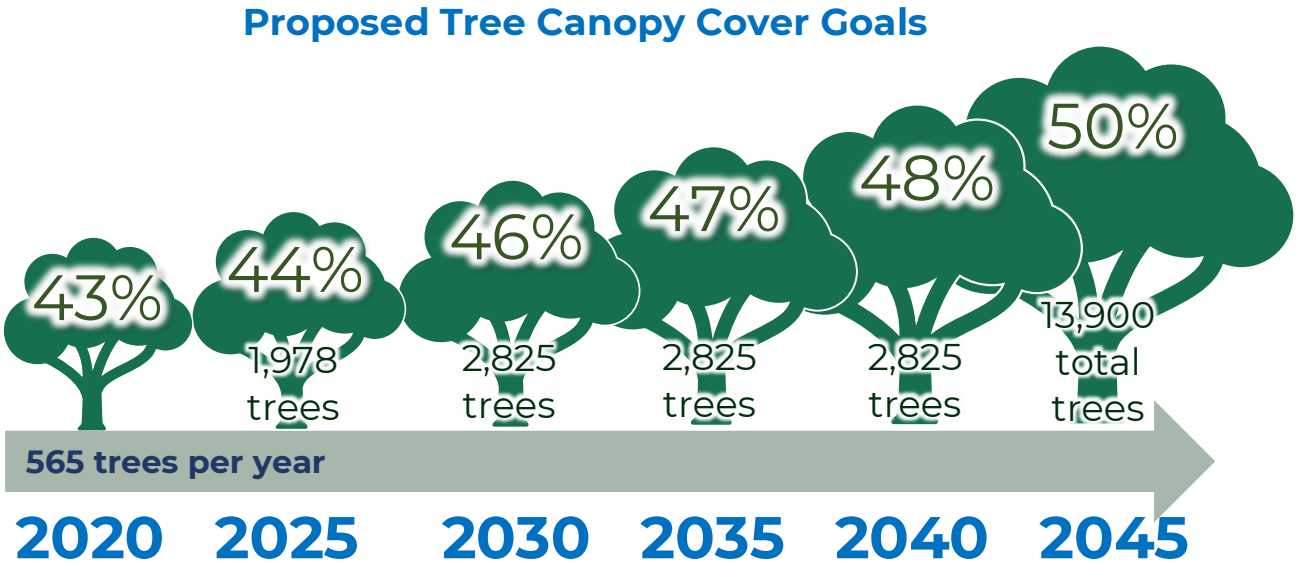


Figure 22. Kirkwood's draft canopy goal milestones

The following provides the calculated process of establishing the 24-year canopy goal for Kirkwood: The amount of tree canopy cover and available planting space was analyzed Citywide, by 13 unique Zoning Classes, and 8 Forestry Maintenance Districts (FMD). To guide public tree management towards the 50 percent canopy goal, the percentage of total possible planting area (vegetative and impervious) to be planted was assigned to each FMD based on the total amount of plantable space, the existing canopy, limitations of the FMD, available resources, and other City needs. This approach realizes the unique opportunities, limitations, extent, resources, and characteristics found among various planning areas. Canopy goals and planting targets must not be standardized across the City, they should be specific to the area. This method was applied and summarized in the following table.

Table 27. Summary of the canopy goal setting process for Forestry Maintenance Districts

Forestry Maintenance District	Total Possible Planting Area (%)	% of Total Possible Planting Area to be Planted	Modeled Canopy % (% of Total PPA)	Number of Trees to Reach Goal	Annual Added (Net) Eco-Benefits ($)
1	22%	28%	42%	960	$10,890
2	25%	36%	48%	1,976	$22,408
3	23%	30%	37%	1,525	$17,290
4	21%	26%	40%	1,233	$13,985
5	20%	26%	57%	3,011	$34,145
6	21%	26%	57%	1,082	$12,268
7	22%	30%	55%	1,550	$17,575
8	26%	35%	51%	1,915	$21,712
TOTAL			**50%**	**13,252**	**$302,667**

Priority Planting Areas to Achieve Canopy Goals and Tree Equity

Once the City finalizes local and Citywide tree canopy goals, it is recommended to establish priority areas based on a variety of themes and community needs. Themes may include ownership type (public and private), areas of low existing tree canopy, Tree Equity Scores (TreeEquityScore.org), and greatest amount of available planting space while other themes may address air quality, stormwater reduction, and water quality. Others may evaluate opportunities to address disadvantaged areas, densely populated regions, and human health factors such as asthma cases, median age, and mental health. In any planting prioritization scenario, the scale may include U.S. Census Bureau Census Block Groups, Zoning Classes, Forestry Maintenance Districts, and Citywide.

Using the 2022 Urban Tree Canopy Assessment (2020 imagery), the City's TreePlotter CANOPY software application (pg-cloud.com/KirkwoodMO), and analyses in a Geographic Information System (GIS), a series of recommended prioritization techniques is provided. The description of the prioritization techniques and scenarios is provided below followed by a series of corresponding priority maps.

- Census Block Groups (CBGs) with low amounts of tree canopy cover. CBGs with the lowest percentage of existing tree canopy cover.
- CBGs with the greatest possible planting area. CBGs with the highest percent of total area available for possible planting. Includes vegetative and impervious possible planting areas.
- Tree planting in CBGs to conserve energy. Trees provide a reduction in energy use in the summer by providing shade and in the winter by reducing wind. This priority map identifies residentially-zoned areas with low tree cover and high total possible planting area.
- Tree planting in CBGs to reduce stormwater runoff. Trees can be integrated to help manage stormwater, specifically when targeting impervious surfaces. This indicator uses available planting area on impervious surfaces and available planting areas within 100 feet of all surface water bodies.
- Tree planting in neighborhoods with underserved populations. Tree canopy is positively correlated with higher median income. Planting trees in lower income communities can support environmental equity. CBG suitability is based on the percentage of residents living below the median income level.
- Tree planting to address dense populations. Tree planting where there are the most people can have the greatest impact in terms of benefits such as shading, reduced energy costs, and sense of community. Areas of higher population densities are prioritized.
- Tree planting to improve human health and wellbeing. Trees clean the air, filter water, and can lower stress levels, in turn, improving public health. Planting trees can be a cost-effective way of improving a city's overall public health.
- Tree planting in areas with the greatest amount of plantable street tree area. The City will lead the implementation of canopy goals and to support this effort, CBGs are prioritized depending on the amount of available planting space within the public rights-of-way. In these areas, the City has the authority to plant trees to increase cover.

View the maps on the following pages for examples of the listed planting priority techniques.

Priority Planting Maps by Theme and Census Block Group

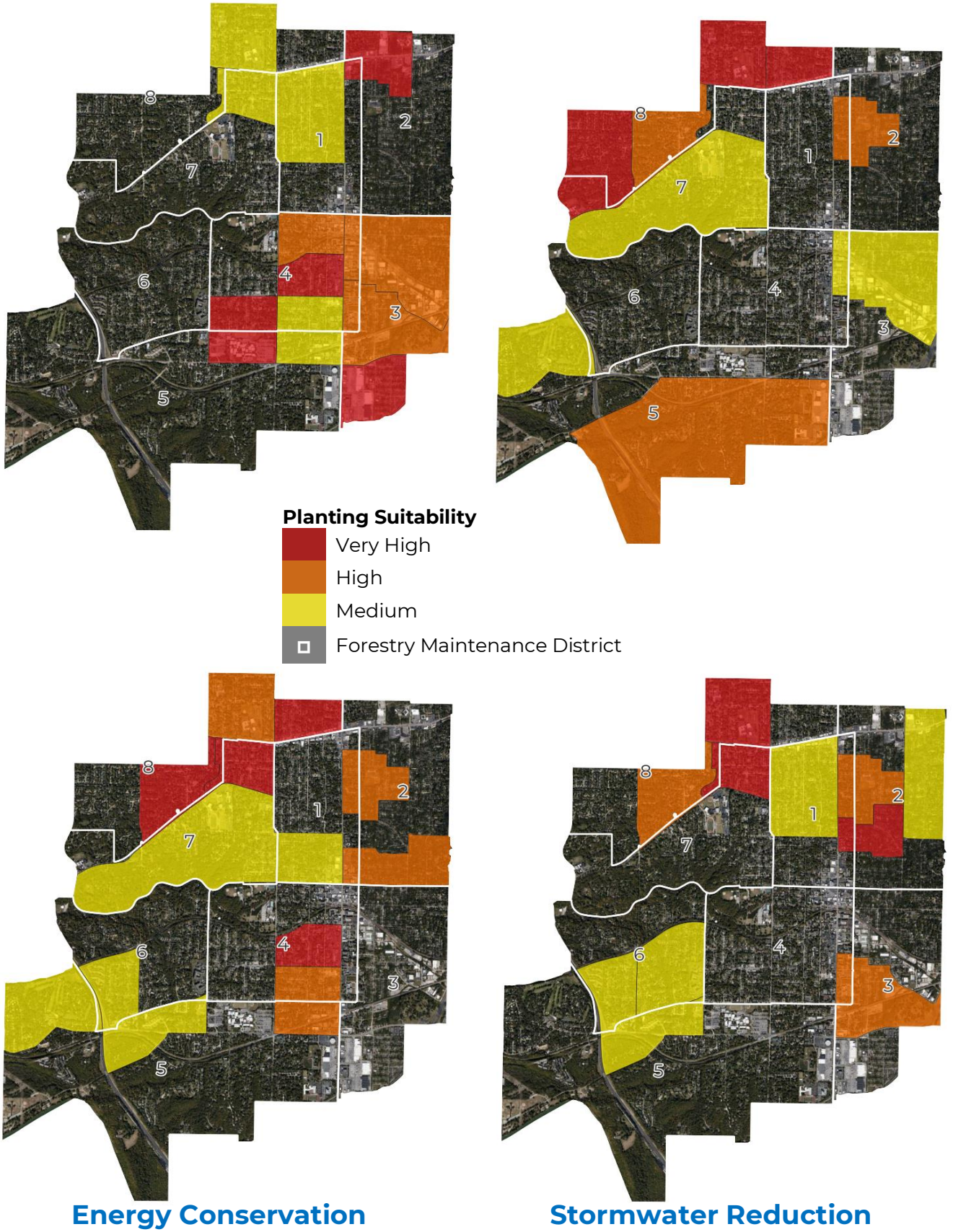
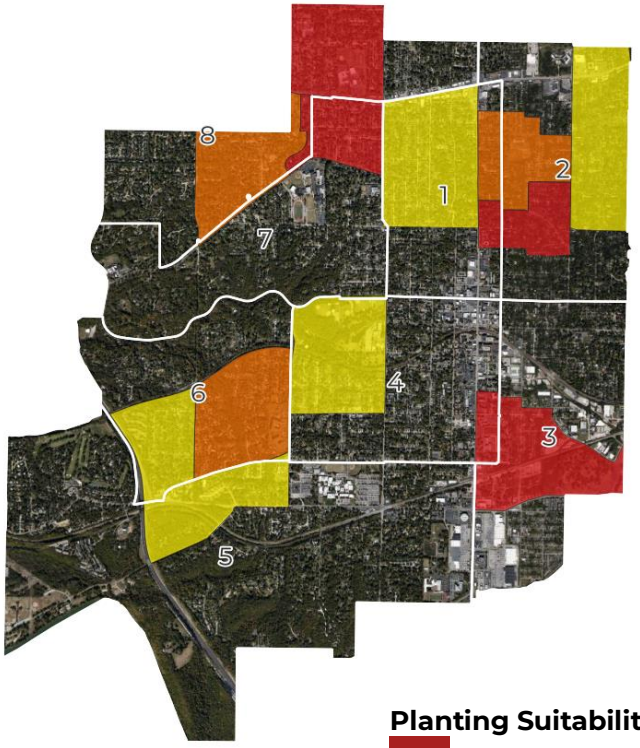


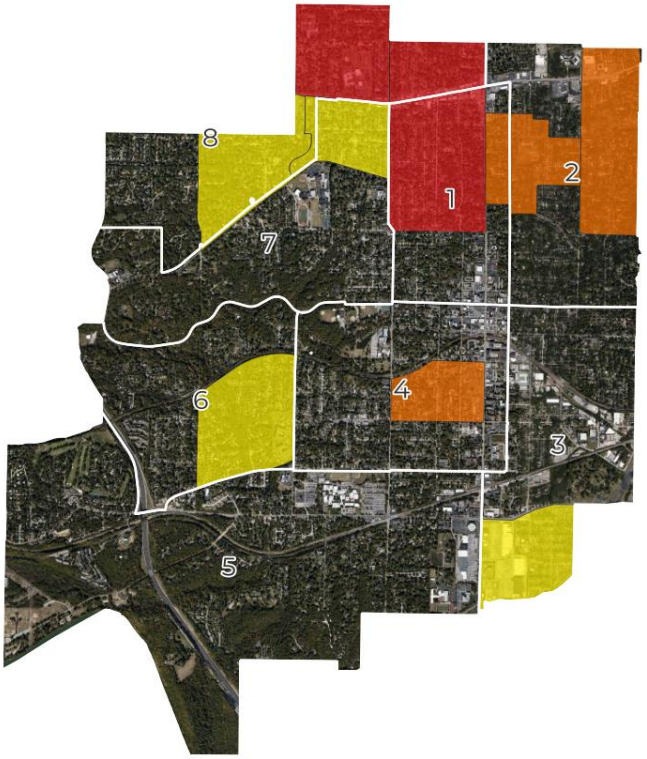
Figure 23. Priority planting maps by theme and Census Block Group

Priority Planting Maps by Theme and Census Block Group

Low Median Income



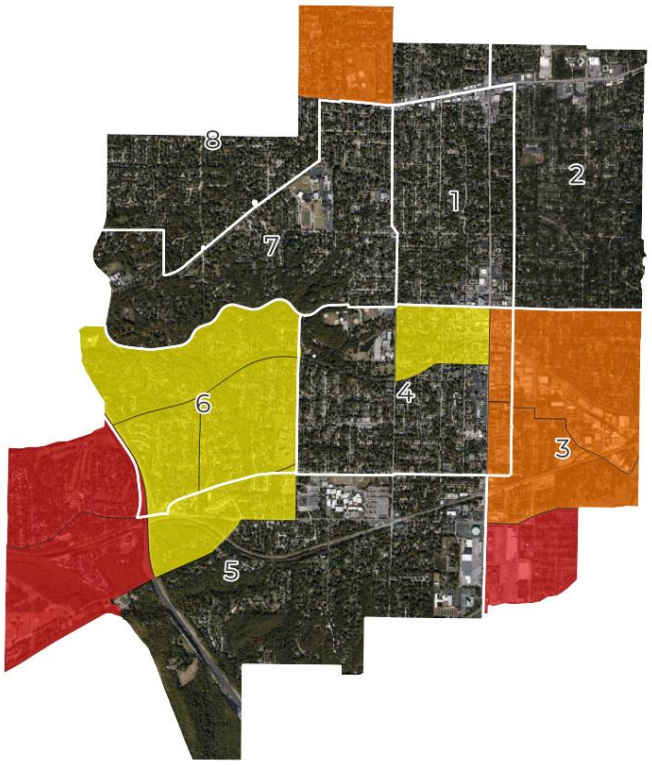
Population Density



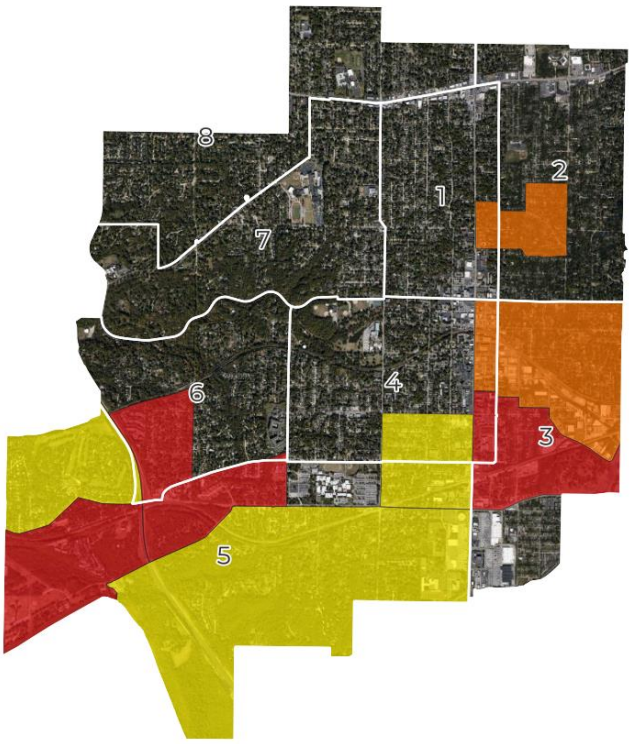
Planting Suitability

- Very High
- High
- Medium
- Forestry Maintenance District

Human Health



Plantable Area in the Right-of-Way



How Are We Doing?

Implementation Plan

The framework of the goals and actions in the Urban Forest Master Plan provides the City of Kirkwood with the means to measure progress and adapt to an everchanging environment and availability of resources. Each of the goals align with the U.S. Forest Service's Urban Forest Audit System and the actions are intended to guide the City towards improvements in ranking for each of the nearly 130 elements within the 11 categories of urban forest management. As actions are implemented, the City may conduct new iterations of the Urban Forest Audit to gauge success, evaluate progress, and adjust accordingly. View the Evaluate section of the Monitoring Plan for more information.

As part of the project, an interactive worksheet of goals, actions, and targets was provided to enable the City's implementers to sort actions by order, priority, effort, goal theme, implementation year, and other action attributes. It is recommended the City establish an urban forestry working group to manage Plan implementation and monitoring. This team should coordinate the implementation of actions with the respective partners or collaborators. For the Plan, actions were provided by goal theme though the City may find it advantageous to view the actions by recommended order, priority, level of effort, or target year.

Based on the assessment of Kirkwood's urban forest resource, the programs that manage it, and the community that shapes and benefits from it, the following implementation schedule is recommended. Implementing the Plan in this manner will effectively and efficiently address the City's shared challenges and priorities using the resources available. As the Plan progresses, more resources will become available to implement the longer-term actions.

Implementation Summary and Schedule

Goal and Action Key

GOAL 1: Tree Management Policy (MP)	GOAL 2: Capacity, Training, and Authority (CT)	GOAL 3: Budget and Funding (BF)	GOAL 4: Assessments and Planning (AP)	GOAL 5: Community Engagement (CE)	GOAL 6: Green Asset Management (GA)

Table 28. Urban Forest Master Plan implementation schedule

Ongoing

CE.04	At minimum, share quarterly informative urban forestry and tree-related content to a social media, City website, and other communication platforms. (Quarterly)
AP.01	Continue to conduct "windshield surveys" for quick visual assessments of public trees. Utilize the information gathered, service requests, and inventory data to prioritize tree maintenance and removals. (2022 start)
GA.01	Prioritize young and large tree maintenance based on updated inventory data and resources. (2022 start)
GA.02	Continue to prioritize and complete necessary public tree removals utilizing contractor protocols. (2022 start)

GA.03	Maintain the current maintenance regimen (8-year cycle) by contracting large tree pruning, young tree training, and other tree maintenance activities based on available resources. Adjust as changes occur as a result of Action GA.01. (2022 start)
AP.02	Maintain the inventory of public street and park trees. Update as maintenance and new plantings occur. Encourage partners to manage a current inventory of utility trees. (2022 start)
CT.02	Utilize a continuous improvement framework (Commitment, Strategy, Process, Performance) to improve operational workflows and coordination among departments impacting or influencing the urban forest. (2022 start)
BF.01	Continue to budget for annual public tree inventory collection and data management equipment needs for the upcoming budget planning sessions. See Appendix D for further guidance. (2022 start)
BF.02	Continue to seek and acquire funding and technical assistance from organizations such as the Missouri Department of Conservation in cooperation with the MO Community Forestry Council's Tree Resource Improvement and Maintenance (TRIM) cost-share grants, U.S. Forest Service, MU Extension, and others. See Appendix D for further guidance. (2022 start)
GA.04	Educate and train City staff and contractors to adhere to Best Management Practices for the maintenance of all diseased/infested City trees. (2022 start)
GA.05	Manage invasives in public parks, rights-of-way, and on public properties as feasible with available funding. (2022 start)
CE.05	Continue to provide information regarding the Tree Ordinance, unauthorized tree plantings, invasives, identifying pests and diseases, planting and young tree care best practices, utility pruning roles and procedures, public tree permitting requirements, and tree maintenance responsibility. (2022 start)
AP.03	Track all city-led tree plantings and tree plantings conducted by partners. Utilize the tree inventory software and consider integrating with the city asset management program. (2022 start)
CE.06	Support volunteer training opportunities as feasible. (2022 start)
CE.07	Continue to strengthen partnerships with civic groups, Homeowners' Associations, volunteers, institutions, internal, City Council, neighborhoods, improvement districts, regional organizations, and non-conventional organizations. (2022 start)
CE.08	Continue to track and annually report urban forestry activities of all partners and continue to maintain Arbor Day Tree City USA designation. Strive to achieve Arbor Day Foundation Growth Awards and Sterling Tree City status. (2022 start)
CT.06	Stay current with industry research, science, and technology through various platforms. An example includes management of current and potential exotic tree pest and disease threats. (2022 start)
BF.05	Continue to secure short-term funding within to manage emergency response for tree damage after storm events, including debris management. (2022 start)

GA.06	Annually revisit contract specifications and in-house policies and directives to ensure that tree care operations adhere to current industry standards, including ANSI A300 Standards for Tree Care Operations, ANSI Z133.1-2012 for Arboricultural Operations Safety Requirements, and ISA Series Best Management Practices (BMPs). Include Kirkwood Electric and other relevant organizations. (2023 start)
GA.07	Continue to implement the tree work order system in the City's tree management software. (2023 start)
AP.04	Use the ISA protocols established in Action GA.10 when conducting risk tree assessments deemed a priority or imminent need. (2023 start)
AP.05	Create an annual activity calendar for urban forest management aligned with actions in this UFMP. (2023 start)
CT.03	Appropriately staff the review of plans for commercial development projects and enforcement of the Tree Ordinance. (2023 start)
MP.01	Align resources and planning efforts across City departments and partners to meet common goals and improve efficiencies. (2023 start)
MP.02	Tree managing staff should engage in City department planning such as updates to the City's Comprehensive Plan, Park and Recreation Master Plan, Stormwater Management Guidance (tree credits), Kirkwood Electric's Utility Line Vegetation Management Program, and other City planning efforts. (2023 start)
BF.03	Develop an annual education and training budget for tree management staff that supports attending CEU accrediting seminars, workshops, and conferences each year. Consider the Tree Care Industry Association's Certified Treecare Safety Professional accreditation. (2023 start)
BF.06	Use the data from the Assessments and Plans actions (i.e., tree maintenance needs, tree planting needs, ecosystem services) to support budget and funding increases aligned with resource needs and actions in the UFMP. (2023 start)
CE.11	Prioritize community service requests and update the City website with frequently asked questions and resources. (2023 start)
GA.09	Use Citywide tree inventory data and best available science for long-term planning and management of existing and future tree pests and diseases impacting the City's urban forest. Consider a tree pest and disease plan. (2024 start)
CE.12	Utilizing the local non-profit organization and/or the Urban Forestry Commission, engage neighborhoods with volunteer tree planting events. Prioritize areas with lower urban tree canopy and other considerations such as underserved communities using a Tree Canopy Assessment (TCA) and other datasets. Develop a Master Tree Planting Plan to support this action. (2024 start)
CE.13	Conduct bi-annual community surveys to gauge public viewpoints and receive feedback on implementation of the UFMP, and program success. Survey responses should inform future urban forest decision making. (2024 start, bi-annually)

AP.06	Complete an urban forest audit using similar criteria as the 2021 audit completed for the UFMP to evaluate improvements in urban forest management and adapt strategies. (2024 start, bi-annually)
BF.04	Utilize Appendix D to secure funding for urban forest management activities (e.g., Urban Tree Canopy Assessment and Inventory updates, neighborhood-level strategic tree planting plans, resources to maintain a growing urban forest, policy and ordinance enforcement). (2024 start)
CT.04	Ensure tree-related operations are represented by staff with industry credentials such as International Society of Arboriculture (ISA) Certified Arborist and Tree Risk Assessment Qualification (TRAQ) either directly through the department or supporting department. (2024 start)
CT.05	Provide or support training to departments involved in the tree permitting processes, plan reviews, tree inspections, project design, and construction. ISA Certified Arborists within the department or supporting department should be involved with these processes. (2025 start)
GA.08	Coordinate with other City departments to maximize the number of trees planted through Capital Improvement Programs and stormwater management projects. Establish procedures for replacing damaged trees during infrastructure replacement projects. (2025 start)
AP.07	Support academic institutions, corporations, healthcare facilities, and Homeowners' Associations (HOAs) or planned communities in a technical and educational capacity to develop urban forest inventories. (2025 start)
AP.08	Support academic institutions, corporations, healthcare facilities, and Homeowners' Associations (HOAs) or planned communities in a technical and educational capacity to develop urban forest management plans. (2025 start)
AP.13	Quantify the ecosystem benefits and appropriate appraisal values of public trees to conduct a cost-benefit analyses of public trees. This informs maintenance recommendations, program structure, and raises public awareness of the urban forest benefits. (2028 start, bi-annually)
CE.14	Track community service requests and responses and link these to the respective tree(s) in the tree inventory software. (2028 start)

YEARS 1-2

CE.01	Coordinate the outreach strategy as a Citywide initiative rather than a departmental effort.
CE.02	Formalize clear and consistent design and language for urban forestry outreach materials.
CE.03	Update the City's website and materials based on information from the UFMP.
CT.01	Establish an urban forestry working group with regular meetings to monitor progress of implementing actions. Finalize lead implementers.
CE.09	Align the roles and responsibilities of the Urban Forestry Commission with the UFMP.
CE.10	Support in a technical capacity the strengthening of a local non-profit organization for the stewardship, outreach, and advocacy of Kirkwood's urban forest.

YEARS 3-5

GA.10	Strengthen protocols and threshold criteria for routine and impromptu public tree risk assessments. Consider ANSI A300 Tree Risk Standards, SOPs, communication protocols, and decision checklist for transparency and consistency.
CT.07	Strengthen or establish written urban forestry protocols, specifications, and standards for capital projects, construction administration, maintenance, contracts, and performance monitoring.
GA.11	Develop a framework and approach to utilize biomass following future storm events. Consider using biomass for (natural) playgrounds, a wood chip program, and pulp wood to paper mills.
CT.08	Evaluate staffing and contractor resources required to effectively plant trees aligned with canopy goals and provide post-planting care.
AP.15	Based on the outcomes of the bi-annual urban forest audit, available resources, industry technology and research, and data, modify existing actions and develop new actions to continue to achieve goals of the 2022 UFMP. Update at least every 5 years.

YEARS 6-10

AP.09	Routinely update the comprehensive public tree inventory in a phased approach by Forestry Maintenance District. At minimum, reinventory the entire public tree population 5 years after the 2022 inventory.
AP.10	Complete an update to the comprehensive high-resolution Urban Tree Canopy (UTC) Assessment using industry recommended protocols.
GA.12	Use the results of an updated high-resolution Urban Tree Canopy (UTC) Assessment to prioritize tree plantings based on low existing tree cover and enhancing benefits provided by trees.
AP.11	Strengthen storm and disaster preparations, mitigations, and recovery strategies, protocols, and mechanisms.
AP.12	Complete a sample inventory of trees in public natural areas and open space.
BF.07	Use inventory data, the UFMP, and other resources to secure the necessary budget to implement pest/disease treatment and control measures.
AP.14	Review, update, and document the tree species appropriate for planting in the public right-of-way and in parks. Encourage appropriate trees for private property in a Recommended Tree Planting List.
GA.13	Update the suitable tree list based on the tree inventory, climate change projections, site suitability, drought tolerance, ecosystem services, tree canopy goals, among other factors.
GA.14	Develop a more strategic approach to tree species and site selection to ensure the resilience and optimize ecosystem service provision of Kirkwood's urban forest.
GA.15	Consider a tree planting program for removed trees and new planting sites that is informed by a comprehensive inventory and Urban Tree Canopy (UTC).
GA.16	Evaluate the feasibility of incrementally implementing programmed pruning of public trees on the recommended 5-year rotation— reduced from the current 8-year rotation.
CE.15	Utilizing the local non-profit organization and/or the Urban Forestry Commission, develop a program that recognizes exemplary urban forest stewards and volunteers representing youth, residents, organizations, and business owners.

YEARS 11+

CT.09	Evaluate the feasibility of a Citywide Volunteer Coordinator dedicated to urban forestry along with the roles and shared goals of the Urban Forestry Commission and local non-profits.
MP.03	As tree-related policies, guidelines, best practices, and standards are refined, update the Tree Manual and consider separate manuals for planners, developers, homeowners, contractors, and private tree care companies.
GA.17	Update maintenance regimen (number of park and street trees pruned annually) by evaluating inventory data, program structure, available resources, and demands.
BF.08	Establish a dedicated, sustained funding source beyond the current departmental budget for urban forestry operations to increase the level of service to meet the community's high standards. Use Appendix D as guidance.

Monitoring Plan

This Urban Forest Master Plan will be updated and revised periodically to reflect changes in the urban forest resource structure and function, to incorporate changes in industry standards, to consider community response, and to measure the progress of the urban forest partners in implementing the recommendations and reaching the established goals. This process should be overseen by an urban forestry working group consisting of City staff and stakeholders (see Action CT.01) using the Evaluate, Monitor, Report, and Revise methodology.

Knowing how the City of Kirkwood and its partners are doing will require a continual process of evaluation. This section presents examples of how to monitor, analyze, and revise the Plan, which will keep stakeholders informed of the status of the Urban Forestry Program. To monitor progress toward implementing the Plan recommendations, an evaluation similar to the U.S. Forest Service's Urban Forest Audit (details below in the Evaluate section) conducted to develop the initial Plan should be completed. This evaluation will identify progress and shortfalls compared to the baseline audit.

In addition, a report card could be created based on outcomes of the audit and distributed to the public every two to three years. This will measure the progress toward implementing the Plan's actions. The Report section provides a suggested structure to measure and report success toward accomplishing each goal. Other indicators to measure progress may need to be developed to ensure a thorough and accurate evaluation.

Figure 24. Summary of the Plan implementation and monitoring process

Evaluate

The U.S. Forest Service's Urban Forest Audit System provides a framework for routine evaluations of the urban forest, the programs that manage it, and the community that shapes and benefits from it. The deliverables to this Urban Forest Master Plan project include guidance for completing an update to the audit completed in 2022 to develop the Plan. This audit system consists of 11 categories of urban forest management, sustainability, and community. Within the 11 categories are approximately 130 subcategories or elements. Each element was ranked or scored based on the consultants' evaluations in 2022 for the Urban Forest Master Plan. It is recommended the City's urban forestry working group (or similar) complete a bi-annual audit to inform any alterations to actions and strategies.

About the Urban Forest Audit

The primary objectives of the audit are defined by the Urban Forest Audit System authors and adapted by the City's urban forestry consulting team to engage the full spectrum of the organizations' management team, provide program direction that increases the level of professionalism in management, conduct a gap analysis of management practices and the health of urban forests, provide strategic direction to improve the health of the urban forest, and optimize management for environmental justice and equitable distribution of resources.

Table 29. Categories for evaluation using the U.S. Forest Service's Urban Forest Audit System

1) Management Policy and Ordinances
2) Professional Capacity and Training
3) Funding and Accounting
4) Decision and Management Authority
5) Inventories
6) Urban Forest Management Plans
7) Risk Management
8) Disaster Planning
9) Standards and Best Management Practices
10) Community
11) Green Asset Evaluation (Observed Outcomes)

Urban Forest Audit Process

The process of analyzing the urban forest involved extensive information and document gathering and research to identify policies, practices, programs, and standards pertaining to categories of urban forest sustainability and management as defined by Clark et al. (1997), Kenney et al. (2011), and the Forest Service. The categories are listed in the table above.

Each category has a series of subcategories pertaining to the specific category. As an example, the subcategories listed on the right are in the Management Policy and Ordinances category:

Table 30. List of subcategories within the Management Policy and Ordinances category of the audit

- 1.01) Climate Change (Sustainability)
- 1.02) No Net Loss
- 1.03) Risk Management
- 1.04) Tree Canopy Goals
- 1.05) Tree Protection
- 1.06) Utility
- 1.07) Human Health
- 1.08) Wildlife Diversity/Habitat/Protection
- 1.09) Performance Monitoring
- 1.10) Private Tree Ordinances
- 1.11) Public Tree Ordinances
- 1.12) Development Standards
- 1.13) High-Conservation Value Forests

All available documents and plans were reviewed and tallied in the audit worksheet as part of the information discovery phase. Based on the evaluation of the documents and outcomes of all planning processes (i.e., research, City staff interviews, urban forest benchmarks, data analyses, and community engagement) each subcategory within the 11 categories was "ranked" using the following system:

0) Not Practiced - Component doesn't exist or is not practiced; 0 points
1) In Development - Component is in development as part of or aside from this Plan; 1 point
2) Adopted Practice - Component is routinely practiced; 2 points
3) Exceeds Adopted Practice - The component is exceeded; 3 points

The points were then totaled for an overall rating to provide a summary of the City's level of achieving each category of urban forest management and sustainability.

Urban Forest Audit Results for Kirkwood

Table 31. Outcomes of the urban forest audit completed in 2022 for Kirkwood's Urban Forest Master Plan

#	Category	SOC* (% Achieved)	Base** (% Achieved)	Overall Rating	Overall (% Achieved)
1	Management Policy, Ordinances	50%	67%	15	54%
2	Professional Capacity and Training	83%	NA	11	69%
3	Funding and Accounting	75%	NA	7	58%
4	Decision, Management Authority	100%	100%	8	100%
5	Inventories	NA	75%	22	85%
6	Urban Forest Management Plans	NA	50%	14	58%
7	Risk Management	58%	50%	10	56%
8	Disaster Planning	NA	50%	6	43%
9	Standards and BMPs***	75%	63%	41	68%
10	Community	100%	NA	24	86%
11	Green Asset Evaluation	NA	NA	15	75%
TOTAL		**77%**	**65%**	**173**	**68%**

*Standard of Care (SOC) elements represent the minimum group of urban forestry management "best practices" that a municipality should consider for implementation. SOC refers to the degree of prudence and caution required of an individual who is under a duty of care (i.e., legal obligation of the controlling authority, owner, or manager) to minimize risk. Neither state, regional, nor national minimum management components have been established for SOC but these are interim recommendations for consideration. (NA = not applicable)

**Base Practices (BP) elements represent additional urban forest management activities or components that may effectively expand a program beyond the SOC group (see footnote above). These elements are typically precursors to other "non-core" elements in the category. (NA = not applicable)

***Best Management Practices (BMPs)

Urban Forest Audit Summary Discussion

The main purpose of the urban forest audit is to apply the research and findings gathered throughout the planning effort to inform the Plan's goals, strategies, and actions. This audit or "gap analysis" enables the Urban Forestry Program to control different aspects of its program with data. This gap analysis identified the shortcomings that the Urban Forestry Program should overcome and by quantifying them, the program can make improvements. It also enables effective monitoring of Plan strategies in that the audit categories and elements can be revisited at key intervals in the Plan implementation process to measure progress and adapt strategies accordingly. For the comprehensive evaluation of all subcategories within the Urban Forest Audit, see Appendix C.

The information provided in the table above describes the current conditions of Kirkwood's urban forest, the programs that manage it, and the community framework. As recommended in the Plan's monitoring methods, the City should use this framework to evaluate implementation progress, report successes, and inform changes to Plan actions. Many of the urban forest audit elements were given a rating of "In Development" as they previously did not exist but are addressed in this Urban Forest Master Plan. This means that the City is already well underway in advancing its program and its Urban Forest Audit score.

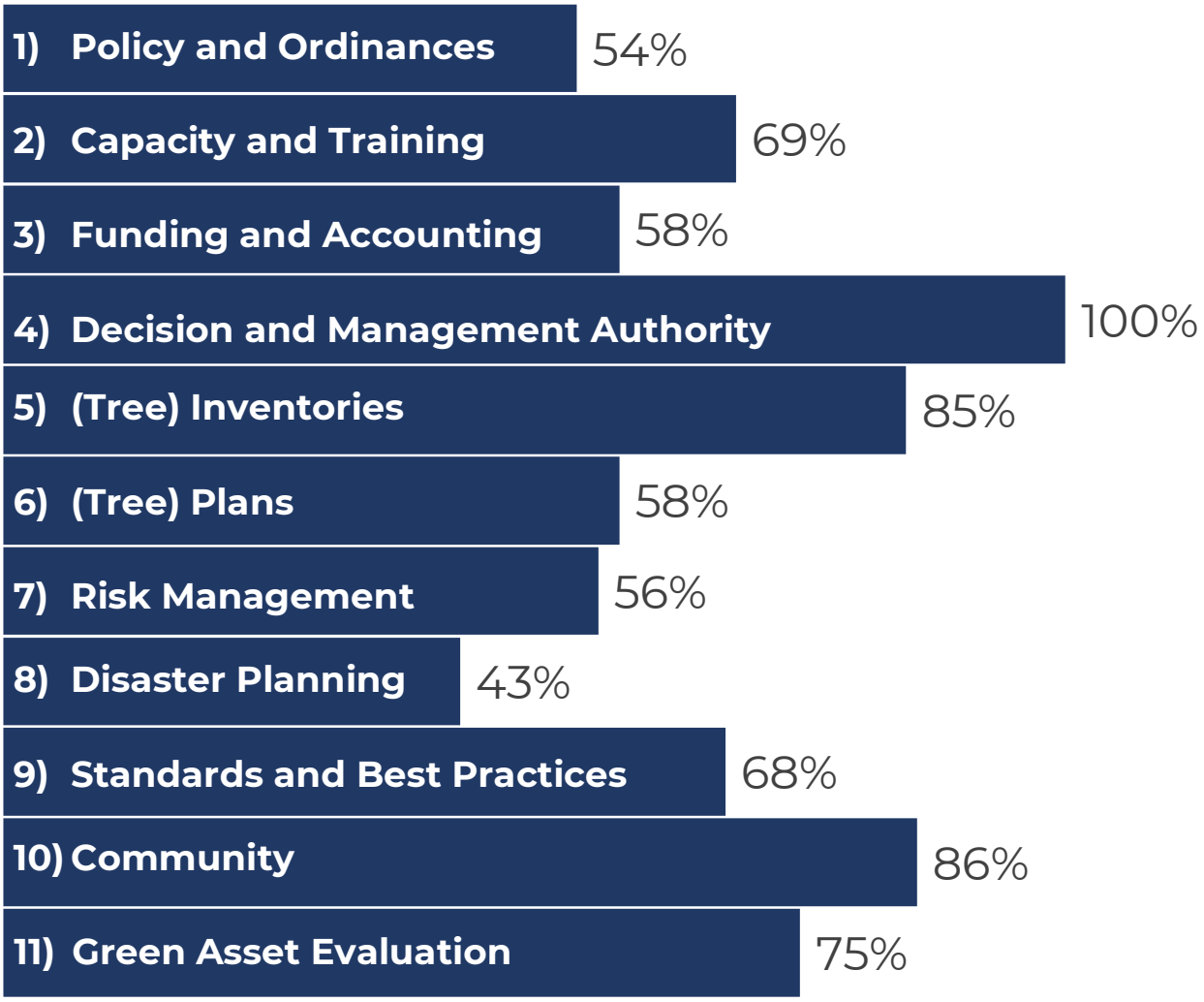


Figure 25. Summary of the 2022 Urban Forest Audit for Kirkwood's Plan

Interpreting the Urban Forest Audit Scores

The Urban Forest Audit System should serve as a baseline assessment from which progress can be measured and strategies can be adjusted using an adaptive management approach. Overall, Kirkwood scored a 68 out of 100 based on the consultants' evaluation. The scores resulting from the evaluation are informative but should not be considered a definitive assessment or a reason for excessive action due to a currently low score or inaction due to a high score. The following provides an interpretation of the scores for the City to consider when implementing the Plan's corresponding actions.

Management Policy and Ordinances

Table 32. Interpretation of the 2022 Urban Forest Audit scores

Category	Implications
Management Policy and Ordinances **Rating of 54%**	**STRENGTHS**: The City scored relatively average in this category due to the existing and recently updated tree ordinances and development standards. As part of the UFMP, a canopy assessment was completed and canopy goals were drafted to support a "no net loss" approach to urban forest canopy management. **OPPORTUNITIES**: Enhanced tree protection and enforcement in the right-of-way and on private property will support a "no net loss" strategy for retaining the benefits of urban forests. Appropriate levels of public and private tree ordinances as well as a strengthened Heritage Tree Program would advance Kirkwood in this category. Also, the City should explore planning options for climate mitigation and adaptation aligned with sustainability efforts and goals and formally adopt canopy goals.
Professional Capacity and Training **Rating of 69%**	**STRENGTHS**: Staff have industry certifications, qualifications, and training. **OPPORTUNITIES**: Kirkwood scored average in this category since the urban forestry program is understaffed compared to industry standards and similar cities. Additional staff involved in tree activities such as permitting, ordinance enforcement, development planning, and community engagement should be certified arborists accredited by the International Society of Arboriculture.
Funding and Accounting **Rating of 58%**	**STRENGTHS**: Urban forestry is budgeted annually, and the Forestry Division is acquiring oversight of the utility vegetation management budget from Kirkwood Electric. **OPPORTUNITIES**: Based on benchmarking research, when excluding the utility vegetation management budget, Kirkwood is below regional averages in terms of budget per public tree ($34.81 compared to $37.35 for cities with similar population size). A diversified, sustainable, and dedicated funding source is needed. Kirkwood has a strong network of engaged community residents who are in support of reallocating resources for urban forestry and provide tree stewardship support (i.e., young tree training).
Decision and Management Authority **Rating of 100%**	**STRENGTHS**: Kirkwood has an Urban Forestry Commission and the Urban Forestry Program has authority over day-to-day activity. The staff closely engage with other City divisions and sections. The City scored high in this category since the audit only contains four subcategories but can be expanded as described in the opportunities below. **OPPORTUNITIES**: Continue to coordinate with other City staff, partners, and contractors. Identify workflow efficiencies and maintain standard operating procedures and contractor specifications.

Category	Implications
Inventories **Rating of 85%**	**STRENGTHS**: Kirkwood has a comprehensive public tree inventory (2022) and a previous inventory from 2014-2017. In 2022, the City completed an assessment of Citywide urban tree canopy cover. The data is used to inform management and prioritize tree planting and preservation for environmental justice and equity. **OPPORTUNITIES**: The City should support in a technical capacity the inventory of trees private property trees including campuses and corporations. In addition, a sample survey of trees in public open space and natural areas would provide data to support sustainable urban forest management. The City should maintain these inventories and conduct reassessments of tree canopy cover every 5 to 10 years to monitor change, track canopy goals, and adapt strategies.
Urban Forest Management Plans **Rating of 58%**	**STRENGTHS**: Tracking and reporting of urban forest management activities, this Plan, and urban forestry referenced in the Comprehensive Plan resulted in higher than average scores for certain elements within this category. **OPPORTUNITIES**: Plans for other landscapes comprising the urban forest such as open space, grounds on public facilities, campus/university trees, and green stormwater management, is an opportunity for Kirkwood. The Park and Recreation Master Plan of 2005 should be updated and reflect goals in this Plan to a degree. Implementation of this Plan will increase the rating as will plans for private trees and enhanced street tree strategic planning such as a street tree planting plan.
Risk Management **Rating of 56%**	**STRENGTHS**: Staff and contractors trained in tree risk assessments and standard of care adopted. The City completed a comprehensive public tree inventory in 2022 to inform management strategies. **OPPORTUNITIES**: Additional internal technical support for assessing trees questioned for removal would improve the efficiency, effectiveness, resourcefulness, and appeal of City operations. A maintained inventory of trees in public rights-of-way is necessary to identify, monitor, plan, prioritize, and mitigate risk. The inventories detail Kirkwood's vulnerabilities to tree pests and diseases, climate change impacts, storm events, invasive species, and the natural or premature senescence of trees. The Plan provides recommendations for implementing risk management standards and best practices.
Disaster Planning **Rating of 43%**	**STRENGTHS**: The City's maintenance staff and contractors address downed trees and limbs and collaborates when extensive response is needed. **OPPORTUNITIES**: Primarily, a multi-faceted disaster plan for public trees is needed along with coordination between the county and neighboring cities.

Category	Implications
Standards, and Best Practices **Rating of 68%**	**STRENGTHS**: Kirkwood has an average rating for this category due to the tree ordinances, Tree Manual, Zoning Ordinance, Comprehensive Plan, and informational fliers such as Kirkwood Electric's Vegetation Management Tree Trimming Policy and Standards. **OPPORTUNITIES**: The City should specifically mention American National Standards Institute's (ANSI) standards, ISA best practices, and other related references in City Code. The Tree Manual could be expanded to include more detail on regulations along with any updates recommended in this Plan. Updates to tree ordinances may include canopy goal policies as recommended in this Plan. Overall, implementing the Plan will raise Kirkwood's score in this category.
Community **Rating of 86%**	**STRENGTHS**: Kirkwood is a Tree City USA city, demonstrating the value placed on urban forests. This Plan included a public survey and has engaged and informed the public through an interactive and current project website— KirkwoodUrbanForest.com. The City conducts Arbor Day events, has an Urban Forestry Commission, supports Keep Kirkwood Green and the Junior Treekeepers program, engages the public through social media, website, and other platforms, addresses service requests, and works closely with other community partners. **OPPORTUNITIES**: Continue to utilize the project website and the City's website, address the concerns and questions posed in the survey, conduct outreach to the public based on survey feedback, establish a recognition program by sector for exemplary urban forest considerations, address underserved areas as identified in the canopy and tree equity assessments, and facilitate more trainings both internally and for the public. Align efforts with ongoing initiatives relating to climate change and sustainability and garner community partnerships that represent the diverse population in the City. Continue to engage with the Urban Forestry Commission and Keep Kirkwood Green to increase capacity, provide support for urban forest advocacy, and support community engagement.
Green Asset Evaluation **Rating of 75%**	**STRENGTHS**: The public tree population is diverse with 174 unique tree species, relatively young (28% in the 0-6-inch size class), and mostly in good condition (67%). **OPPORTUNITIES**: This category is for documenting observed outcomes and improvements which will occur as this Plan is implemented and the comprehensive public tree inventory is maintained. The updates to tree-related ordinances and design standards will likely contribute to urban forest health, preservation, and growth. Currently, no public tree species exceed the recommended 10% distribution nor do any of the tree genera exceed the threshold of 20%. Pin oaks are at 7% and *Quercus* trees are at 17%, respectively. The City should develop a strategic tree planting plan to maintain diversity, meet canopy goals, plant for a changing climate, optimized planting sites, increase the stocking levels, and provide post-planting care. One concern is the top ten most prevalent species comprise nearly half (48%) of the entire public tree population. This example of current vulnerabilities should continue to be monitored and addressed by implementing the Plan.

Monitor

Measuring accomplishment of the actions will require ongoing analysis. The outcomes of the Urban Forest Audit System in the Evaluate section can be used to monitor change over time. These benchmark values should be tracked, and a state of the urban forest report should be prepared and distributed to the public every 2 to 5 years. Analysis may include an updated public tree inventory, i-Tree benefits analyses, or urban tree canopy assessments. The state of the urban forest report should include the benchmark values as reported in the Plan and the Urban Forest Audit System as of 2022, so that the City can measure and compare changes to the urban forest. The report should reflect changes to the audit system that are measured.

The following table provides a summary of the benchmark values that can be used to monitor and report on Plan progress.

Primary Urban Forest Benchmark Values to Measure Plan Progress

Table 33. Kirkwood's primary urban forest benchmark values to measure Plan progress

2020 Urban Tree Canopy (UTC) Cover (Assessed in 2022)	
Tree Equity Score (2022)	87 out of 100
UTC	43%
Short-term Canopy Goal	44% by 2025 (565 trees/year)
Long-term Canopy Goals	46% by 2030 (565 trees/year) 47% by 2035 (565 trees/year) 48% by 2040 (565 trees/year) 50% by 2045 (565 trees/year)
Total Trees to Reach Canopy Goals	13,300 trees by 2045
City-led Tree Plantings to Reach Goals	50% of total trees required (283 trees/year)
Public Tree Counts (202)	
Total Public Trees (alive or dead)	8,614
Total Live Public Trees	8,567
Total Public Street Planting Sites	2,485
Total Public Open Space Trees	Unknown
Tree Benefits	
Citywide (UTC Assessment)	2020: $19,960,457 (total)
Inventoried Public Trees	2020: $1,766,187 (annual)
Cost : Benefit of Public Trees	1:4.47 → for every $1 spent, $4.47 return
Tree and Budget Distribution (2019)	
Public Trees (street and park) per Capita	0.31
Budget per Capita	$10.82
Budget per Public Tree (inventoried)	$34.81
Urban Forestry Program FTEs	2.00
Total Public Trees per Staff	4,307 trees for every 1.0 FTE
Management Activities (2019)	
Public Trees Pruned	1,144
Public Trees Removed	145
Public Trees Planted	78
Number of Volunteers and/or Hours	N/A
Urban Forest Audit System (Total Score of 2022): 68%	
Management Policy and Ordinances	54%
Professional Capacity and Training	69%
Funding and Accounting	58%
Decision and Management Authority	100%
Inventories	85%
Urban Forest Management Plans	58%
Risk Management	56%
Disaster Planning	43%
Standards and Best Management Practices	68%
Community	86%
Green Asset Evaluation	75%
Public Perception (2022)	
Health of public trees in the past 10 years	44% feel the health has declined
Significant/heritage tree protection	71% support protecting trees >30" on 1+ acre private lots
Amount of urban tree canopy cover	93% support increasing canopy cover

Report

Based on the evaluation of Plan implementation progress, the City's urban forestry working group (or similar) should track, record, and report on the metrics described below that are measures or indicators of success for each goal and supporting actions. Note, the series of urban forestry goals detailed below are not listed in any particular priority or order.

Table 34. Evaluation, monitoring, and reporting techniques to achieve the urban forestry goals

1	**TREE MANAGEMENT POLICY (MP):** Urban forest policies are the foundation for preserving the environmental benefits, management, and the character of Kirkwood's urban forest. ▪ List all City and partner-led planning efforts. ▪ Describe related planning efforts. ▪ Communicate Citywide canopy goals and local planting targets. ▪ List recommended changes to City Code, policies, and manuals. ▪ Summarize a list of plans in which urban forestry is integrated. ▪ Distribute any recommended tree list to city staff, partners, and residents. ▪ Summarize updates made to tree-related ordinances, policies, and standards. ▪ Report the number of permits received and approved. ▪ Report the number of trees inspected. ▪ Report the number of trees in the Significant Tree Program. ▪ List audit score and actions/targets achieved, ongoing, and not started.
2	**CAPACITY, TRAINING, AND AUTHORITY (CT):** Kirkwood has the capacity and expertise to provide optimal levels of service for sound urban forest management. ▪ List the team members assembled to implement and monitor the Plan. ▪ List the existing staff and supporting departments and partners. ▪ Summarize roles and responsibilities of the Urban Forestry Commission. ▪ Describe existing and needed certifications, qualifications, and training. ▪ Provide a count of the number of trainings completed. ▪ Report the proportion of public trees to tree management staff. ▪ Report the number of volunteers and volunteer hours. ▪ Describe changes in levels of service based on community service requests. ▪ Report the number of unattended tree maintenance and service requests. ▪ List audit score and actions/targets achieved, ongoing, and not started.
3	**BUDGET AND FUNDING (BF):** City resources enable comprehensive urban forest management for the preservation and enhancement of tree benefits. ▪ Report the proportion of public trees to tree management staff. ▪ Report the proportion of budget to the total public tree population. ▪ Report the proportion of public trees to the City population. ▪ Report the number of volunteers and volunteer hours. ▪ List the unfunded urban forestry needs. ▪ Report the budget, partner funding, permit revenue, and donations. ▪ List audit score and actions/targets achieved, ongoing, and not started.

4

ASSESSMENTS AND PLANNING (AP):

A thorough understanding of the urban forest ensures data-driven decisions, sustainable and comprehensive planning, and amplified tree benefits.

- Report the number of trees inventoried.
- Report the number of public trees planted, pruned, and removed.
- Report the number of trees assessed for risk.
- Report the value of the entire urban forest and public tree population.
- Report the urban forest audit score and future audit scores.
- Report the condition, structure, and diversity of public trees.
- Provide a summary of existing tree canopy cover Citywide and locally.
- List the priority planting areas, canopy goals, and recommended species.
- Report the assessment and planning efforts of partners.
- Describe the high-value conservation and preservation areas.
- List audit score and actions/targets achieved, ongoing, and not started.

5

COMMUNITY ENGAGEMENT (CE):

Sustainable urban forest management and equity is achieved through a partnership with the City and its residents resulting in improved well-being, human health, and local economies.

- List the existing and potential outreach platforms and initiatives.
- List existing and potential partners.
- Report the number of planting events and trees planted.
- Report the history/count of Tree City USA and supporting awards.
- Report the number of volunteers, events, and volunteer hours.
- Report the number of city residents reached through messaging.
- Report on the website user traffic.
- Report the number of private tree plantings as feasible.
- Report the number of trainings, workshops, and attendees.
- Report the results of public surveys.
- Recognize exemplary urban forest stewards.
- Report on the activities of the Urban Forestry Commission.
- Report the activities of local partners as feasible.
- List audit score and actions/targets achieved, ongoing, and not started.

6

GREEN ASSET MANAGEMENT (GA):

Kirkwood proactively manages the public trees, continues to grow and expand a healthy canopy, effectively mitigates storm damage, maintains public safety, and optimizes urban forest benefits.

- Report the number of public trees pruned, removed, and planted.
- Report on the public tree pruning rotation (i.e., number of years).
- Provide a map of the trees prioritized for programmed pruning.
- Report the number of trees managed for pests and diseases.
- Provide an estimate on the amount of invasive plant species managed.
- Report the number of trees planted to address tree equity, climate change.
- Report the number of mitigation plantings and stormwater plantings.
- Count the number of introduced tree species to combat climate change.
- Report progress towards canopy goals and tree planting targets.
- Provide a map of priority planting areas for upcoming year.
- Report the volume of woody biomass utilized.
- List audit score and actions/targets achieved, ongoing, and not started.

Revise

Completion of this Plan is a critical step towards meeting the vision for Kirkwood's urban forest. Continual monitoring, analysis, and reporting will help to keep urban forest partners involved and focused on accomplishing the actions. Plans are typically revised every 10 to 15 years; hence, the Plan will need formal revision to respond and adapt to changes as they develop. Formal revision of the Plan should coincide with the update of the City's Comprehensive Plan, Park and Recreation Master Plan, Stormwater Guidance, climate/sustainability plans, and other relevant planning efforts. Recommendations and goals of each should be compared. Revisions to the Plan should occur with major events, such as newly discovered pests or diseases, changes in program budget and resources, or significant changes to industry standards or legal codes.

Figure 26. Example of the plan implementation, evaluation, and revision process

ACT AND REPORT	EVALUATE AND REVISE	ACT AND REPORT	EVALUATE AND REVISE
Years 1-5	*Year 5*	*Years 6-10*	*Year 10*
Annual Action Plans and Reports	Urban Forest Audit and Plan Amendments	Annual Action Plans and Reports	Urban Forest Audit and Plan Update
Monthly Activities and Annual Report	Updated Benchmarks and Plan Actions	Monthly Activities and Annual Report	Updated Benchmarks and Plan Actions

Applying the Urban Forest Audit to Revise the Plan

The Urban Forest Audit can serve as the tool for the City to effectively Evaluate, Monitor, Report, and Revise the Plan as part of the implementation and monitoring protocols. As found in the 2022 Urban Forest Audit completed to develop the Plan, there are areas of urban forest management where the City is performing at a high level and other areas where improvements are needed. The goals and actions in the Plan address both these strengths and challenges. The following summarizes the relationship of the Plan's actions to the categories in the Urban Forest Audit. Each action in the Plan includes a reference to the Audit's category and subcategory (see Appendix C).

Table 35. Summary count of the evaluations completed in the 2022 Urban Forest Audit

Ranking	Count	%	% of Total
1) In Development	71	28%	55%
2) Adopted Common Practice	51	40%	40%
0) Not Practiced	7	0%	5%
Category Total	**129**	**68%**	**100%**

Out of the nearly 130 elements (or subcategories) within the Audit, the majority (71 elements or 55%) ranked "1) In Development" followed by 51 (40%) elements ranked as "2) Adopted Common Practice". Most of the elements given the "In Development" ranking were a result of the outcomes from the Urban Forest Master Plan or the strategic actions within the Plan to be implemented.

Table 36. Urban Forest Audit scores applied to the Plan's actions

Ranking	Rating	UFMP Goal*	Corresponding Actions
Management Policy and Ordinances	54%	Goal A	Recommending revision to tree-related ordinances
Professional Capacity and Training	69%	Goal B	Recommending program structure and staffing levels, training
Funding and Accounting	58%	Goal B Goal C	Recommending budget analyses, needs
Decision and Management Authority	100%	Goal B	Recommending program structure and staffing levels
Inventories	85%	Goal D	Recommending inventories
Plans	58%	Goal D	Recommending strategic planning
Risk Management	56%	Goal D Goal F	Recommending assessments and maintenance
Disaster Planning	43%	Goal D Goal F	Recommending strategic planning
Standards and Best Practices	68%	Goal A Goal F	Recommending revisions to ordinances and standards
Community	86%	Goal E	Recommending community engagement
Green Asset Evaluation	75%	Goal F	Recommending proper planting and maintained inventory
Category Total	**68%**		

*Goal A: Tree Management Policy; Goal B: Capacity, Training, and Authority; Goal C: Budget and Funding; Goal D: Assessments and Plans; Goal E: Community Engagement; Goal F: Green Asset Management

As the Plan is being implemented, the status or score of the categories within the audit will change. The implementation worksheet provided as part of the Plan includes a reference to the audit category and element to effectively reevaluate and adjust strategies and actions for the revisions to the Plan.

CONCLUSION

Trees are an integral part of the community and the ecological systems in which they exist. They provide significant economic, social, and ecological benefits, such as carbon sequestration, reduction of urban heat islands, energy savings, reduction of stormwater runoff, improvement of water quality, enhancement of human health and wellness, and increase the value of properties. Planting and maintaining trees help Kirkwood become more sustainable and reduce the negative impacts on the ecosystem from urban development. Trees are as necessary as water, infrastructure, and energy to sustaining healthy communities. The health of the urban forest is directly linked to the health of the region.

The goal framework in Kirkwood's Urban Forest Master Plan is based on outcomes of the audit system and in alignment with existing plans to allow the City to incrementally implement actions, effectively monitor progress, and efficiently adapt in an everchanging environment. Successful implementation of actions in this Plan will bring Kirkwood to a higher level of service that is more equitably distributed across the City resulting in a sustainable and thriving urban forest that benefits all residents and future generations—ultimately achieving the Plan vision:

"Kirkwood will prioritize the health of its current and future urban forest to support a healthy, sustainable, and resilient community."

James Clark, emphasizes the importance of an Urban Forest Master Plan in *A Model of Urban Forest Sustainability* (1997):

> "Urban trees and forests are considered integral to the sustainability of cities as a whole. Yet, sustainable urban forests are not born, they are made. They do not arise at random, but result from a community wide commitment to their creation and management."
> Clark et al. A Model of Urban Forest Sustainability, 1997

As stated in this quote, an effective urban forestry program supported by the City's passion for the natural environment will lead Kirkwood to a more sustainable and thriving urban forest.

APPENDICES

Appendix A. Public Tree Inventory Analysis and Summary B

Summarizes the public tree inventory completed in 2022 by extent, location, structure, condition, and maintenance priority to support implementation of this Plan.

Appendix B. Management Schedule and Budget Worksheet U

Based on the analysis of the 2022 public tree inventory, this worksheet details the schedule and estimated costs to complete the maintenance and removal priorities.

Appendix C. 2022 Urban Forest Audit Results W

Provides the status for each element within the 11 categories of urban forest management, sustainability, and equity as defined by the U.S. Forest Service and urban forestry consultants for the UFMP. The interactive worksheet provided as part of the project should be utilized to monitor and adapt UFMP implementation.

Appendix D. Funding Mechanisms HH

To support the implementation of actions in this Plan, a matrix of funding mechanisms is provided that describe the funding option, requirements, considerations, and limitations. The City should have a diverse portfolio of funding sources to be sustainable and achieve the vision of the urban forest.

Appendix E. Trees and Hardscape Conflicts Solutions Workbook JJ

Existing trees in the landscape share limited space with other City infrastructure. As such, the assets are competing for space which may result in conflicts between trees and hardscape. This workbook provides the decision matrix to assess the tree(s), the site(s), and the conflict(s) in a transparent and consistent manner. In addition, alternative solutions for tree and hardscape conflicts are provided for the City to consider for established trees and future tree plantings.

Appendix F. Urban Forest Management Best Practices UU

To support implementation of this Plan, a series of best practices for maintenance and planting is provided. This information should be utilized internally and shared with partners and the community to maintain and grow a healthy and sustainable urban forest.

Appendix G. Storm and Disaster Management Guidance DDD

One area where the Urban Forest Audit identified a shortcoming is in the City's protocols and strategies for storm and disaster preparation, response, and recovery. This resource provides guidance from the U.S. Forest Service and regional examples for the City of Kirkwood to integrate into its existing storm and disaster management program.

Appendix A. Public Tree Inventory Analysis and Summary

To grow a healthy and diverse urban forest, the public tree population must be well understood and managed. Based on a comprehensive tree inventory completed in 2022 by Certified Arborists accredited by the International Society of Arboriculture (ISA), Kirkwood has a total of 8,614 public trees across streetscapes and in maintained areas of public parks and properties. These trees were examined and assessed to determine the species, size, health, structural integrity, quality of the growing space, and maintenance needs, among other key characteristics for management.

The key to maintaining a sustainable and healthy urban forest is species and age diversity, proper tree maintenance, risk management, and community support, which is addressed in the Plan's recommendations.

A Note on the Data Collected and Analyzed

Note, the data collected and analyzed in the following summaries are derived from the 2022 Public Tree Inventory and analyses completed in March 2022 and April 2022. Public trees are dynamic assets that grow and change. Tree condition, observations, defects, maintenance needs, and other factors are constantly changing due to the nature of the trees, the growing environment, and the maintenance history. The summaries and associated recommendations are based on the inventory data at the time of analysis.

Public Trees: Species Diversity

Species composition data are essential since the types of trees present throughout the City dictate the amount and type of benefits produced, tree maintenance activities required, and budget considerations.

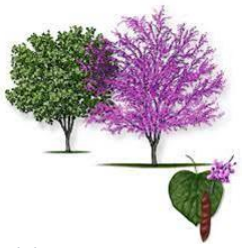
The 8,614 inventoried trees consist of 174 different species and cultivar classifications and 75 unique tree genera. Pin oaks comprise the highest percentage with 17 percent (704 trees) of the total tree population, followed by red maple at 7 percent (626 trees) and eastern redbud with 7 percent (562 trees). The top ten most prevalent species comprise 48 percent of the total inventoried public tree population. The remaining 52 percent is made up of other species that are primarily sweetgums, pears, eastern red cedar, maples, white pines, ash, oaks, crabapples, dogwoods, ginkgo, bald cypress, hackberry, or sycamore— each with at least 100 trees or more.

Figure 27. Most common public tree species (top 3)

Pin oak

Red maple

Eastern redbud



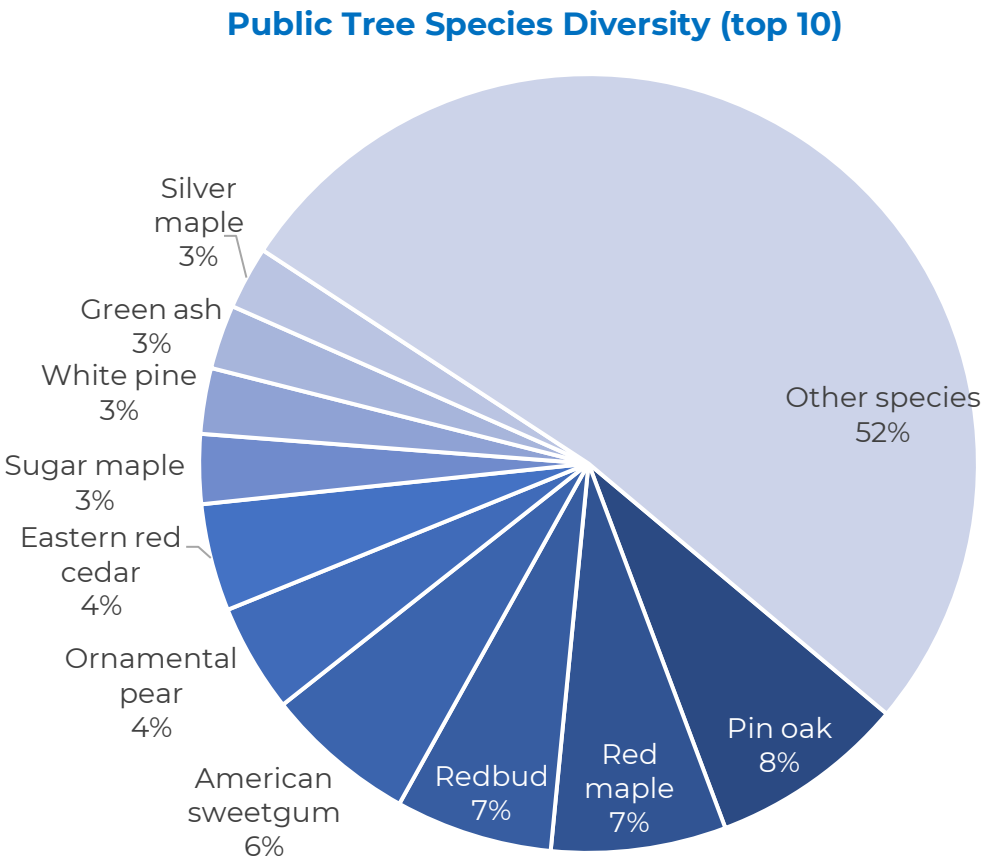


Figure 28. Public tree species diversity (top 10)

Table 37. Most common public tree genera

Genera	% of Population	Genera	% of Population
Quercus (oak)	17%	*Pyrus* (pear)	5%
Acer (maple)	15%	*Juniperus* (red cedar)	5%
Cercis (redbud)	7%	*Pinus* (pine)	4%
Liquidambar (sweetgum)	5%	*Ulmus* (elm)	3%
Fraxinus (ash)	5%	*Cornus* (dogwood)	2%

Public Trees: Size and Age Distribution

The distribution of tree ages influences the structure of the urban forest as well as the present and future costs. An unevenly aged urban forest offers continued flow of ecological benefits and a more uniform workflow allowing managers to more accurately allocate annual maintenance schedules and budgets.

To optimize the value and benefits of Kirkwood's trees, the urban forest, i.e., the public tree population, should have a high percentage of large canopy trees which provide greater ecosystem benefits. On the other hand, there must be a suitable number of younger, smaller trees in the urban forest to account for and eventually replace large and mature trees in decline. Having a healthy percentage of young trees in the urban forest will ensure a sustainable tree population as well as age distribution in future years. To compare Kirkwood's urban forest structure to industry-recommended standards, the "ideal distribution" is used (Richards, 1983 and 1993). The diameter at breast height (4.5-feet) is used to measure relative age.

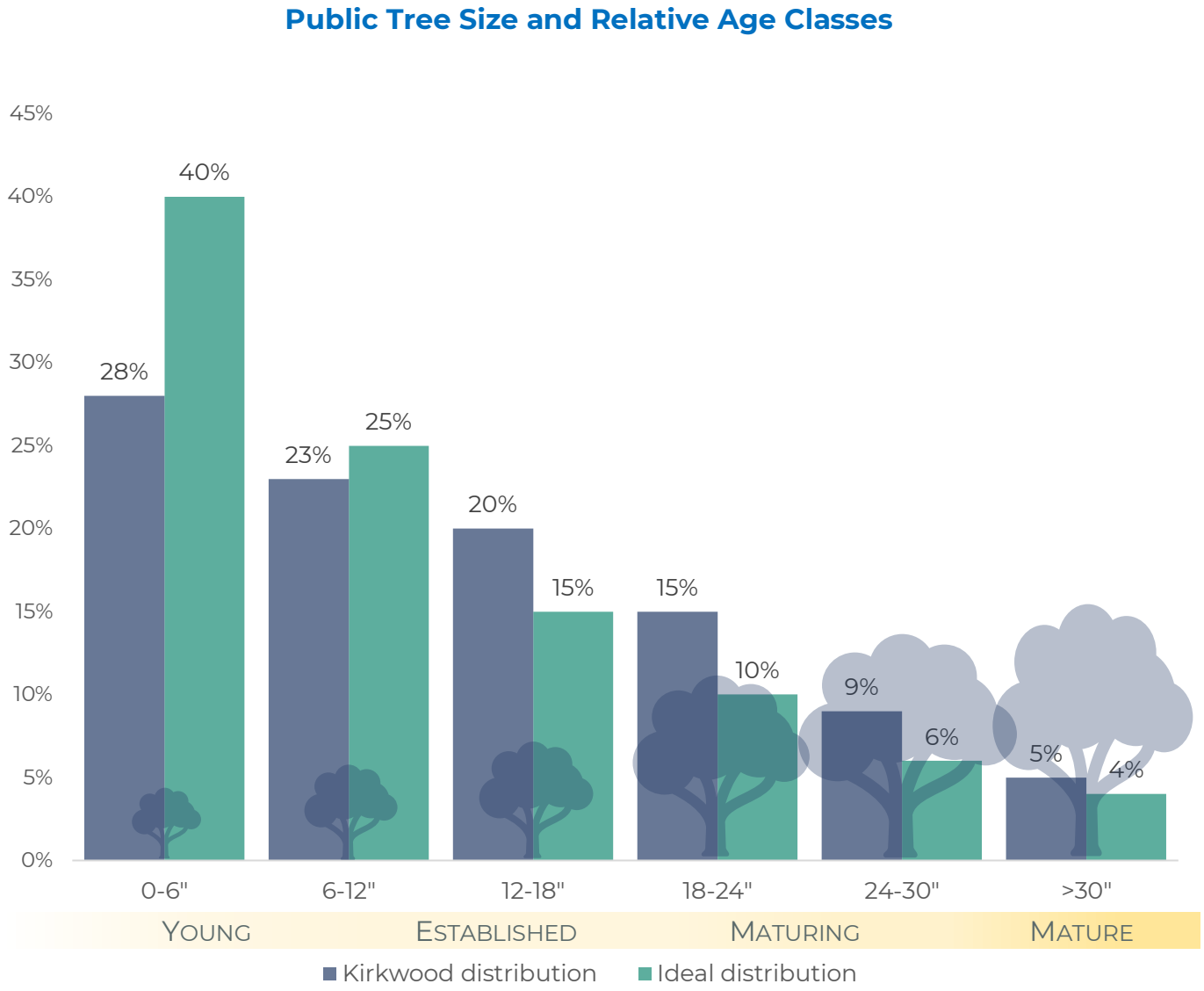


Figure 29. Comparison of the size distribution of Kirkwood's public trees to an ideal distribution

Overall, the age distribution of Kirkwood's public tree population is similar to the ideal age distribution. As the figure above (Figure 29) shows, 51 percent of the public tree population (4,383 trees) is composed of trees with a DBH (or "diameter at breast height," measured at 4.5 feet above grade) ranging from 1 to 12 inches. This indicates that the majority of trees are young or small-statured. Trees in this size class are crucial for a healthy urban forest, however the inventory found there are more trees in the size classes from 12 inches to greater than 30 inches than the ideal distribution. This could be due to the City's long history of planting trees which have now grown to large specimens. One concern is the 0-6-inch class with 12 percent less than the ideal 40 percent. Development often shapes the tree diversity in a city and the City should work with developers to ensure that the species they are planting allow for larger species where possible.

The size classes ranging from 12 inches to over 30 inches are all above the ideal distribution which may represent a declining public tree population, or a significant number of large trees expected to need removal over the life of this Plan. City trees in these larger DBH ranges can offer larger ecological benefits if the trees are properly maintained and remain healthy, but trees of this size should be monitored frequently to determine maintenance needs, potential risks, and signs of decline. The average DBH for the entire population is 13 inches, and the largest recorded DBH is 40 inches.

An ideal age distribution in the tree population allows managers to allocate and project annual maintenance costs uniformly. This ensures continuity in overall tree canopy coverage and associated benefits which are often dependent on the growing space of individual trees (e.g., open grown versus restricted growing areas). It is recommended to monitor and strategically manage large trees throughout the City and weigh the risks and benefits that are associated with large, mature trees.

Public Trees: Height

The height of trees is a contributor to the structure of the public tree population. Heights may correlate with the associated benefits and services provided by trees as more height may indicate more leaf area. During the 2022 inventory, height ranges for the public tree population were gathered.

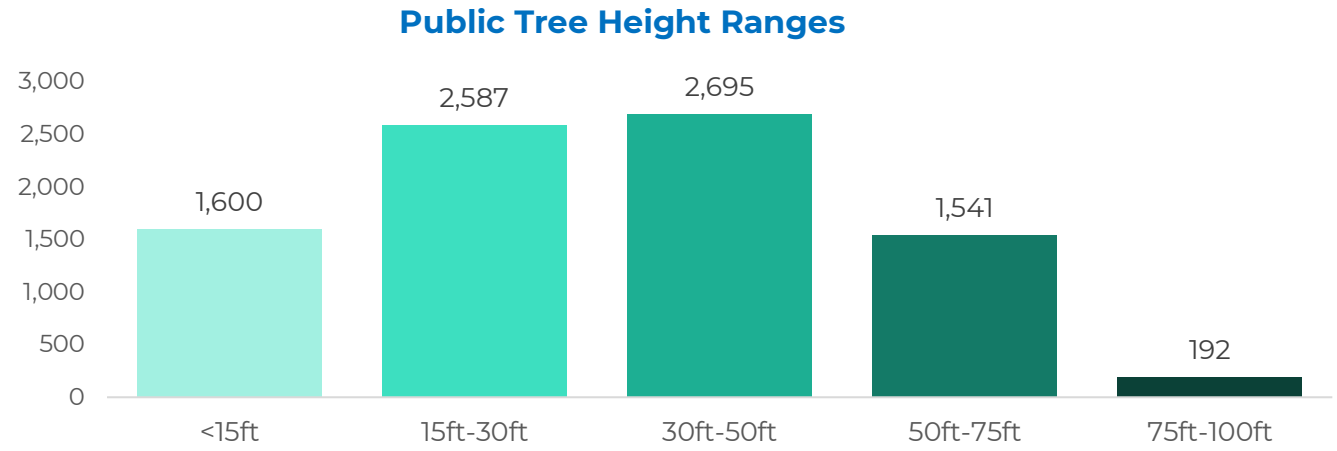


Figure 30. Tree height ranges for the public tree population

Most of the public trees are in the 30-50-foot height range (31 percent) or the 15-30-foot range (30 percent). Only 2 percent of the inventoried trees are in the 75-100-foot height range.

Public Trees: Distribution by Forestry Maintenance District (FMD)

The City manages its urban forest by Forestry Maintenance District. A total of 8 districts comprise the entire city. The structure of the public tree population along with the condition, maintenance needs, and planting sites dictate current and future maintenance and management needs.

Shown in Figure 32 below, District 2 has the greatest number of trees with 1,271 or 15 percent of the entire public tree population whereas, District 6 has 791 trees or 9 percent. The average number of trees across the 8 FMDs is 1,077 trees.

The map to the right provides a view of the districts showing District 5 has the greatest amount of land area and District 1 has the least amount which likely impacts the total number of trees.

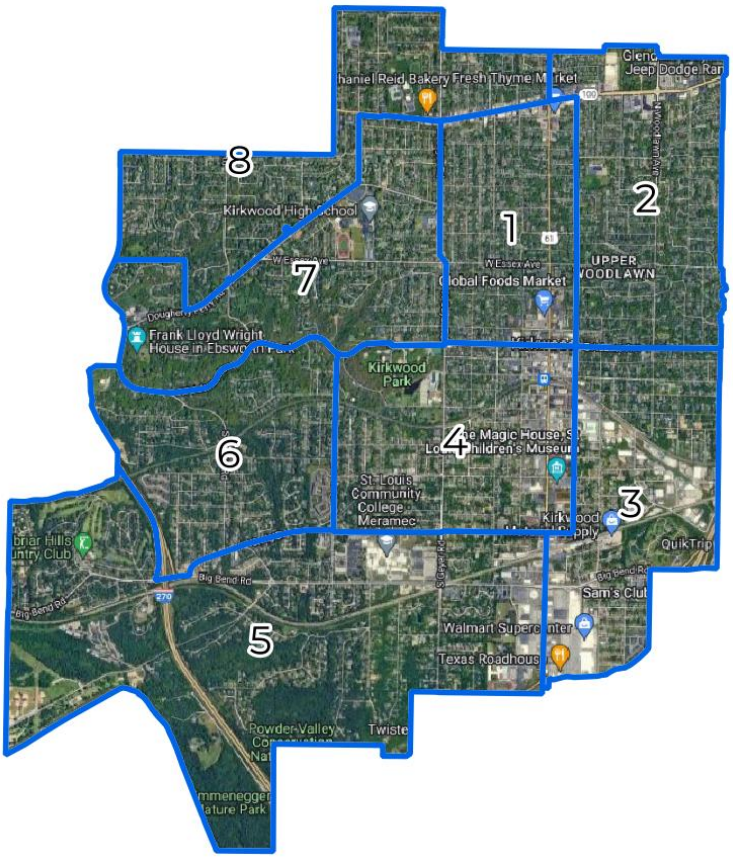


Figure 31. Map of Kirkwood's Forestry Maintenance Districts

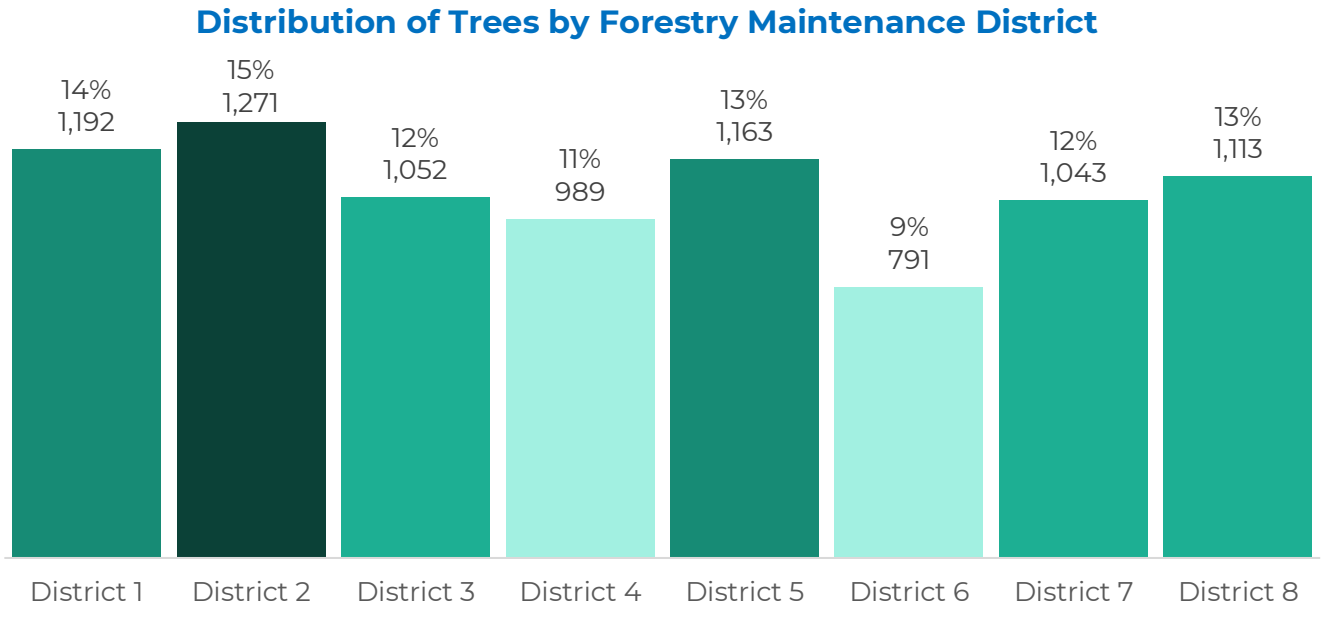


Figure 32. Distribution of trees by Forestry Maintenance District

Public Trees: Condition

Tree characteristics and environmental factors affect the management needs for urban trees. An analysis of the condition and maintenance requirements assists managers in planning Kirkwood's public trees and the Citywide urban forest.

Tree condition indicates how well trees are managed and how well they perform, given site-specific conditions. Tree maintenance needs are assigned for public safety reasons and for the health and longevity of the trees themselves. Understanding the maintenance needs assists tree managers in establishing daily work plans and maintaining public safety. These needs are examined in the Maintenance Needs section of this study.

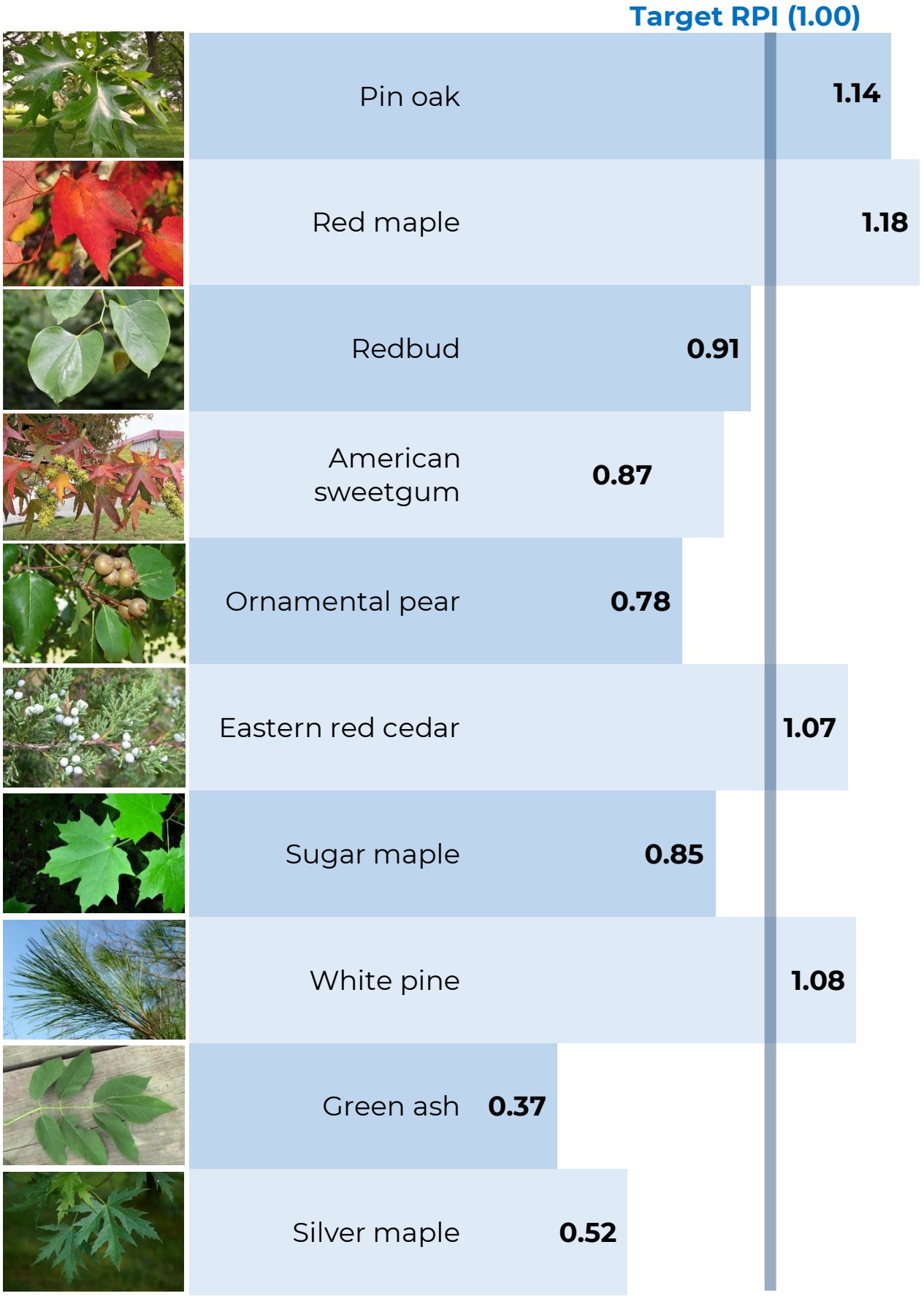
The public tree inventory data were analyzed to identify potential trends in tree condition and management needs. Information on the condition of trees plays an important role in planning, budgeting, and use of resources. Each inventoried tree's health was evaluated by ISA Certified Arborists based on the condition of the wood and the foliage as well as the structure.

Figure 33. Summary of public tree condition classes

Figure 33 summarizes the 8,614 trees that were assigned a condition rating and shows an example of the canopy health for each respective classification. The data show that every two of three trees inventoried are classified as being in "Good" condition, comprising 67 percent or 5,790 trees, followed by those in "Fair" condition comprising 24 percent (2,096 trees). 539 (6 percent) trees are noted as being in "Poor" or "Dead" condition. The dead trees or trees noted for removal should be addressed and planned for immediately. Trees classified as "Critical" may have a chance at recovery depending on the factor(s) affecting the rating. These trees should be examined to determine the mitigation necessary, if any.

Relative Performance Index of Most Common Public Tree Species

Table 38. Relative Performance Index of the most common public trees



In addition to understanding the overall condition of the public tree population to inform management strategies, an analysis of performance was also conducted for the ten most prevalent tree species using the Relative Performance Index approach. Relative Performance Index (RPI) is a comparison of a species' condition rating of "Good" and the tree population's "Good" rating. Using the percent of Good trees for a given species divided by the tree population percentage of Good trees gives a value of equal to 1, less than 1, or greater than 1. A value equal to 1 means the particular species is as healthy as the overall tree population. A value less than 1 means the species is not as healthy as the overall tree population. A value greater than 1 means the species is healthier than the overall tree population. RPI answers the question of how well a species is performing in terms of health compared to the entire inventoried population.

For the public tree population, red maple, pin oak, white pine, and eastern red cedar are performing better than the overall public tree population. Redbuds, sweetgums, and sugar maples are performing similar to the overall public tree population but pears, silver maples, and green ash are underperforming and are in the poorest condition of the top ten most prevalent tree species. These metrics are useful in identifying concentrations of maintenance demand and determining the appropriate tree species to plant in the future.

Public Trees: Observations and Defects

Tree observations (or defects) were recorded during the 2022 inventory to further describe a tree's health, structure, or location when more detail was needed. A total of 21 unique observation options were included in the inventory, 4,014 trees had one or more defects, and a total of 7,339 observations were recorded.

The table (Table 39) to the right provides a summary of the observations for Kirkwood's public trees. A total of 7,339 observations were recorded during the tree inventory, with 4,014 trees (46 percent) noted as having at least one observation while 4,600 trees (53 percent) have no observation recorded. Crown dieback was the most frequent observation recorded (25 percent or 2,168 trees) during the 2022 tree inventory. 19 percent or 1,596 trees were noted as having poor structure, and 17 percent or 1,496 trees were observed to have cavity decay.

Public Tree Observations

Observation	Count	% of Trees
Crown Dieback	2,168	25%
Poor Structure	1,596	19%
Cavity Decay	1,496	17%
Poor Root System	501	6%
Hardscape Damage	491	6%
Improperly Pruned	221	3%
Poor location	212	2%
Mechanical Damage	193	2%
Serious Decline	159	2%
Pests	138	2%
Girdling Roots	130	2%
Canker	13	0%
All other observations	21	0.2%
TOTAL	**7,339**	**85%**

Table 39. Observations and defects recorded for Kirkwood's public trees

Of the total observations made, 98 percent are preventable or mendable meaning the defects or concerns observed are primarily human-caused. For example, poor structure can be prevented or limited with proper young tree pruning, implementing best practices and standards would prevent or reduce the number of improperly pruned trees, and poor root systems can be prevented by choosing quality tree nursery stock, proper planting, and amending soils. Trees with poor location and/or hardscape damage observations could have been prevented by choosing the appropriate species for the site and ensuring adequate root space. Lastly, adequate

mulch rings, growing space, grates, and awareness would reduce the count of mechanical damage observations. The data also shows the impacts of deferred maintenance. About 56 percent of the observations recorded could be addressed or prevented with proactive pruning.

Potentially Human-Caused Defects

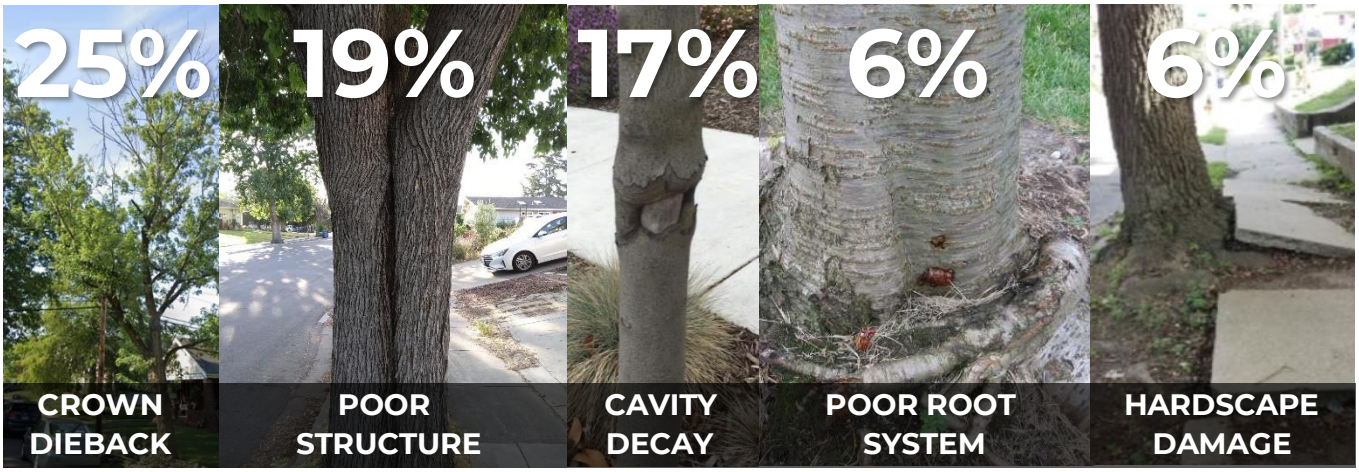


Figure 34. Examples of the potentially human-caused defects seen in the public tree observations

Public Trees: Primary Maintenance Needs

The inventory required an assessment of the maintenance needs, if any, for each tree. A total of 10 unique maintenance needs or priorities were included as options in the inventory.

Table 40 provides a summary of the priority maintenance and removal recommendations for all of the inventoried trees. 95 percent of the public tree population requires routine pruning with 2,379 (28 percent) small trees and 5,771 (67 percent) large trees. Only 4 percent (306 trees) are recommended for removal and 15 percent (47 trees) of the 306 trees were given a Priority 1 rating for removal. Newly planted trees should be structurally pruned (training pruned) within five years of planting.

Public Tree Maintenance Needs

Maintenance Need	COUNT	%
Priority 1 Removals	47	1%
Priority 2 High Risk Prune	100	1%
Priority 3 Recommended Removal	259	3%
Priority 4 Routine Large Prune	5,771	67%
Priority 5 Young Tree Prune	2,379	28%
Trees to Monitor	59	1%
Existing Stump Removal	10	0.1%
TOTAL	**8,625**	**100%**

Table 40. Public tree maintenance needs

Young tree training pruning is performed to improve tree form or structure; the recommended length of young tree pruning cycles is three years since young trees tend to grow at faster rates (on average) than more mature trees. The young tree cycle differs from a routine pruning cycle in that these trees generally can be pruned from the ground with a pole pruner or pruning shear.

The objective is to increase structural integrity by pruning for one dominant leader in most cases for most tree species. Young tree training pruning is species-specific, since many trees may naturally have more than one leader. For such trees, young tree training pruning is performed to develop a strong structural architecture of branches so that future growth will lead to a healthy, structurally sound tree. In addition to training pruning, young trees may also require additional maintenance such as added or amended mulch, watering, added or removed stakes and ties, and/or clearance of debris and litter. These needs can potentially be addressed during young tree training pruning.

Trees included in the young tree training pruning cycle are generally less than six inches DBH. These younger trees sometimes have branch structures that can lead to potential problems as the tree ages. Potential structural problems include codominant leaders, multiple limbs attaching at the same point on the trunk, crossing/interfering limbs, or dead/diseased/damaged limbs. If these problems are not corrected, they may worsen as the tree grows, increasing risk and creating potential liability.

Public Tree Maintenance Details

Figure 35. Common public tree maintenance needs

PUBLIC TREES: RISK TREE MANAGEMENT

Overview

Risk management is a well-established concept in the management of public spaces. Acceptable levels of risk have been recognized or defined for most basic infrastructure elements such as sidewalks, curbs, streets, playgrounds, and utilities. In many communities, these elements are assessed and managed according to acceptable levels of risk that are specified within written policies or enacted through management practices. Although not all pot-holes can be immediately filled in, not all heaving sidewalks immediately repaired, not all burned-out street light bulbs immediately replaced, a successful risk management program provides a community with a systematic approach to implement corrective actions within a reasonable timeframe.

An urban community consists of both the gray infrastructure (buildings, streets, utilities) and the green infrastructure— the urban forest. Although gray infrastructure has long been assessed and monitored for acceptable levels of risks, green infrastructure has for the most part not received the same subjective evaluations. The urban forest is an integral part of a community's infrastructure, and trees often dominate the landscape or at least are the most

visible part of it. Urban trees contribute to increased quality of life for many communities and their residents. Most people prefer to live, recreate, and work in communities of healthy and well-maintained urban forests. Considerable research documents that people not only prefer to recreate in well-maintained parks with trees, but are willing to pay extra for the privilege. Safety, or at least the perception of safety, is critical if urban forests are to be managed and enjoyed.

Management of Tree Risk

Community managers have the responsibility to create and maintain a safe and useful urban forest for their constituents. Urban foresters need the training, expertise, and data to recognize varying levels of risk, and to manage the forest at an acceptable level of risk. Tree risk management involves the process of inspecting and assessing trees for their potential to injure people or damage property. Traditionally the term "hazard" (or hazardous) had been used in the context of evaluating trees for their failure potential. To many people, "hazard" suggests trees are at immediate risk for failure. In this report, the term "risk" trees is used to define trees with structural defects that may cause the tree or tree part to fail, where such a failure may cause property damage or personal injury. Trees will vary, ranging from low to high risk for failure and may require attention immediately or in the near future. The threshold of risk acceptable to liable parties is dependent upon their policies and objectives. To make objective, science-based decisions on the safety of trees and the urban forest, individual trees and site conditions need to be evaluated for the level of risk that they do or do not present.

Liability and Risk

Community leaders and decision-makers must consider the perceived public liability for tree damage and injury claims. In the extreme, trees are excluded from public rights-of-way to minimize public exposure. In the risk management field this is called risk avoidance. In these cases, the public benefits that trees provide, which usually outweigh the perceived costs, are not delivered to the community. Attempts to attain zero risk often become costly over time, due to premature tree removals, more frequent tree replacements, and loss of benefits that mature trees provide. Instead, the City should actively monitor, prioritize, and mitigate risk as funding permits.

Street Tree Management in Kirkwood

The City is responsible for the maintenance, removal, and planting of street trees as well as pruning the trees for street and sidewalk clearance, and the removal of dead, weak, or hazardous limbs. While pruning conforms to accepted professional standards, street trees are not pruned for aesthetic purposes. Pruning may be done by the adjacent property owner with a permit. Pruning must adhere to City standards in order to protect the health and vitality of public trees.

The City's Public Services Department maintains these street trees. This assessment aims to provide the City with the guidance to effectively mitigate priority risks within the confines of available resources and funding.

Purpose of Tree Risk Management

The purpose of a tree risk assessment is to inspect and assess in detail the structure and quality of the tree, tree parts, surrounding targets, and environmental conditions. An assessment provides the persons or entity responsible for tree care with options for mitigating or reducing risk associated with each tree assessed. By evaluating and ranking

the risk potential, tree managers can prioritize mitigation efforts within the limits of available funding and resources.

Trees may appear to be permanent fixtures of our environment though at some point, trees will eventually decline in health, deteriorate in structure, collapse, and decompose. Trees may decline and eventually die from myriad causes including disease, insect attack, drought, uprooting, and catastrophic stem failure in high winds, or from combinations of factors working together. Others may die from old age and go through a natural cycle of senescence before failure. Some trees die and later collapse as their stems and branches decay, and some begin to break up while they are still green. While any large tree poses a risk of failure in high winds, in situations where people and trees must live together in close proximity it is important to identify where a tree has become an unacceptable risk.

Many different kinds of professionals are interested in managing tree risk in communities. For the City of Kirkwood, the Forestry Division implements long-term planning and management of the street tree population and the Urban Forestry Commission supports these activities. Tree managers in Kirkwood need reliable information concerning the identification and management of hazard or "risk" trees. In addition, public trees need to be routinely pruned to minimize risk, maintain public safety, improve tree health, strengthen the structure of trees, and provide a continual flow of ecosystem benefits and services.

Procedures for Tree Risk Management

The City should use tree inventory data, inventory software, service requests, and staff observations to continue to prioritize trees for risk assessment and potential mitigation. Risk assessors should use the ISA Level 2 Basic Risk Assessment protocols along with the American National Standards Institute's (ANSI) A300 Standards.

Both empirical data and subjective data should be gathered for each tree. The industry protocols require the assessor to evaluate the tree for conditions and factors that may qualify as a potential risk. The evaluation considers the tree's crown and branches, trunk(s), and roots. If a potential risk is identified in either or all of the tree's components, the site information is collected, and the risk assessment commences. Potential targets such as people or vehicles are noted along with site factors and tree health issues. The tree component causing the potential risk is then examined and documented. For the crown or branches, issues such as deadwood are recorded along with the deadwood size and the level of load bearing on the branch or branches. The likelihood of failure and impact are recorded, and the likelihood of failure and impact is autopopulated based on the ISA tree risk assessment matrix (see tables below). In addition, the level of consequence is autopopulated as is the risk rating for the specific tree component (e.g., crown and branches). If other tree components such as the trunk or roots pose a potential risk, a similar process is completed. Once all components are assessed, an overall risk rating is autopopulated indicating the risk level as extreme, high, moderate, or low risk.

Table 41. The ISA tree risk assessment matrix to establish a risk rating

Likelihood of Failure	Likelihood of Impact			
	Very Low	Low	Medium	High
Imminent	Unlikely	Somewhat Likely	Likely	Very Likely
Probable	Unlikely	Unlikely	Somewhat Likely	Likely
Possible	Unlikely	Unlikely	Unlikely	Somewhat Likely
Improbable	Unlikely	Unlikely	Unlikely	Unlikely

Likelihood of Failure	Consequences of Failure			
	Negligible	Minor	Significant	Severe
Very Likely	Low	Moderate	High	Extreme
Likely	Low	Moderate	High	High
Somewhat Likely	Low	Low	Moderate	Moderate
Unlikely	Low	Low	Low	Low

Definitions

Risk Tree: Formerly referred to as a hazard tree, a risk tree has structural defects in the roots, stem, or branches that may cause the tree or tree part to fail, where such failure may cause property damage or personal injury.

Tree Defects: Tree defects are often organized into two categories— 1) injury or disease that seriously weakens the stems, roots, or branches of trees, predisposing them to fail or, 2) structural problems arising from poor tree architecture, including poorly attached stems and branches that lead to weak unions, shallow rooting habits, inherently brittle wood, and other physiological conditions.

Low Risk: The low risk category applies when consequences are “negligible” and likelihood is “unlikely”; or when consequences are “minor” and likelihood is “somewhat likely” (refer to Table 41 for terminology). Some trees with this level of risk may benefit from mitigation or maintenance measures, but immediate action is not usually required. Tree risk assessors may recommend retaining and monitoring these trees, as well as mitigation that does not include removal of the tree.

Moderate Risk: Moderate risk situations are those for which consequences are “minor” and likelihood is “very likely” or “likely”; or when likelihood is “somewhat likely” and consequences are “significant” or “severe” (refer to the ISA tree risk assessment matrix table in the overview provided at the beginning of this report). The tree risk assessor may recommend mitigation and/or retaining and monitoring. The decision for mitigation and timing of treatment depends upon the risk tolerance of the tree owner or manager..

High Risk: High risk situations are those for which consequences are “significant” and likelihood is “very likely” or “likely,” or when consequences are “severe” and likelihood is “likely”. This combination of likelihood and consequences indicates that the tree risk assessor should recommend mitigation measures be taken as soon as is practical. The decision for mitigation and timing of treatment depends upon the risk tolerance of the tree owner or risk manager. In populations of trees, the priority of high risk trees is second only to extreme risk trees.

Extreme Risk: The extreme risk category applies in situations in which failure is "imminent" and there is a high likelihood of impacting the target, and the consequences of the failure are "severe" (refer to Table 41). The tree risk assessor should recommend that mitigation measures be taken as soon as possible. In some cases, this may mean immediate restriction of access to the target zone area to avoid injury to people.

Programmed Pruning: Designed to create structurally sound trunk and branch architecture, this "preventative maintenance" will sustain a tree's benefits to the longest extent possible until the tree naturally reaches a point of senescence— or process of deterioration with age. Programmed pruning is typically implemented citywide or in prioritized maintenance corridors on a rotation of five to seven years depending on the tree species, density of trees, frequency of pedestrians and vehicles, available budget, and other factors. This means that each tree in the programmed pruning cycle is pruned for clearance, risk, health, and/or structure at least once within the programmed cycle (e.g., five to seven years). The goal with mature trees is to develop and maintain a sound structure to minimize risks such as branch failure. This task is easier provided a good structure was established earlier in the tree's life. When properly executed, a variety of benefits are derived from pruning. Benefits include reduced risk of branch and stem breakage, better clearance for vehicles and pedestrians, improved health and appearance, and enhanced view.

Tree risk management and programmed pruning should be a prominently positioned component of Kirkwood's Urban Forestry Program. Tree risk management and programmed pruning plans should complement the City's overall street and park tree management program goals, align with the Urban Forest Master Plan, and should be fully integrated with the tree planting, plant health care, and emergency response programs.

Programmed Pruning for Tree Preservation and Reduced Risk

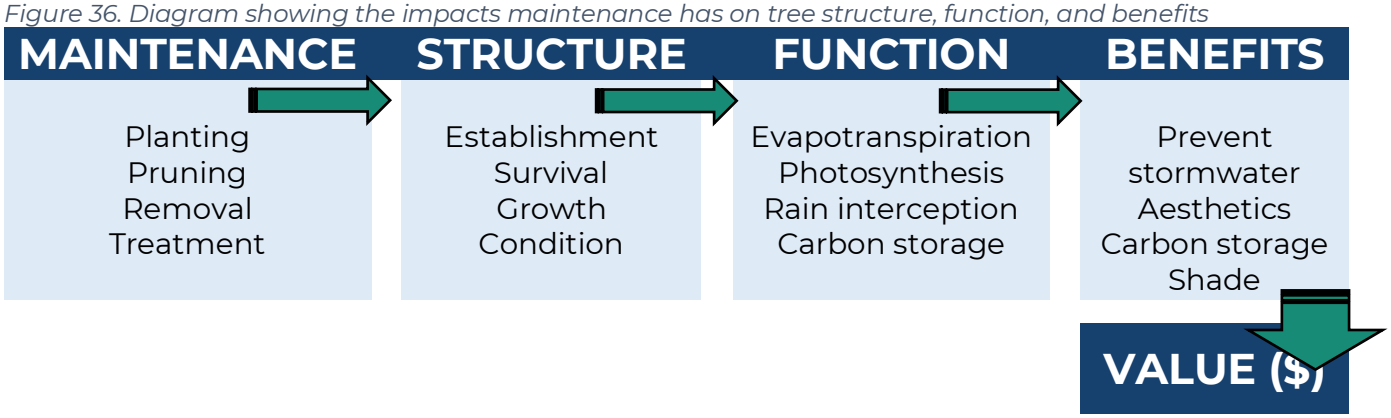
In addition to more frequent tree assessments, proper tree planting, and structural pruning of young trees, the routine maintenance of street trees reduces the overall risk, improves the health of trees, and reduces long-term costs.

Routine maintenance, often referred to as grid pruning or programmed pruning, is the most cost effective near- and long-term pruning management strategy for city tree maintenance since every tree within a given grid, priority area, or zone is pruned each pruning cycle. When each tree is inspected and pruned on a regular cycle, both short- and long-term maintenance costs are reduced due to efficiencies in mobilization, scheduling, and service tracking; both preventative and reactive maintenance are performed in one operation and the need for future priority pruning is minimized. Conversely, street trees that are not pruned on a regular cycle, or their maintenance is deferred, results in the opposite effect— as the interval between pruning increases the tree health declines and the maintenance costs increase.

The level of care or maintenance performed on a planted tree is linked to tree establishment, survival, growth, condition, and longevity. Survival, growth, and condition are closely connected to one another and to the structure of a tree (size, leaf area) and of the urban forest (canopy cover, diversity, age distribution). As a result, tree structure impacts the functions provided by the urban forest and ultimately the level of benefits generated by the tree. Thus, less than optimal maintenance may lead to decreased benefits produced by the urban forest. The benefits lost are the "costs" of not maintaining trees.

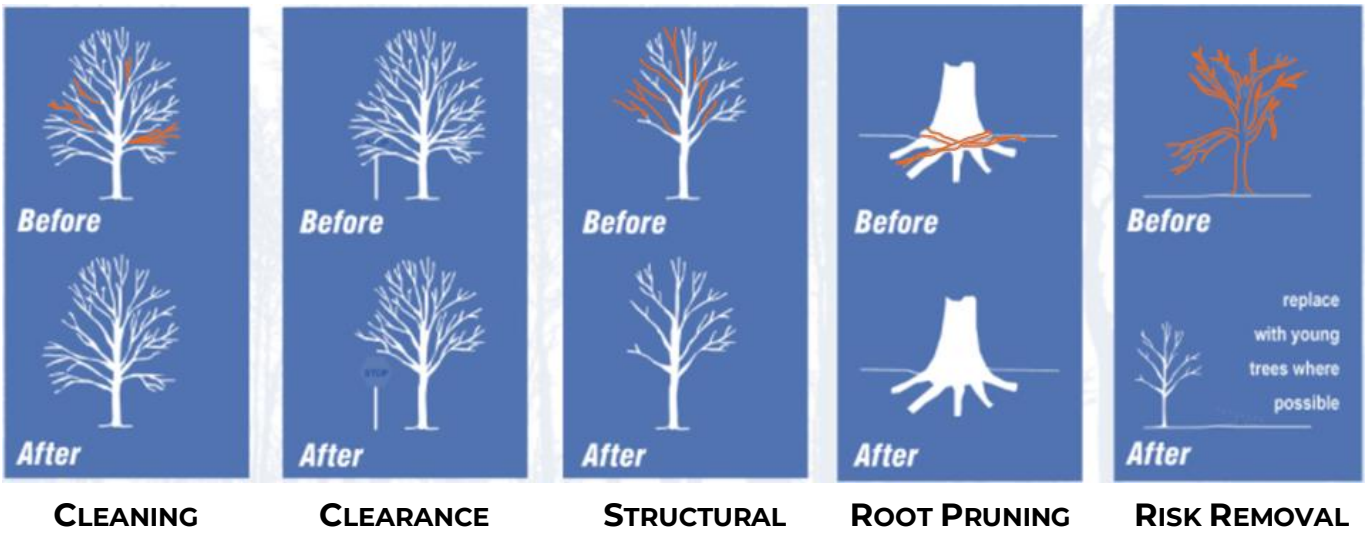
The Impacts of Programmed Pruning

Figure 36. Diagram showing the impacts maintenance has on tree structure, function, and benefits



Examples of Programmed Pruning Techniques for Preventative Maintenance

Figure 37. Examples of techniques for routine tree pruning (Source: Arbor Day Foundation)



Planting Sites Inventory

Tree species diversity, addressed through strategic planting, protects a city's tree canopy cover by limiting the amount of damage from any one threat such as pests, drought, or storms. A commonly accepted diversity goal is for no single species to account for more than 10 percent of the population, no genus more than 20 percent and no family more than 30 percent (Santamour, 1990). This rule can be applied at the city, neighborhood, and block level.

Growing Space of Existing Trees

The planting site width for tree roots and basal flare within the growing space can impact tree growth, health, and maintenance costs over time. Adequate space and soil volume should be considered for each site based on tree species requirements and root biology. Frequency of maintenance is also a consideration for tree selection when a tree needs to be replaced. An analysis of growing space can assist tree managers in making future tree species selections for sites with similar characteristics.

The growing space types were collected for each inventoried public tree. An analysis of the growing space of existing public trees informs future planting sites and the tree species appropriate for replanting. The table and chart below show the number of trees and percentage of each growing space classification. Of the inventoried trees, a total of 4,237 trees (49 percent) are growing in front yards and 2,801 trees (33 percent) in planting strips.

Growing Space of Existing Public Trees

Table 42. Summary of growing space types for public trees

Growing Space	Count	%
Front Yard	4,237	49%
Planting Strip	2,801	33%
Other (Maintained)	950	11%
Median	357	4%
Other (Unmaintained)	258	3%
Cutout	12	0.1
TOTAL	**8,615**	**100%**

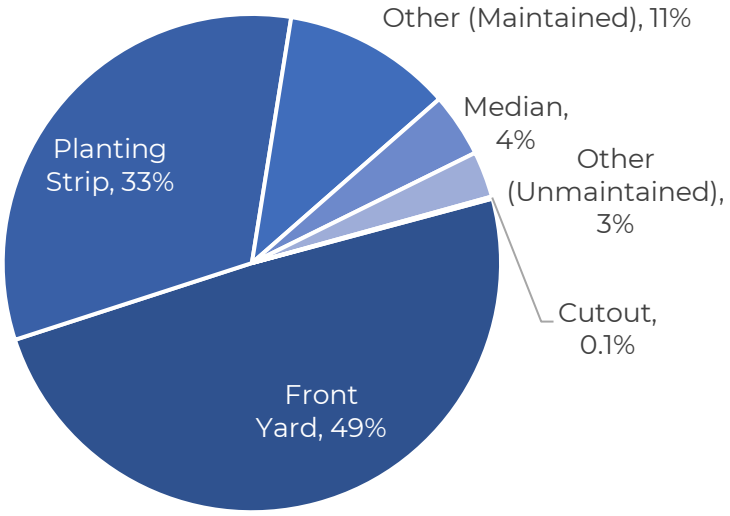


Figure 38. Growing space widths for existing trees

Figure 39. Visual depiction of planting site widths of existing public trees

Future Planting Sites

In addition to the inventory of public trees throughout Kirkwood in 2022, an inventory of future possible planting sites within the public street right-of-way was completed. A total of 2,485 possible sites were inventoried (22 percent of all 11,109 sites inventoried). 95 percent (2,358) sites are within the rights-of-way and adjacent to the single family land use. At each site, the planting width and presence of wires were documented. Of the 4,885 possible planting sites, 46 percent (2,253 sites) are in the medium size class and 97 percent (4,728) of sites do not have any wires or observable utilities present.

Growing Space Size for Future Planting Sites

Table 43. Summary and depiction of possible future planting sites in the public right-of-way

Planting Site Width	Count	%
CLASS I (SMALL) 1-5 Feet	852	34%
CLASS II (MEDIUM) 6-10 Feet	1,092	44%
CLASS III (LARGE) >11 Feet	541	22%
TOTAL	**2,485**	**100%**

Table 44. Summary of possible planting sites with no site (wire) conflicts

Planting Site Width	Count of No Wires	% Total Sites within Class
CLASS I (SMALL), 1-5 Feet	110 of 852	13%
CLASS II (MEDIUM), 6-10 Feet	1,092 of 1,092	100%
CLASS III (LARGE), >11 Feet	536 of 541	99%
TOTAL	**1,738 of 2,485 sites**	**70%**

Public Tree Stocking Level

There are numerous opportunities to plant more trees on public property in the City of Kirkwood. Historically, the locations of new tree plantings on City-owned rights-of-way in Kirkwood have been based on constituent requests, the replacement of dead or dying trees (where feasible), and project-specific plantings (e.g., streetscape improvement projects). With the updated tree inventory, City managers now also know the exact location of additional planting sites that are available throughout the City. Kirkwood's public tree inventory includes 2,485 *possible* planting sites in the public rights-of-way as of 2022. These sites would need further evaluation to determine if they are feasible and preferrable sites for new trees, but the dataset provides initial information on how the City can grow its urban forest over time. In addition to tree inventory data, the development of a prioritization scheme based on canopy data in the Urban Forest Master Plan allows the City to begin significant tree planting efforts in high priority areas of the City.

According to the 2022 inventory data, the current stocking level is 78 percent based on a total 11,109 possible public planting sites, including 8,567 living trees, 47 dead trees, 10 stumps, and 2,485 possible planting sites. "Stocking" is a traditional forestry term used to measure the density and distribution of trees. In this case it means that, of the total number of available planting sites identified in the tree inventory along the public right-of-way, 78 percent currently have a tree or stump present. Note that this value only considers the currently available planting areas along the street right-of-way, and not impervious surfaces that could become planting locations. Moreover, this value does not incorporate potential planting locations in unmaintained areas of parks or other civic spaces. Of the total public trees in the inventory, 306 trees were recommended for removal (based on 2022 inventory). These recommended removals represent a future increase in total number of potential planting sites. An important benchmark in maintaining a sustainable urban forest is to keep it at least 90 percent stocked, such that no more than 10 percent of the existing planting sites remain vacant. The City should make every effort to budget for tree planting in the future to maintain the urban forest at least 90 percent stocked and to continue increasing its canopy. Before committing to enhanced tree planting, the responsibility and resources for post-planting care and long-term maintenance need to be identified.

Public Tree Stocking Level

Attribute	Count
Living Trees	8,567
Dead Trees	47
Stumps	10
Possible Planting Sites	2,485
Total Sites	11,109
% Stocked	**78%**

Table 45. Summary of the stocking level for public trees (2022)

Summaries by Forestry Maintenance District

The Plan recommends management by Forestry Maintenance District (FMD) to provide equitable levels of service, canopy, and benefits. The following tables summarize the structure, condition, and maintenance priorities of the 8,614 public trees across the 8 FMDs.

Tree Structure by Forestry Maintenance District

FMD	0-6" DBH Class	6-18" DBH Class	18 to >30" DBH Class	TOTAL
1	373	461	358	**1,192**
2	443	435	393	**1,271**
3	238	571	243	**1,052**
4	297	407	285	**989**
5	300	524	339	**1,163**
6	225	393	173	**791**
7	307	414	322	**1,043**
8	237	482	394	**1,113**
TOTAL	**2,420**	**3,687**	**2,507**	**8,614**

Table 46. Summary of tree size classes (DBH) by FMD

Tree Condition by Forestry Maintenance District

FMD	TOTAL	Good Condition	Good % Within	Good % Whole	Dead Trees	Dead % Within	Dead % Whole
1	**1,192**	888	74%	10%	7	1%	0%
2	**1,271**	1,014	80%	12%	4	0%	0%
3	**1,052**	586	56%	7%	6	1%	0%
4	**989**	686	69%	8%	3	0%	0%
5	**1,163**	825	71%	10%	10	1%	0%
6	**791**	508	64%	6%	7	1%	0%
7	**1,043**	710	68%	8%	5	0%	0%
8	**1,113**	573	51%	7%	5	0%	0%
TOTAL	**8,614**	**5,790**			**47**		

Table 47. Summary of tree condition by FMD

Tree Maintenance Priority by Forestry Maintenance District

FMD	Priority 1 Removals	Priority 2 High Risk Prune	Priority 3 Recommended Removals	Priority 4 Routine Pruning	Priority 5 Young Prune	Monitor	Activity Totals
1	7	10	27	779	367	3	**1,193**
2	4	4	17	800	441	5	**1,271**
3	6	0	108	678	223	37	**1,052**
4	3	1	49	629	293	14	**989**
5	10	2	11	843	297	0	**1,163**
6	7	1	11	549	223	0	**791**
7	5	24	20	693	301	0	**1,043**
8	5	58	16	800	234	0	**1,113**
TOTAL	**47**	**100**	**259**	**5,771**	**2,379**	**59**	**8,615**

Table 48. Tree maintenance priority by FMD

FMD 8 has the greatest number of trees in the 18-30-inch DBH class (394 trees) and FMD 2 has the greatest number of trees in the 0-6-inch class (443). FMD 5 has the greatest number of dead trees (10 trees) and FMD 2 has the greatest number of trees in good condition (1,014 trees). Most Priority 1 Removals are in FMD 5 (10 trees), Priority 2 Prune in FMD 8 (58 trees), Priority 3 Removals in FMD 3 (108 trees), large tree Priority 4 Routine Pruning in FMD 5 (843 trees), and Priority 5 Young Tree Training Pruning is greatest in FMD 2 (441 trees).

Appendix B. Management Schedule and Budget Worksheet

Excerpt from the Interactive Worksheet

Table 49. Public tree management worksheet from 2022 inventory

Estimated Costs for Each Activity			Year 1		Year 2		Year 3		Year 4		Year 5		Year 6		Year 7		Year 8			
Activity	DBH Class	Cost/Tree	#	Cost	#	Cost	#	Cost	#	#	#	Cost	#	Cost	#	Cost	#	Cost	8-Year Cost	Total Trees
Priority 1 Removals (addressed in first 3 years) Includes Stump Removal	0-3"	$150	2	$300	2	$300	1	$150											$750	5
	3-6"	$325	3	$975	3	$975	2	$650											$2,600	8
	6-12"	$650	7	$4,550	7	$4,550	6	$3,900											$13,000	20
	12-18"	$1,250	3	$3,750	3	$3,750	1	$1,250											$8,750	7
	18-24"	$1,850	2	$3,700	1	$1,850	1	$1,850											$7,400	4
	24-30"	$3,000	1	$3,000	1	$3,000		$0											$6,000	2
	>30"	$4,700	1	$4,700		$0		$0											$4,700	1
Activity Total(s)			**19**	**$20,975**	**17**	**$14,425**	**11**	**$7,800**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**$43,200**	**47**
Priority 2 High Risk Prune (addressed in first 3 years)	0-3"	$30		$0		$0		$0											$0	0
	3-6"	$35	1	$35		$0		$0											$35	1
	6-12"	$250	2	$500	1	$250		$0											$750	3
	12-18"	$350	8	$2,800	8	$2,800	6	$2,100											$7,700	22
	18-24"	$550	13	$7,150	13	$7,150	11	$6,050											$20,350	37
	24-30"	$850	8	$6,800	8	$6,800	8	$6,800											$20,400	24
	>30"	$1,150	5	$5,750	5	$5,750	3	$3,450											$14,950	13
Activity Total(s)			**37**	**$23,035**	**35**	**$22,750**	**28**	**$18,400**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**$64,185**	**100**
Priority 3 Recommended Removals (addressed in Years 1-8) Includes Stump Removal	0-3"	$150	1	$150	1	$150	1	$150	1	$150	1	$150	1	$150	1	$150	1	$150	$1,200	8
	3-6"	$325	2	$650	2	$650	2	$650	2	$650	3	$975	3	$975	3	$975	3	$975	$6,500	20
	6-12"	$650	11	$7,150	11	$7,150	11	$7,150	11	$7,150	10	$6,500	10	$6,500	9	$5,850	9	$5,850	$53,300	82
	12-18"	$1,250	9	$11,250	9	$11,250	9	$11,250	9	$11,250	9	$11,250	9	$11,250	9	$11,250	7	$8,750	$87,500	70
	18-24"	$1,850	6	$11,100	6	$11,100	6	$11,100	6	$11,100	6	$11,100	6	$11,100	6	$11,100		$0	$77,700	42
	24-30"	$3,000	3	$9,000	3	$9,000	3	$9,000	3	$9,000	3	$9,000	3	$9,000	3	$9,000	3	$9,000	$72,000	24
	>30"	$4,700	2	$9,400	2	$9,400	2	$9,400	2	$9,400	2	$9,400	1	$4,700	1	$4,700	1	$4,700	$61,100	13
Activity Total(s)			**34**	**$48,700**	**34**	**$48,700**	**34**	**$48,700**	**34**	**$48,700**	**34**	**$48,375**	**33**	**$43,675**	**32**	**$43,025**	**24**	**$29,425**	**$359,300**	**259**
Priority 4 Routine Large Tree Prune (addressed in Years 1-8)	6-12"	$250	232	$57,938	232	$57,938	232	$57,938	232	$57,938	232	$57,938	232	$57,938	232	$57,938	232	$57,938	$463,500	1,854
	12-18"	$300	202	$60,563	202	$60,563	202	$60,563	202	$60,563	202	$60,563	202	$60,563	202	$60,563	202	$60,563	$484,500	1,615
	18-24"	$450	150	$67,388	150	$67,388	150	$67,388	150	$67,388	150	$67,388	150	$67,388	150	$67,388	150	$67,388	$539,100	1,198
	24-30"	$550	85	$46,544	85	$46,544	85	$46,544	85	$46,544	85	$46,544	85	$46,544	85	$46,544	85	$46,544	$372,350	677
	>30"	$800	53	$42,700	53	$42,700	53	$42,700	53	$42,700	53	$42,700	53	$42,700	53	$42,700	53	$42,700	$341,600	427
Activity Total(s)			**721**	**$275,131**	**721**	**$275,131**	**721**	**$275,131**	**721**	**$275,131**	**721**	**$275,131**	**721**	**$275,131**	**721**	**$275,131**	**721**	**$275,131**	**$2,201,050**	**5,771**
Priority 5 Young Tree Training Prune (addressed in Years 1-8)	0-3"	$50	127	$6,331	127	$6,331	127	$6,331	127	$6,331	127	$6,331	127	$6,331	127	$6,331	127	$6,331	$50,650	1,013
	3-6"	$75	171	$12,806	171	$12,806	171	$12,806	171	$12,806	171	$12,806	171	$12,806	171	$12,806	171	$12,806	$102,450	1,366
Activity Total(s)			**297**	**$19,138**	**297**	**$19,138**	**297**	**$19,138**	**297**	**$19,138**	**297**	**$19,138**	**297**	**$19,138**	**297**	**$19,138**	**297**	**$19,138**	**$153,100**	**2,379**
Existing Stump Removals (Addressed in Years 4-8)	0-3"	$50							1	$50		$0		$0		$0		$0	$50	1
	3-6"	$75								$0		$0		$0		$0		$0	$0	
	6-12"	$125							1	$125	1	$125	1	$125	1	$125		$0	$500	4
	12-18"	$200							1	$200	1	$200		$0		$0		$0	$400	2
	18-24"	$350							1	$350	1	$350		$0		$0		$0	$700	2
	24-30"	$500							1	$500		$0		$0		$0		$0	$500	1
	>30"	$1,200								$0		$0		$0		$0		$0	$0	
Activity Total(s)			**0**	**$0**	**0**	**$0**	**0**	**$0**	**5**	**$1,225**	**3**	**$675**	**1**	**$125**	**1**	**$125**	**0**	**$0**	**$2,150**	**10**
Maintenance and Removal Totals			**####**	**$386,979**	**1,105**	**$380,144**	**1,092**	**$369,169**	**1,058**	**$344,194**	**1,056**	**$343,319**	**1,053**	**$338,069**	**1,052**	**$337,419**	**1,043**	**$323,694**	**$2,822,985**	**8,566**
1:1 Replacement Plantings	Material	$400	53	$21,200	51	$20,400	45	$18,000	34	$13,600	34	$13,600	33	$13,200	32	$12,800	24	$9,600	$122,400	306
	Planting	$120	53	$6,360	51	$6,120	45	$5,400	34	$4,080	34	$4,080	33	$3,960	32	$3,840	24	$2,880	$36,720	306
	Care	$160	53	$8,480	51	$8,160	45	$7,200	34	$5,440	34	$5,440	33	$5,280	32	$5,120	24	$3,840	$48,960	306
Activity Total(s)			**159**	**$36,040**	**153**	**$34,680**	**135**	**$30,600**	**102**	**$23,120**	**102**	**$23,120**	**99**	**$22,440**	**96**	**$21,760**	**72**	**$16,320**	**$208,080**	**918**
Canopy Goals	Material	$400	283	$113,200	283	$113,200	283	$113,200	283	$113,200	283	$113,200	283	$113,200	283	$113,200	283	$113,200	$905,600	2,264
	Planting	$120	283	$33,960	283	$33,960	283	$33,960	283	$33,960	283	$33,960	283	$33,960	283	$33,960	283	$33,960	$271,680	2,264
	Care	$160	283	$45,280	283	$45,280	283	$45,280	283	$45,280	283	$45,280	283	$45,280	283	$45,280	283	$45,280	$362,240	2,264
Activity Total(s)			**849**	**$192,440**	**849**	**$192,440**	**849**	**$192,440**	**849**	**$192,440**	**849**	**$192,440**	**849**	**$192,440**	**849**	**$192,440**	**849**	**$192,440**	**$1,539,520**	**6,792**
Planting & 1-Month Post-Planting Care Totals			**336**	**$228,480**	**334**	**$227,120**	**328**	**$223,040**	**317**	**$215,560**	**317**	**$215,560**	**316**	**$214,880**	**315**	**$214,200**	**307**	**$208,760**	**$1,747,600**	**2,570**
Management Totals			**####**	**$615,459**	**1,439**	**$607,264**	**1,420**	**$592,209**	**1,375**	**$559,754**	**1,373**	**$558,879**	**1,369**	**$552,949**	**1,367**	**$551,619**	**1,350**	**$532,454**	**$4,570,585**	**11,136**

Worksheet Summary Tables

Table 50. Public tree management worksheet summaries

Management Activity Costs	Duration	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Totals
Priority 1 Removals & Stump Removal	Years 1-3	$20,975	$14,425	$7,800						$43,200
Priority 2 High Risk Prune	Years 1-3	$23,035	$22,750	$18,400						$64,185
Priority 3 Recommended Removals & Stump Removal	Years 1-8	$48,700	$48,700	$48,700	$48,700	$48,375	$43,675	$43,025	$29,425	$359,300
Priority 4 Routine Large Tree Prune	Years 1-8	$275,131	$275,131	$275,131	$275,131	$275,131	$275,131	$275,131	$275,131	$2,201,050
Priority 5 Young Tree Training Prune	Years 1-8	$19,138	$19,138	$19,138	$19,138	$19,138	$19,138	$19,138	$19,138	$153,100
Existing Stump Removals	Years 4-8	$0	$0	$0	$1,225	$675	$125	$125	$0	$2,150
Annual Totals		$386,979	$380,144	$369,169	$344,194	$343,319	$338,069	$337,419	$323,694	$2,822,985

Management Activity Counts	Duration	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Totals
Priority 1 Removals & Stump Removal	Years 1-3	19	17	11						47
Priority 2 High Risk Prune	Years 1-3	37	35	28						100
Priority 3 Recommended Removals & Stump Removal	Years 1-8	34	34	34	34	34	33	32	24	259
Priority 4 Routine Large Tree Prune	Years 1-8	721	721	721	721	721	721	721	721	5,771
Priority 5 Young Tree Training Prune	Years 1-8	297	297	297	297	297	297	297	297	2,379
Existing Stump Removals	Years 4-8	0	0	0	5	3	1	1	0	10
Annual Totals		1,109	1,105	1,092	1,058	1,056	1,053	1,052	1,043	8,566

Tree Planting Activity Costs	Duration	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Totals
1:1 Replacement Plantings	Years 1-8	$36,040	$34,680	$30,600	$23,120	$23,120	$22,440	$21,760	$16,320	$208,080
Planting for Canopy Goals	Years 1-8	$192,440	$192,440	$192,440	$192,440	$192,440	$192,440	$192,440	$192,440	$1,539,520
Annual Totals		$228,480	$227,120	$223,040	$215,560	$215,560	$214,880	$214,200	$208,760	$1,747,600

Tree Planting Counts	Duration	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Totals
1:1 Replacement Plantings	Years 1-8	53	51	45	34	34	33	32	24	306
Planting for Canopy Goals	Years 1-8	283	283	283	283	283	283	283	283	2,264
Annual Tree Totals		336	334	328	317	317	316	315	307	2,570

Management	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Totals
Count	1,445	1,439	1,420	1,375	1,373	1,369	1,367	1,350	11,136
Cost	$615,459	$607,264	$592,209	$559,754	$558,879	$552,949	$551,619	$532,454	$4,570,585

Appendix C. 2022 Urban Forest Audit Results

Urban Forest Audit Scoring Key

Not Practiced (0)	In Development (1)	Adopted Practice (2)

Table 51. Results of the 2022 Urban Forest Audit

MANAGEMENT POLICY

Category	Component Evaluated	Description or Criteria for Evaluation
1.00	**Approved Policy Statements**	**Written policy statements approved by a governing body.**
1.01	Climate Change (Sustainability)	Also referred to as Sustainability. With reference to urban trees. Addresses the long-term health and productivity of the natural resource.
1.02	No Net Loss	Can refer to trees, basal area, or canopy.
1.03	Risk Management	Should reference: ANSI A300 Part 9, ISA BMP, and prioritization funding mechanisms.
1.04	Tree Canopy Goals	Overall community/campus goal, or by designated "zone".
1.05	Tree Protection	Construction and/or landscape maintenance.
1.06	Utility	Utility pruning, planting, and installation policy (e.g. boring vs. trenching).
1.07	Human Health – Physical & Psychological	Recognizes and addresses the human health benefits of the natural resource (e.g., exercise, air quality, stress management, shade). Could also include Urban Heat Island (UHI) policies.
1.08	Wildlife Diversity/Habitat/Protection	Mammals, birds, or reptiles.
1.09	Performance Monitoring	Recognizes the annual or biennial calculation of metrics (e.g. some component of ecosystem services) for the purpose of tracking management performance.
1.10	Ordinance (Private)	Tree protection and management for trees on private property.
1.11	Ordinance (Public)	Tree protection and management for public trees.
1.12	Development Standards	US Green Building Council's LEED® rating systems (or similar internationally) LEED v4 BD+C (Sustainable Sites) LEED 4 ND (Neighborhood Pattern & Design, Green Infrastructure) ASLA's SITES® Rating System
1.13	High-Conservation Value Forests	Programs or policies for identification, acquisition, and/or protection of groups of trees or forests that provide unique public benefits.
1.14	Urban Interface (WUI)	Programs or policies that improve management of the urban interface for fire and/or invasive species.

Capacity and Training

Category	Component Evaluated	Description or Criteria for Evaluation
2.00	**Professional Management**	**Provision for professional consultation.**
2.01	Certified Arborist - Staff	International Society of Arboriculture
2.02	Certified Arborist - Contracted	International Society of Arboriculture
2.03	Certified Arborist - Other Resource	International Society of Arboriculture
2.04	Other Professional - Advising/directing UF management	This could be a professional in an allied field like Landscape Architecture.
2.05	Municipal Forestry Institute	Graduate of Society of Municipal Arborist's MFI program or similar
2.06	USFS Urban Forestry Institute or similar	Attendance at USFS UFI or similar
2.07	Campus/city arborist – ISA CA instructor for CEUs	Arborist routinely provides ISA CEU presentations/workshops.
2.08	Tree Board University or similar	On-line training modules from Oregon U&CF for Tree Board/Advisory Council or similar
2.09	Organizational Communications	Process, procedures, and protocol for cross-professional communications within the organization (all departments "touching" trees).

Funding and Accounting

Category	Component Evaluated	Description or Criteria for Evaluation
3.00	**Urban Forestry Budget**	
3.01	Budgeted Annually	Budget authorized/required for tree board, tree maintenance, and/or tree planting.
3.02	Contingency Budget Process	A protocol is in place to prioritize urban forestry management activities during budget shortfalls; e.g. during times of limited funding for: 1) risk management, 2) young tree care, 3) mulching.
3.03	Funding Calculated from Community Attribute	Budget in terms of per capita, per tree, or for performance (e.g. per tree weighted by size class or age.
3.04	Funding Based on Performance Monitoring	Budget connected with/based on ecosystem service (ES) monitoring and performance.
3.05	Urban Forestry Line Item	Is the budget specific to urban forest management?
3.06	Green Asset Accounting	Maintain green infrastructure data in the "unaudited supplementary disclosure of an entity's comprehensive annual financial report (CAFR)". GASB 34 implementation for municipalities.

Authority

Category	Component Evaluated	Description or Criteria for Evaluation
4.00	**Authority**	
4.01	Urban Forest Manager	Professional urban forest manager with authority over the program and day-to-day activity. Including designated budget line item.
4.02	Staff Authority	Designated staff with authority over the program and day-to-day activity. Including designated line item.
4.03	Communication Protocol	Established protocol and mechanism(s) for communication among all members of the urban forest management "community" in your municipality or organization (e.g. manager, department under control, advisory board, finance, field operations, public, NGOs, business community, developers).
4.04	Tree Board, Commission, or Advisory Council	Establishes a board for public participation (advisory or with authority).

INVENTORIES

Category	Component Evaluated	Description or Criteria for Evaluation
5.00	**Inventories and Assessments**	
5.01	Canopy Inventory (UTC)	Periodic (≤5 year) canopy inventory and assessment. Public & private.
5.02	Ecosystem Services	Recent (≤5 year) ecosystem services (ES) inventory & assessment? Public: 100% or street trees; Public & Private: Sample; or Campus. Or, are ES calculated annually or biennially based on partial re-inventory and projected growth as a monitoring tool.
5.03	Public Trees ↓	↓ Evaluate below ↓
5.04	Street Trees	Is there a recent (5 year) inventory?
5.05	Parks/Riparian Areas	Is there a recent (5 year) inventory?
5.06	Other Public Trees	Public facility landscaped areas, Industrial parks, green space.
5.07	Continuous inventory on a cycle (≤5 years; i.e. panel)	Partial re-inventory to support continuous forest inventory, growth projections, and the calculation of ecosystem services for the purpose of long-term monitoring of urban forest management performance (e.g. carbon or leaf surface).
5.08	Private Trees ↓	↓ Evaluate below ↓
5.09	Campus (Educational)	Is there a recent (5 year) inventory?
5.10	Corporate	Is there a recent (5 year) inventory?
5.11	Other Private Property	Is there a recent (5 year) inventory?
5.12	Continuous inventory on a cycle (≤5 years; i.e. panel), inventory software	Partial re-inventory to support continuous forest inventory, growth projections, and the calculation of ecosystem services for the purpose of long-term monitoring of urban forest management performance (e.g. carbon or leaf surface).
5.13	Green Stormwater Infrastructure (GSI)	BMP stormwater mitigation practices and locations (e.g. Washington DC)
5.14	Spatial	Inventory data includes Lat/Long (i.e. GIS). Should address the spatial relationship between the natural resource and people (i.e. residents, visitors, activities) that would help manage the resource for benefits associated with proximity (air quality, recreation, stress mitigation, improved educational opportunity).
5.15	Maintenance and Planting Records Maintained	Planting details (nursery, species, size, cost, contractor, etc.) maintained with inventory or as separate database or recordkeeping system. Also pruning and removal histories.

PLANS

Category	Component Evaluated	Description or Criteria for Evaluation
6.00	**Management Planning Activities**	
6.01	Annual Maintenance Calendar	An annual calendar that defines typical activity by season. To support scheduling.
6.02	Public Trees ↓	↓ Evaluate below ↓
6.03	Street Tree Management	Is there a recent (5 year) plan for street trees?
6.04	Parks/Riparian Area Management	Is there a recent (5 year) plan ?
6.05	Other Public Trees	Public facility landscaped areas, Industrial parks, green space.
6.06	Private Trees ↓	↓ Evaluate below ↓
6.07	Campus (Educational)	Is there a recent (5 year) plan for Campus trees?
6.08	Corporate	Is there a recent (5 year) plan?
6.09	Other Private Property	Is there a recent (5 year) plan?
6.10	Green Infrastructure	Is there a plan for green infrastructure (i.e. nodes & linkages)? Large-scale projects.
6.11	Other Written Plans	Other natural resource plans (e.g. tree canopy). May be a component of another plan.
6.12	Tree Planting	Is there a recent (3 year) tree planting plan?). May be a component of another plan.
6.13	UF as Part of a Comprehensive Plan	Is any UF management plan referenced in the comprehensive plan (i.e. county or municipality) or master plan (i.e. Campus)?
6.14	Urban Forest Planning and Management Criteria and Performance Indicators	Criteria and indicators based on *A Model of Urban Forest Sustainability* (Clark, J.R., Matheny, N.P., Cross, G., and Wake, V. 1997 Journal of Arboriculture.) or on work of W.A. Kenney, P.J.E. van Wassenaer, and A.L. Satel in *Criteria and indicators for strategic urban forest planning and management*. (2011)

Risk Management

Category	Component Evaluated	Description or Criteria for Evaluation
7.00	**Risk Management Activities**	
7.01	TRAQ Attained	At least one staff or consultant is TRAQ.
7.02	Annual Level 1 (ANSI A300 Part 9 & ISA BMP)	All trees in high occupancy areas visited annually.
7.03	Mitigation Prioritization	A protocol for prioritizing mitigation following Level 1 and Level 2 assessments. Reflects the controlling agency's threshold for risk.
7.04	Occupancy Areas Mapped	Has TRAQ staff/consultant discussed/mapped occupancy levels with controlling authority?
7.05	Recordkeeping, Reporting, and Communications	A process has been put in place to maintain records on requests, inspections, evaluations, and mitigation of risk; and on the communications among the managers related to those risk assessments.
7.06	Standard of Care Adopted	Controlling authority has adopted a Standard of Care (SOC) or risk management policy.
7.07	Tree Risk Specification	Is there a written specification that meets requirements of ANSI A300 (Part 9)? And, has it been discussed with the controlling authority with relevance to the controlling authority's threshold for acceptable risk?
7.08	Urban Tree Risk Management	The community has prepared and follows a comprehensive program for urban tree risk management.
7.09	Invasive Management	Plan to address and manage invasive: plants, insects, and disease.

DISASTER PLANNING

Category	Component Evaluated	Description or Criteria for Evaluation
8.00	**Disaster Planning Activities**	
8.01	Response/Recovery Mechanism	Staff knowledge of the municipality's protocol for requesting disaster resources through the county or state with access to mutual aid and EMAC.
8.02	Urban Forestry as part of the County Disaster Plan	The UF plan (8.3) is incorporated into the county/municipal disaster plan; specifically in reference to debris management and risk mitigation.
8.03	Urban Forestry Disaster Plan	A separate/specific plan within the urban forestry management program (i.e. who to call, priorities).
8.04	Pre-disaster Contracts	Contracts are in place for critical needs.
8.05	Mitigation Plan	A mitigation plan has been developed for pre-disaster, recovery, and post-disaster.
8.06	EMAC Mission Ready Packages (MRP)	Municipality has published disaster resources with state EM and participates in inter-state Mutual Aid to support Urban Forest Strike Teams (UFST).
8.07	Urban Forest Strike Team	Participation in the UFST project.

Standards and Best Management Practices

Category	Component Evaluated	Description or Criteria for Evaluation
9.00	**ANSI Standard & BMP Activities**	
9.01	ANSI Standards	Reference and adherence to ANSI Standards for arboricultural practices (A300), safety (Z133), or Nursery Stock (ANSI Z60.1) (any or all).
9.02	Ages/Diameter Distribution	Specific management for the development of an age-diverse tree population
9.03	Arborist Standards	Standards of practice for arborists (i.e. Certification).
9.04	Best Management Practices (BMPs)	Establishes or references tree maintenance BMPs (i.e. written comprehensive standards & standards).
9.05	Fertilization and Mulching	Fertilization or mulching standards required for conserved & planted trees.
9.06	Lightning Protection Systems	BMP written to the ANSI A300 Standard.
9.07	Planting	Planting and transplanting standards required/specified.
9.08	Pruning	Pruning standards required for conserved & planted trees.
9.09	Removal	Infrastructure damage, stump grinding, etc.
9.10	Support Systems (Guying and Bracing)	BMP written to the ANSI A300 Standard.
9.11	Tree Risk	Tree risk assessment procedures; ISA BMP or equivalent.
9.12	Construction Management Standards	Written standards for: tree protection, trenching/boring in CRZs, pre-construction mulching, root or limb pruning, watering (any or all).
9.13	Design Standards	Standards for design that specifically require trees; standards for tree placement (i.e. location), soil treatment, and/or drainage.
9.14	Genus/Species Diversity	Suggests or requires diversity of plant material.
9.15	Green Stormwater Infrastructure (GSI)	BMPs for site level GI practices like rain gardens and swales. Small-scale projects.
9.16	Inventory Data Collection	Community has adopted or developed applicable standards for local urban tree inventory data collection to support QA/QC.
9.17	Minimum Planting Volume	Minimum required root zone volume.

STANDARDS AND BEST MANAGEMENT PRACTICES (CONTINUED)

Category	Component Evaluated	Description or Criteria for Evaluation
9.00	**ANSI Standard & BMP Activities**	
9.18	Minimum Tree Size	Minimum caliper for tree replacements, and/or minimum size of existing trees to receive tree density or canopy credit.
9.19	Root Protection Zone (CRZ)	Defines adequate root protection zone; Critical Root Zone (CRZ).
9.20	Safety	Safety logs, trainings, reference to ANSI Z133 Safety Standard
9.21	Topping	Prohibits topping or other internodal cuts (public & private).
9.22	Tree Species List	Identifies and publishes a list of the most desirable, recommended, and/or preferred species (may include native and non-native species); alternatively, a list of species prohibited.
9.23	Tree Quality Standards	Written standards for tree selection at nursery in addition to Z60.1.
9.24	Utility Right-of-Way (ROW) Management	Requirements for planting, pruning, and/or removal of trees within a utility ROW.
9.25	Urban Agriculture	Enabled urban food forestry practices.
9.26	Wood Utilization	Larger diameter material is processed for wood products.
9.27	Third-party forest products certification compliance	Examples: American Tree Farm System (ATFS), Forest Stewardship Council™ (FSC®)
9.28	Energy generation	Local or regional use of chips or other woody debris for co-generation facilities.
9.29	Composting of Leaf and/or Other Woody Debris	Leaves and small woody debris are captured and used on-site or processed by someone by composting for reuse.
9.30	Watering Standards	

COMMUNITY

Category	Component Evaluated	Description or Criteria for Evaluation
10.00	**Activities that Build Community**	
10.01	Social Media Website or Similar	Does your community/campus use social media platforms or similar to document and publicize your urban forestry program, activity, or events?
10.02	Education	The urban forest is used as an educational laboratory for class activity; Kids in the Woods, PLT, high school, or college level.
10.03	Private Property Tree Program	Does your community sponsor this program locally?
10.04	Public-facing Tree Inventory and Management Software	Public access to the community tree resource via an on-line mapping program (i.e. any Web Map Service; WMS).
10.05	Public Perception	Is public management consistent with private property requirements for tree protections and care? Does the Campus/public tree management reflect neighborhood norms?
10.06	Recognition Programs	Programs that raise awareness of trees or that use trees to connect the community to significant events or activities.
10.07	Arbor Day Celebration	Whether or not associated with Tree City USA.
10.08	Arboretum designation	Internal or third party arboretum designation.
10.09	Significant trees	For example: size, history.
10.10	Memorial/Honorarium	Tree planting or tree care programs than honor/memorialize individuals, organizations, or events.
10.11	Social Media	Does your community/campus make use of Twitter, Facebook, Blogs for internal or external outreach?
10.12	Active Communications	Press releases, regular news articles (print), “State of the Urban Forest” reports, periodic analysis of threats and opportunities.
10.13	Tree Care	Are volunteers trained and used for basic tree care (e.g. mulching, pruning, planting).
10.14	Tree Campus USA®, Tree City USA®, Tree Line USA®	Community/campus meets current qualifications for any of these programs.
10.15	Volunteer Opportunities	Ad hoc or scheduled. Any/all age groups. Tree Campus USA student activities.

Green Asset Evaluation

Category	Component Evaluated	Description or Criteria for Evaluation
11.00	**Observed Outcomes (Activity, Health)**	
11.01	Deadwood	Look for evidence of periodic or ad-hoc deadwood removal (i.e. lack of dead limbs ≥ 2" in the trees or on the ground).
11.02	Genus Diversity	No genera exceed 20% of population; make specific observations for *Acer*, *Quercus*, *Fraxinus, Ulmus* and other local species of concern.
11.03	Mature Tree Care	Mature trees are retained in the landscape, and are of acceptable risk; i.e. veteran tree management.
11.04	Mulching	Evidence of adequate (i.e. spatial extent, depth, and material) roots zone mulching for all age classes.
11.05	Planting Site Volume Optimization	Are species & sites matched for optimization of above ground canopy; right tree in the right spot concept.
11.06	Rooting Volume Optimization	Are species & sites matched for optimization for below ground rooting volume; right tree in the right spot concept.
11.07	Species Diversity	No species/cultivars exceed 10% of population; make specific observations for *Acer*, *Quercus*, *Fraxinus, Ulmus* and other local genera of concern. Also evaluate the role of regionally local native species.
11.08	Soil Compaction	Observe evidence of soil compaction by users or staff during maintenance. Include "desire" lines and construction activity at time of evaluation.
11.09	Tree Health	Rate the overall tree health in all size (age) classes; look for crown dieback, decay, foliage density & color.
11.10	Young Tree Pruning	Look for evidence of periodic (e.g. every 3 years to year 9) structural pruning (e.g. subordination cuts, dominant central leader, co-dominant stems lower that 20').

Appendix D. Funding Mechanisms

Table 52. Financing options for Kirkwood's urban forest management programs

Financing Options	Attributes	Process	Opportunities	Challenges
Feasible Options				
Special Assessment Districts	Special assessment for landscaping, open space improvements, acquisition, and maintenance.	City agency / property owners initiate via petition, City agency administers; based on benefits calculated in engineer's report; >50% of property owners in proposed district must approve via (mail) ballot.	Citywide district possible for all street trees; individual districts more feasible in areas with many trees, high maintenance needs, and/or political support.	Typically funds more than just street trees.
Parcel Tax	Assessment levied independent of property value, can be equal amount per parcel or dependent on lot size.	2/3 of voters (not just property owners) must approve via election ballot.	Tax can be directly related to program costs; maintenance taxes deductible for property owners.	2/3 voter approval; potential competition from other services (e.g. schools); flat tax distributes cost inequitably.
General Obligation (GO) Bond	Low-interest loan for capital projects; repaid by levying tax revenue.	2/3 voter approval required.	Frequently used tool in municipal government.	Funding provided for set period; maintenance ineligible for funding.
Stormwater Utility	Urban forests mitigate storm-water runoff. A portion of the stormwater management fee can be earmarked for urban forestry.	Utilize the stormwater fee collected from every developed property parcel in the City to support the stormwater management program.	Additional funding to urban forestry and incentive to property owners to plant trees as a Best Management Practice under the Stormwater Utility Fee Credit Program.	Planting trees needs are in the Stormwater Guidance but should be revisited to reflect canopy goals per the UFMP.
Partnerships	Non-profits, corporate partners, grant funding; for tree planting and establishment.	Various, depends on City's processes.	Decrease costs, increase capacity, develop a tree steward organization and program.	Union resistance, sustainable funding stream required.

Financing Options	Attributes	Process	Opportunities	Challenges
Additional Options				
Pest Control Fee	A fee for forestry related services such as pest control and replanting.	A forestry fee specific to pest control added to the public service utility billing as a levy.	Opportunity to offset costs of managing and recovering from emerald ash borer and other tree pests and diseases.	Increased fee may require voter approval. The City must analyze pest control costs to establish the appropriate fee amount.
Tree Work and Land Development Permit Fees	An increase in fees for registered tree care companies, the Tree Work Permit Application, and development fees.	City assesses the actual costs of managing permits, reviews and inspections and applies an applicable fee. Updates to City ordinances may be required.	Additional fees may be directly applied to urban forest management.	Increasing the fees may require election ballots and/or updates to City ordinances.
General Fund	City's primary funding pool for wide range of municipal services.	Annual budget via City's legislative process.	History of funding for tree planting and establishment.	Not a guaranteed source or amount of funding; funds at risk if budget shortfalls arise.
Carbon Offsets	A cap-and-trade program in Kirkwood would create a cap on greenhouse gas emissions trading options.	City Forest Credits is a nonprofit carbon registry that manages carbon and impact standards for metropolitan areas in the U.S. The City should be involved in designing project (i.e. tree planting) requirements and tracking.	Cap and trade systems like California's can provide economic incentive to drive more "natural climate solutions."	A large quantity of trees must be planted to qualify as a carbon offset and the trees must be properly managed to ensure long-term survival and carbon storage.
Parking Benefit District (PBD)	Revenue from parking meters for range of right-of-way improvements and maintenance.	Enacted via local ordinance specifying boundaries, rates, use of funds; City administers with input from advisory committee.	No ballot approval required; visitors bear burden over residents; revenue can be expended beyond district boundaries.	Adjustments will need to be made based to the agency overseeing excess meter revenue; typically funds more than trees.

Appendix E. Trees and Hardscape Conflicts Solution Workbook

Decision Matrix

The development of Kirkwood's Urban Forest Master Plan identified the need to clarify the decision process to address tree and sidewalk or construction conflicts. A clear decision matrix can help to reduce inter- and inner-department uncertainty and establish or adhere to consistency and fairness. The City's departments have standard operating procedures and checklists for evaluating conflicts at a project site, but these traditionally have not been available to the public. To make the decision process around the retention or removal of trees more transparent and consistent, a clarified process, decision matrix, and solution toolkit should be developed to highlight the key decision points.

Proposed Decision Matrix for Tree and Sidewalk Conflicts

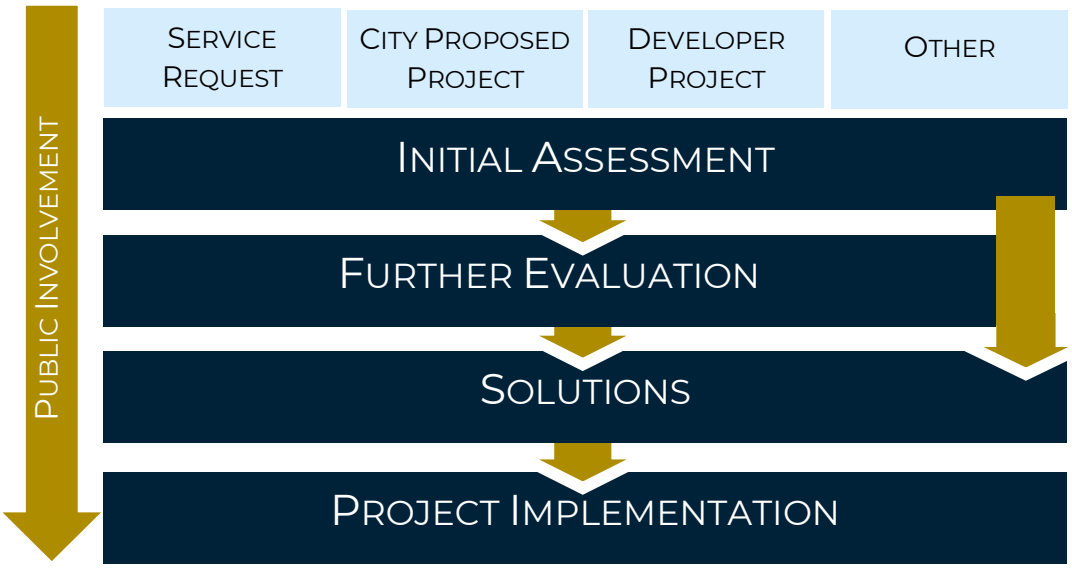


Figure 40. Proposed decision matrix for tree and construction conflicts

Initial Assessment

The following applies to tree removal requests and proposed projects.

The initial assessment of trees, sidewalks (or other infrastructure), and site at the service request location or project location provides consistency and predictability by collecting the appropriate information. It is recommended to have the Forestry Division involved in the initial assessment process and/or a City staff member with an International Society of Arboriculture Certified Arborist accreditation.

- Tree Preservation Potential. What is the tree quality or health, and is it worth preserving? Is the tree part of the City's Significant Tree Program (if applicable)?
- Tree Mitigation Exploration. If the request to remove the tree is a result of infrastructure damage and the tree exhibits poor health or vigor, can the tree's health or vigor be mitigated by any means other than removal?
- Public Safety Risk. Is the tree a potential hazard that cannot be mitigated by any means other than removal? This includes any tree or tree part that poses a high risk of damage to persons or property located in public places. Use the International Society of Arboriculture's tree risk evaluation standards.

- Initial Assessment Timing. It is recommended that the initial assessment be conducted within 3-4 weeks of receiving a service request for removal. If the assessment is required due to a proposed project, the assessment should occur no later than 30% design or equivalent of design effort (e.g., during the Environmental Assessment period).
- Tracking. Consider tracking service requests in the City's TreePlotter software or similar program.
- For an example Initial Assessment Checklist, see the Example Initial Assessment Checklist further below.

Initial Tree Decision

If the tree removal request was made due to the condition of the tree or other reason not relating to the damage or impediment of infrastructure such as sidewalk, the Urban Forester or representative may conduct the initial tree decision. If infrastructure is part of the assessment and/or the tree removal request was initiated for a proposed project, the City Engineer or appropriate staff should also be part of the initial tree decision. The appropriate staff will visit the tree and/or proposed project location and assess the tree (and sidewalk, if applicable) conditions. The following actions will result from the assessment:

1. Remove Tree. The tree removal request was made not as a result of the tree impacting or damaging infrastructure and the tree is identified as unhealthy or unsafe with no remediation possible.
   - Remove the tree and consider the "no net loss" policy of replacing the tree. Some cities implement a 2:1 replacement to removal ratio. The replacement policy should be based on City Code, the Zoning Ordinance, and other guidelines. Replacement of trees can occur on site, same street, or City-approved location. A fee in-lieu should also be considered as an option as described in City Code.
   - Removal of the tree should be prioritized based on other work orders, the risk assessment of the tree, and other factors.
   - The service request, decision, work order, tree information, and tree removal information should be tracked in the City's TreePlotter software or similar program.
2. Retain Tree. Based on the assessment, the tree is not in decline or the issues can be remediated. Alternatively, if the tree in question is part of a Significant or Heritage Tree Program, the tree may be preserved depending on the tree condition and presence of hazards or risks as described in the City policies and manuals.
   - Document the decision, inform the property owner or project developer.
   - Conduct the remediation activity to the tree if needed.
   - Prioritize and track this information in TreePlotter or similar program.
   - Conduct follow-ups with the property owner and monitor the tree if necessary.
3. Remove Tree and Replace Sidewalk. The service request or proposed project identifies a tree that is causing sidewalk conflicts and the tree has been deemed unhealthy and no remediation is possible. The City should reference City Code as to what is defined as unhealthy or hazardous.
   - Remove the tree and consider the "no net loss" policy of replacing the tree. Some cities implement a 2:1 replacement to removal ratio. The requirement to replace the tree will be the City and Urban Forester's discretion. The replacement policy should be based on City Code, the Zoning Ordinance, and other guidelines. Replacement of trees can occur on site, same street, or City-approved location. A fee in-lieu should also be considered as an option as described in City Code.

- Removal of the tree should be prioritized based on other work orders, the risk assessment of the tree, and other factors.
- The service request, decision, work order, tree information, and tree removal information should be tracked in the City's tree inventory software or similar program.
- Replace the sidewalk using appropriate design standards and materials and consider designing according to standards that will protect any replacement trees and provide ample soil volume and root space for the new or existing trees.

4. Retain Tree and Maintain Sidewalk. A tree in question is in conflict with infrastructure and the assessment determined that the tree is to be retained and the infrastructure (i.e., sidewalk) is to be corrected. The sidewalk will be of standard width and a tree pit of standard width (at minimum) can be installed or retained.
   - Coordinate with the adjacent property owner the timing and approach for maintaining the sidewalk. Some cities offer incentives or funding to support sidewalk maintenance when the issue causing the sidewalk damage has been identified to be caused by a City-owned right-of-way tree. Be sure to inform the property owner of alternative sidewalk amendments such as width reduction, alternative materials, among other solutions.
   - If any root pruning is needed to amend the sidewalk, the Forestry Division and/or a Certified Arborist hired by the property owner or a certified consultant/contractor hired by the City should evaluate to determine the appropriate root pruning, branch pruning, soil amendments, and other maintenance required.
   - Documentation in TreePlotter or similar software as stated before is recommended.
5. Evaluate Tree and/or Sidewalk Further. During the initial tree decision, it is not appropriate for extensive explorations of pavement, soils, or tree root systems. There are limitations to the initial assessment and decision. The purpose of the initial assessment is to identify where these future actions are required so that the appropriate schedule and funding can be determined.
   - Documentation in TreePlotter or similar software as stated before is recommended.

Further Evaluation

The team conducting further evaluation may include an arborist, landscape architect, engineer, or other professionals with expertise relevant to the project details and situation. In addition to collecting information about the trees and infrastructure (i.e., sidewalk) the following additional items may be considered:

> Level of impact, future risks, cost/benefit, anticipated sidewalk maintenance if the tree is kept, public/environmental benefit, community values, policy guidance, neighborhood context, historic districts, planned construction, funding forecasts.

Solutions

The following best practices and approaches are provided as examples. The City should review and update these as new or improved practices and materials emerge.

1. If Tree Removed, Obtain Valuation. If the tree must be removed, the City should provide guidelines to replace the removed tree. Guidelines should be based on City Code, the Zoning Ordinance, and other policies. Ideally, the tree would be replaced at

the same location if the site is suitable for trees in the first place. If not possible, the City should have a procedure in place for the relocation of replacement trees.

2. If Tree is Retained, Determine Management Approach. Since the initial assessment offered the opportunity to closely examine the tree and the site, future management approaches and decisions should be discussed and documented. These include future tree replacement species for when the tree does over mature and decline or conduct corrective actions to provide clearance for pedestrians, vehicles, utilities, and signs.
3. Identify Potential Sidewalk Solutions. The Alternative Solutions Toolkit Overview section provides information and resources regarding sidewalk solution options. Information gathered during the initial assessment and subsequent site visits will support the selection of options that should be presented to the property owner, developer, or City staff to ensure goals of sidewalk repair and tree preservation are kept.
4. Identify Opportunities to Improve Conditions for New Trees. When trees are planted by the City, the appropriate tree species for the location should be determined and the City should adhere to best practices in site and tree pit preparation to provide enough soil volume to support tree root growth and minimize future pavement damage by roots. If a tree is being planted at or near where the tree removal request was made, an evaluation of why the request was made should be considered. This may include such things as inadequate soil volume, insufficient growing space, tree leaf litter, messy fruit, poor structure, allergies, screening of shade-intolerant garden or landscape vegetation, or a combination of factors.

Project Implementation

Whether the sidewalk repair is occurring at a location where the tree is retained or removed, the sidewalk must adhere to the Americans with Disabilities Act (ADA) requirements and City standards and is the responsibility of the adjacent property owner. Tree repaving projects, curb and gutter repairs, and other Capital Projects should also adhere to this evaluation process. All matters relating to the removal or remediation of the tree will be conducted by the City unless the responsibility of tree maintenance in public rights-of-way changes. Regarding tree maintenance, mitigation, or removal, the City should involve the public by:

1. Providing a public notice prior to the initial tree assessment.
2. Share the results of the initial assessment.
3. Share the solution decision.

EXAMPLE INITIAL ASSESSMENT CHECKLIST FOR TREE CONFLICTS

This resource can be adapted for the City of Kirkwood to make decisions regarding tree removals and tree and hardscape (i.e., sidewalks) conflicts.

INITIAL ASSESSMENT CHECKLIST

[CITY LOGO]

[City of ####] Trees and Sidewalks Operations Plan, Initial Street Tree and Sidewalk Assessment Checklist
DATE
Prepared By:

The purpose of this document is to outline <u>INITIAL ASSESSMENT</u> for locations where sidewalk work is located within the dripline of an existing street tree.

Project Location/Address	
Tree Species/Diameter	
Street Classification/Type	
Tree Asset Inventory ID	
Sidewalk Segment #	
Is this assessment along a corridor project?	

An [ENGINEER] and [ARBORIST] will look at the site and assess the condition of the sidewalk and the tree.
If the tree has the following characteristics, it should be removed/replaced pursuant to [CITY CODE CITATION]: The City's policy is to retain and preserve street trees whenever possible. Accordingly, street tree removal shall not be permitted unless the [AUTHORITY] determines that a street tree:

- Is a hazardous tree;
- Poses a public safety hazard;
- Is in such a condition of poor health or poor vigor that removal is justified; or
- Cannot be successfully retained, due to public or private construction or development conflicts.

Initial Assessment

- **Is the tree healthy and worthy of preservation?**
- **Yes**
- **No**

  Describe:_____

- **Poor Health – Is this tree in a condition of poor health or poor vigor that cannot be mitigated by any means other than removal?**
- **Yes**
- **No**

  Describe:_____

- **Hazardous Tree— Defined in [CITY CODE CITATION] any tree or tree part that poses a high risk of damage to persons using, or property located in the public place, as determined by the [AUTHORITY] according to the tree hazard evaluation standards established by the International Society of Arboriculture.**
- **Yes**
- **No**

  Describe:_____

- **Minimum Standards—Is there enough space for a [6 foot wide sidewalk and a 5 foot wide] planting strip?**

- **Yes**
- **No**

Describe:_____

- **Public Safety Hazard—Does the tree present a public safety hazard that cannot be mitigated by any means other than removal?**
- Does the tree location obstruct the visibility for pedestrians, cyclists, and/or cars at an intersection?
- Is the tree impacting a curb ramp such that it no longer meets City of [CITY] ADA requirements?
- Is the tree potentially impacting private property?
- **Yes**
- **No**

Use this space to draw a sketch of the location. Identify existing clearances from nearby infrastructure.

Recommendation for this tree:

- ***–Remove Tree / Replace Sidewalk***
  A tree is identified to be removed if it is not healthy or if it is hazardous as identified in the Street Tree Ordinance.
- ***–Keep Tree and Maintain Sidewalk***
  A tree will be kept and the sidewalk will be maintained if a sidewalk of standard width and a tree pit of standard width (at a minimum) can be installed or retained around a healthy tree.
- ***–Evaluate Sidewalk and/or Tree Further***
  [DEPARTMENT] views trees and sidewalks as important public infrastructure assets. [DEPARTMENT] intends to keep healthy trees and have accessible sidewalks. If standard widths cannot be met then [DEPARTMENT] will take the time and resources to evaluate if alternative approaches (such as sidewalk width reduction, alternative sidewalk materials, adjustments to the tree pit and/or tree root pruning) can be used to retain a tree and provide an accessible sidewalk at problem locations.

NEXT STEPS

If Tree is REMOVED –Replace the removed tree with the minimum 2:1 replacement ratio. Identify if the replacement trees can be located in the same location or on the same street as the removed tree. If not, replacements should be planted as close to the removal as geographically feasible. Identify the estimated cost to remove the tree(s), repair the sidewalk, and plant replacement trees.

If Tree is KEPT –Estimate the cost of the sidewalk repair that would achieve the desired lifecycle for the repair. Estimate sidewalk and tree maintenance needs/costs and any maintenance to the tree that is being retained (e.g., root pruning, branch pruning, soil amendments).

If EVALUATE Further – Use Tree and Sidewalk Evaluation Form (IN DEVELOPMENT) and/or the tree risk assessment should follow ISA TRAQ guidelines: http://www.isa-arbor.com/education/onlineresources/basictreeriskassessmentform.aspx

Arborist	**Engineer**
Title	**Tile**
Date	**Date**

Alternative Solutions Toolkit Overview

MATERIAL

Paving and Other Surface Materials

These materials can be used to create a walkable surface or to delineate space for people and/or the tree.

DESIGN

Infrastructure-Based Design Solutions

These design considerations can be employed to support a tree and/or sidewalk.

ROOT

Rootzone-Based Materials

These tools can support tree health and guide tree growth below ground.

TREE

Tree-Based Solutions

These solutions are focused on tree selection and tree maintenance.

Table 53. Description of possible alternative solutions for tree and construction conflicts

TOOL TYPE	TOOLS	PROACTIVE	RESPONSIVE	COST*	EXPECTED USEFUL LIFE			
				$ $$ $$$ $$$$	Month	Year	Decade	Century
MATERIAL	**PAVING AND OTHER SURFACE MATERIALS**							
	Asphalt	P	R	$-$$$	M	Y	D	C
	Expansion Joints	P	R	$	M	Y	D	C
	Pavers	P	R	$$-$$$	M	Y	D	C
	Pervious Concrete	P	R	$$$-$$$$	M	Y	D	C
	Reinforced or Thicker Slab	P	R	$$-$$$	M	Y	D	C
	Rockery / Wall	P	R	$$-$$$$	M	Y	D	C
	Beveling	P	R	$-$$	M	Y	D	C
	Porous Asphalt	P	R	$-$$$	M	Y	D	C
	Shims	P	R	$	M	Y	D	C
	Tree Guards and Tree Rails	P	R	$$-$$$	M	Y	D	C
	Decomposed Granite	P	R	$-$$	M	Y	D	C
	Mudjacking (Concrete Leveling)	P	R	$$-$$$$	M	Y	D	C
DESIGN	**INFRASTRUCTURE-BASED DESIGN SOLUTIONS**							
	Monolithic Sidewalk	P	R	$$$	M	Y	D	C
	Pavement Thickness	P	R	$$$	M	Y	D	C
	Tree Pit Sizing	P	R	$	M	Y	D	C
	Bridging	P	R	$$$$	M	Y	D	C
	Curb Bulbs	P	R	$$$-$$$$	M	Y	D	C
	Curb Realignment	P	R	$$$-$$$$	M	Y	D	C
	Curving or Offset Sidewalk	P	R	$$-$$$	M	Y	D	C
	Easement	P	R	$-$$$	M	Y	D	C
	Suspended Pavement Systems	P	R	$$$-$$$$	M	Y	D	C
	Lowered Sites	P	R	$$$-$$$$	M	Y	D	C
	Soil Volume	P	R	$-$$$	M	Y	D	C

TOOL TYPE	TOOLS	PROACTIVE	RESPONSIVE	COST*	EXPECTED USEFUL LIFE
				$ $$ $$$ $$$$	Month Year Decade Century
ROOT	**ROOTZONE-BASED MATERIALS**				
	Mulch	P	R	$	M Y D C
	Root Barriers	P	R	$	M Y D C
	Continuous Trenches	P	R	$$$	M Y D C
	Foam Underlay	P	R	$-$$	M Y D C
	Modified Gravel Layer	P	R	$	M Y D C
	Root Paths	P	R	$-$$	M Y D C
	Soil Modification	P	R	$-$$	M Y D C
	Steel Plates	P	R	$$-$$$	M Y D C
	Structural Soils	P	R	$$-$$$	M Y D C
	Subsurface Aeration / Irrigation	P	R	$$	M Y D C
TREE	**TREE-BASED SOLUTIONS**				
	Urban Forestry Street Tree List	P	R	$	M Y D C
	Corrective Pruning	P	R	$-$$	M Y D C
	Root Pruning	P	R	$-$$	M Y D C

*General cost notes:

- Sidewalk material costs, when given in linear feet, assume 6-foot sidewalk width
- Costs are planning-level costs and will vary for actual construction
- Costs do not include design, permitting, or other "soft" costs
- Costs not included in tool costs but which would be necessary with use of some solutions include:
  - Drainage structure and connection
  - Curb ramps

Figure 41. Example of alternative solutions for tree and construction conflicts

Asphalt

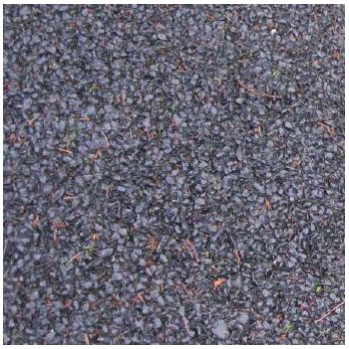
Expansion Joints

Pavers

Pervious Concrete

Beveling

Porous Asphalt



Shims

Tree Guards/Rails

Decomposed Granite

Mudjacking

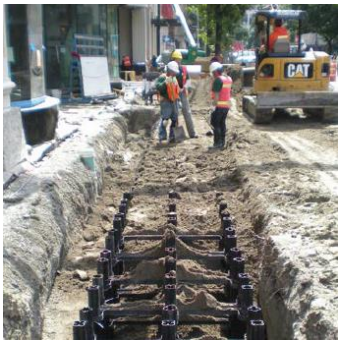
Bridging

Bulbouts

Curb Realignment

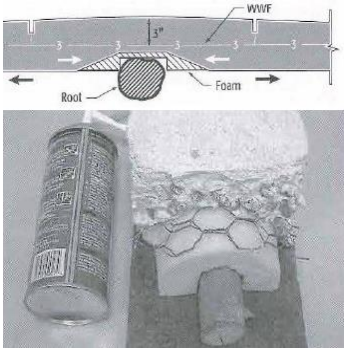
Easement

Suspended Pavement



Root Barriers

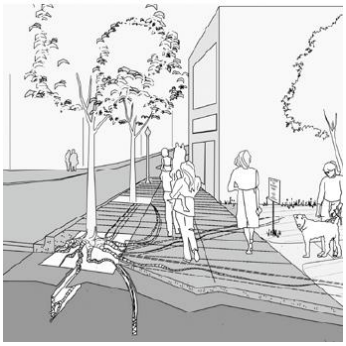
Foam Underlay



Mod. Gravel Layer

Structural Soils

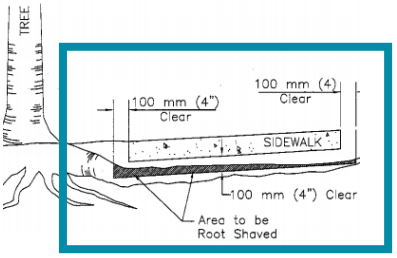
Root Paths



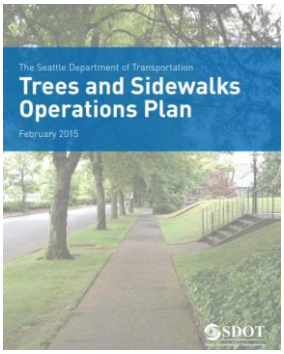
Corrective Pruning

Root Pruning

Root Shaving



Source of Material Examples & Images:



Appendix F. Urban Forest Management Best Practices

Tree Inventory Best Practices

The City of Kirkwood has an inventory of public trees that was completed in 2022. To maintain efficient management, grow a sustainable and resilient urban forest, communicate the benefits of trees, and adapt Plan strategies, the public tree inventory needs to be maintained and updated as changes occur such as maintenance, removals, and plantings. It will be necessary for the City to reassess each public tree to update the condition, size, observations, and maintenance needs that will support and inform urban forest management in the future. In conducting future inventories of public trees, the City should adhere to the International Society of Arboriculture's Best Management Practices – Tree Inventories, Second Edition (2013) resource that details the standards, practices, and protocols.

Tree Maintenance Best Practices

The following provides an overview of tree maintenance best practices. It is not intended to be an extensive or comprehensive summary of best practices. All tree maintenance practices should follow the American National Standards Institute's (ANSI) A300 Standards (Parts 1-10).

Reasons for Tree Pruning

1. *Pruning for Safety*

Involves removing branches that could fall and cause injury or property damage, trimming branches that interfere with lines of sight on streets or driveways, and removing branches that grow into utility lines. Safety pruning can be largely avoided by carefully choosing species that will not grow beyond the space available to them and have strength and form characteristics that are suited to the site.

2. *Pruning for Health*

Involves removing diseased or insect-infested wood, thinning the crown to increase airflow and reduce some pest problems, and removing crossing and rubbing branches. Pruning can best be used to encourage trees to develop a strong structure and reduce the likelihood of damage during severe weather. Removing broken or damaged limbs encourages wound closure.

3. *Pruning for Form*

Improves the structure of trees and removes branches that are more likely to fail. Branches that are poorly attached may be broken off by wind and accumulation of snow and ice. Branches removed by such natural forces often result in large, ragged wounds that rarely seal.

4. *Pruning for Aesthetics*

Involves enhancing the natural form and character of trees or stimulating flower production. To reduce the need for pruning it is best to consider a tree's natural form. It is very difficult to impose an unnatural form on a tree without a commitment to constant care.

Common Types of Tree Pruning

1. *Crown Cleaning*

Consists of the selective removal of dead, dying, diseased, and weak branches from a tree's crown. No more than 25 percent of the live crown should be removed in any one year, even for young trees.

2. *Crown Thinning*

Primarily for hardwoods, thinning is the selective removal of branches to increase light penetration and air movement throughout the crown of a tree. The intent is to maintain or develop a tree's structure and form. To avoid unnecessary stress and prevent excessive production of epicormic sprouts, no more than one-quarter of the living crown should be removed at a time. If it is necessary to remove more, it should be done over successive years. Branches with strong U-shaped angles of attachment should be retained. Branches with narrow, V-shaped angles of attachment often form included bark and should be removed.

3. *Crown Raising*

The practice of removing branches from the bottom of the crown of a tree to provide clearance for pedestrians, vehicles, buildings, lines of site, or to develop a clear stem for timber production. After pruning, the ratio of the living crown to total tree height should be at least two-thirds. On young trees temporary branches may be retained along the stem to encourage taper and protect trees from vandalism and sunscald.

4. Crown Reduction

Most often used when a tree has grown too large for its permitted space. This method, sometimes called drop crotch pruning, is preferred to topping because it results in a more natural appearance, increases the time before pruning is needed again, and minimizes stress. Crown reduction pruning, a method of last resort, often results in large pruning wounds.

Figure 42. Examples of the types of tree pruning

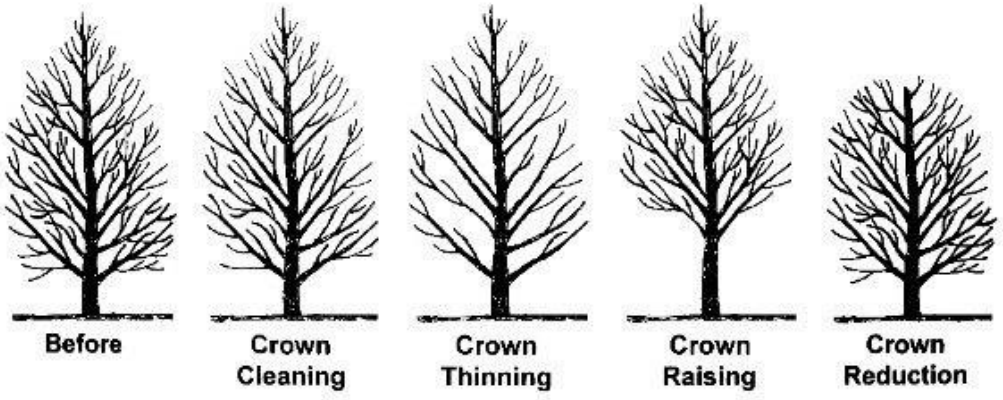


Image source: Arbor Day Foundation

Tree Pruning Cuts

Pruning cuts should be made so that only branch tissue is removed, and stem tissue is not damaged. To find the proper place to cut a branch, look for the branch collar that grows from the stem tissue at the underside of the base of the branch. On the upper surface, there is usually a branch bark ridge that runs parallel to the branch angle, along the stem of the tree. A proper pruning cut does not damage either the branch bark ridge or the branch collar. A proper cut begins just outside the branch bark ridge and angles down away from the stem of the tree, avoiding injury to the branch collar.

Figure 43. Types of pruning cuts and proper branch cutting technique

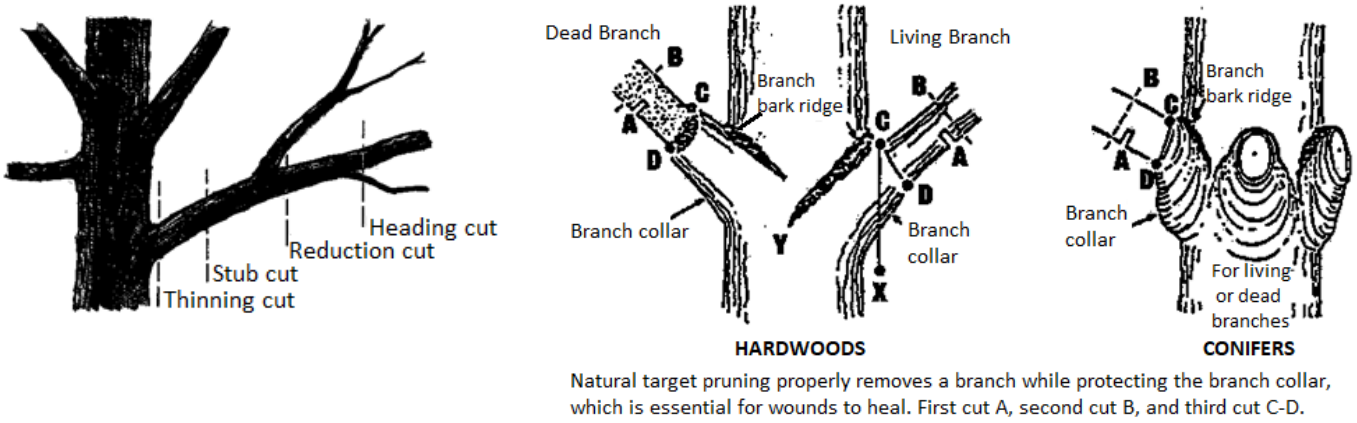


Image source: Pennsylvania State University Urban Forestry Extension

Utility Tree Maintenance Best Practices

Utility Tree Pruning Overview

The City should work with the utility companies to ensure proper pruning practices are followed and that open communication between the company, the City, and the public are maintained. The International Society of Arboriculture provides guidelines for maintaining trees near power lines (Best Management Practices – Utility Pruning of Trees, G. Kempter, 2004).

Maintaining power lines free of tree growth is based on a consistent, planned trimming cycle of the utility vegetation management company. This approach improves electric service to all the customers who get their power from that line. A sensible approach to trimming trees means having a thorough maintenance plan that improves the safety and reliability of electric service to residents. Residents and the City staff should not attempt to trim any vegetation growing near or on any overhead power lines.

Utility Tree Maintenance Techniques

1. *Directional Pruning*

Removes entire branches and limbs to the main trunk of the tree and future growth is directed away from the power lines. Reduction cuts are used for removing these branches and limbs and should be pruned properly back to a lateral branch that is at least one-third the diameter of the branch being removed. This allows for good wound closure and protects apical dominance and reduces sprouts. Avoid topping or rounding over trees. This removes more foliage than directional pruning, increases the number of tree wounds, stresses the tree, causes unstable decay, and increases water sprouts.

2. *Right Tree Right Place*

Selecting the right tree for the site can reduce potential safety hazards and improve the reliability of the electric service. Smaller trees near power lines do not need to be excessively pruned and do not lose their natural form.

3. *Recommended Trees*

Trees potentially suitable for planting adjacent to power lines should be shorter and slow growing to prevent clearance issues.

Figure 44. Examples of trees directionally pruned for clearance from power lines

Photo source: Pennsylvania State University Urban Forestry Extension

Young Tree Maintenance Best Practices

Proper pruning is essential in developing a tree with a strong structure and desirable form. Trees that receive the appropriate pruning measures while they are young will require less corrective pruning as they mature.

Young Tree Maintenance Techniques

1. *Consider the Natural Form and Desired Growth*

Accentuate the natural branching habit of a tree and correct any structural problems over time, if needed, to not stress the tree.

2. *Pruning in 1-2 Years after Planting*

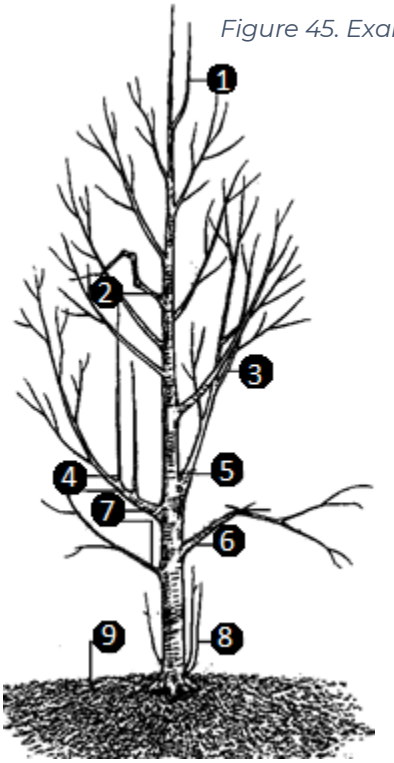
Prune as little as possible after planting to ensure there are enough temporary branches to produce food for new growth of roots, trunk, and branches. Prune only dead, broken, malformed, or diseased branches. Remove codominant leaders to maintain one dominant trunk. Prune for clearance if absolutely necessary. Keep size of branch removed to less than one inch in diameter.

3. *Pruning 2-3 Years after Planting*

Prune any dead, broken, malformed, or diseased branches. Remove any suckers from the base of the tree. Next, determine the permanent branch structure. Apply the following:

- Remove, thin, or cut back any competing leaders.
- Remove crossing or rubbing branches, keep the branch that maintains the natural form.
- Thin excessively crowded branches but do not lions-tail.
- Remove branches with narrow angles between the branch and trunk (consider species).
- Remove branches to maintain well-spaced branches along the trunk. Ideal mature trees will have lateral branches that are 18-24 inches apart (depending on species).
- Avoid pruning near time of bud break.
- Prune flowering trees after flowering.

Figure 45. Example of branches to be pruned for newly planted trees to promote good structure



1. Prune competing leader
2. Prune malformed branches
3. Remove crossing branches
4. Remove water sprouts
5. Remove branches with poor angles
6. Prune broken or damaged branches
7. Prune temporary branches over time
8. Remove suckers
9. Apply 2-3” of mulch

Photo source: Pennsylvania State University Urban Forestry Extension

Tree Planting Best Practices

The following provides an overview of best practices that should be considered and followed before during and after planting trees.

- Trees to be planted should be selected from an approved tree planting list developed to maintain and enhance species diversity that are suitable for the Kirkwood, MO Plant Hardiness Zone and changing climates.
- Planting material will conform to the latest version of the American Standard for Nursery Stock (American National Standards Institute [ANSI] Z60.1). Trees to be planted should be of standard quality or better, and should be true to name and type of their species variety.
- Trees should not be planted in tree lawns less than two feet in width or in planting pits less than five feet long by five feet wide.
- Trees should not be planted within 50 feet of any major intersection, or within 20 feet of a fire hydrant, a driveway, or a pole supporting a light.
- The burlap and twine from balled-and-burlap trees should be removed from the tree and the tree pit. Wire tree baskets may remain on the root ball, but the top one-third should be clipped and removed from the planting hole.
- Mulch should be placed around trees in a minimum three-foot circle and three-inch depth to protect trees from lawnmower damage and competition from turf; mulch will be kept away from tree trunks.
- Newly planted trees should be irrigated weekly during droughts in the growing season for three years.
- As recommended in the UFMP, an updated tree planting detail should be added to the City's Tree Manual, design and landscaping standards, and corresponding documents.

Tree Irrigation Considerations and Best Practices

- Current limiting factor is budget for watering newly planted trees.
- With dry and increasingly hot summers this is a critical requirement for new tree establishment.
- Establishing new trees requires four to five years of supplemental irrigation during the summer months.
- Based on industry estimates, 400 trees currently costs $100,000, so every 100 new trees planted requires an additional $25,000.
- Development of a certain size or where frontage improvements trigger tree planting should be required to install permanent in-ground irrigation systems.

Private Property Tree Management Best Practices

One factor to developing a sustainable urban forest is the extent to which the City can effectively influence the management of trees on private property as most of the urban forest exists on privately-owned land. These private property trees are managed differently than street trees, and are under the purview of the Public Services Department's Planning Division. The City's methods by which it can influence tree management on private property are a combination of indirect actions, such as community education campaigns, and direct actions, such as City ordinances, policies, and permits. While each method has a different approach to influence private property owners, the goal is the same: to grow and maintain healthy trees on privately-owned land.

An attractive quality of a robust community education campaign is voluntary participation from private landowners to contribute to reaching environmental and sustainability goals by implementing City standards for tree management. While some private landowners will adopt and implement City tree management standards, it is not reasonable to expect all private landowners to do so, which is the impetus for City ordinances, policies, and permit procedures to further enforce tree management standards on private property.

Public Education Regarding Ordinance, Permitting, Programs, and Best Practices

Frequent communications and messaging relating to urban forest management best practices and industry standards keeps the public informed and reminded of the importance of proper tree care. The details regarding private property tree ordinances, regulations, permitting processes, and programs can be shared on the City's website, included as call-out box reminders in the permitting process, added to utility mailings, among other mediums and platforms. It is important to consider the barriers that inhibit public access to information and materials. Strategies to remove barriers include language translations, accommodating vision and hearing impairments, among others. It is recommended the City pursue or strengthen these outreach approaches after implementing portions of this Plan that pertain to updating tree ordinances and regulations.

Additional Best Practices for Urban Forest Management

Pest and Disease Management

A principle to controlling insect pests, invasive plant species, and tree diseases is an innovative strategy known as Integrated Pest Management (IPM), which integrates cultural (growing) practices, monitoring, threshold and life cycle analysis, and chemical application strategies to effectively manage urban forest pest populations in an ecologically-sound manner.

Encourage Naturally Occurring Biological Control

Biological control uses living natural enemies, antagonists, or competitors (biological control agents) to control other living organisms. Examples of naturally occurring biological controls include lady beetles, lacewings, parasitic wasps, predatory mites, spiders, earwigs, insectivorous birds, and bats. By using plants that attract the living organism above, chemical use for preventing and treating tree pests and diseases is minimized.

Use Alternate Plant Species

With tree inventory data that describes the composition of tree species in the urban forest, concentrations of susceptible trees and problematic trees can be thoroughly identified and understood. The information can be utilized to update the palette of trees that are planted

by the City to reduce the likelihood of tree pest and disease issues. Some well-known alternate tree species that are resistant to tree pests and diseases include the 'Frontier' elm or Asian elm species that are resistant to Dutch Elm Disease and powdery mildew resistant cultivars of crapemyrtle. In addition, the City should consider reducing or eliminating the planting of trees that are prone to honeydew producing aphids and oak trees should not be planted where oak root fungus is known to exist or propagate.

Use Cultural Practices

Cultural practices discourage pest invasion and some of the practices include good tool sanitation, removing debris and infested plant material from the site, proper watering and fertilizing, growing competitive plants, or using pest resistant tree species. Expanding on the examples, the City should avoid sprinkler irrigation around trees that are susceptible to anthracnose such as Chinese elms and sycamores and avoid irrigation around the trunks of native oaks in the dry season. Thinning out tree canopy can reduce foliar disease problems and pruning trees at certain times of the year can reduce pest problems. For example, to avoid bark beetle infestations, it is recommended to prune pines and elms in the winter. If a disease or insect is spotted in a tree, it can be removed and properly disposed of to potentially reduce the spread. Another example of a pest and disease best practice is to only fertilize trees when absolutely needed. The use of fertilizers can be reduced or eliminated if the appropriate trees for a given site are planted. Lastly, the habitat can be altered to make a site less suitable or compatible for pest development. Examples include planting trees at or above grade to reduce crown rot problems and frequent monitoring and management of oaks where Sudden Oak Death is an issue.

Tree and Infrastructure (Sidewalk) Conflicts

The City should refine and formally adopt the decision checklist and protocols provided in Appendix E and include alternative solutions in design guidelines and standards. Alternative solutions may offer cost savings in some instances though generally, the City's sidewalk program is underfunded. Primarily, the City maintains and replaces sidewalks and curb and gutters as needed and as funding enables. In most Missouri cities that are not responsible for sidewalk maintenance but offer or would like to offer a cost-share program, funds are generated through a ballot-approved Sales and Use Tax. Sales tax rates for funding sidewalk programs average 0.2 percent. In addition to local funds, state or federal grants exist to support cost-share programs. And though grant funding may be available for sidewalk repair it is not a consistent long-term option. Other funding options or mechanisms include special citywide assessments, bonds, improvement districts, or tax incremental financing.

Whenever new development triggers frontage improvements there are opportunities for improved street tree planting and would be an appropriate time to levy enhanced use fees and consider alternative solutions to tree removal or sidewalk replacement. The City should explore these options such as the Sales and Use Tax to address sidewalk repair and replacement needs per the Americans with Disabilities Act (ADA) requirements.

Urban Wood Utilization

Trees in the urban environment are part of a continuous cycle. A tree is planted, it grows for a period of time, and then inevitably it declines and must be removed. Historically, tree removal has been considered a negative side of urban forestry. The cost of removing a tree and then disposing of the resulting debris is seen as a burden to homeowners and municipalities alike and creates a gap in the urban tree cycle. Urban wood utilization is a term and practice describing the reuse of wood with the goal of diverting organic waste

from landfills where materials decompose and release methane, a greenhouse gas contributing to climate change. Wood biomass from the urban forest is often disposed of rather than put to use in some new manner. To complete the cycle of urban trees there is a need and opportunity to make use of the resulting biomass to keep the carbon in the wood rather than be released into the atmosphere. Good logs can be milled into lumber for furniture, flooring, or kitchenware and lower quality materials can be used as a biofuel to displace fossil-fuel use or composted into quality soil amendments like mulch.

Currently, Kirkwood does not implement an urban wood utilization program and could explore the financial costs and return on investment to implement a program. In addition to the environmental benefits of carbon storage, urban wood utilization programs contribute to the green economy of Kirkwood and can provide employment opportunities throughout the entire process to remove, store, treat, and prepare wood for its second life.

To develop an urban wood utilization or urban wood use program, it is recommended the City start simple and allow the program to evolve. One of the first steps is to inventory the volume of biomass generated annually and identify other local partners that can add to the volume. From the inventory, the City can assess its operational, equipment, personnel, and administrative needs and begin to identify local and regional markets and partners that have a demand or need for the biomass. With this understanding, the program can then establish goals and begin implementation. Additional information and resources are available online and one example with potential models for adoption is on the University of Missouri's Extension Program's website— www.extension.missouri.edu/publications/g5153.

Appendix G. Storm and Disaster Management Guidance

The City of Kirkwood has procedures and mechanisms in place to prepare, respond, and recover from extreme weather events though the following resource may be considered to strengthen protocols.

Resources

- https://www.fs.usda.gov/ccrc/topics/urban-forests
- http://www.gicinc.org/storm_mit.htm

Guidance

Preparation – Planning and Warning Activities

- Install and utilize early warning systems such as the National Weather Service, local news stations, local police and fire departments
- Prepare a disaster response plan
    - Identify individual/departmental roles
        - Establish an official Tree Care Manager (both for management of the urban forest resource and as the point of contact for storm mitigation efforts)
        - Build a storm mitigation team
        - Establish Public Services Director or similar as disaster control supervisor.
            - Has overall direction for storm clean-up efforts
            - Makes decisions relating to storm clean-up efforts and advises on the need for outside assistance (contractors, other Public Services divisions)
            - Is responsible for decisions relative to abandoning other divisional responsibilities in favor of storm damage clean-up efforts
            - Works with City communications office and the Public Information Officer for alerting media as to the progress and problems associated with the storm
            - Coordinates with Urban Forester to prioritize response efforts
    - Contacts for additional support
        - National level tree service firms
        - Smaller, local tree service firms
        - Utility specialists
- Create a more resilient urban forest
    - Regular tree risk assessments
        - ISA Level 1 or 2 – annually
        - Dedicated line-item budget for assessments
    - Systematic risk-reduction removals/pruning
    - Lightning protection systems for high-value/significant trees
    - Post-storm event level 1 assessments
- Planting considerations for storm damage resistance
    - Ice Storm Susceptibility of Common Tree Species
        - Susceptible: Siberian elm, American elm, honeylocust, common hackberry, Bradford pear, American linden, black cherry, black locust, silver maple, pin oak, green ash
        - Intermediate: White ash, red maple, northern red oak, yellow poplar, sycamore, eastern white pine, sugar maple

        - Resistant: Yellow birch, shagbark hickory, hawthorn, horsechestnut, American hophornbeam, spruce, eastern hemlock, arborvitae, baldcypress, Norway maple, catalpa, ginkgo, sweetgum, white oak, swamp white oak, littleleaf linden, silver linden, Kentucky coffeetree, black walnut, ironwood, beech
        - Species that retain foliage into the fall (more susceptible to autumnal ice storms): European white birch, sweetgum, magnolia variety (*Magnolia* x *soulangiana*), scarlet oak, pin oak, English oak, weeping willow
        - Species that leaf out early (susceptible to early spring ice storms): Boxelder, yellow poplar, European mountain ash, Siberian elm
    - Climate change considerations
        - Warmer winter temperatures
        - Increased pest/disease due to more favorable conditions
        - Increased winter precipitation
        - More snow and ice loading
        - Flooding
        - Decreased summer precipitation
            - Drought stress
        - More frequent and intense extreme weather events
- Mitigation
    - Reducing greenhouse gas emissions
    - Allocate resources to trees that mitigate emissions
        - Large hardwoods
    - Maintaining tree canopy
- Promote energy efficiency
    - Strategically planting trees around buildings
    - Increase stormwater infiltration
    - Using wood versus steel in construction projects
- Adaptation
    - Planting a diverse mix of pest-tolerant, well-adapted, low-maintenance, long-lived, and drought-resistant trees ensures greater resilience
        - Species type
        - Species to avoid
            - Planting small groves of especially water-tolerant species in areas receiving peak volumes of stormwater runoff reduces flooding and pollutant transport
            - Establishing and adhering to regular maintenance cycles
        - Pruning young trees properly promotes strong branch attachments that are less vulnerable
            - Distribute urban forest benefits equitably
        - Underserved populations will be disproportionately impacted by climate change – focusing on these demographic areas with urban forest solutions can help

Response – Immediate Activities during and after Natural Disasters

- Storm damage response
- Funding
- Sources of assistance
- State forestry/natural resources
- Federal disaster relief
- USDA Forest Service
- Emergency plans and contracts
- Tree damage response
    - Priority streets/corridors for first response
        - CLASS I: First, all life-threatening situations should be given priority. Supervisors should make an on-site visit to determine the severity of the damage in the event of multiple hazardous situations. Crews should remedy the situation to a point where it is no longer life threatening before proceeding to the next location. Final clean up should wait until all life threatening situations are resolved and all streets have been cleared.
        - CLASS II: Second, all major property damage instances should be remedied to a point where the crisis is abated. Supervisors should personally inspect and determine the priority of the tree management program responses. Again, final clean up at those sites should wait until all streets and specialized areas are cleaned up.
        - CLASS III: Third, preferential streets (considered to be all main thoroughfares) should be cleared of fallen trees and debris. State and county highway departments may be called to clear U.S., state and county routes. This should be followed by clearing residential streets and then parking lots, cul-de-sacs and other specialized areas, including parks. Because the specialized forestry skills required to abate life threatening and property damage situations would be utilized immediately, the street clearance work (in case of widespread and severe damage) may not be undertaken by tree management program personnel until sometime well after the storm has passed. In this situation, the tree manager should recommend to the Public Services Director that other public works crews be considered to assist in street clearance work. immediate supervision of these supplementary crews would be under the direction of their respective divisions.
- Cleanup
    - Debris disposal
        - The Public Services develops a budget for normal disposal costs associated with yearly tree maintenance tasks. Major tree debris disposal will require additional funding which may be authorized by the City Manager.
- Damage Assessment
    - The Department of Public Services should immediately issue a press release detailing the magnitude of the storm and the expected clean up time. Additionally, the press release should request that citizens haul all debris from private trees and pile it between the sidewalk and the curb in an orderly fashion with the butt of the branches facing in one direction. The press release should also inform the citizens that the City will pick up the debris.

- A critical tool to assist any emergency response is a current tree inventory of all publicly owned trees. Using the inventory, the City can determine the actual damage to the urban forest. Accurate damage (in dollars) can be assessed and submitted for potential reimbursements. Specific costs can be developed for the repair of the urban forest (pruning, removal, cabling, and rodding) and for replanting efforts

- Use i-Tree storm for predictions
- FEMA contacts/expectations
- Participate in the USFS Urban Forest Strike Team training curriculum.

Recovery – Activities to Regain or Improve upon Pre-disaster Conditions

- Tree planting
  - Align with a tree planting strategy that provides guidance on priority areas, tree species selection, post-planting care, and routine maintenance.
  - Align planting with urban tree canopy goals
  - Utilize the Citywide Recommended Tree List
- Tree care
  - Conduct young tree training to prevent future maintenance issues, improve structural integrity, and reduce future costs
  - Conduct routine programmed pruning of established trees in the public tree population to reduce the risk of storm damage
  - Inventory, assess, and monitor trees to prioritize maintenance and for information useful in prioritizing storm response
  - Implement plant health care for trees affected by pests and diseases. Implement an Integrated Pest Management program for prevention, treatment, and recovery due to pests and diseases
- Training
  - Provide or support tree maintenance, planting, and risk assessment training for City staff and community partners
  - Stay current on research relating to storm disaster prevention, response, and recovery
- Celebrations
  - Continue to build support for the urban forest through events and programs such as the Arbor Day celebration, Tree City USA recognition, recognition programs for community tree stewards, memorial tree programs, and the Significant Tree Program

CITY OF KIRKWOOD, MO
URBAN FOREST MASTER PLAN

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